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STANDARDS AND GUIDELINES

FOR

ROADS & STORMWATER

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

DOCUMENT INFORMATION

Standards and Guidelines for Roads & Stormwater

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4.0	Sep 2024	

Document Structure

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Acronyms

- **CCT**: City of Cape Town
- **COTO**: Committee of Transport Officials
- **DMS**: Develop Management Scheme
- **ECSA**: Engineering Council of South Africa
- **NBR**: National Building Regulations
- **NDT**: National Department of Transport
- **NMT**: Non-Motorised Transport
- **PSP**: Professional Service Provider
- **SABS**: South African Bureau Standards
- **SANAS**: South African National Accreditation System
- **SANS**: South African National Standards
- **SATAS**: South African Technical Auditing Service
- **TGSI**: Tactile Ground Surface Indicators
- **TMH**: Technical Method for Highways
- **TRH**: Technical Recommendations for Highways
- **UD**: Universal Design
- **UTG**: Urban Transport Guidelines
- **WCG**: Western Cape Government

Glossary & Definitions

- **Approval Authority**: The Directorate/Department/Branch who will be responsible for the approval of the engineering design or material specifications. Unless stated otherwise, this will generally be the District Engineer (Roads and Stormwater Branch).
- **Carriageway**: The portion of road assigned to the movement of vehicles, including any shoulders or auxiliary lanes.
- **Carriageway Crossing:** Also known as vehicular access way or driveway; An entrance or exit way, or a combined entrance and exit way, between a land unit and an abutting road.
- **The City** or **Council**: The City of Cape Town
- **Cross Slope**: The slope that is perpendicular to the travelling directions
- **Longitudinal Slope**: The slope that is parallel with the travelling direction.
- **Red Book**: The Neighbourhood Planning and Design Guide, 2019 (previously known as *Guidelines for Human Settlement Planning & Design)*
- **SABS, SATAS** or similar: A certification body that is accredited by SANAS. Through their accreditation, the certification body is allowed to sample and test products and certify a producer's product to a specific SANS standard.
- **SANS**: National specification body; refers to a standard that specifies the performance requirements of a specific product. The standards may be awarded to a product by any accredited certification body complying with SANAS requirements and accredited to SANS 17065
- **SANAS**: The only recognised National Accreditation Body in RSA. SANAS is responsible for the accreditation of certification bodies. Accreditation certificates are issued to certification body, e.g. SABS or SATAS.
- **Width**: The distance measured at a right angle to the direction of travel.

CHAPTER 1

INTRODUCTION

Chapter Content

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CHAPTER 1: INTRODUCTION

1.1 Purpose of this Document

This document has been prepared to lay down standards and guidelines for urban developments within the City of Cape Town metropolitan area. Such a development generally entails the planning, design and construction of the roads and utility services infrastructure that is required to service a residential, commercial, or industrial urban community. The aforementioned is not necessarily limited to the construction of new infrastructure, but may also include alterations to existing infrastructure.

This document will be available to all developers and consultants (i.e. designers), in order to provide assistance with the design and construction of urban infrastructure.

It is the responsibility of the designers to confirm that they are utilising the latest available version of this document.

This document will aim to:

i) Give guidance to where relevant specifications and guidelines can be found;
ii) Highlight and, in some instances, repeat important aspects of such relevant documentation;
iii) Provide minimum specifications relevant to the City's needs;
iv) Make designers aware of the City's adopted policies;
v) Strive towards uniformity in terms of design criteria and material specifications;
vi) Ensure that all materials used in any public roadway or road reserve comply with the highest standard as approved by South African National Standards (SANS).

The current document focuses primarily on the roads and stormwater disciplines. However, ultimately, the intention is to expand the document, in order to include all services in one easily distributable and concise document.

1.2 Design Approval

The engineering design drawings shall be approved by the Approval Authority. For the remainder of this document, the "approval authority" shall refer to the *Director: Roads Infrastructure Management* or the relevant delegated District Engineer (District Offices, roads and stormwater section), unless stated otherwise.

The Roads and Stormwater district areas can be found on the "*RIM Districts*" Map (refer to Part C).

The approval of the design in no way absolves designers from any responsibilities and/or liabilities in respect of their design.

For further information, designers can refer to Chapter 18, which explains the process and requirements regarding the approval of engineering design drawings.

1.3 Discrepancies

Should any discrepancies become apparent, it shall be referred to the delegated approval authority (facilitating the engineering design approval) or the contact persons listed in this document.

1.4 Applicability

The standards and guidelines contained in this document are applicable to all residential, industrial and commercial developments in the City of Cape Town metropolitan area.

1.5 Deviations

Where existing infrastructure and site-specific conditions require deviation from this document, such deviations must be approved by the Approval Authority.

1.6 Site Specific Conditions and Future Developments

Where abnormal site conditions exist or where a development needs to service existing or future developments, the Approval Authority may require a higher standard of the services to be provided.

Special or unique design situations shall be addressed on a case-by-case basis.

1.7 Legal Background

The following documents may be applicable:

Acts

- Constitution of the Republic of South Africa (108 of 1996)
- Municipal Structures Act (117 of 1998)
- Municipal Structures Amendment Act (58 of 1999)
- Municipal Systems Act (32 of 2000)
- Municipal Systems Amendment Act (7 of 2022)
- National Environmental Management Act (107 of 1998)
- National Heritage Resources Act (25 of 1999)
- National Road Traffic Act (93 of 1996)

By-Laws & Policies

- CCT Informal Trading By-Law, 2009
- CCT Municipal Planning Amendment By-Law, 2019
- CCT Development Management Scheme
- CCT Outdoor Advertising & Signage By-Law, 2013
- CCT Parking By-Law, 2010
- CCT Parking Policy, 2014
- CCT Stormwater Management By-Law
- CCT By-Law Relating to Streets, Public Places and the Prevention of Noise Nuisances, 2007

Ordinances

- Roads Ordinance (No 19 of 1976)

1.8 Referenced Documents & Hyperlinks

This document makes reference to various external literatures. All the referenced literature will be provided in Chapter 20 (i.e. *Document References*). The document library will provide the full details of the referenced literature.

It is the designer's responsibility to ensure that the literature is still applicable and relevant (i.e. not outdated or superseded).

To: *Part A Overview*

To: *Chapter Overview*

CHAPTER 2

ROAD PLANNING

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CHAPTER 2: ROAD PLANNING

2.1 Relevant Codes of Practice, Policies and Guidelines

The following documents may be applicable to this chapter:

- COTO: TMH 16 - South African Traffic Impact and Site Traffic Assessment Standards and Requirements Manual - Version 1.01, Feb 2014
- CCT: Boundary Walls and Fences Policy
- CCT: Development Management Scheme
- CCT: Guidelines for Designing or Approving Hard and Soft Landscaping in the Urban Road Reserve
- CCT: Guidelines for Provision of Vehicular Access Crossing
- CCT: Guidelines for the Erection of Balconies, Canopies and Columns on the Verge
- CCT: Guideline for the Formalising of Parking Areas on Verges
- CCT: Integrated Transport Plan
- CCT: NMT Policy and Strategy Volume 1 & 2
- CCT: Specification for Construction of Vehicular, Pedestrian and Wheelchair Access Ramps
- CCT: Traffic Calming Policy
- CCT: Trees Management Policy
- NDT: Pedestrian and Bicycle Facility Guidelines, 2003
- Roads Ordinance (No 19 of 1976)
- Roundabouts: An Informational Guide, 2nd Edition, 2010
- SANRAL: Geometric Design Guidelines
- SARTSM Volume 2 (May 2012, Digitised Version)
- The Neighbourhood Planning and Design Guide ("Red Book"), 2019
- UTG 1: Geometric Design of Urban Arterials, 1986
- UTG 5: Geometric Design of Urban Collector Roads, 1988
- UTG 7: Geometric design of Local Residential Streets, 1989
- UTG 10: Guidelines for the Geometric Design of Commercial and Industrial Local Streets, 1990
- WCG: Access Management Guidelines, 2020
- WCG: Geometric Design Manual, 1996

2.2 General

This section of the guidelines covers primarily Class 2, 3, 4 and 5 roads.

Where the City is responsible for the design of a Class 1 road, designers can refer to the following WCG and SANRAL documentation for planning purposes:

- SANRAL: Geometric Design Guidelines
- WCG: Geometric Design Manual, 1996

Road Planning should not be done in isolation by the Engineering profession, but must be dealt with in close co-operation with the other related disciplines, e.g. planning.

The planning process needs to respond to the following inputs:

- Environment;
- Community it serves;
- Modes of transport;
- Public transport needs;
- Integration with public transport networks and;
- Recreational and community facilities;
- Land use.

For middle to higher order roadways, the scheduling of Project Management Team (PMT's) meetings are advised. During these meetings, all the relevant role players and disciplines are invited to provide input into the planning process and ultimately assist with the fulfilment of the design requirements from all the required stakeholders.

Priority should be given to the needs of transport modes, based on the following order of precedence:

1) Walking
2) Cycling
3) Public transport (that includes mini-bus taxis)
4) Commercial vehicles
5) Private vehicles

2.3 Town Planning

2.3.1 Access on Municipal Roadways

The position/spacing of new intersections and driveways (where applicable) on the municipal road network (Class 1 to 4 roads) will be evaluated in terms of the *Road Access Guidelines (RAG)* (2002).

2.3.2 Access to Properties

Access restrictions on properties need to be established at the planning stage and the rules need to be incorporated in Overlay Zone regulations applicable to a particular area or land unit.

2.3.3 On-Site Parking Requirements

The provision for on-site parking is covered in City of Cape Town's Development Management Scheme for the relevant area.

2.3.4 Setbacks for Garages, Carports and Security Gates

The minimum required street building line setback, as prescribed in the City's Development Management Scheme, must be adhered to at all times. Any relaxation of the street building line needs to be approved by means of a Land Use Management application for a regulation departure.

Designer must take note that for any proclaimed road, in terms of Section 17 of the Road Ordinance (No. 19 of 1976), no structures may be erected within 5m from the boundary of the statutory width (i.e. proclaimed road reserve). Should any structure be proposed within said 5m, approval must be obtained from the Administrator, which would be the Western Cape Government for roads situated within the City of Cape Town metropolitan area.

2.3.5 Setbacks and Stacking Space for Access Gates

The stacking distance (space) in front of access gates to developments shall be measured from the gate (or access control) to the edge of the closest road edge (kerbline). When the access is situated along a road that will be widened (or may potentially be widened), the stacking distance will be measured to the future kerbline. Where a concept or prelim design is not available for the aforementioned instance, the future kerbline would have to be indicated schematically.

A minimum stacking distance of 6m is generally required. However, the stacking distance shall depend on the development's type of land use, GLA or number of units and order of adjacent road. The stacking distance is usually determined by a Transport Engineering Professional, by means of a queue length analysis (typically as prescribed in TMH 16).

2.3.6 Access Gates: General Requirements

The following requirements shall be applicable to the installation of access gates:

i) No part of any gate shall be installed within road reserves. Gates on a boundary must be completely on the private side thereof.
ii) Gates shall not open into road reserves, but inwards, away from the road reserve. Gates opening towards the road must be set back so that the open gate is completely within the private property.
iii) The location of gate control devices within the road reserve is not permitted.
iv) No part of a gate's mechanism may be accessible from the road reserve. Suitable protection must be in place where necessary.

Designers can refer to the *CCT Development Management Scheme* and *National Building Regulations (SANS 10400)*.

2.4 Road Planning Guidelines

2.4.1 Road Classification and Road Reserve Width

Designers should read the contents of this document in conjunction with Part II: Chapters F, G and I of the "*Red book*", where the emphasis is on Movement Networks rather than the conventional hierarchical structure.

Designs should be based on the functions that each Link within a Movement Network needs to perform, to determine the appropriate road reserve widths, footway and on-street parking provisions. Engineering judgement should prevail rather than merely opting for the minimum standard solution.

It is of utmost importance that Designers ensure the required road reserve width is provided, in order to accommodate the required cross section elements, i.e. proposed roadway, NMT facilities and services (above- and belowground).

The six-class urban road classification system is summarised in the table below, as per TRH26 and AMG. Designers can refer to Section 3.2.1 and Section 3.2.2 for the typical cross section requirements for the various types of road classes.

Table 2-1: Urban Road Classification and Functions

Class	Name	Order	Function [1]	
1	Principal Arterial (freeway)	Higher	Mobility	Mainly provides mobility to the metropolitan area.
2	Major Arterial			Provides connections between larger regions of a metropolitan area.
3	Minor Arterial			Provides connections between districts of the metropolitan area. Form the last leg of the journey on the "mobility" road network, bringing traffic to within 1km of its final destination.
4	Collector Street	Middle	Mobility/ Access	Collects and distributes traffic between local streets and the arterial system. Intended to serve an access function, with limited mobility.
5	Local Street	Lower	Access/Activity	Provide access to individual properties.
6	Walk- & Cycleway[2]	-		Pedestrian and Cycle Ways only

[1] *Description provided for metropolitan areas or large cities.*

[2] *While Class 6 facilities are defined as being within an exclusive right of way, pedestrian and cycle facilities may also be found within the rights of way of road Classes 2 to 5 (AMG).*

Refer to:

- COTO TRH 26: South African Road Classification and Access Management Manual (2012)
- WCG: Access Management Guidelines (AMG) (2020)

The classification of roads within the City of Cape Town metropolitan area can be found on the City's *Road Network, Metropolitan Area - Public Right of Way Map* (refer to Part C).

2.4.2 Design Speed

At a Road planning stage, it is important to establish whether the design standards for a given speed can be maintained within the chosen road layout. Steep terrains require special attention from a road planning perspective.

During the subdivision stage, the road layout should be designed such that speed control and traffic control is inherent in the layout. "Add-on" measures, such as speed humps, are not supported. Refer to Section 2.4.10 for further detail.

2.4.3 Road Reserve Characteristics

The cross section of the road reserve shall provide for all functions that the road is expected to fulfil, including:

- Safe and efficient movement of all users including and especially pedestrians and cyclists;
- Universal Access;
- Provision for parked vehicles;
- Provision for utility services both under and above ground;
- Street lighting;
- Landscaping;
- Traffic signs and signals;
- Street name and direction signs;
- Road Markings;

In addition to the above, the selected roadway and road reserve should comply with the following:

- The safety and convenience of pedestrians and cyclists must be ensured by providing sufficient on- or off-road paths or sidewalks;
- The roadway width must allow vehicles to proceed safely at the operating speed intended for the class of road;
- The road reserve width should be sufficient to provide adequate access to individual erven. The word "adequate" must be read in context with the mode of transport that is expected to dominate each specific road or pedestrian access way;
- Widening of the roadway and road reserve may be required at strategic locations to allow for wider heavy vehicle paths;
- Widening of the verge and subsequent road reserve may be required to ensure adequate sight distances around horizontal curves and at intersections. The use of mirrors to improve sight line problems is not permitted;
- Appropriate verge width must be provided to enable the safe location, construction and maintenance of required utility services, e.g. electricity, water, telecommunication, street lighting, stormwater side drains, etc. See Chapter 4 on Road Verges, for more information.

2.4.4 Parking

Provision for parking shall form an inherent part of any new development. It is paramount that parking provision does not limit site distance at intersections or bends. Designers should consider the provision of on- or off-street parking, in conjunction with other issues, such as driveway access, waste collection, etc.

Property owners adjoining roadways should provide sufficient on-site or off street parking, as required by the City's *Development Management Scheme*.

In areas where public transport is promoted and available, reduced parking requirements will apply, due to the reduced use of private vehicles and lower demand for parking. These areas are known as "Public Transport Areas" and are divided into two categories, i.e. PT1 and PT2:

- A PT1 classification demarcates an area where the use of public transport is promoted, but where the City considers the provision of public transport inadequate or where the use of motor vehicles is limited.
- A PT2 classification demarcates an area where the use of public transport is promoted and the City considers the provision of public transport good, or where the use of motor vehicles is very limited.

Provision for on-street parking should be considered, among others, at the following locations:

i) Public Amenities
ii) Educational Institutions
iii) Recreational Facilities
iv) Public Health Facilities

2.4.5 Waste / Refuse and Emergency Vehicles

Access for waste collection and emergency vehicles is one of the most important aspects in the planning of any new development. Road layouts and reserve widths should be designed to accommodate typical waste collection and emergency vehicles. Designs should be based on a refuse vehicle, as specified in Section 17.2.2.

Designers should also refer to the following City of Cape Town documents, which contain the complete list of requirements and specifications for refuse removal facilities:

- Solid Waste Management: "*Waste / Recycling Storage Area / Rooms: Standards and Guidelines*".
- Solid Waste Management: "*New Developments: Minimum Requirements for Vehicle Access/Waste Collections*".

In Low Cost Housing developments, large turning circles are generally not affordable. In such cases, refuse collection points need to be provided adjacent to the roadway. The distance from the collection point to the furthest household should not exceed 20m (or 3 erven).

A typical collection point can consist of a demarcated and surfaced or paved area behind the road kerb. A minimum width of 1.5m is required, with a length equal to the number of refuse bins to be accommodated/stacked on refuse collection day.

Collection areas should be carefully selected, in order to ensure the following are avoided:

i) Being too close to or opposite residential frontages or accesses;
ii) Obstruct vehicular sight lines;
iii) Impede safe pedestrian movement.

The City's waste collection services do not enter private properties. Therefore, refuse rooms (removal points) are generally provided adjacent to the public street. This generally results in the refuse removal vehicle temporarily parking inside the roadway, while the refuse bins are being collected. In certain situations, the presence of the stationary refuse vehicle severely impacts the safety of the traffic and mobility of the road. In such situations, refuse embayments are required.

In relation to the refuse points, refuse embayment shall be provided for the following situations:

i) Next to mixed or higher order roads;
ii) Where the vehicle sight lines are hindered.

Designers can refer to Section 17.2 for design specifications for refuse removal facilities.

2.4.6 Public Transport

On designated or potential public transport (PT) routes (or potential bus routes), provision must be made for PT facilities, including PT stops, shelters, bus embayments and trip-end facilities. Such provisions should include consideration for pedestrian access, driveway locations and geometric design at intersections.

Designers shall also take into account any future IRT/BRT lanes, in order to ensure sufficient road reserve is provided and abortive costs are minimised.

Street networks should be planned to bring commuters and pedestrians within a convenient walking distance (not more than 400m) of public transport stops, especially in affordable housing areas. Refer to *Chapter 15 of the Access Management Guidelines* for the optimal location and minimum guidelines for bus and minibus taxi stops.

The minimum roadway width for bus routes shall be 7.4m, measured from kerb-face to kerb-face.

Dimensions must be determined according to the size of the bus using the route and the number of busses stopping at any one time. Refer to Drawing RD8.3 for the typical details of bus stops or bus embayments (also referred to as "transport stops"). Drawing RD8.2 can be consulted for taxi embayments.

On lower order roads, where space is limited or not available for a full bus embayment and the stopping time is of short duration, a bus stop in the traffic lane may be considered. In this case, a minimum length of 12m must still be reserved and clearly marked on the road.

2.4.7 Intersections

Street layouts must be planned for maximum safety. The aim should be to minimize the number of intersections required for any development. Skewed intersections must be avoided and in no case should the angle be less than 70°. Staggered intersections are not preferred.

The provision of vehicular access close to intersections and traffic circles needs to be carefully considered. Operational and safety considerations must warrant restrictions on access.

Land uses that generate large volumes of traffic should have vehicle access points well away from intersections.

The City's DMS stipulates the minimum spacing of a carriageway crossing from an intersection, based on the prolongation of street boundaries. The minimum spacing is as follows:

- Industrial-zoned properties: 15m
- Other properties: 10m

The aforementioned spacing requirements are illustrated in the figure below.

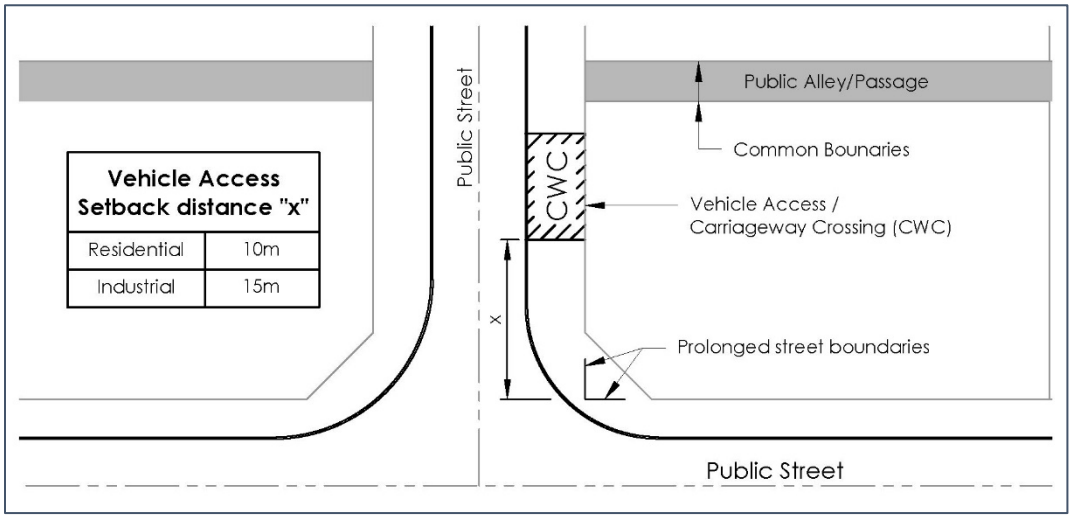


Figure 2-1: Spacing of Carriageway Crossings from intersections

2.4.8 Sight Distance at Unsignalised Intersections (Sight Triangles)

It is of utmost importance to ensure that intersections are designed to optimise safety and avoid crashes at potential vehicle conflict points. One way to ensure safety at intersections is to provide adequate sight triangles on the approach/side road(s).

Intersection sight triangles refer to the area in the quadrants of an intersection that shall be kept clear to ensure adequate sight distance between the opposing legs of the intersection.

The sight triangles at any intersection should be kept clear of obstructions, including street furniture and landscape elements. However, the placement of objects less than 0.6m in height inside sight triangles may be considered.

Designers can refer to Section 3.2.6 for further details regarding the determination of intersection sight triangle requirements for various types of developments and roadways.

2.4.9 Traffic Control at Intersections

Intersections where more than 100 vehicles per hour (all movements combined) are expected need to be analysed at design stage to establish the type of control measure to be implemented. Traffic circles are in many cases preferred to signalised intersections because of the inherent safety and efficiency benefits, and lower maintenance cost.

Traffic circles are also excellent traffic calming measures, especially if they form part of an overall traffic-calming plan.

Three or four way stop control at busy intersections is not acceptable, and should be furthermore avoided at minor intersections. Consideration should rather be given to the use of traffic roundabouts or raised intersections, provided these comply with the prescripts of the City's Traffic Calming Policy.

2.4.10 Traffic Calming

The layout of streets must be designed in such a way that traffic calming is a natural result and the requirement for "add-on" measures (such as speed humps) is avoided. This can be achieved by reducing block lengths where possible and by avoiding unnecessary through routes. On collector roads, speed-reducing measures such as traffic circles and pedestrian crossings, with median islands, could form part of an inherent traffic calming strategy.

Where "add-on" traffic calming measures (e.g. speed humps, raised pedestrian crossings, raised intersections, etc.) are required/provided, these shall adhere to the City's Traffic Calming Policy.

Stop or yield control may not be used for the sole purpose of traffic calming. The SARTSM warrants for stop or yield controls shall be met.

2.4.11 Recreational Facilities in Road Reserve ("Woon-erf" Concept)

Where recreational facilities are required within the road reserve (i.e. "woon-erf"), the following shall be considered:

i) Traffic Calming;
ii) Non-Motorised Transport facilities;
iii) Refuse collection (wheelie bin or black bag storage space);
iv) Turning space/movement of vehicles;
v) Parking space for visitors;
vi) Access for service and emergency vehicles.

These areas can typically be in the middle of a "super block" or opposite an entry or exit point to a 'Pedestrian Only Link'. These areas should be large enough to have the desired impact or serve the required purpose.

Designers should ensure that the road reserve width is sufficient, in order to accommodate the above.

2.4.12 Fences

Urban streets are not provided with fences. Fences constitute, and are part of, the abutting land. Fences remain the responsibility of the landowner and should therefore be located on private property, not the road reserve. Section 17.7 provides further details on fencing.

Refer to:

- City's Gated Development Policy, 2007
- City's Boundary Walls and Fences Policy, 2009

2.4.13 Guardrails

The following guideline documents should be consulted for warrants and installation details when designing roadside guardrails:

- Geometric Design Manual, Western Cape Government (WCG, previously known as PAWC) ("Yellow Book"), 1996.
- SANS 1350.
- COTO Standard Specifications for Road and Bridge Works for South African Road Authorities: Chapter 11.
- South African Road Safety Manual, Volume 6, Part C: Traffic Barriers.
- Technical Recommendations for Highways (THR) 17: Geometric Design of Rural Roads, Section 7

The provision of guardrails, within the road reserve, for the sole purpose of protecting anything other than legitimate road users, shall not be permitted. Guardrails and other measures for the protection of private property, if desired, must be located outside the road reserve. Guardrails shall not be provided solely for access control purposes.

It must always be borne in mind that guardrails, and other barriers next to the roadway, are in themselves hazards to road users and should only be installed when the off road hazard is greater than the hazard posed by the barrier.

Guardrails shall generally be installed with a post spacing of 3.81m. A post spacing of 1.905m shall be applicable for the first and last three lengths of any installation, including the three lengths immediately in advance or beyond abridge balustrade. Furthermore, a 1.905m post spacing may also be considered where the consequences of a vehicle leaving the roadway are extremely severe or where there is a limitation regarding the guardrail deflection.

Examples where guardrails (with a 3.81m post spacing) may be required:

i) Roadside obstacles and abrupt drop-offs present within 10m of the carriageway edge, namely:
   a) A drop-off, next to the road, with a slope steeper than 1:1 and height greater than 1m.
   b) Large boulders, permanent bodies of water deeper than 600mm next to the road and large trees close to the roadside.
   c) Bridge piers, abutments, balustrades and large steel sign supports.

ii) Highway embankments, where the severity is warranted (refer to "Equal Severity Curve" section further on for more details);

iii) At the outer edge of substandard curves, or wherever vehicles often leave the road, where the hazard to the occupants of the vehicle leaving the road is greater than that of the guardrail.

iv) On narrow medians.

When installing a guardrail, the following must be adhered to:

a) Guardrails shall generally be installed with a post spacing of 3.81m. A post spacing of 1.905m shall be applicable for the first and last three lengths of any installation, including the three lengths immediately in advance or beyond a bridge balustrade. Furthermore, a 1.905m post spacing may also be considered where the consequences of a vehicle leaving the roadway are extremely severe or where there is a limitation regarding the guardrail deflection

b) Excavation & Backfill:
    - The holes for guardrail posts shall be excavated to a sufficient size, to permit the placing of the post and ensure adequate space for backfilling and compaction of the backfill material.
    - Posts shall be planted to a minimum depth of 1m.
    - After posts have been placed, the holes shall be backfilled with an approved sandy/natural material, compacted in layers of 100mm thickness (maximum). If required, water shall be added to the backfill material, in order to ensure that material can be compacted at/near the optimum moisture content.
    - For general conditions, compacted natural backfill is sufficient. However, concrete or soilcrete backfill may be used for instances where additional stability is required (e.g. poor soil conditions, on bridge approaches, locations where high impact resistance is required, etc.). Designers shall ensure that the appropriate backfill material is used for the site specific conditions. The aforementioned shall be discussed with the Approval Authority prior to construction.

c) Guardrails should not be used where they will be struck head-on or at an angle of more than 45° to perpendicular. Guardrail systems are designed to take a glancing blow only.

d) The minimum length that guardrails shall be provided is 30m.

e) End treatment:
    - Where possible, use a flare with a bullnose end-piece.
    - End wings or dipped ends may only be used on the downstream side of a one-way condition, where there is no danger of an end-on collision.

f) The guardrail must be installed at the prescribed height;

g) Anchoring section: At the end, an 11.43m section of the guardrail shall have posts spaced at 1.905m, instead of the normal 3.810m;

h) Spacer blocks shall never be omitted;

i) Successive lengths of guardrails shall be lapped, so that the upstream section overlaps the downstream section along the adjacent traffic stream;

j) The guardrail shall be provided with all its bolts, including all the shear bolts;

k) Guardrails posts shall be replaced where they have become rotten or structurally unsound;

l) Reflectors shall be placed on all new guardrail installations, regardless of the lighting conditions and shall be placed on at least every third rail;

m) Interruptions in continuity should only be introduced if this is strictly necessary. Wherever possible, such interruptions shall be so designed to make it impossible for a vehicle to collide with the start of a section end-on. Where interruptions are introduced, no section should be less than 30m in length;

n) Guardrails shall not be erected above one another. Normal guardrail poles are not strong enough to resist the additional moment on impact and this practice is therefore not recommended.

o) Guardrail posts shall not be anchored over concrete slabs where slenderness poses a safety risk.

p) Where guardrails are provided on horizontal curves (i.e. on radii), the guardrails shall be curved to fit the required radius. Should the instance arise where a guardrail cannot be curved to a required radius, alternatives shall be discussed with the RIM District Office.

q) Any alternative design and/or installation method for guardrails shall be discussed and approved by the City, prior to commencement of works.

Equal Severity Curve

Warrants for the provision of guardrails along embankments (fills) is measured according to a severity index (SI). The severity index is based on the slope and height of an embayment. The Severity Indices can be found on Equal Severity Curve (ESC), as illustrated in the *TRH17* and *Yellow Book*.

A severity index of 4.8 is considered as a warrant for the provision of guardrails.

The method to determine the severity indices for a given embankments is described below (in accordance with the Yellow Book and TRH17):

a) Consider embayment/fill geometry (see Figure 2-2):
   i) Measure the fill height (H_F)
   ii) Determine the height (H_1) at which the SI = 4.8 from the ESC. If $H_F > H_1$, then guardrails are warranted.
   or
   Determine the severity index of the fill (SI_F) using the fill slope (S_F) and fill height (H_F) from the ESC. If $SI_F > 4.8$, then guardrails are warranted.
   iii) If guardrails are not warranted in terms of the fill geometry, then the natural slope below the fill has to be checked.

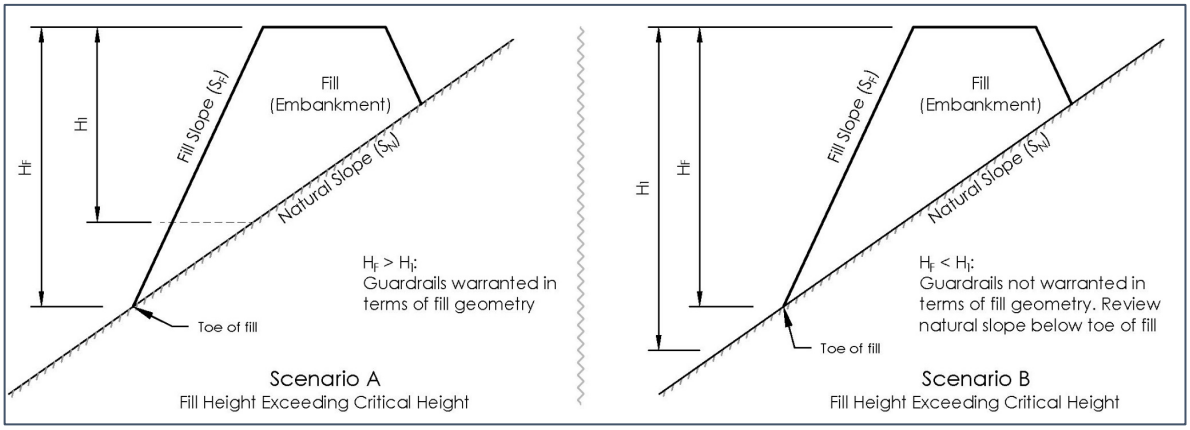


Figure 2-2: Severity Index based on Fill/Embankment Height

b) Evaluate the natural slope (S_{NT}) below the fill (at the toe) (see Figure 2-3):
   i) To evaluate the natural slope at the toe of fill, follow the below steps:
      - Establish H_1, as described in a) above.
      - Calculate the surplus height (H_2) by subtracting H_F from H_1 (i.e. $H_2 = H_1 – H_F$).
      - Determine the severity index (SI_2) of the fill using H_2 and S_F from the ESC.
      - Determine the height (H_3) of a natural slope using SI_2 and S_{NT} from the ESC.
      - Measure the height (H_B) of the natural slope below the toe of the fill.
   ii) If the S_{NT} is flatter than 1:4 (25%), the natural slope is not considered to have an effect on the severity index. Therefore, if SI_F <4.8 and S_{NT} is flatter than 1:4, guardrails is not warranted.
   iii) If the S_{NT} is steeper than 1:4, the accident severity potential of the accident is increased. Therefore, if $SI_F < 4.8$ and S_{NB} is steeper than 1:4, but $H_B > H_3$, then guardrails are warranted. Otherwise, if $H_B > H_3$, then guardrails are not warranted.

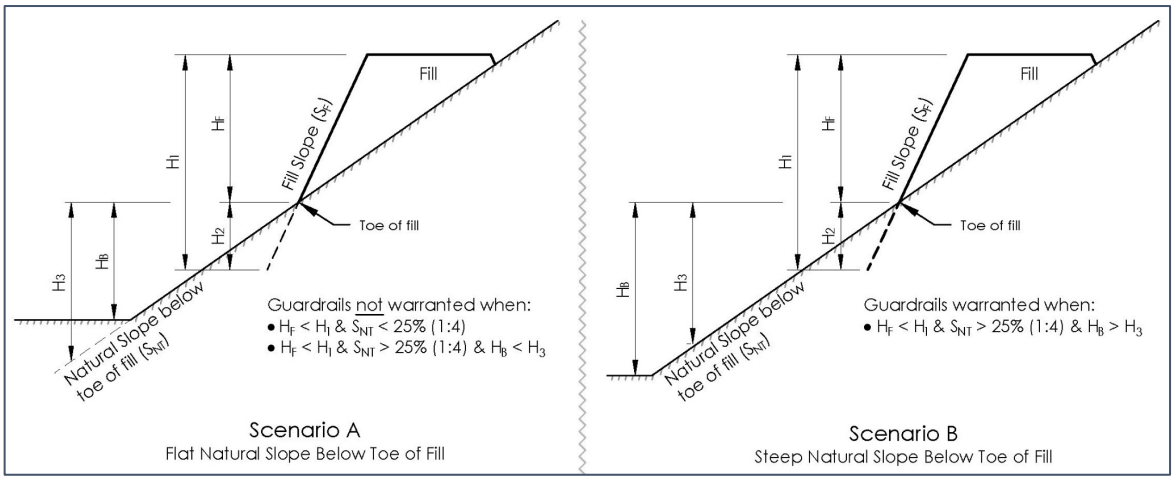


Figure 2-3: Evaluation of natural slope below toe of fill/embankment

Deflection for Longitudinal Guardrails

Where guardrails are installed to act as longitudinal guardrails (i.e. parallel to the travel direction or roadway), it is important to ensure that sufficient space is available behind the guardrail, in order to accommodate the deflection of the guardrail upon impact. If the available space is limited, then the deflection can be reduced by increasing the post size or reducing the post spacing.

The table below contains design deflections for guardrail systems, as per SARSM Vol 6 Table C-7). The aforementioned can be used to provide guidance in the instance where structures or any type of vulnerable entity is present along the road.

Table 2-2: Design deflections for guardrails

Post Diameter	Post Spacing	Maximum Deflection [1]
180mm	3.81m	1.98m
180mm	1.905m	910mm
210mm	1.905m	600mm

[1] Deflections assume a 2040kg vehicle, 100 km/h impact at 25 degrees

Refer to drawing series RD13 for typical guardrail details.

2.4.14 Bollards

Off-street bollards

Off-street bollards shall not interfere with the movement of pedestrians and cyclists.

Precast concrete bollard are the preferred bollard type to be used. Where alternative bollards are proposed, i.e. decorative aggregate-finished bollards, it shall be discussed and approved by the Approval Authority prior to implementation. In certain instances, where decorative aggregate-finished bollards are approved, the provision of a yellow retro-reflective band, minimum 50mm wide, near the top, may be required by the Approval Authority. The aforementioned is specifically important for bollards situated close to roadways or parking areas.

Should the provision of bollards inside NMT facilities be required, it shall be painted as per Drawing GE1.1. The selection of the paint colour should provide the best contrast with the adjacent NMT facility surface (e.g. if the NMT facility has an asphalt surface, the "Red" option should be utilised).

On-street Bollards

In certain instances, the need may arise to install bollards inside the roadway. This may be required to manage or direct traffic within the roadway or to provide protection for cycle facilities. Rigid bollards are not allowed in the roadway, since such bollards will act as hazards to motorists and are thus a safety risk. Therefore, where on-street bollards are proposed, flexible bollards shall be utilised, as per Drawing GE1.2.

Flexible bollards may be required for traffic management purposes in the following circumstances:

- Prohibit illegal U-Turning
- Hazardous locations
- Lane Definition
- Prohibit unsafe overtaking
- To manage traffic flow
- Guidance

Factors to consider in the design of the above shall include:

- Maintaining minimum lane widths,
- Manoeuvrability, especially turning movements.
- Visibility
- Reflectivity

Flexible bollards may also be provided on the side of roadways, where at-grade class 2 cycle facilities are required. Details regarding the aforementioned are further discussed in Chapter 5.

The provision of flexible bollards for traffic management shall be approved by the *Transport Network Development Branch* and bollards for at-grade class 2 cycle facilities shall be approved by the *Universal Access and Non-Motorised Transport Branch*.

2.4.15 Street Name Signs

Street names shall be illustrated by either of the following methods:

- Signs on pole-mounted nameplates;
- Embossed lettering painted on kerbs (white background with black lettering);
- Normal block painted kerbs (white background with black lettering).

Refer to Drawing RD15 for further details regarding the above-mentioned methods.

In areas where there is a high risk of theft or vandalism, the painted lettering options are preferred, as described above.

Street nameplates should always be mounted on steel poles. If there is risk of the steel poles being stolen, the use of timber poles will be considered in exceptional cases. Exceptions will only be allowed in special cases, at the discretion of the Director: Roads Infrastructure Management.

Free standing street name kerbs are not preferred. However, where these are unavoidable, they should be situated against the road reserve boundary, provided that they do not pose a tripping hazard for pedestrians.

Street names shall comply with the City's *Street Naming and Numbering Policy (June 2014)*.

2.5 Determination of Existing Services

As part of the planning process, the exact position of above- and belowground services shall be determined.

Methods for obtaining the location of services include, but are not limited to, the following:

i) Topographical survey;
ii) Ground Penetrating Radar (GPR);
iii) Submission of an "existing services request" to the City.

Existing Services Information

As mentioned above, designers may submit an electronic enquiry to the City, requesting information on the available existing services in the proposed works area.

The aforementioned can be submitted to the relevant District Office. The request can be directed at the GIS official (listed under "Existing Services Information (GIS)") on the *"RIM Districts"* Map (refer to Part C).

Designers should take note of the below regarding the above-mentioned requests:

- Every effort is been made to ensure the accuracy of the information. The spatial data portrayed is considered current, accurate and complete, as per information received by the City (from other internal line departments responsible for the maintenance of these datasets and the as-built records of professional service providers).
- The data provided cannot be guarantee to be exact. The applicant shall verify the positions of services and all attribute data (e.g. cover levels, invert levels, depth of manholes, etc.) on site (prior to commencement with planning or construction).
- The City accepts no responsibility, and will not be held liable, for any errors or omissions contained in the provided information.

2.6 Urban Street Design

The "Urban Street Design Guide" can also be consulted for designs in urban environments, specifically CBD areas.

To: Part A Overview | To: Chapter Overview

CHAPTER 3

ROAD DESIGN

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CHAPTER 3: ROAD DESIGN

3.1 General

The following section of this document primarily covers Class 2, 3, 4 and 5 roads.

Where the City is responsible for the design of a Class 1 road, designers can refer to the following:

- SANRAL: Geometric Design Guidelines
- WCG: Geometric Design Manual, 1996

As mentioned in Chapter 2 of this document, for middle to higher order roadways, the scheduling of Project Management Team (PMT's) meetings are recommended, in order to assist with the thorough planning and design of said roads.

The following manuals provides a detailed coverage of the geometric design for roads:

- UTG 1: Guidelines for the Geometric Design of Urban Arterial Roads
- UTG 5: Geometric Design of Urban Collector Roads
- UTG 7: Geometric Design of Urban Residential Streets
- UTG 10: Guidelines for the Geometric Design of Commercial and Industrial Local Streets
- The *Red Book, Part II Chapter I: Transportation and Road Pavement*

Other documents in Chapter 20 can be referred to for items not covered in the above documents.

3.2 Road Design Criteria

The basic criteria relating to the design of roadways in an urban environment are provided in this section.

Designers can refer to the above-mentioned manuals for further details.

3.2.1 Road Reserve Width

The typical road reserve widths for the various road classes, as detailed in Section 2.4.1, are provided in the table below:

Table 3-1: Typical Road Reserve Widths and Design Speeds for Urban Road Classes

Class	Name	Road Reserve (m)	Design Speed (km/h)
2	Major Arterial	40m	80
3	Minor Arterial	32 - 40m	70
4	Collector Street	18 - 20m[1]	60
5A	Local Street: Commercial & Industrial	16-30m	40
5B	Local Street: Residential	12m	40
5C		10m	40
5D[2]		8m	40
6	Walk- & Cycleway[2]	6m	n/a

[1] In certain instances, 25m road reserve might be required (major collectors)
[2] Class 5D roads should be limited to short lengths and straights.

3.2.2 Road Cross Section Requirements

The recommended minimum requirements for the different classes of roadways, as described above, are provided hereafter (Class 1 roads are excluded). It shall be noted that these details refer to the typical cross section requirements for the relevant road classes and are subject to change.

3.2.2.1 Class 2 – Major Arterial

Table 3-2: Cross Section requirements for a Class 2, Major Arterial

Description	Specification	
Road Reserve width	40m	
On-street Arrangement	• 5m Median • Configuration per direction: o 1 x 3.7m right lane (including channel, if provided) [2] o 1 x 3.4m left lane o 1 x 2.4m Shoulder (excl. channel) / Class 2 Cycle Lane	
NMT Facilities [1]	Pedestrians	2m [3] (Minimum)
	Cyclists	1.5m Class 2 Cycle lane [4]
Kerb type	BK4	
Preferred Road Profile	Cross fall per carriageway	

[1] *Refer to Chapter 5 for further requirements on pedestrian footways and cycling facilities on high order roads.*

[2] *If a lane is situated adjacent to a kerbline where no channel is present (e.g. typically on the high side of the carriageway), the lane width shall be 3.7m. See* ***Figure 3-1***

[3] *Footway width subject to due consideration of projected pedestrian volumes.*

[4] *Refer to Section 5.4.5 for further details.*

Notes on Class 2 road cross section:

i) Direct property access (residential or commercial) is not allowed.

ii) No outfall channels permitted on the high side of the carriageway.

iii) If circumstances require the provision of a channel on the high side of the carriageway (e.g. for drainage or constructability purposes), infall channels shall be used. However, the provision of the aforementioned shall be properly motivated and discussed with the approval authoirty.

iv) No kerbside parking allowed along a Class 2 road.

v) Turning lanes (adjacent to basic lanes) shall generally be 3m (excl. channels and offsets). The width should be increased to 3.4m where high volumes of heavy vehicles are expected to be turning.

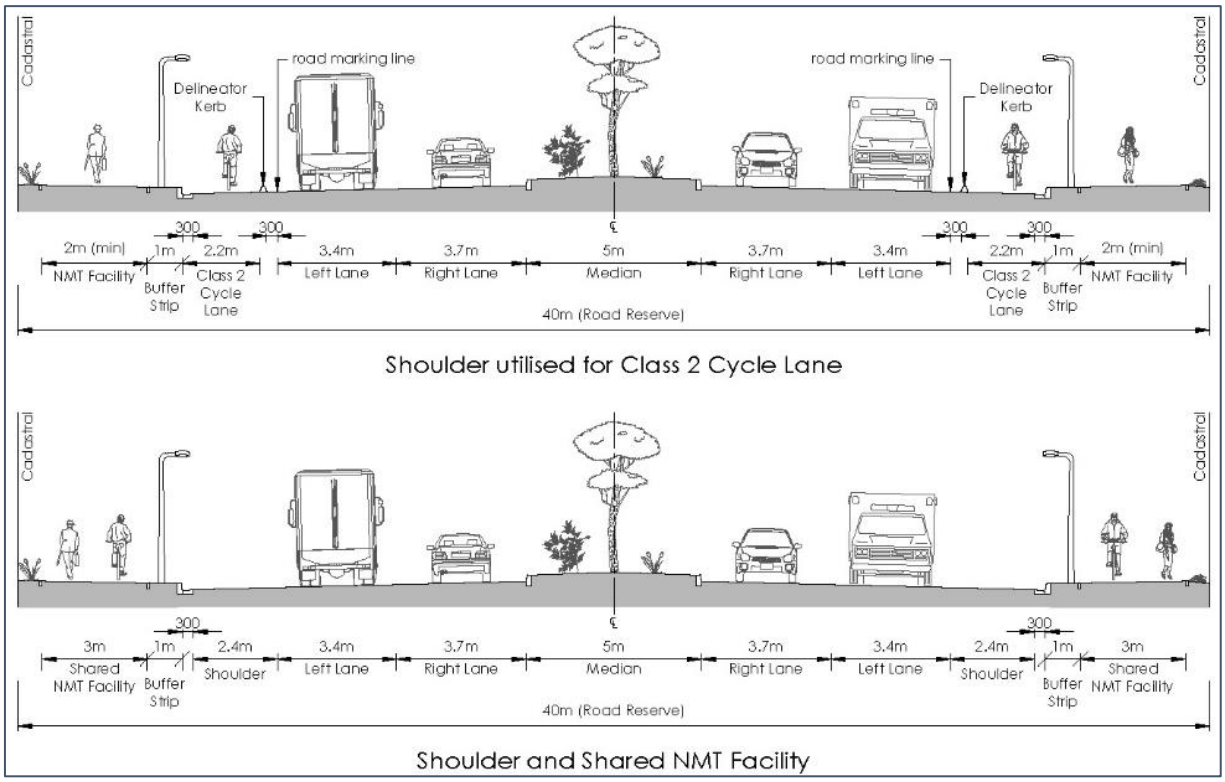


Figure 3-1: Typical Cross Sections of a Class 2 Major Arterial road

Refer to Drawing RD6.1 for the typical cross section details of a Class 2 road.

3.2.2.2 Class 3 – Minor Arterial

Table 3-3: Cross Section requirements for a Class 3, Minor Arterial

Description	Specification	
Road Reserve width	32 - 40m	
On-street Arrangement	• 5m Median • Configuration per direction: o 1 x 3.7m right lane (incl. channel, if provided) [3] o 1 x 3.4m left lane o 1 x 2.5m for parking / Shoulder / Class 2 or 3 Cycle Lane OR o 2.5m for Parking & 1.5m for Cycle Facility	
NMT Facilities [2]	Pedestrian	Minimum: 2m ; Preferred: 2.5m
	Cycling	Class 2 or 3 Cycle Lane
Kerb type[1]	BK2 / BK4	
Preferred Road Profile	Cross fall per carriageway	

[1] *BK2 kerbs are generally preferred for CBD and urban areas (due to the lower kerb face height for pedestrian and vehicular access). BK4 is the preferred kerb type where there is limited commercial developments and accesses. However, if the design involves proposed upgrades, e.g. road widening or dualing, and the existing kerb type is BK2, then the BK2 kerb should be considered to provide uniformity.*

[2] *Refer to Chapter 5 for further requirements on pedestrian footways and cycling facilities on high order roads.*

[3] *If a lane is situated adjacent to a kerbline where no channel is present (e.g. typically on the high side of the carriageway), the lane width shall be 3.7m. See **Figure 3-2**.*

Notes on Class 3 road cross section:

i) Direct property access is not recommended.

ii) No outfall channels permitted on the high side of the carriageway.

iii) If circumstances require the provision of a channel on the high side of the carriageway (e.g. for drainage or constructability purposes), infall channels shall be used. However, the provision of the aforementioned shall be properly motivated and discussed with the Approval Authority. If the aformentioned applied, a formal stormwater system shall be installed to accommodate the runoff on the high side.

iv) The sharing of cycle facilities with kerbside parking are not allowed. Cycle lanes shall either be a Class 2 or 3 facility.

v) Where kerbside parking and a Class 2 cycle facility is required, the carriageway shall be widened to accommodate the cycle facility between the parking bay and the kerbline, with a 500mm (min) buffer between the cycle lane and parking. Refer to Section 5.4.5.

vi) Where parking bays are required in a CDB or intermediate urban area, a combination dropped kerb and channel should be considered on the inside edge of parking, with the parking bay sloping towards the channel. The forementioned could assist in avoiding excessive/undesirable slopes on vehicular accesses to commercial developments.

vii) Turning lanes (adjacent to the basic lanes) shall generally be 3m (excl. channels and offsets). The width should be increased to 3.4m where high volumes of heavy vehicles are expected to be turning.

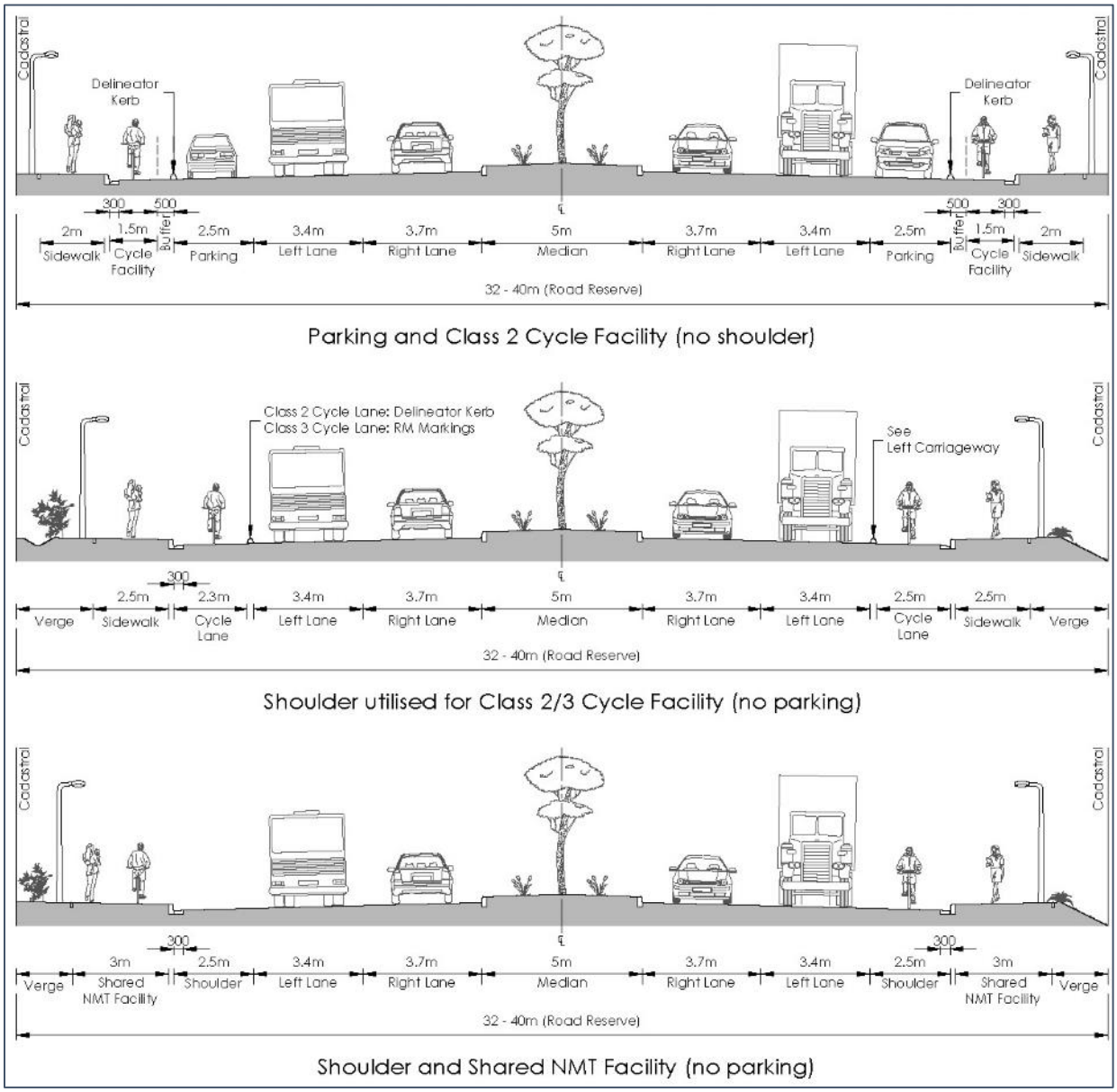


Figure 3-2: Typical Cross Sections of a Class 3 Minor Arterial road

Refer to drawing series RD6.2 for the typical cross section details of a Class 3 road.

3.2.2.3 Class 4 – Collector

Table 3-4: Cross Section requirements for a Class 4, Collector

Description	Specification	
Road Reserve width	18m - 20m	
On-street Arrangement	• Minimum roadway width of 8m (including channels) [1] • Configuration width per direction: o 3.4m (excl. channel) [5]: Parking and/or cycle facility o 3.7m (excl. channel) [6]: No Parking and/or cycle facility o 1 x 2.5m for Parking and/or 1.5m for Cycle facility per direction	
NMT Facilities [3]	Pedestrians	1.8m (min.) ; 2m (pref.)
	Cyclists	Class 3 Cycle Lane @ 1.5m (for road speed limit up to 60km/h) or 1.8m (for road speed limit > 60km/h)
Kerb Type	BK2 [2]	
Preferred Road Profile	Camber or Cross-fall	
Minimum Erf splay dimensions at intersections [4]	5m x 5m	

[1] *Minimum width as per UTG 5.*

[2] *For areas with narrow erf frontages (i.e. frontages <10m), MK10 kerbs with C1 channel or CK5 combination kerb and channel may be used.*

[3] *Refer to Chapter 5 for further requirements on pedestrian footways.*

[4] *The erf splay dimensions can be greater, should the sight distances demand it.*

[5] *If a lane is situated adjacent to a kerbline with no channel present (e.g. typically on the high side of the carriageway, with a median island), the lane width shall be increased to 3.7m (i.e. surfaced width).*

[6] *If no channel is present (e.g. on super-elevation), then the surfaced width shall be increased to 4m.*

Notes on Class 4 road cross section:

i) The sharing of cycle facilities with kerbside parking are not allowed.

ii) Where kerbside parking and a Class 2 cycle facility is required, the carriageway shall be widened to accommodate the cycle facility between the parking and the kerbline with a 500mm (min) buffer between the cycle lane and parking. Refer to Section 5.4.5.

iii) Where a median island is required:
- No outfall channels permitted on the high side of the carriageway.
- If circumstances require the provision of a channel on the high side of the carriageway (e.g. for drainage or constructability purposes), infall channels shall be used. However, the provision of the aforementioned shall be properly motivated and discussed with the Approval Authority. If the aformentioned applied, a formal stormwater system shall be installed to accommodate the runoff on the high side.

iv) Where parking bays are required, a combination dropped kerb and channel should be provided on the inside edge of the parking bays, with the parking bay sloping towards the channel. The forementioned could assist in avoiding excessive/undesirable slopes on vehicular accesses to residential properties.

v) If only a Class 3 cycle facility is required, a width of 1.5m shall be provided for such facility. Shoulders are not typically provided on Class 4 roads.

vi) Turning lanes (adjacent to the basic lanes) shall generally be 3m (excl. channels and offsets). The width should be increased to 3.4m where high volumes of heavy vehicles are expected to be turning.

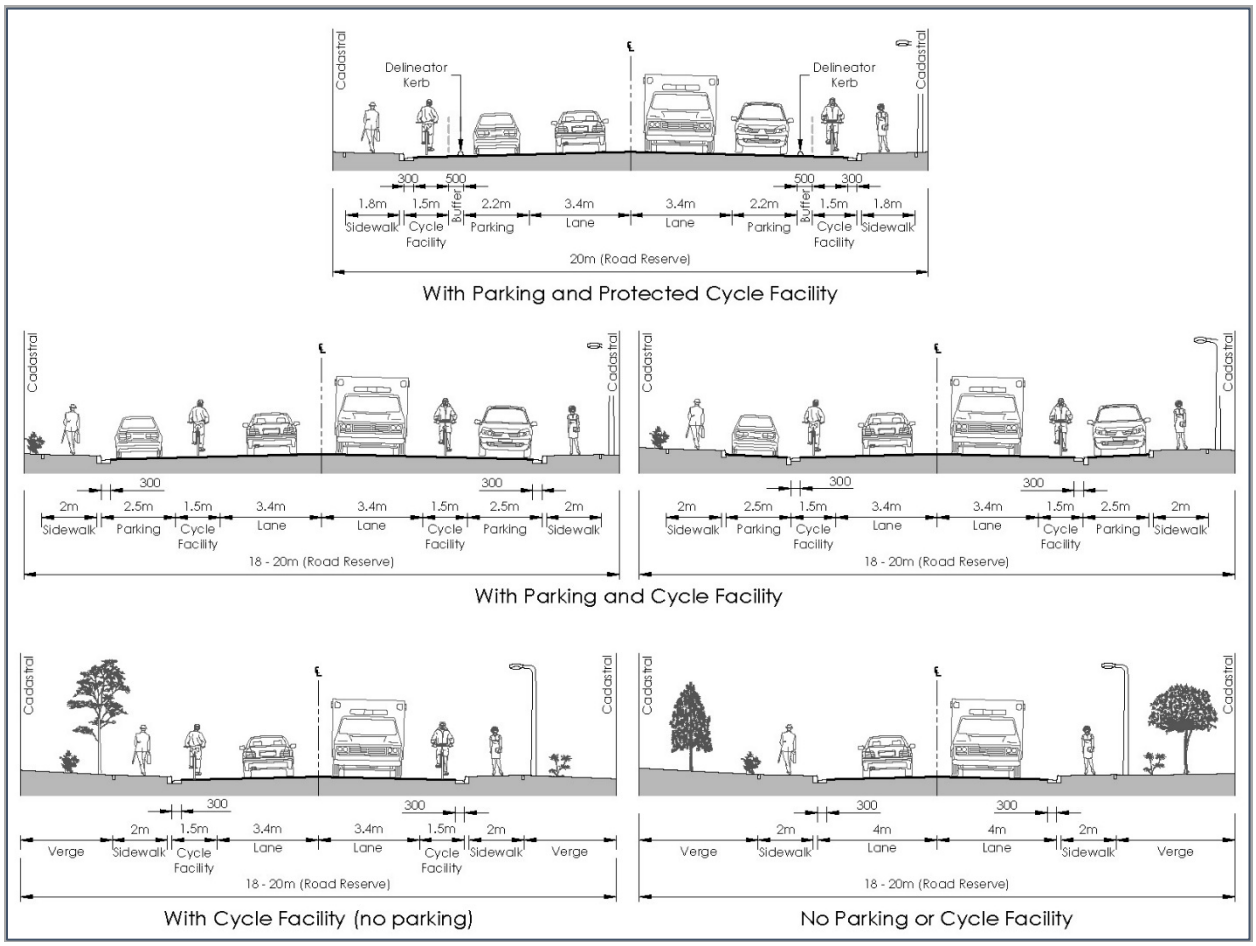


Figure 3-3: Typical Cross Sections of Class 4 Collector roads

Refer to drawing series RD6.3 for the typical cross section details of Class 4 roads.

3.2.2.4 Class 5 – Local Roads

Local Commercial and Industrial Streets (5A)

Table 3-5: Cross Section requirements for a Class 5 Commercial & Industrial Roads

Description	Specification	
Lane Configuration (Two Way)	One-lane Single Carriageway	Two-lane[1] Single or Dual Carriageway
Road Reserve width[2]	16-20m	24-30m
Basic Lane/Road Width	Road Width = 8m (incl. channels)	Basic Lane width = 3.7m (excl. channel)
NMT Facilities [3]	Pedestrians	Minimum: 1.8m ; Preferred: 2m
	Cyclists	Class 4 Cycle Facility
Kerb Type	BK2	
Preferred Road Profile	Camber or Cross-fall per direction	
Minimum Erf splay dimensions at intersections [4]	5m x 5m	

[1] *Where a dual carriageway is provided, the median island shall have a minimum width of 2m.*

[2] *The road reserve widths are given as an approximation. Since the cross section layout of local commercial and industrial streets various broadly, the road width shall be determined by the requirements of the specific development.*

[3] *Refer to Chapter 5 for further requirements on pedestrian footways.*

[4] *The erf splay dimensions can be greater, should the sight distances demand it.*

Notes on Class 5A roads:

i) Shoulders are typically not provided.

ii) Widening on horizontal curves shall be provided where required.

iii) Where a median island is required:

- No outfall channels shall be permitted on the high side of the carriageway.
- If circumstances require the provision of a channel on the high side of the carriageway (e.g. for drainage or constructability purposes), infall channels shall be used. However, the provision of the aforementioned shall be properly motivated and discussed with the Approval Authority. If the aformentioned applied, a formal stormwater system shall be installed to accommodate the runoff on the high side.

iv) Turning lanes (adjacent to the baisc lanes) shall generally be 3.4m (excl. channels and offsets). In developments, or parts thereof, where few heavy vehicles are expected, the turning lane width may be reduced to 3m (excl. channels).

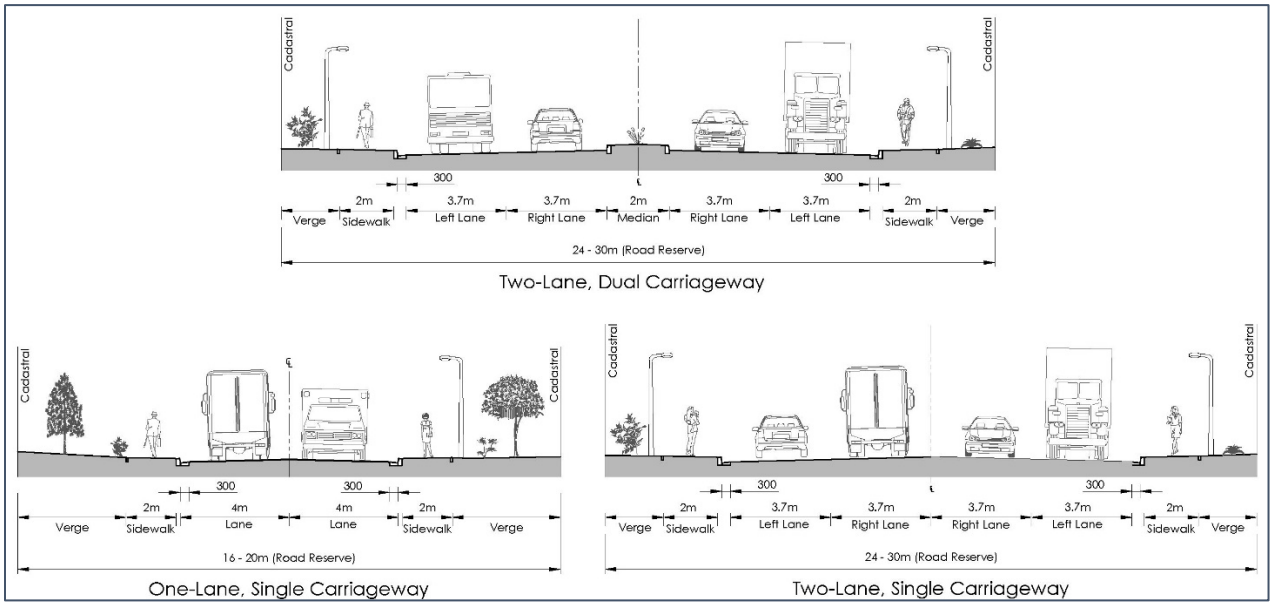


Figure 3-4: Typical Cross Section of Class 5 Local Commercial and Industrial Roads

Refer to drawing series RD6.4A-C for the typical cross section details of Class 5 commercial and industrial roads.

Local Residential Streets (5B-D)

Table 3-6: Cross Section requirements for a Class 5 Residential Access Roads

Description		Specification		
Road Sub-class		**5B**	**5C**	**5D[7]**
Road Reserve width		12m	10m	8m
Roadway width (incl. channel)		6.4m [5]	5.5 m	5.0m
NMT Facilities [1]	Pedestrians	1.5m / 2.0m	1.5m	1.5m
	Cyclists	Class 4 Cycle Facility		
Kerb Type	Erf Frontage ≥ 10m	BK2 / BK2 + C1[2]		
	Erf Frontage < 10m	MK10 / CK5[3]		
Preferred Road Profile		Camber [6]	Cross-fall	Cross-fall
Minimum Erf splay dimensions at intersections [4]		5m x 5m	3.5m x 3.5m	3.5m x 3.5m

[1] *Refer to Chapter 5.2 for further requirements*
[2] *If the road has a cross-fall profile, then the kerb type on the low side will be BK2+C1 and on the high side BK2 only.*
[2] *If the road has a cross-fall profile, then the kerb type on the low side will be CK5 and on the high side MK10.*
[4] *The erf splay dimensions can be greater, should the sight distances demand it.*
[5] *The minimum width may be reduced, if properly motivated.*
[6] *Cross-fall road profile may be considered, if motivated properly.*
[7] *Class 5D roads should be limited to short lengths and straights.*
* *Barrier kerbs shall be used on all radii/bellmouths at intersections.*

Notes on Class 5B-D roads:

i) Where these roads are situated in sandy areas and/or where there is a high risk of mole activity, moles barrier shall be provided.

ii) Class 5B & 5C roads
- The Approval Authority may require that the portions of road verge, where sidewalks are not present, be surfaced.

iii) Class 5D:
- Class 5D's narrow road reserve width makes it difficult to safely accommodate all the required services (underground and aboveground). Class 5D roads should therefore only be provided in special circumstances, with the support of the Approval Authority.
- The verges shall be surfaced, unless required otherwise by the Approval Authority. The verges shall be constructed as pedestrian footways (in terms of layerworks and slopes).

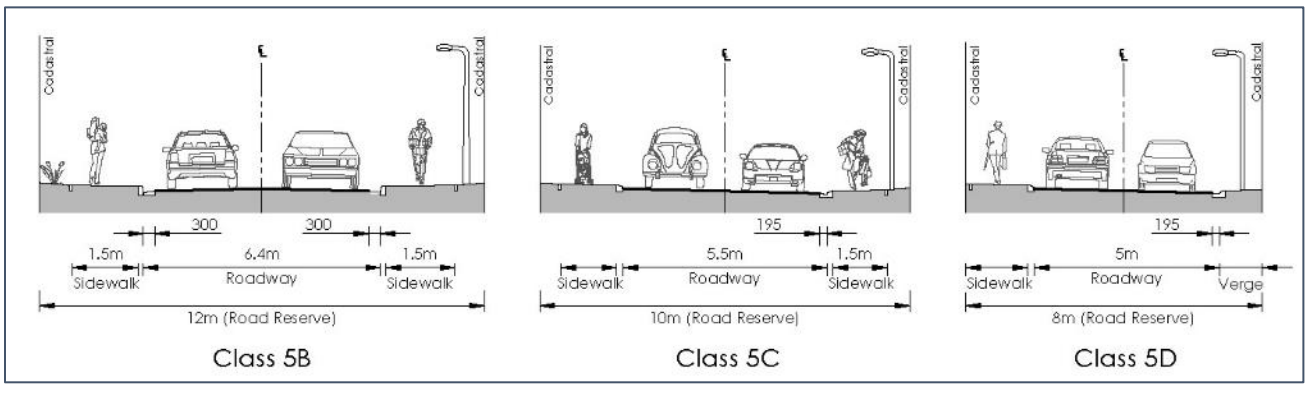


Figure 3-5: Typical Cross Section of Class 5 Local Residential Access Roads

Refer to drawing series RD6.4E-G for the typical cross section details of Class 5 Local Residential roads.

3.2.2.5 Class 6 – Pedestrian Walkways

Table 3-7: Cross Section requirements for a Class 6 Road, Pedestrian Walkways

Description	Specification
Road Reserve Width	6m
Minimum Surfaced Width	3m
Maximum Length	50m
Kerb Type (edge restraint)	CK5 & MK10/E1 or E1 both sides
Preferred Profile [1]	Cross-fall

[1] *Cross-fall should be away from adjacent properties (where applicable).*

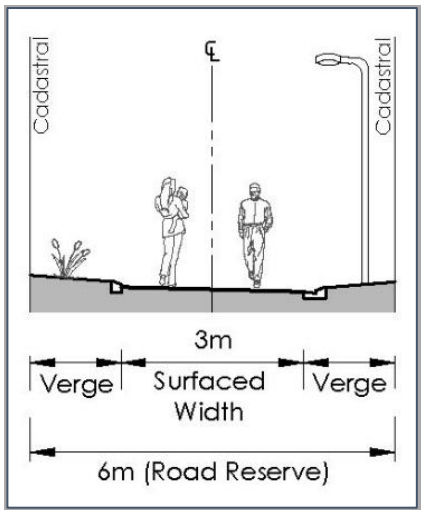


Figure 3-6: Typical Cross Section of a Class 6 Pedestrian Walkway

Refer to Drawings RD6.5 for the typical cross section details of Class 6 pedestrian walkway.

Typical characteristics of a Class 6 road include:

- Limited vehicular ownership
- Restricted vehicular access
- No kerbed entrance (bell mouth) from adjoining roadways - roadways and pedestrian links to be separated by kerbs
- To be accessible for emergency and service vehicles
- No through traffic allowed
- Ensure multi-directional pedestrian circulation
- No turning area necessary
- More convenient and direct access route
- Link between communities, hubs, public transport interchanges, etc.
- Recreational purposes ("Woon-erf" Concept)

3.2.2.6 Other considerations for road cross sections

Accommodation of NMT Users

Where a specific road forms part of a designated Cycle Route, the appropriate cycle facilities shall be provided in the cross section. The existing and proposed cycle routes can be found in the City's latest *Integrated Transport Plan* and on the *"Non-Motorised Transport (NMT) Network Plan Cycle Routes, City of Cape Town Metropolitan" Map* (refer to Part C).

An important consideration with regards to the provision of cycle facilities is the separation between vehicles, cyclists and pedestrians. Based on the importance of the cycle route, the appropriate cycle facility should be provided. There are currently 4 classes of cycle facilities, with each class based on the facility's level of exclusivity and segregation from other NMT facilities and vehicular traffic. Refer to Chapter 5 for more information and details on the various cycle facility classes.

Where cycle facilities are provided within the road carriageway, green painted lanes shall be provided at conflict points with vehicles. Refer to Section 5.4.4 for further details.

Phased Dualling of Arterial Carriageways

Where the construction of dual carriageways are required as part of a specific development's conditions of approval or congestion relief, it is often the case that both carriageways are not immediately required (to accommodate the existing and proposed traffic volumes).

In such instances, it is common practice to construct the first carriageway, which will accommodate traffic in both directions. Should this approach be followed, the first carriageway should be constructed with a road width of 9.8m (measured kerbface-to-kerbface). The aforementioned shall consist of an appropriate cycle lane and a 3.4m vehicle travel lane in each direction.

The abovementioned is illustrated in the figure below, using a Class 3 cycle lane as an example.

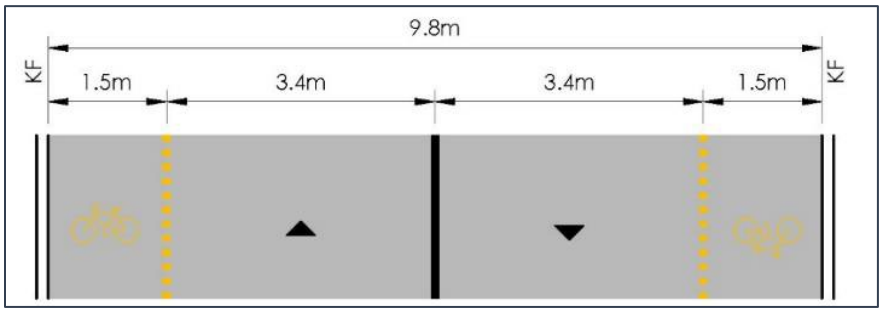


Figure 3-7: Interim layout for first carriageway of a future dual carriageway

3.2.3 Horizontal Alignment

3.2.3.1 Horizontal Curves

Minimum bellmouth and horizontal inside curve radii shall preferably be as follows:

Table 3-8: Bellmouth Radii and Horizontal Curve Radii

Road Classification	Road Reserve	Bellmouth Radii	Horizontal Centreline Radii
Class 2: Major Arterial (higher order)	40m	12 – 14m	315 - 425m
Class 3: Minor Arterial (higher order)	32-40m	12 – 14m	230 - 300m
Class 4: Collector (middle order)	18m/20m	10 – 12m	90 - 220m
Class 5A: Local Commercial & Industrial Streets	18-30m	10 – 12m	50-60m
Class 5B: Local Residential Access, Collector (lower order)	12m	8 – 10m	50m
Class 5C-D: Local Residential Access Street (lower order)	10m/8m	5 – 8m	35m

* *Where concentric curves are designed, curve widening shall be considered.*
* *The horizontal curve radii should be used as a guide and must be based on the design speed of the road. Refer to UTG 1 & 5, Table 9.1 for further details.*

3.2.3.2 Minimum Cross-fall

A cross-fall of 2.5% shall apply to all cambered and cross-fall roads.

3.2.4 Vertical Alignment

Vertical alignment is the combination of parabolic vertical curves and grades (also referred to as tangents). Grades have the properties of length and gradient, expressed as a percentage (%), indicating the height gained or lost over a horizontal distance.

The selection of rates of grade and lengths of vertical curves is based on assumptions about characteristics of the driver, vehicle and roadway.

Vertical alignment shall be designed to ensure the optimal safety of the road user, while also being aesthetically pleasing. Furthermore, vertical alignment shall be designed in conjunction with the horizontal alignment.

3.2.4.1 Vertical Curvature

The rate of vertical curvature is the distance required to effect a 1% change of grade. Vertical curves are specified in terms of this factor, namely "K", and expressed as follows:

$$K = \frac{L}{A}$$

where *L =* *vertical curve length (m)*

A = *algebraic difference between the gradients on either side of the vertical curve*

K = *rate of vertical curvature (change)*

The above expression is illustrated in the figure below:

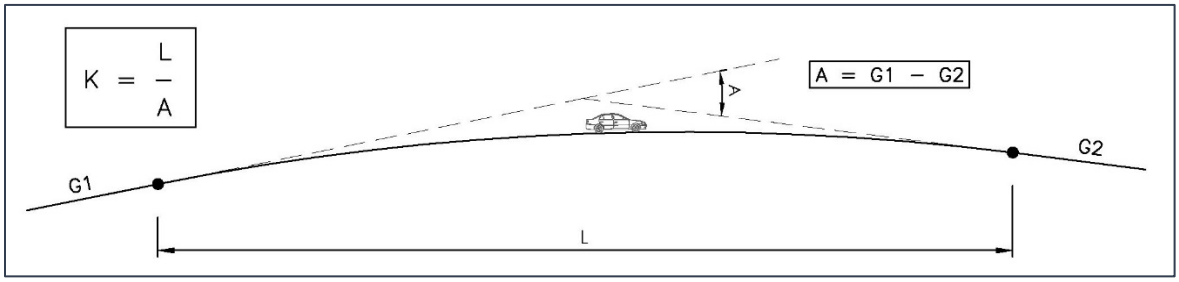


Figure 3-8: Rate of vertical curvature

The minimum rate of curvature is determined by sight distance, including considerations of comfort of operation and aesthetics. Stopping sight distance is generally used for vertical curves. However, special circumstances may require the use of decision sight distance (DSS) or even passing sight distance (PSD).

For crest curves, the sight distance is measured from an eye height of 1.05m, to an object height of 0.15m. For sag curves, the sight distance is replaced by a headlight illumination distance of the same magnitude, assuming a headlight height of 0.6m and a divergence angle of 1° above the longitudinal axis of the headlight (or plane of vehicle). The sight distance on vertical curves is illustrated on the figure below.

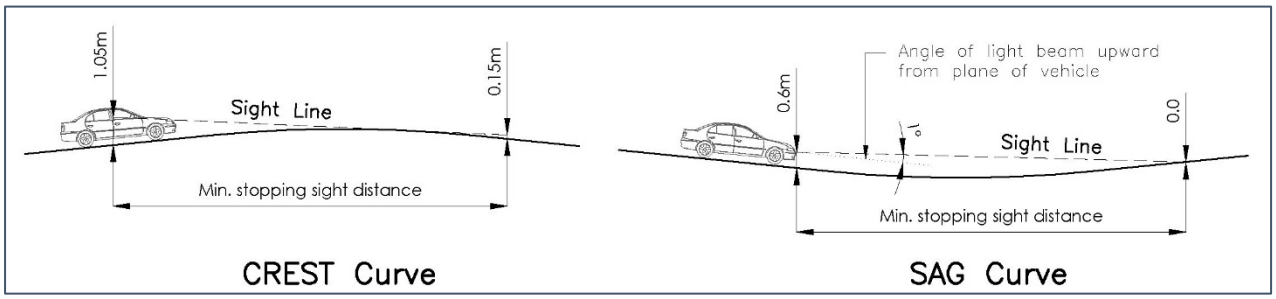


Figure 3-9: Sight distances on vertical curves

The minimum rates of vertical curvature (i.e. K-values) for various road classes are given in the table below.

Table 3-9: Minimum K-values for vertical curves

Design Speed *(km/h)*	Stopping Sight Distance[1] *(m)*			K-values								
				CREST			Sag					
							Headlight			*Comfort*		
	Road Class[2]											
	5B-D	5A[3]	4,3,2	5B-D	5A[3]	4,3,2	5B-D	5A[3]	4,3,2	5B-D	5A[3]	4,3,2
20	18	20	-	1	1	-	2	4	-	2	4	-
30	30	35	-	1	2	-	2	5	-	2	4	-
40	45	55	45	2	6	6	6	10	6	4	4	4
50	65	80	65	6	11	11	11	17	11	6	6	6
60	85	110	80	10	16	16	17	26	17	8	8	8
70	-	-	95	-	-	23	-	-	24	-	-	12
80	-	-	115	-	-	33	-	-	31	-	-	16

[1] Based on level sections. Adjustments required for gradients.
[2] Refer to Section 2.4.1 and Section 3.2.1 for road class details.
[3] Based on heavy vehicles (on Class 5 commercial roads).

3.2.4.2 Minimum length of vertical curves

In certain instances, especially flat terrains, the algebraic difference between successive grades might be very small and can result in the intervening minimum vertical curve becoming very short. Where tangents are specifically long, these short vertical curves can create the impression of a "kink" in the grade line and can therefore be non-aesthetic. In order to avoid these undesirable "kinks" in the vertical alignment, vertical curves shall be provided for aesthetic reasons.

Vertical curves shall be provided where the algebraic difference for the respective road classes are as follows:

- Class 5 : Greater than 2%
- Class 4 – 2 : Greater than 1%

Where the above algebraic differences are exceeded, the following minimum lengths of vertical curves shall apply:

Table 3-10: Minimum lengths of vertical curves

Design Speed *(km/h)*	Length of vertical curve *(m)*		
	Road Class[2]		
	5B-D	5A[1]	4,3,2
20	20	20	-
30	20	20	-
40	30	30	60
50	30	30	80
60	40	40	100
70	-	-	120
80	-	-	140

[1] Based on heavy vehicles (on Class 5 commercial roads).
[2] Refer to Section 2.4.1 for road class descriptions.

3.2.4.3 Minimum longitudinal gradient

The minimum longitudinal gradient shall be 0.5% (i.e. 1:200).

Gradients less than 0.5% should be agreed with the Approval Authority, in conjunction with the stormwater drainage design.

3.2.4.4 Vertical Clearance

A minimum vertical clearance is required, from any point in a roadway, to an overhead structure. If the structure is light, such as a pedestrian overpass, then the vertical clearance required shall be increased. It is also recommended that any future overlays be taken into consideration when determining clearances.

The table below illustrates the minimum vertical clearance for various structures.

Table 3-11: Minimum Vertical Clearance

Structure	Minimum Vertical Clearance
New Roadway Bridges	5.20m
Beam and Slab Roadway Bridges; Agricultural Underpasses	5.60m
Service and Pedestrian Bridges	6.0m
Existing Structures (absolute minimum)	5.0m[1]

[1] *After overlays (except for pedestrian bridges, which shall be discussed with the approval authority).*

Vertical clearance for overhead traffic signs shall be a minimum of 5.2m. Designers can refer to the *SADC-RTSM-Vol1* and *SARTSM-Vol2* manuals for further details relating to vertical clearance requirements or road traffic signs.

3.2.5 Sight Distances on Roadways

Sight distance is a fundamental criterion in the design of any road. It is essential for the driver to be able to perceive hazards on the road and have sufficient time to initiate any necessary evasive action safely.

The section below provides an overview of the various sight distances applicable to road design, as derived from the various UTG manuals.

Stopping Sight Distance (SSD)

Stopping distance involves the capability of a driver to bring a vehicle safely to a standstill. The distance is based on speed, driver reaction time and skid resistance. Stopping sight distance is measured from an eye height of 1.05m to an object height of 0.15m. An object height of 0.15m is used, since an obstacle with a lower height would not normally represent a significant hazard.

Barrier Sight Distance (BSD)

Barrier sight distance relates to the legal limit below which overtaking is legally prohibited. Sight distance is measured between an eye height of 1.05m and an object height of 1.3m, which represents the height of an approaching vehicle.

Passing Sight Distance (PSD)

Passing sight distance is determined on the basis of the length needed to safely complete normal passing manoeuvres.

Decision Sight Distance (DSD)

Stopping sight distances are usually sufficient to allow reasonably competent and alert drivers to come to a hurried stop under ordinary circumstances. However, these distances are often inadequate when:

- Drivers must make complex or instantaneous decisions,
- Information is difficult to perceive
- Unexpected or unusual manoeuvres are required.

Decision sight distance is the distance required for a driver to:

- detect an information source or hazard, which is difficult to perceive in a roadway environment that might be visually cluttered,
- Recognize the hazard or its threat potential,
- Select appropriate action and complete the manoeuvre safely and efficiently.

The values for decision sight distance are substantially greater than stopping sight distance, since it gives drivers additional margin for error and affords them sufficient length to manoeuvre their vehicles at the same or reduced speed, rather than to simply stop.

For measuring decision sight distance, the height of eye of 1.05m should be used together with an appropriate height of an object, depending on the anticipated prevailing conditions. The lower end of the range relates to situations in which a driver can perceive the overall picture, whereas the higher end relates to more ambiguous situations.

The various types of sight distances, as described above, are summarised in the table below. These sight distances are based on level roads. Designers can refer to the relevant UTG manuals to obtain the relevant sight distances on grades.

Table 3-12: Sight distances on level roadways

Sight Distance Type	Stopping			Barrier	Passing	Decision
Design Speed (km/h)	Road Class[2]					
	5B-D	5A[1]	4, 3, 2			
20	18	20	-	-	-	-
30	30	35	-	-	-	-
40	45	55	45	-	-	-
50	65	80	65	150	340	135 - 195
60	85	110	80	180	420	170 - 235
70	-	-	95	215	490	200 - 275
80	-	-	115	250	560	235 - 315

** Sight distances given in meters (m).*
[1] Based on heavy vehicles (on Class 5 commercial and industrial roads).
[2] Refer to Section 2.4.1 and Section 3.2.1 for road class details.

3.2.6 Intersection Sight Triangles (Shoulder Sight Distance)

Intersections shall be designed to optimise safety and avoid crashes at potential vehicle conflict points. The aforementioned can be achieved by providing adequate sight triangles on the approach/side road(s).

Drivers approaching an intersection, from a side-road, shall be able to see and be seen by drivers proceeding along the through road (i.e. conflicting traffic streams). The visibility in this visual field must be unobstructed and is known as a "sight triangle". This triangle is formed by the driver's eye, at the decision point (apex), and the stopping distances on either side of the stem-road, which forms the base.

The sight triangles at any intersection should be kept clear of obstructions, including street furniture and landscape elements. However, the placement of objects less than 0.6m in height inside sight triangles may be considered.

The Tables and Figures below provides the sight triangle requirements for various type of developments and through roads (lower and middle order roads), as per prescribed by the UTG7 and UTG10.

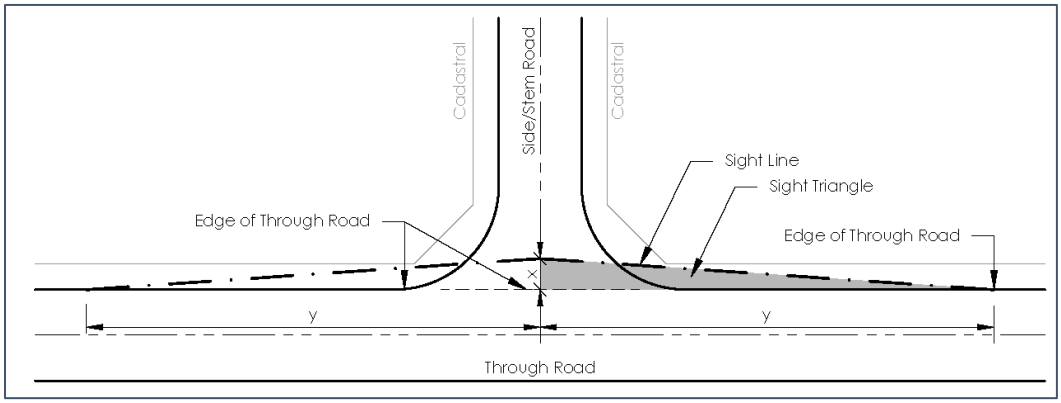


Figure 3-10: Sight Triangle for Urban Local Residential Streets

Table 3-13: Recommend Sight triangle dimensions for Urban Local Residential Streets

Through Road Class/Type	Dimensions (m)	
	X	Y
Major Residential access link	2.4m	45m
Access Loop/Way/ cul-de-sac	2.4m	35m

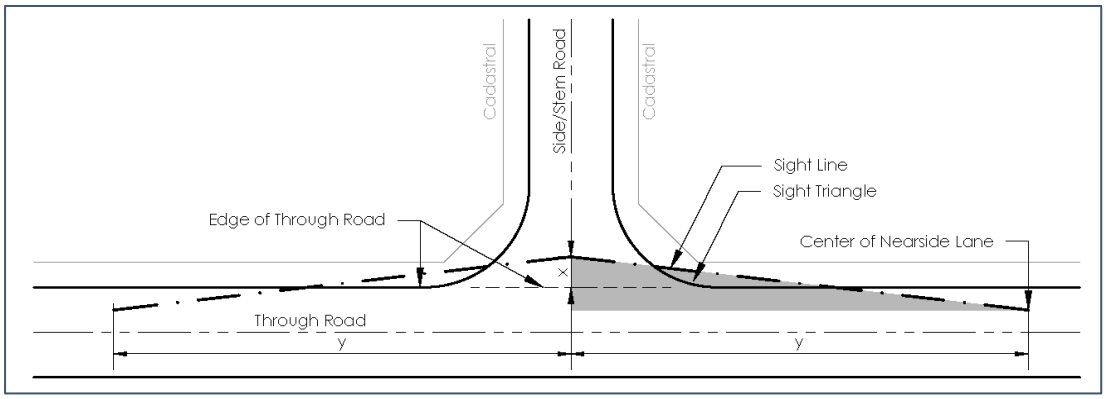


Figure 3-11: Sight Triangles for Industrial/Commercial Developments

Table 3-14: Recommended Sight Triangle dimensions for Industrial/Commercial Developments

Type of Development	Dimensions (m)			
	Yield Control		Stop Control	
	X	Y	X	Y
Regional shopping centre/single site commercial development	9	55	2.4	45
Industrial townships/parks	9	90	4.5	90
Office/science parks	9	55	2.4	45
Truck parks/transhipment centres/warehousing	9	75	4.5	55
Exhibition centres/theme parks/sports centres and stadia	9	55	2.4	45
Central and suburban/regional business areas	9	55	2.4	45

Designers can consult the following documentation for sight triangles on middle to higher order roads:

- UTG 1: Guidelines for the Geometric Design of Urban Arterial Roads
- UTG 5: Geometric Design of Urban Collector Roads
- COTO TMH 16 (Volume 2)

3.2.7 Tapers

The section below provides an overview of taper rates. Designer shall refer to the relevant UTG manuals and SADC RTSM Volume 1 for further details.

3.2.7.1 Types of Tapers

There are two types of tapers, namely active and passive. Each taper has different geometric requirements in various circumstances. The various characteristics of the two tapers are summarised in the table below:

Table 3-15: Types of Tapers

Taper Type	Characteristics
Active	• *Forces* or *causes* a lateral transition of traffic. • Typically used to narrow a roadway or a lane, or to merge two lanes into one (i.e. lane drop). • Active tapers are further split into two sub-categories, namely *Painted* and *Kerbed*; • Active tapers constitute a hazard to the extent that a driver that fails to perceive the change in circumstances may either drive off the travelled way or hit the adjacent kerbing. • Active tapers should generally be long, since they are seen as hazardous.
Passive	• *Allows* a lateral transition of traffic. • Typically used to widen a roadway or a lane, or to add a lane. • Creates space on the travelled way and is thus not seen as a hazard. • Passive tapers may be shorter, since they are not hazardous.

Furthermore, tapers are also used at the start and end of embayments for bus stops and parking.

The two types of tapers are illustrated in the figure below:

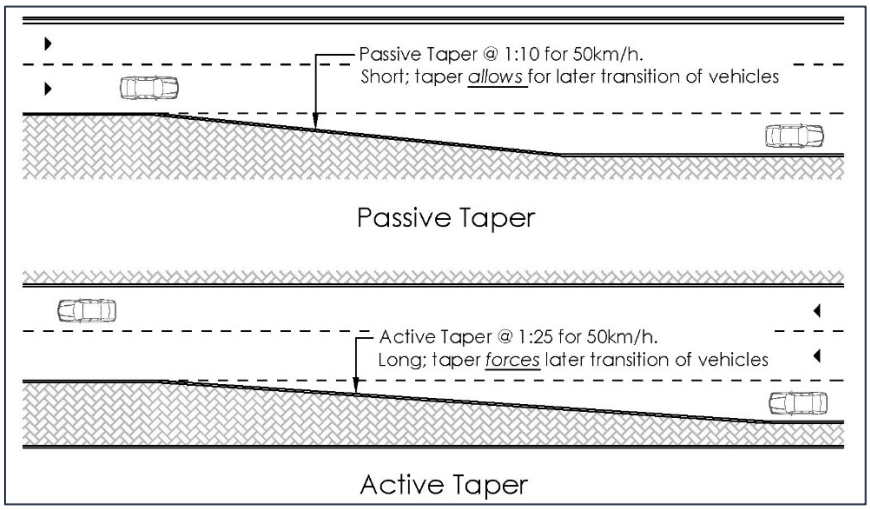


Figure 3-12: Taper rates

3.2.7.2 Taper Rates

The table below provides taper rates for various design speeds.

Table 3-16: Taper Rates

Design Speed (km/h)	Taper Rates (1:__)		
	Active		Passive
	Painted	Kerbed	
30	20	10	5
40	23	13	8
50	25	15	10
60	35	20	15
70	40	25	18
80	45[1]	30[1]	20

[1] *As per SADC RTSM Volume 1*

3.2.7.3 Applications of tapers

As stipulated in UTGs, tapers are typically used in the following scenarios:

a) *Tapers to define turning lanes*: When a right-turn lane is introduced, a passive taper is required from the right edge of the through lane to the right edge of the right-turn lane. The passive taper is normally 1:10. However, in urban conditions, there might be a need for storage space in the turning lane, which outweighs the need for a smooth transition. A 1:2 taper can therefore be used, in order to allow additional vehicles to queue and consequently lessens the possibility of vehicles at the tail of the queue blocking the through traffic. Where such short passive tapers are utilised, designers shall perform vehicle tracking of larger vehicles, in order to prevent the rear wheels from mounting the sidewalk or island.

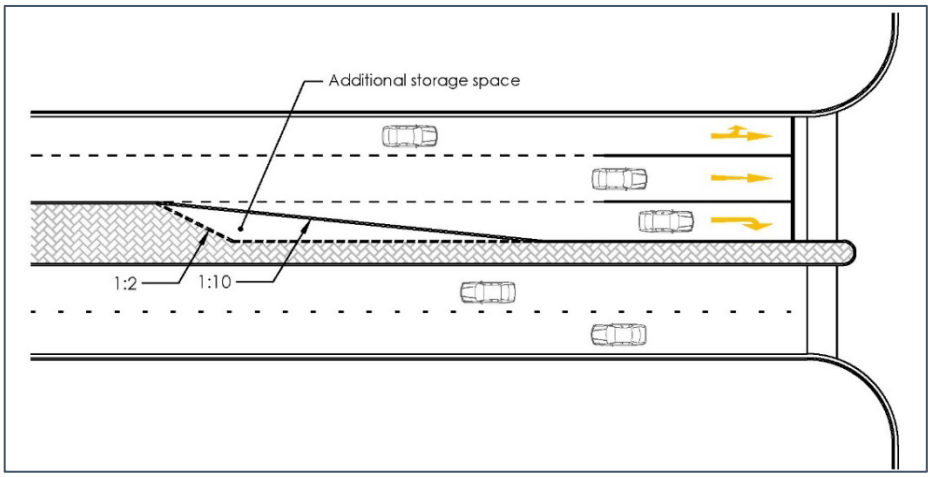


Figure 3-13: Passive taper for right-turn lane

b) *Tapers to narrow or merge lanes*: These tapers are active. The more gradual taper rates associated with painted line tapers are preferred in all applications.

c) *Tapers to widen or add lane*: These tapers are passive and can be sharper/shorter than active tapers. As noted in item (a) above, the taper rate can be as low as 1:2 if the additional lane has storage behind an intersection as its prime function.

d) *Tapers in turning roadways:* Passive and active tapers may be used to set off a turning roadway from through lanes in channelized intersections.

e) *Tapers in bus stop embayments:* For bus stop embayments, the taper leading into the embayment will be an entry taper and the taper leading out of the embayment will be an exit taper.

f) *Tapers in parking embayments:* For parallel parking embayments, entry and exit tapers are provided at the start and end of the embayments, respectively. Both tapers are generally provided at the same rate.

3.2.8 At Grade Intersections

The following basic criteria for intersections shall apply:

i) Roads should intersect at 90° angles. Skewed intersections shall be avoided and in no case shall the angle of intersection be less than 70°.

ii) Intersections shall preferably not be positioned in or near horizontal curves of small radii, on the inside of any horizontal curves, nor on or close to sharp crests. Safe horizontal and vertical sight distance shall be the deciding criteria.

iii) The maximum grade for approach legs to an intersection is 5%, for a minimum distance of 20m from the edge of the intersection. The grade of the major road should be carried through.

iv) Cross-grades at intersections should not exceed 5%.

v) Grades within the intersection to be a preferred minimum of 1%.

vi) All turning movements shall be checked for compliance with the swept path of the design vehicle applicable to the intersection.

vii) All intersections to have barrier kerbs at bellmouths, extending 2m into the tangents on both ends of the bellmouth.

viii) For kerb radii of less than 20m, 300mm kerb lengths shall be used.

ix) The minimum distance between intersections shall be as guided in the *WCG Access Management Guidelines (2020)*, provided that it complies with the design speed of the road.

3.2.9 Kerbs, Channels and Edgings

The table below provides an overview of the basic types of precast concrete kerbs, channel and edgings and its usage in the municipal environment.

Table 3-17: Precast Concrete Unit Types and Usage

Type	Ref.	Characteristics and Usage
Kerbs	BK1	• *Used at* parking areas or the back of NMT facilities, to minimise the "cut" effect
	BK2	• *Used on Class 5 local residential roads, where the erf frontages (i.e. street boundaries) are at least 10m,* Class 5 commercial roads, Class 4 collector roads and parking areas
	BK4	• *Used on Class 3 and 2 arterial roads*
	MK1/MK2	• *Used at splitter islands and center islands at roundabouts*
	MK5	• *Used at the truck apron at roundabouts*
	MK10	• *Generally used on Class 5 local residential roads, where the erf frontages (i.e. street boundaries) are less than 10m.* • *Provided on the high side of the roadway.*
	CK5	• *Generally used on Class 5 local residential roads, where the erf frontages (i.e. street boundaries) are less than 10m.* • *Provided on the lower side of roadway, to act as drainage conduit*
	Kassel	• *Used at IRT stations*
	DK2	• *Used at IRT lanes[2] and for the protection of in-road cycle facilities*
	DK3	• *Used at IRT lanes[2], staggered pedestrian crossings, to protect people on the refuge island, parking areas and for the protection of in-road cycle facilities*
Channels	C1	• Constructed as infall channels along carriageways. • Outfall channels are not permitted • Used for the construction of double or triple flat channels
	C2	• *Used as "buffer zone" at universal access ramps* • *Constructed level or with a maximum drop of 10mm (for drainage)*
Edgings	E1	• *Used as edge restraints for pedestrian footways, off-road cycle paths and light to medium duty carriageway crossings.*
	E3	• *Used as edge restraints for roadways (typically rural roads where no formal underground pipe stormwater drainage network is present and the stormwater runoff must drain overland) or heavy carriageway crossings*

All kerbs and channels shall conform to SANS 927.
[1] BK = Barrier Kerb | DK = Delineator Kerb
[2] The use of delineator kerbs for IRT lanes shall be discussed and confirmed with the Approval Authority.

In certain instances, kerbs may be required as temporary protection measures, e.g. protection of on-road cycle facilities or delineation. In such instances, the kerbs are modified to minimise the intrusive nature of the installation and removal thereof. Even though these kerbs are intended for temporary use, it may be used as permanent measures. The use of such kerbs shall be discussed and approved by the Approval Authority prior to implementation.

The kerb, channel and edging details can be found in drawing series RD1.

3.2.10 Green Infrastructure

In an attempt to improve infrastructure sustainability, minimise environmental impact and align with the City's Green Procurement Action Plan, the use of more environmentally friendly products is encouraged. The City's *Green Procurement Action Plan* and *Supply Chain Management Policy* can be consulted in this regard.

In line with the above, the use of hybrid mineral polymer eco-aggregate products (including, but not limited to, precast concrete kerbs and channels, block pavers, etc.) may be considered by the City, provided that the aforementioned products conform to the relevant specifications and requirements (i.e. SANS) in terms of shape, size, material properties, compressive strength, flexural strength, etc. Requests for the use of these products shall be submitted to the Approval Authority prior to implementation, accompanied by relevant test results performed by a SANAS accredited civil engineering material laboratory.

3.3 Traffic Roundabouts

Every traffic roundabout shall be individually designed for site specific and traffic conditions. However, in order to create some uniformity within the City, certain roundabouts requirements are prescribed hereafter.

The contents of this section was adopted from the *Roundabouts: An Informational Guide*. This section merely provides an overview of the basis and most important elements of roundabouts. For more information on the basic elements of geometric design for roundabout, designers are referred to the following:

- *Roundabouts: An Informational Guide – Chapter 6* (requires adaptation for South African use).
- WCG: *Roundabout Framework, Volume 2: Evaluation and Implementation Guideline*, May 2018.

3.3.1 Roundabout Features and Elements

The typical roundabout features and elements are illustrated in **Figure 3-14** below.

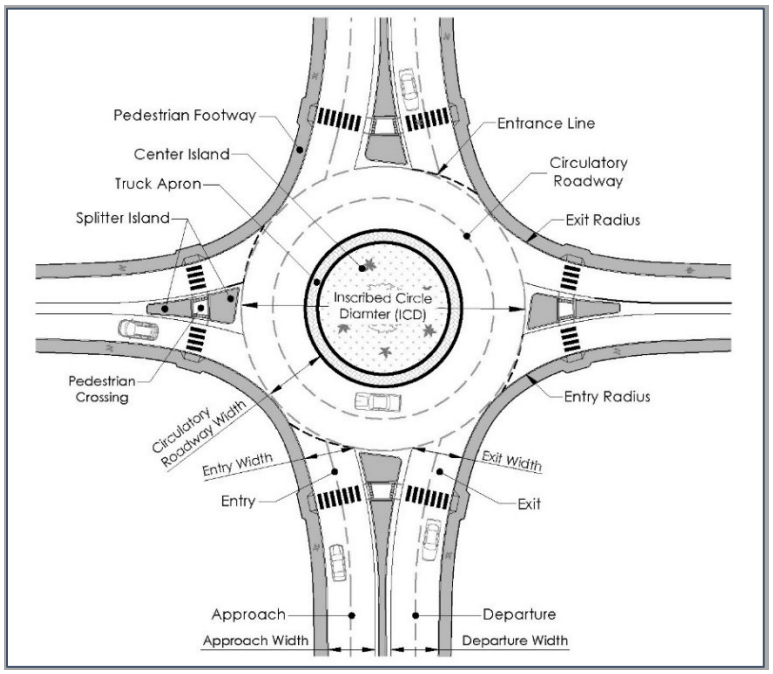


Figure 3-14: Typical roundabout features and elements

3.3.2 Roundabout Categories

This section will focus on 4 types of roundabouts, which were categorised according to size, function and environment. The various categories are listed below:

i) Mini-Roundabout
ii) Urban Compact Roundabout
iii) Urban Single-Lane Roundabout
iv) Urban Double-Lane Roundabout

Below is a brief discussion on the typical characteristics of each roundabout category, with a visual illustration.

Mini-Roundabout

Mini-roundabouts are small roundabouts used in low-speed urban environments, where there is a limited road reserve (i.e. lower order roads). Pedestrian safety is considered high for these roundabouts, due to the low vehicle speeds and short crossing distances.

The center island can be traversable or non-traversable, depending on the types of vehicles to be accommodated. Traversable center islands are generally provided to accommodate the turning movements of larger vehicles. The splitter islands can be striped (painted) or raised.

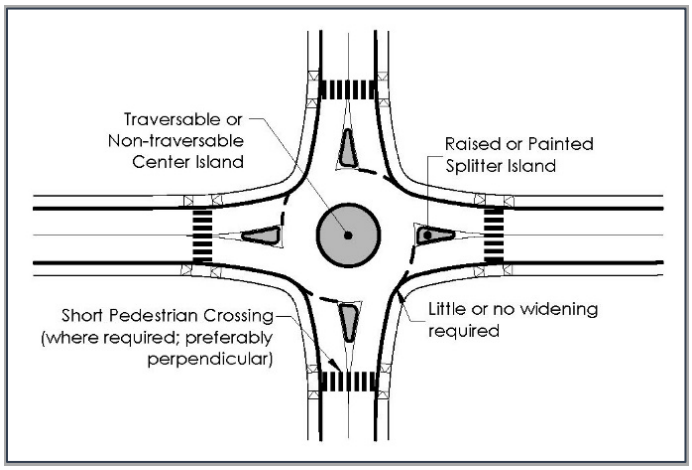


Figure 3-15: Typical Mini-Roundabout

Urban Compact Roundabout

Urban compact roundabouts are slightly larger than mini-roundabouts and are typically provided on middle order roads. The perpendicular approach legs require vehicles to make turning movements at lower speeds at the entries and circulatory roadway, which promotes pedestrian and bicycle safety.

The roundabout consists of single entry and exit lanes, with a single circulatory roadway lane. Raised splitter islands are used, with at-grade pedestrian refuge areas. The center island is non-traversable and generally accompanied by a mountable apron to accommodate the larger vehicles.

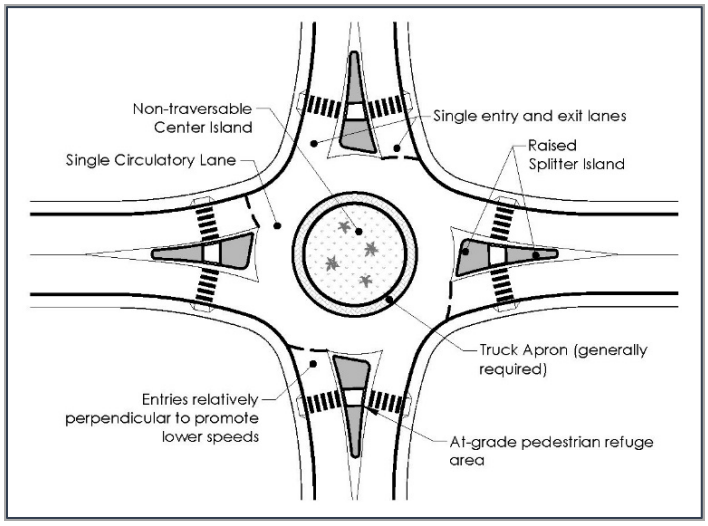


Figure 3-16: Typical Urban Compact Roundabout

Urban Single-Lane Roundabout

Urban single-lane roundabouts are generally provided on higher order roads, with the design focused on achieving consistent entering and circulating vehicle speeds. These roundabouts have larger inscribed circular diameters compared to urban compact roundabouts. Their more tangential entries and exits results in higher vehicle capacities and also allows for slightly higher speed at the entry, on the circulatory roadway and at the exit.

The roundabout consists of a single entry and exit lane at all legs, with a single circulatory roadway lane. Raised splitter islands are used, with at-grade pedestrian refuge areas. The center island is non-traversable. An apron is generally not preferred, since the circulatory roadway width is usually sufficient to accommodate larger vehicles. However, if the aforementioned is not possible (e.g. limited road reserve), a mountable apron may be provided.

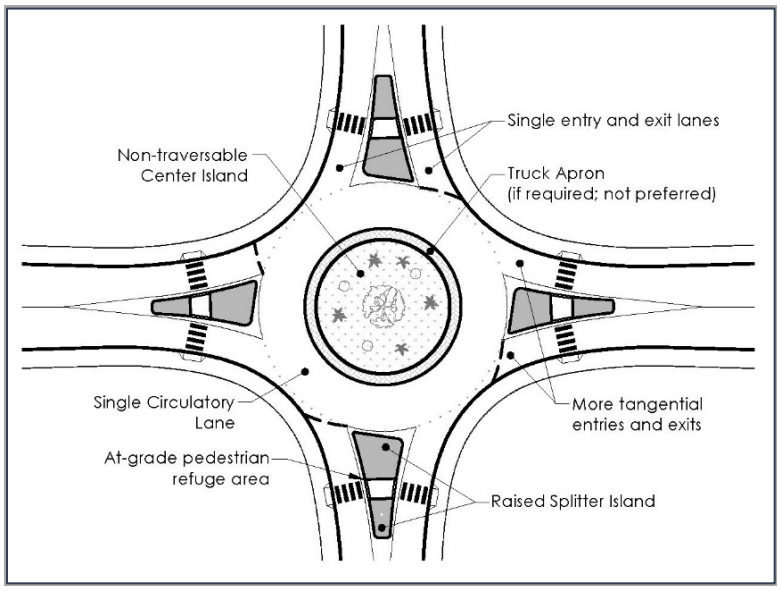


Figure 3-17: Typical Urban Single-Lane Roundabout

Urban Double-Lane Roundabout

Urban double-lane roundabouts are provided on higher order roads, with the focus on maintaining consistent speeds throughout the roundabout. These roundabouts have large inscribed circular diameters, in order to provide wider circulatory roadways to accommodate multiple vehicles travelling side by side.

The roundabout consists of two entry lanes on one or more approaches, with two circulatory roadway lanes. Raised splitter islands are used, with at-grade pedestrian refuge areas. The central island is non-traversable and excludes an apron.

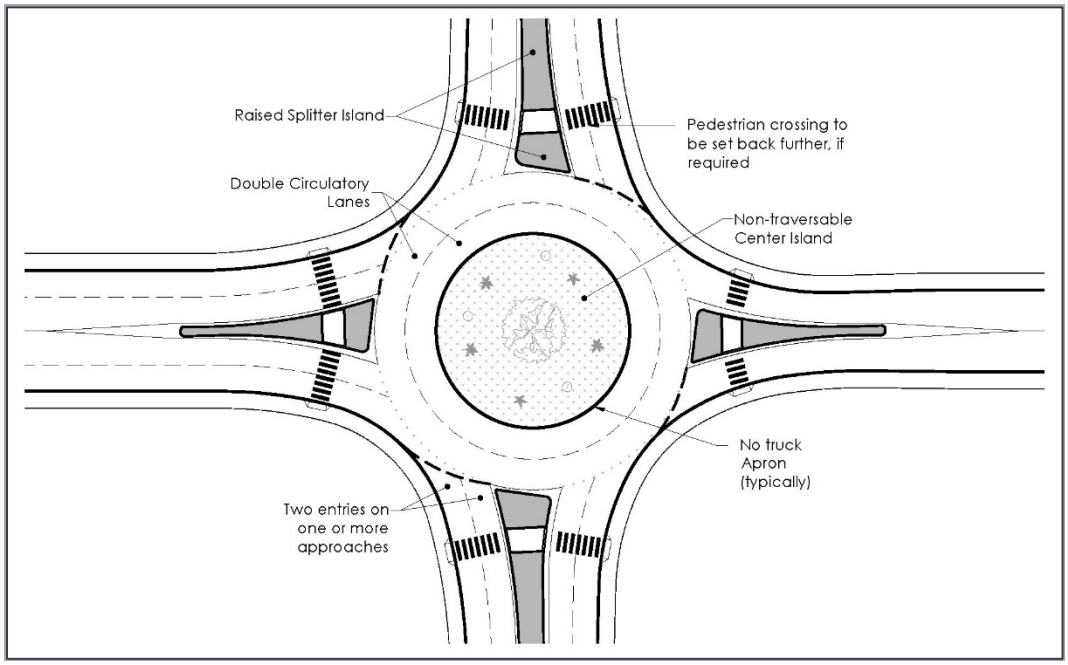


Figure 3-18: Typical Urban Double-Lane Roundabout

3.3.3 Layout and Inscribed Circular Diameter

The following will be applicable to the layout and size of roundabouts:

a) Traffic roundabouts shall be designed according to the appropriate design vehicle and speed.
b) The position and size of the central island will determine the amount of deflection that is imposed on the through vehicle.
c) The kerbing used along the entry and exit curves shall be Barrier Kerbs (BK2 or BK4).
d) For Mini-roundabouts on Lower Order roads, the kerb type may match the kerbing used on the approaching road.
e) The table below provides recommended ranges of inscribed circular diameters for the various roundabout categories.

Table 3-18: Recommended Roundabout Inscribed Circular Diameters

Type or Use	Design Vehicle	Max. Entry Design Speed	Inscribed Circle Diameter (ICD)
Mini-Roundabout (Lower order) Class 5 Road	Single unit truck (SU)	25 km/h	13 – 25m
Urban Compact (Single Lane) Mixed (middle order) Class 4 Road	SU and BUS	30 km/h	25 – 30m
Urban Single Lane Mixed (higher order) Class 3 Road	Semi–trailer (WB15)	35 km/h	30 – 40m
Urban Double Lane Mixed (higher order) Class 2 & 3 Roads	Semi–trailer (WB15)	35 km/h	45 – 55m
	Articulated Truck [1] (18.5m AT)	25 km/h	53m (min)

[1] Vehicle tracking similar to 22m interlink.

3.3.4 Entry, Circulatory and Exit Lanes

The following will be applicable to entry, circulatory and exit lanes of roundabouts:

a) The amount of lanes at roundabouts, i.e. entry, circulatory and exit lanes, should be based on the traffic requirements.
b) Designers shall take all future upgrades (i.e. additional lanes) into account.
c) The number of entry lanes, including the total width thereof, controls the capacity on the approach and is determined from traffic assessments (analysis). The aforementioned will also determine the appropriate lane discipline of the approach lanes (i.e. left, straight, right).
d) It is important that lane continuity is maintained through roundabouts, e.g. if a roundabout is serving a two-lane approach on a dual carriageway, then two entry lanes should be provided (even if the two lanes are not required in terms of capacity).
e) The number of exit lanes should not be greater than the number of circulatory lanes.
f) The required circulatory roadway width is determined from the number of entry lanes, the width of the entry lanes and the turning requirements of the design vehicle(s). The circulatory roadway should be wide enough to accommodate the swept path of all the required movements of the design vehicle(s). However, on smaller roundabouts, the swept path of heavy vehicles can be accommodated by providing a truck apron.
g) The design vehicle shall normally be the largest vehicle expected to use the roundabout.
h) On two-lane roundabouts, the circulatory width needs to cater for the turning movement of the largest vehicle expected to use the roundabout, turning on the inside of a passenger vehicle.
i) The crossfall or superelevation of the circulatory roadway should cater for the stability of the design vehicle, specifically larger vehicles with heavy loads. The grades should also ensure that sufficient stormwater drainage is achieved.
j) Drivers entering the roundabout should be able to clearly see traffic in the circulatory roadway and other approaches, in order to avoid conflict situations.

3.3.5 Central Island & Apron

The following will be applicable to center islands and aprons:

a) The shape of the center island shall be circular and should preferably be raised in order to improve visibility of the island for approaching drivers (without compromising vehicle sight distance).
b) Central islands to generally be non-traversable and shall have Barrier Kerbs (BK2 / BK4).
c) Where central islands need to make provision for the occasional traversing of heavy vehicles (i.e. mini-roundabouts), MK5 Mountable or MK2 Semi-Mountable kerbs shall be used.
d) In certain instances, the available right-of-way or other constraints might prevent the option to expand the inscribed circle diameter to accommodate larger vehicles. In such cases, a mountable truck apron may be added to the outer edge of the central island, in order to allow the over-tracking of larger vehicles, while still maintaining the required deflection for smaller (passenger) vehicles.
e) Where an apron is required, a MK5 Mountable Kerb shall be used. The MK5 kerb will allow heavy vehicles to mount the apron with relative ease, but will guide normal passenger vehicle to remain in the circulatory lanes. Barrier Kerbs shall be used on the central island.

The figure below provides a typical section, illustrating the circulatory roadway, truck apron and central island of a roundabout.

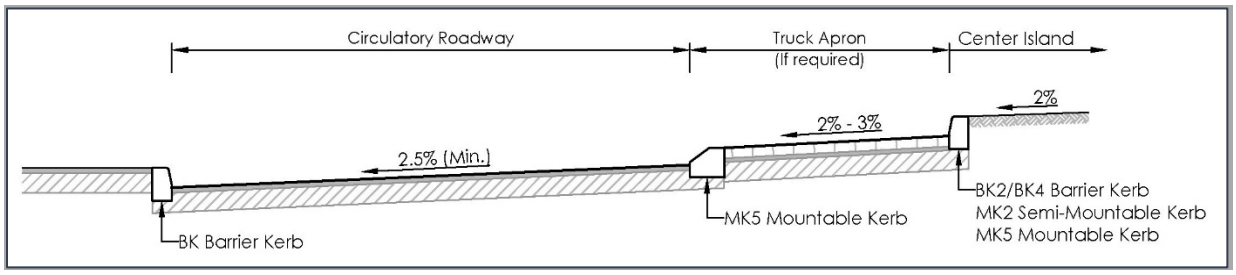


Figure 3-19: Circulatory Roadway, Truck Apron and Central Island

3.3.6 Splitter Island and Pedestrian Crossing

The following will be applicable to splitter islands and pedestrian crossings at roundabouts:

a) Splitter islands shall be provided on all roundabouts, in order to control vehicle speeds, guide vehicles into the roundabout, provide shelter for pedestrians and provide space to erect the necessary signage.
b) The total length of splitter islands should be a minimum of 15m.
c) The minimum width for splitter islands shall be as follows:
    i) Generally: 1.2m.
    ii) When signage is provided on splitter islands: 1.6m.
    iii) At pedestrian crossing points: 1.8m preferred (absolute minimum 1.5m), set back at least one vehicle length (minimum: 6m, preferred: 7.5m) from the entrance/exit line.
d) Kerb type:
    i) Barrier Kerbs (BK2 or BK4) shall generally be used for raised splitter islands.
    ii) For mini-roundabouts, where splitter islands are relatively small and no pedestrian crossings are envisaged, mountable (MK10) or semi-mountable (MK2) kerbs may be considered.
e) Appropriate provision for universal access shall be made at pedestrian crossings. Dropped kerbs to be flush with the road and splitter island surfaces.
f) Tactile paving to be provided as per section 5.7.

The figure below provides typical minimum dimensions for splitter islands, including the bulllnose radii and offsets.

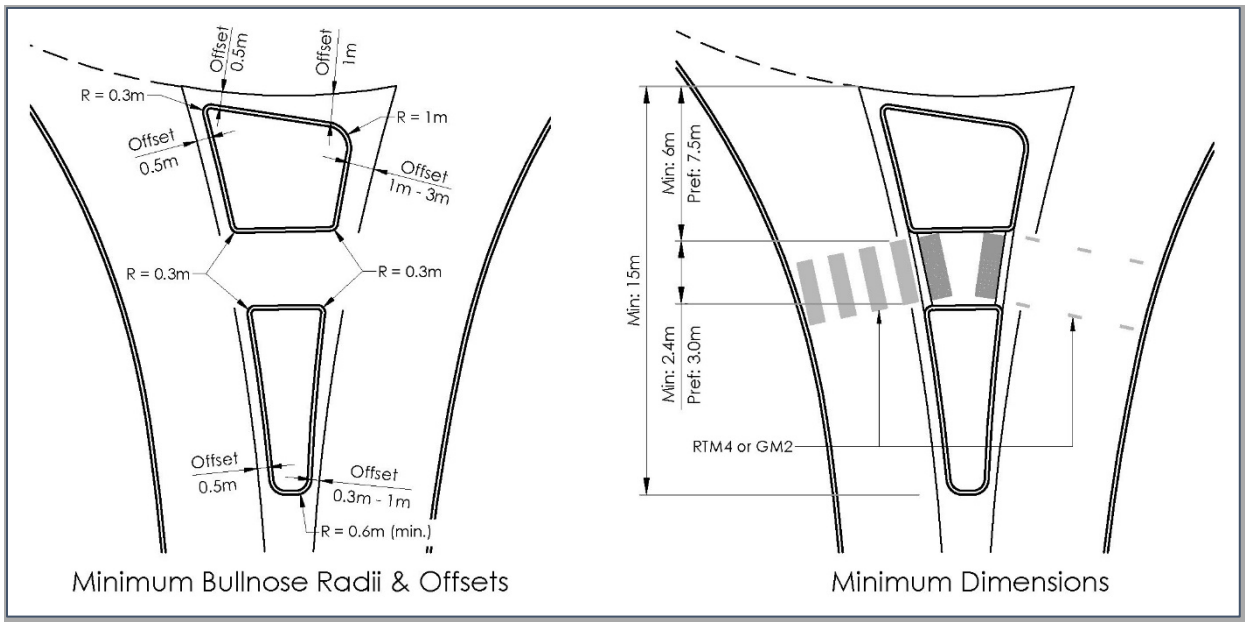


Figure 3-20: Splitter Island Dimensions and Offsets

3.3.7 Safety and Drainage

The following shall be taken into consideration with regards to the safety and drainage of roundabouts:

a) The circulating roadway shall have a negative super-elevation, in order to ensure that the stormwater drains away from the center island.
b) If a negative super-elevation is not possible, sufficient stormwater catchpits shall be provided around the center island (i.e. at low points).
c) Rapid crossfall changes should be avoided, since such changes can cause instability for heavy vehicles and their loads.
d) Should vegetation/landscaping be proposed on the center island, the aforementioned shall not impede the sight distance of drivers approaching the roundabout.

3.3.8 Layerworks, Surfacing & Markings

Where roundabouts are retrofitted, the road layerworks shall match the existing pavement on the higher order road or the minimum layerworks as prescribed in this document (i.e. Chapter 8), whichever is the strongest.

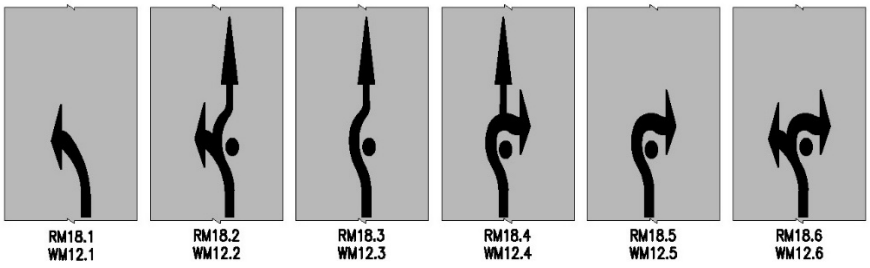
Center and splitter islands shall have paved surfaces. Kerbs to be painted matt black and retro reflective white, alternately, to clearly distinguish the islands from the roadway.

The red and white GM8 marking shall be used at all roundabouts, including any other hazardous locations (or potential hazardous location).

Traffic Circle Direction Arrows ("Fish Hook" arrows)

The City obtained Ministerial approval for the experimental use of the "fish hook" approach arrows at selected multi-lane roundabouts in the City of Cape Town metropolitan area, as part of a pilot project. The use of these arrows will therefore be permitted, provided that Designers obtain approval prior to implementation thereof. The details of the aforementioned arrows can be found on drawings RM6.

Table 3-19: Traffic Circle Directional Arrows

Description	Traffic Circle Direction Arrows	Traffic Circle Direction Arrows Ahead
Type & Colour	Regulatory - Yellow	Warning - White
Code[1]	RM18	WM12
Application Details	The Traffic Circle Direction Arrow markings: • shall impose a mandatory requirement that drivers of vehicles shall only proceed in the direction indicated by such arrow at the traffic circle ahead. • shall be in yellow and should be of a size as indicated in Drawing RM6. Arrows may be used to indicate a mandatory requirement to turn left only, turn left or proceed straight only, turn right only or proceed straight only, turn right only or turn right or left only from the applicable lane so marked. • will be most commonly marked on multi-lane approaches to a traffic circle. The arrows may be marked on controlled or uncontrolled approaches to a traffic circle whether the control is by means of a road sign or traffic signal. When marked in a lane they should be located between the CHANNELISING LINE markings RM3 and approximately 1m before the point of entry into the circle but not beyond any transverse road marking. If a STOP LINE or YIELD LINE marking is used, the arrows should be located approximately 1m ahead of such markings. • shall be marked in: o a lane when the lane is an EXCLUSIVE or DEDICATED TURN lane; o a lane when more than one directional movement is permitted from the lane(e.g. a right turn movement AND a straight-on or through movement); o a lane adjacent to a kerbed or painted channelising island which defines a turning roadway or slip road; o all lanes, when turning movements are permitted to the left and/or right, from two or more lanes. In order that drivers may be made aware of the mandatory traffic circle direction control as early as possible, RM18 markings shall be preceded by at least two TRAFFIC CIRCLE AHEAD ARROW markings WM12, in each lane which is controlled by RM18. Any dedicated left lane that does not traverse the circulating roadway of the traffic circle, should be marked with normal left-turn arrow marking RM8.1, not with RM18.1.	The Traffic Circle Direction Arrow Ahead markings: • are to warn road users that a MANDATORY TRAFFIC CIRCLE DIRECTION ARROW marking RM18 is ahead, which will require the driver to proceed only in the direction/s indicated by the arrow. WM12 marking used in a lane shall have the identical shape as the RM18 markings used in such a lane. • shall be marked in white and should be of a size as indicated in Drawing RM6. At least two WM12 arrow markings shall precede a RM18 arrow marking, EXCEPT when the RM18 marking is in a recessed or EXCLUSIVE or DEDICATED left or right turn lane, which is less than 25m in length. The WM12 marking shall be marked at least 27m in advance of the RM18 marking to which it refers. A spacing between successive markings of 27m to 45m is preferred (in urban module). However, NO WM7 arrow shall be marked between the WM12 marking and the traffic circle to which it refers, if for example an intersecting side road is located between the WM12 marking and such traffic circle.
Illustration		

[1] *Codes have not been formally included in the SADC-RTSM and should thus only be used for information purposes.*

3.3.9 Landscaping on Center Islands

3.3.9.1 General

Even though landscaping on the center islands of roundabouts improves the aesthetics of the area, it is of utmost importance that the safety of the road user is not compromised.

Trees, tall shrubs and boulders are identified as potential roadside hazards in the South African Road Safety Manual (SARSM), with the aforementioned highlighting the following three aspects to take into consideration:

i) The mature size of shrubs and trees;
ii) The effect of the mature size on road safety, visibility and maintenance requirements;
iii) Future changes in road cross section.

The following shall be taken into consideration regarding the provision of landscaping on center islands:

- Landscaping should enhance the visibility of center island (where applicable) and clearly indicate to the driver that they cannot pass straight through the intersection;
- Landscaping shall minimize introducing hazards to the intersection, such as large trees, poles, walls, large rocks, etc.;
- The required sight distances shall be maintained at all times;
- Landscaping should discourage pedestrian traffic through the center island.

Further to the above, the following shall also be taken into consideration:

- Trees should preferably be located at least 3m from the edge of the traffic lane and outside of the clear zone, whichever is the widest.
- The clear zone, according to the SARSM, is the minimum horizontal clearances between the edge of a traffic lane and the side of a tree trunk (measured at a height of 500mm when mature), shrub or any other fixed obstacle. The following minimum clear zones shall apply to urban roads:
    - Speeds up to 80km/h : 5m
    - Speeds up to 70 km/h : 3m
    - Speeds less than 70km/h: 1m
- Due to the damage caused by roots to the road pavement structure, the distance between the road edge and the side of the mature tree trunk should be 1.5m, unless root barriers are installed.
- A minimum horizontal clearance of 300mm, up to a height of 5.1m between any part of the tree or shrub and the kerb line or road edge, shall be ensured. Steep cross-falls on circulatory lanes may require additional clearance.
- No landscaping may obscure road signs. The future growth of trees or shrubs shall thus be taken into account.

Designers can also refer to the City's latest version of the *Guidelines for Designing or Approving Hard and Soft Landscaping in the Urban Road Reserve*.

3.3.9.2 Landscaping on Various Types of Roundabouts

The size of the roundabout will determine the type of landscaping or features to be applied. Various considerations for each type of roundabout are provided hereafter.

Mini-roundabouts

Since mini-roundabouts are small, with vehicles following the same approach as a stop controlled intersection, it is important to ensure that visibility is maintained throughout the entire roundabout.

Landscaping is typically not provided on the center islands of mini-roundabouts, since the center island is usually surfaced to accommodate the turning movements of larger vehicles. However, where landscaping is provided, it should be limited to low-growing shrubs (maximum height of 600mm when mature), in order to ensure complete visibility. Trees should be avoided.

Urban Compact Roundabouts

Urban Compact roundabouts are slightly larger than mini-roundabouts, with a yield-to-right control. The larger inscribed diameter allows for a non-traversable center island, generally accompanied by a mountable truck apron.

Landscaping may be provided on the non-traversable center island. Even though urban compact roundabouts are larger and have longer circulatory lanes, the spacing between vehicles ("vehicle gaps") in the roundabout may still be relatively short. It is therefore important that landscaping be limited to low-growing shrubs (maximum height of 600mm when mature), in order to ensure sufficient visibility. Small trees may be considered, provided that the trunk diameter does not exceed 100mm (when mature) and 1) a minimum vertical clear zone of 2.5m is maintained or, alternatively, 2) the tree has a high permeability (minimum 50%).

Urban Roundabouts (Single or Double Lane)

Urban single- and double lane roundabouts have large inscribed diameters and focus on achieving and maintaining consistent speeds throughout the roundabout.

Due to the larger the spacing between vehicles ("vehicle gaps") in the roundabout, it is not required for approaching drivers to "see through" the intersection (to observe vehicles approach from the opposite direction). Emphasis is rather placed on the provision of the required sight distances to the vehicles approaching from the right.

Due to the higher approaching and entry speeds of vehicles, it is crucial that splitter islands, median islands (at the entry and exit points) and the relevant portions of the center island are kept clear of any landscaping that might compromise the vehicle sight distance. The positioning of trees and shrubs shall therefore be carefully determined, to ascertain that the correct sight distance for the design speed is available (in accordance with the road design manuals).

Trees with trunk diameters exceeding 150mm (when mature) are not recommended, since the aforementioned are regarded as fixed objects and are thus hazards to motorists. However, where provided, the position thereof shall be carefully considered.

3.4 Steep Roads & Parking Areas

3.4.1 Design Parameters

The following absolute minimum/maximum parameters shall be adhered to:

Cross Section Grades

i) Maximum road cross-fall: 5%

Longitudinal Grades

ii) Unconditional steepest grade is 12.5%
iii) Steepest grade: 25% (For exceptional circumstances: 27.5 %)
iv) Maximum Length:
  a) Overall grade less than 20%: *No maximum*
  b) Overall grade greater than 20%: *see **Figure 3-21***
v) Approach to Intersection:
  a) Maximum grade: 5%
  b) Minimum Length = 10m (to enable drainage to be collected and to provide stopping space and start-up length away from the corner. Vertical curve excluded)

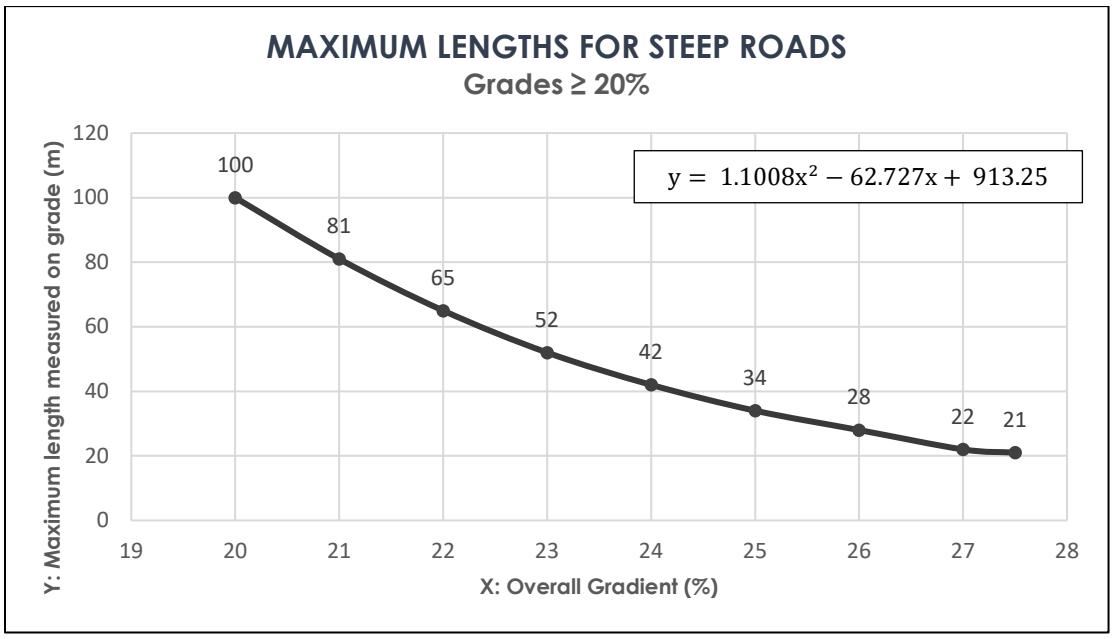


Figure 3-21: Maximum Length for steep roads

3.4.2 Parking Areas

The maximum grade for parking areas shall not exceed 5%.

3.4.3 Driveways

Refer to Section 6.3.4 for further information regarding ramp grades on driveways (carriageway crossings).

3.4.4 Constructability

The constructability of the road pavement shall be considered for any roads steeper than 12.5%. The Approval Authority shall be consulted in this regard.

3.4.5 Private Access Ways (Private Sites)

Private access ways shall adhere to the following:

- Minimum width 3m.
- Approach to roadway: Max 5% grade.
- Approach to roadway: Min length 6m (Vertical curve excluded)

3.5 Drainage Considerations

In the case of a private road or driveway, precautions shall be taken to ensure that no stormwater from City roads discharges into the private road or driveway.

Measures to achieve the above shall be discussed and approved by the Approval Authority.

Drainage from abutting land, including pathways and steps, shall be catered for e.g. kerbs and channel.

3.6 Other Design Considerations

Vehicle Turning (Tracking)

Where "bump-outs" are provided on intersection bellmouths (e.g. to improve pedestrian safety and universal access), designers shall carry out the necessary vehicle/s turning movement checks for the specific location. The aforementioned is required in order to ensure that vehicles are able to perform the necessary turning movements around the proposed "bump-outs".

To: Part A Overview

To: Chapter Overview

CHAPTER 4

ROAD VERGES

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CHAPTER 4: ROAD VERGES

4.1 General

The *COTO: TRH 27 - South African Manual for Permitting Services in Road Reserves - Version 1.0, Aug 2012*, has reference.

The verge needs to perform a number of functions, including:

- Providing space for both below and above ground services;
- Providing space for street furniture items, such as bus shelters, etc.;
- Provide for the safe movement of pedestrians, wheelchairs and cyclists, where applicable;
- Provide for on-street parking where required;
- Provide for adequate sight distance around curves and at intersections;
- Provide space for landscaping, supported by the *Director: Roads Infrastructure Management* and approved by the *Director: Recreation and Parks*.
- Provide additional capacity for overland stormwater drainage in the road prism.

The following criteria shall be adhered to:

- The verge width should be sufficient to incorporate the above functions. A minimum width of 1.5metres is recommended.
- In affordable housing developments, verges shall be fully surfaced to the appropriate standards, regardless of kerb type.
- Where mountable kerbs are used the mountable kerb installations shall require a minimum of 1m lateral support layerworks.
- Loose or unbound stones (of any size) on verges and islands shall not be allowed.

Relevant Codes of Practice, Policy and Guidelines:

i) CCT: Integrated Transport Plan
ii) NDT: NMT Facility Guidelines, 2014.
iii) NDT: Pedestrian and Bicycle Facility Guidelines, Aug 2003.
iv) South African Road Traffic Signs Manual (SRTSM), Volume 2 (3rd Edition, May 2012).

4.2 Verge Cross Section

Factors that determine the verge cross section are:

i) A cross-fall towards the kerb is required for surface drainage.
ii) A minimum width of 1.5m is required immediately adjacent to the kerb, with a cross fall of 2% towards the kerb, to allow for the following:
    - Surface drainage;
    - Pedestrian and cyclists refuge and passage;
    - Refuse bin placement
    - Road signs;
    - Street lighting poles.
iii) The verge cross fall, beyond 1.5m from the kerb, shall not exceed 17%, unless suitably design measures (i.e. retaining structures, landscaping, surface hardening, etc.) are taken to ensure the stability and functionality of the verge.
iv) The level at the erf boundary shall be sufficiently higher than the top of kerb, to ensure that the overland stormwater flow stays within the road prism. A minimum slope of 2% shall be maintained

4.3 Underground Service Position

4.3.1 Stormwater & Sewer Drainage

Stormwater

Stormwater pipelines shall be located underneath the roadway, positioned in such a way that the manholes will be located outside the vehicle wheel tracks. In exceptional circumstances, pipes may be placed in the verge, subject to the approval of the relevant road authority.

Sewer

Sewer pipes should preferably be located under the centre line of the roadway, or slightly offset on cambered roads. In steep sloping terrains, where properties on the lower side are not connected to the sewer, sewer-lines may be located on the high side of the road reserve, permitting relatively short connections.

Reservation width for Stormwater and Sewer services

The reservation width for stormwater and sewer pipes is determined by the lines of influence, which are drawn at 45° angles, from the edges of the trench base, up to the surface. The trench base is situated at a depth of 150mm below the underside of the pipe and the width thereof is calculated based on the outside diameter of the pipe.

The reservation width may be increased where poor ground conditions exist.

The figure below provides an illustration on how the reservation width, as described above, can be determined.

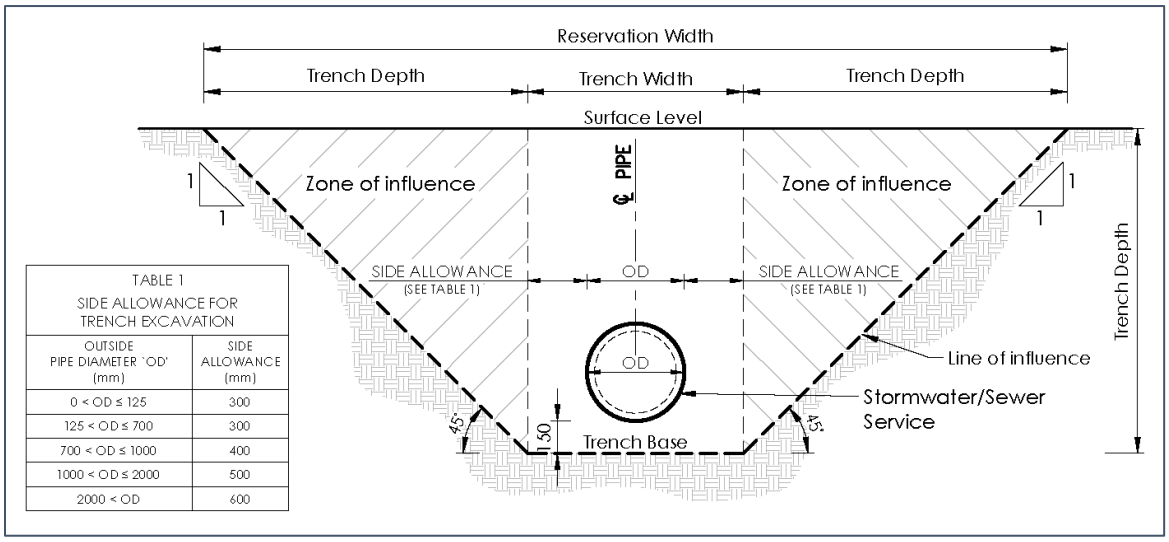


TABLE 1
SIDE ALLOWANCE FOR TRENCH EXCAVATION

OUTSIDE PIPE DIAMETER 'OD' (mm)	SIDE ALLOWANCE (mm)
0 < OD ≤ 125	300
125 < OD ≤ 700	300
700 < OD ≤ 1000	400
1000 < OD ≤ 2000	500
2000 < OD	600

Figure 4-1: Reservation Width for Stormwater and Sewer Services

4.3.2 Water Mains

Water mains should be located outside the roadway, on the high side of the road reserve; this will ensure that, in the event of a burst water main, flooding of properties on the lower side is minimized. Water mains should be located at least 1m away from the property boundary, unless directed otherwise. The minimum reservation width is 700mm, or the pipe diameter plus 600mm for pipes up to 300mm in diameter.

Water mains should preferably not be located underneath surfaced footways, to ensure easy access for maintenance water connections and disconnections, as well as the asset management of the roadway.

4.3.3 Electricity and Telecommunication Services

General Requirements

It is generally preferred that Electrical and Telecommunication Services be installed on opposite sides of the road reserve, especially in the case of high voltage electrical cables. Furthermore, it is recommended that electrical services and water mains be installed on the opposite side of the road reserve.

All telecommunication services shall be installed within a 1m wide shared space, measured from the erf boundary, and shall not exceed a depth of 1m. Where unstable ground conditions exist, shoring/protection should be applied in order to protect adjacent structures.

Electrical services shall preferably be installed with a horizontal clearance of 500mm from the erf boundary. Overhead Telecommunication and Electrical poles shall generally be located as close as possible to the property boundary, with a minimum horizontal clearance of 300mm.

Manholes

All telecommunication manholes, whether these are in the roadway or not, shall be designed to withstand traffic loading and shall have a chimney of at least 300mm between the manhole lid and the top of the roof slab.

A 300mm chimney allows some flexibility, should an adjustment or widening be required to tie in with the road levels. It also provides for reasonable layer works over the roof slab and minimises the likelihood of reflective cracking caused by differential settlement. The specification of telecommunication manholes, as reference in the Red Book, can be used as guide.

Designer can refer to Section 17.5.2 for further details regarding telecommunication manholes.

4.3.4 Subsurface Drains

Subsurface drains, where required, should preferably be installed on both sides of the road reserve, directly behind the kerb line. Refer to Drawing SW1 for further details.

4.3.5 Reinstatement of Trenches in Road Reserves

Refer to Drawing RD16 for the various reinstatements methods of trenches in road reserves. Technical information regarding various type of pavement layers can also be found in Section 8.

Designers can also refer to the latest revision of the *Wayleave Process and Standards for The Installation of Services in Road Reserves*, which provides detailed information regarding the reinstatement requirements for trenches in road reserves.

4.4 Above Ground Service Reservations

When placing above ground services, consideration shall be given to pedestrians with disabilities. Desire lines shall also not be compromised.

4.4.1 Electrical Infrastructure and Street Lighting

Where street lighting is mounted on separate poles, the set-back and position shall be as prescribed in Chapter 14.

Streetlights, electrical poles, substations and electrical kiosks should be placed clear of future driveways, preferably in line with common erf boundaries, and clear of the shoulder site distance triangle at intersections and T-Junctions. The aforementioned services should also not compromise the movement of NMT users.

4.4.2 Landscaping in Road Reserves

Where the planting of large trees along roads form part of the development, the following guidelines should be followed:

- Trees may not be planted nearer than 1.5m from the kerb (clear distance);
- Trees should not be placed less than 6m to 8m apart on road reserves;
- No trees may be planted nearer than 10m from a street intersection;
- No trees may be planted nearer than 2m from any of the following structures:
  - Fire hydrants,
  - Any electrical or Telkom boxes,
  - Stay wires, etc.
- No trees may be planted nearer than 4m (preferably 5m) from stormwater catchpits, unless required otherwise. Distance to be measure from the edge of tree stump, to outside edge of stormwater catchpit;
- No trees shall be planted on any underground stormwater infrastructure/conduit.
- No trees may be planted within 1m from any wall;
- No trees may be planted within 5m of a streetlight or electrical pole;
- Trees should not be planted within 3m from a driveway;
- Trees should not be planted within 5m from any road sign;
- Trees should not be planted in such a way that may interfere with any overhead or underground services.

Designers should take note that the above is purely provided as guidelines. The planting of any trees within the road reserve shall adhere to the City's *Tree Management Policy (2015)*, which, inter alia, regulates the planting of trees in road reserves and provides guidance with respect to positioning of trees in relation to utility services.

It is generally accepted that the care and maintenance of the verge surfaces be carried out by the adjacent landowners. Trees and shrubs that obstruct sight lines may be removed or trimmed by the City.

Designer can also refer to the City's latest version of the *Guidelines for Designing or Approving Hard and Soft Landscaping in the Urban Road Reserve*.

To: *Part A Overview*

To: *Chapter Overview*

CHAPTER 5

Non-Motorised Transport Facilities

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CHAPTER 5: NON-MOTORISED TRANSPORT FACILITIES

5.1 General

This section provides an overview regarding the basic requirements and guidelines for non-motorised transport, which predominantly consist of pedestrian and cycle facilities.

For a more comprehensive background, refer to the following documentation:

1) CCT: Integrated Transport Plan
2) CCT: NMT Policy and Strategy Volume 1 & 2.
3) CCT: Universal Access Policy for Transport for Cape Town (Policy Number 17958)
4) NDT: National Technical Requirements 1: Pedestrian Crossing - Part 1, Version 6, Nov 2016.
5) NDT: National Technical Requirements 1: Pedestrian Crossing - Part 2, Version 6, Dec 2016.
6) NDT: NMT Facility Guidelines, 2014
7) NDT: Pedestrian and Bicycle Facility Guidelines, Aug 2003

5.2 Importance of NMT Facilities

Pedestrian and cycle facilities should form part of any new development. Designers must prioritise integrating walking and cycling in early design stages, as they offer diverse benefits:

1) Individual Well-being and Physical Health
   - Promotes cardiovascular fitness.
   - Encourages an active and healthy lifestyle.
   - Reduces sedentary behaviour, positively impacting personal well-being.
2) Environmental Sustainability
   - Mitigates air pollution by reducing reliance on motorised vehicles.
   - Contributes to global climate change efforts by minimising carbon emissions.
   - Fosters a healthier environment for communities.
3) Economic Benefits and Personal Finance
   - Generates cost savings for individuals through reduced vehicle ownership expenses.
   - Alleviates financial burdens related to fuel and maintenance costs.
   - Provides collective financial relief, contributing to economic resilience.
4) Accessibility and Inclusive Mobility
   - Facilitates easy movement for diverse population segments.
   - Empowers vulnerable groups by removing transportation barriers.
5) Societal Equity
   - Recognises NMT as a cornerstone for economic and social equity.
   - Holds transformational potential in addressing societal challenges and fostering inclusivity.

It is for this reason that surfaced footways shall be provided on at least one side of every road. Where pedestrian traffic is expected to be high, priority shall be given, e.g. at places of worship, schools, public amenities, commercial areas and along public transport routes. Footways shall typically be located adjacent to the road kerbline.

Appropriate pedestrian crossing points at schools, community amenities, opposite expected pathways, at busy intersections and at places of attraction need to form part of any development proposal. These crossings together with other measures, such as roundabouts, should form part of a built-in traffic calming strategy.

A satisfactory level of service should be provided, that includes users with disabilities and those with limited mobility. Universal accessibility in the built environment shall become a priority. The provision of these facilities should be such that it encourages the use of these modes of transport.

As mentioned in Chapter 2, if a specific road forms part of a designated Cycle Route, the appropriate cycle facilities shall be provided in the cross section. The existing and proposed cycle routes can be found in the City's latest *Integrated Transport Plan* and on the *"Non-Motorised Transport (NMT) Network Plan Cycle Routes, City of Cape Town Metropolitan"* Map (refer to Part C).

5.3 NMT Facility Classification System

The NMT classification system has three divisions, namely:

1) Pedestrian Facilities (4 classes)
2) Cycle Facilities (4 x classes)
3) Shared Pedestrian-Cycle Facilities (2 x classes)

The abovementioned facility types have their own sub-classification system (i.e. classes), which is based on the facility's level of exclusivity, segregation from other NMT facilities and position relative to the road reserve. These classes are summarised in the following tables and illustrated on the succeeding figures.

Pedestrian Facilities

Table 5-1: Pedestrian Facility Classification System

Class	Description
1	An exclusive pedestrian way, where the route follows an independent alignment not associated with a road and is typically situated outside the road reserve.
2	An exclusive pedestrian way, segregated from any parallel/adjacent roadway (e.g. by landscaping and/or barriers). The route follows a roadway alignment and is typically situated within the road reserve, but is physically separated from the road carriageway and vehicular traffic (generally by means of kerbs).
3	An exclusive pedestrian way or area, with vehicular access limited to deliveries, maintenance and/or emergency vehicles.
4	A pedestrian way or area situated within a road carriageway. The route does not have an exclusive use area, but applicable warning signs and/or markings are provided. Such facilities are generally seen as the "woon-erf" concept.

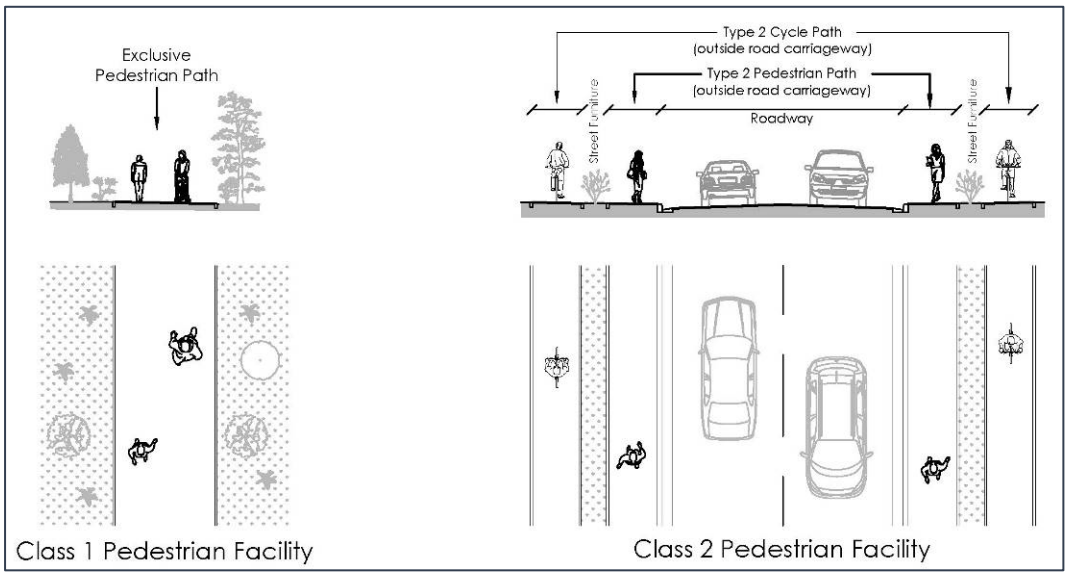


Figure 5-1: Pedestrian Facility Classes

Cycle Facilities

Table 5-2: Cycle Facility Classification System

Class	Description
1	An exclusive cycle way. The route follows an independent alignment not associated with a road and is typically situated outside the road reserve.
2	An exclusive cycle way, segregated from any parallel/adjacent pedestrian way (e.g. by landscaping and/or barriers). The route follows a roadway alignment and is typically situated within the road reserve, but is physically separated from the road carriageway and vehicular traffic (generally by means of kerbs).
3[1]	An exclusive cycle way located within the road carriageway. The route is demarcated by exclusive bicycle lane road markings. Where shoulder(s) are provided/present within the road carriageway, the aforementioned may be used as a Class 3 cycle facility.
4	A cycle way located within the road carriageway. The route does not have an exclusive use area, but applicable warning signage is provided.

[1] Refer to Section 5.4.5 for further discussion details.

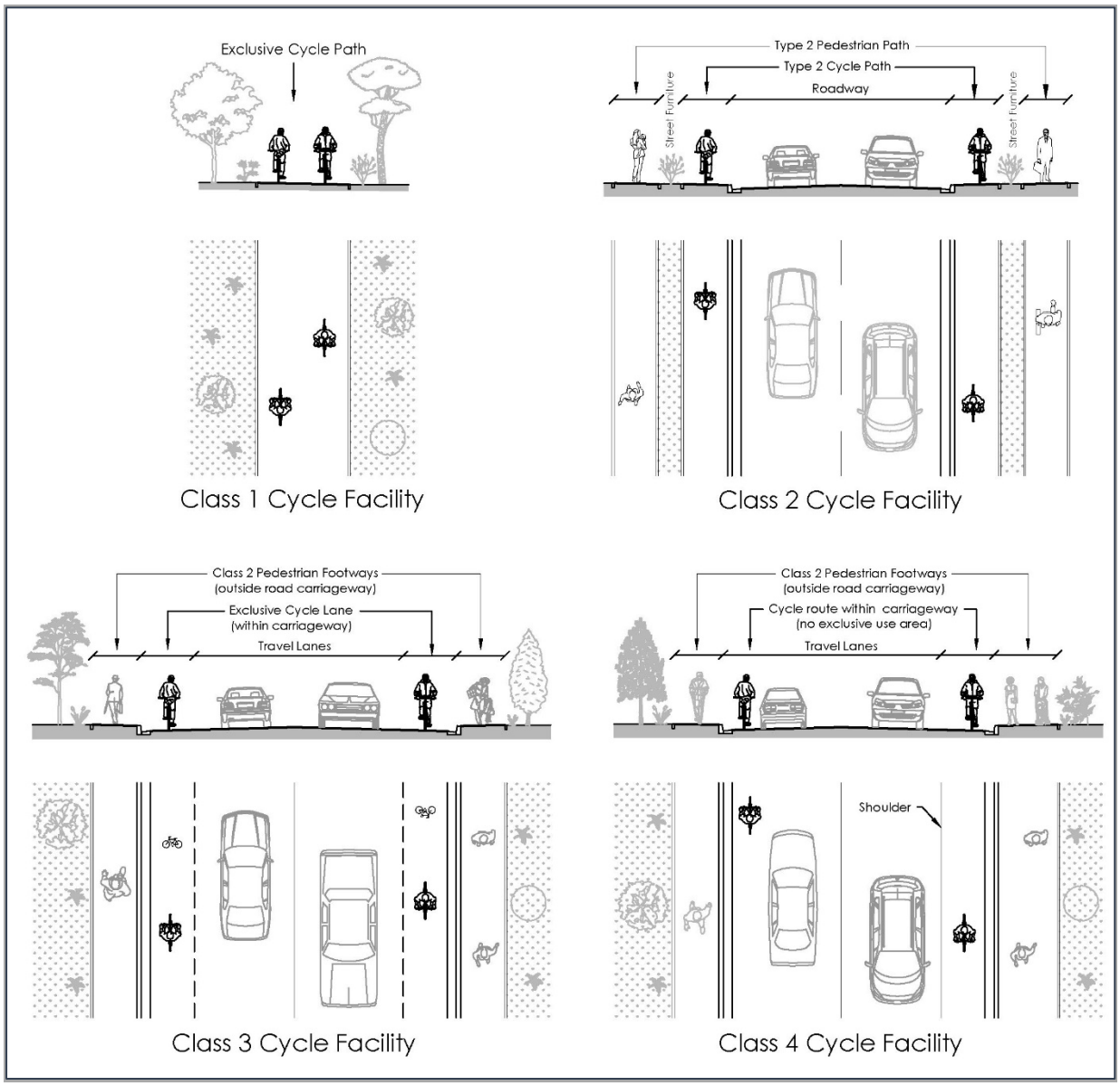


Figure 5-2: Cycle Facility Classes

Shared Pedestrian-Cycle Facilities

Table 5-3: Shared Pedestrian-Cycle Facility Classification System

Class	Description
1	An exclusive and integrated shared pedestrian-cycle way. The route follows an independent alignment not associated with a road (typically situated outside the road reserve). There is also no separation between the pedestrian and cycle use areas.
2	An exclusive and integrated shared pedestrian-cycle way. The route follows a roadway alignment and is typically situated within the road reserve, but is physically separated from the road carriageway and vehicular traffic (generally by means of kerbs). There is also no separation between the pedestrian and cycle use areas.

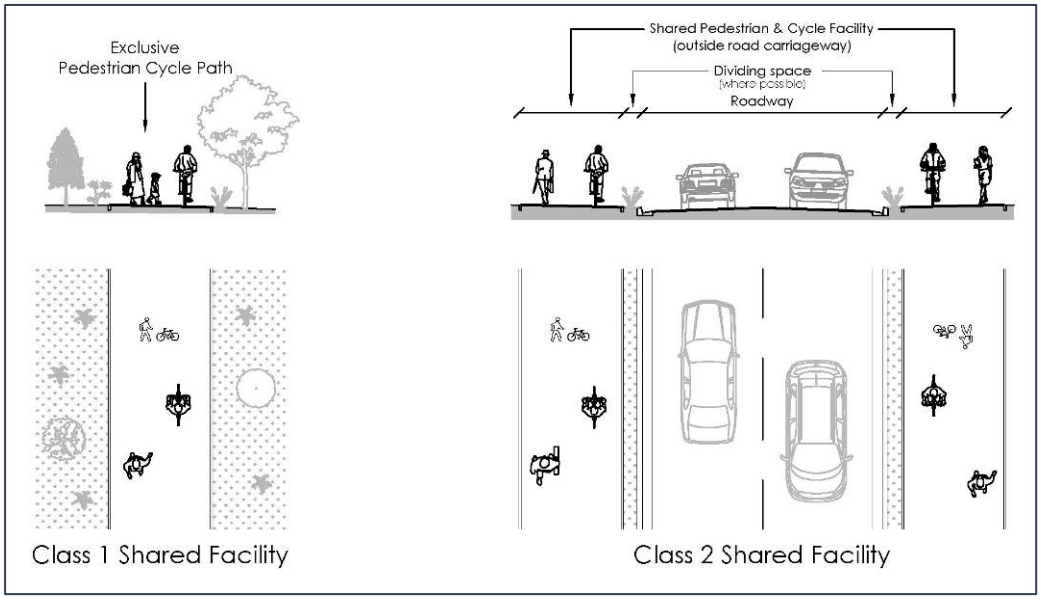


Figure 5-3: Shared Pedestrian-Cycle Facility Classes

5.4 Pedestrian and Cycle Way Design

5.4.1 Pedestrian and Cycle Facility Width and Vertical Clearance

The minimum widths and vertical clearance requirements for the various NMT facilities are provided hereafter and summarised in **Table 5-4**.

Pedestrian Facilities

The following dimensions shall be applicable for the design of pedestrian facilities:

a) The minimum clear width of any pedestrian footway shall never be less than 1.5m.
b) Where inadequate space is available (e.g. around obstacles), a clear width of 1.2m may be acceptable, provided that it be limited to a short distance.
c) The width of any edge restraint (e.g. kerbs, edgings, etc.) shall be excluded from the minimum clear width.
d) A minimum vertical clearance of 2.1m shall be provided along the entire width of the pedestrian footway.
e) Where trees overhang into footways, an additional 300mm vertical clearance shall be allowed for, in order to allow for movement of tree branches.

The figure below illustrates the clear width and vertical clearance requirements for footways.

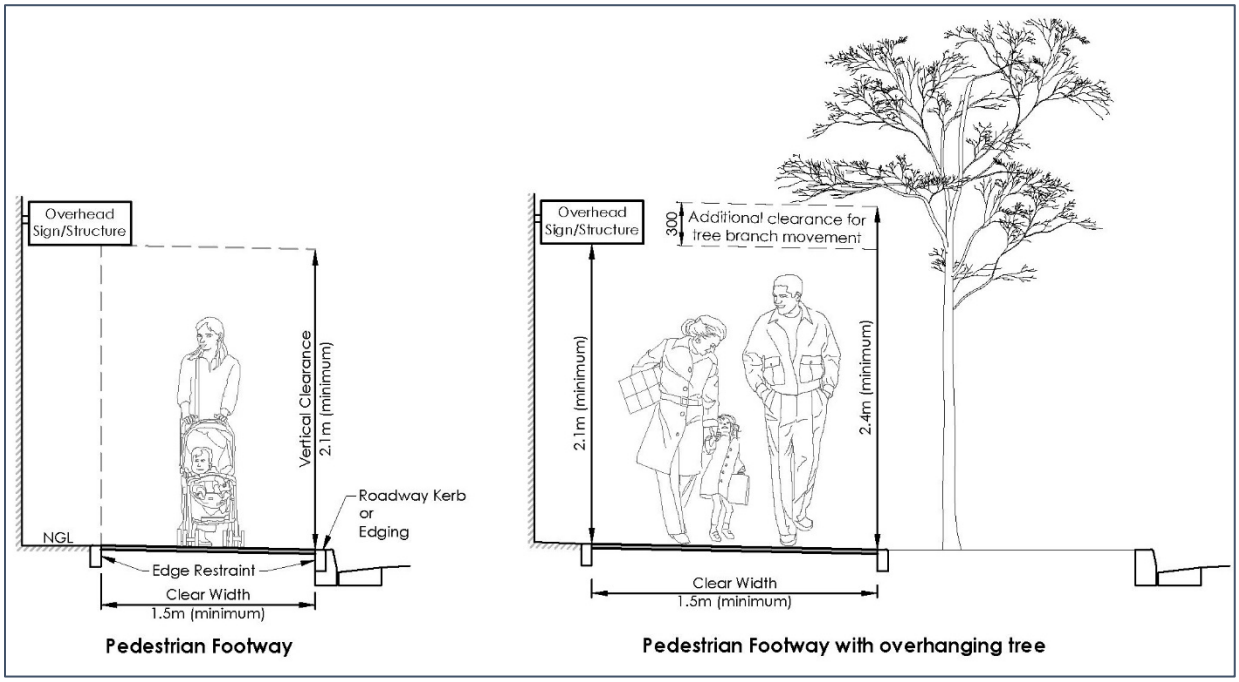


Figure 5-4: Clear width and vertical clearance requirements for pedestrian footways

Cycle Facilities

The following dimensions shall be applicable for the design of cycle facilities:

a) The typical design envelope for bicycles consists of a 1m width and 2.2m height.
b) Further to the 2.2m height, an additional overhead clearance of 300mm (minimum) shall be provided, in order to have a total vertical clearance of 2.5m.
c) To accommodate the manoeuvring and operations of cyclists, including avoidance of adjacent objects (e.g. pedestrians, other cyclists, street furniture, etc.), a path width of 1.5m is required.
d) A reduction from the 1.5m width shall be allowed over short distances. However, the aforementioned shall be discussed with and approved by the Approval Authority.
e) Where vehicle speeds exceed 60km/h, provision has to be made for the wind (aerodynamic) effect from passing vehicles.
f) Along higher order roads, where speed limit is 80km/h, the minimum width for Class 3 cycle facilities shall be 1.8m.
g) For Class 3 cycle facilities, the path width may include the roadway channel.
h) For a two-way cycle facility (generally Class 1 and 2 facilities), the following shall apply:
   - 500mm lateral clearance required between opposing bicycle operating/manoeuvring spaces.
   - An absolute minimum path width of 2.5m will thus be required for a two-way cycle facility (3m acceptable and 3.5m desirable).
   - The NDoT *Pedestrian and Bicycle Facility Guidelines* requires an additional 500mm horizontal clearance on either side of the cycle path.
   - In enclosed areas, widening of the path width shall be considered.

The figure below illustrates the requirements relating cycle paths.

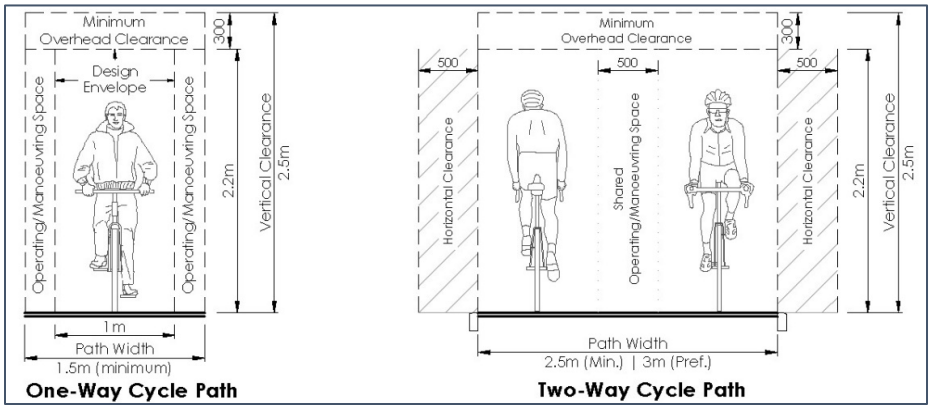


Figure 5-5: Cycle Facility width and vertical clearance requirements

Shared Pedestrian-Cycle Facilities

The following dimensions shall be applicable for the design of shared pedestrian-cycle facilities:

a) The minimum width for a shared pedestrian-cycle facility shall never be less than 3m, provided that the cycling is one-way only.
b) Where a shared facility has to accommodate two-way cycling movements, the path width shall be widened to 4m (minimum). If high pedestrian volumes are expected, a 4.5m width should be considered, preferably with a demarcation between the NMT types.

The figure below illustrates the requirements relating to shared pedestrian-cycle paths.

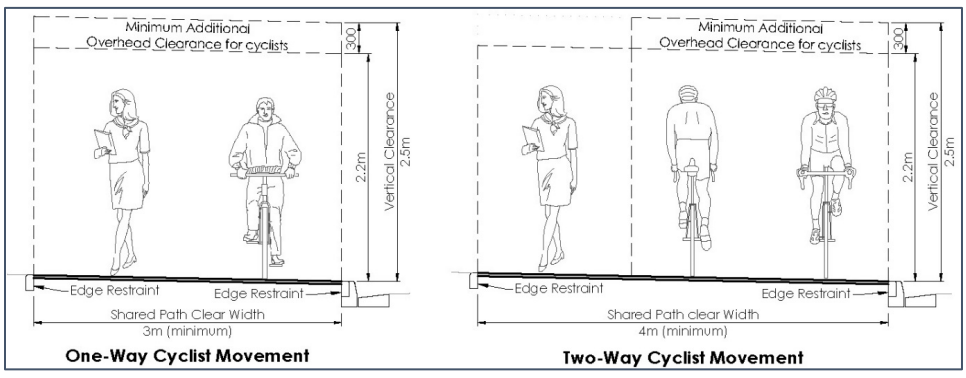


Figure 5-6: Shared Pedestrian-Cycle Facility requirements

The minimum width for surfaced pedestrian footways and cycle ways are summarised in the table below:

Table 5-4: Recommended Minimum NMT Facility Widths and Clearances

NMT Facility		Road Characteristic		Width [3]		Minimum Vertical Clearance
Type	Class			Min.	Pref.	
Pedestrian Footway [1]	Class 1	n/a		2m		2.1m
	Class 2	Class 5 (Lower order)	D - 8 RR	1.5m		2.1m
			C - 10m RR	1.8m		2.1m
			D - 12m RR	1.8m		2.1m
			A	1.8m	2m	2.1m
		Class 4 (Middle order)		1.8m	2m	2.1m
		Class 3 (Higher order)		2.0m	2.5m	2.1m
		Class 2 (Higher order)[4]		2.0m	2.5m	2.5m
	Class 3 & 4	n/a		Varies		Varies
Cycle Way[2]	Class 1	n/a		1.5m		2.5m
	Class 2	Any Class		1.5m		2.5m
	Class 3	Speed Limit: < 60km/h		1.5m		2.5m
		Speed Limit: > 60km/h [5]		1.8m		2.5m
	Class 4	n/a		n/a		n/a
Shared	Class 1	n/a		3.0m		2.5m
	Class 2	Any Class		3.0m		2.5m

***Notes**: Designer can also refer to Drawing RD18.1.*

[1] For high pedestrian volumes, the pedestrian footway width should be increased.

[2] Based on an urban environment.

[3] Based on one-way movements.

[4] If cyclists must be accommodated, a 3m shared NMT facility to be provided along Class 2 roads.

[5] Refer to Section 5.4.5 regarding safety improvement for cycle facilities along high-mobility routes

The above table is only a guide for determining the width (class) of the pedestrian and cycle facility. However, designers should always consider the following at the start of the design process (NTR1, 2016):

- Road Classifications: Observe and understand the local functionality of the road, and all the users, to determine the appropriate pedestrian and cycling infrastructure. Past practices have based the NMT infrastructure on road classification only.
- NMT and Vehicular Data: Designers should collect all data related to walking and cycling. This can comprise of counts, LOS, crossing volumes, queue lengths, accident data, route mapping etc. This will ensure that the design process is systematic and based on sound engineering judgement.
- Primary Geometric Design: Consider the pedestrian and cycling infrastructure in conjunction with primary geometric design elements such as horizontal and vertical alignments, intersection control, median islands, bellmouth radii etc. Past practices considered motorised transport only when establishing the primary geometric design elements which resulted in a compromised NMT facility.

For a more comprehensive understanding of the NMT design principles, refer to Table 5-5 that was adapted from the NMT Facility Guidelines (2014).

Table 5-5: Recommended Minimum NMT Facility Widths and Clearances

Road Type	Motorised Transport				Conflict Risks		Non-Motorised Transport					
	Speed		Volume				Desire lines	Volume		Dimensions [2]		Design requirements
	High	Low	High	Low	High	Low		High	Low	Walkway	Cycleway	
NMT Only	N/A	N/A	N/A	N/A	NMT right of way	NMT right of way	Follow lines direct	No mixing of NMT Still researching volume range	Shared facility allowed only if there are spatial constraints	2m to 2.5m	1.5m to 2.5m	• Levelling of NMT facilities always • Walkway and cycleway can be placed next to each other to minimise Earthwork • All UD users accommodated in the walkway
Class 1 Highway	Very high road safety risk	N/A	Very high road safety risk	High road safety risk	Grade separation required	Warning signs are required	Bridges and tunnels need to be placed strategically	No mixing of NMT		1.5m to 1.8m	1.5m to 1.8m	• Barriers between MT and NMT • All UD users accommodated in the walkway
Class 2 and 3 Arterial	High road safety risk	N/A	High road safety risk	Road safety risk	Separation of cycling via kerb **and** road marking/colour	Separation of Cycling via kerb or road marking/ colour	Facilitate NMT at intersections or create crossing Infrastructure (preferably signalized if warrants are met)	No mixing of NMT		2.0m to 2.5m	1.5m to 1.8m	• Separation of cycling via kerb or colour • All UD users accommodated in the walkway • Implement protected cycling facilities through intersections for high volume and high-speed routes. • Obtain NMT and MT data to inform an appropriate intervention measure [1]. • Consider staggered crossing facilities when four or more all-inclusive vehicular lanes must be crossed by an NMT user.
Class 4 Distributor	Road safety risk	Low road safety risk	Road safety risk	Low road safety risk	Crossing facilities at attractions, such as schools and PT stops	No special infrastructure is required	Facilitate NMT at intersections or create crossing infrastructure	No mixing of NMT		1.8m to 2.0m	1.5m to 1.8m	• Marked separation of cycling • Cycleway width can be less for short distances • All UD users accommodated in the walkway
Class 5	Design speed is 40km/h		Road safety risk	Low road safety risk	No special infrastructure is required		Traffic calming might be required to reduce speed differential between NMT and MT	No mixing of NMT		1.8m (preferably more)	N/A Cyclists roadway in	• All UD users accommodated in the walkway

[1] Data can refer to accident data, counts, LOS, queues, crossing volumes etc.

[2] Dimensions amended to align with this document.

5.4.2 Pedestrian Refuge Areas (Islands)

Pedestrian refuge areas refer to the areas in the roadway which are normally protected by a constructed island (e.g. median islands at pedestrian crossing points, splitter islands on the approaches to road junctions, mid-block pedestrian crossings, etc.). The strategic placement of refuge areas can greatly improve the safety of pedestrians crossing roadways.

The following requirement are applicable to pedestrian refuge areas/islands:

i) Refuge islands shall be constructed with barrier kerbs all around.

ii) Two types of refuge walkways shall be considered, i.e. Cut-Through Type or Transition Type. Refer to **Figure 5-7** for a visual representation. The refuge walkway type shall be dependent on the available space (length of island) and site conditions.

iii) The width of the refuge island shall have a minimum width of 2m (2.5m preferred), measured from kerb face to kerb face. Where large signage is required, the width shall be increased to accommodate the required lateral clearances.

iv) The length of standalone refuge islands shall not be less than 6m. Where possible, the desired length is 30m.

v) At standalone refuge islands, the necessary warning signage shall be provided on the island approaches, as per SARTSM Volume 2, including the necessary painted tapers and barrier lines on either side of the island.

vi) The width of the refuge walkway shall be a minimum of 1.6m (preferably 2m). At controlled pedestrian crossings, the width of the refuge walkway shall be a minimum of 2.4m or equal to the width of the painted pedestrian crossing lines (RTM3) or "zebra" blocks (RTM4).

vii) The thoroughfare area of the refuge island shall be flush with the road surface (or channel invert, if a channel is present) and have sufficient gradients to accommodate drainage. The following shall be adhered to:

- Maximum Desired gradient: 1:20 (5%);
- Maximum Desired Cross-fall: 1:50 (2%).

viii) Tactile Ground Surface Indicators (TGSIs):

- Warning TGSIs shall be provided as per Section 5.7.3.
- TGSIs shall be set back 300mm from the kerb face by means of a C2 channel. Refer to Drawing RD2.2, Type "E" and "F" for further details.

The figure below illustrates the two types of refuge walkways.

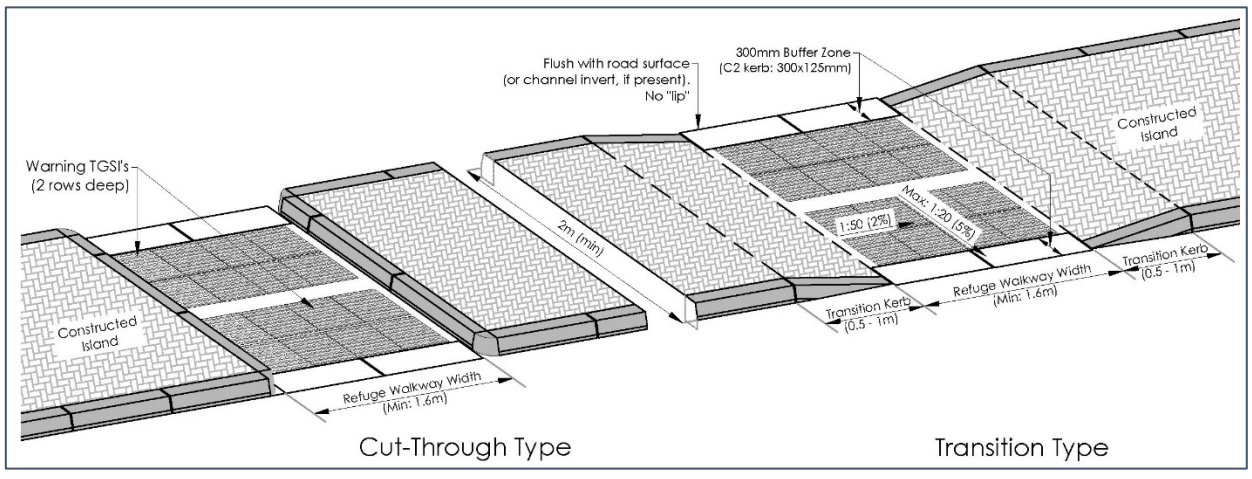


Figure 5-7: Pedestrian Refuge Area types

Staggered pedestrian crossings on median islands should follow the guidelines provided in NTR1 Part 2 (2016). When the vehicular road width exceeds four all-inclusive lanes (including bus lanes and all vehicular lanes, including turning lanes, irrespective of the direction of traffic flow) and the pedestrians are expected to cross the vehicle road width under more than one signal, a staggered pedestrian crossing, with an area of refuge in the median, should be provided.

The pedestrian crossings must be staggered to obviate pedestrians confusing the median islands with walk through islands. The stagger is preferred to be to the right, when crossing from the vehicle approaching side, as this assists with vehicle stacking through intersections as well as allowing for better vision of pedestrians crossing for oncoming vehicular traffic. The dropped walking area, along the stagger of the median island, should be protected with upright delineator kerbs or back-to-back barrier kerbs on either side. The choice of kerbs will depend on the stormwater drainage considerations "through" the median island and will thus depend on the road cross-fall and longitudinal grade.

For wider median islands, where illegal vehicular activity is expected, the provision of bollards inside the crossing space in the median island may be considered. In such instances, designers shall ensure that the bollard placement is optimised, in order to prevent illegal vehicle movement without impacting wheelchair users.

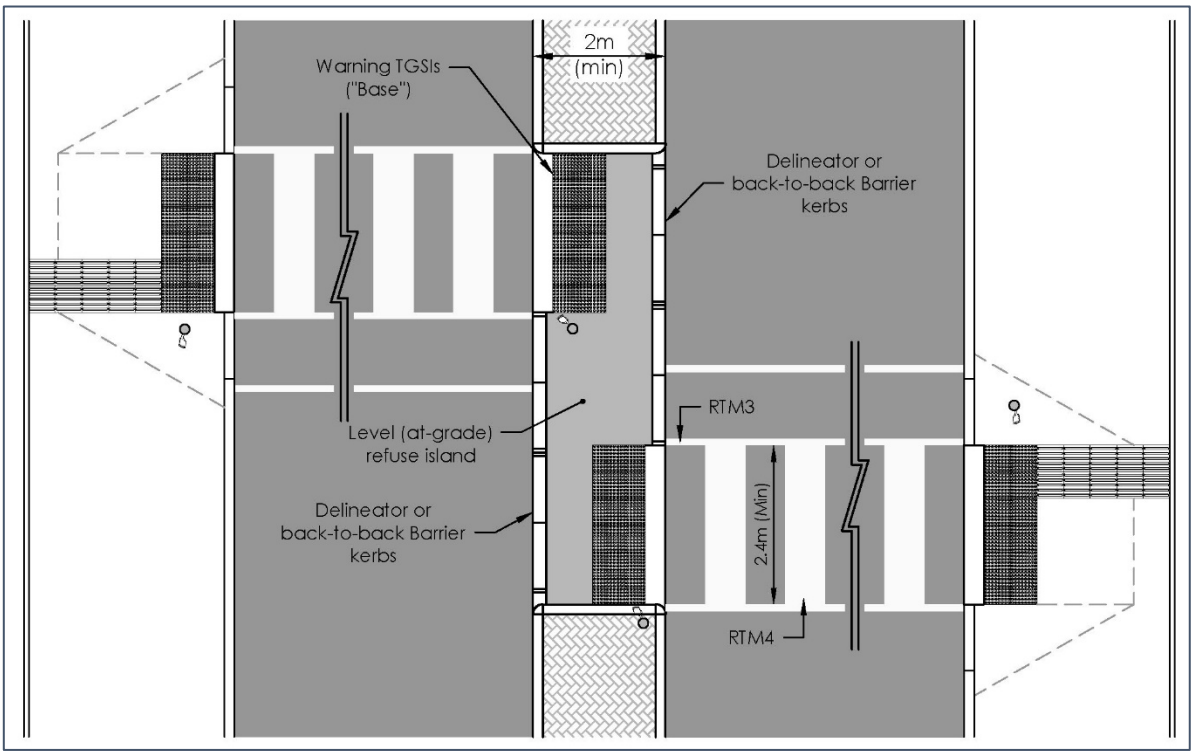


Figure 5-8: Staggered pedestrian crossing

5.4.3 Road Markings and Signage for NMT Facilities

Reference Documents

- Southern African Development Community, Road Traffic Signs Manual ("SADC-RTSM-VOL1").
- *South African Roads Traffic Signs Manual ("SARTSM-VOL2").*

Design Considerations

Table 5-5 summarises the recommended road signs and markings to be provided for the various NMT facilities. Signs and markings shall be applied in accordance with *SARTSM-VOL2*.

Designer shall ensure that traffic signs are placed/installed in such a manner that it does not impede the safe movement of pedestrians and cyclists. Refer to Section 9.2.3.

Table 5-6: Recommended Road Signs and Marking for NMT Facilities

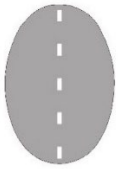
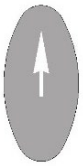
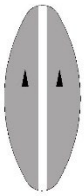
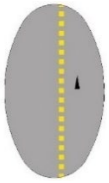
NMT Facility		Recommended Signage and Markings	
Type	**Class**		
Pedestrian Way	1	Signs	R110 Pedestrians Only
	2	Signs	R110 Pedestrians Only
		Optional	R113: *Cyclists and Pedestrians Only with Barrier* **OR** R115: *Pedestrians and Cyclists Only with barrier* (only applicable if there is a parallel cycle facility present adjacent to the pedestrian footway, i.e. segregated facilities). Should either of the aforementioned signs are used, a R110 sign will not be required.
	3	Signs	R5 *Pedestrians Priority* (vehicular access limited to deliveries, maintenance and/or emergency vehicles)
	4	Signs	R403 *Woonerf* (at start of facility) R403-600 *End of Woonerf* (where facility ends)
Cycle Way	1	Signs	R111 Cyclists Only
		Markings	GM6.1 Cycle Facility symbols [1]
		Optional	WM3 *Dividing Line* for cyclists travelling in opposite direction (only applicable for two-way use area).
	2	Signs	R111 Cyclists Only
		Markings	GM6.1 Cycle Facility symbols [1] WM3 *Dividing Line* for cyclists travelling in opposite direction (only applicable for two-way use area).
		Optional	R113: *Cyclists and Pedestrians Only with Barrier* **OR** R115: *Pedestrians and Cyclists Only with barrier* (only applicable if there is a parallel cycle facility present adjacent to the pedestrian footway, i.e. segregated facilities). Should either of the aforementioned signs are used, a R111 sign will not be required.
	3[2]	Signs	R304 *Bicycle Lane* (at start of exclusive use lane) R304-600 *End of Bicycle Lane* (at end of exclusive use lane)
		Markings	RM9 Exclusive Use Lane line RM17.1 *Cycle Lane* symbols [1] GM5 *Bicycle Guide Lines* where cycle lanes cross intersecting roads, including GM6.1 symbols and *Green Cycle Strips.* *Green Cycle Strips* at potential conflict points
	4	Signs	W309 Cyclists
Shared Pedestrian-Cycle Way	1	Signs	R112 Cyclists and Pedestrians Only **OR** R114 Pedestrians and Cyclists Only
		Markings	GM6.1 *Cycle Facility* & "General Pedestrian" symbols
		Optional	GM2 *Guide Lines* to show separation between pedestrian and cycle operating areas GM4.1 *Information Arrow* to indicate direction of travel (only applicable for two-way cycle areas)
	2	Signs	R112 Cyclists and Pedestrians Only **OR** R114 Pedestrians and Cyclists Only
		Markings	GM6.1 *Cycle Facility* & "General Pedestrian" symbols
		Optional	GM2 *Guide Lines* to show separation between pedestrian and cycle operating areas GM4.1 Information Arrow to indicate direction of travel (only applicable for two-way cycle areas)

[1] *Designer to ensure sufficient provision/spacing of symbols along route.*
[2] *Refer to Section 5.4.5 for further discussion regarding the accommodation of cycle ways in road shoulders.*

Applicable Signage and Markings

The Table below contains an overview of the relevant signage and road marking typically used for NMT Facilities, as described above.

Table 5-7: Typical Road Signs and Marking for NMT Facilities

Road Signs					
					
R110 Pedestrians only	**R111** Cyclists only	**R112** Cyclists and Pedestrians Only	**R113** Cyclists and Pedestrians Only with Barrier	**R114** Pedestrians and Cyclists Only	**R115** Pedestrians and Cyclists Only with Barrier
					
R304 Bicycle Lane	**R307-600** End of Bicycle Lane	**R403** Woonerf	**R403-600** End of Woonerf	**R5** Pedestrians Priority	**W309** Cyclists
Road Markings					
					
GM2 Guide Lines	**GM4.1** Information Arrows	**GM5** Bicycle Guide Lines	**GM6.1** Cycle Facility	**RM3** Channelizing line	**RM9** Exclusive Use lane line
					
RM17.1 Cycle Lane Symbol	**WM3** Dividing Line	**-** Green Cycle Strip	**-** General Pedestrian Symbol		

Notes: As per SADC-RTSM-VOL1

5.4.4 Green Cycle Strips and Accommodation of Cyclists

A green cycle strip is a green-coloured polymer cement pavement coating which is provided at locations where there is a high risk of conflict between cyclists and vehicles.

The coating is generally spray applied to the existing roadway surface in a hexagon pattern (by use of a stencil), in order to provide a hard wearing and skid resistant surface coating. The minimum coating thickness is 2mm. The green-coloured surface is considered to improve the visibility of the cycle lanes and provide enhanced warning of potential conflict areas.

Designers can refer to Section 9.3.5 for further details regarding the coating specifications.

The following shall be noted regarding the provision of green cycle strips:

i) The green cycle strip should be a minimum width of 1m. Where the standard 1.5m width of a cycle facility is reduced (as mentioned in Section 5.4.1), the width of the green cycle strip may also be reduced.

ii) The green cycle strips shall be provided for the full extent/length of the conflict zone.

iii) Where cycle lanes are painted in between lanes on the approaches to intersections or junctions, typically between the through and left-turn lanes, or through/inside the intersection or junction (as described in the subsequent sections), these painted lanes may be narrower (between 1m – 1.2m).

iv) Since the green cycle strip is a shared space, a white GM6.1 guidance "Bicycle" symbol shall be used on the green strip, as opposed to the yellow RM17.1 regulatory symbol.

v) Designers shall take into consideration any future upgrades planned for roadways and intersections. If a roadway or intersection is not built in the ultimate configuration, the omission of the green cycle strips should be considered, in order to avoid abortive costs.

5.4.4.1 Intersections

As a minimum requirement, green cycle strips shall be provided at the following intersection scenarios:

i) Scenario A: On the approach to any intersection, where a Class 3 cycle facility is terminated and a dedicated left-turn lane or left-slip lane is introduced.
   - In this situation, the conflict zone exists between the point where the cycle facility terminates, up to the start of the intersection.
   - With the provision of the green cycle strip on the approach (between the through and left-turn lane), the left-turn conflict is thus removed inside the intersection.
   - The "tail" of the green cycle strip may be extended in the direction of the approach, in order to provide advance warning for vehicles and cyclists of the upcoming conflict zone.
   - The approval authority may require that the green cycle strip also be provided through the intersection, should site/route specific conditions warrant it.

ii) Scenario B: Through any intersection, where there is a conflict zone between cyclists and left-turning vehicles inside the intersection.
   - Such a situation will typically occur when there is not a dedication left-turn lane or left-slip lane on the approach to an intersection.
   - In the absence of a dedicated left-turn or left-slip lane on the approach, no conflict areas exist on the approach.
   - The conflict zone will therefor occur inside/through the intersection, between the vehicles performing left-turn movements and cyclists travelling straight (across the intersection).

iii) Scenario C: Through uncontrolled intersections with side roads, where there is conflict with left-turn vehicles.

iv) Scenario D: Along Bus/Taxi embayments located adjacent to Class 3 cycle facilities.

Designers to take note that for all the above scenarios, the green cycle strips are provided where there is shared space between vehicles and cyclists. The green cycle strips therefore create an environment where the awareness of both vehicles and bicycles are increased.

Designers must take further note of the following with regards to the provision of the relevant road markings:

- At conflict Scenario C, the RM9 marking shall terminate at the approach bellmouth tangent, at which point the GM5 and green cycle strip shall commence. On the opposite side road bellmouth tangent, the GM5 marking and green cycle strip shall terminate, at which point the RM9 marking shall commence/continue.
- RM17.1 (yellow bicycle symbol) shall be provided as follows:
  - 10m prior to the commencement of the GM5 markings and immediately after the termination thereof (approximately 1.5m).
  - Inside the RM9 markings, opposite all side roads and vehicular accesses.
- GM6.1 (white bicycle symbol) shall be provided as follows:
  - 1.5m after the commencement of the green cycle strip.
  - Spacing of 27m, but may be reduced if increased awareness is required.
  - Inside inspections, the GM6.1 symbol(s) shall be oriented in the direction conflicting vehicle movement, placed inside the GM5 markings. Refer to "Detail 1" in Figure 5-8.

Refer to the figure below for a visual illustration regarding the application of the green cycle strips for the different conflict scenarios described above, including the provision of the relevant road markings.

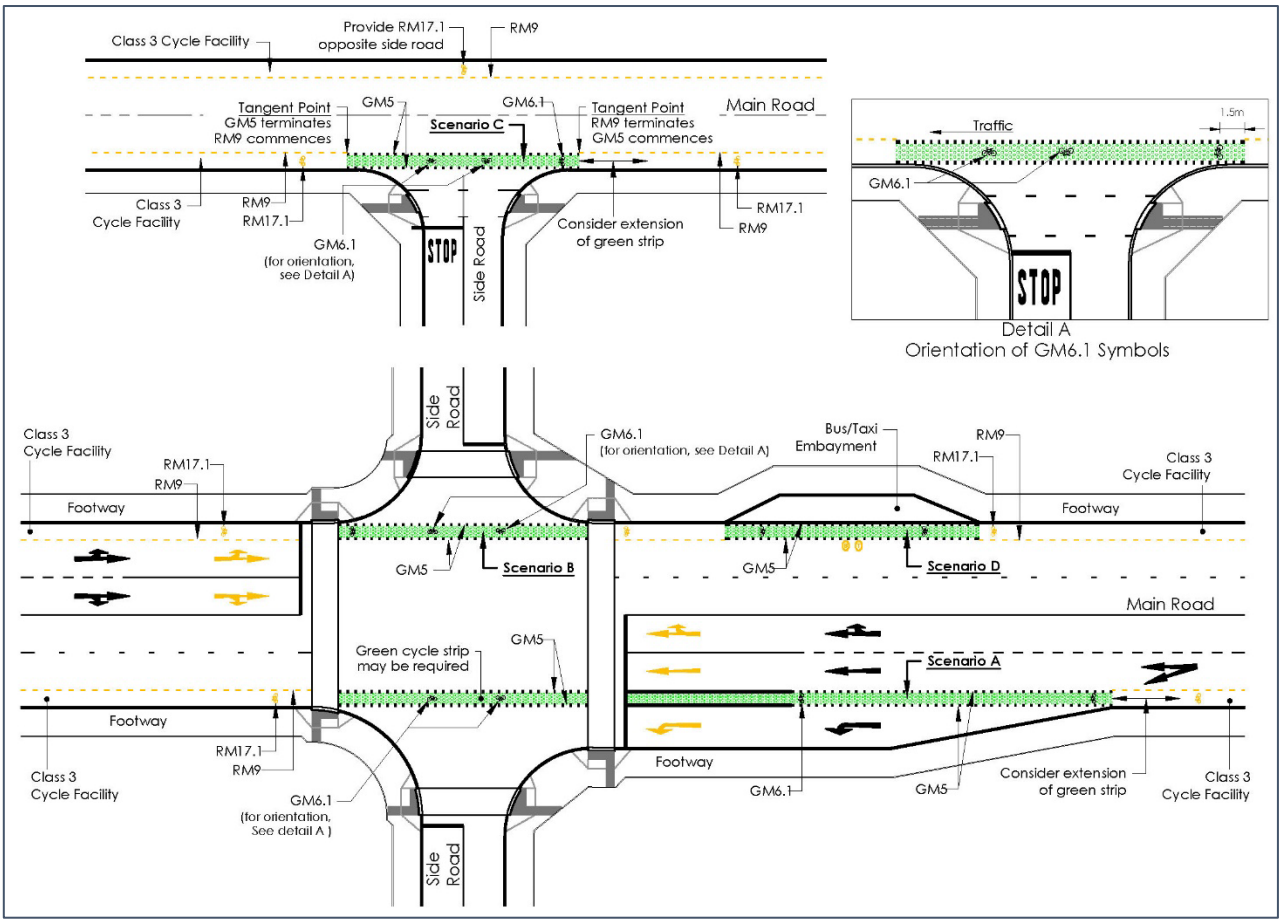


Figure 5-9: Provision of green cycle strips at intersections.

The above details can also be found on Drawing RM1.1.

5.4.4.2 Roundabouts

Roundabouts typically require great concentration from drivers in terms of observation and decision making. Since bicycles are less visible than vehicles, cyclists are more vulnerable at roundabouts. It is therefore important that where class 3 cycle facilities intersect roundabouts, cyclists are safely accommodated.

Where cyclists have to be accommodated outside the roadway, the following shall be applicable:

a) On the approach to the roundabout, the Class 3 cycle facility (RM9) shall terminate at a minimum distance of 15m from the yield line of the pedestrian crossing. Where no pedestrian crossing is present, the Class 3 facility shall terminate minimum 30m from the roundabout yield line.

b) Where the Class 3 cycle facility terminates, a safe bicycle ramp shall be provided, in order to direct the cyclists onto a Class 2 shared NMT facility (minimum 3m wide).

c) Similarly, on the roundabout exit, a bicycle ramp shall be provided at a minimum distance of 15m past the pedestrian crossing. Where no pedestrian crossing is present, the bicycle ramp shall be provided minimum 30m beyond the inscribed circle.

d) At the aforementioned bicycle ramp, the Class 3 cycle facility shall commence.

e) General notes:
   - Cyclists may use the pedestrian crossing points to cross the roadway.
   - Where no pedestrian crossing is present, a crossing point shall be provided for cyclists, which shall include a bicycle ramp and cut-through in the splitter island (if applicable), with the necessary bicycle crossing road markings.
   - Designers can refer to drawing series RD3.2 for details regarding bicycle ramps.

The figure below provides a visual illustration regarding the accommodation of cyclists outside the roadway at roundabouts.

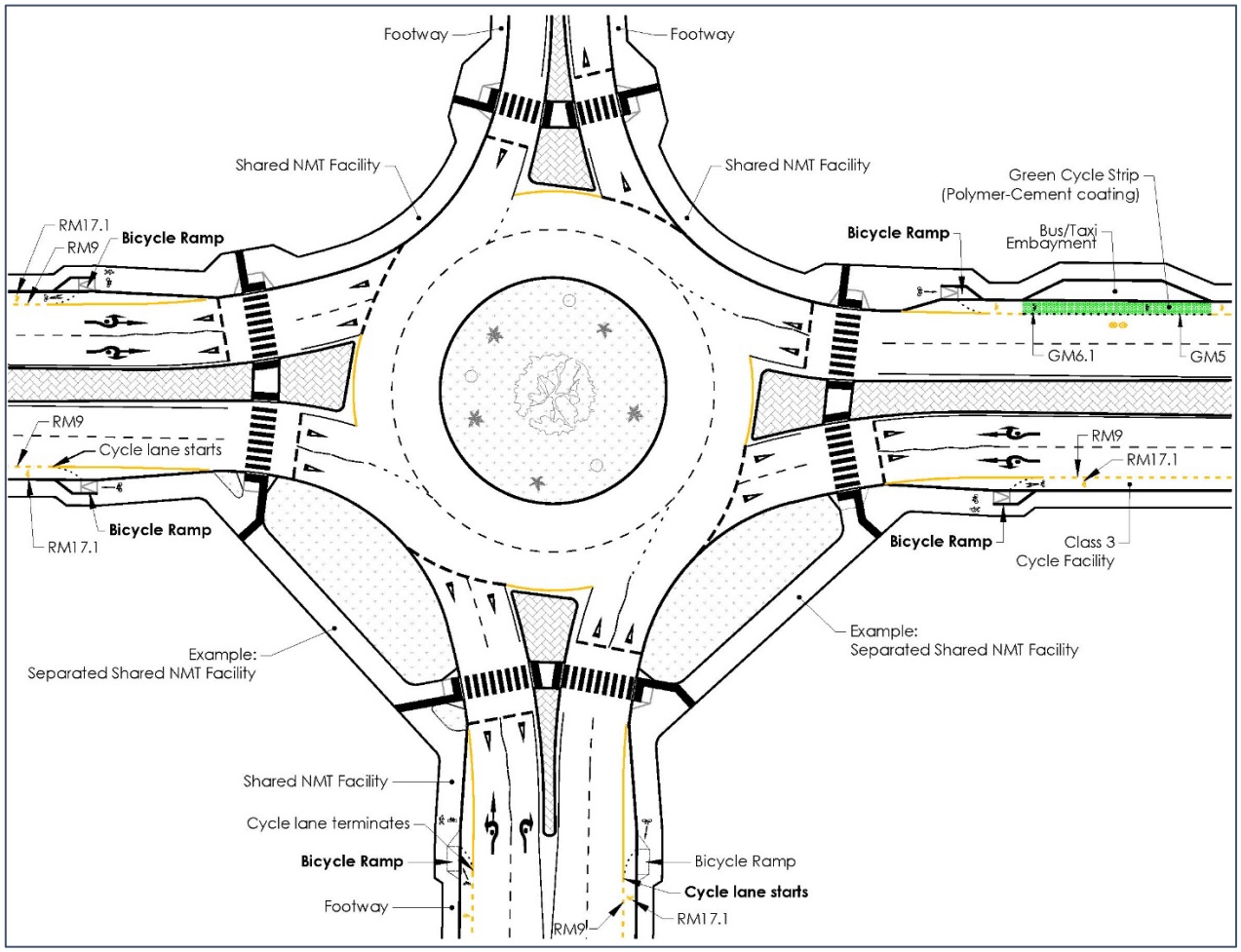


Figure 5-10: Accommodation of cyclists outside the roadway at roundabouts

Where cyclists have to be accommodated through a roundabout:

a) On the approach to the roundabout, the Class 3 cycle facility (RM9) shall terminate at the yield line of the pedestrian crossing. Where no pedestrian crossing is present, the Class 3 facility shall terminate 10m from the roundabout yield line.

b) The green cycle strip shall be provided/start from the opposite side of the pedestrian crossing or 10m from the roundabout yield line (in the absence of a pedestrian crossing).

c) The green cycle strip shall be provided completely on the inscribed circle of the roundabout.

d) On the roundabout exits, the green cycle strips shall extend up to the yield line of the pedestrian crossing. Where no pedestrian crossing is present, the green cycle strip shall extend 10m beyond the inscribed circle of the roundabout.

e) The Class 3 cycle facility shall commence on the opposite side of pedestrian crossing or 10m from the inscribe circle (in the absence of a pedestrian crossing).

f) Designers to take note of the following:

- The yield line at pedestrian crossings and the roundabout entries shall extend across the green cycle strip as well (i.e. the yield shall also be applicable to cyclists in the aforementioned situations).
- The orientation of the white GM6.1 guidance "Bicycle" symbol shall be applied appropriately at the various conflicts points (i.e. at the entry and exit points).

It must be noted that the accommodation of cyclists at roundabouts shall not be "either or", with regards to the methods describes above. It is possible to incorporate both accommodation methods into the design. In such an instance, the Class 3 cycle facility will not terminate at the bicycle ramps, but shall merely continue and thereafter adhere to the requirements as described in the "through roundabouts" method. By applying both methods, the design will ensure that:

- The more skilled or experienced cyclists (or cyclists travelling at faster speeds) can continue travelling safely on the carriageway and through the roundabout.
- Less experienced or vulnerable cyclists have the option to rather access a shared NMT facility and avoid the potential and dangerous conflict situations at the roundabout.

The figure below provides a visual illustration regarding the accommodation of cyclists both through the roundabout and off-road. Designers can also refer to Drawing RM1.2.

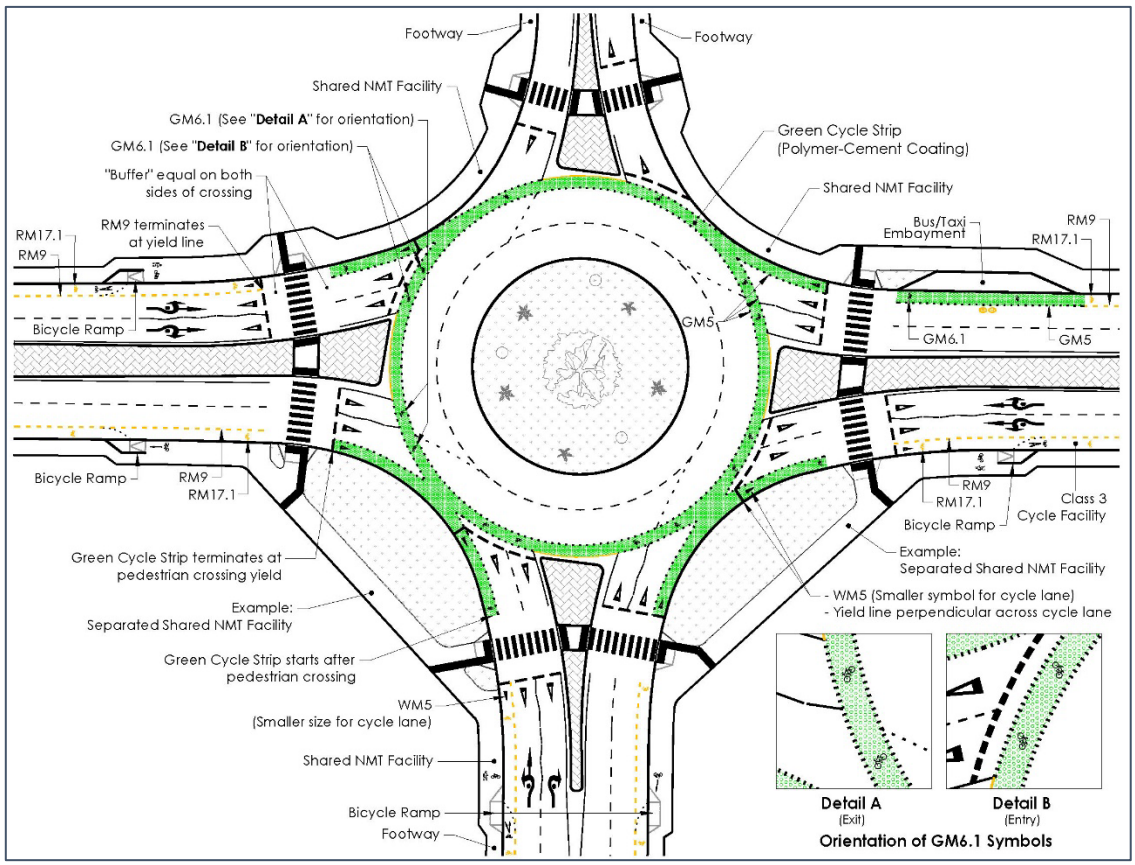


Figure 5-11: Accommodation of cyclists through roundabouts

5.4.5 Enhancing Safety and Accessibility for Cyclists on High-Volume or High-Speed Routes

This section guides designing cycle facilities for routes experiencing high vehicle volumes or speeds. Drawing from international best practices, if a route witnesses volumes equal to or surpassing 5,000 vehicles per day (or 500 vehicles per hour) or maintains an 85th percentile vehicle speed of 50 km/h or more, it is imperative to implement a separated or protected cycle facility. This may include a Class 1 Cycle facility, Class 2 Cycle facility, or a shared Class 2 facility.

The figures below provide examples of protecting a cycling facility.

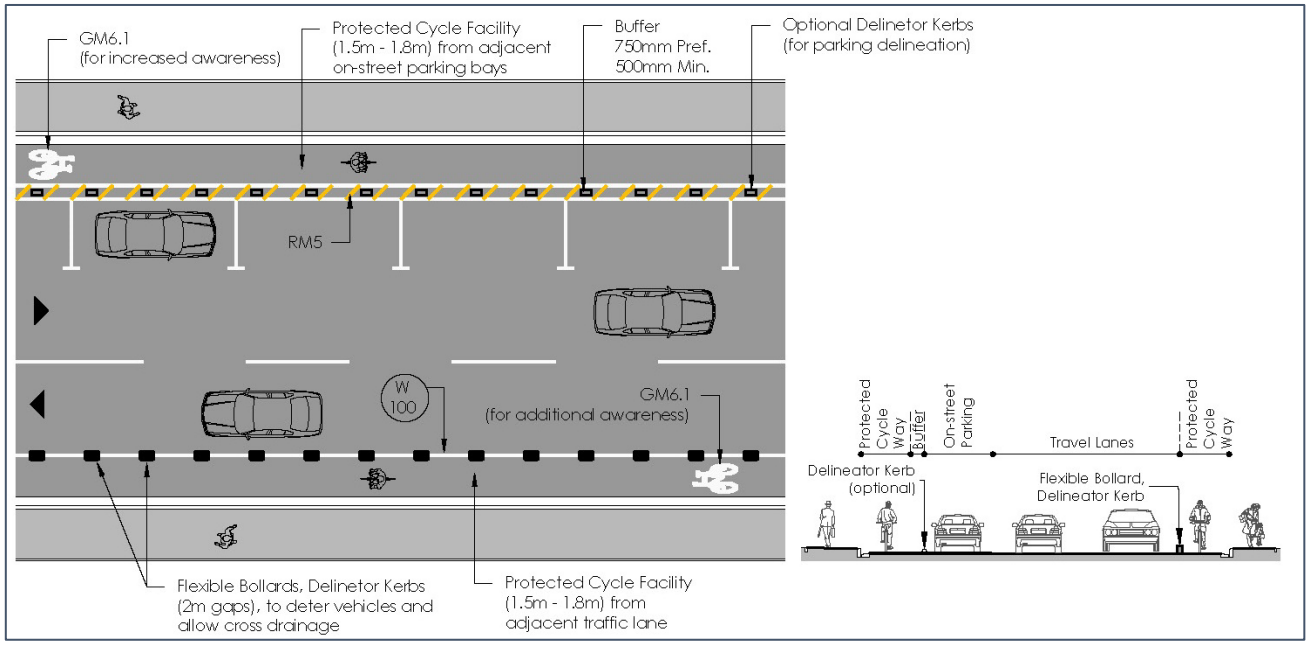


Figure 5-12: Protected cycling facilities

Designers can also refer to Drawing RD18.2.

Road Shoulder

According to the City's guidelines, a 2.4m shoulder is recommended for Class 2 major arterial roads, typically meeting criteria for high-volume or high-speed routes. In such cases, designers are encouraged to provide a physically protected facility. If space constraints arise, an alternative is utilising the shoulder to create a protected facility such as using flexible bollards (for temporary intervention), delineator kerbs (permanent or removal type) (for low-speed environments) and median islands. However, the decision to remove the shoulder for cycling is context-specific and several factors shall be considered before implementation:

i) Cycle Routing, Connectivity and Mobility: Does the route effectively connect to the broader cycling network? If the route is a high mobility cycle route, shared facilities will not be favoured.

ii) Demand and Attractiveness for Cyclists: Will cyclists use the route if a protected facility is in place? Is the route perceived as secure and appealing?

iii) Severity and Frequency of Crashes: What is the historical data regarding the severity and frequency of crashes on the route?

iv) Driver Behaviour: Is the shoulder currently used for its intended purpose, or is it subject to illegal parking, overtaking, or other undesirable driver behaviours?

v) Existing geometry and resilience: Is the route a dual carriageway and/or is there sufficient lane width (more than 3.4m)? If the shoulder is utilised, will the route be resilient to breakdowns?

Taking these considerations into account ensures a thoughtful approach to the use and potential modification of road shoulders for cycling, contributing to the creation of safer and more cyclist-friendly environments.

Slip Lanes

Slip lanes prove unsuitable for intersections witnessing significant pedestrian and cycling activity. This stems from the fact that slip lanes facilitate heightened vehicle speeds, compelling pedestrians and cyclists to deviate from their intended paths. In the design process, it is recommended that designers avoid slip lanes and carefully consider the following:

- *Essential Use of Slip Lanes*: Employ slip lanes only when absolutely necessary to achieve optimal vehicle performance, particularly concerning Level of Service (LOS) for vehicles. If the primary focus of the intersection is to prioritise walking and cycling, then slip lanes should not be allowed.

  If it is absolutely necessary for interventions to improve motorised transport, consider incorporating low-speed slip lanes in urban areas, integrating stop or yield controls. Reserve high-speed slip lanes, complete with acceleration lanes, solely for intersections characterised by high vehicle volumes and no pedestrian and cyclist presence.
- *Consideration of Dedicated Left-Turn Lanes*: Explore alternatives such as dedicated left-turn lanes, ensuring appropriate signal phasing aligns with the traffic flow.

On-Street Parking

In areas where on-street parking is justified, the recommended layout prioritises safety and comfort by placing the cycle track or lane between parked vehicles and the footpath. Additionally, when loading bays are necessary, positioning the cycle track behind the loading bay further enhances safety and comfort compared to cycling adjacent to moving traffic.

To ensure a high level of service, visibility is crucial for cyclists, drivers, and passengers. This entails employing a contrasting cycle track colour, cycle markings, and high-visibility crossings. Moreover, a buffer between the cycle facility and parked vehicles is essential to facilitate the safe opening of car doors without compromising cyclist safety. The desirable minimum buffer width is 750mm, with an absolute minimum of 500mm in areas where the desired width is not achievable. If bollards or other vertical elements are incorporated in the buffer, careful positioning is required to avoid obstructing vehicle doors.

At side roads, clear inter-visibility between cyclists and turning vehicles is vital. To achieve this, parking/loading bays should conclude at least 10m before an intersection and recommence at least 5m after the intersection.

Cycle lanes on the traffic side of parking are appropriate when the parking bays have numerous buildouts, making construction of a protected cycle facility costly, or if there are particular requirements for disabled parking bays.

Signalised Intersections

Signalised intersections play a crucial role in regulating traffic flows at intersections with high volumes or speeds. Recognising the heightened risk for cyclists, as nearly half of severe collisions involving cyclists occur at intersections, designers are urged to adopt a safe system approach. This approach aims to minimise potential conflicts and, in the event of collisions, ensure outcomes are as benign as possible. Key considerations in this context include:

- *Separation of Cyclists*: Separate cyclists from both motor traffic and pedestrians to the greatest feasible extent.
- *Legible and Forgiving Layouts*: Ensure that intersection layouts are easily comprehensible and forgiving, reducing the likelihood of errors.
- *Controlled Motor Vehicle Speeds*: Enforce measures to maintain slow motor vehicle speeds through intersections, enhancing overall safety.
- *Short Crossing Distances and Short Cycle Lengths*: Provide short crossing distances to mitigate the potential for conflicts, especially between cyclists and other road users. Short cycle lengths allow for more frequent crossing opportunities and reduces pedestrian waiting times.

Importantly, intersections should also feel safe to use for cyclists of all ages and abilities. If intersections are not perceived to be safe, this will likely be a barrier to new and less confident cyclists. Protected intersections will encourage more cyclists and features of this are shown below:

Table 5-8: Protected Intersections

Protection Type	Description	Visual example
Protected Corner Islands	Raised island, typically elliptical in shape, located at junction corners that provide cyclists protection from turning vehicles and a sae space whilst waiting to cross. The islands also help to control motor vehicle turning speeds	
Set Back Crossings	The crossing is set back from the edge of the main road. This can improve visibility between straight-ahead cyclists and turning motorists at the conflict point, helping to reduce blind spots. Set back crossings can also help create stacking space for cyclists waiting to cross the junction.	
Parallel Crossings	Cyclists and pedestrians cross the junction in their own dedicated space, avoiding the use of shared space. In some protected junction arrangements, cyclists and pedestrians can run in the same stage, which can increase junction efficiency and reduce delays for all users.	

Source: Irish Cycle Design Manual

Designers are strongly urged to familiarise themselves with the Irish Cycle Design Manual, NACTO, CROW, Auckland Transport, New South Wales, etc., and apply its principles to their projects. While these guidelines are readily attainable for greenfield projects, retrofit environments may require the exercise of sound judgment and the application of principles outlined in these manuals.

5.4.6 Footways on steep terrains

The maximum longitudinal grade for a footway is 15%.

Where the footway grade will exceed 15%, i.e. to match the topography or the alignment of the road, steps shall be constructed and conform to the following:

i) Minimum width of steps: 1.5m
ii) Landings shall be at least 1.2m long, with a maximum of 12 steps between landings;
iii) Maximum rise per step is 170mm and minimum thread (step depth) is 300mm;
iv) Step rise and step depth shall be uniform for each section between landings;
v) Steps, where required, shall be provided after the road has been built;
vi) Handrails shall be provided on both sides.

The figure below illustrates the dimensions of the risers, threads and landings on steps.

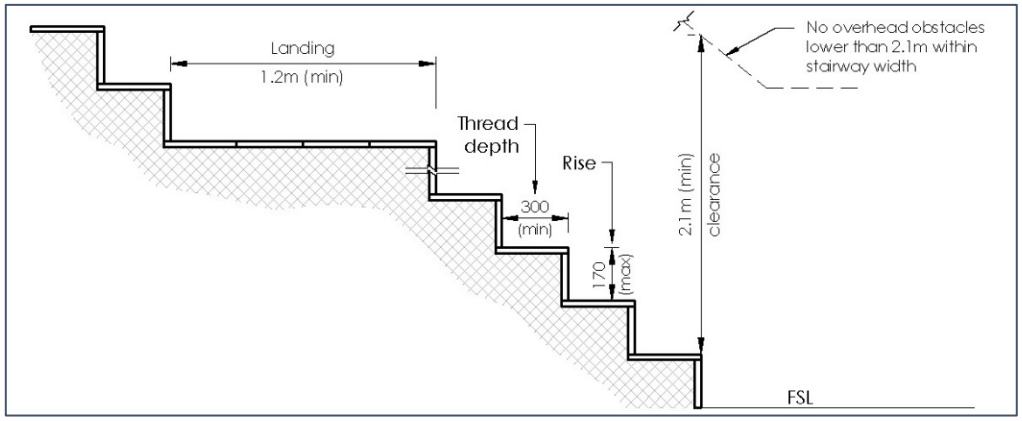


Figure 5-13: Dimensions for risers, threads and landings on steps

5.4.7 Provision of fences and handrails

In the presence of steep cross slopes or vertical drops behind pedestrian footways, the provision of fences and/or handrails should be considered to ensure public safety.

DoT: Pedestrian and Bicycle Facility Guidelines recommends that handrails be considered in where:

- A vertical drop of more than 800mm with a side slope steeper than 1:2 occurs within 1.2m from the edge of the footway;
- A vertical drop of more than 1.8m with a side slope steeper than 1:3 occurs within 1.2m from the edge of the footway.

5.4.8 Reduction in bellmouth radii

Bellmouth radii should only accommodate vehicles appropriate to specific roadways and routes consistent with the approved road network design. Larger vehicles should be encouraged to use alternative routes through the judicious use of geometric design. A reduced bellmouth radius has significant benefit in terms of traffic calming and facilitates safe pedestrian crossings. In addition, it allows for minimal TGSI distortion as discussed in Section 5.7.4.

Along public transport routes and areas with significant pedestrian movement, designers should consider a bellmouth radius of 6-8m, where possible.

For routes with significant freight or truck movements, designers can consider the following strategies before simply accommodating them:

- *Recessed stop lines*: By shifting the stop lines back on the destination street, larger vehicles may be able to make a left-turn by swinging into the opposing lanes on the destination street while the opposing traffic is stopped.
- *Compound corners*: Designers can design a bellmouth that changes the kerb radius over the length of the left-turn. This can be utilised in situations where there are high pedestrian volumes that need to be considered and does not compromise on the TGSI layout. Take note, this design element allows for sweeping turns and, therefore, does not slow turning vehicles.

5.5 Universal Design

Universal design involves the design of built environments and infrastructure which caters for the needs of and can be used by all people, regardless of their age, ability or status in life. The aforementioned includes people with disabilities or special needs. Some of the universal design principles include the following:

- Equitability: *Design should be useful and caters for people with diverse abilities.*
- Flexibility: *Design should accommodate a wide range of individual preferences and abilities.*
- Simplicity and Intuitiveness: *Design should be easy to understand and comprehend.*
- Perceptible Information: *Design should communicate sufficient information in an effective manner.*
- Tolerance for Error: *Design should minimize/eliminate any hazards/obstacles and negative/dangerous consequences, in the event of accidental or unintended user actions (errors)*.
- Size and Space for Approach and Use: *Design should provide sufficient space and size for the intended purposes.*

In the built environment, designers shall always incorporate universal design principles into their designs, specifically NMT facilities. By applying these principles, a universally accessible environment is created, where the pedestrian's travel path is unobstructed from any type of obstacle(s) that would hinder their movement from the origin to the destination. The aforementioned will, among others, allow pedestrians to access public spaces and transport systems, without their movement being hindered in the process.

One of the most important measures of universal design is the provision of pedestrian ramps along constructed footways or where a constructed footway intersects with a roadway (i.e. pedestrian crossing). Such ramps allow all pedestrians to use these facilities and assist them in crossing the road, especially people with special needs or disabilities (e.g. wheelchair users).

This document only provides a brief overview of the basic requirements for universal design (with specific focus on universal access and tactile paving). In order to develop a comprehensive understanding of the need and application of universal design, including examples thereof, designer should consult the following documents:

- NDoT: National Technical Requirements 1: Pedestrian Crossing - Part 1, Version 6, Nov 2016.
- NDoT: National Technical Requirements 1: Pedestrian Crossing - Part 2, Version 6, Dec 2016.
- NDoT: Position Paper on Tactile Ground Surface Indicators (TGSI's), Apr 2016
- NDoT: NMT Facility Guidelines, 2014.
- SANS 10400-S The Application of the National Building Regulations, Part S – Facilities for persons with disabilities
- SANS 784 Design for access and Mobility, Part 4 - Tactile Indicators
- ISO 21542 Building construction - Accessibility and usability of the built environment

5.6 Universal Access Ramps

As mentioned above, one of the outcomes from applying universal design principles is the creation of universally accessible environments for all types of pedestrians. The aforementioned can be achieved by ensuring ramps and landings adhere to the required standards.

5.6.1 Slopes and Landings along Footways

The table below provide a summary of the permitted longitudinal and cross slopes for pedestrian and wheelchair ramps, the maximum vertical rise and maximum ramp length between landings (as prescribed by SANS 10400-S).

Table 5-9: Ramp requirements for people with disabilities

Preference		Slope	Maximum Vertical Rise	Maximum Ramp Length Between Landings
Longitudinal Slope (i.e. slope parallel with footway)	Absolute Maximum	1:12 (8.3%)	500mm	6m
	Maximum (Acceptable)	1:15 (6.7%)	665mm	10m
	Preferred	1:20 (5%)	750mm	15m
Cross Slope		1:50 (2%)	-	-

Notes: Any ramp provided for the use of persons with wheelchairs shall have a minimum trafficable surface of 1.1m.

The following will be required in terms of landings:

i) Level landings shall be provided at the top and bottom of any ramp.
ii) Level landings shall be provided between two consecutive ramps, where the maximum ramp length cannot be adhered to (refer to **Table 5-7**).
iii) The length of level landings shall never be less than 1.2m (1.5m preferred).

5.6.2 Kerb Ramps at Dropped Kerbs & Pedestrian Crossings

At any point where a pedestrian need to gain access from a footway onto an adjacent road, or vice versa, the roadway kerbs shall be dropped, in order to create a universal access for pedestrians. These types of ramps are generally referred to as "kerb ramps". Kerb ramps do not only provide a facility for people with physical disabilities (e.g. wheelchair users), but ensures that the crossing point can be used by all types of pedestrians.

Kerbs ramps are predominantly provided in the following scenarios:

- Wheelchair ramps: Where wheelchair users need to access a footway or facility from a roadway or parking area (or vice versa).
- Pedestrian Crossings: Where pedestrians need to cross a roadway.

Pedestrian crossings are divided into two categories, namely:

- Controlled: At controlled crossings, a control mechanism is present in order to regulate pedestrian movement. This can either be in the form of traffic signals (intersections) or RTM4 "Zebra" blocks and yield markings/signs (mid-blocks). It must be noted that mid-block crossings can be signalised.
- Uncontrolled: No form of control are provided at intersections or other crossing points.

The following shall be noted regarding kerb ramps:

General

1) Kerb ramps shall not be located where stormwater grid inlets are present.
2) The ramp shall be orientated in the movement direction of the pedestrian crossing.
3) Kerbs shall be dropped in accordance with Drawing RD2.2.
4) The dropped kerb(s) shall be flush with the adjacent surfaces (i.e. zero kerb-face height).
5) The extent of the dropped kerbs shall be equal to the required width of the kerb ramp type.

6) Ramp Widths:
   a) The required width of kerb ramps are provide in the table below:

Table 5-10: Kerb Ramps Widths

Ramp Type		Ramp Width
Pedestrian Crossing	Controlled	2.4m (minimum), 3.0m (Preferred) ➢ *The minimum width 2.4m is prescribed by SADC RTSM Volume 1 for signalised (RTM3) and "zebra" block (RTM4) crossings.*
	Uncontrolled	1.6m (absolute minimum) ➢ *Absolute minimum width. Typically applied on lower or middle order roads.* ➢ *Where uncontrolled crossings are present on Class 3 roads and higher, wider ramp widths of 2.4m wide shall be applied. Any deviation from the aforementioned width shall be motivated.*
Wheelchair Ramp		1.2m (preferred) ; 1m (minimum)

* *Refer to **Table 2-2** for road classification*

   b) The ramp widths for the various pedestrian crossings types shall also be read in conjunction with the provision of tactile ground surface indicators (TGSIs), which is a standard requirement at any pedestrian crossing, regardless of the control type. Refer to Section 5.7.3 for further details.
   c) The provision of TGSIs is not required at wheelchair ramps.

7) Transition kerbs shall be provided on either side of the ramp, in order to transition from the full height kerb to the dropped kerbs (flush with adjacent surface). A slope of 1:12 is preferred along the transition kerbs. However, where the aforementioned is not possible, the length of the transition shall never be less than 1m.
8) Ramp Gradients:
   - 1:20 (5.0%): Preferred, where space allows it.
   - 1:15 (6.7%): Acceptable
   - 1:12 (8.7%): Maximum
9) Landings:
   a) Level landings shall be provided at the top (back) of any kerb ramp, which shall be clear of obstructions.
   b) The length of level landings shall never be less than 1.2m (1.5m preferred).
   c) For narrow footways, a diversion shall be provided on either side of the ramp, leading to the level landing at the back of the ramp. These diversions shall be at least 1.2m wide (1.5m preferred). Refer to **Figure 5-13**, Scenario A.
   d) Where insufficient space makes it impossible to provide level landings at the back of kerb ramps (e.g. narrow verges, immovable infrastructure, street furniture, etc.), the length of the transition kerbs should be increased, in order to achieve a 1:12 slope along the transition kerb (illustrated between points "A" and "B" in **Figure 5-13**, Scenario A).
   e) Alternatively, longitudinal ramps can be provided on either side of the kerb ramp, which slope shall not exceed 1:12. In such a scenario, the kerb ramp shall have a gradient of 1:50 (2%). The aforementioned will result in the lowering of the back of footway level, which may create a flooding risk for adjacent properties (located lower than the roadway). In such instance where a flooding risk exists, edge restraints (e.g. barrier kerbs) shall be provided at the back of the footway, extending between the top edges of the longitudinal ramps. The top of the edge restraints shall have a constant height, equal to the full-height level of the back of footway. Refer to **Figure 5-13**, Scenario B.

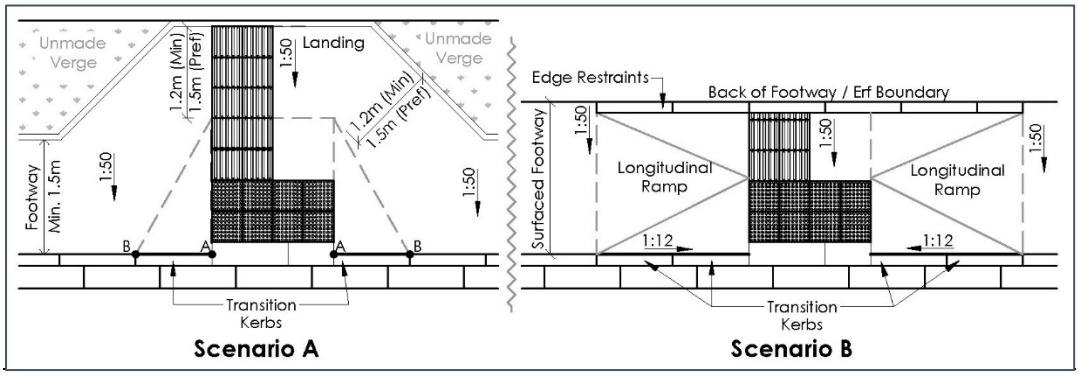


Figure 5-14: Landings at Kerb Ramps

10) It is recognised that in certain instances, the abovementioned widths and gradients cannot be achieved, due to the site specific restrictions. In such situations, the provision of an alternative accessible route shall be discussed with the Approval Authority.

The NTR1 Part 2 recommends that pedestrian crossings are located perpendicular to the sidewalk and road kerb (i.e. passing vehicle traffic). This implies that the pedestrian crossing is constructed on straight road edges (or as far out of the radius of the bellmouth as possible), in order to assist with the correct orientation. The perpendicular (or 90-degree) orientation assist pedestrians with visual impairments and also offers pedestrian the shortest crossing route. Where the aforementioned is not possible, pedestrian crossings should be provided as per the NTR1 Part 2's *first 20-degree rule* (i.e. pedestrian crossings can only be located within the first 20 degrees of the bell mouth, on the outer edge of the intersection).

However, it is recognised that implementation of the *first 20-degree rule* is simply not always possible, especially on lower order roads (with smaller road reserves) with uncontrolled crossings. In such instances, pedestrian crossings may be situated on the bellmouth (i.e. ramp at an oblique angle), on condition that the location of the pedestrian crossing shall be provided in such a way that the tactile paving adheres to the "adapted TGSI layout" (i.e. maximum distortion), as explained in Section 5.7.4.

Designers can also refer to drawing series RD4 for the detail drawings of the various kerb ramps.

5.6.3 Minimum Distance Between Kerb Ramps

Where two kerb ramps are situated on the same bellmouth, the separation distance between the ramps should not be less than 1.2m (1.5m preferred). The aforementioned separation is similar to landing requirements. It allows the ramps to function individually/separately, improve circulation and avoids inconvenient changes of gradients.

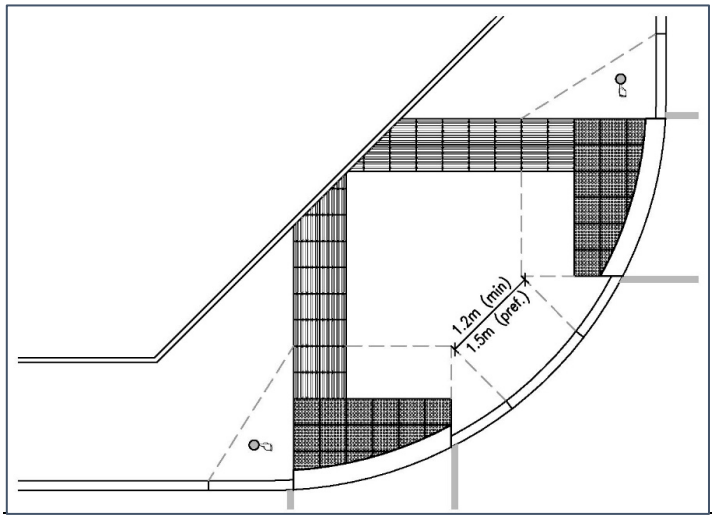


Figure 5-15: Minimum Spacing between Kerb Ramps

5.7 Tactile Ground Surface Indicators

The use of Tactile Ground Surface Indicators (TGSIs, also known as "Tactile Paving") has been researched and documented extensively. This section will therefore only provide a brief overview on the use of tactile paving. Designers are encouraged to consult the relevant studies on tactile paving, including the documents referenced in Section 5.5, in order to develop an in-depth understanding of its use and importance in the built environment.

5.7.1 Purpose

Non-motorised transport facilities should cater for all types of pedestrians, including people with visual impairment (i.e. blind or partially sighted). The use of tactile paving plays a big role with the aforementioned.

TGSIs are precast blocks installed into pedestrian surfaced footways and creates a tactile surface that can be detected underfoot or with walking sticks (canes). Tactile paving can convey important information to visually impaired pedestrians and thus assist them with mobility and wayfinding in the built environment.

Tactile paving shall be installed at all pedestrian crossings, regardless of the control type.

5.7.2 Types and Functions of TGSIs

The two main functions of tactile paving blocks are to provide warning and guidance for visually impaired people along the accessible path of travel and adjacent points of interest/reference.

The two types of tactile paving blocks used to fulfil the above functions are "Warning" and "Guidance/Directional" blocks. Warning and Guidance blocks shall be installed at all pedestrian crossings, regardless of the control type.

Warning Blocks

Warning TGSIs alert pedestrians to hazards located in or along the accessible path of travel, provide directional orientation and indicate a change in direction, including information points. Warning tactile blocks are thus installed to an approaching hazard. Examples include, the top and bottom of a stair case, when there is a change in grade (i.e. a ramp), bus stop, pedestrian crossing, etc.

At pedestrian crossings, warning TGSIs are predominantly used to indicate the road crossing point. Even though the primary function of the warning block is to indicate the crossing point (i.e. a hazard), it also enables pedestrians to orientate themselves, in order to cross the roadway in the right direction (i.e. directional orientation).

Guidance (Directional) Blocks

Guidance TGSIs are installed to provide guidance, give directional orientation to visually impaired pedestrians along a specific path, route or open spaces, in the absence of (or insufficient) other directional tactile cues (e.g. a building line wall, fence, kerb edges or handrail). In the built environment, where various street furniture is present, the directional blocks can be used to safely guide visually impaired people along intended pathways, which are free of obstacles.

Guidance blocks to be installed with the raised bars orientated in the direction the pedestrian must be guided to (i.e. point of reference). The guidance pathway should be kept as straight as possible, in order to avoid visually impaired pedestrians losing their way or deviating from the intended path (by losing contact with the tactile surface, due to a sudden change in direction).

The pathway shall be unobstructed by street furniture or other hazards. Sufficient unobstructed space shall be provided on either side of the directional path, to avoid pedestrians colliding with obstacles (preferably more than 600mm).

In open spaces, the blocks must be installed in a continuous line, along the path of travel, between points of reference and shall be a 400mm strip.

Shape and Size

In line with the specification and requirements of SANS 784, TGSIs shall comply with the following:

- Shape: The shape of the TGSI is symmetrical, with a typical dimension of 400mm.
- Thickness: 60mm – 75mm
- Design: Warning – Grid pattern of flat-topped domes.
  Directional – Rows of parallel bars (flat-topped) with rounded ends.
- Colour: The TGSI shall provide a high visual contrast to the adjoining surface and surrounding environment, in order to warn vision-impaired pedestrians of hazards.

The two block types can be seen in the figure below, along with the abovementioned specifications and requirements.

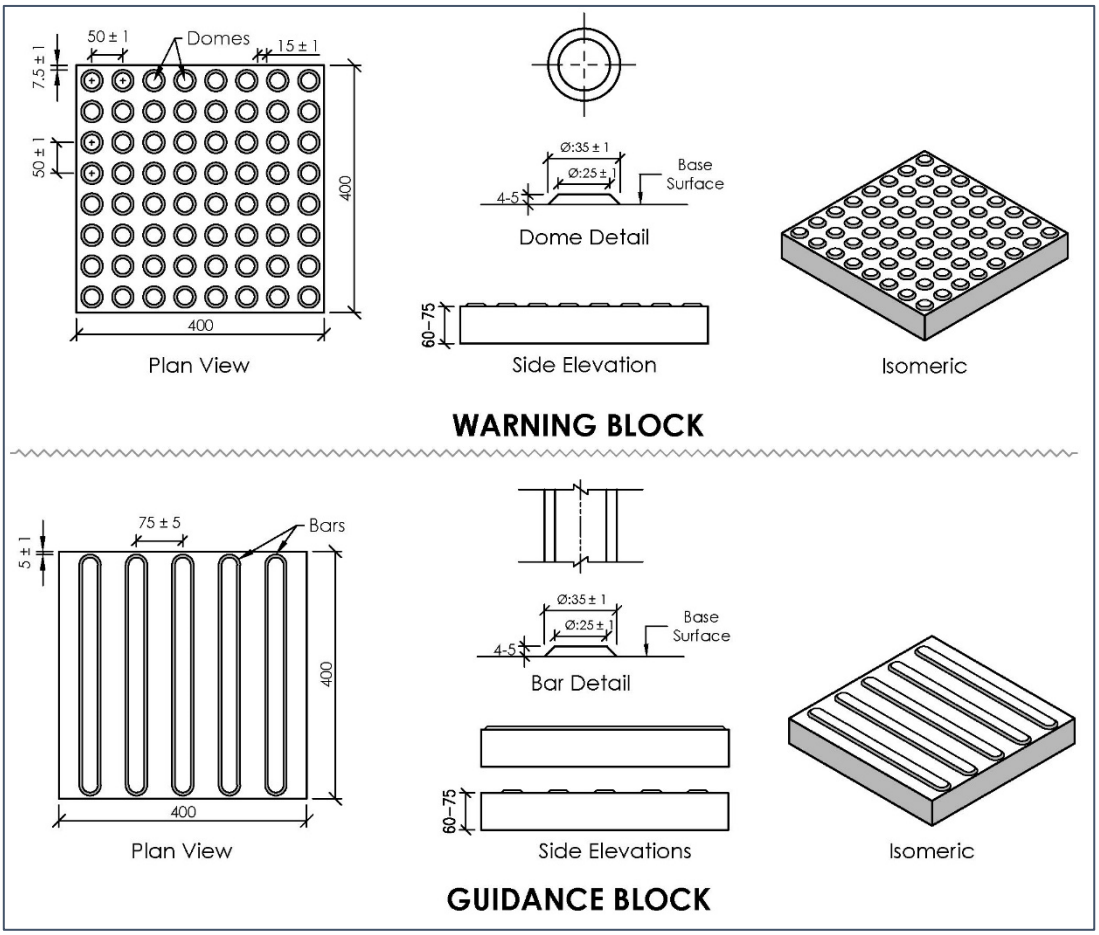


Figure 5-16: Tactile Ground Surface Indicators types and typical dimensions

Designers shall take note that the previous "bubble blocks" (with typical dimensions of 320x320x75mm) are no longer accepted.

5.7.3 Configuration and Layout of TGSIs

TGSIs are installed in order to convey a certain message to a pedestrian, whether it is to pause and consider a change in direction, indicate an eminent hazard or to provide guidance to a specific point of reference. Tactile paving needs to be applied consistently in the built environment. Layouts should be simple and logical, in order to allow visually impaired pedestrians to interpret the intended message and navigate accordingly.

The following section will discuss the application of warning and guidance TGSIs in the built environment, with specific focus on pedestrian crossings.

5.7.3.1 Basic "L-shape" Configuration

The L-shape configuration is the ideal TGSIs layout and shall be installed at all pedestrian crossings, regardless of the control type.

The L-shape consist of two components, i.e. the "base" and "tail" (often referred to as the "stem").

- "Base": Consists of two rows of warning blocks (i.e. 800mm deep).
  The width of the warning blocks shall extent across the entire width of the kerb ramp. The blocks are installed perpendicular to the direction of vehicular traffic and perpendicular to the guidance blocks.
- "Tail": Consists of two guidance blocks (i.e. 800mm wide), which shall never be less than 1.2m in length.
  The "tail" should extend across the entire width of the accessible path of travel, in order to intersect visually impaired pedestrians and guide/direct them to the pedestrian crossings.

The figure below illustrates the basic L-shape configuration.

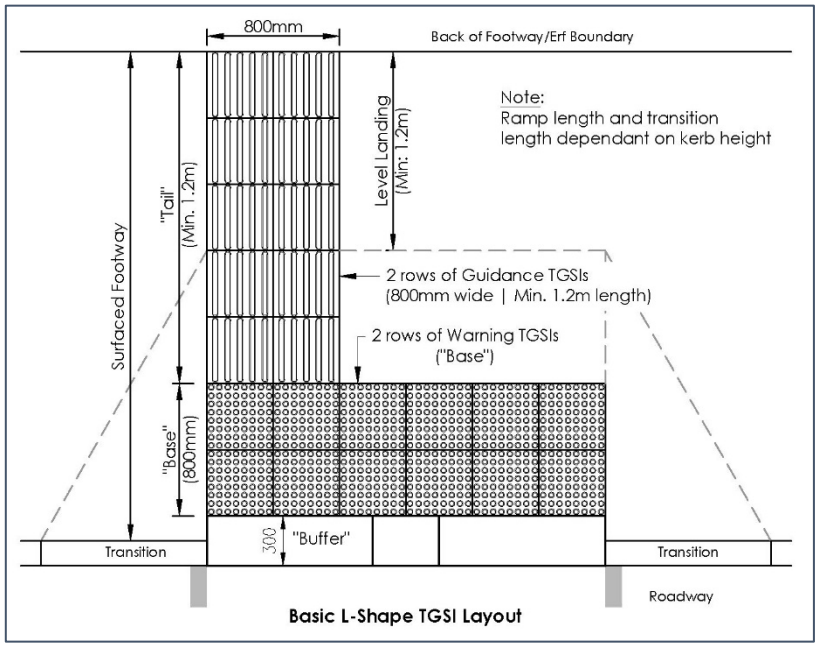


Figure 5-17: Basic "L-shape" TGSI Configuration

The L-shape ensures an effective, simplistic and intuitive layout of TGSIs. The straight lines, edges and orientation of the tactile blocks makes it easy for visually impaired pedestrians to "read", understand and comprehend. It is therefore important to ensure that the lines and edges of the kerb ramp align with the tactile paving. The figure below illustrates the guidance and direction provided by the L-shape layout, along with the kerb ramp.

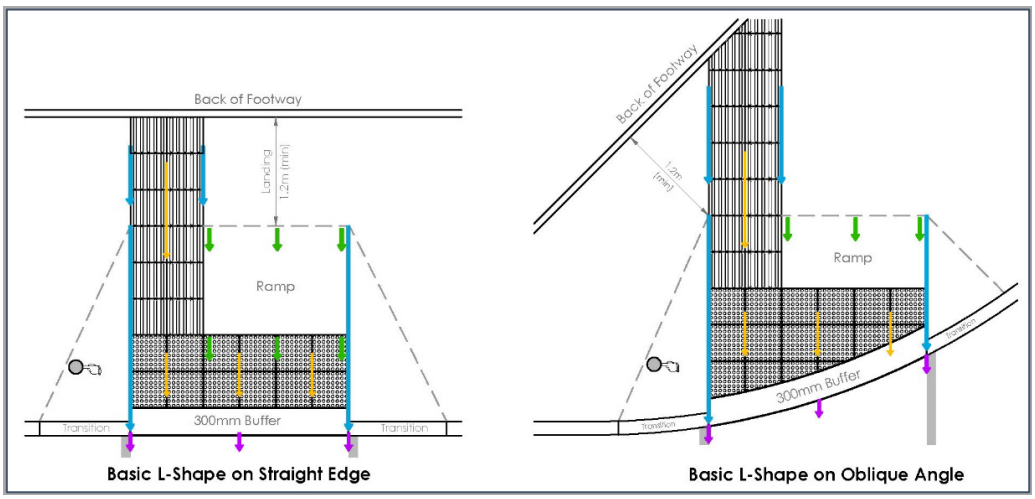


Figure 5-18: Direction and Guidance provide be "L-shape" TGSI Configuration

5.7.3.2 Pedestrian Crossings

The following shall be applicable regarding the installation of TGSIs at pedestrian crossings:

1) Both warning and Guidance TGSIs shall be provided at all pedestrian crossings.

Warning Blocks

2) Warning blocks compensate for the absence of the full-height kerbs and alerts visually impaired people that they have reached a pedestrian crossing point.
3) The warning blocks shall be installed along the full width of the dropped kerbs (i.e. kerb ramp width). This will warn visually impaired pedestrians of the impending hazard (traffic) and also indicate to the extent of the crossing's boundaries/edges.
4) Blocks to be set back a minimum of 300mm from the roadway kerb face (i.e. hazard), in order to create a "buffer" zone.
5) Blocks to be installed to a minimum depth of 800mm (i.e. two rows of blocks).
6) Warning blocks (2 x 2 blocks) shall be installed where:
    a) Two "tails" intersect;
    b) A change in direction (along guidance blocks) occurs. If the change in direction is less than 45-degrees, warning blocks are not required.

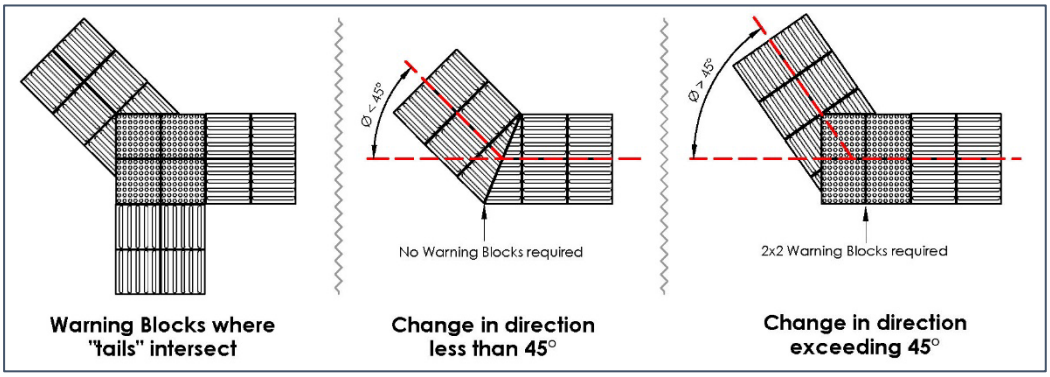


Figure 5-19: Warning at "tails"

7) At signalised crossings, where a push-button is present, blocks should be located within the zone of common reach (of the push button) of no more than 600mm from the outer edge of the warning blocks. Push-buttons should be placed at a height of 1.1m from the surface.
8) Pedestrian crossing points situated on bellmouths (i.e. ramp at an oblique angle) are not preferred. However, where the aforementioned is unavoidable, the following will be applicable:
    a) The back edge of the warning tactile paving shall be installed in a straight line.
    b) The back edge of the tactile paving should be at a right angle to the direction of the crossing (over the roadway). This might result in the tactiles not laying parallel with the kerbline. However, the back edge (and side edge) is often used by visually impaired people to align themselves correctly with the direction of the crossing.
    c) The maximum distortion of the warning blocks at the "base" shall adhere to the specifications of the adapted TGSI layout. Refer to Section 5.7.4.
    d) The cutting of tactile blocks will be allowed. Any cutting shall be done mechanically (i.e. sawing).
    e) Where small wedges are created between the front row of tactile paving and the "buffer", due to the radius of the bellmouth and the limited available space, such wedges shall be filled with in-situ concrete. The concrete shall be 100mm thick, with a slip-resistant surface.

Guidance (Directional) Blocks

1) Guidance blocks shall be installed as a strip consisting of two rows of blocks (i.e. "tail" of 800mm wide).
2) In order for the guidance blocks to be detected by a pedestrian approaching the crossing at an angle, the strip shall extend from the back of the "base", across the entire width of the footway, up to the back of the footway or where it intersects with another "tail".
3) As mentioned above, where two "tails" intersect, a 2x2 warning block configuration shall be installed. From here, the guidance strip (800mm wide) shall extend to the nearest back-of-footway or erf boundary.
4) Blocks to be installed in between warning TGSIs, indicating a change/choice of direction (e.g. at two adjacent pedestrian crossings on a corner of an intersection).
5) At signalised intersections, the blocks provide guidance to the pedestrian push-button assembly location. The guidance TGSIs shall be installed from the back of the footway and terminate at warning TGSIs.
6) The "tail" shall lead visually impaired pedestrians to the traffic signal push-button, which should preferably be situated on the side of the crossing which faces on-coming traffic (unless site specific conditions or the geometric layout dictates otherwise).

Configurations for Controlled Pedestrian Crossings

The figure below illustrates the TGSI layouts and dimensions for the two types of controlled pedestrian crossings (as explained in Section 5.6.2).

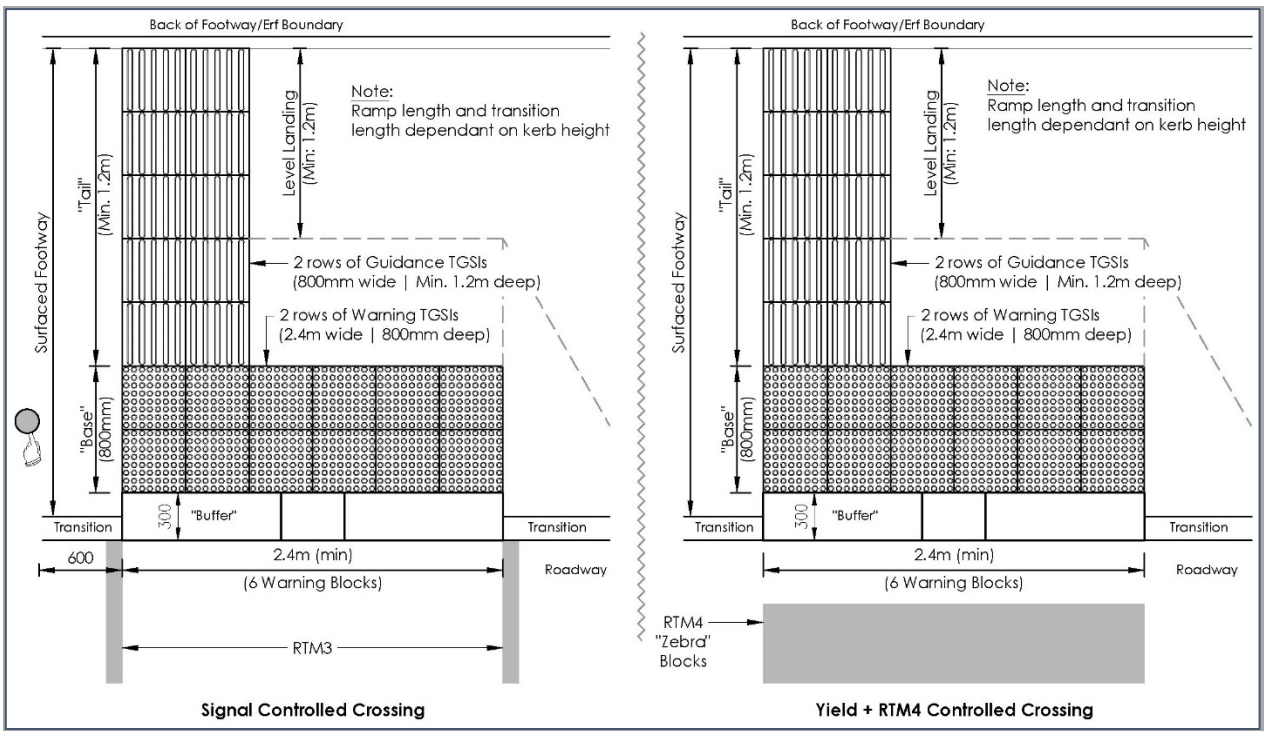


Figure 5-20: TGSI Installation at Controlled Crossings

Configurations for Uncontrolled Pedestrian Crossings

The figure below illustrates the TGSI layouts and dimensions for the two types of uncontrolled pedestrian crossings (as explained in Section 5.6.2).

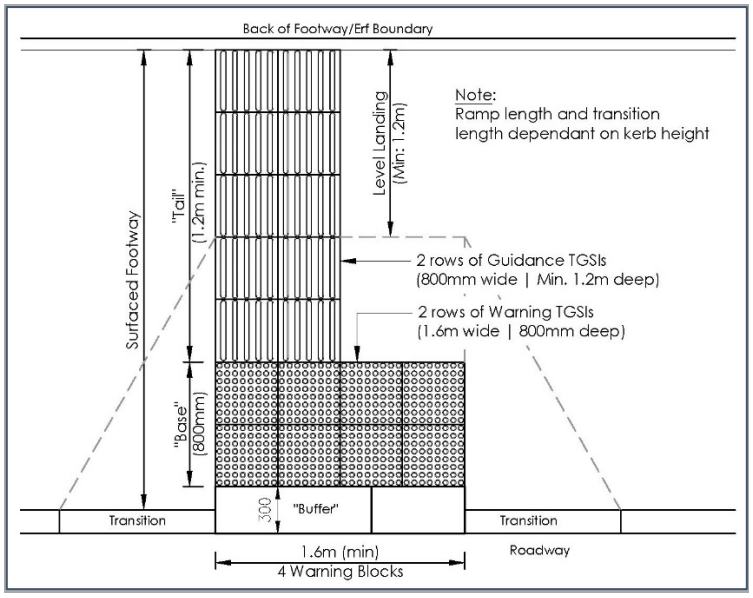


Figure 5-21: TGSI Installation at Uncontrolled Crossings

It must be noted that at uncontrolled crossings, the provision of tactile blocks merely informs the visually impaired pedestrian about the presence of the crossing point and the hazardous situation. It is still the pedestrian's responsibility to use the facility safely, by ensuring the road is safe to cross, as the pedestrian does not have priority or a pedestrian controlling phase.

5.7.3.3 Refuge Areas on Median or Splitter Islands

The following shall be required at refuge areas in median islands:

1) Warning TGSIs shall be installed on all pedestrian island crossings (refuge areas), at a minimum depth of 800mm (i.e. 2 rows of blocks), set back 300mm from the kerb face of the roadway (i.e. "buffer"). The aforementioned shall be provided on either side of the island.
2) Warning blocks shall be provided along the full extent of the refuge walkway width. The walkway width will vary, depending on the crossing type and control.
3) Where the width of a refuge island does not exceed 2.2m, the entire section between the buffer zones will be filled in with warning blocks. Refer to **Figure 5-20**.

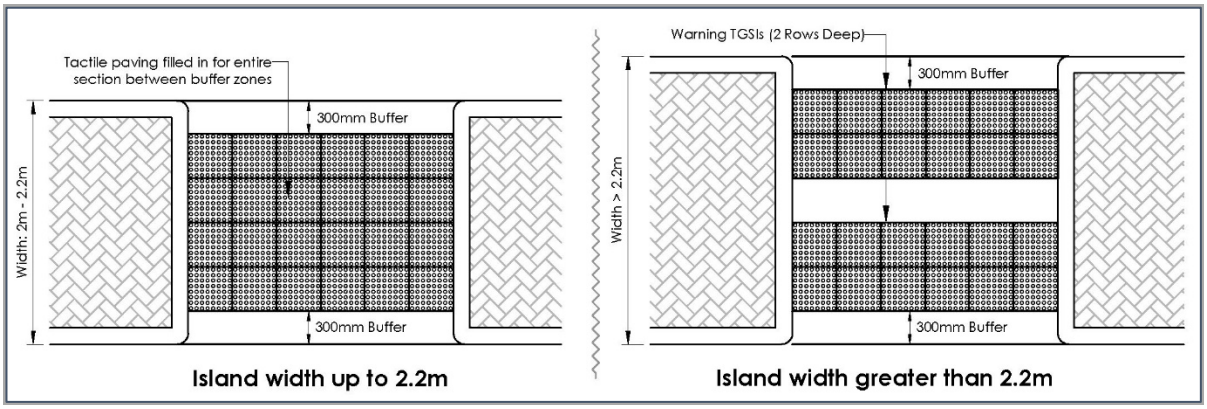


Figure 5-22: Warning TGSIs at refuge islands

4) Where Warning TGSIs are provided on refuge islands, the "cut-through' type is preferred, since the full-height kerbs through the island act as directional tactile cues for visually impaired pedestrians. Refer to Section 5.4.2 for more details on "cut-through" refuge islands. However, in certain scenarios, ramps may be implemented.
5) Where pedestrians are able to cross the full width of the road in a single phase, warning TGSIs are generally not required at the refuge island.

6) Where slip lanes are provided at intersections, the aforementioned often results in multiple crossings leading/connecting to the splitter island. On these islands, it is import that TGSIs are provided correctly, in order to guide visually impaired pedestrians between the various crossings. The figure below illustrates an example of a splitter island with 3 pedestrian crossings, where TGSIs are installed in such a manner as to safely guide pedestrians between the crossings.

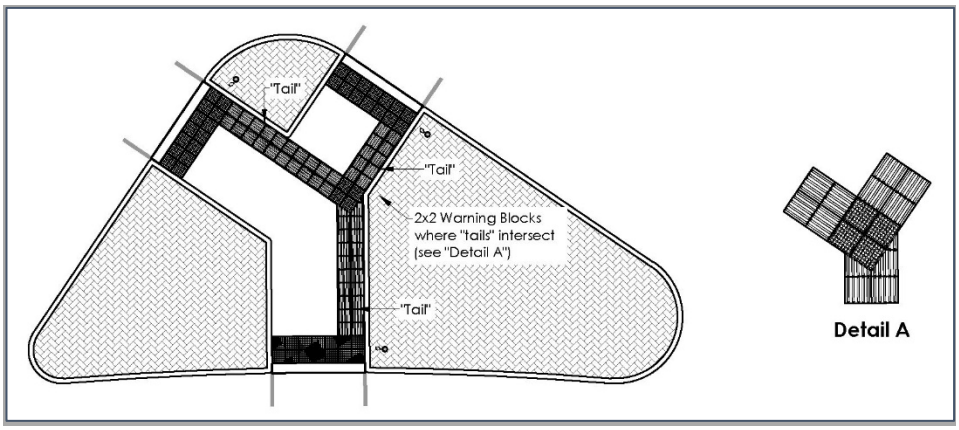


Figure 5-23: TGSIs at multi-crossing splitter island

5.7.4 Adapted TGSI Layout (Distortion)

As mentioned previously, locating the pedestrian crossing on the straight edge after the bellmouth may prove challenging and is therefore not always possible. This will result in the crossing located on kerb radius (i.e. oblique angle).

According to the NDoT's *Position Paper on Tactile Ground Surface Indicators*, an adapted TGSI layout may be used where kerb ramps are located on a bellmouth. The adapted TGSI layout refer to the maximum allowable distortion of the warning blocks. Where adapted TGSI layouts are used, the warning blocks may not exceed 3 blocks on one side (long side) and one block on the other side (short side) of the kerb ramp.

Figure 5-23 illustrates how the pedestrian crossing can be moved, in order to achieve the maximum allowable distortion. The preferred green L-shape can be seen in Position A. As the crossing moves towards the inside of the bellmouth, the warning blocks are filled in towards the front (behind the buffer). The warning blocks are thus colour coded to show the distortion as the position changes from A to B to D. Position D is unacceptable, since the layout becomes nonsensical, excessive and difficult to read by visually impaired pedestrians.

A position between B and D can be found (i.e. Position C), which adheres to the maximum allowable distortion of the warning blocks. The aforementioned can be achieved by moving the TGSI layout forward and along the buffer, until one warning tactile is provided on the short side (inside) and 3 warning tactiles on the long side (outside).

Intersections with large kerb radii may prove problematic, since the adherence to the maximum distortion of the tactile layout usually results in the crossing being located quite far back from the intersection. This not only results in the crossing being situated further from the direct line of travel, but may also impact the sight lines. When sight lines are negatively affected, and the crossing has to move forward, the kerb radius can be reduced (without negatively impacting the turning movements of the vehicles).

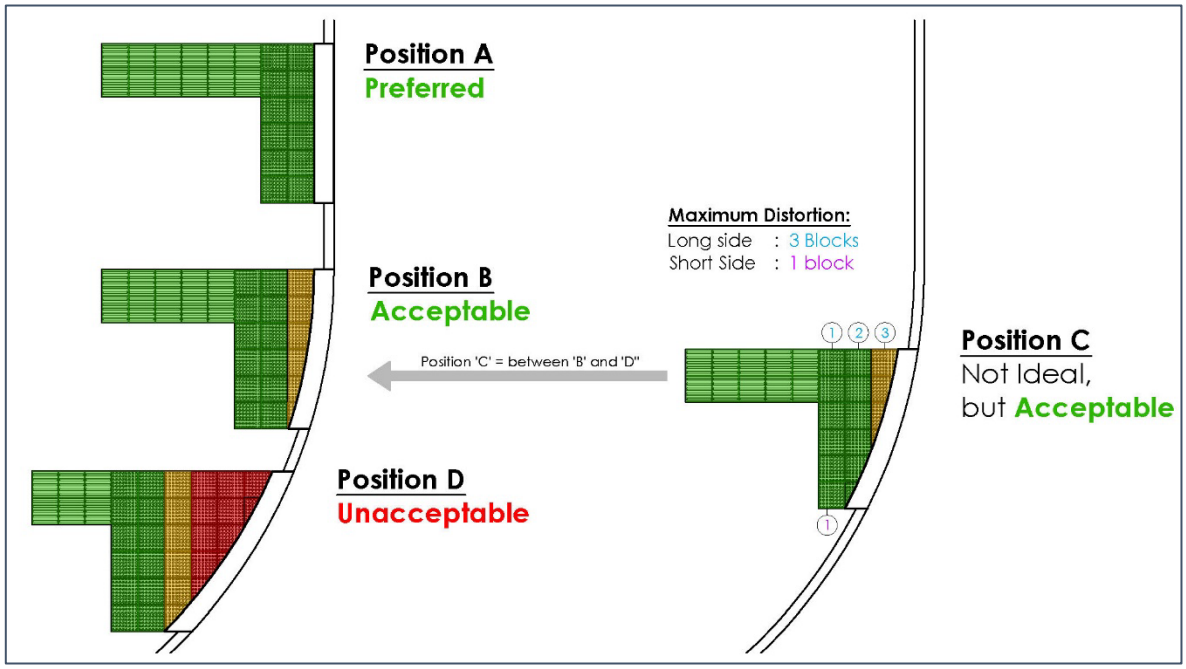


Figure 5-24: Maximum Distortion of Warning blocks on Oblique Angles

5.7.5 Installation Details of TGSI's and example layouts

Designers can refer to drawing series RD4 for the details regarding the provision of kerb ramps and TGSIs on the various pedestrian crossing types. The aforementioned also provides typical examples of the preferred and not preferred pedestrian crossings for the various control types.

5.8 Mid-Block Pedestrian Crossings

Mid-block pedestrian crossings are dedicated spaces on roadways, at non-intersection locations, where pedestrians can cross the road from one side to the other in a safe manner. These crossings should be strategically placed and warranted, in order to improve pedestrian mobility and safety.

There are two types of mid-block crossings, namely 1) Road-Level Pedestrian Crossings and 2) Raised Pedestrian Crossings. The two types of crossings are discussed in further details below.

5.8.1 Road-Level Pedestrian Crossings Warrant

Road-level crossings are typically provided along arterial (Class 2 and 3 roads) or where high pedestrian volumes are present. At these crossings, the crossing space is level with the adjacent roadway surface.

These crossings can be yield-controlled or signal-controlled. Although there are warrants for both these control conditions, designers should also carefully consider factors such as safety, vulnerability of the NMT user, accident data etc. when doing their investigation.

Yield-Controlled Mid-Block Crossing

The provision of yield–controlled pedestrian crossings on Class 2 or 3 arterials should be subject to careful consideration, given the operating speeds of the roads and the potential for drivers to disregard yield signs. Designers should refer to the warrants for a yield-controlled mid-block crossing as per TM16 Vol 2:

> *"A formal pedestrian or bicycle crossing (priority or signal controlled) is warranted at locations where the pedestrian volume during any hour (of the year) exceeds 20 pedestrians per hour and where either of the following conditions exists:*
>
> *a) More than two lanes have to be crossed in one stage without provision of a pedestrian or cyclist refuge (e.g. on a median) or;*
>
> *b) The traffic volume that must be crossed in one stage exceeds 1 000 vph during any hour of a normal week.*

Signal-Controlled Mid-Block Crossing

The provision of a signal-controlled mid-block crossing is subject to the SARTSM Volume 3 traffic signal queue length warrants being met. Traffic signals are warranted if any any one of the following conditions are met:

a) *WARRANT 1: The average length of ANY individual queue equals or exceeds four (4) over any one hour of a normal day.*
b) *WARRANT 2: The SUM of the average lengths of all queues equals or exceeds six (6) over any one hour of a normal day.*
c) *WARRANT 3: The SUM of the average lengths of all queues equals or exceeds four (4) over each of any eight hours of a normal day (the hours do not have to be consecutive, but they may not overlap).*

Designers should note that a queue for a pedestrian or cyclist is the total number waiting to cross from one approach.

Kerbs ramps shall be provided, in order to safely accommodate all pedestrians from the pedestrian footway/sidewalk onto the crossing space. The kerb ramps shall be constructed as described in Section 5.6 and TGSIs provided as per Section 5.7.3.2.

Where a median island is present, pedestrians shall be accommodated through the median, as described in Section 5.4.2 and TGSIs provided as per Section 5.7.3.3.

The figure below illustrates the basic layout of a signalised and unsignalised road-level mid-block pedestrian crossing.

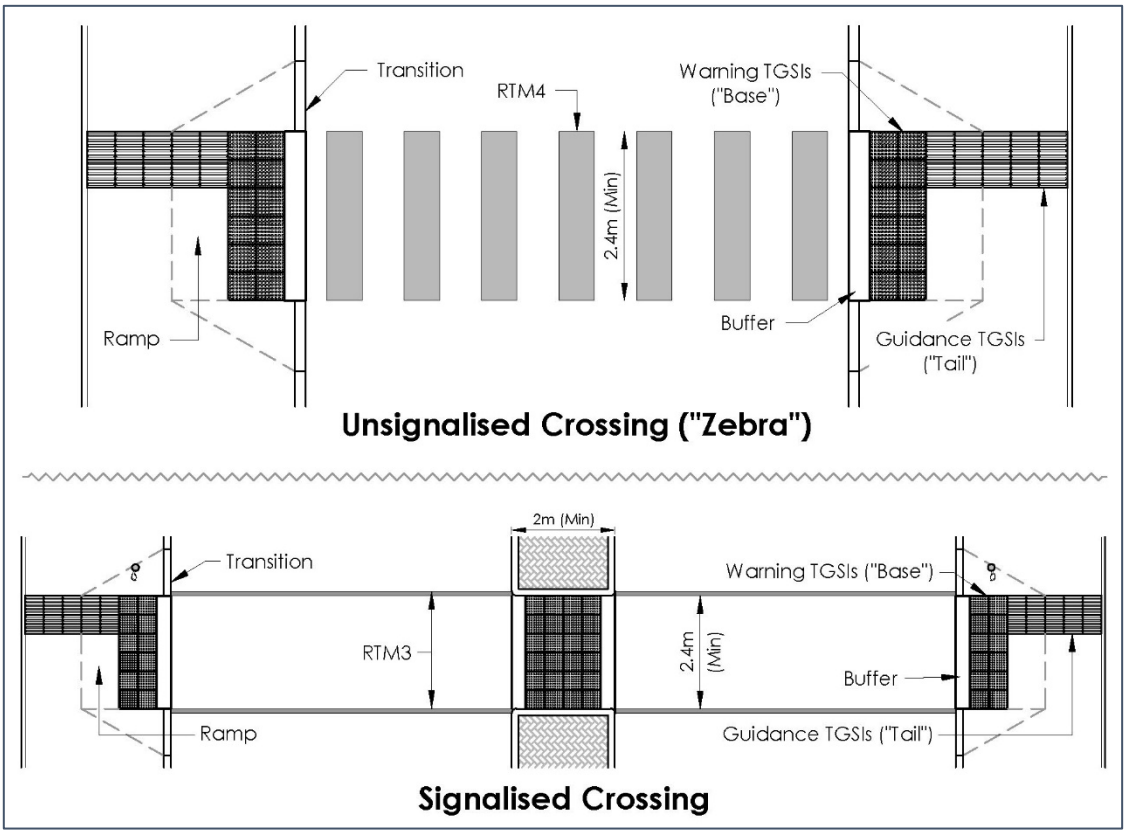


Figure 5-25: Examples of Road-Level Mid-Block Pedestrian Crossings

Note: The road markings on the approaches to the pedestrian crossings are not shown in the above figures. Designers can refer to the SADC RTSM Vol 1 and SARTSM Vol 2 for the aforementioned details.

5.8.2 Raised Pedestrian Crossings

Raised pedestrian crossings are typically provided on lower order roads (Class 5 roads) and also act as traffic calming measures, which improves the safety of pedestrians crossing the roadway. At these crossings, the crossing space is raised to a height of 85mm above the existing road surface (i.e. "table"), with ramped sides on the approaches. In order to tie-in with the adjacent kerb ramps, side ramps also needs to be constructed between the table and the buffer. However, these ramps often result in steep slopes transitioning from the kerb ramp into the road and up against the raised crossing slopes. The aforementioned results in wheelchairs running the risk of overturning or being trapped, leaving the crossing inaccessible and unsafe.

It is therefore advised to extend the raised crossing space (table) across the entire roadway width, from kerb to kerb. However, doing so will result in new challenges, such as the accommodation of stormwater.

The above is only a concern on the low side of the roadway, where precast concrete drainage channels are generally present. It will not pose a challenge on the high side of the roadway (for example with roads in cross-fall). In such instances, the raised table can merely be extended to the kerb-face, with the necessary kerb ramp constructed thereafter. The kerb ramp shall be constructed as described in Section 5.6, according to the required width and maximum allowable slopes. However, the extent of the vertical dropped kerb will vary, since the ramp will tie in with the top of the raised table and not the existing road surface.

In order to address the stormwater challenge on the low side(s), two options are available, which are described hereafter.

Catchpit Positioning

Where possible, the raised pedestrian crossing can be positioned downstream of existing catchpits, in order to drain the runoff which will be trapped at the start of the ramps.

Alternatively, new catchpits may be installed, provided that there is an existing underground stormwater system to connect to. This option is not preferred, since the construction of new catchpits compromises the integrity of the roadway and its layerworks. Should this option be supported be the Approval Authority, the inlet capacity can be increased by providing additional catchpits. For cambered-profiled roads, catchpits shall be provided on either side of the road, whereas a catchpit shall only be provided on the low side of the road in cross-fall.

Care shall be taken to ensure that the catchpits are cleaned on a regular basis, in order to avoid flooding on the upstream side of the pedestrian crossing during minor storm events. During major storm events, ponding of stormwater will occur (up to a height of 85mm). Thereafter, the runoff will overtop the table, which is acceptable, since roadways are regarded as the primary drainage conduits in an urban environment.

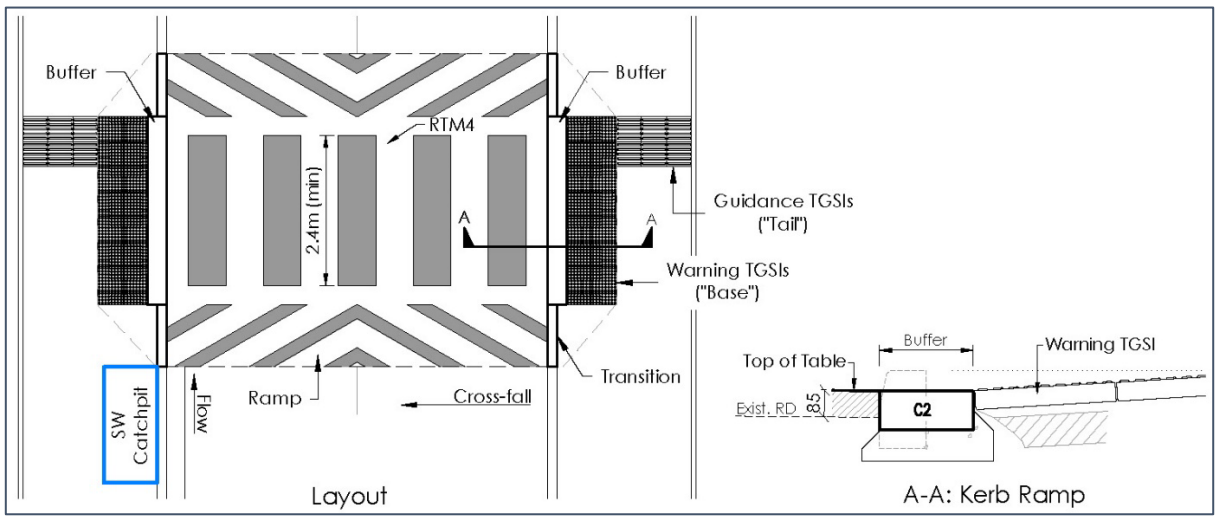


Figure 5-26: Example of Raised Mid-Block Pedestrian Crossings ("Catchpit Positioning" Option)

Note: The road marking on the approaches to the pedestrian crossings are not shown in the above figure. Designers can refer to the SADC RTSM Vol 1 and SARTSM Vol 2 for the aforementioned details.

Drainage Opening

Where it is not possible to position the raised pedestrian crossing downstream of a stormwater catchpit(s), or construct new catchpits, the stormwater runoff has to be accommodate "through" the crossing.

In order to achieve the above, an opening need to be provide along the crossing, allowing the stormwater runoff to drain through the crossing.

Care shall be taken to ensure that the channels and drainage opening(s) on the upstream side of the raised pedestrian crossing are cleaned on a regular basis, in order to avoid flooding during minor storm events. During major storm events, ponding of stormwater will occur (up to a height of 85mm). Thereafter, the runoff will overtop the table, which is acceptable, since roadways are regarded as the primary drainage conduits in an urban environment.

Alternative drainage openings will be considered. However, such alternatives shall be submitted to and supported by the Approval Authority, prior to implementation. Pipes shall not be considered as an alternative, since they are known to block-up quickly and are more troublesome and difficult to clean.

The drainage opening option is illustrated in the figure below. Designers can refer Drawing RD11 for further details.

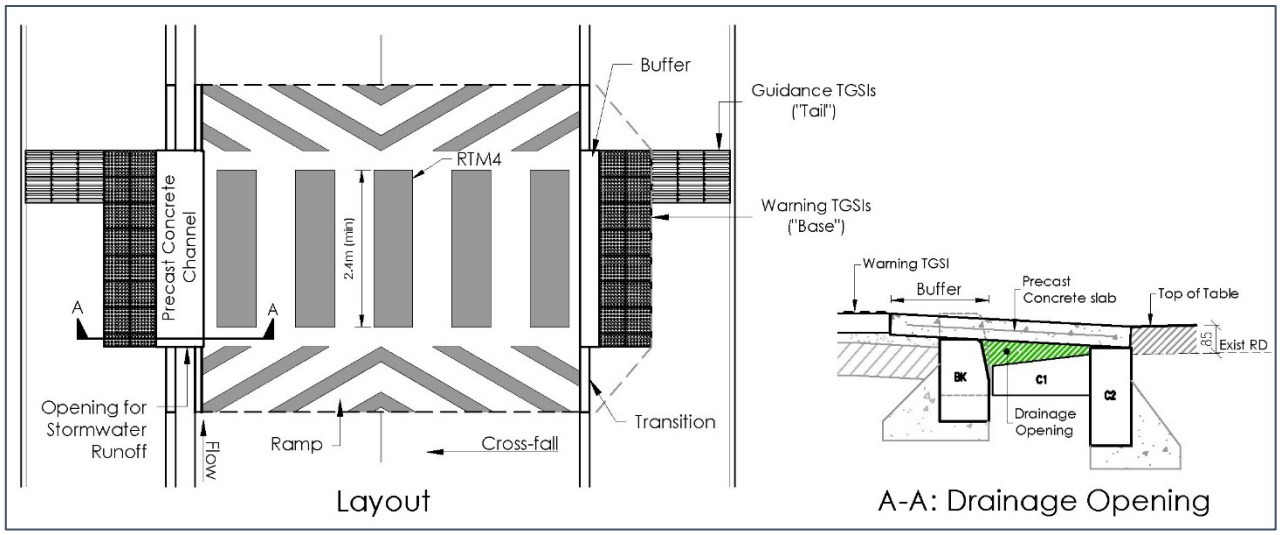


Figure 5-27: Example of Raised Mid-Block Pedestrian Crossings ("Drainage Opening" Option)

Note: The road marking on the approaches to the pedestrian crossings are not shown in the above figure. Designers can refer to the SADC RTSM Vol 1 and SARTSM Vol 2 for the aforementioned details.

5.9 Other considerations

Designers should note the safety and operational issues that arise where pedestrians and cycling routes cross certain types of intersections or roadways.

At major signalised intersections, footpaths and cycle ways should preferably be combined to one crossing point with special pedestrian and cycle phases provided for.

Traffic signs shall be placed at a minimum distance of 1.1m from the roadway kerb, in order to accommodate disabled pedestrians. Refer to the figure below.

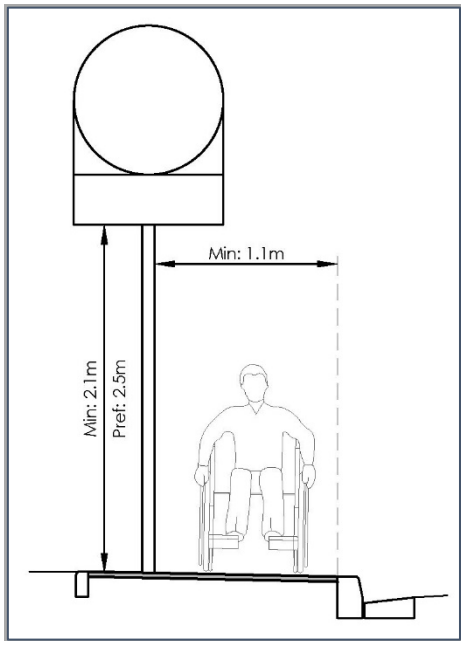


Figure 5-28: Placement of signs on kerbside footways

To: **Part A Overview**

To: *Chapter Overview*

CHAPTER 6

CARRIAGEWAY CROSSINGS

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CHAPTER 6: CARRIAGEWAY CROSSINGS

6.1 General

Carriageway crossings (CWC), also known as vehicular access ways or driveways, shall be constructed where vehicles are crossing over the footway or verge, in order to enter a property from a road.

In designing carriageway crossings, the primary consideration shall be the safety of all users, especially pedestrians and cyclists on pathways and traffic from the road. A carriageway crossing is an encroachment of vehicular traffic across a pedestrian right of way, and not the other way around. The design thereof should therefore convey this principle.

Carriageway crossings shall be constructed wherever vehicular access is gained across a pedestrian right of way, i.e. footways or any NMT facilities. Examples include, but are not limited to, access to a private dwelling, parking area, access to parking garages, etc.

Where barrier kerbs are present along roadways, carriageway crossing are generally constructed either of two ways, namely:

Splays: Splay type carriageway crossings are always preferred, since it provides the safest environment for pedestrians.

Kerb returns: The use of kerb returns (i.e. bellmouth approach) for carriageway crossings are not favoured, since it resembles normal road intersections and thus implies vehicular right of way. The use of kerb-return type accesses should therefore be reserved for road intersections. However, kerb returns may be considered for accesses where there is high frequency of ingress and egress vehicle movement (e.g. gated developments) or for larger industrial/commercial developments. The use of kerb return accesses is subject to the approval of the Approval Authority.

Where mountable kerbs are present along the roadway, splays or kerb-returns are generally not required, since the roadway kerbs do not have to be dropped.

Regardless how a carriageway crossing is constructed, designers shall always ensure that pedestrian movement is accommodated and universal design principles are applied.

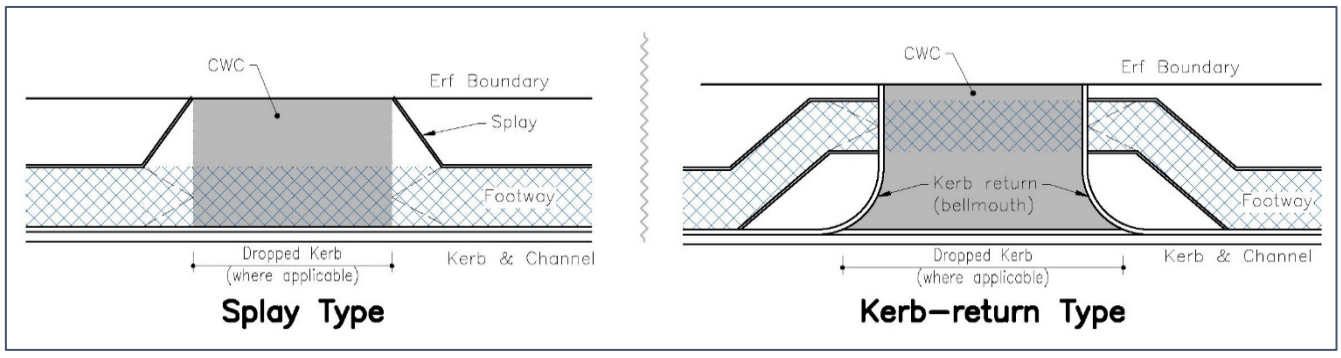


Figure 6-1: Carriageway Crossing Types

6.2 Relevant Codes of Practice, Policies and Guidelines

The list below contains, among others, the relevant codes of practice, policies and guidelines regarding carriageway crossings:

i) CCT: Development Management Scheme
ii) CCT: Guidelines for the Provision of Carriageway Crossings
iii) CCT: Universal Access Policy for Transport for Cape Town (Policy Number 17958)
iv) SANS 10400: National Building Regulations
v) UTG 5: Geometric Design of Urban Collector Roads.
vi) UTG 7: Geometric design of Local Residential Streets;
vii) UTG 10: Guidelines for the Geometric Design of Commercial and Industrial Local Street;
viii) WCG: Access Management Guidelines, 2020

6.3 Carriageway Crossing Design

6.3.1 Width and set-back

Carriageway crossings should be designed to allow vehicles to enter the site, by turning at slow speeds, from the traffic lane nearest to the site, without intruding into other traffic lanes, especially on higher order roads. Where two-way traffic is expected, the driveway should be of sufficient width to allow two vehicles to pass, in order to avoid queueing on public roads. The width of carriageway crossings shall conform to the City of Cape Town's Development Management Scheme.

High volume carriageway crossings, especially where access is controlled via gatehouses, booms, etc. (generally all except those serving single residential properties) shall be designed with sufficient stacking length, to avoid queuing into the public street. This will entail the access control being set back on the property. Refer to Section 2.3.4 with regards to the stacking requirements for carriageway crossings with access gates.

6.3.2 Material Specifications

Carriageway crossings should be designed for the most common vehicle that will be using them (i.e. intended vehicle usage type). Table 6-1 can be used as a guide in this regard. Any deviations from the Guidelines in Table 6-1 shall be discussed with the approval authority.

Material specifications and requirements to comply with Chapter 8 (i.e. *Pavement Design*).

CWC layerworks should also at least be similar to the adjacent roadway (which pavement class in turn is based on the road category). However, in order to simplify the pavement design for carriageway crossings, a few typical pavement structures were compiled for carriageway crossing servicing various types of land uses. The aforementioned can be found in Table 6-1 and should be used as a guide. Designer can refer to Table 8-11 for the pavement structures of various pavement classes and road categories.

6.3.3 Dropped/Lowered Kerb Types

The use of double-flat channels ("v-channel") at carriageway crossings (between the roadway and the ramp) is not allowed.

The two kerb types used predominantly in the built environment is the *barrier* and *mountable* types. The treatment of the respective type of kerbs at carriageway crossing is discussed below.

Barrier Kerbs

Barrier kerbs are usually present in both residential and commercial developments/areas. These kerbs are generally accompanied by a precast concrete channel (on low side of the road).

The upright design/nature and vertical kerb-face height of barrier kerbs makes them extremely difficult to mount for normal passenger vehicles (in some cases even impossible). Therefore, wherever a CWC is situated along roadway with barrier kerbs, said kerbs shall be dropped/lowered, in order to provide access to vehicles.

The barrier kerb shall be lowered to a height, which fulfils two functions, namely:

i) Allow vehicles to mount/access the carriageway crossing, and
ii) Contain the flow of stormwater runoff within the kerb-and-channel portion.

In order to achieve the above, the barrier kerb shall be dropped/lowered to a residual kerb-face height of 40mm for the low side of the road (measured from the invert of the channel) or 30mm for the high side of the road (measured from the road surface, where no channel is present).

Refer to Drawing RD2.1 (i.e. detail "*Type A*") for the dropped barrier kerb details.

Mountable (semi-mountable) Kerbs

Due to its nature/design, mountable kerbs do generally not require lowering for CWCs. However, there are instances where mountable kerbs requires modification, due to the provision of a CWC.

Where a mountable kerb includes a channel, it is generally supplied as a precast unit (e.g. CK5 kerb). Where such kerbs shall be modified, in order to accommodate a new carriageway crossing, the aim is to modify the kerbs without compromising or damaging the roadway. The aforementioned will involve the following:

i) Separate the "kerb" portion from the "channel" by saw cutting the unit, vertically, at the channel invert.
ii) Remove the "kerb" portion, while ensuring that the "channel" remains undisturbed/intact, and replace it with a barrier kerb, dropped to a vertical kerb-face height of 40mm, measured from the channel invert.

Refer to Drawing RD2.1 (i.e. detail "*Type B*") for the modification of mountable kerbs for carriageway crossings.

Where the mountable kerb and channel are two separate entities, the standalone kerb can simply be removed and replaced with the dropped barrier kerb (40mm vertical kerb-face height).

6.3.4 Gradients Across Carriageway Crossings

Refer to Drawings RD5.1 and RD5.2.

The section will focus on three scenarios, namely:

- Wide verge with pedestrian footway (verge > 2m)
- Wide and unmade verge (verge > 2m)
- Narrow verge (surfaced, unsurfaced or stabilised) (verge < 2m)

6.3.4.1 Barrier Kerbs

Where barrier kerbs are provided or present, the kerbs shall be dropped as described in Section 6.3.3 above and the gradients shall adhere to the requirement described hereafter.

For both low laying erven (i.e. erf situated lower than the adjacent roadway) and high laying erven (i.e. erf situated higher than the adjacent roadway), the carriageway crossing shall always have an upwards gradient (from the road edge towards the erf boundary) up to a certain point (specified below). Thereafter, the CWC gradient may change, in order to tie in with the adjacent erf. The aforementioned is required in order to contain the stormwater runoff of larger storms inside the road prism and subsequently prevent flooding of private properties.

High Laying Erven

Where an existing surfaced pedestrian footway is present with a wide verge, the following gradients shall be maintained over the carriageway crossing:

i) 2% or 1:50: Maximum gradient from back of kerb (BoK) up to back of footway (BoF), in order to accommodate the pedestrian footway.
ii) 8% or 1:12: Maximum gradient for vehicular ramps, provided from BoF to erf boundary, if used by pedestrians and vehicles.
iii) 10% or 1:10: Maximum gradient for vehicular ramps, provided from BoF to erf boundary, if used by vehicles only.
iv) Level at erf boundary shall not be lower than the "Full Height" level at BoF (Point "A").

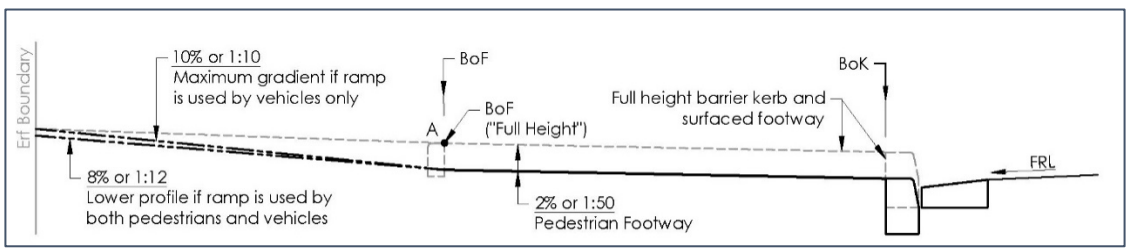


Figure 6-1: Gradients for CWC with a pedestrian footway (BK, wide verge, High Laying Erf)

In the absence of a surfaced pedestrian footway, the following cross slopes shall be maintained over the carriageway crossing, in order to accommodate pedestrian movements and perform a drainage function:

i) 2% or 1:50: Maximum gradient (incline towards the erf boundary) provided over a minimum width of 1.5m (up to Point "B") immediately adjacent to the back of kerb. The aforementioned allows for the safe passage of pedestrians and cyclists, driveway access without vehicles scraping and stormwater drainage.

ii) 8% or 1:12: Maximum gradient for vehicular ramps, provided from the above-mentioned 1.5m width (Point "B"), if used by pedestrians and vehicles.

iii) 10% or 1:10: Maximum gradient for vehicular ramps, provided from the abovementioned 1.5m width (Point "B") up to the erf boundary, if used by vehicles only.

iv) Level at erf boundary shall not be lower than the level at Point "C".

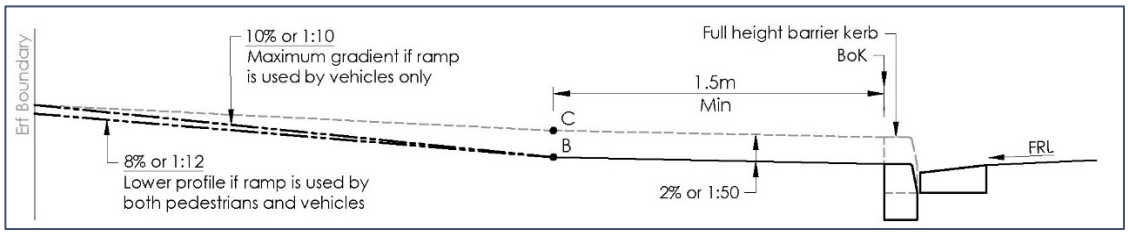


Figure 6-2: Gradient for CWC with unmade wide verge (BK, High Laying Erf)

Where a narrow verge is present (unsurfaced, surfaced or stabilised), the following cross slopes shall be maintained over the carriageway crossing, in order to perform a drainage function:

i) The level at the erf boundary shall be equal to the level at Point "D".

ii) The carriageway crossing slope will thus vary, in accordance with the roadway kerb type applied at road edge.

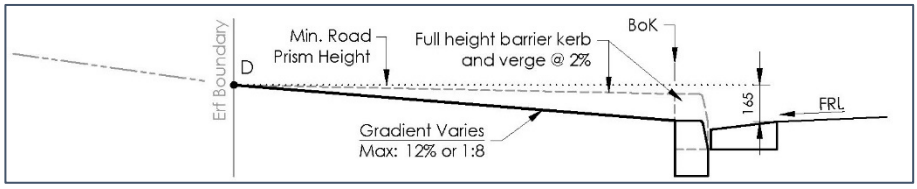


Figure 6-3: Gradients for CWC with narrow verge (BK, High Laying Erf)

Low Laying Erven

Where an existing surfaced pedestrian footway is present with a wide verge, the following gradients shall be maintained over the carriageway crossing:

i) 2% or 1:50: Maximum gradient from back of kerb (BoK) up to back of footway (BoF), in order to accommodate the pedestrian footway.

ii) 8% or 1:12: Maximum gradient for vehicular ramps, provided between BoF and erf boundary, up to the "Min Crest Height" (Point "B"), if used by pedestrians and vehicles.

iii) 10% or 1:10: Maximum gradient for vehicular ramps, provided between BoF and erf boundary, up to the "Min Crest Height" (Point "B"), if used by vehicles only.

iv) A 5% transition shall be provided between the change in gradients, in order to avoid undercarriage scraping.

v) The level at Point "B" shall never be lower than Point "A".

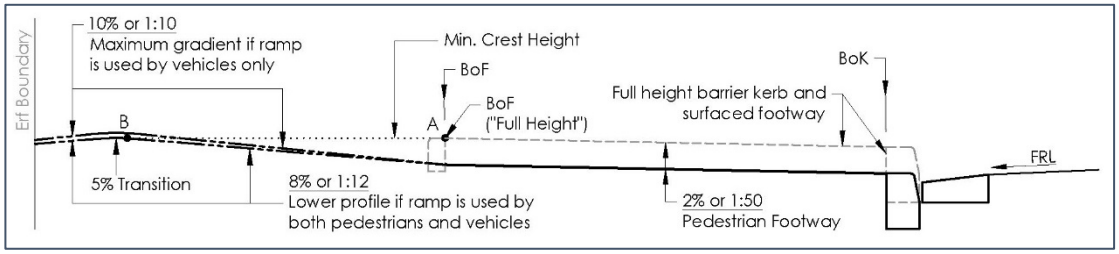


Figure 6-4: Gradients for CWC with a pedestrian footway (BK, Wide Verge, Low Laying Erf)

In the absence of a surfaced pedestrian footway, the following gradients shall be maintained over the carriageway crossing, in order to accommodate pedestrian movements and perform a drainage function:

i) 2% or 1:50: Maximum gradient (incline towards the erf boundary) provided over a minimum width of 1.5m (up to Point "C") immediately adjacent to the back of kerb. The aforementioned allows for the safe passage of pedestrians and cyclists, driveway access without vehicles scraping and stormwater drainage.

ii) 8% or 1:12: Maximum gradient for vehicular ramps, provided from the abovementioned 1.5m width (Point "C") up to the "Min. Crest Height" (Point "B"), if used by pedestrians and vehicles.

iii) 10% or 1:10: Maximum gradient for vehicular ramps, provided from the abovementioned 1.5m width (Point "C") up to the "Min. Crest Height" (Point "B"), if used by vehicles only.

iv) A 5% transition shall be provided between the change in slopes, in order to avoid undercarriage scraping.

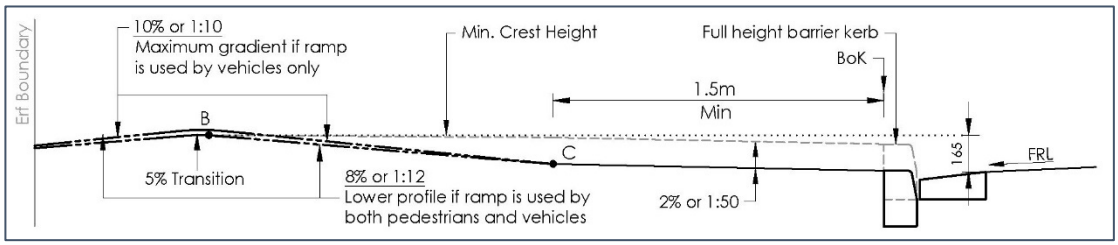


Figure 6-5: Gradients for CWC with an unmade wide verge (BK, Low Laying Erf)

Where a narrow verge is present (unsurfaced, surfaced or stabilised), the following gradient s shall be maintained over the carriageway crossing, in order to perform a drainage function:

i) The level at the erf boundary shall be equal to the "Full height" level at Point "D".

ii) The carriageway crossing gradient will thus vary, in accordance with the roadway kerb type applied at road edge.

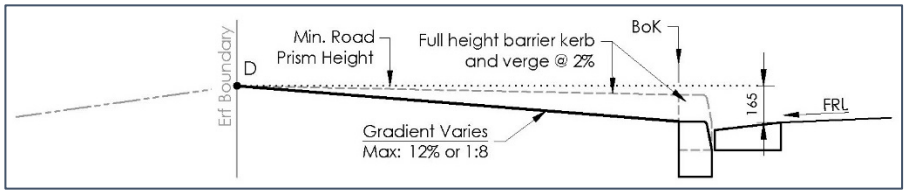


Figure 6-6: Gradients for CWC with narrow verge (BK, Low Laying Erf)

6.3.4.2 Mountable Kerbs

As described above, due to its nature/design, mountable kerbs do generally not require lowering for CWCs. The CWC shall therefore be constructed directly adjacent to the back of the mountable kerb.

Where a surface footway is present, the following shall be applicable:

i) The existing surfaced footway shall remain undisturbed.

ii) Incline provided from BoF (Point "A") towards erf boundary, up to the "Min. Road Prism Height" (Point "B"):

- Minimum: 2% or 1:50
- Maximum: 8% or 1:12 (if used by pedestrians and vehicles)
  10% or 1:10 (if used by vehicles only)

iii) For low laying erven, the provision of a vertical/transition curve might be required at Point "B", in order to avoid undercarriage scraping.

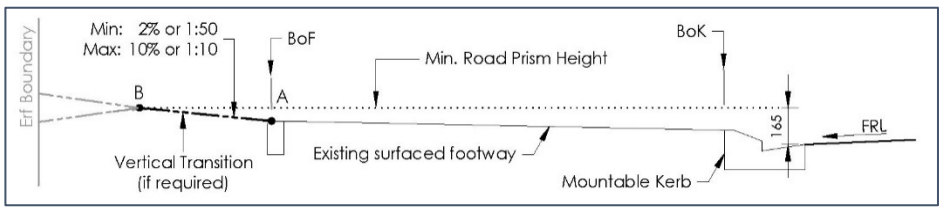


Figure 6-7: Gradients for CWC with a pedestrian footway (Mountable kerb, Wide verge)

In the absence of a surfaced pedestrian footway, the following gradients shall be maintained over the carriageway crossing, in order to accommodate pedestrian movements and perform a drainage function:

iv) 2% or 1:50: Maximum gradient (incline towards the erf boundary) provided over a minimum width of 1.5m (up to Point "C") immediately adjacent to the back of kerb. The aforementioned allows for the safe passage of pedestrians and cyclists, driveway access without vehicles scraping and stormwater drainage.

i) Incline provided from the abovementioned 1.5m width (Point "C") up to the "Min. Road Prism Height" (Point "B"):
- Minimum: 2% or 1:50
- Maximum: 8% or 1:12 (if used by pedestrians and vehicles)
  10% or 1:10 (if used by vehicles only)

v) For low laying erven, the provision of a vertical/transition curve might be required at Point "B".

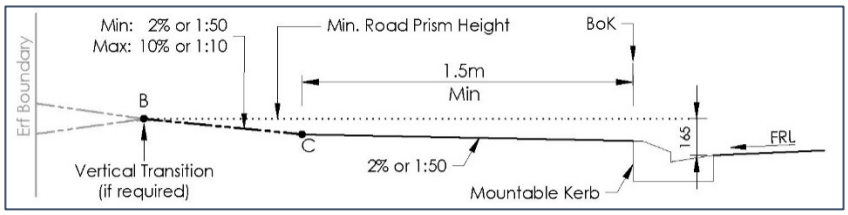


Figure 6-8: Gradients for CWC an unmade wide verge (Mountable kerb)

Where a narrow verge is present (unsurfaced, surfaced or stabilised), the following gradients shall be maintained over the carriageway crossing, in order to perform a drainage function:

i) Incline provided from the back of kerb (BoK) up to the erf boundary (Point "D"):
- Minimum: 2% or 1:50
- Maximum: 8% or 1:12 (if used by pedestrians and vehicles)
  10% or 1:10 (if used by vehicles only)

ii) The level at the erf boundary shall be equal to the level at Point "D".

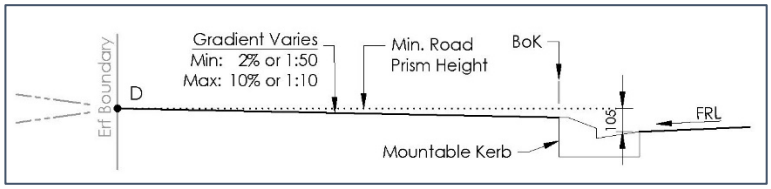


Figure 6-9: Gradients for CWC with narrow verge (Mountable kerb)

6.3.4.3 Roadway Edging

Where only a roadway edging is present along the road edge (i.e. no barrier or mountable kerbs), the CWC shall be constructed directly behind the back of the edging and the ramp shall adhere to the requirements below.

Where a wide verge is present, the following gradients shall be maintained over the carriageway crossing, in order to accommodate pedestrian movements and perform a drainage function:

i) 2% or 1:50: Maximum slope (incline towards the erf boundary) provided over a minimum width of 1.5m (up to Point "A") immediately adjacent to the back of edging. The aforementioned allows for the safe passage of pedestrians and cyclists, driveway access without vehicles scraping and stormwater drainage.

ii) Incline provided from the abovementioned 1.5m width (Point "A") up to the "Min. Road Prism Height" (Point "B"):
- Minimum: 2% or 1:50
- Maximum: 8% or 1:12 (if used by pedestrians and vehicles)
  10% or 1:10 (if used by vehicles only)

iii) For low laying erven, the provision of a vertical/transition curve might be required at Point "B".

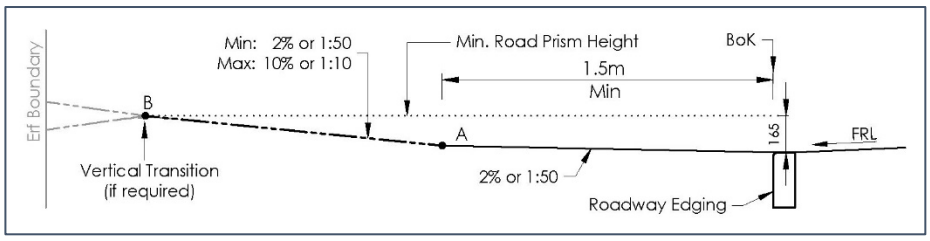


Figure 6-10: Gradients for CWC with wide verge (Roadway edging)

Where a narrow verge is present (unsurfaced, surfaced or stabilised), the following gradients shall be maintained over the carriageway crossing, in order to perform a drainage function:

i) 2% or 1:50 (Minimum) to 10% or 1:10 (Maximum): Incline provided from the back of edging up to the erf boundary (Point "C").

ii) The level at the erf boundary shall be equal to the level at Point "C".

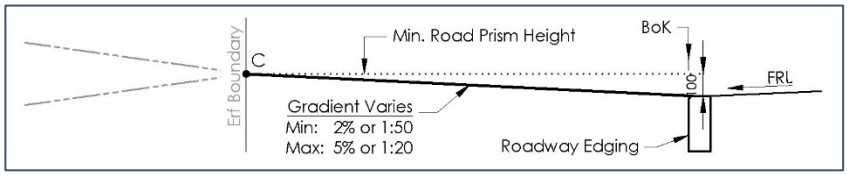


Figure 6-11: Gradients for CWC with narrow verge (Roadway edging)

In the instance where no road edge restraint is present, a roadway edging shall be provided behind the road edge. Thereafter, the same principles shall be followed as described above.

6.3.4.4 General

In order to avoid scraping of vehicles, the following shall be noted:

i) Neither the change in grade between the carriageway crossing and the road, nor the grade between the carriageway crossing and the private driveway, may exceed 17%. Adherence to this should ensure that most vehicles will not experience scraping when using CWC's.

ii) Designers should use a South African passenger vehicle with an undercarriage clearance of 130mm in order to determine whether the vehicle will scrape or not. However, the design clearance should not be less than 50mm between the undercarriage of the vehicle and the surface.

6.3.5 Other design considerations

Further to the above, the following shall be taken into consideration:

i) A minimum cross slope of 1% is required for surface drainage beyond the back of footway or the required 1.5m wide space (as described above).
ii) Surfaces shall be skid resistant, even during wet conditions.
iii) Ramps across drainage channels are not allowed.
iv) Access restrictions on certain road classes, or sections of road, shall apply.
v) The necessary sight distance (sight triangles) shall be achieved. This is particularly crucial at CWC's which will serve high volumes of vehicles. Refer to Section 2.4.8 for further information.
vi) The distance/spacing of a carriageway crossing from an intersection shall comply with the City's DMS. The minimum spacing, based on the prolongation of the street boundaries, is 15m for industrial-zoned erven and 10m for any other erven. Refer to **Figure 2-1** in Section 2.4.7 for a visual illustration.

6.4 Service Ducts

Provision shall be made for the installation of ducts under new carriageway crossings. The aforementioned will accommodate potential future services, without breaking up the carriageway crossing layerworks. The provision of ducts is especially important where a stabilised base layer or in-situ concrete surface layer is present.

The following shall be noted regarding ducts under carriageway crossings:

i) The ducts shall be uPVC (unless required otherwise), including end caps and draw wires.
ii) The ducts shall extend 1m beyond the side edging (on either side).
iii) A minimum of two (2) ducts shall be provided, with a minimum diameter of 160mm. The number of ducts, including the size thereof, to be confirmed with the Approval Authority.
iv) Ducts shall be installed below the CWC layer works, subject to a minimum cover of 800mm.
v) If a surfaced footway is present, the ducts shall be installed minimum 300mm behind the footway.

Ducts markings shall be provided on the side edging, by cutting vertical lines equal to the amount of ducts installed.

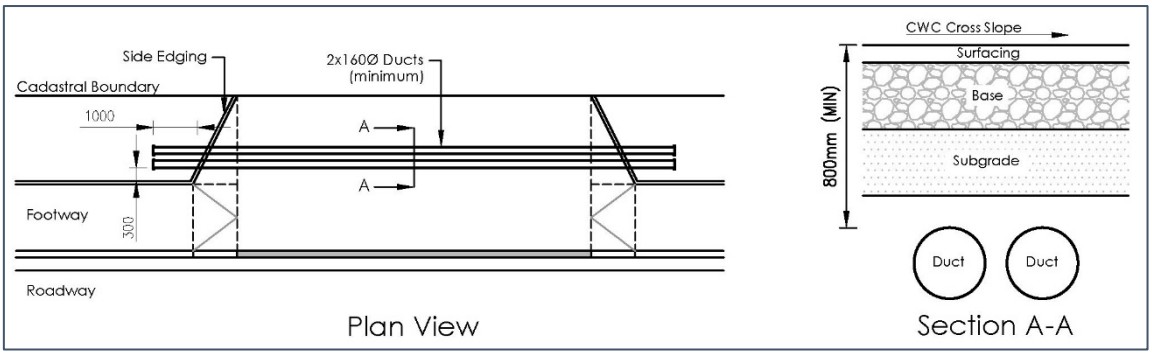


Figure 6-12: Position of Ducts under Carriageway Crossings

Table 6-1: Typical Guidelines and Specifications for Carriageway Crossings

CARRIAGEWAY REQUIREMENTS							
CWC DUTY	**LIGHT**		**MEDIUM**		**HIGH**		
CWC USAGE	**Normal Single Residential erven**		**Residential Flats, Place of worship, schools, etc.**		**Warehouse, Industrial, Commercial, Service Station, Service Station, loading area.**		
SURFACE TYPE	**Asphalt**	**Pavers**	**Asphalt**	**Pavers**	**Asphalt**	**Pavers**	**Concrete**
EDGE RESTRAINTS	"E1" precast concrete edging (150 x 75 mm)				"E3" precast concrete Edging (250 x 100mm)		
TYPICAL LAYERWORKS [1]	30mm AC 150mm G4 150mm G7	***Concrete*** 60mm Pavers 20mm Sand 150mm C4 150mm G7 or ***Clay*** 50mm Pavers 20mm Sand 150mm C4 150mm G7	40mm AC 150mm G4 150mm G7	***Concrete*** 70mm Pavers 20mm Sand 150mm C4 150mm G7 or ***Clay*** 60mm Pavers 20mm Sand 150mm C4 150mm G7	40mm AC 150mm G3 150mm C4 150mm G7	***Concrete*** 80mm Pavers 20mm Sand 150mm C4 150mm G7	150mm JCP 150mm C3 150mm G5 150mm G7
CLAY PRESENT	150mm		+ 300mm		+ 300mm		
Where clay material is encountered, an additional sand layer shall be constructed, as per the thickness specified above							

MATERIAL SPECIFICATIONS				
MATERIAL REQUIREMENTS	**Layer**	**Class/Type**	**Minimum Compaction**	**Minimum Strength Specifications**
	Asphalt	COLTO Type, CCC, Residential Mix	93% MVD	-
	Base	G3 – Crushed Stone G4 – Crushed Stone	98% MDD 98% MDD	CBR:80 CBR:80
	Subbase	G5 – Crushed Stone C3 – Cement Stabilised subbase C4 – Cement Stabilised subbase	95% MDD 97% MDD 96% MDD	CBR:45 UCS = 1.5 to 3MPa, ITS = 250KPa UCS = 0.75 to 1.5MPa, ITS = 200KPa
	Selected Layer	G7 – In-situ or Imported Sand	93% MDD 100% MDD	CBR:15 CBR:15
SURFACE TYPE NOTES	**Asphalt** • 30mm Thickness shall be COLTO Fine Graded **or** Residential Mix (50/70 Pen Grade Binder) • 40mm thickness shall be COLTO Medium Graded **or** CCC (50/70 Pen Grade Binder) **Concrete Pavers** • Light Duty : Class 30/2.0. Full, Partial or No interlocking. • Medium Duty : Class 30/2.0. Full interlocking or Partial Interlocking. • Heavy Duty : Class 40/2.6. Full interlocking. **Clay Pavers** • Class PA **or** PB pavers. **Concrete** • Compressive Strength = 35MPa, Flexural Strength = 4.2MPa			

[1] *Layerworks are provided as a guide. The layerworks should take into consideration the class of the adjacent roadway.*

Material Notes

AC = Asphalt Surfacing | JCP = Jointed Concrete Pavement
ITS = Indirect Tensile Strength
MDD = Compaction as per Maximum Dry Density (Mod AASHTO)
MVD = Compaction as per TMH1, method C4 (Max Voidless density) (Rice)
UCS = Unconfined Compressive Strength
The standard for Base (G4, G3) and Subbase (G5) shall be in accordance with the TRH 14.

Refer to **Chapter 8** for full pavement and material specifications and requirements.

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CHAPTER 7

PARKING

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PARKING 7: PARKING

7.1 General

This section covers some basic parking layout design guidelines.

For new commercial developments, parking shall be provided in terms of the Development Management Scheme.

Parking areas shall have a pavement structure for a U4-C category road, as specified in Chapter 8 of this document. For areas which are also used by heavy vehicles (e.g. loading areas), the pavement structure should be designed to accommodate such loadings. Refer to Table 8-11 for further details.

7.2 Relevant Codes of Practice, Policies and Guidelines

The list below contains, among others, the relevant codes of practice, policies and guidelines regarding parking:

i) CCT: Development Management Scheme

ii) City of Cape Town Parking Standards, Cape Institute for Architecture, 22 September 2017, Newsflash.

7.3 Parking Dimensions

The recommended dimensions for angled and parallel parking layouts are indicated in the table below. However, it is still the designer's responsibility to ensure that the required movements of the design vehicle can be accommodated in the proposed parking layout.

Table 7-1: Dimensions for angled and parallel parking layouts.

Angled Parking					
Parking Angle 'Φ'	Bay Length [1] 'BL'	Bay Width 'BW'	End Bay Width 'EBW'	Aisle Widths	
				2-way	1-way
90°	5.0m	2.5m	2.9m	7.5m (7.0m min)	7.5m (7.0m min)
60° Non-interlocking	5.3m	2.5m	2.9m	5.4m (5.2m min)	4.4m
60° interlocking	4.8m	2.5m	2.9m	5.4m	4.4m
45° Non-interlocking	4.9m	2.5m	2.9m	5.2m	4.4m
45° interlocking	4.2m	2.5m	2.9m	5.2m	4.4m
Parallel Parking					
Type	**Bay Length [4] 'BL'**		**End Bay Length 'EBL'**	**Bay Width 'BW'**	
Parallel	6.0m		5.0m [3]	2.2m / 2.5m [2]	
Kerb-side Embayment	6.0m		6.0m	2.2m / 2.5m [2]	

[1] *Measured perpendicular to kerbline*

[2] *2.5m = 2.2m bay width + 300mm additional space (measure to kerb face of roadway or edge of traffic lane) to allow the driver and occupants of the vehicle to safely enter or leave the vehicle.*

[3] *If end bay is adjacent to motor cycle bays, the length shall be increased to 6m.*

[4] *Measured parallel to kerbline*

The above parking requirements are illustrated in **Figure 7-1**. For full parking layouts, with complete dimensions, refer to drawing series RD9.

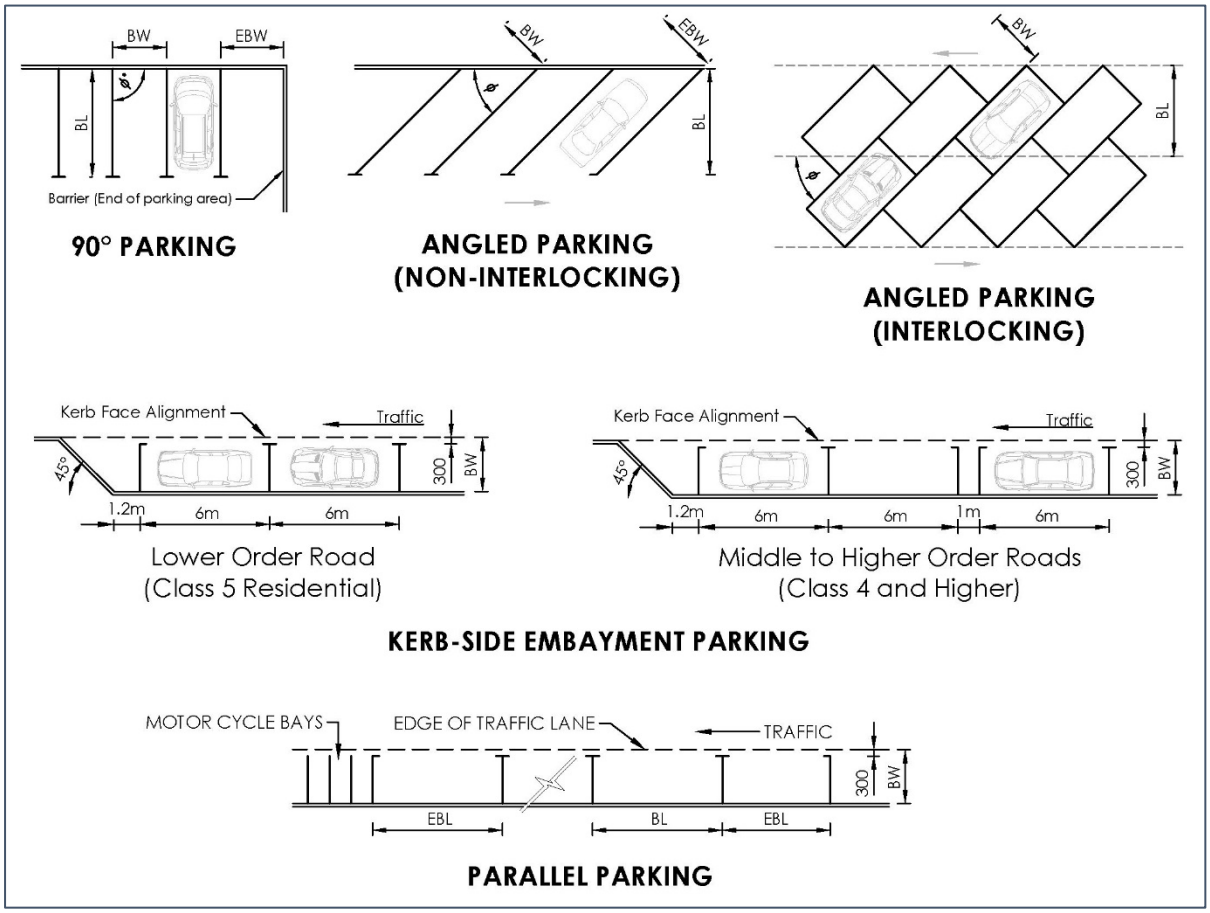


Figure 7-1: Dimensions for angled and parallel parking layout

7.4 Parking Areas

7.4.1 Parking Layout

The following shall be considered when designing parking layouts:

i) The recommended parking layout is 90° bays, with two-way movement in aisles.

ii) Parking layouts shall be designed that all bays can be entered or exited without difficulty. To achieve this, additional clearance space beyond end-bays may be required, to allow turning movements.

iii) Kerbs in parking areas should never be higher than 150mm.

iv) The use of bollards in parking areas should be avoided.

v) Parking bays shall, as far as possible, never be allowed to abut vertical structures, such as walls. Should the aforementioned, for whatever reason, be unavoidable, the width of the bay abutting said structure shall be sufficiently widened, in order to accommodate the opening movement of the parked vehicle.

vi) A minimum 1.5m-wide surfaced footway shall be provided between the parking bay and structure.

7.4.2 Safety

Parking areas should be designed to provide a safe environment for all its users.

The following safety consideration shall be noted:

i) The layout shall minimize vehicular and pedestrian conflicts.

ii) Careful consideration shall be given to the placement of poles, trees, and columns.

iii) Safe pedestrian pathways shall be provided along pedestrian desire lines.

iv) Adequate lighting shall be provided.

v) Vertical clearances shall be adequate for pedestrians and cyclists.

vi) To avoid sight distance restrictions, careful consideration shall be given to the location of street furniture.

7.4.3 Facilities for persons with disabilities

Adequate parking provisions, near entrances, shall be made for people with disabilities. Such parking bays shall be 3.7m wide, to allow easy wheelchair access between parked vehicles. Kerbs at these aisles shall be dropped/lowered, with the top of the kerb flush with the road surface. Disabled parking bays, including access aisles, should be located on a level surfaces, as far as possible.

The dimensions for special facilities is contained in SANS 10400-S, *The Application of the National Building Regulations, Part S: Facilities for persons with disabilities*.

Parking bays for people with disabilities shall be clearly marked, as prescribed by the SARTSM (Volume 2, page 14.5.2).

7.4.4 Landscape Elements

Landscaping is an important element of a parking area. A well-designed parking area, shaded by trees, screened by hedges, shrubs or grassed mounds provides relief from the expanses of a featureless paved area. The following design principles should be adopted:

i) All planting areas shall be contained within kerbs;
ii) Choose appropriate ground surfaces around trees and open areas. These could include mulch, natural gravel, porous paving, groundcover plants and grass. Grassed surface areas should not be steeper than 1:4. Loose stone beds are not permissible as a surfacing medium.
iii) Pedestrian routes need to be carefully planned, e.g. make provision for paths through garden beds. A vertical clearance of at least 2.2m (2.5m preferred) over the entire width of all pedestrian ways is required.
iv) The layout of street lighting and street planting shall be co-ordinated, in order to avoid the creation of poorly lit ("dark") areas.
v) Shrubs or trees shall not be planted closer than 800mm from a kerb, in order to avoid damage from vehicle overhang.
vi) Appropriate shrubs and trees shall be selected, in order to reduce maintenance and irrigation.
vii) The use of brick or concrete pavers, or any other type of surface treatment, may be considered to improve aesthetics in parking areas. However, the aforementioned should be discussed with the approval authority.

Section 4.4.2 of this document can also be consulted, which provides information with regard to "Landscaping in Road Reserves".

7.5 Parallel Parking Embayments

Where parallel parking embayments are provided and a drainage channel is required between the embayment and the adjacent road, the following will be applicable:

- The use of double-flat channels ("v-channel") is not allowed.
- A combination channel and dropped barrier kerb shall be constructed, with a 40mm vertical face height on the barrier kerb.

The figure below provides a typical representation of parallel parking embayment. Refer to Drawing RD8.1 for further details.

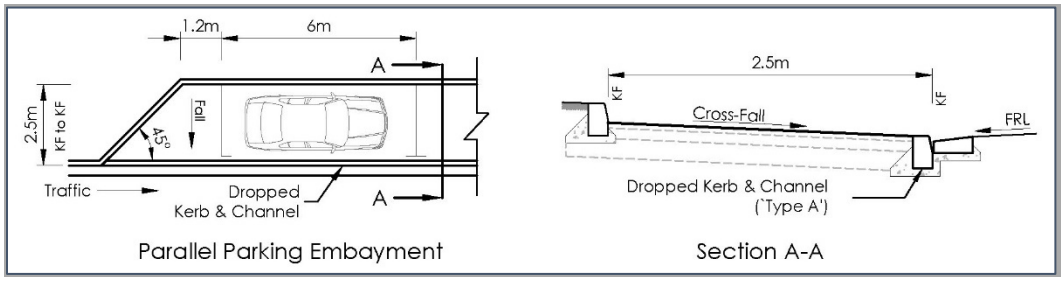


Figure 7-2: Parallel Parking Embayment

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CHAPTER 8

PAVEMENT DESIGN

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CHAPTER 8: PAVEMENT DESIGN

8.1 General

Pavement design is a process of selecting appropriate pavement and surfacing layers to ensure that the pavement will carry the traffic for the structural design period, at an acceptable level of service, without any major structural distress.

Designers should base their design on a life cycle strategy, comprising of high initial standards, followed by very low or minimal maintenance needs over the analysis period.

Designs should be based on actual traffic counts or predictions in terms of Equivalent 80 kN Standard axle loads. Designers shall be able to show, through proper designs, how they have decided on their recommended pavement structure and shall not just use the catalogue of minimum standards provided in this document to choose a pavement structure. Submissions without proper traffic and pavement design calculations as backup will not be accepted.

8.2 Relevant Codes of Practice, Policies and Guidelines

The list below contains, among others, the relevant codes of practice, policies and guidelines regarding pavement design. Designers shall ensure that the latest version is used, as these are updated from time to time:

i) Interim Guideline for the design of Hot Mix Asphalt in South Africa, 2001.
ii) SANS 1058 – Concrete Paving Blocks;
iii) SANS 1575 – Burnt Clay Paving Units;
iv) SABITA, Manual 35/TR8, Rev. Second Edition, February 2020 – Design and use of Asphalt in Road Pavements;
v) SABITA, TG 1, Fourth Edition, January 2019 – Technical Guide: The Use of Modified Bituminous Binder in Road Construction;
vi) SABITA, TG 2, Second Edition, May 2009 – Technical Guideline: Bitumen Stabilised Materials;
vii) SANRAL, South African Pavement Engineering Manual (SAPEM) – Chapter 10 Pavement Design, Second Edition, October 2014.
viii) The Neighbourhood Planning and Design Guide ("Red Book"), 2019.
ix) TRH 4 – Structural Design of Flexible Pavements for Inter-urban and Rural Roads;
x) TRH 14 – Guidelines for Road Construction Materials.

8.3 Pavement structures

Road pavements are generally classified into two categories, namely surfaced and unsurfaced. Surfaced pavements are further sub-categorised as flexible, semi-rigid (block) and rigid, while gravel roads are regarded as having an unsurfaced pavement. This document only covers surfaced pavements.

A brief description of the aforementioned are provided below (as derived from the *Red Book Chapter I*) and illustrated in **Figure 8-1**. Designers can refer to the *Red Book 2019* or *SAPEM: Chapter 10* for further information and details regarding surfaced pavements.

Flexible Pavements

Flexible pavements are usually designed in such a way that the material quality gradually and smoothly increases from the in-situ subgrade up to the structural layers and surfacing to form a well-balanced pavement structure. Alternatively, a granular base may be placed on a stronger, lightly cemented subbase to form an inverted pavement structure.

The different types of flexible pavements commonly used, with reference to the material in the base layer, are as follows:

- Unbound granular,
- Hot mix asphalt,
- Bitumen stabilised layer,
- Cemented stabilised layer.

Block Pavements (Semi-rigid Pavements)

Semi-rigid pavements consist of constructed block or segmented paving. Sand is placed in the joints between the blocks to fill the gaps, enhance interlocking between the blocks and enhance load transfer between blocks. The block system provides a durable wearing course, supported by subbase and selected layers, of which the thickness depends on the applied loading and subgrade strength.

Rigid Pavements

Concrete roads, also referred to as rigid pavements, are particularly strong and have a very high modulus of elasticity. This results in great load spreading in the top layer and hence low stresses in the underlying sub-structure. Concrete pavements can be constructed on poor subgrades, and generally have fewer pavement layers than flexible pavements.

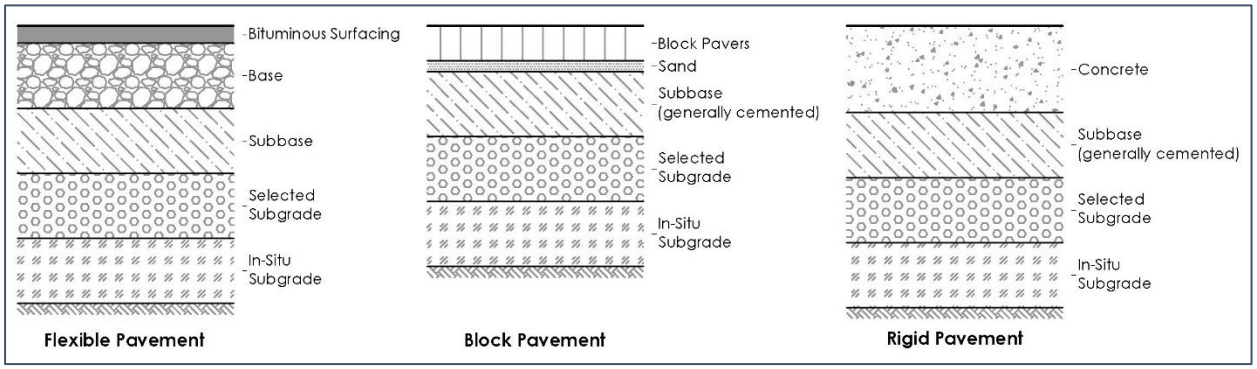


Figure 8-1: Pavement Structures

8.4 Protection of the Road Pavement

Mole Barriers

In areas where mole or mole-rat activity is evident, and where open, unhardened space along a road is going to be a permanent or semi-permanent feature, the installation of mole barriers will be required to protect the road pavement layers. Materials used for mole barriers shall be environmentally acceptable. Mole barriers shall be placed in such a way that there is no gap between these and the road pavement structure.

Where subsurface drains are provided (typically installed directly behind the roadway kerb), with no NMT facilities present, the mole barrier shall be placed behind/outside the subsurface drain.

Where NMT facilities are present, the mole barrier shall be placed behind the NMT facility, in order to provide protection to the aforementioned infrastructure as well.

Refer to Drawing RD14 for the typical mole barrier installation details.

Subsurface Drainage

In areas where a high water table exists, especially during the rainy season, sufficient subsurface drainage shall be provided to protect the pavement layers against ingress of water.

Refer to Drawing SW1.1 for the typical subsurface drainage installation details.

8.5 Pavement Design

8.5.1 Level of Service

The level of service should be related to the function of the street. A higher order, or a road of high importance, should have a higher level of service. The road's physical properties and standards should be higher, with a reduced risk of failure. It is therefore of utmost importance that every road pavement has to be designed according to conditions applicable.

For all formal roads within the City of Cape Town, a basic minimum level of service (LOS) of 5, as per Table I.4 of the "*Red Book*", is required, unless such roadways forms part of interim measures, where only rudimentary services are provided. Formal roadways, with open lined stormwater channels, are generally not acceptable, because of the windblown sand and litter problems.

8.5.2 Minimum Pavement Design Guidelines

Where possible, designers shall base their design on the estimated equivalent E80s over the design period. A minimum pavement catalogue guideline, as given in Table 8-11 at the end of this chapter, shall apply for road categories U2-B, U3-B, U4-C U5-D and U6-E, as defined in Chapter I of the "*Red Book*".

The structural design periods for all road categories shall be 20 years.

The table below provides a summary of the various road categories, pavement classes, road classes and approximate design reliabilities.

Table 8-1: Road Categories, Pavement Classes, Road Classifications & Reliabilities

Road Category [1]	Road Classification	Pavement Class	Design Reliability (Approx.)
U1-A	Class 1: *Principal Arterial*	ES10 - ES100	95%
U2-B	Class 2: *Major Arterial*	ES1- ES10	90%
U3-B	Class 3: *Minor Arterial*	ES1- ES10	90%
U4-C	Class 4: Collector	ES0.003 - ES3	80%
U5-D	Class 5: Local Street	ES0.003 - ES1	60% [2]

[1] *Adopted from Red Book (which is a combination of the THR4 and TRH26)*
[2] *Adopted from UTG3.*

8.6 Material Specifications and Utilisation

8.6.1 Bituminous Surface and Base Treatments

8.6.1.1 Asphalt Utilisation

The minimum compacted thickness of asphalt surfacing, including the permitted mix types, for various scenarios are given ion the table below.

Table 8-2: Minimum Asphalt Surfacing Thickness and Mix Type Use

Use	Min. Thickness	Mix Type
Roadways	40mm	COLTO Medium, CCC and Residential Mix
NMT Facilities & other	30mm	COLTO Fine

8.6.1.2 Asphalt Specifications

Unless there are specific asphalt functionality requirements that require specialised asphalt design, all bituminous surface treatments shall be in the form of continuous graded, Hot Mix Asphalt.

For any roads within the City, which the City will take ownership of, the following standards and requirements shall be adhered to:

1) No asphalt mixes (surfacing or bases) specified in terms of SANS 1200M will be accepted.
2) Where COLTO mixes are specified, the COLTO specifications shall be adhered to.
3) The use of natural sand shall only be permitted in CCC Type surfacing mixes, provided they still meet the performance criteria.
4) Mix requirements shall be met, regardless of binder type being used.
5) Binder type shall be appropriately selected for the applicable traffic conditions and abutting land uses (e.g. grey water)
6) Binder type(s) shall be clearly specified in the Specifications, Drawings and Bill of Quantities in terms of *Sabita: TG1*. E.g.:
   - Penetration Grade Binders: 70/100, 50/70, 35/50, or
   - Modified binders: A-E2, A-P1, A-R1, A-R2, A-H2.
7) Nominal Mix proportions to be used for tender purposes only and may vary with final approved mix design.

8) All sieve sizes shall be reported in terms of SANS 3001 and not in terms of TMH 1.
9) Standard/Typical cross sections shall fully specify the thickness, the type of asphalt and the binder type. E.g.:
   - *40mm Medium Continuously Graded Asphalt Surfacing (COLTO Type, 50/70 Bitumen*)
10) Irrespective of the recipe mixes, every asphalt used on roads operated by the City, shall comply with a mix design, supplied by the asphalt supplier and approved by the engineer.
11) No asphalt will be accepted by the City, without proof from an independent laboratory that the asphalt placed is in accordance with the approved mix design and that compaction has been achieved in accordance with the specification.

Any deviation from the above-mentioned standard mix types shall only be allowed with the approval of the *Director: Roads Infrastructure Management*. It shall be noted that the City reserves the right to reject any asphalt that does not conform to the above standards.

The various gradings, mix proportions and mix requirements for the above-mentioned asphalt mix types are provided **Table 8-3** and **Table 8-4**.

Table 8-3: Grading Limits for Combined Aggregate and Mix Proportions

	Sieve size (mm)	Continuously Graded						
		Asphalt Bases		Asphalt Surfacing				
		COLTO	CCC	CCC MEDIUM	COLTO MEDIUM	Residential Mix (10mm)	Bitumen-Rubber [1]	COLTO FINE
		28mm Max		14mm Max				
Percentage Passing (by mass)	28	100	100	-	-	-	-	-
	20	87 - 96	85 -100	-	-	-	-	-
	14	7 3 - 85	73 - 91	100	100	100	100	100
	10	64 - 79	-	83 - 91	84 - 1 00	84 - 100	83 – 100	100
	7	-	-	71 - 7 9	-	67 - 88	-	-
	5	43 - 61	43 - 64	60 - 68	56 - 77	55 - 76	53 – 72	66 – 89
	2	28 – 44	2 7 - 45	37 - 43	33- 48	35 - 52	30 – 47	42 – 56
	1	20 - 35	-	28 - 34	25 - 40	24- 39	-	33 – 53
	0,6	15 - 30	16 - 31	21 - 27	18 - 32	18 - 32	13 – 25	24 – 40
	0,3	11 - 24	-	13 - 17	11 - 23	11 - 23	8 – 18	16 – 28
	0,15	8 – 19	8 - 21	7 - 11	7 - 16	7 - 16	-	10 – 20
	0,075	5 – 12	5 - 16	5,8 - 7,8	4 - 10	4 - 10	4 – 8	4 – 12
Nominal Mix Proportions by mass	Aggregate	94 ,5%	94,75%	94,2%	93,5%	93.4%	92.0%	93.0%
	Binder	4,5%	4,25%	4,8%	5.5%	5.6%	7.0% [2]	6.0%
	Active Filler: Hydrated lime	-	-	1.0%	1.0%	1.0%	-	1.0%
	Active Filler: Cement	-	-	-	-	-	1.0%	-

All mixes are Continuously Graded

[1] Non-Homogeneous Modified Binder (Bitumen – Rubber)

[2] Modified Binder: A-R1 or A-R2.

Table 8-4: Asphalt Mix Requirements (Base and Surfacing)

Property	Unit	Base Mixes	Surfacing Mixes		
			COLTO Medium/ CCC	COLTO Fine/ Residential	Bitumen Rubber (AR-1 or A-R2)
Marshall Stability	kN	8- 18	8 - 18	8-18	>8
Marshall Flow	mm	2 - 6	2 - 6	2 - 6	2-5
Stability /Flow	kN/mm	>2,5	> 2,5	>2,5	>2.5
VMA	%	> 14	>15	>15	>15
VFB	%	65- 75	65-75	65-75	65 - 75
Air voids	%	4 - 6	4 - 6	3 - 5	2-6
Indirect tensile strength @ 25°C	kPa	> 1000	> 1000	>800	>650
Dynamic Creep Modules @ 40°C	MPa	> 20	> 20	>15	> 15
Modified Lottmann @ 7% Voids	TSR	> 0,7	> 0, 8	>0,8	> 0.75
Air permeability @ 7% voids	cm^2	< $1x10^{-8}$	< $1x10^{-8}$	< $1x10^{-8}$	< $1x10^{-8}$
Binder film thickness	microns	5,5 - 8,0	5,5 - 8,0	5.5 - 8,0	>15
Filler bitumen ratio		1 - 1,5	1 - 1,5	1-1,5	0.8-1.5
Immersion index	%	>75	>75	>75	>75
MMLS Rutting (100k repetitions, 93% Rice briquette, 50°c , 7200rep/hr)	mm	< 2.3	< 2.0	n/a	< 2.0
Voids in mix (300 gyrations of The Superpave Gyratory Compactor)	%	> 2.0	> 2.5	n/a	> 2.0

All mixes are Continuously Graded

8.6.1.3 Modified Bituminous Binders

Continuously graded asphalts produced with aggregate from the Tygerberg formation of the Malmesbury group (in asphalt mix design, termed "hornfels" and occasionally "greywacke") harden prematurely due to the absorption by the aggregate of oils from the bitumen. To counter this hardening, it is recommended that continuously graded medium asphalts are specified with A-E2 modified bituminous binder.

Where roads are expected to experience or be subject to severe traffic conditions, the utilisation of modified bituminous binders is recommended. Such conditions include, but are not limited to, the following:

- Steep roads/terrains.
- High occurrence of heavy traffic loadings.
- Heavy traffic loadings at low speeds, e.g. "crawl/climb lanes", approaches to intersections (i.e. braking, acceleration and deceleration zones), etc.
- High incident of turning movements (i.e. at intersections).

Binders are modified by the introduction of polymers (elastomers and plastomers), in order to enhance the performance of the bituminous layer by providing improved durability, flexibility, resilience and stiffness. Two of the primary objectives of modified binders is to increase the resistance to permanent deformation (rutting) and improve fatigue resistance of the layers.

Each type of modifying agent provides unique improvement in the bitumen. The type of modified binder shall therefore be carefully selected, based on the intended purpose (i.e. traffic conditions). Modified binders shall be specified in terms of Sabita: TG1.

8.6.1.4 Moisture Insensitive Pavements (Grey Water)

Studies have shown that grey water runoff contribute to the failure of the bituminous surface and underlying pavement layers. Grey water contributes to an increased deterioration of the bituminous layer, which consequently leads to in an ingress of moisture to the underlying layers. The aforementioned will result in an overall accelerated pavement deterioration, especially in the case of granular of crushed stone bases.

It is therefore recommended that, if there is a high likelihood that roads may be exposed to grey water runoff, such pavement designs shall be adapted to provide a moisture insensitive pavement structure. Refer to Table 8-11 for proposed moisture insensitive pavement options.

8.6.1.5 Fuel Spillages

Bituminous surfaces are susceptible to damage from fuel spillages, such as diesel and petrol, including solvents. The aforementioned spillages are most likely to occur at busy intersections, bus depots and climbing lanes.

At locations where there is a high risk of fuel spillages, modified binders, with improved fuel resistant properties to bituminous surfaces, should be used. Such modified binders include, for example, the A-P1 modified binder, which is modified with EVA (Ethylene-Vinyl-Acetate).

8.6.1.6 Compaction Requirements

Asphalt surfacing and BTB placed within roadways shall be spread with a self-propelled mechanical spreader (paver). Instances where the application of the aforementioned becomes impractical (i.e. narrow trench reinstatements or road patches), the asphalt surfacing and BTB may be placed by hand.

Asphalt surfacing on areas outside of roadways (i.e. footways, medians and splitter islands, etc.) may also be placed by hand.

Jumping compactor (a.k.a. "jumper", "jolly jumper" or "jumping jack" compactor) shall not be used for the compaction of asphalt surfacing or BTB.

The table below provides a summary of the minimum compaction specifications for asphalt surfacing and base layers.

Table 8-5: Asphalt Surfacing and Base Compaction Specifications

Description	Type	Minimum Specification	
		Measurement Type	Value
Asphalt Surfacing	Continuously Graded	Compaction (Max Voidless Density)	93% [1]
Bituminous Treated Base (BTB)			93% [2]

[1] Compaction for Asphalt Surfacing shall not exceed 96% MVD
[2] Compaction for BTB shall not exceed 96.5% MVD

8.6.2 Segmented Block Paving

8.6.2.1 Classification and Requirements

The two types of block paving surfaces allowed in the City of Cape Town are concrete and clay. The pavers shall adhere to the following requirements:

Table 8-6: Concrete and Clay Paver Specifications

Attribute	Paver Type				
	Concrete			Clay	
Class	30/2.0		40/2.6	PA [3]	PB
Type	Bond[4]	Full Interlocking (*all sides*)		-	
Strength[1]	Comp: 30MPa Tens: 2.0MPa		Comp: 40MPa Tens: 2.6MPa	MoR: 4MPa	MoR: 3MPa
Thickness[2]	50mm	60-80mm	80mm	50mm	50mm

SANS adherence: Concrete Pavers = SANS 1058 | Clay = SANS 1575
[1] Comp = Compressive Strength | Tens = Nominal Tensile Splitting Strength | MoR = Modulus of Rupture
[2] Minimum thickness that will be considered
[3] PA blocks have high degree of uniformity (length-to-width ratio of 1:1; 2:1 or 3:1) and stringent tolerances
[4] Bond pavers may be bevelled

8.6.2.2 Utilisation

The table below indicates the recommended utilisations of block paving for different scenarios. Any deviation from the below shall be discussed with the Approval Authority.

Table 8-7: Utilisation of Block Paving

Paver	Concrete			Clay	
Class	30/2.0		40/2.6	PA	PB
Type	Bond	Full interlocking	Full interlocking	-	-
Min. Thickness	50mm	60/80mm	80mm	50mm	50mm
Roads: Class 2 & 3			x		
Roads: Class 4		x	x		
Roads: Class 5A			x		
Roads: Class 5B-D		x	x		
NMT Facilities	x	x	x	x	x
Median & Splitter Islands	x	x	x	x	x
Hard Landscaping	x	x		x	x

The provision of block paving in in areas where there is a high likelihood of theft shall be discussed with the Approval Authority.

Where alternative paving blocks are proposed, it shall be discussed with the Approval Authority, in order to ascertain whether the City will be able to maintain the asset. Should alternative paving blocks be approved, the-following shall be applicable:

- The surface roughness of pavers shall be adequate, in order to ensure sufficient skid resistance in all weather conditions.
- The pavers shall have a level surface finish, in order to accommodate people with disabilities.
- In instances where there is no formal maintenance agreement between the City and the Developer, the City will endeavour, but shall not be obliged, to use the same or similar materials for future maintenance.

8.6.3 Concrete

Unless approved otherwise, concrete layers shall adhere to the following:

Table 8-8: Concrete Specifications

Description	Type	Minimum Strength Specification
Concrete	JCP/CRCP [1]	Compressive: 35MPa | Flexural: 4.2MPa

[1] JCP = Jointed Concrete Pavement | CRCP = Continuously Reinforced Concrete Pavement

8.6.4 Subgrade Bearing Capacity

The bearing capacity and quality of the in-situ subgrade or fill material is very important in the selection of the appropriate pavement layers. Designers should conduct a proper soil survey to determine the California Bearing Ratio (CBR) of the in situ material within the material depth, as specified in TRH4. The classification of the subgrade material shall be based on the soaked CBR at 93% of Mod. AASHTO maximum Density (100% for sand).

The table below provides the typical material depths to be used for determining the designing CBR of the in-situ subgrade.

Table 8-9: Typical Material depths to determine CBR of In-situ material

Road Category	Material Depth [1]
UA	1000 – 1200mm
UB	800 – 1000mm
UC	800mm
UD	700mm

[1] As specified in TRH 4, 1996 [Table 15]

8.6.5 Specifications of Underlying Granular Pavement Layers

The underlying pavement layers and material shall comply with the following:

Table 8-10: Underlying Granular Pavement Material Specifications

Layer	Class	Material Type	Min Strength Specifications	Max PI	Minimum Compaction
Base	G2	Crushed stone	CBR: 80	6	85% BRD
	G3	Crushed stone	CBR: 80	6	98% MDD (100% for Class 3 Roads)
	G4	Crushed stone	CBR: 80	6	98% MDD
	BSM	Bitumen Stabilized Material	ITS: Min 250kPa (Level 2 design)	6	98% MDD
Subbase	G5	Crushed stone	CBR: 45	6	95% MDD
	C3	Cement Stabilized subbase	UCS: 1.5 to 3MPa ITS: 250 to 500kPa	6	97% MDD
	C4	Cement Stabilized subbase	UCS: 0.75 to 3.0 MPa ITS: 200 to 450kPa	6	96% MDD
Selected layer (upper 300mm)	G7	In-situ or Imported sand	CBR: 15	12	93% MDD (100% for sand)
Subbase for sidewalks	Surfaced	Crushed Stone	CBR: 45	6	95% MDD
	Un-surfaced	Natural Gravel or Crushed Stone wearing course	CBR: 45	6	95% MDD

BRD = Bulk Relative Density | MDD = Maximum Dry Density | ITS = Indirect Tensile Strength
UCS = Unconfined Compressive Strength

Materials made from blended reclaimed concrete and masonry aggregates, including recovered asphalt, shall be used in cases where the consistency of the material can be guaranteed. The material shall be tested by a soil laboratory, in order to confirm that the material meets the necessary requirements for its intended purpose. Once the aforementioned results have confirmed that the material is suitable, special approval shall be obtained from the *Director: Roads Infrastructure Management*. Materials made from blended reclaimed concrete and masonry aggregates shall only be used in subbase fill for sidewalk/NMT applications.

8.6.6 Selected Layers

Designs for all categories of roads should assume that all subgrades are brought to at least equal (G7) support standard. Subgrade conditions that are below a G7 standard shall be treated as per Table 22 of TRH 4, or be replaced with suitable material.

8.7 Off-road NMT Facilities

This section pertains to the pavement requirements for off-road NMT facilities (i.e. Class 1 and 2 Pedestrian Ways, Cycle Ways and Shared Facilities).

The type of surface treatment proposed shall be in accordance with the sections as described above in Section 8.6.

Where mountable kerbs are present (i.e. on lower order roads with narrow erf frontages), vehicles mount the kerbs in order to access the adjacent properties. Consequently, where pedestrian footways are situated directly adjacent to mountable kerbs, the footways are also subjected to these vehicular loads.

Therefore, where NMT facilities are provided adjacent to mountable kerbs, the NMT facilities shall be provided with the same layerworks as the carriageway crossings (in the area/street).

8.8 Median and Splitter Islands

On median and splitter islands, where no pedestrian or vehicles traffic are present, the pavement layerworks may be relaxed where asphalt, block paving or concrete surface treatments are proposed.

Since the above surface will not be subjected to vehicular loads, designers may use surface treatments similar to Table 8-9.

Where block paving is proposed, the provision of a base/subbase will not be required. In such instances, pavers may be placed on 150mm G7 material (the 25mm blinding layer shall still be provided underneath the paving blocks).

8.9 Compaction Equipment

Pavement layer compaction during construction has a major effect on the structural bearing capacity of the pavement. The higher the construction density of a layer, the higher the strength and resistance to deformation.

Please note that static rolling compaction will be required when working in closed proximity to sensitive services. Such static rolling compaction shall be designed.

8.10 Labour Intensive Construction

On projects where labour intensive methods are specified, a critical review of the specifications for road pavement layers needs to be made. All road construction activities cannot be labour intensive.

Relevant Codes of Practice, Policy and Guidelines:

- Guidelines for the implementation of labour-intensive infrastructure projects under the Expanded Public Works Programme – Second Edition July 200.

The activities that can be labour-based are the following:

- Spreading, levelling of Water bound Macadam layer;
- Excavation up to 1.5 metres in depth, in material suitable for hand excavation;
- Spreading of homogeneous or coarse graded materials;
- Kerb laying and ancillary works;
- Paving of sidewalks, walkways and road surface patches (Paving of roadways in asphalt shall be undertaken using an asphalt finishing paver);
- Placing of concrete on road surfaces;
- Accommodation of Traffic.

The construction methods chosen should result in the same standard as specified in COTO. For labour intensive projects, segmented concrete or clay block pavements, concrete pavements (JCP) or the use of Water bound Macadam, as a base layer for granular pavements, is recommended.

8.11 Asphalt Surface Joints on Roadways

Designer shall give careful considerations regarding the positioning of asphalt joints, whether as part of the construction of new roadways, upgrading/widening of existing roadways or maintenance activities.

Longitudinal joints are generally the weakest link in an asphalt pavement structure, due to the typical lower densities surrounding the joint (compared to the remainder of the paved lane). Deterioration of the joint areas leads to the intrusion of water and air into the asphalt layer, which ultimately results in the failure of the surface layer and, if not remedied timeously, secondary failure to the underlying layers.

The placement of longitudinal joints onto wheel-paths escalates the abovementioned deterioration and resulting failures, which leads to earlier than planned maintenance of the pavement layer(s).

The section below provides a brief overview of the basic requirements for asphalt joints in roadways. Designers can refer to the following document for further details:

- *COTO: Standards Specification of Road and Bridge Works for South African Road Authorities, Draft Standard. Chapter 9: Asphalt Layers, October 2020.*

8.11.1 Machine Applied Paving Operations

Asphalt surface joints shall adhere to the following:

a) All joints shall be parallel or at right angles to the centreline described by the ultimate lane - marking design. No diagonal joints across lanes will be allowed.
b) No joints will be allowed in the centre of a lane, even if this is between the wheel paths.
c) Joints shall be positioned on the lane marking, unless required otherwise by the Approval Authority. Such instructions by the Approval Authority notwithstanding, the maximum deviation off the lane marking shall be 150mm.

At unconfined longitudinal joints, which typically occurs either at the roadway edge or at the first lane placed), roller passes over the joint will cause it to deform sideways rather than compact. The following will therefore be required for unconfined longitudinal joints:

a) Unconfined joints shall be cut back a minimum width of 80mm or twice the asphalt thickness, whichever is the greatest. The paving width shall be carefully planned, in order to accommodate the aforementioned cuttings, while still adhering to the abovementioned joint placement.
b) Unconfined joints shall be cut by a roller wheel or milled back using a milling machine, unless required otherwise. No saw cutting will be allowed on newly placed asphalt or any cut that will be paved against.

The cut edges of all asphalt joints shall receive a coat of rubberized bitumen emulsion along the entire vertical face, prior to the adjacent asphalt being placed.

Whenever the paving operation ceases and the temperature of the mat has reduced to below the appropriate compaction temperature, a proper transverse construction joint shall be formed. All transverse joints shall be cut vertically. The minimum cut back distance shall be at least the layer thickness constructed.

The length of cutting back at the transverse joint constructed, where paving has to be recommenced, shall be from the point at which the paved profile last meets the design levels to the end of that asphalt mat paved, to a minimum of 2m, unless agreed otherwise by the Employer's Agent, per instance. The transition from the previously laid mat to the new mat shall be smooth at the design speed of the road and according to the relevant ride quality specifications.

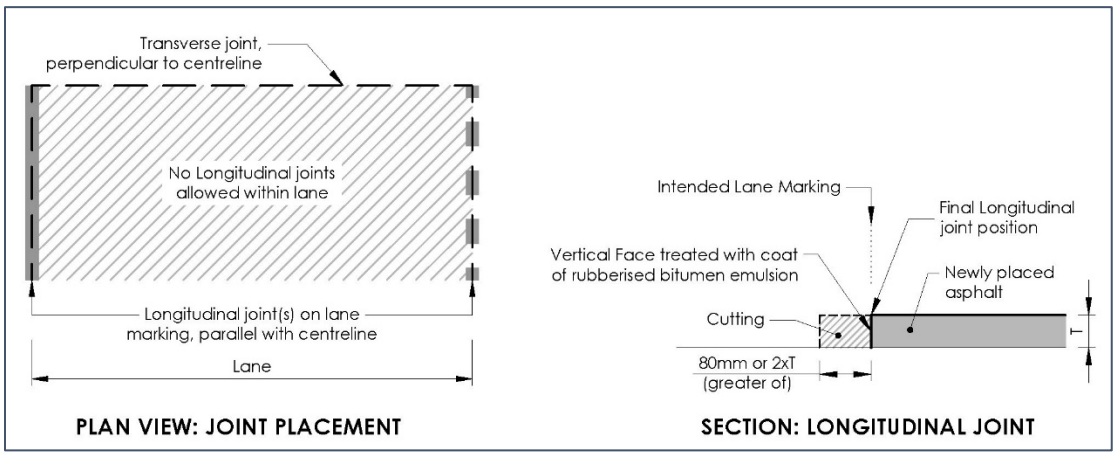


Figure 8-2: Asphalt Joint Placement

8.11.2 Road Widening, Add-on Measures and Installation of NMT and TSM Facilities

Where road widening or add-on measures are undertaken, which often results in the changing of lane markings, as well as the installation of facilities such as Non-Motorised Transport (NMT) and/or Traffic Safety Management (TSM) on existing roads resulting in the remarking of existing roads with or without adding road layerworks, designers shall ensure that longitudinal joints are placed as stipulated above in Section 8.5.1. Where required, the existing asphalt surface shall be milled back to the required position.

8.11.3 Trench and Service Reinstatements

Where the existing pavement layers have to be reinstated due to an open trench operation or the repair of an underground service, the following shall be applicable to the asphalt joints:

a) Asphalt joints shall be neatly cut in straight lines, parallel or at right angles to the centreline described by the ultimate lane-marking design, using a mechanical saw-cutting machine.
b) The longitudinal joints shall not be positioned in/on any wheel-paths.
c) The longitudinal joints shall be positioned as per Section 8.5.1 above. Where the aforementioned is not possible, the joint shall be positioned in the centre of the lane, subject to approval from the Approval Authority, prior to commencement of the works.
d) The cut edges of all joints shall receive a coat of rubberized bitumen emulsion along the entire vertical face, prior to the asphalt being placed.

8.11.4 Joints adjacent to Thermoplastic Road Markings

On asphalt surfaced roadways where thermoplastic road markings are required or proposed, designers shall ensure that longitudinal asphalt surface joints are positioned 150mm off the lane marking (unless required otherwise by the Approval Authority).

The abovementioned will prevent possible disturbance of the joint and any subsequent cracking.

8.12 Joints between Pavement Layers

The longitudinal joints between pavement layers shall be staggered/stepped/overlapped by a minimum width of 150mm or the thickness of the layer, whichever is greater.

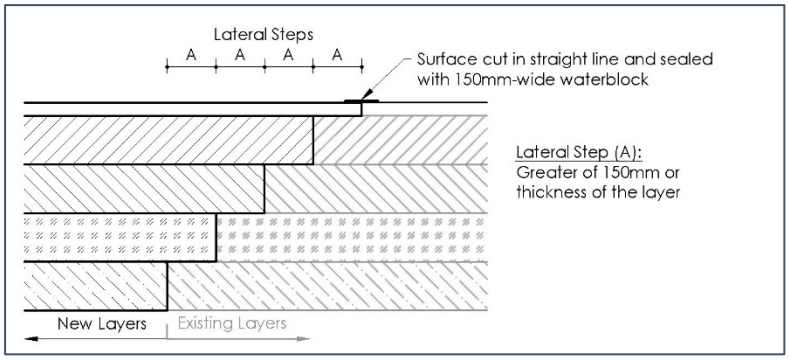


Figure 8-3: Lateral Tie-in Detail between Pavement Layers

8.13 Steep Terrains

Each site for which an application is made for a steep road or driveway, i.e. having a proposed longitudinal grade exceeding 12.5%, shall be investigated and assessed on its own merits.

The pavement structure shall be constructible on steep slopes.

If the gradient of a road is such that an asphalt pavement is not possible, then Block or Concrete pavements shall be considered, with anchor beams at regular intervals. The aforementioned will most likely only occur on lower order roads.

8.14 General Requirements

The surface roughness shall be adequate to ensure skid resistance in all weather conditions.

The stability of abutting slopes and boundary walls shall be ensured.

The existing services shall be adequately protected and arrangements for access thereto shall be made in consultation with the service authorities where required.

To: Part A Overview
To: Chapter Overview

Table 8-11: Guideline Catalogue Specification for Pavements

Design Consideration						Pavement Structures (excl. Foundation [2])					
Road Category				Pavement Class	E80's / Lane (1x10⁶)	Flexible Pavement [3]			Block Pavements (Concrete)	JCP/CRCP (Concrete)	Moisture Insensitive Pavement [1] (Grey Water & Wet Areas)
U2-B	U3-B	U4-C	U5-D			Granular Bases	Asphalt Bases	Macadam Bases			
Class 1 & 2 Roads	Class 2 & 3 Roads	Class 4 Roads	Class 5 Roads – Residential	ES0.003	<0.003	40mm AC 150mm G4 150mm G7	-	40mm AC 150mm WM2 150mm G7	60mm 20mm SND 150mm G5 150mm G7	140mm JCP 100mm C3 G9 In-situ	30mm AC 150mm BSM2 150mm G7
				ES0.01	0.003 - 0.01	40mm AC 150mm G4 150mm G7	-	40mm AC 150mm WM2 150mm G7	60mm 20mm SND 150mm G5 150mm G7	140mm JCP 100mm C3 G9 In-situ	30mm AC 150mm BSM2 150mm G7
				ES0.03	0.01 - 0.03	40mm AC 150mm G4 150mm G7	-	40mm AC 150mm WM2 150mm G7	60mm 20mm SND 150mm G5 150mm G7	140mm JCP 100mm C3 G9 In-situ	30mm AC 150mm BSM2 150mm G7
				ES0.1	0.03 - 0.10	40mm AC 150mm G4 100mm G5 150mm G7	-	40mm AC 150mm WM2 100mm G5 150mm G7	80mm 20mm SND 150mm G4 150mm G7	150mm JCP 150mm C3 G9 In-situ	40mm AC 150mm BSM2 100mm G5 150mm G7
				ES0.3	0.10 - 0.30	40mm AC 150mm G4 125mm G5 150mm G7	-	40mm AC 150mm WM2 125mm G5 150mm G7	80mm 20mm SND 150mm G4 150mm G7	160mm JCP 150mm C3 G9 In-situ	40mm AC 150mm BSM2 125mm G5 150mm G7
				ES1	0.30 - 1.0	40mm AC 150mm G4 150mm G5 150mm G7	40mm AC 75mm BTB 150mm C4 150mm G7	40mm AC 150mm WM2 150mm G5 150mm G7	80mm 20mm SND 150mm C4 150mm G7	Design Using CnCPave	40mm AC 150mm BSM2 150mm G5 150mm G7
			Commercial & Industrial	ES3	1.0 - 3.0	40mm AC 150mm G3 150mm C4 150mm G7	40mm AC 80mm BTB 200mm C4 150mm G7	40mm AC 150mm WM1 150mm C4 150mm G7	80mm 20mm SND 200mm C3/C4 150mm G7	Design Using CnCPave	40mm AC 150mm BSM1 / 80mm BTB 150mm C4 150mm G7
				ES10	3.0 - 10.0	40mm AC 150mm G2 250mm C3 150mm G7	40mm AC 100mm BTB 300mm C3 150mm G7	40mm AC 150mm WM1 125mm C4 125mm C4 150mm G7	80mm 20mm SND 250mm C3/C4 150mm G7	Design Using CnCPave	40mm AC 150mm BSM1 / 80mm BTB 250mm C4 (2x125mm) 150mm G7
Dedicated NMT Facilities *(Pedestrian Footways, Cycle Paths, etc.)*						30mm AC 125mm G5 150mm G7	-	-	60mm/60mm 20mm SND 125mm G5 150mm G7	-	30mm AC 125mm BSM2 150mm G7

[1] *All Greywater asphalts to be mixed using A-P1 (EVA) Modified binders and 1% SASOBIT as a compaction agent. The 30mm thickness shall be a COLTO Fine graded mix and the 40mm thickness a COLTO Medium graded mix.*

[2] *All the roadway pavement structures illustrated above shall consist of a foundation with a 150mm G9 layer, on top of a 150mm G10 layer.*

[3] *For Pavement Classes ES0.003-ES0.03, 30mm Asphalt Surfacing for Flexible Pavements may be considered, provided that traffic loads will be limited to passenger vehicles only.*

CHAPTER 9

TRAFFIC SIGNAGE, MARKINGS AND CONTROL DEVICES

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CHAPTER 9: TRAFFIC SIGNAGE, MARKINGS AND CONTROL DEVICES

9.1 Relevant Codes of Practice, Policies and Guidelines

The following shall be application with regards to the provision of road traffic signage, road markings and traffic signals:

- COTO: Standards Specifications, Chapter 11
- National Road Traffic Act (Act 93 of 1996)
- SARTSM and SADC-RTSM manuals:

  Volume 1: Uniform Traffic Control Devices (*SADC-RTSM-Vol1*)
  Detailing signage policies and design principles together with specific information on the meaning and application of all traffic control devices

  Volume 2: Traffic Control Device Applications (*SARTSM-Vol2*)
  This volume covers the use of sets of signs, markings and signals for specific applications

  Volume 3: Traffic Signal Design (*SARTSM-Vol3*)
  Detailing in depth, requirements for the selection and installation of traffic signals and their methods of control

  Volume 4: Traffic Signs Design (*SADC-RTSM-Vol4*)
  Dimensional details for all road traffic signs and sign face components

- The CMA Specification for Traffic Signals.

9.2 Road Traffic Signs

9.2.1 Materials

Road signs shall comply with SANS 1519-1 *Road Signs, Part 1: Retro-reflective sheeting material* and SANS 1519-2 *Road Signs, Part 2: Performance requirements for road signs*.

Unless specified otherwise, ground-mounted signs shall be designed for normal climatic conditions. Back plates shall be 1.4mm thick Z275 galvanised steel plate (Type A back plates as described in Clause 15.7.9 of *SARTSM-Vol2* Chapter 15). Bolts, nuts and washers to be Grade 8.8 steel (as per SANS 135) and shall be hot-dip galvanised (as per SANS 121).

Gantry-mounted signs shall be designed for marine or chemically polluted corrosive environments (Type B back-plates as described in Clause 15.7.9 of *SARTSM-Vol2* Chapter 15). Bolts, washers and nuts to be stainless steel, Grade 304 (manufactured to SANS 136). Nuts for both Type A and B back plates shall be steel self-locking.

All road traffic signs shall be manufactured with retro-reflective background material. The two predominantly used retro-reflective material classes are as follows:

* Class 3 Prismatic Retro-reflective material (10-year warranty);
* Class 4 Retro-reflective material (material must conform to Class 4A and 4B SANS 1519 standards,12-year warranty/grade).

The table below provides a guideline regarding the recommended uses of the different Classes of retro-reflective material.

Table 9-1: Guidelines for uses of retro-reflective material

Location	Class
▪ Urban or Suburban areas with low night traffic volumes, low ambient light conditions, low travel speeds ▪ Rural areas, no ambient light, low travel speeds ▪ Rural areas, low or no ambient light, high travel speeds (>=100km/h)	3
▪ Urban or Suburban areas with high night traffic volumes, high ambient light conditions, high travel speeds (>=100 km/h) ▪ All hazard marker signs Series W401 to W415	3/4
▪ Hazardous or high accident locations	4

9.2.2 Road Sign Supports

Road sign supports shall either be manufactured from steel or timber material.

Steel

Steel circular hollow section (CHS) shall comply with the requirements of SANS 50025 or BS 4360. Steel CHS supports shall have a minimum outside diameter of 60mm and a minimum wall thickness of 3.5mm.

Structural steel shall be grade S355 (as per EN10025), manufactured in accordance with SANS 657 and be hot-dip galvanised to SANS 121 (ISO 1461) (heavy duty) passivation. The base of the CHS shall be painted from the top of the concrete foundation, up to a height of 100mm above the surface level. Such surfaces shall be prepared for painting by chemical cleaning in accordance with the requirements of the code of practice of the Hot-Dip Galvinisers Association of Southern Africa (1990). The painting shall consist of one coat epoxy primer (Sigma cover 280 or equivalent approved) to DFT 100 microns, followed by one coat polyurethane top coat (Sigmafast or equivalent approved) to DFT 100 microns, colour grey (code CNC 5027/RAL 7040).

All-road sign supports shall have welded end caps on top to prevent ingress of water.

Where sign bending, rotation or removal (theft or vandalism) is a problem, the below measures can be considered. These shall be discussed and approved by the Approval Authority:

- Provision of anti-rotation measures in, accordance with Detail 15.20.2 of Figure 15.20 in SARTSM-Vol2, Chapter 15.
- Replacement of the steel CHS with a timber post (only applicable to the "straight type" road sign supports). Furthermore, the Approval Authority may require that the timber post be painted golden yellow colour (two coats).

Instances may arise where road sign supports are not desired inside NMT facilities, specifically Class 3 cycle facilities and/or Class 2 shared facilities. In such scenarios, the road sign support has to be position behind the NMT facility, which will result in the road sign being situated far from the cone of vision from vehicles (especially for roadways with multiple lanes and a shoulder). The aforementioned challenge can be overcome with the provision of cantilever road sign supports.

The cantilever structure consists of two interlocking steel posts of circular hollow section, which are bolted together. The base pole is installed in a mass concrete backfill, with the main pole fixed thereto. The road sign(s) is installed/fixed to the main pole. Bolts, nuts and washers to be grade 8.8 (as per SANS 135), unless specified otherwise, and shall be hot-dip galvanised (as per SANS 121).

During fabrication, all burr and sharp edges shall be removed prior to welding. All welds to be 6mm fillet welds, with all weld scale to be removed prior to galvanising. After fabrication and approval, all steelwork is to be hot-dip galvanised to SANS 121 (ISO 1461) (heavy duty) passivation.

Handling, transport and storage: after surface coating, no component is to be subjected to any welding, cutting, grinding, abrading, heating, bending, impact or any other operation likely to damage the zinc coatings. Any contravention of these requirements will render the affected component liable to rejection.

The CHS diameter, wall thickness and size of the concrete foundations will depend on the type, number and size of the signs, including the support type. Table 9-2 and Figure 9-1 can be used a guide to determine the required diameter and wall thickness of the supports, including the foundation size.

Table 9-2: Steel Road Sign Supports – Pole and Foundation Sizing Guideline

Scenario	Sign	Small Signs				Medium Signs			
		Sign Area	Pole Size Bottom [1]	Pole Size Top [1]	Foundation (Fw) [1]	Sign Area	Pole Size Bottom [1]	Pole Size Top [1]	Foundation (Fw) [2]
		m²	*mm*	*mm*	*mm*	*m²*	*mm*	*mm*	*mm*
1	A	0,16	-	60x3.5	500	0,35	-	60x3.5	600
	B	0,28	-	60x3.5	600	0,62	89x6	76x3.5	700
	C	0,28	-	60x3.5	500	0,64	-	60x3.5	500
	D	0,44	89x6	76x3.5	700	0,99	102x6	89x3.5	800
	E	0,27	-	63x3.5	600	0,61	89x6	76x3.5	700
	A+A	0,31	-	63x3.5	600	0,70	89x6	76x3.5	700
	C+C	0,57	-	60x3.5	500	1,28	-	63x3.5	600
2	A	0,16	89x6	76x3.5	500	0,35	89x6	76x3.5	600
	B	0,28	89x6	76x3.5	600	0,62	89x6	76x3.5	700
	C	0,28	89x6	76x3.5	500	0,64	89x6	76x3.5	500
	D	0,27	89x6	76x3.5	700	0,993	102x6	89x3.5	800
	E	0,48	89x6	76x3.5	700	0,61	89x6	76x3.5	700
3	A+A	0,31	89x6	76x3.5	600	0,70	102x6	89x3.5	800
	C+C	0,57	89x6	76x3.5	500	1,28	89x6	76x3.5	500
4	A	0,16	89x6	76x3.5	500	0,35	89x6	76x3.5	600
	B	0,28	89x6	76x3.5	600	0,62	102x6	89x3.5	800
	C	0,28	89x6	76x3.5	500	0,64	89x6	76x3.5	500
	D	0,27	102x6	89x3.5	800	0,99	114x6	102x3.5	900
	E	0,48	102x6	89x3.5	800	0,61	102x6	89x3.5	800
5	A+A	0,31	102x6	89x3.5	600	0,70	114x6	102x3.5	800
	C+C	0,57	102x6	89x3.5	800	1,28	114x6	102x3.5	1000
6	A	0,16	89x6	76x3.5	500	0,35	89x6	76x3.5	700
	B	0,28	89x6	76x3.5	600	0,62	102x6	89x3.5	800
	C	0,28	89x6	76x3.5	500	0,64	89x6	76x3.5	700
	D	0,27	102x6	89x3.5	800	0,99	114x6	102x3.5	900
	E	0,48	89x6	76x3.5	600	0,61	102x6	89x3.5	800
7	A+A	0,31	89x6	76x3.5	600	0,70	114x6	102x3.5	800
	C+C	0,57	89x6	76x3.5	500	1,28	102x6	89x3.5	700

[1] Pole size refer to the pole diameter and wall thickness.

[2] *Foundation shall square excavation, with the "Fw" denoting the side dimensions (i.e. Fw x Fw). The foundation depth shall be taken as 950mm unless specified otherwise on the detail drawings.*

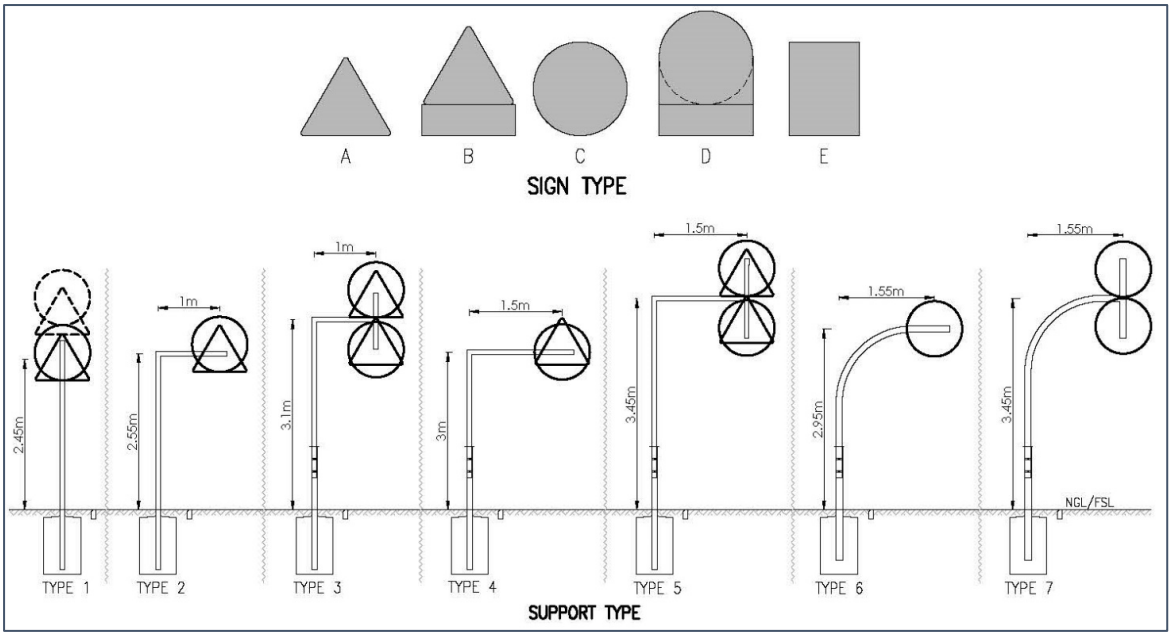


Figure 9-1: Road traffic sign and support type

Timber

Timber post for road sign supports shall conform to the requirements of SANS 754 or SANS457-2 and SANS457-3. Timber posts shall have a minimum nominal diameter of 120mm (peeled poles). Posts to be Class H4 "Tanalith" treated (or equivalent) and shall conform to SANS 10005.

General

For steel posts greater than 76mm diameter and timber posts greater than 100mm diameter, two breakaway holes shall be drilled as per SARTSM-Vol2 Chapter 15, Table 15.51.2 and Alternative 2 Page 15.7.7.

All supports, whether timber or steel, shall be treated such that no raw hole and/or weld shall be exposed to weathering (including inside of breakaway and drainage holes).

Mass concrete (Class 25/28) shall be used as backfill for the support foundation (no "soilcrete" allowed). After backfilling, the surface shall be reinstated to its original condition. The pavement structure shall be reinstated to the same standard and depth as the surrounding layers.

Refer to Drawing series RM4 for typical installation details of single support ground mounted signs.

For scenarios not covered by Table 9-2, the design of sign supports and foundations shall be in accordance with the Figures 15.51 – 15.55 from SARTSM-Vol2 Chapter 15.

9.2.3 Road Sign Clearance Requirements

The position and dimensions for the placement of permanent signs (i.e. vertical and lateral clearance requirements) are provided in the table and illustrated in the figure below. For further details, designers can refer to Fig 15.12 of SARTSM-Vol2, Chapter 15.

Table 9-3: Dimensions for Permanent Sign Placement

Description	Position Ref.		Dimensions (mm)		
	Vertical	Lateral	Minimum	Preferred	Maximum
Kerb: Unmade Verge or Pedestrian Footway		B[1]	500	750	-
	D		2100	2500	3000
Kerb: Shared NMT Facility		B[1]	500	750	-
	E		2500	-	3000
No Kerb (Shoulder)		A	1200	1500	2000
	C		600	2100	2500

[1] *Where signs are situated on surface footways, a minimum lateral clearance of 1.1m is required between the back of roadway kerb and outer edge of sign pole, in order to accommodate wheelchair users. Refer to section 5.8.*

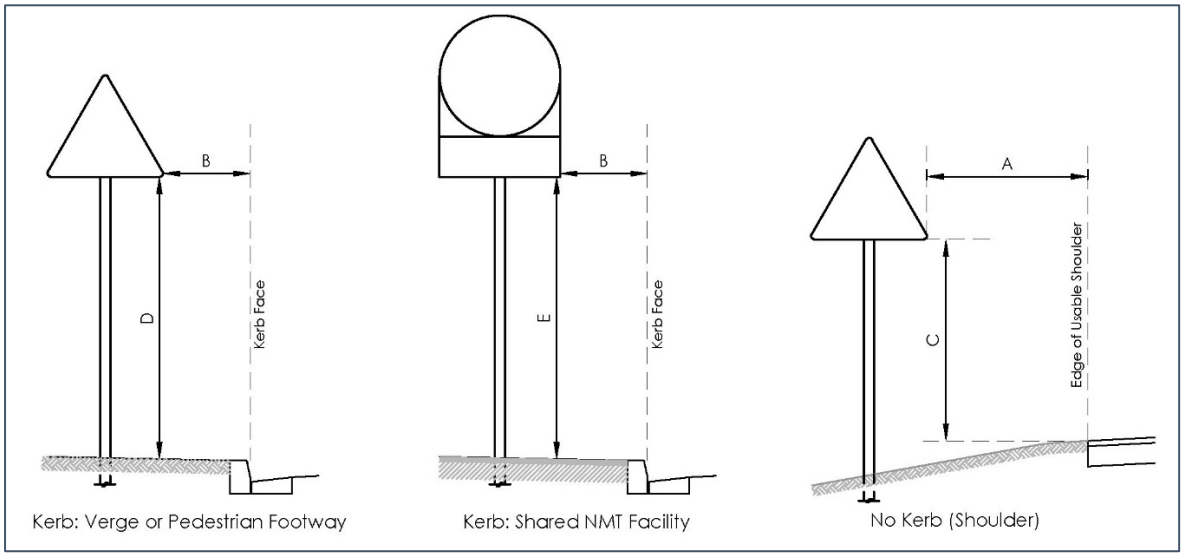


Figure 9-2: Lateral and Vertical Position of Road Signs

Refer to Drawing RM3 for further details.

9.3 Road Markings

The various types and typical requirements for road-markings are described below.

Retro-reflective road markings are the most commonly used road marking type. Plastic road markings may be considered for higher order roads. The type of road marking to be applied shall always be discussed with the Approval Authority.

9.3.1 Solvent-borne road markings

Road-marking paint shall comply with requirements of SANS 731 as follows:

- Type 1: road-marking paint for machine spray application: quick-drying paint, only for machine spray application to concrete or bituminous (or both) road surfaces;
- Type 2: road-marking paint for general (or hand) application: paint for general application (by hand) to concrete or bituminous (or both) road surfaces.
- The "no-pick-up" time shall comply with the Class 1 requirement.

Solvent-borne road-marking paint shall be applied at a nominal rate of 0.42 l/m², unless directed otherwise.

9.3.2 Retro-reflective road markings

Retro-reflective road-marking paint shall comply with the specifications in section 9.3.1. Glass beads shall be used to improve the paint's retro-reflectivity and comply with the requirements of SANS 51423.

Refer to section 9.3.6 for further requirements on retro-reflective glass beads.

9.3.3 Hot-melt plastic (Thermoplastic) Road Markings

Hot-melt plastic (also known as Thermoplastic) road-marking material shall comply with the requirements of EN 1436. Drop-on glass beads and anti-skid aggregates and mixing of the two shall comply with the requirements of SANS 51423. Blending of thermoplastic road marking material and glass beads shall comply with SANS 51424.

The binder shall be an elasticized synthetic resin and the material shall be reflectorized by mixing a minimum of 20% by mass Class A glass beads in accordance with SANS 51424 into the material. An additional topping of drop-on glass beads shall be applied to the hot surface of the material for immediate retro-reflectivity and shall comply with SANS 51424. The white road marking material shall contain a minimum of 6% titanium dioxide by mass. White, yellow and red road markings shall conform to a Class S_1 skid resistance as per EN1436 when tested 14 days after application.

Thermoplastic road marking shall be applied at a nominal rate of 2.5 kg/m², in order to achieve a minimum thickness of 1.25mm to 1.5mm.

9.3.4 Two-component plastic (Cold plastic) Road Markings

Screed Type

Screed type cold plastic road marking material shall be used for symbols, arrows and letters (hand painted markings) and shall consist of a two-component solvent-free methacrylate resin paint, formulated with fillers, anti-skid aggregates and glass beads for reflectivity.

Class A glass beads shall be added to the mixture, 25% by mass, in accordance with SANS 51424. Additional drop-on glass beads shall be applied to the wet surface of the material directly after application and shall comply with SANS 51424.

The material shall be applied to the subject area using a trowel or a draw box, delineated using masking tape. Materials shall comply with the requirements of EN 1436 and SANS 51423 for drop-on glass beads for road marking and anti-skid aggregates and mixtures thereof.

The white, yellow and red road marking shall conform to a Class S_1 skid resistance, as per EN1436. The retro-reflective luminance of the white and yellow road marking shall conform to Class R_4 and Class R_3, respectively, as per EN1436.

Screed type cold plastic shall be applied at a nominal application rate of 1.90kg/m² per 1mm thickness, in order to obtain a thickness of 1.5mm to 5mm.

Spray Type

Spray type cold plastic road marking paint shall consist of a solvent-free methacrylate resin and hardener suitable for spray application purposes. The road marking paint shall be applied to a clean and contaminant-free surface using an airless spray machine. Once the road marking paint is applied, a drop-on mixture, consisting of Class A glass beads and a benzoyl peroxide hardener, shall immediately be sprayed on the wet paint surface to allow curing.

The road marking paint shall comply with the requirements of EN 1436, and SANS 51423 for "drop-on" glass beads for road marking and anti-skid aggregates and mixtures thereof.

The white, yellow and red road markings shall conform with a Class S_1 skid resistance, as per EN1436:2018. The retro-reflective luminance of the white and yellow road marking shall conform to Class R_4 and Class R_3, respectively, as per EN1436:2018.

The following nominal rates shall apply to the spray type cold plastic material:

Table 9-4: Nominal spray rates for Spray Type Cold Plastic material

FILM THICKNESS	BASE SPRAY	DROP ON MATERIAL	THICKNESS
0.80 µm	0.80 l/m^2	0.80 kg/m^2	1.6 – 1.8 mm

9.3.5 Polymer Cement Road Marking/Coating

The polymer cement pavement coating is typically provided on cycle facilities and is green-coloured, in order to provide increased visibility of the potential conflict zone between cyclists and vehicles.

The compound consists of a combination of cementitious powder, plasticizer, sand (1-3mm particle size) and water. The coating is generally applied in a hexagon pattern (by use of a stencil), in order to provide a hard wearing and skid resistant surface coating.

The coating is generally spray applied to the existing road surface to a minimum thickness of 2mm.

Retro-reflectivity can be achieved with the addition of glass beads as per SANS 51423.

9.3.6 Retro-reflective Glass Beads

Should retro-reflectivity be required, glass beads shall be applied to the relevant road markings as stated above. The beads shall be applied at a nominal application rate of 400gm/m^2, unless instructed otherwise.

The beads shall comply with Class A beads in accordance with SANS 51424, with the following typical requirements:

Table 9-5: Requirements for retro-reflective beads

Attribute	Requirement/Value		
Colour	Crystal Clear		
Roundness	>80%		
Size range of	14 – 200 US Mesh (75 – 1400 Microns)		
Refractive index	>1.5		
Specific gravity	±2.5		
Granulometry	Sieve	Cumulative Retained Mass	
		Minimum	Maximum
	1700	0	2
	1400	0	10
	1180	5	30
	850	40	80
	600	70	100
	425	80	100
	355	90	100
	212	95	100
	Pan	100	100

9.4 Road Studs

9.4.1 Materials, Design and Application

Road studs shall comply with the requirements of SANS 1442, SANS 1463-1 and 1463-2.

Road studs shall adhere to the following requirements:

a) Roads studs shall be bi-directional.
b) Road studs shall be non-depressible (Type A).
c) Permanent road studs (Type P) shall be installed as anchored road studs. Temporary road studs (Type T) may be installed as bonded or self-adhesive road studs.
d) Permanent roads studs shall be galvanised steel or cast iron, or aluminium. In areas where there is a high risk of theft, plastic or plastic-composite road studs may be used.. Temporary road studs shall be plastic. Road stud type and specifications shall be submitted to and supported by the Approval Authority prior to installation.

The road studs requirements are summarised in the table below.

Table 9-6: Roads Stud Requirements

Classification	Area of Application		
	General	High Theft Risk	Temporary
Description	Bi-directional	Bi-directional	Bi-directional
Material	Galvanised Steel or Cast Iron, Aluminium	Plastic or plastic composite	Plastic or plastic composite
Design	Type A	Type A	Type A
Use	Type P	Type P	Type T
Reflector	Type 2 or 3	Type 2 or 3	Type 2
Installation	Anchored	Anchored	Bonded/Self-adhesive
Height above Road	H2 – H3	H2 – H3	H1
Typical Dimensions (min footprint)	100mm x 75mm	100mm x 100mm	100mm x 50mm

***Notes**: Table to be read in conjunction with SANS 1463-1.*

9.4.2 Installation

Road studs shall be installed after the road marking has taken place.

Roads studs shall be installed as per the manufacturers' installation specifications. In the event that the aforementioned are not available, the Contractor shall submit an installation procedure to the Engineer for approval, prior to installation.

The studs shall be protected against vehicular impact until the adhesive or epoxy has hardened. The road surface shall be thoroughly cleaned prior to the installation of the road studs.

9.5 Traffic Signals

9.5.1 General

For all forms of traffic control devices reference should be made to the latest edition of the Southern African Development Community Road Traffic Signs Manual (SADC-RTSM).

For detailed design and construction of traffic signals, reference needs to be made to the specifications as laid down in the Cape Metropolitan Area (CMA) Specification for Traffic Signals.

Traffic control devices shall comply in all respects with the requirements of the National Road Traffic Act 1996 (Act No. 93 of 1996) and the National Road Traffic Regulations 2000, promulgated in terms of the Act. It is therefore important that professionals, with experience and knowledge of the subject, undertake the design, installation and operation of traffic signals and signage.

9.5.2 Traffic Signals Design

New Traffic Signal proposals, or amendments to existing signalised intersections, shall be submitted to the *Manager: Network Facilitation and Development* for approval. If the proposed works include geometric alterations to the intersection(s), approval of the aforementioned shall be obtained prior to the civil engineering drawings being submitted to the *Director: Roads Infrastructure Management* for approval.

For Traffic Signal proposals, refer to the latest version of the City's *Traffic Signals Construction Procedures*.

For further information, designers can contact the *Manager: Network Facilitation and Development.*

9.6 Street names and numbers

Street names and street numbers shall be implemented in accordance with the City's *Street Naming and Numbering Policy*.

Street names

Street names shall be provided using two methods, i.e. painted on roadside kerbs and pole mounted name plates, as per the relevant detail drawings. Street names shall always be painted on roadside kerbs, but the provision of street name plates is optional. Where there is a high likelihood of theft in the area, street name signs should rather be omitted. The Approval Authority shall be consulted to provide guidance on the aforementioned.

Lettering for street names shall be in accordance with *SADC-RTSM-Vol1,* namely typeface *DIN (Standard) 1451 Part 2, Styles "A" and "B"*. A lettering height of 75mm is preferred.

Street Numbers

Street numbers must be displayed in a location that is clearly visible from the street. The number should be at least 1.5m above the center line of the adjacent road or carriageway and should be prominent and easy to read from the street. The street number should be displayed on the side of the house fronting the adjacent road or, in the instance where a boundary wall has been constructed, on the boundary wall.

The provision of street numbers by means of paint on the adjacent roadside kerb shall not be permitted on municipal roadways..

9.7 Repainting of road marking at end of defect liability period

On new road upgrade projects, where possible, provision should be made for the repainting of the road marking at the end of the 12-month defects liability period. On City funded project, allowance should be made for the aforementioned during the planning stage.

To: *Part A Overview*

To: *Chapter Overview*

CHAPTER 10

STORMWATER DESIGN

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CHAPTER 10: STORMWATER DESIGN

10.1 General

Designers shall base their design on a sustainable stormwater management system and all factors that will impact on the future operation and maintenance of the system shall be considered. Maintenance requirements shall be kept to an absolute minimum.

For a more detailed approach to Stormwater Management, reference needs to be made to the guidelines as set out below.

The Stormwater drainage design is to be based on the concept of Minor and Major systems, as prescribed in the *Red Book*.

10.2 Standard Reference Documents, Codes of Practice, Policies and Guidelines

The following documents may be applicable to this chapter:

(a) Alternative Technology for Stormwater Management - The South African Guidelines for Sustainable Drainage Systems, Report to the Water Research Commission by the University of Cape Town, May 2013

(b) CCT: Design Rainfall Depth Grid

(c) CCT: Floodplain and River Corridor Management Policy, Version 2.1, May 2009

(d) CCT: Management of Urban Stormwater Impacts Policy, Version 1.1, May 2009

(e) CCT: Stormwater Management By-Law (approved by Council 30 August 2005)

(f) CCT: Stormwater Management on Slopes Adjacent to Natural Areas, Version 1.0, November 2003

(g) CCT: Sustainable Urban Drainage Systems – Landscape and Indigenous Plant Species Guidelines, Version 1.0, by Catchment, Stormwater and River Management Branch for the City of Cape Town, 28 February 2011

(h) SANRAL, Drainage Manual, 6th Edition.

(i) The Neighbourhood Planning and Design Guide ("Red Book"), 2019.

(j) TRH 15 – Subsurface Drainage for Roads.

10.3 Stormwater Design

10.3.1 General Design Principles

The following elements shall be incorporated in stormwater drainage design:

i) The main stormwater routes should be located along natural drainage routes.

ii) Major systems shall be free draining and local low points in roads shall be avoided, unless unencumbered overland escape routes can be provided. Where overland escape routes are provided, no private structures, fences, etc., shall be allowed.

iii) Runoff from adjoining properties shall be adequately accommodated. This includes runoff from upstream properties, where applicable.

iv) During major storm events (greater than 1:2 year in the case of residential areas), the traffic function of residential and lower order roads is interrupted and the full Stormwater carrying capacity of the roads can be utilised. The maximum allowable inundation of Mixed (Higher order) and Class 4 Local Distributors above road crown during 1:50 year storm events, is 150mm.

v) Localised Low Points:
   a) Where localised low points are unavoidable and where provision has to be made for emergency overland escape routes, the number of catchpits and conduit size shall be increased to accommodate a 1:10 year return storm.
   b) Where such overland escape routes are not possible, the intakes and/or catchpits and conduit system serving the area shall be capable of accommodating at least a 1:50 year storm.
   c) Overland and pipe routes shall be accommodated in a servitude registered in the name of the City of Cape Town and provide for adequate access to enable maintenance activities to be carried out.
   d) Overland escape routes should be designed to accommodate overland runoff without causing damage to nearby or adjacent properties.

vi) Debris and pollutant removal facilities, i.e. Sustainable Urban Drainage System (SUDS), shall be designed and constructed to protect downstream facilities and infrastructure.

vii) Appropriate measures shall be put in place to minimise scour and erosion.

viii) Stormwater discharge shall not be concentrated on any downstream property, except where such concentration of flow occurred previously, or if the flow is discharged via a servitude, in favour of the upstream property.

ix) The post-development runoff shall not exceed the pre-development runoff. Stormwater storage facilities will need to be designed to restrict the runoff from developments where the post-development runoff exceeds that of the pre- development. Refer to the *Management of Urban Stormwater Impacts Policy* document.

x) Due consideration is to be taken at design stage of all future maintenance requirements and activities.

xi) All materials used in the works shall bear the mark of an accredited certification body (e.g. SABS, SATAS, etc.), where such mark has been awarded for a specific type of material. The manufacturer shall be in a position to furnish the current valid certification permit for such materials. Where materials are proposed for incorporation in the works that do not bear the mark of an accredited certification body, prior approval shall be obtained for the use of such materials from the Approval Authority.

xii) For any proposed developments, designers should take into consideration the existing and any future development plans. The City's *Catchment, Stormwater and River Management (CSRM)* branch to be consulted in this regard.

10.3.2 The Minor System

The minor system provides for the convenience of the community by rapidly removing runoff caused by storms of relatively frequent recurrence intervals (2 to 5 years) from the drainage area, predominantly via an underground pipe network. The system includes catchpits, manholes, road-edge channels, open channels, etc.

The applicable minor system design storm return period varies according to land use. The return periods to be applied are listed in the table below.

Table 10-1: Design Storm Recurrence Interval per Development Type

Development Type	Design storm recurrence interval (years)
Residential	2
General commercial & industrial	5
Public buildings	5
High value CBD	5 to 10

10.3.3 The Major System

The major system is the trunk system that receives stormwater discharge from the minor system. It also functions as the emergency system that operates during overflow from, or failure of, the minor system. The system includes watercourses, large conduits, roads, stormwater attenuation facilities (ponds), drainage servitudes and flood plains. Public open spaces, sports fields and parking areas can also be utilised to form part of the major system.

The major system fulfils a flood control function only during major, infrequent storm events. During such events, temporary disruption of many normal activities within the catchment will occur, owing to the intensity and magnitude of the event. The loss of convenience is tolerable, if no flooding of private property occurs and the disruption is restricted to the following:

i) Residential and lower order roads;
ii) Recreational areas and public open spaces;
iii) Parking areas;

The minor underground pipe system shall be assumed to be flowing full during a major storm event. The effect/ramifications of blockages occurring in the minor system shall be checked at design stage.

The flood plain management system for all new urban developments will be designed to safely contain floods up to the 1:20 year flood, without the flooding of properties, i.e. within the road reserve boundaries. Conditions shall also be checked for the 1:100 year event to assess the risk of floor levels being flooded. Floor levels are to be 250mm (minimum) above the 1:100 flood levels. (Calculated considering the theoretical energy levels)

10.3.4 Rainfall and Modelling Criteria

The City's "Design Rainfall Depth Grid" data, which includes 15% for Climate Change, shall be used for all stormwater attenuation and treatment calculations. This information can be obtained from CSRM branch.

Designers shall clearly stipulate which rainfall stations/nodes were utilised for calculation purposes.

10.4 Physical Design Criteria

The physical criteria and requirements for the various stormwater design elements are set out in the sections below.

10.4.1 Stormwater Pipes and Box Culverts (Underground Conduits)

The following parameters contained in the table below will be applicable to the design of underground stormwater conduits:

Table 10-2: Stormwater Conduit Design Criteria

Characteristic			Design Parameter
Conduit Material (Pipe / culvert)			Concrete (Reinforced [5])
Conduit Type		Pipe joint type	Spigot & Socket Joints (including rubber ring) NO OGEE JOINT PIPES
		Culvert[1]	Rectangular Portal Culvert, with "v-shaped" concrete base slab
Conduit Class		Pipe (all diameters)	100D
		Culvert[1]	100S
Minimum Size	Pipes	Catchpit connections	300 mm (nominal dia.)
		Main lines	375 mm (nominal dia.)
	Culverts		600mm (height)
Bedding type for pipes			Class B
Position in road reserve [2]			1.7m, North or East from road centre line
Minimum Pipe Slope	Catchpit Connections		1:60 (1.67 %)
	375mm dia.		1:360 (0.28 %)
	450mm dia. and larger		Minimum velocity criteria applies
Manning's coefficient of friction (n)			0.012
Minimum velocity (80% full flow [3])			0.9 m/s [4]
Maximum velocity (Without checking for hydraulic jump)			3.5 m/s
Maximum velocity (*Checking for hydraulic jump*)			5.0 m/s (Minimum pipe class 100D)
Anchor blocks			375mm to 450mm dia pipes steeper than 1:6 (16.67%)
			Pipes larger than 450mm dia steeper than 1:8 (12.50%)
Pipe cover	Inside roadway	General conditions	Greater of: • 450mm cover, or • Top of pipe 100mm below SSG layer
		Catchpit connections	350mm minimum cover (pref. 400mm)
	Outside roadway		750mm cover
Maximum distance between manholes			90m
Maximum distance: catchpit to manhole			15m

[1] Culvert design to be in accordance with specific site requirements. Loading conditions for each application to be confirmed.

[2] For narrow roadways designers to ensure that the positions of stormwater manholes to be clear of vehicle wheel paths.

[3] Based on circular conduits (pipes).

[4] Minimum flushing velocity to be applied to the design flow as well.

[5] Reinforcement may be omitted in stormwater pipe sizes smaller than 600mm diameter, provided that the pipes conform to the Class 100D specification as per SANS 677.

Further to the aforementioned design criteria, the following shall apply:

1) Underground conduits are to be laid within the road reserve or in public open spaces. Where crossing private property is unavoidable, the conduit shall be protected by a registered servitude, in favour of the City of Cape Town.
2) Generally, structures are not permitted within the reservation width of the underground stormwater conduit. Refer to Section 4.3.1 for further clarification. Furthermore, sufficient space shall be allowed for equipment and machinery requirements.
3) The vertical clearance between stormwater conduits and other services is to be a minimum of 150mm.
4) Steeper gradients shall be used at the head of the system, where full flow is not yet achieved.
5) In sandy areas, consideration should be given to increasing the coefficient of friction (n) in calculations, to compensate for the partial siltation of the underground conduits.
6) Where underground conduits enter rivers, canals or ponds:
    a) The invert shall be above normal wet season water level;
    b) The soffit shall be above the water level achieved during minor storms;
    c) The discharge points shall be provided with adequate erosion protection measures, such as rock filled gabions, reno-mattresses, stilling basins, stone pitching, energy breakers, etc.
7) Stormwater conduits are generally laid shallower than sewers.
8) Stormwater pipe cover:
    a) Where stormwater pipes are provided inside the roadway:
        - Under general conditions, a minimum vertical clearance of 100mm shall be provided between the bottom of the selected sub-grade (SSG) layer and the top of the stormwater pipe (socket), on condition that the cover shall never be less than 450mm (to the road surface), unless supported otherwise by the Approval Authority.
        - For catchpit connections, a minimum cover of 350mm (preferably 400mm) may be provided. Instances where a pipe is installed inside (or close to) the subbase, care shall be taken to protect the pipe during compaction operations of the subbase.
    b) Stormwater pipes outside the roadway shall be provided with a minimum cover of 750mm, unless supported otherwise by the Approval Authority.
    c) Designer shall adhere to SANS 10102 Parts 1 and 2 regarding earth loads on underground conduits.
9) Free flowing junctions (i.e. 45° junctions) should be detailed where possible and 90° junctions avoided.
10) Connections from catchpits to the main lines are to be as close to 60° (relative to the road centreline) as possible.
11) Only reinforced concrete spigot and socket, with rubber ring seals, are permitted. Interlocking joint (ogee) pipes shall **not** be used in any application.
12) Where cutting of pipes are required, the pipe is to be cleanly cut. Any exposed reinforcing shall be adequately treated and protected against corrosion.
13) Anchor blocks:
    a) Anchor blocks in 20MPa concrete are to be provided on steep slopes as follows:

Table 10-3: Anchor Block Spacing

Grade	Spacing for 2.44m pipe lengths
Over 50%	Every joint
30% to 50%	Alternate joints
20% to 30%	Every fourth joint
10% to 20%	Every eighth joint

    b) Anchor blocks are not required for grades less than 10%.
    c) Refer to Drawing SW6 for anchor block details.
14) Stormwater culverts shall be the Rectangular Portal type, which shall have "V-shaped" inverts (base slabs) to accommodate low flows.
15) Where the box culvert height is less than 1.2m, the Width to Height (W:H) ratio shall not exceed 2:1.

10.4.2 Stormwater Catchpits

The following will be applicable to the design of stormwater catchpits.

General

1) The maximum flow capacity of the road cross-section, at the particular gradient, shall be used to determine the required inlet capacity and spacing of catchpits. The contributory overland stormwater runoff to the road (i.e. from adjacent developments/properties) should also be taken into consideration in this regard.
2) Street capacity and kerb flow interceptions should be based on the charts developed by Zwamborn, Wessels, Lotter and Grobler, as published in the *SANRAL Drainage Manual*. Reference can also be made to the charts developed by Forbes and Rooseboom. Designers should be able to provide calculations on request.
3) The percentage flow bypassing a catchpit shall not exceed 20%.

Catchpits type and specifications

4) The different types of catchpits used in the City are as follows:
    i) **Catchpit Type A**: Kerb & Grid Inlet Combination
        a) Refer to Drawing SW3.1 for typical details.
        b) The minimum requirement consists of a double kerb and grid inlet combination, with the chamber constructed under the grid inlet.
        c) Should additional inlet capacity be required due to specific site conditions, the amount of inlets may be extended, subject to consent from the approval authority.
        d) It shall be noted that the inlet kerb is not very resistant to wheel impacts, especially heavy vehicles. Therefore, where there is a high probability of wheel impacts to the kerbs (e.g. industrial areas), a grid inlet type catchpit should rather be considered. If required, additional grid inlets may be provided to ensure sufficient intake capacity.
    ii) **Catchpit Type B:** Double Kerb Inlet only (2 x 1m inlet kerb type)
        a) Refer to Drawing SW3.2 for typical details.
        b) The minimum requirement consists of a double kerb inlet (i.e. two inlets adjacent to one another), with the chamber situated behind the kerbline.
        c) This catchpit is generally utilised on lower order roads.
        d) It shall be noted that the inlet kerb is not very resistant to wheel impacts, especially heavy vehicles. Therefore, where there is a high probability of wheel impacts to the kerbs (e.g. industrial areas), a grid inlet type catchpit (Type D) or a catchpit with the inlet combined with the cover slab (Type F) should rather be considered. If required, additional grid inlets may be provided to ensure sufficient intake capacity.
    iii) **Catchpit Type C:** Double Kerb Inlet only (Extended Inlet type kerb)
        a) Refer to Drawing SW3.3 for typical details.
        b) Consists of a 2m continuous kerb inlet structure, with the chamber situated behind the kerbline (covered with precast concrete top slab). The inlet kerb includes stirrups at the back, which is casted into the cover slab for additional stability.
        c) This catchpit is generally utilised on middle to higher order roads.
        d) Due to the size and height of the inlet kerb, it should preferably be used where type BK4 barrier kerbs are present.
        e) The presence of stirrups in the kerb (casted into the concrete cover slab of the chamber) makes it more resistant to potential wheel impacts.
        f) This catchpit has a higher intake capacity, due to the uninterrupted 2m inlet.
    iv) **Catchpit Type D:** Grid Inlet only
        a) Refer to Drawings SW3.4 & SW3.5 for typical details.
        b) The minimum requirement consists of a double grid inlet.
        c) This catchpit is generally utilised on lower order roads, industrial areas or where double flat channels ("v-channels") are present.
        d) This catchpit may be considered as an alternative to the Kerb-and-Grid Inlet Combination catchpit, where there is a high probability of wheel impacts to inlet kerbs.

v) **Catchpit Type E:** Steep Slopes

a) Refer to Drawing SW3.6.

b) Catchpit utilised on roads with longitudinal gradients greater than 8%, where sufficient space is available to accommodate the structures.

vi) **Catchpit Type F:** Cover-Inlet Combination Slab (wide inlet type)

a) Refer to Drawing SW3.7.

b) This catchpit is similar to Type C. It has a 1.75m continuous inlet, with the chamber situated behind the kerbline. The main difference is the inclusion of the inlet (along the kerb face) with the cover slab, cast as a single unit. There are thus no standalone inlet kerb.

c) The incorporation of the inlet interface with the cover slab makes the structure more resilient to potential wheel impacts. The continuous inlet also provides for a high intake capacity.

d) This catchpit can be utilised on lower, middle and higher order roads, with either BK2 or BK4 kerbs present.

vii) **Catchpit Type G:** Shallow Flow Chamber

a) Refer to Drawing SW3.8.

b) This catchpit shall be used for instances where a kerbed sidewalk is present, but no underground stormwater network. The stormwater runoff will be collected by the kerb inlet and conveyed directly (through the catchpit chamber) to the back of the catchpit, where it will be directed to an overland channel.

5) Where grids are utilised, grids with slots in the same direction as the channel flow are preferred. In instances where the grid slots are at right angles to the flow (e.g. to accommodate cycle lanes), due to the tendency of the upstream grid being blocked with debris, a longer chamber with an additional grid and frame should be installed to allow for additional intake capacity.

6) Grids and frames shall be manufactured from ferrous materials or polymer concrete. For ferrous materials, the grid is to be fixed to the frame by means of stainless steel (304) bullet hinges. The frame and grid shall be the heavy duty type and be able to withstand the loading requirements of SANS 50124, capable of bearing a test load of 250kN.

7) Grids and frames manufactured from ferrous materials are the preferred choice. However, in places where there is a high likelihood of theft, grids and frames manufactured from polymer concrete may be considered. Provision of the aforementioned shall be discussed with approval authority.

8) Where catchpit chambers are situated behind the kerbline, a rectangular ductile iron hinged type cover and frame shall be used (with typical dimensions of 900x450mm).

9) Kerb inlet openings shall be 100mm in height.

10) The top of inlet kerbs shall be level with adjoining kerbs.

11) Catchpits should not be less than 750mm in depth and should preferably not exceed 1.2m in depth.

12) Step irons shall be provided where catchpit depths exceed 1m.

13) A chamfer to the opening around the connection pipe socket shall be provided to improve the hydraulic efficiency and prevent debris from snagging.

14) Skew catchpits shall be used where the road gradient exceeds 8% and shall be offset to the road edge/kerbline.

15) In sandy areas, catchpits shall not be benched, but the floor shall be at the same level as the outlet invert. In some instances, the provision of a sand trap might prove useful, in order to minimise the amount of sand being discharged to the main system. Provision of the aforementioned to be discussed with the approval authority.

16) In areas with a high incidence of litter and debris, the installation of vertical Y20 galvanised trash bars at the kerb inlet opening should be considered. Refer to Drawing SW10. However, in areas where there is a high likelihood of theft, an alternative preventative measure should be investigated.

17) Trash bar installations are not advisable in trapped low spots or in high vegetated areas.

18) Bricks used in the construction of catchpits shall comply with the specifications for masonry units. Refer to Section 10.4.10.

Catchpit spacing & placement

19) At trapped low areas, the number of catchpits shall be increased, in order to allow for additional inlet capacity and accommodate upstream flow conditions.
20) Trapped low areas on roadways should be avoided as far as possible. However, where unavoidable, additional catchpits should also be provided upstream, in order to limit the area of flooding.
21) Length of channel flow to the first catchpit will not exceed 120m.
22) Distance between catchpits shall not exceed 90m, unless hydraulic calculations indicate that alternative distances can be accommodated.
23) Careful consideration should be given to the placing and spacing of catchpits in affordable housing areas, as the catchpits are frequently used for refuse and sewerage disposal.
24) Catchpits shall be located upstream of intersections, in order to prevent/minimise surface flows.
25) Catchpits should be placed before road super-elevations. Particular attention is to be taken in placing inlets where the road cross falls roll over.
26) Catchpits may not be positioned on radii of intersections ("bellmouhts") or on sharp horizontal curves, due to the high probability of wheel impacts.
27) Catchpits shall not, as far as possible, be placed along vehicle entrances, i.e. carriageway crossings. However, where unavoidable, the grid inlet type shall be used.

Connections

28) Catchpit-to-catchpit connections are not permitted. Catchpits shall connect to the main stormwater system via a 300mm (minimum) pipe diameter.
29) Combination catchpit-manholes are not permitted.
30) Catchpit connection lengths (i.e. from the catchpit to the main system) may not exceed 15m.

10.4.3 Stormwater Manholes

General, Provision and spacing

1) Manholes shall be provided at all horizontal and vertical changes in conduit direction, at all pipe junctions and where there is a change in conduit size.
2) Junction boxes are not permitted.
3) Maximum spacing between manholes shall not exceed 90m.
4) Where flatter grades are present and the up- and downstream conduits are the same size, designers should check for head-loss in the manhole.

Connections

5) All conduit connections shall be aligned crown-to-crown at manholes.
6) The size of downstream conduits may not be smaller than upstream conduits.
7) Where the construction of catchpit connections will result in excessively steep/deep excavations (to accommodate crown-to-crown alignments to the main line), drop connections ("backdrops") may be provided at the manhole. Drop connections deeper than 1m should be avoided to minimise erosion of the manhole floor. However, where these drops are unavoidable, the thickness of the manhole floor slab should be increased.

Chamber and Chimney

8) Maximum chimney height shall not exceed 400mm.
9) Shallow manholes shall only consist of a chamber and chimney. Refer to Drawing SW2.2.
10) For deep manholes, an access shaft may be provided, on condition that the chamber section has a minimum height of 2m. Refer to Drawing SW2.3 for more details.
11) Manhole access shafts to be located in such a manner as to permit free access for bucket machine cleaning cables and equipment.
12) Widening shall be provided on outside curves of benching to accommodate bucket cleaning.
13) Bricks used in the construction of manholes are to comply with the specifications for masonry units. Refer to Section 10.4.10.
14) Step irons shall be provided at manholes where the depth exceeds 1m.
15) In sandy areas, the provision of a sand trap might prove useful, in order to minimise the amount of sand being distributed to the downstream system. Provision of the aforementioned to be discussed with the approval authority.
16) Instances where shallow stormwater conduits are applicable, the use of brick only chambers and chimneys may be considered, provided that designers compile a detail and obtain approval for the use thereof from the Approval Authority.

Cover & Frame Types

17) All stormwater manhole covers and frame shall be Class 400D as per SANS 50124.
18) The types of covers and frames to be used are provided in the table below.

Table 10-4: Stormwater Manhole cover and frames

Type	Utilisation
Ductile Iron with Concrete Infill [1]	• All municipal stormwater manholes inside public road reserves. • All municipal stormwater manholes inside private developments, where the manholes are situated in a roadway or NMT facility that is used by the general public.
Hinged Ductile Iron (Type 2A) [2]	Accepted for municipal stormwater manholes on private developments, provided it is outside roadways and NMT facilities used by the general public
Ductile Iron with ventilation openings (Type 2B) [2]	

[1] *Refer to Drawing SW2.4.*
[2] *Manhole types referenced in terms of SANS 558.*

Safety considerations for deep manholes

19) Where manholes reach excessive depths, safety improvements may be required by the Approval Authority. The aforementioned improvements includes:
    i) Provision of slabs at 2m intervals, unless agreed otherwise, for fall protection. The openings should preferably not be aligned, in order to ensure additional safety. The aforementioned would however require an offset between step iron alignments for each section, since the step irons have to align with the slab opening.
    ii) Provision of a handle/hook at top of manhole for the securing of harness ropes.
20) Where such measures are required, a method statement shall be submitted for approval.

10.4.4 Sub-surface Drains

The following parameters contained in the table below will be applicable to the design of sub-surface drainage systems. Designer can also scrutinise *TRH15 Subsurface Drainage for Roads* for more details regarding sub-surface drains.

Table 10-5: Sub-surface Drain Design Criteria

Characteristic	Design Parameter
Pipe type	HDPE Double Walled slotted pipe (with smooth internal surface)
Minimum drainage pipe diameter	110mm
Drainage medium	19mm stone (complying with the relevant standard or particular grading as specified)
Synthetic filter (general purpose)	Geo-textile, Grade A2
Rodding eye spacing	Straight Sections: 90m (max) At bends (change in direction)
Cover Box Type	Type 11D (SANS 558)
Minimum internal manhole diameter	1m

Refer to Drawing series SW1 and SW2.1 for the typical details of sub-surface drains.

Drawing SW1.3 provides a guideline for the general provision of sub-surface drains. However, the responsibility ultimately remains with the designer to ensure that adequate sub-surface drainage is provided for the site-specific conditions.

Further to the above, the following shall be taken into consideration:

General

1) Sub-surface drainage is required to ensure that pavement and subgrade layers are well-drained at the material depth, as defined in TRH 4.

2) The provision of subsurface drains will depend on site-specific conditions, i.e. soil type, water table in rain season, natural drainage direction, presence of irrigation, infiltration, etc.
3) Geotechnical investigations shall be conducted during the rainy season, in order to determine the existing soil conditions and water table.
4) Sub-surface drains to be laid at least 750mm below the road surface.
5) Sub-surface drainage systems shall be installed in all areas where a high water table can be expected.
6) Sub-surface drains shall generally be installed along a road on the upstream side of the road reserve, to form a cut-off drain, directly behind the kerb line.
7) "Sausage" or "Fin"-type sub-surface drains are not permitted.

Materials and Connections

8) All sub-surface drains shall be provided with piped systems.
9) Manholes shall be provided where a change in direction occurs or multiple lines connect.
10) Rodding eyes shall be spaced at 90m (maximum) intervals for straight sections and where a change in direction occurs (i.e. at bends).
11) Rodding eyes may be provided with or without an access box. In area where there is a high likelihood of theft or damaged to the rodding eye, the access box shall be omitted.
12) Boxes shall be Type 11D (as per SANS 558), with the hinged cover opening towards NMT traffic (where situated inside NMT facilities).
13) Rodding eyes shall not be located within carriageway crossings or any other areas subjected to vehicular traffic.
14) The pipes shall have a stone bedding and geotextile blanket, with the perforations or openings in the pipe being laid according to the manufacturer's guidelines.
15) Sub-surface drains shall have dual-filter mediums, that consist of a combination of granular and synthetic materials.
16) In areas of high clay content, geo-textile shall be omitted. A Well-mixed and compacted crushed stone layer shall be provided around the pipe, with an increased clean sand backfill layer on top.
17) Designers shall ensure that the specified geo-fabric is suitable for use in the specific in-situ soil conditions.

Median Islands along dualled carriageways

18) Designs shall adhere to the requirements of section 4.2.4.3 of TRH15. Raised medians shall be designed to prevent infiltration of water. Where the aforementioned is not possible, effective subsurface drainage shall be provided.
19) Median islands shall be graded towards the carriageway(s) and shall not have a depression (to avoid the congregation of water).
20) Sub-surface drainage is generally not installed when the median island is surfaced. However, site-specific conditions, as explained above, may require otherwise.

10.4.5 Open Stormwater Channels

The following minimum standards shall apply to open stormwater channels:

Table 10-6: Open Stormwater Channel Design Criteria

Criteria	Unlined	Lined
Minimum longitudinal slope	1:200 (0.50 %)	1:400 (0.25 %)
Maximum flow velocity	1.0m/s	2.5m/s
Maximum side slopes	1: 5	Varies depending on material [1]

[1] *Acceptable linings include grouted stone pitching, concrete, rock filled gabion baskets, reno-mattresses, concrete blocks (flexible), etc.*

Unless the channel has the dual role of a treatment facility, its low flow area shall be lined in order to prevent erosion and ensure the facilitation of cleaning operations. Typical examples of lined open channels are shown in Drawing SW13. Refer to Section 10.5.4 for details pertaining to erosion control measures.

Open Stormwater channels are generally not accepted in areas where windblown sand and debris are prevalent and should thus be avoided in such areas.

10.4.6 Stormwater Ponds

The following design criteria will be applicable to stormwater ponds:

Table 10-7: Stormwater Pond Design Criteria

Characteristic		Design Parameter
Minimum invert slope	Lined	1:400 (0.25%)
	Unlined	1:200 (0.50%)
Minimum outlet diameter		375mm [1]
Maximum embankment slope (grassed)		1: 5 (20%)

[1] *Special outlet design may be required to limit flow, in order to meet downstream system constraints.*

Further to the above, the following shall be taken into consideration:

1) Any new stormwater pond shall be approved by the City's *Catchment, Stormwater and River Management Branch*.
2) The number of stormwater ponds must be kept to a minimum, to reduce maintenance requirements. Numerous small ponds shall be avoided.
3) Where possible, stormwater ponds shall be designed as dual purpose facilities or recreational areas.
4) Where required, subsurface drains shall be installed to allow efficient drainage of the ponds. Provision to be made at outlet structures to accommodate the connection of the subsurface drains (i.e. backdrops).
5) Grassed ponds shall have an irrigation system installed.
6) Maintenance requirements shall be taken into account at design stage and could include measures such as lined low flow channels.
7) Dry stormwater ponds are preferred. However, where not possible, wet ponds are permissible, provided that the water depth can be sustained at a minimum depth of 1.2m throughout the dry season.
8) Adequate warning signs and safety measures, such as fencing, shall be provided around wet ponds to ensure public safety.

Where fencing around ponds are required, welded mesh-panel (high security) type fencing shall be provided, in accordance with the specifications and requirements in Section 17.7. A gate shall also be provided for vehicular access to perform maintenance operations. Gate proposals shall be submitted for approval prior to procurement

Designers shall submit any fencing proposals to the Approval Authority prior to construction.

10.4.7 Flood Escape Routes

Trapped low points shall be avoided through sound layout and planning practices. Where trapped low points are unavoidable, flood escape routes (i.e. overland escape routes) shall be accommodated through one of the following systems:

- Public open spaces provided along drainage routes;
- Registered servitudes for escape routes over private properties. No structures or boundary walls shall be erected within such servitudes. This option is not recommended and should only be used in exceptional circumstances.

It must further be noted that at trapped low points, the underground drainage system shall allow for the 1:50 year storm event.

10.4.8 Road Drainage Considerations

General

Where channels are located outside the roadway and flow velocities exceed 2.5m/s, energy dissipation measures shall be introduced.

Intersections and Junctions

Runoff from side roads shall be controlled. The runoff from a side road should be collected upstream of the intersection, to avoid overrun/surface flows across intersection.

Roads with steep gradients that terminate downhill in a T-junction, should be avoided.

Unsurfaced Roads

For unsurfaced roads, side (open) drains shall be provided to accommodate the stormwater runoff. Side drains shall be lined when the flow velocity exceeds 1.0 m/s.

At road crossings or residential accesses, underground conduits shall be used to drain the water under the road, with headwalls on either side. Where there is insufficient depth to provide such underground conduit, a low water drift shall be used.

Double flat channels ("V-drain")

Grid inlet type catchpits shall be used where double flat channels are present.

Double flat channels may not be constructed across the intersections of roadways.

Medians on Dual Carriageway Roads

On dual carriageway roads, a paved/surfaced raised median island is preferred. Where this requirement cannot be met, the unpaved median island shall be provided with effective subsoil drainage systems to prevent water from entering the adjacent pavement layers.

10.4.9 Specification for Masonry Units (Bricks)

Burnt Clay Masonry Units (to SANS 227)

Table 10-8: Burnt Clay Masonry Units

Attribute	All Stormwater Structures *(manholes, catchpits, wing walls, headwalls, etc.)*
Class	NFXE (*Engineering unit*)
Type	Solid (un-perforated)
Nominal compressive strength	21MPa
Dimensions	222x106x73mm
Limits for cold water absorption	Not more than 12%
Efflorescence	Special grade

Concrete Masonry Units (to SANS 1215)

Table 10-9: Concrete Masonry Units

Attribute	*Surface Infrastructure (wing walls, headwalls, etc.)*
Type	Solid (un-perforated)
Nominal compressive strength	21MPa
Dimensions	222 X 106 X 73mm
Colour	'Cement grey'
Texture	Plain face
Ave drying shrinkage	0.06% (Normal shrinkage unit)

10.5 General Development Considerations

10.5.1 On-site Stormwater Requirements

10.5.1.1 Application of Water Sensitive Urban Design Principles in Stormwater Management

As required by the City's *Management of Urban Stormwater Impact Policy (MUSI Policy)*, Water Sensitive Urban Design (WSUD) principles will be incorporated into urban developments through the application of sustainable urban drainage systems (SUDS). The aforementioned shall be incorporated for all new developments, including both Greenfield areas and redevelopment in Brownfield areas, as well as additional development on an existing developed site.

10.5.1.2 Sustainable Urban Drainage Systems (SUDS) Objectives for Developments

The two main SUDS objectives are as follows:

- To improve quality of runoff (treatment);
- To control the quantity and rate of runoff (attenuation).

For Greenfield Developments, Brownfield and Existing Development Sites larger than 4000m², on-site treatment and attenuation will be required.

For Brownfield and Existing Development Sites smaller than 4000m², with a total impervious area (existing + new) greater than 600m², on-site treatment and attenuation is not required (but encouraged, where practical), provided that regional off-site treatment and run-off control measures are available. If the aforementioned measures are not available, the following on-site treatment will typically be required:

- Treatment volume equivalent to the ½-year 24hour storm;
- Attenuation volume equivalent up to the 1:50-year storm.

The criteria for achieving SUDS objectives for various development scenarios are provided in the Annexure to the *Management of Urban Stormwater Impact Policy*.

For further details, designers can contact the CSRM branch for on-site stormwater requirements of development approvals.

10.5.1.3 Approval of Stormwater Management Systems

All stormwater management systems (SWMS), including stormwater management plans, for new developments, planned and designed in terms of *Urban Stormwater Impact policy*, shall be approved by the CSRM Branch. Furthermore, approval of the SWMS and/or SWMP shall be obtained prior to the civil engineering drawings being submitted (to the District Engineer) for approval.

10.5.2 Stormwater Erf Connection Manholes

Where the impervious area of an erf exceeds 600m², the erf shall be serviced with an underground connection. Additional connections may be provided for larger erven, especially if there is a high likelihood that the erven may be subdivided in the future. The provision of additional connections shall be subject to the Approval Authority's consent.

Where such a stormwater service connection(s) is required from the development to the municipal main line, the following will be required:

- A stormwater manhole connection shall be provided inside the erf (as close as possible to the erf boundary).
- A minimum 375mm diameter connection pipe (from the connection manhole to the main line).

The drainage of "backyards" serving attached houses/structures shall be taken into account at design stage, preferably by the installation of an underground system.

10.5.3 Pollution Control

Oil interceptor traps shall be provided at taxi ranks to facilitate the removal of oil and other pollutants, resulting from the washing down of vehicles.

All developments are required to trap litter, oil, grease, etc. at the source of origin.

10.5.4 Access Considerations & Erosion Control

Access for river cleaning equipment shall be considered at design stage for developments in the vicinity of river corridors.

For areas with high concentrated stormwater runoff, the provision of erosion protection measures may be required. Such measures typically include, but are not limited to, grouted stone pitching , rock-filled gabion baskets, reno-mattresses, flexible paver structures, grass blocks, riprap, concrete, etc. Erosion control measures shall be discussed with and approved by the Approval Authority prior to construction.

It shall be noted that the use of riprap is not allowed within the public road reserve.

10.6 Inspection and Handover

Where infrastructure will be handed over to the City (on completion of construction), all stormwater conduits (including connections) shall be inspected by means of a CCTV inspection camera and a report submitted to the relevant District Office (Roads and Stormwater branch), together with a copy of the recorded footage (MS Windows Media Player compatible). Any faults found during the camera inspection shall be rectified to the City's satisfaction prior to the hand-over (acceptance) of the infrastructure.

To: ***Part A Overview***

To: ***Chapter Overview***

CHAPTER 11

SANITATION (SEWER)

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CHAPTER 11: SANITATION (SEWER)

The information provided in this Chapter is an overview of the basic sanitation requirements from the City's Water and Sanitation department.

For comprehensive requirements, Designers shall consult the latest version of the City's *Service Guidelines and Standards for Water & Sanitation Department*.

11.1 General

The sanitation system described in this section is that of a fully waterborne sewerage system with separate connections to individual erven.

The main sewer line will be constructed within road reserves. Midblock sewers are generally not permitted and will only be allowed where it is impossible to drain to the road reserve.

With any proposed development an overall sewerage management plan needs to be submitted that takes into consideration existing and future developments. Existing downstream systems shall also be investigated, in order to determine the potential for capacity for additional flows.

11.2 Relevant Codes of Practice, Policy and Guidelines

- The Neighbourhood Planning and Design Guide ("Red Book"), Chapter K, 2019.
- CCT, Service Guidelines and Standards for Water & Sanitation Department – latest version.

11.3 Design

11.3.1 Sewer Design Criteria

Table 11-1: Sewer Design Criteria

Characteristic			Design Parameter
Sewer Flow (excluding infiltration) based on land use (Minimum) [1] PDDWF (litres/unit/day)	Residential		480
	Low-Income Housing		290
	Group/Cluster Housing		380
	Flats		250
	Retirement Village		480
	Business/Commercial		520
	Industrial		320
	Warehousing		240
	Institutional		480
	Education		390
	Other (not specified above)		Table K.8 (Red Book, Section K)
Allowance for groundwater infiltration [2] (L/min/m pipe/m Ø)	Minimum		0.03
	Maximum		0.04
Minimum velocity			0.6 - 0.7 m/s
Peak factor [3]	Residential		1.8 – 2.5
	Business/Commercial		1.3 – 1.5
	Industrial	Light	2.5 – 4.0
		Heavy	2.0 – 3.0
	Clinics, Restaurants, Laundromats, Hotels		1.8 – 2.5

PDDWF = Peak daily dry weather flow for the peak day in the week

[1] Figures are given as the minimum sewer flow for the various land use types. Designers shall refer to Table K.4 (Red Book, Chapter K) for the exact sewer flows, based on the applicable land use type (i.e. density and stand size).

[2] According to Section K.4.2.2 (Red Book, Chapter K), "typically, 35% of the total base flow measured in sewers is due to groundwater infiltration through joints and cracks in the sewer pipe system".

[3] As per Table K.8 (Red Book, Chapter K).

11.3.2 Sewer Pipe Lines

Table 11-2: Sewer Pipe Line Design Criteria

Characteristic		Design Parameter
Minimum diameter (nominal)	House connections [1]	110mm
	Main lines	160mm
Bedding type		Class B (SANS 1200 LB)
Position in road reserve		Road centre line or slightly offset on cambered roads. Refer to Section 4.3.1
Minimum full flow velocity		0.9 m/s
Maximum velocity		3.5m/s
Minimum cover		1m
Maximum distance between manholes		90m
Minimum gradient for 160mm pipes, based on number of dwelling units	Less than 10 units	1 : 100
	10 to 80 units	1 : 120
	81 to 110 units	1 : 150
	111 to 130 units	1 : 180
Minimum gradient for pipe sizes >160mm	200mm	1 : 260
	225mm	1 : 300
	250mm	1 : 340
	300mm	1 : 440
	375mm	1 : 600
	450mm	1 : 760
	525mm	1 : 940
	600mm	1 : 1080

[1] *Connection from the main municipal sewer network to the connection point inside the property.*

11.3.3 Pipe Materials

Table 11-3: Sewer Pipe Materials

Diameter Range	Specification
<400mm	uPVC Heavy Duty Class 34 complying with SANS 791. Fittings to comply with SANS 1601 for stiffness Class 400 pipes.
> 400mm	Reinforced concrete pipes containing dolomitic aggregates can be used for sewers larger than 400mm. The pipes should have an approved sacrificial lining inside as per SANS 677. Other specifications are as contained in SANS 1200 LD

Notes:

SANS 791 - Unplasticized poly (vinyl chloride) (PVC-U) sewer and drain pipes and pipe fittings
SANS 1601 - Structured wall pipes and fittings of unplasticized poly (vinyl chloride) (PVC-U) for buried drainage and sewerage systems
SANS 677 - Concrete non-pressure pipes
SANS 1200 LD - Standardized specification for civil engineering construction Section LD: Sewers

All pipes, fittings and accessories shall comply with the latest edition of the relevant SANS specification.

11.3.4 Erf Connections

The following shall be applicable for sewer erf connections:

i) Sewer erf connections shall be 110mm nominal diameter and extend 1m into the erf boundary.
ii) The minimum slope for erf connections shall be 1:60.
iii) The sewer erf connection shall be terminated with an end cap, rodding eye or boundary chamber. In affordable housing developments, where the dwelling is constructed within 2m from the road reserve, the erf connection shall be extended so that the rodding eye is positioned against the house wall, orientated to facilitate rodding.
iv) A shared connection for two properties will only be permitted in affordable housing developments.
v) erf connection depth shall generally be 1m, but deep enough to drain the furthest possible point of an erf. erf connections shall not be deeper than 1.2m.
vi) Junctions and specials to be same wall thickness as the sewer main.
vii) Each erf connection shall be linked to the main with a Y-junction or be connected at a manhole.
viii) The position of the erf connection shall be marked on the kerb by cutting a single groove into the concrete surface with an angle grinder, 75mm high x 5mm thick. The marking shall be painted brown (100m wide), with an approved paint. See Section 13.5.
ix) Marker posts to be installed at sewer erf connection points to consist of 75mm x 150mm x 1m concrete edging stones placed vertically, protruding 100mm above finished ground level.

11.3.5 Manholes

The following shall be applicable for sewer manholes:

i) Manholes shall be provided at all horizontal and vertical changes in direction, including pipe junctions and end points.
ii) Maximum distance between manholes shall be 90m.
iii) All pipe connections, excluding backdrop connections, shall be crown-to-crown.
iv) The two types of sewer manholes are:
    1) Precast Fibre Cement (FC) Solid Shaft and Base Type Manholes (preferred type).
    2) Precast Concrete Ring Manholes, with concrete starter ring and base (no brickwork allowed). Minimum 1m diameter, with precast top slabs.
v) Brickwork of manhole chimney to be plastered externally and internally. No brickwork allowed elsewhere in sewer manholes.
vi) Dolomite aggregate and low alkali sulphate-resistant cement to SANS 50197-1 shall be used for all concrete, mortar and screeding.
vii) All manholes shall be waterproof.
viii) Connecting pipework shall be fitted with flexible joints.
ix) Covers and Frames:
    a) All sewer manhole covers and frame shall be Class D400 as per SANS 50124.
    b) The types of covers and frames to be used are provided in the table below:

Table 11-4: Sewer Manhole cover and frames

Type	Utilisation
Ductile Iron with Concrete Infill	All municipal sewer manholes in public road reserves. All municipal sewer manholes inside private developments, where the manholes are situated in a road or NMT facility used by the general public.
Hinged Ductile Iron	Accepted for all municipal sewer manholes on private developments, provided it is outside roadways and NMT facilities used by the general public

11.3.6 Rodding Eyes

The following requirements will be adhered to when installing rodding eyes:

i) Long radius bends shall be used at rodding eyes.
ii) The rodding eye shall be covered with a manhole cover and frame as specified for sewer manholes situated in road reserves.
iii) Rodding eye covers on private properties shall be as per the requirements of the latest *Service Guidelines and Standards for Water and Sanitation*.

CHAPTER 12

WATER RETICULATION

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CHAPTER 12: WATER RETICULATION

The information provided in this Chapter is an overview of the basic water reticulation requirements from the City's Water and Sanitation department.

For the comprehensive requirements, Designers shall consult the latest version of the City's *Service Guidelines and Standards for Water & Sanitation Department*.

12.1 General

Developers are required to provide water reticulation networks, with capacity sufficient to cater for the type of development proposed. Any proposed system needs to integrate with existing and future surrounding developments.

The design shall be analysed on the City's overall water reticulation network. The *Water and Sanitation Department* may require a hydraulic modelling analysis for a project, in order to evaluate and properly develop the available water source. Improvements may need to be incorporated into the network, to provide an overall well-balanced system.

Designers shall make every effort to loop water mains throughout a system and to eliminate dead-end mains.

Transmission water mains are typically 250mm in diameter and larger. Transmission mains shall have parallel distribution mains, in order to supply water for service connections. House connections will not be allowed on transmission mains.

Bulk transmission mains, generally those with a diameter greater than 350mm, are not covered in this section. Special approval for the pipe materials, specials, fittings and chambers need to be obtained from the Water Services Department.

12.2 Relevant Codes of Practice, Policy and Guidelines

- The Neighbourhood Planning and Design Guide ("Red Book"), Chapter J, 2019.
- CCT, *Service Guidelines and Standards for Water & Sanitation Department* – latest version.

12.3 Water Reticulation Design

12.3.1 Design Criteria

Table 12-1: Water Reticulation Design Criteria

Characteristic			Design Parameter
Water Demand based on land use (Minimum) [1] AADD (litres/unit/day)		Residential	600
		Low-Income Housing	300
		Group/Cluster Housing	400
		Flats	250
		Retirement Village	600
		Business/Commercial	650
		Industrial	400
		Warehousing	300
		Institutional & Education	600
Peak Factor [2] (peak hour, PF_{hour})		Low-Income Housing	3.00 – 3.60
		Residential	3.00 – 4.60
		Business/commercial/ industrial	3.00 – 3.30
		Large single users	2.50
		Inner city	2.00
Hydrant Spacing for Fire Fighting [4]	Risk Category		-
	A	Non-residential buildings with divisions not greater than 5000m²	85m
	B	Non-residential buildings having divisions not greater than 2500m²	120m
	C	Non- residential premises not greater than 1250m²	200m
	D1	Houses more than 30m apart	300m
	D2 – D3	Houses up to 30m apart	200m
Minimum Fire Flows [3] (at one hydrant)		High to Moderate Risk Groups	1500 litres / min
		Low Risk Groups	900 litres / min
Pressure for reticulation systems		Minimum peak pressure	20m
		Recommended maximum static pressure	60m
		Absolute maximum static pressure	90m

AADD = Average Annual Daily Demand

[1] Figures are given as the minimum AADD for the various land use types. Designers shall refer to Table J.2 (Red Book, Chapter J) for the exact water demands, based on the applicable development type (i.e. density and stand size).

[2] Figures are given as an overview. Designers shall refer to Table J.9 (Red Book, Chapter J) for the exact peak factors, based on the applicable development type (i.e. TAADD in supply zone).

[3] Refer to Table J.17 (Red Book, Chapter J) for further details (i.e. Total Fore Flow, Minimum Pressure at fire node, Minimum pressure at rest of system).

[4] Refer to SANS 10090 (2018) for comprehensive requirements.

[5] Refer to Table J.12 (Red Book, Chapter J) for further details/comments and exceptions.

12.3.2 Water Pipe Lines

Table 12-2: Water Pipe Line Design Criteria

Characteristic			Income Group		
			Lower	Middle	Higher
Minimum Pipe Diameter[1]	House connections serving one erf		15mm	20mm[1]	20mm[1]
	House connections serving two erven		20mm (branching to 2 x 15)	40mm (branching to 2 x 20)	40mm (branching to 2 x 20)
Minimum Pipe Size for distribution (network) water mains (excluding water connections)		Mild Steel and Stainless Steel	100mm (nominal)		
		uPVC and HDPE	110mm (nominal)		
Minimum gradient			0.3%		
Minimum cover for pipe sizes	20mm to 50mm		600mm		
	75mm to 100mm		800mm		
	150mm to 200mm		1m		
	250mm to 350mm		1.2m		
Bedding type			Class B (SANS 1200 LB)		
Position in road reserve			In verge of road reserve. Refer to Section 4.3.2		

Tables references as per Chapter J of the Red Book (2019)
[1] Where a pipe crosses a roadway, the size shall be 25mm up to erf, where after it reduces to 20mm. Refer to Table J.13

12.3.3 Isolating Valves

The following shall be applicable to isolating valves:

i) Isolating valves shall be provided in such a manner that no more than four valves need to be closed to isolate a section of main.

ii) Valves shall be spaced so that the total length of main included in an isolated section does not exceed 600m.

iii) Where pipes intersect, isolating valves shall generally be installed in the smaller diameter branches.

iv) Valves shall generally be located opposite erf boundary (splay) pegs. Avoid placing valves underneath kerb lines or driveways.

12.4 Water Reticulation Materials

12.4.1 Pipe Materials

Table 12-3: Water Reticulation Pipe Materials

Diameter Range	Specification
20mm to 40mm	HDPE Class 16, type 5 complying with SANS 533 using compression fittings and joints.
75mm to 300mm	uPVC Class 12 heavy duty complying to SANS 966 using spigot and socket rubber ring joints
100mm to 300mm	Fibre cement C.O.D. Class D bitumen dipped complying to SANS 1223 with Triplex Couplings
> 300mm	As specified by the CCT: Water and Sanitation Department

SANS 533 - Black polyethylene pipes for the conveyance of liquids Part 1: Low density black polyethylene pressure pipes
SANS 966-1 - Components of pressure pipe systems Part 1: Unplasticized poly (vinyl chloride) (PVC-U) pressure pipe systems
SANS 1223 - Fibre-cement pressure pipes and couplings

All pipes, fittings and accessories shall be Class 16, in compliance to the latest edition of the relevant SANS or ISO specifications and JASWIC approval.

All bends, tee's reducers, etc., to PVC pipes shall be Ductile Iron to SANS 52842, fusion-bonded thermoplastic coated internally and externally to minimum 250 micron coating thickness.

12.4.2 Valves

The following shall be applicable to valves:

i) Scour and air valves to be installed as required. Scour valves may not discharge into underground drainage systems, only into open surface drains.

ii) All valves shall be in accordance with the latest edition of SANS 1200 or SANS 664, and be approved by the *CCT: Water and Sanitation Department*.

iii) Valves are to be of the resilient seal or wedge-gate type. Resilient seal valves shall be used for general applications, and wedge-gate valves shall be used for valves dividing zones, or similar key applications

iv) Valves shall be clockwise opening, left hand closing.

v) Direction of opening is to be clearly marked on valve body or spindle cap.

vi) Valves shall be Heavy Duty Class 16.

vii) Valves shall have non-rising spindles.

viii) Valves shall be fitted with cast iron cap tops, secured with retaining bolts.

ix) Cast iron gate type valves shall be downright or similar approved.

x) Only valves supplied with a Protective Epoxy Paint, applied to a minimum thickness of 225 micron to all internal surfaces after it has been thoroughly cleaned by grit blasting to Sa 2½ finish (in compliance with the requirements of SIS 05 09 00 or ISO 8501-1), or valves with similar approved coatings, will be acceptable. The epoxy product shall be submitted to the *CCT: Water and Sanitation Department* for approval, prior to application.

xi) Valve bell tobies shall be shall be polymer concrete, conforming to SANS 50124.

xii) Valve covers for general purpose valves shall be painted blue and shall protrude about 25mm above ground level in non-paved areas.

xiii) Valve covers for zonal valves and valves, which generally remain closed, shall be painted red and shall protrude about 25mm above ground level.

12.4.3 Fire Hydrants

The following shall be applicable to fire hydrants:

i) Designers' attention is drawn to the location of fire hydrants within a proposed reticulation system. Fire hydrants not only provide water for firefighting but also assist in maintenance and repair issues such as drainage of the system and for air relief. The location of fire hydrants at low and high points in the system is therefore essential. Fire hydrants should also be located such that they will be easily accessible. Fire hydrants must be located so that firefighting equipment can reach it.

ii) The position of all fire hydrants must be clearly marked with the appropriate symbol painted onto the road surface at the nearest point on the road, or by painting a kerb (1m) yellow at the closest point on the same side as the hydrant.

iii) Fire hydrants shall be installed in accordance with SANS 1200, comply with the local Fire Department standard regulations and approved by the *CCT: Water and Sanitation Department*.

iv) All Fire Hydrants shall be 65mm diameter (internal).

v) Outlets shall be London round thread with loose cap and securing chain.

vi) Hydrant spindles shall be provided with cast iron caps, secured with retaining bolts.

vii) Hydrants shall be clockwise opening / left hand closing.

viii) Only hydrants supplied with minimum thickness of 225 micron epoxy paint applied to all internal surfaces after it has been thoroughly cleaned by grit blasting to Sa 2 ½ finish (in compliance with the requirements of SIS 05 09 00 or ISO 8501-1), or hydrants with similar approved coatings, will be acceptable.

ix) Hydrant covers shall be polymer concrete conforming to SANS 50124 and shall be painted with a minimum of two coats yellow oil paint, or impregnated with yellow colouring during casting. The covers are to be secured to the frame with a galvanised chain or cable.

x) Hydrants shall be supplied and installed complete with a flanged CI extension piece complete with cadmium-plated nuts and bolts to ensure depth not greater than 400mm.

xi) Hydrants shall be installed at the end of dead "runs" for charging and bleeding the lines.

12.4.4 Fittings and Specials

The following shall be applicable to fittings and specials:

i) Fittings and specials for uPVC pipes shall be cast iron or ductile iron, with spigot and socket rubber ring joints, and shall comply with the relevant requirements of SANS 966 or SANS 52842.

ii) All cast iron or ductile iron fittings shall be fusion bonded thermoplastic coated internally and externally to a minimum thickness of 250 micron.

iii) Only stainless steel bolts and nuts shall be used on all fittings, such as saddles, flanges, short collar couplings, etc.

12.4.5 House Connections

The following shall be applicable to house connections:

i) Saddles shall be 16 bar (PN 16) polypropylene with DZR brass (dezincification resistant brass) inserts secured with stainless steel bolts and nuts.

ii) Ferrules are not required.

iii) The position of the house connection shall be marked on the kerb by cutting a 5mm deep slot with an angle grinder into the concrete kerb face. The slot shall be painted blue.

12.4.6 Domestic Water Meters < 50mm in diameter.

Should the Developer elect to supply the water meter boxes and meters, the following shall apply:

i) The meter shall comply with the relevant requirements of SANS 1529-1 and shall be approved in terms of Section 18 of the Trade Metrology Act No. 77 of 1973 and Regulation 80 of Part II of the Trade Metrology Regulations. All meters shall be tested and sealed by an accredited laboratory.

ii) The meter must be plastic bodied, semi-positive rotary piston volumetric type, accuracy performance to Class "C" Specification, (KSM-T) with the following features:

   a) Meter body to be manufactured from specially blended polyacetal.

   b) Meter must be approved by Trade Metrology for vertical and horizontal installation.

   c) Each meter must be backed with a 3 year guarantee against faulty workmanship and/or materials. Spare parts for meter and box must be locally available for a period of at least 10 years.

   d) Meter must be fitted with a pulse output facility (1 pulse / 0,5 litre).

   e) Meter must be fitted with a non-return valve.

   f) Meter must be fitted with a three-way brass ballcock with trickle flow facility and special dual purpose key for lid and valve.

   g) Meter must be fitted with an accredited certification body (e.g. SABS) approved DZR Brass couplings, supplying 20mm female threaded.

   h) Meter couplings shall be designed that they retract when loosened to allow fitting or removal of the meter without complete disassembly connection points through meter box.

   i) All purchased meters must have zero readings.

iii) The meter box shall be fitted with a base plate, a plastic male thread on both ends and a hinged lid, with viewing slot and tamper-proof locking mechanism. All shall be moulded from modified poly-propylene (UV stabilised).

iv) For affordable housing developments, the preferred position of the water meter box is mounted on the wall of the proposed houses, provided that the house is situated within 2m from the erf boundary. In all other cases the meter shall be installed as per the requirements of the *Service Guidelines and Standards for Water and Sanitation*.

v) A brass stopcock shall be installed on the property side of the water meter box, secured to the meter box with a short 15mm copper connecting pipe.

vi) Samples, together of the proposed materials and fittings, shall be supplied to the *CCT: Water and Sanitation Department* for approval.

12.4.7 Air Valves

All air valves shall be approved before installation.

12.4.8 Bulk water meter chambers

The following shall be applicable to bulk water meter chambers:

i) Bulk water meter chambers to be as per the requirements of the *Service Guidelines and Standards for Water and Sanitation Department.*
ii) Bulk water meter chambers to be painted externally with coats to approve water tightness.
iii) In the case of private developments, the valves directly after the bulk water meter chambers, shall be fitted with hand wheel, instead of a cast iron cap tops.

12.4.9 Compression fittings for HDPE Pipes

The following shall be applicable to compression fittings for HDPE Pipes:

i) All compression fittings included in this specification shall be designed and be suitable for use with potable water distribution systems and be supplied from manufacturer complying with the requirements of ISO 9002. Fittings bodies may be of various configurations and include male adaptors, female adaptors, couplings, reduced couplings, elbows 90°, elbows 90° with male off take, elbows 90° with female off takes, elbows 45°, elbows 45° with male off take, Tee 90°, Tee 90° reduced / increased, Tee 90° with male off take, Tee 90° with female off take, Flanged joints, end caps and wall plate-elbows. The main size range is from 16 mm diameter up to 110mm diameter. The fittings must be able to operate at a constant working pressure of 16 bar at an ambient temperature of 20°centigrade.
ii) Suppliers must provide approvals of minimum three internationally recognised authorities, such as DVGW, DS, SVGW etc. for their products.
iii) All bodies shall be injection moulded from recognised top quality polypropylene (PP) (black). The bodies must have moulded-in manufacturer identification, material and series information and show the dimensions of the pipe outside diameter and if necessary of the threads. All male and female threads of the bodies shall be injection moulded according to the ISO 7/1 standard.
iv) All compression fitting nuts shall be injection moulded from recognised top quality polypropylene (PP) and be coloured blue. The nuts must have an UV resistance of grade 8 according to ASTM D2565 and shall have moulded-in manufacturer identification and show the KIWA and Australian standard approval. The outer circumference must be provided with ribs to enhance handgrip or the tightening of the nut with adequate tools
v) All clamp rings shall be injection moulded from recognised top quality Polyacetalic Resin (POM) and be coloured white. Clamp rings shall not be connected to the thrust rings but be able to move freely on them. Thrust rings and clamp rings must be two (2) different components.
vi) All thrust rings shall be injection moulded from recognised top quality polypropylene (PP) and be coloured black. Thrust rings up to 50mm diameter shall be secured in the body so that they cannot fall if the fittings are disassembled. Thrust rings must not be connected to the clamp rings. Thrust rings must apply pressure on the gaskets if the nuts are tightened. Thrust rings and clamp rings must be two (2) different components.
vii) All gaskets shall be made of a recognised top quality Nitrile Rubber (NBR) and not contain a plasticiser that when in direct contact, has a harmful effect to either plastic pipes or fittings. Each gasket must have a smooth finish and be free from moulding flashes or similar. Gaskets up to 63mm diameter must have an average Shore hardness of 70 ± 5 degrees. Gaskets greater than 63mm in diameter must have an average Shore hardness of 60 ± 5 degrees.
viii) All gaskets will be coloured black. All gaskets must have a conical shape on the inside of the gasket for an easy insertion of the pipe without disassembling of the fitting. All gaskets are to have a wide flat sealing contact function with the pipe in question. All gaskets must have a cylindrical shape on the outside of the gasket. Gaskets must have two (2) lips on the bottom of the gaskets to guarantee a good sealing in cases of suction and vacuum. Gaskets must be pre - lubricated to facilitate easy installation. The use of 0-rings as a pipe to fitting seal is not permitted.
ix) The compression fittings must conform to the relevant internationally recognised performance requirements:
    - Type test Standard Dimensions of the threads - ISO 7/1
    - Tightness of the joints - ISO 3458
    - Tightness of the joints when subjected to bending - ISO 3503
    - Resistance to pull-out - ISO 3501
    - Internal under-pressure test - ISO 3459
    - Long term pressure test - ISO/DIS 14236
x) Samples need to be submitted to the COCT Project Manager for approval.

12.4.10 Testing of Water Mains

All water mains shall be pressure tested as specified in SANS1200-L, with all fittings, specials and house connections and leadings in place.

12.4.11 Corrosion Protection Specifications

All mild steel pipes, specials and fittings with nominal diameter up to and including 150mm shall be hot dipped galvanized to SANS 121 and SANS 32. All steel pipes, specials and fittings with nominal diameter greater than 150mm shall be lined internally and coated externally with Protective Epoxy Paint Product applied in three coats of minimum 125 microns DFT (dry film thickness) per coat to manufacturer's specifications. The epoxy product shall be submitted to the *CCT: Water and Sanitation Department* for approval, prior to application.

All bolts, nuts and washers for mild steel pipework shall be hot dip galvanised to SANS 121 and SANS 32. All bolts and nuts shall be grade 8.8 to SANS 1700 and ISO 898. Two washers shall be used with every bolt connection to prevent damage to coatings.

Suitable isolation shall be provided between flanges, washers and bolts to prevent galvanic corrosion between dissimilar metals (e.g. between stainless steel and mild steel or cast iron). Shaft thread shall be covered with heat shrink insulation (or similar approved) and 3mm Caf non- conductive washers shall be used with standard washers where dissimilar fittings are joined.

Plain ended fittings shall be joined with approved couplings coated with 300 microns of a Polymer Resin product to the manufactures specifications.

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CHAPTER 13

DUCTS

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CHAPTER 13: DUCTS

13.1 General

Engineering drawings for proposed roadways shall make provision for ducts (a.k.a. "sleeves") for the various services, in order to prevent unnecessary future trench excavations.

At design stage, the service providers shall be contacted and their needs for ducts, for future cables or other services, shall be obtained in writing.

13.2 Design Criteria

13.2.1 Electrical

The following shall be applicable to duct installations for electrical services:

i) Draw wires to be installed in all ducting, with a 2m free length at each end.
ii) Duct ends shall be sealed with uPVC end-caps.

The design criteria contained in the table below shall be adhered to for electrical services.

Table 13-1: Ducting Design Criteria for Electrical

Characteristic		Design Parameter
Ducts for Road Crossings		
Duct extension beyond kerb line (minimum distance)		1m
Depth between the road surface and top of the duct encasement		900mm
Ordinary trenching for electrical cables outside roadway		
Minimum depth below finished surface and cable	High voltage cables	1m
	Medium voltage cables	800mm
	Low voltage cables	600mm
Minimum trench width		600mm
Minimum side clearance (between trench wall and cable)		200mm
Minimum horizontal clearance between adjacent cables		150mm
Minimum vertical clearance between cables		100mm

All multiple layers of ducts shall be encased in 10MPa concrete.

For electrical services, ducts shall be arranged and concrete encased, as shown on drawing series GE6. The maximum allowed deviation in any direction is 30mm.

All pipe-ends shall have sharp edges and irregularities removed prior to installation. Before the installation of end- caps, all pipes shall be checked for obstructions, which shall be removed by using a "pig".

Electrical duct crossings shall have danger tape installed on top of the concrete duct section, just below the pavement structure of a road.

13.2.2 Traffic Signals

Where required, ducting for Traffic Signals shall be provided with a Cable Inspection Chamber at duct ends, as per detail Drawing GE12.

All traffic signal ducts installed deeper than 1m shall be encased in 10MPa concrete.

13.2.3 Telecommunication

The design criteria contained in the table below shall be adhered to for telecommunication services.

Table 13-2: Ducting Design Criteria for Telecoms

Characteristic	Design Parameter	
Number of Ducts	**1, 2 ,4**	**8**
Minimum depth	1m	
Minimum trench width	450mm	690mm
Minimum side clearance (between trench wall and duct)	90mm	50mm
Minimum horizontal clearance between adjacent ducts	50mm	
Minimum vertical clearance between ducts	80mm	

Where the cover to the top most ducts is less than 600mm, the ducts shall be encased with concrete, as per the requirements of the City's *Telecommunications Infrastructure* department.

Designers can refer to Section 17.5 for further details.

13.2.4 Street Lighting

The following shall be applicable to duct installations for street lighting services:

i) A galvanized draw wire shall be installed within each duct, with the end protruding at least 500mm.

ii) All duct ends shall be capped.

iii) Spare ducts shall be provided with rust-free draw wire and the PVC covering shall remain over the duct ends after installation. If no PVC covering is provided, the draw wires shall be rust-resistant. All draw wires shall conform to the requirements of the City's *Public Lighting Development* guidelines.

iv) At road crossings, a suitable number of 110mm diameter ducts shall be provided for all low voltage cables crossing (in addition to any duct requirements issued by the City's *Electricity Generation and Distribution* (EGD).

v) One spare duct per low voltage crossing shall be provided. Any additional duct requirements shall be determined by the City's Public Lighting Development division.

The design criteria contained in the table below shall be adhered to for street lighting services.

Table 13-3: Ducting Design Criteria for Street Lighting

Characteristic	Design Parameter
Duct extension beyond kerb line (minimum distance)	1m
Minimum depth	1m[1]

[1] *Where kerbside footways are present and the street light poles are situated behind the footway, the ducts shall be extended to 500mm behind the back of footway.*

Designers can refer to Chapter 14 for further details regarding street lighting.

13.3 Ducting Pipe Materials

The table below illustrates the relevant pipe diameter and specification for service ducts, which shall be provided for various service providers:

Table 13-4: Ducting Pipe Materials and Specifications

Service Provider		Pipe Diameter	Specification
Electrical	Low Voltage	110mm	uPVC Class 400 KPa complying with SANS 1601 using spigot and socket rubber ring joints.
	Medium Voltage	160mm	
Irrigation (parks)		110mm	uPVC Class 34 heavy duty complying with SANS 791 using spigot and socket rubber ring joints
Telecommunication		110mm	HDPE Double-Wall Corrugated Pipe, compression resistance of Type 450N, complying with SANS 61386-24 and using sealing rings
Traffic Signals		110mm	uPVC Class 400 KPa complying with SANS 1601 using spigot and socket rubber ring joints. or HDPE Double-Wall Corrugated Pipe, compression resistance of Type 450N, complying with SANS 61386-24 and using sealing rings

Notes:

SANS 791 - Unplasticized poly (vinyl chloride) (PVC-U) sewer and drain pipes and pipe fittings

SANS 1601 - Structured wall pipes and fittings of unplasticized poly (vinyl chloride) (PVC-U) for buried drainage and sewerage systems

SANS 61386-24 - Conduit systems for cable management: Part 24: Particular requirements — Conduit systems buried underground

13.4 Treated Effluent

Provision should be made for the accommodation of future underground treated effluent pipes.

Due to the larger pipe sizes of main treated effluent lines, the standard 110mm or 160mm uPVC or HDPE pipes/ducts might not suffice. This might require the provision of different types of pipes to act as ducts for the future treated effluent services, e.g. reinforced concrete pipes (spigot & socket, Class 100D) or larger HDPE pipes.

Designers should contact the City's *Water & Sanitation: Water Demand Management & Implementation branch* to acquire the necessary information regarding the planned treated effluent routes and any specific requirements with regards to the accommodation of future treated effluent pipelines.

13.5 Underground Duct and Services Marking Details

The table below illustrates the required marking specifications for underground service type.

Table 13-5: Underground Duct and Services Marking Details

Services Type	Lettering	Colour	Specification
Ducts			
Electrical	E	Red	Cut lettering on kerb face with grinder, 75mm high x 5mm thick
Traffic Signals	R	Yellow	
Parks (Irrigation)	P	Black	
Telecommunication	T	Green	Cut lettering, including vertical grooves equal to the number of ducts, on kerb face with grinder, 75mm high x 5mm thick
Spare/Open (future Services)	-	-	Cut vertical grooves, equal to the number of ducts, on kerb face or CWC edge restrains with grinder, 75mm high x 5mm thick
Water mains			
Valve	V	Blue	Blue cover for chamber. Cut V on kerb face (75mm x 75mm)
Fire hydrant	H	Yellow	Yellow cover for chamber. Paint one kerb (1m) yellow
Erf Connections			
Sewer	-	Brown	Cut single groove on kerb face with grinder 75mm high x 5mm thick
Water	-	Blue	
Electrical	-	Red	

13.6 Future Services

Where intersection upgrades are undertaken, provision shall be made for the installation of additional ducts, in order to accommodate future services without damaging the roadway through open excavation.

Similarly, where open trenching within a roadway is approved by the District Office, the City may require the provision of a spare duct for the reasons stated above.

To: Part A Overview

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CHAPTER 14

PUBLIC STREET LIGHTING

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CHAPTER 14: PUBLIC STREET LIGHTING

14.1 General

This chapter provides a brief overview of the basic requirements in terms of the placement of street lighting poles in relation to the roadway, design approval, inspection protocols and duct requirements for public street lighting.

All concepts shall be discussed with and approved by the City's *Public Lighting Development* division(PLD) of the Energy and Climate Change directorate timeously, prior to any contractual mechanism being put in place, to avoid delays and contract changes. All designs shall utilise the PLD equipment specifications and shall be strictly in accordance with the equipment specifications, to ensure compatibility with spare holding and replacement equipment, once the installation is completed.

For comprehensive requirements regarding public street lighting, designers shall refer to the latest version of the applicable design and installation standards of the City for the provision of public lighting services, obtainable from the PLD division. It must be noted that this chapter does not replace the aforementioned documents, but rather supplements the requirements thereof.

In addition to the design requirements of the lighting installation, the coordination of and application for the point(s) of supply for these installations shall be done with the relevant Electricity Generation and Distribution (EGD) Service Connection Planning office (either Wynberg, Bloemhof or Cape Town offices.)

14.2 Design and Approval

At the onset of a proposed development or public road, the PLD division shall be consulted, in writing, to establish the basic design parameters and methodology of construction. Designers shall undertake the design of the public lighting layout of the development or public road in accordance with aforementioned specifications. The final design shall state the classification of the road(s), including all design data and design calculations in accordance with SANS10098 lighting levels.

Consultation with the representative of the *PLD* division during the design stage is essential. The final design documentation shall be submitted, in duplicate, to the *PLD* division for approval before commencement of construction. A minimum period of three (3) weeks is required for the scrutiny of such designs and the approval thereof. The consultant shall also make contact with PLD division prior to commencement of the works.

The approved design shall be marked "APPROVED" and signed by the PLD official. The design shall then be resubmitted to PLD in an approved ArcGIS shape file format, for loading onto the City's GIS system as the approved version.

Street lighting shall be designed using the following as reference documents:

- SANS 10098-1 Public Lighting Part 1: *The lighting of public thoroughfares*
- SANS 10098-2 Public Lighting Part 2: *The lighting of certain specific areas of streets and highways*
- The latest guidelines/requirements of the City's *Public Lighting Development* branch.

Where public street lighting is provided in areas with high vandalism, anti-vandalism mechanisms shall be incorporated to the design.

14.3 Inspection and Handover

Site inspections will be required at the following construction milestones, with a minimum of a 48-hour notice period:

- Prior to pole installation (for inspection of poles).
- Cable installation, prior to the backfilling/closure of trenches.
- When the first termination is done, to ensure the method used is acceptable.

A final inspection with the Contractor, the Consulting Engineer and the City shall be held prior to handover. A 14-day advance notification is required for the afore-mentioned inspection. The project/installation shall only be handed to, and taken over by, the City on the date of the handover documentation signing. As part of the hand-over documentation, a fully detailed Bill of Materials, including the appropriate costs, shall be submitted, together with the final as-built GIS data (Shape file with: cadastral, pole height, luminaire mounting height, luminaire type and wattage, outreach arm, cable types and sizes, duct banks, supply kiosks, and photocell), including any other information as stipulated in the *Public Street Lighting* guidelines.

14.4 Ducts

At road crossings, a suitable number of 110mm diameter ducts shall be provided for all low voltage cables crossing (in addition to any duct requirements issued by EGD).

The following may be drawn into a low voltage duct:

- Up to four street lighting cables; or
- Up to four service connection cables; or
- One low voltage distribution cable.

One spare duct per low voltage crossing shall be provided. Any additional duct requirements shall be determined by the City's *Public Lighting Development* division.

A galvanized draw wire shall be installed within each duct, with the end protruding at least 500mm. All duct ends shall be capped. Spare ducts shall be provided with rust-free draw wire and the PVC covering shall remain over the duct ends after installation. If no PVC covering is provided, the draw wires shall be rust-resistant. All draw wires shall conform to the requirements of the PLD guidelines.

Ducts shall extend 1m beyond the kerbs, on either side of the road, and shall be installed at a minimum covered depth of 1m. Where kerbside footways are present and the street light poles are situated behind the footway, the ducts shall be extended to 500mm behind the back of footway.

Ducts shall be marked as per Section 13.5.

14.5 Street Light Pole Position

The positioning of street light poles shall be carefully considered, taking into consideration the movement of NMT users (e.g. pedestrians and cyclists) and vehicles. Where NMT facilities are present, the pole placement shall always accommodate the movement of people with disabilities (e.g. wheelchair users).

In terms of SANS 10098 - Part 1, the minimum set-back for street light poles is 500mm.

The section below stipulates the preferred positioning of street light poles in relation to the adjacent road and NMT facilities. However, the aforementioned positons are subject to change, due to possible site conditions/constraints. The final pole positions shall be approved by PLD. All setback dimensions shall be measured from the stipulated reference point, up to the edge of the street light pole.

The preferred street light pole positions are summarised in Table 14-1 at the end of this chapter.

14.5.1 Surfaced Roads

14.5.1.1 Roads with kerb present

Lower to Middle Order Roads

Along lower to middle order roads (i.e. Class 4 & 5 roads, as per Section 2.5), street light poles shall be positioned a minimum of 500mm from the kerb face. Where poles are placed more than 500mm, designers shall ensure that at least 1m of clear width is provided behind the pole, in order accommodate pedestrian movement (specifically people with disabilities).

The figure below illustrates the preferred placement of street light poles along lower and middle order roads.

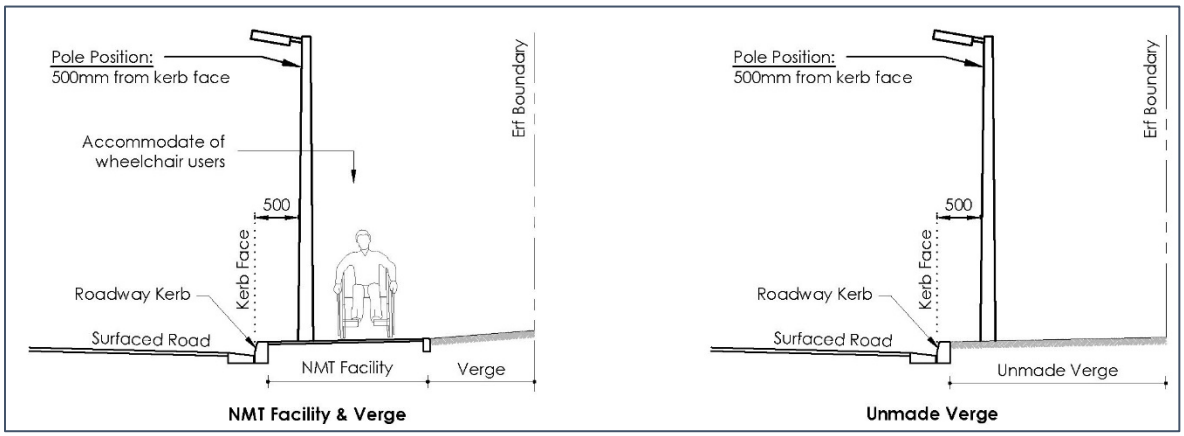


Figure 14-1: Position of street light poles on Lower & Medium Order Roads

Higher Order Roads

Along higher order roads (i.e. Class 2 & 3 roads, as per Section 2.5), pedestrian volumes are significantly higher. In some instances, the NMT facility acts as a shared facility for pedestrian and cycles. It is therefore preferred to have the street light pole positioned outside the NMT facility along higher order roads, in order to provide an unobstructed path of travel. The aforementioned can be achieved as follows:

1) Placing the pole behind the NMT facility. In such instances, the increased setback shall not negatively impact the pole spacing and lux (light) levels. The necessary lighting requirements shall still be adhered to. The aforementioned shall be discussed with the PLD division.

2) Placing the pole inside the "buffer strip" (between the roadway kerb and NMT facility), where such spaces are present. In such instances, the pole shall be placed at least 500mm behind the roadway kerb.

In some instances, the placement of street light poles outside the NMT facility will not be possible. In such cases, the pole shall be placed at an appropriate position inside the NMT facility, as described below:

i) Where the width of pedestrian NMT facility (footway) exceed 2.5m, the pole shall be placed in the middle of the NMT facility, in order to allow for equal clear widths for the NMT users.

ii) Where a shared NMT facility is present (which shall never be less than 3m), the following shall apply:

- If a demarcation line exists between various NMT types or the direction of travel, the poles shall be positioned on the demarcation line. A 15m long barrier line (including arrow markings) shall be provided on the existing demarcation line, on the approach(es) to the pole (i.e. obstruction). Refer drawing RM5.
- If no demarcation line exists, the pole shall be placed in the middle of the shared NMT facility, in order to allow for equal clear widths for the various NMT users. In addition, a 15m long barrier line (including arrow markings) shall also be provided on the approach(es) to the pole (i.e. obstruction). Refer drawing RM5.

The figure below illustrates the preferred placement of street light poles along higher order roads, as described above.

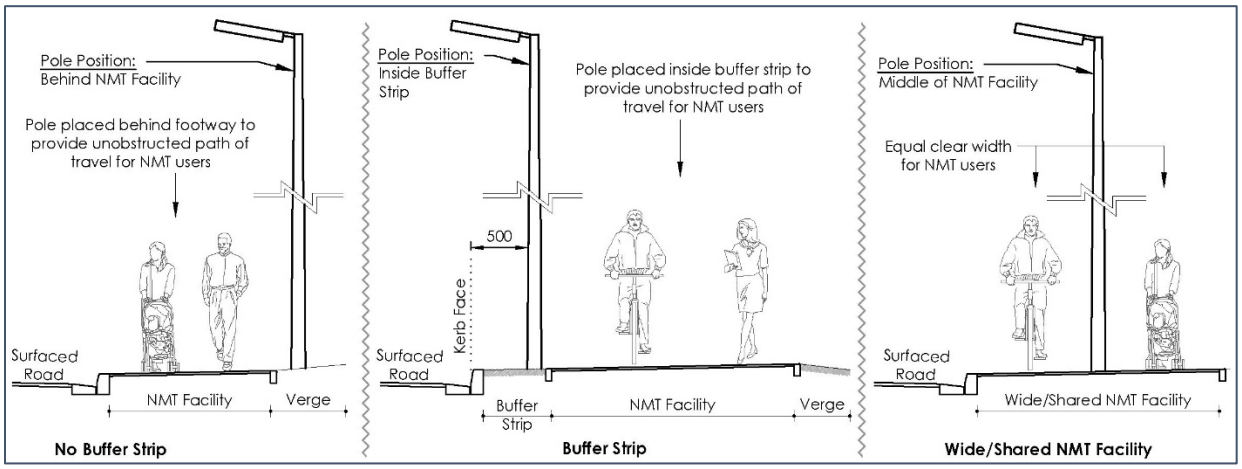


Figure 14-2: Position of street light poles on Higher Order Roads

14.5.1.2 Roads with no kerb present

For surfaced roads without any roadway kerbs present, i.e. only surfaced or gravel shoulder (or verge), poles shall have a minimum setback of 2.5m from the edge of the traffic lane. The aforementioned setback is necessary to provide a stopping space for vehicles in case of a breakdown or emergency. The setback also decreases the risk of vehicles colliding with light poles. Refer to **Figure 14-**3 below.

It should be noted that the 2.5m is the preferred setback. In certain instances, the aforementioned will not be possible due to site conditions/constraints. In such instances, PLD shall be consulted regarding the pole placement.

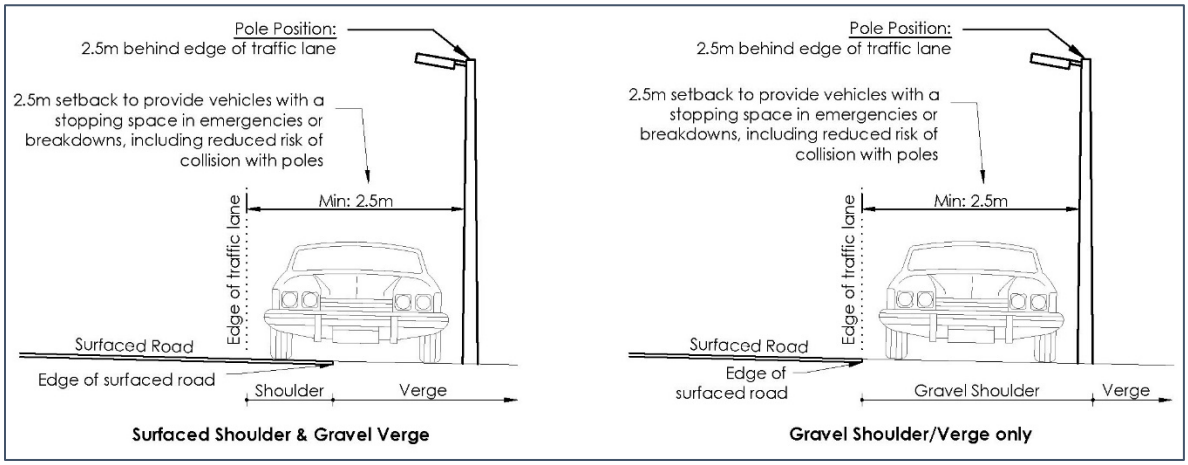


Figure 14-3: Position of street light poles where no kerbs are present

14.5.2 Gravel roads

For gravel roads, poles shall have a minimum setback of 2.5m from the edge of the graded roadway. The aforementioned setback is necessary to provide a stopping space for vehicles in case of a breakdown or emergency. The setback also decreases the risk of vehicles colliding with light poles. Consideration should also be given to any regrading or future upgrades. Refer to **Figure 14-4** below.

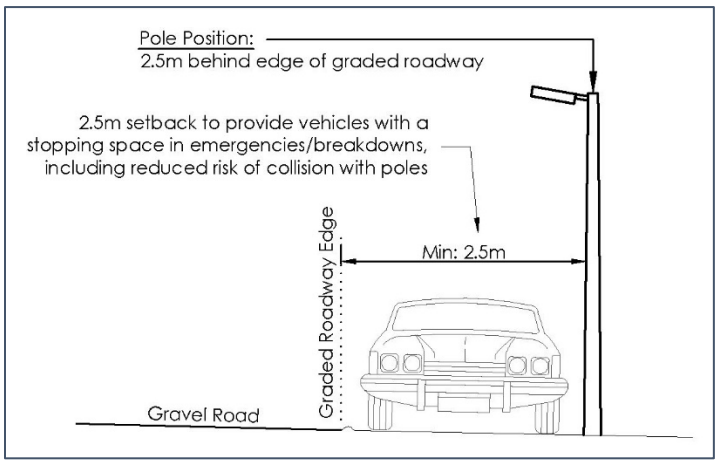


Figure 14-4: Position of street light poles on gravel roads

It should be noted that the 2.5m is the preferred setback. In certain instances, the aforementioned will not be possible due to site conditions/constraints. In such instances, PLD shall be consulted regarding the pole placement.

The table below provides a summary of street pole positioning for the various scenarios described above.

Table 14-1: Requirements for street light pole positioning

Scenario	Roadway Kerb	Position of pole [1]
Surfaced Roads		
Lower to Middle Order Roads	Yes	500mm from the roadway kerb
Higher Order Roads	Yes	Outside NMT Facility
Only asphalt and/or gravel shoulder/verge	none	Setback 2.5m from the edge of the traffic lane
Gravel Roads		
Gravel Roads	none	Setback 2.5m from the edge of the graded roadway [2]

[1] *Setback measured to face of pole*
[2] *Consideration should also be given to any regrading or future upgrades.*

To: ***Part A Overview***

To: ***Chapter Overview***

CHAPTER 15

GEOTECHNICAL

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CHAPTER 15: GEOTECHNICAL

15.1 General

The objective of this chapter is to provide guidance to designers in obtaining sufficient geotechnical subsurface information for the design and successful implementation of the works. The City's minimum geotechnical investigation requirements, that should be carried out prior and during construction, are stipulated in this chapter. Sufficient geotechnical subsurface investigation and laboratory testing are often neglected on projects and results in increased financial and safety risks. Soil and ground conditions are inherently variable and hence geotechnical investigation requirements are often underestimated. Cost overruns on projects, due to insufficient subsurface investigation and design, could be mitigated by undertaking a detailed geotechnical investigation and design.

This chapter's purpose is to:

- Provide geotechnical guidance for urban developments,
- Provide minimum investigation requirements,
- Give guidance on information to be provided in the Geotechnical Factual Report (GFR), Geotechnical Investigation Report (GIR) and Geotechnical Design Report (GDR), and
- Establish minimum design criteria.

This guide is also intended to assist designers in ensuring they request and receive the required level of geotechnical input for the project and are able to document the required work to the appropriate level of detail, in accordance with geotechnical codes and guidelines. This chapter serves as general guidance and does not replace the services of professional advisers on specific projects.

15.2 Relevant Codes of Practice, Policies and Guidelines

The following documents may be applicable to this chapter:

- BS8004:2015+A1:2020 Code of practice for foundations
- Department of Labour - Construction Regulations (2014)
- EN1997-1. Eurocode 7: Geotechnical Design -Part 1: General rules
- EN1997-1. Eurocode 7: Geotechnical Design -Part 2 Ground Investigation and testing
- GFSH-2 Geotechnical Site Investigations for Housing Developments
- SAICE Site Investigation Code of Practice
- SAICE SAIEG and AEG Guideline for Soil and Rock Logging in South Africa
- SAICE The Safety of Persons Working in Small Diameter Shafts and Test Pits for Geotechnical Engineering Purposes
- SAICE - Lateral Support in Surface Excavations Code of Practice
- SANS 634 - Geotechnical Investigations for Township Development
- SANS8006-1 Code of practice for strengthened/reinforced soils and other fills
- SANS 10400-G: Excavations
- SANS 10400-H: Foundations
- SANRAL Standard Specification for Subsurface Investigations
- SANRAL South African Pavement Engineering Manual (SAPEM), Chapter 7
- TRH4:1996 Structural Design of Flexible Pavements for Interurban and Rural roads
- NCMA Design Manual for Segmental Retaining Walls (2012)
- ASTM D6916, Test method for determining shear strength between segmental concrete units
- ASTM D6638, Test method for determining connection strength between Geosynthetic and segmental concrete units
- SANS508:2020 Concrete retaining blocks

15.3 Geotechnical Reports

Geotechnical Factual Report (GFR)

For tender purposes only, the factual account of the Geotechnical Investigation, without any interpretation, shall be provided in a Geotechnical Factual Report (GFR).

This will typically include information as detailed in Section 5.3 and 5.7 of the SAICE Site Investigation Code of Practice.

Geotechnical Investigation Report (GIR)

All investigation reports should be prepared in accordance with the requirements of SAICE Site Investigation Code of Practice or GFSH-2 and EN1997-2, including any related test standards under which the work is carried out. General Requirements, presentation and evaluation of geotechnical information shall be as per Section 6 in EN1997-2 and Section 5 of SAICE's Site Investigation Code of Practice.

Geotechnical Design Report (GDR)

Geotechnical Design should be undertaken in accordance to EN1997-1 or related design standards under which the work classifies. The Geotechnical Design Report (GDR) shall be in accordance to Section 2.8 of EN1997-1.

Geotechnical Baseline Report (GBR)

The Geotechnical Baseline Report (GBR) shall set out the anticipated geology, stratigraphy and groundwater depths. The GBR should be agreed between the various parties to a contract before commencement of construction and indicate who is liable for any deviation in the assessed conditions. The GBR shall be used by the Resident Engineer and Contractor to confirm condition and to operate under the changed physical conditions clause in the contract. This is typically used on tunnelling or pipe jacking projects.

15.3.1 CCT Standard Geotechnical Report Layout

The City's preferred Geotechnical Report Layout are as detailed in **Table 15-1**. This layout may be slightly altered should scope permit, but all reports shall roughly follow the proposed layout. This will allow the City to get a standardised format across the board, ensure relevant aspects are considered by the PSP and allow the split between factual and interpretive component of works. Only the factual portion of the report must be included in the tender document.

For township development, the standard report format detailed in SANS634:2012 will be applicable.

All geotechnical reports shall contain graphs summarising the comparative penetration test results for the site and a two or three dimensional ground model schematics, depending on the complexity.

Table 15-1: CCT Geotechnical Report Format

Suggested Layout	Factual versus Interpretive
1. Introduction 1.1 Terms of Reference 1.2 Objectives and Methodology (Confirm compliance with code) 1.3 Proposed Development (structures, shoring, services) 1.4 Preliminary loading provided by structural engineer 1.5 Classification into Geotechnical Category (SANS10160-5) 1.6 Scope and Limitations of Assessment 1.7 Codes of Practice 1.8 Information Sources	Factual account (to be provided in tender document)
2. Site Characterisation 2.1 Site Location and Description 2.2 Topography, Existing Infrastructure and Site history 2.3 Climate 2.4 Neighbouring structure behaviour 2.5 Geology and Engineering Geology 2.6 Seismicity	

Suggested Layout	Factual versus Interpretive
3. Investigation Methodology 3.1 Overview 3.2 Soil Profile and Summary (Stratigraphy) 2D ground model to be provided 3.3 Laboratory Testing 3.4 Dynamic Cone Penetrometer (DCP/DPL) Testing (EN1997-2 terminology) 3.5 Dynamic Probe Super Heavy (DPSH) (EN1997-2 terminology) 3.6 Standard Penetration Test (SPT) (EN1997-2 terminology) 3.7 Other methods	
4. Geotechnical Interpretation 4.1 Overview 4.2 Foundation Recommendations (including calculation methods) 4.3 Subgrade Conditions and Material Utilisation 4.4 Groundwater 4.5 Excavatability 4.6 Stability of trenches/cut slopes (including calculation methods used) 4.7 Design of other geotechnical Structures stating applicable codes (piles, MSEW, Soil Nail Walls, Piled walls, etc.) 4.8 Further works, Construction Quality Assurance and Validation	Interpretive account (not to be provided in tender document)

15.4 Minimum Site Investigation Requirements

It is a legislated requirement that field investigations be carried out by a competent person, in order to advise on the existing ground conditions of the area earmarked for development and to provide advice on precautionary measures, foundation and excavation conditions or the need for soil improvement.

Site investigation and characterisation can be undertaken by a geo-professional, which could either be an Engineering Geologist (BSc and Honours in Geology and Engineering Geology) or Geotechnical Engineer/Technologist (BTech, BSc or BEng in Civil Engineering as primary degree) with sufficient background in subsurface investigations.

The investigation and laboratory testing requirements for complex projects (including geotechnical structures such as retaining walls, deep excavations or piled foundations, etc.) are often best scoped by the Professionally registered (ECSA) Design Geotechnical Engineer/Technologist. The Geotechnical Engineer/Technologist should have proven design experience to understand what information is required to undertake the Geotechnical design.

If geotechnical investigation work is tendered out to a sub-consultant, the main PSP will employ a Geo-professional to scope the required investigation to ensure competitive sub-consultant pricing based on a set scope. This scoping can be forwarded to the City's Engineering Services Unit (ESU), before tendering/requesting quotes, in order to ensure that the proposed scope is satisfactory based on the proposed development.

The minimum depth of investigation shall be 3.0m, except for pavements rehabilitation projects where this criteria may be relaxed.

15.4.1 Minimum Pavement Investigation

The performance of any pavement is strongly dependent on its foundation. It is therefore very important to obtain sufficient information about the subgrade conditions. This information can be obtained through subsurface investigation and laboratory testing. The subgrade conditions will vary over the length of a pavement/pipeline. The layers placed above the subgrade needs to be sufficiently stiff and thick, in order to prevent overstressing the subgrade. Conventionally, the California Bearing Ratio (CBR) is used in design. The CBR test should be undertaken after saturation of 4 days to allow for extreme conditions and seasonal fluctuation of the groundwater table.

The SAICE Site Investigation Code of Practice recommends a typical spacing of 2 investigation points per kilometre during the Feasibility stage investigation and 5 per kilometre during the Detailed Design Stage investigation. This spacing should be reduced for roads of shorter length (minimum of two). TRH4 specifies that the quality of material up to a depth of 1.2m below the final road level needs to be established. It is therefore prudent to know the proposed geometry and elevations of the roadway. The investigation should therefore consider the final road level and depths of test pits or other exploratory methods (if in cut), to concentrate the investigation at the depths under interest.

The stress imposed on the subgrade is reduced by overlaying it with appropriate layers to achieve a structurally balanced pavement. Subgrade conditions are divided into four categories as provided in **Table 15-2**.

Table 15-2: Subgrade CBR Classification

Class	Subgrade CBR (%) [1]	Material Quality	Treatment/Comment
SG1	>15	Good	Just rip and re-compact
SG2	7 to 15	Moderate	Requires 150mm CBR>15% (G7) above. See **Figure 15-1**
SG3	3 to 7	Fair	Requires 150mm of CBR>15% (G7) and 150mm of CBR>7% (G9) selected layers above. See **Figure 15-1**.
SG4	<3	Poor	Special treatment required

[1] *Confirmed by laboratory MDD and CBR testing and not solely DCP correlations*

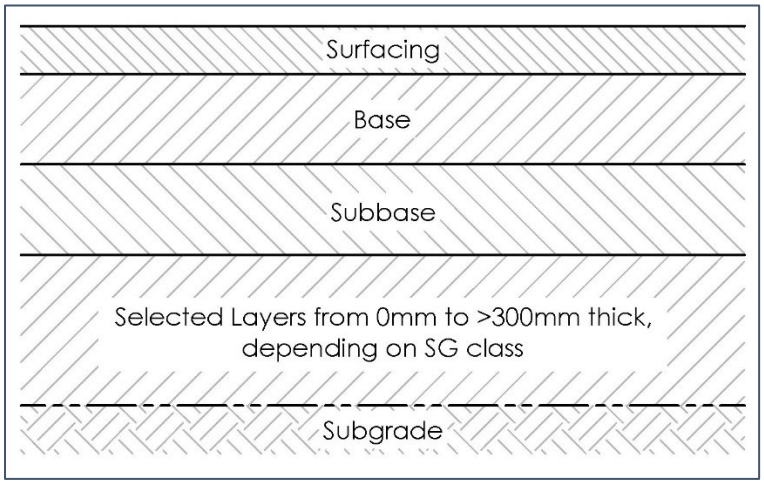


Figure 15-1: Pavement structure

In some instances, the geotechnical investigation might be undertaken in the drier summer months, but groundwater levels could change during the winter (in Cape Town) due to seasonal variations. This often results in the need to import either rockfill to be worked into the subgrade, to achieve compaction of subbase layers above, or the requirement to excavate deeper and place rockfill in a geotextile layer. Careful consideration should be given by the Geotechnical Engineer to the effect of infiltration on construction requirements.

The effect of expansive/heaving or collapsible subgrade soils should be considered in the design of the pavement structures.

Additional measures might include the use of geo-grids above soft subgrade layers. However, the calculations required to model the improvement achieved using geo-grids are often proven difficult and might therefore require the use of proprietary product software.

15.4.2 Minimum Culvert and Bridge Foundation Investigation

The number of investigation points at each bridge foundation shall be selected based on the length of the foundations, as detailed in **Table 15-3**. This would require preliminary sizing based on loads (Axial, Lateral and Bending Moment) acting on the foundation, using expected allowable bearing pressures or pile configuration by a professionally registered Geotechnical Engineer.

Table 15-3: Recommended Number of Investigation Points per foundation

Length of bases	Recommended Number Investigation points per foundation position
<5m	1 when on land ; 2 in a River
5 to 15m	2
15 to 30m	3
>30m	4

For culverts, the investigation points shall be at a length spacing of 15m apart or increased for smaller culverts. A minimum of two investigation points shall be required if the culvert length exceeds 6m.

The method of investigation could consist of either excavator dug test pits for dry excavation for small bases (<2m wide) and shallow bedrock profile or typically rotary core boreholes with SPT-N tests for larger bases (>2m) and a deep bedrock profile.

Investigation should be at least to a depth (d) of 2 times the breadth (b_g) of a spread foundation or a minimum of 3m into bedrock below the foundation (**Figure 15-2**). For a culvert, the investigation depth (d) shall be the largest value of:

- $d = h + 2b_g$, or
- d = h+3m into bedrock.

It is clear from these recommendations that some concept design needs to be present before specifying the required investigation. The structural engineer should therefore preferably provide the estimated loading to the geotechnical professional for due consideration.

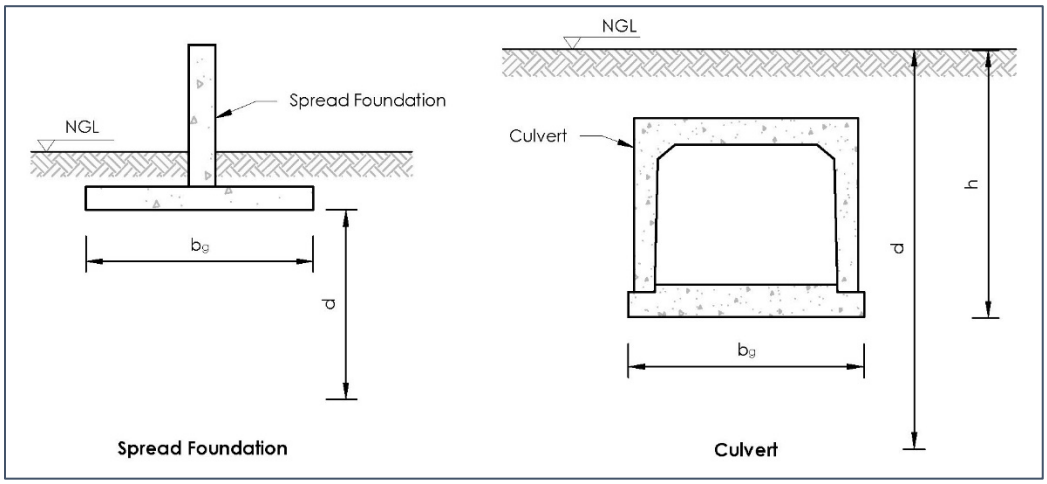


Figure 15-2: Depth of investigation for spread foundation or culvert

For piled foundations, the investigation depth (d) shall be the maximum of (EN1997-2):

- $h + L + b_g$
- $h + L + 5m$
- $h + L + 3D_f$

as illustrated in **Figure 15-3**, where,

h = depth to bottom of pile cap,
L = length of the piles,
b_g = the breath of the pile cap,
D_f = Pile diameter.

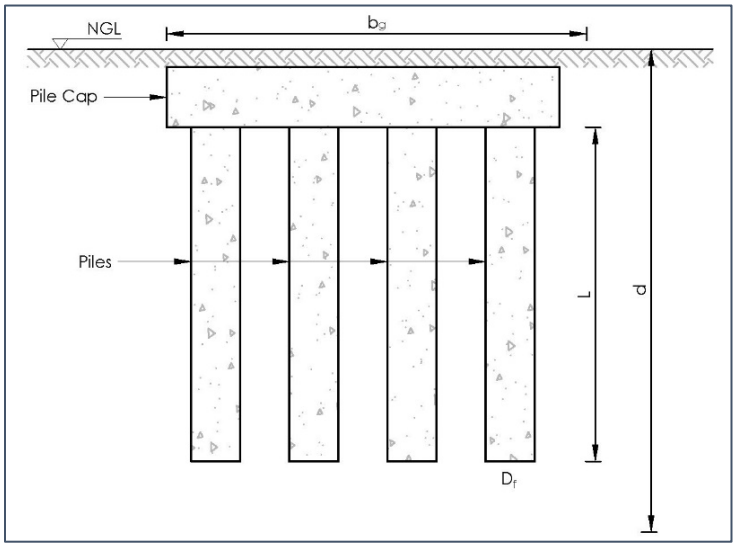


Figure 15-3: Depth of investigation for piled raft

Sufficient SPT-N test results shall be available to undertake the design. Additionally, Sufficient Laboratory tests must be specified by the professionally registered ECSA Design Geotechnical Engineer to undertake the design.

Hand dug test pits, as an only means of investigation, are not permitted, unless it can be proven that no other feasible method of investigation exists. These shall then preferably be supplemented by hand augers, modification of DCP rods with hollow slot to retrieve disturbed soil samples and/or rotary core

15.4.3 Minimum Fill Embankment Investigation

For road embankments exceeding 5m in height, slope stability analysis need to be undertaken.

The investigation point spacing shall be at intervals of 100-150m and supplemented by excavator test pits in between (cohesion and water table permitting) for long fill embankments. In problematic soil condition areas, spacing can be reduced to up to 25m between points.

As illustrated in **Figure 15-4**, the depth of investigation for fill embankment shall be the largest value of:

- $d > 2h$,
- $d > 3m$,
- 3m into bedrock.

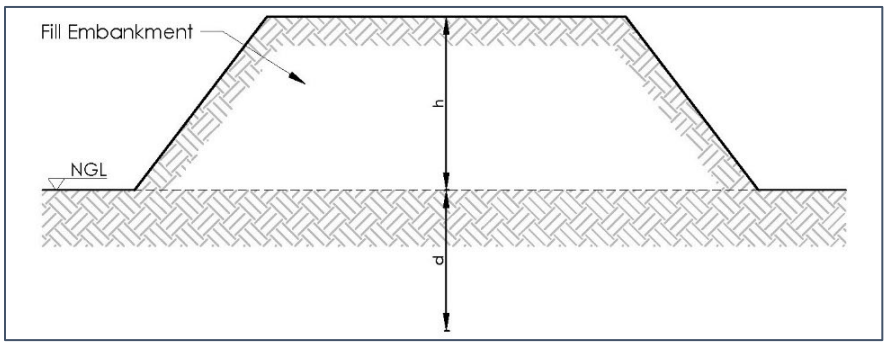


Figure 15-4: Depth of investigation for fill embankment

This would typically imply that rotary core boreholes will be required for fill embankments exceeding 5m in height, as excavator test pits will be too shallow.

Sufficient Laboratory tests must be specified by the professionally registered ECSA Design Geotechnical Engineer to undertake the design.

15.4.4 Minimum Road Cut Investigation

For road cuttings, the depth of investigation shall be the largest of:

- d >2.0m + h, or
- d>0.4h + h.

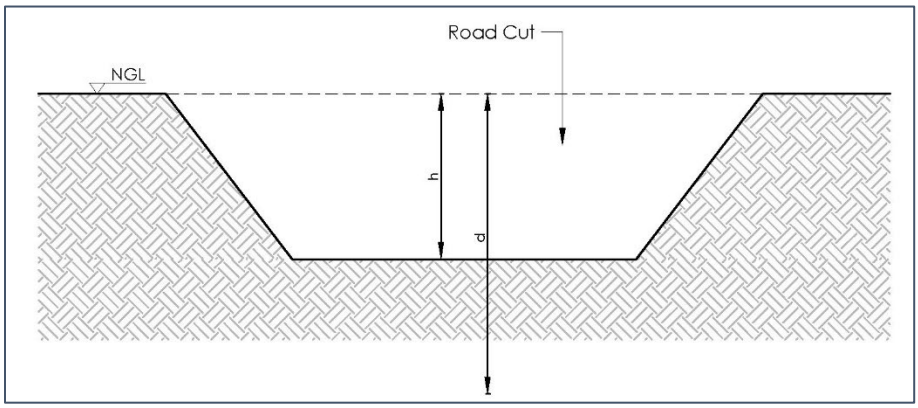


Figure 15-5: Depth of investigation for road cut

This would typically imply that rotary core boreholes will be required to assess cut embankments exceeding ±4m in height, as excavator test pits will be too shallow. In rock cuts, orientated core will typically be required and possibly the use of a down-the-hole telescopic viewer.

Sufficient laboratory testing shall be scheduled by the Design Geotechnical Engineer for parameters required in the design of cuts.

15.4.5 Minimum Investigation for Micro-tunnelling and Pipe Jacking

For micro-tunnelling or pipe jacking, the depth of investigation shall be (see **Figure 15-6**):

$$d \geq h + 2b$$

A minimum of five investigation points shall be undertaken per kilometre or increased if geology varies significantly between boreholes. One investigation point shall also be undertaken per launching pit.

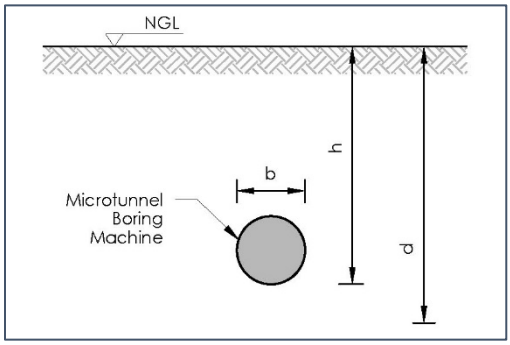


Figure 15-6: Depth of Investigation for Micro-tunnelling and Pipe Jacking

This would typically imply that rotary core boreholes will be required to assess profile and micro-tunnelling cutting wheel requirements (soft, medium face, etc.). Using rotary core drilling will ensure rock samples can be retrieved for testing.

Sufficient laboratory testing shall be scheduled by the Design Geotechnical Engineer to establish rock hardness and soil properties.

15.4.6 Minimum Investigation for Trench Shoring

For linear trench shoring, the depth of investigation shall be the larger value of (See **Figure 15-7**):

- $d \geq 2m + h$, or
- $d \geq 1.5w + h$

A minimum of four investigation points shall be undertaken per kilometer.

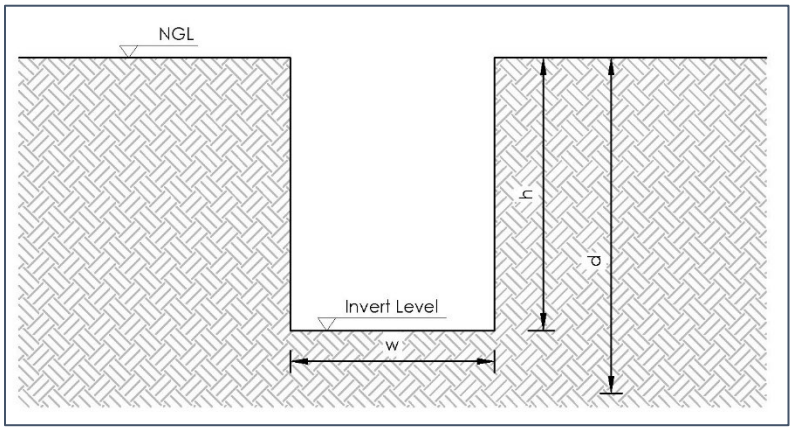


Figure 15-7: Depth of investigation for trench shoring

This would typically imply that rotary core boreholes will be required to assess trench shoring when the trench depth exceeds ±4m in depth, as excavator test pits will be too shallow. In rock cuts, rock hardness needs to be tested.

Sufficient laboratory testing shall be scheduled by the Design Geotechnical Engineer for parameters required in the design of shoring and dewatering.

15.4.7 Minimum Requirements for existing face logging

The minimum requirement for existing cut face logging is:

- Rock hardness map covering the entire cut face,
- Dip and strike readings,
- Description of positions of loose rock blocks,
- Description of discontinuity planes and infill,
- Retrieval of rock with jointset for shear testing if possible.

A cherry picker and traffic accommodation might often be required during such logging exercise.

15.4.8 Field Testing

Various methods of field tests and investigation are used in South Africa.

Intrusive site investigation methods can be categorised into two categories:

i) Excavatory methods, which recover/extract soils and allow measurement of groundwater table levels,
ii) Probing Methods that measures resistance.

These two categories of investigation should preferably not be undertaken in isolation. With probing methods only, one can often not use empirical correlations, which requires distinguishing between cohesive and cohesionless soils, establish heave potential, consolidation properties, collapse potential, water table levels(unless rods are carefully inspected), etc. With only excavatory methods, penetration information typically used in empirical design methods might be missing (these might include pile design using SPT-N, stiffness correlations with SPT-N, shear parameter correlations, etc). Hoeever, Laboratory testing could eliminate these problems should sufficient undisturbed samples be retrieved, but the cost will be significantly more than using empirical correlations. Laboratory testing should however always occur to ensure correlation effectiveness.

The most common probing methods includes Dynamic Cone Penetrometer/Dynamic Probe Light (DCP/DPL), Standard Penetration Testing (SPT), Dynamic Probe Super Heavy (DPSH) and Continuous Surface Wave(CSW). Excavation Methods of recovery include test pitting, open auger excavation and rotary core boreholes (often supplemented with SPT-N readings). When highly variable and erratic profiles (such as granite) are encountered and needs to be excavated, levels can be confirmed using Geophysical methods.

When using SPT-N to infer a clay's consistency, it shall be done using correlations for "insensitive clays" in accordance with AEG, SAICE and SAIEG's Guidelines for Soil and Rock Logging in South Africa (2002). It has been noted that consultants still use the old Terzaghi and Peck (1967) correlation which is considered outdated. The saturation level at which the SPT-N readings are taken could have a significant effect on SPT-N readings and inferred consistency as matric suction in the pore spaces increases the resistance. This requires careful consideration and requires testing that can establish the in-situ degree of saturation of materials. SPT-N results shall not be corrected for energy, unless the energy input is measured. The measurement of energy input to SPT rods are currently not being undertaken and require attention from drilling contractors and clients in South Africa.

The reference provided in Soil survey for engineering by Brink, Partridge and Williams (1982) for DCP/DPL blowcount (mm/blow) results in too high consistency correlations, as it almost assumes a 1:1 ratio between SPT and DCP blow counts. This is considered incorrect when reviewing international literature, since DCP testing occurs at significantly smaller input energy compared to SPT. These correlations shall not be used, but DCP results shall rather be logged using the internationally acceptable N_{10L} value. The consistency for sands are provided in **Table 15-4** below as calculated from Annex G in EN1997-2.

Table 15-4: DCP/DPL N_{10} Consistency correlations for sands and gravels

Consistency	On site test	Typical Dry Density (kg/m³)	N_{10L} blow counts
Very Loose (Above groundwater)	Crumbles very easily when scraped with geological pick.	<1450	<1
Loose (Above groundwater)	Small resistance to penetration by sharp end of geological pick	1451 to 1600	1-6
Medium Dense (Above groundwater)	Considerable resistance to penetration by sharp end of geological pick.	1601 to 1750	>6
Dense (Above groundwater)	Very high resistance to penetration of sharp end of geological pick; requires many blows of pick for excavation	1751 to 1925	>50
Very loose (Below Groundwater)	Crumbles very easily when scraped with geological pick.	<1450	<1
Loose (Below groundwater)	Small resistance to penetration by sharp end of geological pick	1451 to 1600	1-4
Medium Dense (Below groundwater)	Considerable resistance to penetration by sharp end of geological pick.	1601 to 1750	>4
Dense (Below groundwater)	Very high resistance to penetration of sharp end of geological pick; requires many blows of pick for excavation	1751 to 1925	>50

No guidance is provided for consistency correlation for clays in international standards (to our knowledge). 1xN_{10L} readings should be considered the same as 1xSPT-N (blows over 300 mm) to infer consistency, until studies confirms these correlations (See **Table 15-5**). It shall however be noted that unsaturated clays could have a significant effect on measured penetration (stiffer response) and therefore careful consideration is required on moisture content fluctuations which might occur during the lifetime of structures placed on top of clays, designed using allowable bearing pressure correlations from penetration test results. It is strongly advised that bulk density and moisture content of retrieved undisturbed samples be tested to establish the degree of saturation. This in turn could provide guidance on applicability of inferred consistency using "saturated" blow counts. The water table level can also be measured on rods during extraction, although this measurement will purely be indicative.

Table 15-5: DCP/DPL N_{10} Consistency correlations for clays

Consistency	On site test	UCS (kN/m²)	Saturated N_{10L} blow counts
Very Soft	Pick head can easily be pushed in to the shaft of handle; easily moulded by fingers.	<50	<4
Soft	Easily penetrated by thumb; sharp end of pick can be pushed in 30 – 40 mm; moulded with some pressure.	50 to 125	4-10
Firm	Indented by thumb with effort; sharp end of pick can be pushed in up to 10 mm; very difficult to mould with fingers; can just be penetrated with an ordinary hand spade.	126 to 250	11-30
Stiff	Penetrated by thumb nail; slight indentation produced by pushing pick point into soil; cannot be moulded by fingers; requires hand pick for excavation.	251 to 500	31-50
Very Stiff	Indented by thumb nail with difficulty; slight indentation produced by blow of pick point; requires power tools for excavation.	500 to 1000	>50

[1] *UCS = Unconfined Compressive Strength*

EN1997-2 describes various test methods and correlations, which can be used to derive geotechnical parameters from in-situ field-testing.

All logging shall occur as per standard descriptors detailed in ISO 22476-2.

15.4.9 Laboratory testing

Various laboratory tests methods are available. The test used in typical Geotechnical Civil Design are described in EN1997-2, with reference to applicable testing standards.

Typical tests used in South Africa for Geotechnical Design, includes:

- Foundation Indicator (Grading, Hydrometer Analysis and Atterberg Limits),
- In-situ Moisture Content, Bulk Density and Dry Density,
- Maximum Dry Density (MDD),
- California Bearing Ratio (CBR),
- Shear Box Test,
- Oedometer Test (Swelling and compression),
- Triaxial Test,
- Permeability,
- Point Load Index (PLI),
- Uniaxial Compression Test (UCS) on rock,
- Chemical Tests (Carbonate, Sulfate and Chloride Content and pH).

15.5 Geotechnical Design

EN1997-1, SANS8006-1, SAICE Lateral Support in Surface Excavation Code of practice and other more specialised Codes of Practice should typically be used for the design of geotechnical structures.

The design of geotechnical and geostructural elements shall be undertaken by a Geotechnical Engineer or Technologist, who has a Bachelor's Degree in Civil Engineering, is registered as a professional engineer or engineering technologist with ECSA and who has demonstrable continuous experience and continuous professional development in such design.

15.5.1 Fill Embankments

Fill embankments often need to be constructed as part of a development. This fill embankment is typically constructed using G10 (with CBR>3% at 90% MDD) material, unless better quality materials are economically available.

The maximum slope angle used is typically 1:2 (V:H) when landscaping is present on the slope to prevent sloughing failures during rainfall and associated infiltration events. For slopes with heights >5m, slope stability and settlement analysis, considering the subsurface soils and fill material properties, shall be undertaken.

Sloughing failures often occur due to infiltration into the embankment materials for steep side slopes that might seem stable during the drier seasons.

For a dry infinite slope failure, the Factor of Safety (FoS) can be established from:

$$FoS = \frac{\tan\phi'}{\tan\beta}$$

where φ' = internal friction angle,
β = slope angle.

When saturated (even if only a top few millimetres) the FoS reduces to:

$$FoS = 0.5\frac{\tan\phi'}{\tan\beta}$$

This often results in creep of a thin layer of soil downslope or a planar slope failure.

Where vegetation is present on fill embankments, slopes should typically be 1:3 (V:H) or flatter, in order to accommodate tractor mowers performing maintenance. Steeper slopes may be considered if petrol brush cutters are used.

If these maximum slope angles cannot be achieved due to land ownership constraints or adjacent structures, fill retaining walls should be considered (Section 15.5.3).

Highly compressible clays, uncontrolled fill or municipal solid waste below fills could result in differential settlements due to consolidation or slope failures. These soil strengths and consolidation properties need to be tested and considered in the Geotechnical Design, when encountered.

15.5.2 Cut Embankments

Cut Embankments can consist of cutting into soil or rock masses. In soils, the material will be heterogeneous and the water table will play a significant role in the slope stability. Typically, in soils the cut slope should not exceed 1:2 (V:H) due to similar considerations for infinite slope failures as discussed in Section 15.5.1. The slope should preferably be vegetated, to ensure increased stability. In some instances, if the slope shows constant oozing of water, without drying out, a shallower cut angle or lateral support measures shall be considered. The Geotechnical Engineer needs to confirm the applicable cut angles, bearing in mind cut foundation conditions, and the undertaking of relevant analysis. In temporary applications, steeper cut slopes may be considered, bearing in mind the phreatic surface and capillary cohesion that might change. The Geotechnical Engineer shall clearly state all his assumptions, in writing, and provide permission for workers to enter or work below such unsupported cut faces.

All excavation works shall comply with Section 13 of the Construction Regulations (2014).

Cuts in rock often require controlled blasting and the stability are highly reliant on the jointing and discontinuity planes in the rock mass. Rock can often be cut at quite steep angles. Stereographic plots shall be derived for the rock mass and the stability assessed using preferably Finite Element Modelling. When blasting in an urban environment, specialist blasting professionals, with knowledge on controlled urban blasting methods, should be consulted. In certain areas, chemical fracturing will be more appropriate to prevent flyrock and damage to neighbouring properties

If safe cut angles cannot be achieved due to land ownership constraints or adjacent structures, cut retaining walls can be considered (Section 15.5.3 and 15.7).

15.5.3 Earth Retaining structures

Different retaining wall solutions can be used to construct soil retaining structures. This section aims to clarify when certain types of retaining structures are more applicable to the planned works than others. When using the wrong system, the project and labourers are exposed to financial and safety risks.

In general, one should distinguish between cut-, fill- and cut-fill-walls. There is often a misconception that a fill wall is the only option when having to cut, placing reliance on temporary cut stability. This puts construction workers and properties at risk if soils are excavated, unsupported, near vertical and not battered (battering comes with a cost implication as additional backfilling will be required). Typically, a cut wall is constructed top-down, with methods such as soil nails, sheet piles or soldier pile walls. Fill walls are constructed from the bottom up and typically consist of Mechanically Stabilised Earth Walls (MSEW), block-, gabion- or reinforced concrete-walls. Cut-fill walls are constructed by first cutting (often unsupported and near vertical) and then placing a retaining system in front of the cut, with minor backfill.

Only in exceptional instances is it advocated to cut close to vertical and then construct a fill wall (cut-fill wall), such as widening a fill embankment. The temporary stability of the cut face should always be the governing consideration when cutting without employing any temporary stabilisation measures and should be assessed using sufficient laboratory test results and guidance from a professionally registered ECSA Geotechnical Engineer. Constructing near vertical cut-fill walls using material found on site often results in cheaper solutions. However, this is often done to the detriment of safeguarding the cut face without sufficient proof that it would be stable during construction, unless battered back to sufficient slope angles or stabilised (then more expensive).

MSEW structures should be designed in accordance with SANS 8006 Part 1. On City Projects designed by the Client, the internal and external stability shall be for the Consultant's responsibility. This shall be done without referring to proprietary product, but by providing strip/geo-grid loads per level for the maximum wall height and embedment levels. During construction, the strengths of strips or geo-grids for the nominated proprietary systems shall be vetted and approved by the Consultant.

Table 15-5 contains typical scenarios where retaining walls might be required, including discussion on the preferred retaining solution.

Table 15-6: Retaining wall Scenarios and Options

Scenario	Options	Preferred Solutions	Non-Preferred/Risky Solutions
Cut to create level platform (Fig. 15-6)	1. Cut wall 2. Cut-fill wall (unsupported cut) 3. Cut-fill wall (supported cut, i.e. more expensive than 1 and 2)	Soil Nail wall (cohesion permits) or Soldier Pile Walls	Unsupported near vertical cut with fill retaining wall (segmental blocks, MSEW or concrete gravity wall)constructed in front of cut (**Figure15-9**)
Widening on Fill/Slope (Fig. 15-8)	• Cut-fill wall (unsupported cut) • Cut-fill wall (supported cut, i.e. more expensive than 1 and 2)	Temporary Cut wall consisting either soil nail wall (cohesion permits) or Soldier Pile wall	Unsupported near vertical cuts as temporary cut measure
Raised Fill	1. Fill Wall (**Figure 15-11**)	MSEW, reinforced concrete retaining wall, crib wall or gabion wall (lifespan to be considered)	Non-interconnecting and non-stabilised segmental block walls

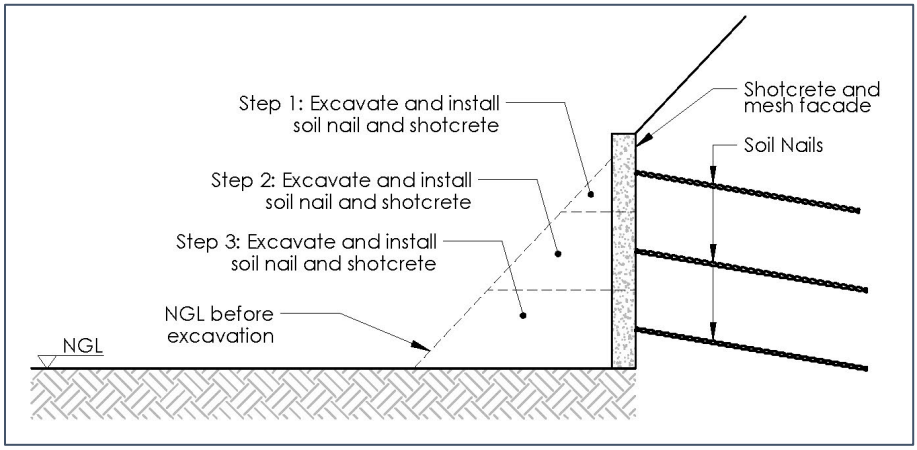


Figure 15-8: Cut-wall, stabilised from the top down (soil nail or soldier pile wall)

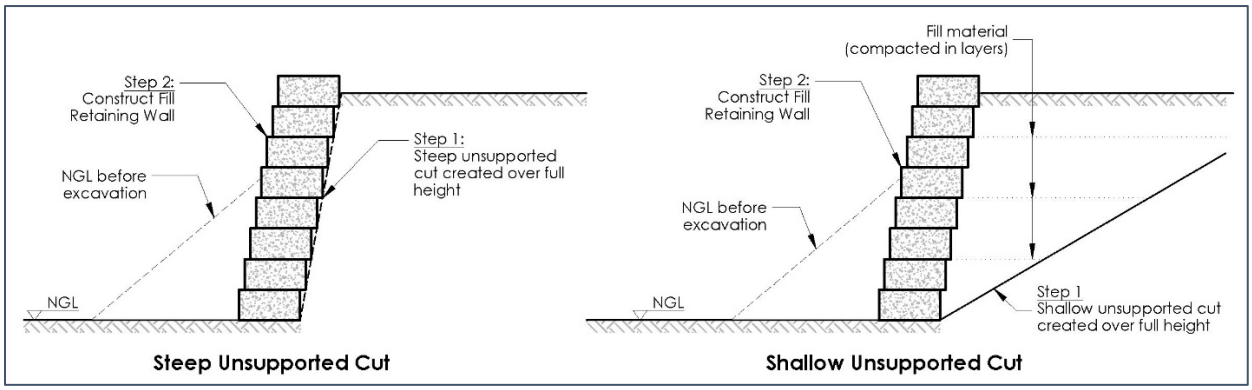


Figure 15-9: Cut-and-fill wall, stabilised from the bottom up (risk of collapse)

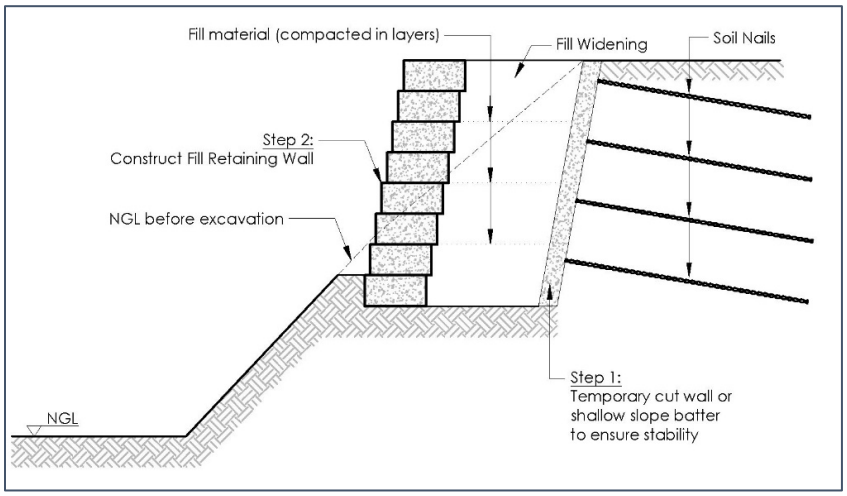


Figure 15-10: Cut-and-fill wall, widening of road fill

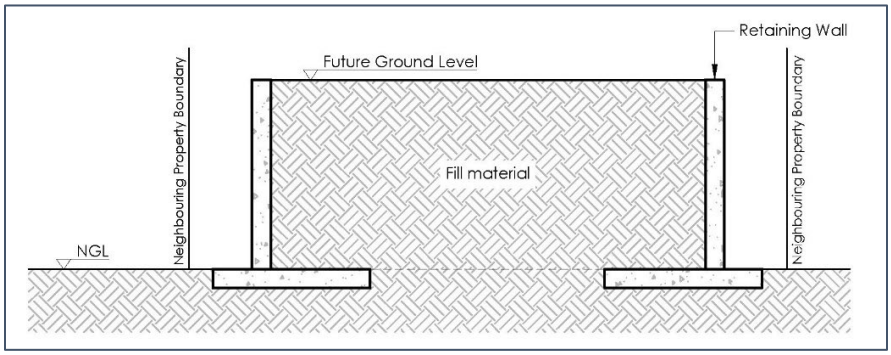


Figure 15-11: Fill retaining walls

15.5.4 Segmental Block Retaining Walls (SBRW)/Concrete Block Retaining Walls (CBRW)

Segmental Block Retaining Walls have been identified by ECSA as problem structures (Practice Note No. 2017/01).

Segmental block walls can be used in various ways, namely:

- Gravity retaining walls (Block and infill only),
- Gravity retaining walls with No-fines concrete (NFC) backfill or with cement stabilised material,
- Segmental blocks reinforced with reinforcement and concrete,
- Mechanically stabilised earth wall (MSEW) with geo-grids connecting to the blocks.

On City Projects designed by the Client, the design of segmental block walls shall be for the Consultant's responsibility without making reference to any proprietary products.

Typical details are provided in Drawing GE13 for gravity segmental block walls.

15.5.4.1 Design requirements

Numerous design codes might be applicable, depending on the method used for segmental block walls. The table below lists applicable standards codes and manuals.

Table 15-7: Applicable Code of Practice/Manual for SBRW in different applications

Application	Code of Practice/Manual
Gravity Segmental Block Walls	NCMA Design Manual for Segmental Retaining Walls (2012)
MSEW Segmental Block Walls	SANS8006-1 and NCMA Design Manual for Segmental Retaining Walls (2012)
Reinforced Segmental Block walls with foundation	SANS10100-1 Code of Practice The structural use of concrete Part 1:Design
Segmental Block wall with No-Fines Concrete Backfill	Concrete Masonry Association of Australia RW03 Concrete Masonry Gravity Retaining Walls

Backfill quality, compaction and density testing requires special attention during construction.

15.5.4.2 Block-to-block shear strength and block-to-soil-reinforcement connection strength

SANS8006-1, Section 6 refers to ASTM D6638 and ASTMD6916 for the determination of connection strength between Geo-synthetic and segmental concrete units and the determination of shear strength between segmental concrete units.

Very few suppliers of blocks have these test results available in South Africa and careful consideration needs to be given by the Geotechnical Design Engineer in this regard.

15.5.4.3 Open block configuration

The open block configuration is commonly used in South Africa, although not favoured internationally. The open block assembly (**Figure 15-12**) will result in increased tensile loads, exceeding 100%T_j (Table 20 in SANS8006-1) due to arching of the geo-grid between clamped position inside the segmental block unit. This increased tensile capacity requirement will govern the design. The increased tensile load in the grid at the block connection can be assessed by using the following equation over a reference length of 1m:

$$T_{facing} = T_j / w_{contact}$$

where T_j is the maximum tensile force in accordance to SANS8006-1, and

$w_{contact}$ is the sum of the in-contact widths per metre length (in metres).

This load needs to be designed for when using an open block assembly.

In addition to the above, the grid will be more dependent on the radial strength of the geo-grid, since the arching will result in tensile loads developing in the geo-grid between the non-machine and cross-machine directions.

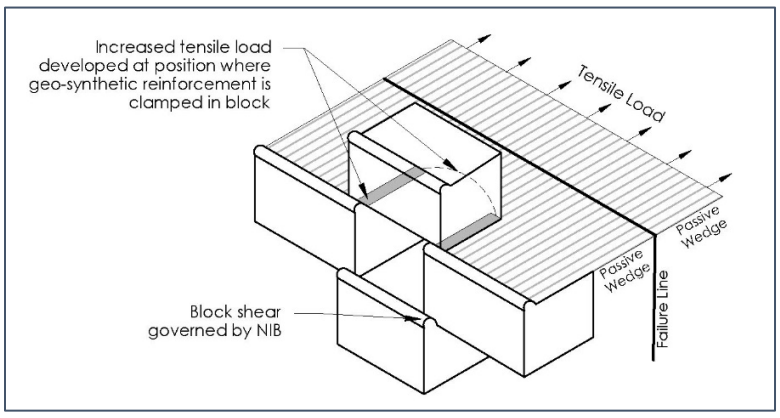


Figure 15-12: Increased tensile load in grid at clamping point when using an open block assembly

15.5.4.4 No-fines concrete (NFC) backfill

No-fines concrete (NFC) backfill could be used in conjunction with segmental retaining blocks, especially when there are space constraints, since the base width required could be up to half that required by a geo-grid reinforced segmental wall. However, this system normally requires temporary shoring of a cut face (see critique in 15.5.3). The design of suitable shoring measures shall be undertaken in accordance to SANS8006-2 and the SAICE Lateral Support in Surface Excavation code of practice and shall be at a nominal batter of 10-degrees, to limit the risk of the formation of a tension crack at the shoring-SRW backfill interface. The drainage used behind the shoring shall be connected to the drainage of the SRW to prevent any build-up of hydrostatic pressures.

No-fines concrete placed behind segmental retaining walls shall be free-draining and connected to weepholes or subsoil drains, to extend beyond the front facing. In the unhardened state, no fines concrete shall have a low slump and shall not exert lateral pressures exceeding 4kPa on the segmental block facing restraining the unhardened NFC. NFC used to provide enhanced stability to a segmental retaining wall shall have a bulk density not less than 1800kg/m^3. A staged construction procedure in controlled lift heights shall be detailed by the designer, to ensure that the temporary stability of the facing units during placement of the NFC is adequate.

The NFC shall form a coherent mass, capable of adhering to the facing. This can be achieved by having an open panel at the back of the segmental block retaining unit, allowing NFC to fill the voids in the blocks or by the use of geo-synthetics with an open aperture extending into the backfill from the facing unit. However, these geo-synthetics shall be capable to operate in a high alkalinity environment. Typically, PET are sensitive to high alkalinity environments, although preferred due to its low creep properties.

NFC meeting the following specification is deemed satisfactory for this application:

- Aggregate shall be GP (Unified Soil Classification System) nominal 20mm crushed rock aggregate (with all particles in the range 12mm to 20mm),
- Compressive strength shall not be less than 10MPa,
- Aggregate to cement ration shall not be greater than 6:1 (by volume)

The following should be highlighted:

- The bearing capacity requirements will be larger than those for conventional Mechanically Stabilised earth walls,
- The internal stability of the NFC mass must be checked and the stresses in the zone of concentration checked to be σ_{max} <0.3UCS (**Figure15-13**).

Cement Stabilised Backfill can be considered, but the quality assurance of such layers and adequate mixing remains problematic on smaller sites. Geotextile filters normally needs to be placed between the NFC and the in-situ soils, if a shoring system are not used to prevent ingress of fines into the NFC. At the top of the cement stabilised backfill, a plastic sheeting shall be placed over the segmental blocks and the cement stabilised materials, in order to prevent water from infiltrating into any stabilisation cracks or cracks that formed between the segmental blocks and the cement stabilised materials. It has been shown that waterfilled cracks in such walls may result in failure. Considering these cracks and poor mixing of cement into backfill materials on small sites, the use of cement stabilised material over NFC is not preferred.

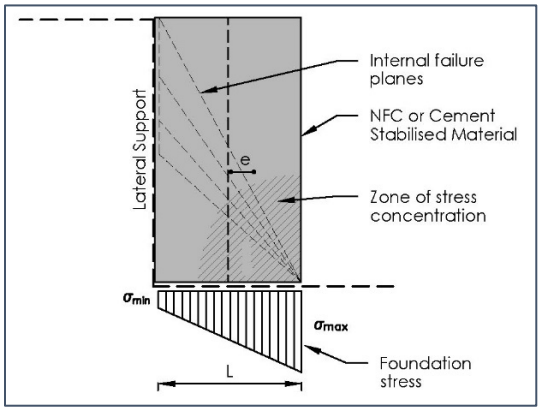


Figure 15-13: Internal stability analysis on NFC or Cement Stabilised Backfill

Cement stabilised backfill might also be considered with similar considerations as mentioned above. However, the cement stabilised material might be significantly less permeable and thus require careful attention to drainage.

15.5.4.3 Wrap-around Geo-grids

The use of near vertical wrap-around systems, with geo-grids wrapped into the backfill and connected at the block facing, is not allowed, unless it can be shown that direct sliding will not occur.

15.5.4.6 Drainage

Water often is the leading cause of failure of these walls and water pipes shall preferably not be placed above or behind these walls.

Drainage measures shall comply with the NCMA's Design Manual for Segmental Retaining Walls (2012). The filter drain behind the segmental blocks can be replaced with a geotextile if the fill material is permeable enough.

The three groundwater level scenarios are summarised below and detailed in **Figure 15-14**:

- Case 1: Groundwater level >0.66H below the toe of the wall and negligible groundwater flow into the backfill).
- Case 2 (Groundwater level <0.66H below the toe of the wall and negligible groundwater flow into the backfill): In addition to the vertical filter drain as detailed for Case 1, a blanket drain will be installed.
- Case 3 (Groundwater level near the toe of the wall with groundwater flow into the backfill): In addition to the measure employed by Cases 1 and 2 a chimney drain must be installed behind the reinforced mass to a height of 0.7H.

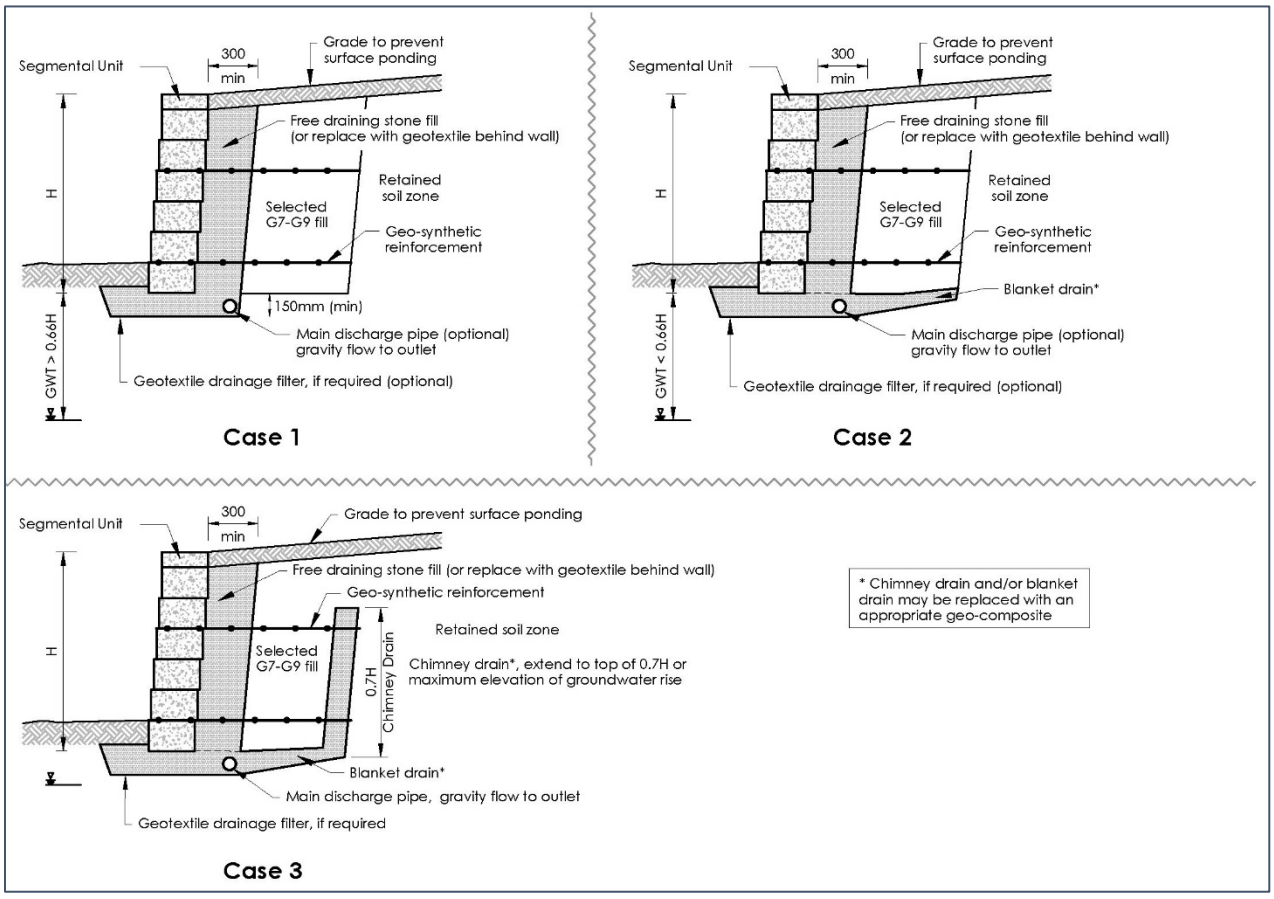


Figure 15-14: Required drainage measures for various Groundwater level scenarios

The crest of the slope shall be graded and a swale drain installed to prevent ponding of any water on top of the wall.

If scour is anticipated, the toe of the wall shall be placed deeper to prevent undermining and subsequent leaching of the fill material. In such cases, consideration can also be given to the construction of an apron slab in front of the wall.

15.5.4.7 Geogrid spacing

For segmental block that are less than 250mm wide in wall cross section, the maximum grid spacing shall be two blocks. A maximum grid spacing of 600mm is suggested, but the spacing should never exceed 800mm.

15.5.4.8 Frictional Connection

Most of the segmental retaining blocks in South Africa make use of a frictional connection. These connection capacities will vary between different blocks, depending on the geo-grid used and the infIll used inside the blocks. Therefore, such systems shall be tested in accordance to ASTM D6638.

15.5.4.9 Positive Connection

Positive connections are required to the facing in cases where large lateral loads are expected at the top of the SRW, either due to structures placed in close proximity on top of the wall or due to impact barrier or earthquake loads. For roads retained right up against these walls, the walls shall have a positive connection to the block or discrete MSEW panels shall be used.

15.5.4 Foundations

For single and double storey residential units, SANS 10400-H should be considered and the site appropriately classified during the geotechnical investigation. Foundation design should comply to EN1997-1 and BS8004. Lateral loads acting on piles or piled groups will result in bending moments, in addition to axial loads acting on the piles. These bending moments should be calculated by the Geotechnical Design Engineer/Technologist, considering appropriate soil stiffness/resistance offered by the surrounding soils. Group effects on leading and trailing piles should appropriately be considered. The structural section should be sufficiently designed, considering the support offered by the adjacent soils. Typical piled foundations used in Cape Town include:

- Continuous Flight Augers (CFA),
- Driven Cast In-Situ (DCIS) piles,
- Percussion piles (Odex or Symmetrix drilling),
- Screwed-In-Casing-Augered Piles (SICAP),
- Oscillator piles,
- Forum Bored Piles,
- Micropiles.

On City projects, where the design is undertaken by either the City or an appointed consultant, the pile foundation shall be designed by the consultant and not advertised as a design build component. This will ensure piles are designed to the same standard as that of the structure resting above it, investigations are appropriately sufficient to use in design and that alternatives are appropriately scrutinized. This will also ensure that the Contractor making the least conservative assumptions, which might pose a risk to the City or the foundation's durability, do not win the project without appropriate vetting by the consultant.

The formation of bulbous bases for DCIS piles (typically used in Cape Town) are highly influenced by the plasticity of the soil. Sands are well suited to forming a bulbous base, whilst clays are less suitable. If the materials at the base are cohesive, this would reduce the pile capacity. It is therefore crucial to establish Atterberg limits with depth. DCIS piles normally require an SPT-N blow count of 25 to be suitable for bulbous base formation, but in cohesive soils the shaft adhesion will play a larger role in capacity, which might require increased pile lengths and not sole reliance on capacity from a bulbous base.

The use of steel piles should be with extreme caution, bearing in mind the need for future lifespan expansion and inspection of piles, underpinning and practicality of employing such measures in future.

15.6 Trench Shoring and dewatering

Trench shoring for pipe laying or repairs is often a complex operation in Cape Town, due to the cohesionless nature of the sands encountered in the Cape Flats, the high groundwater table and pedogenic calcrete layers present. This section summarise methods of trench shoring and dewatering.

The Construction Regulations (2014) state that a contractor may not require or permit any person to work in an excavation which has not been adequately shored or braced, unless the sides of excavations are battered to at least the maximum angle of repose of the material, or permission to enter has been given by a competent person.

Soil Type A, B and C are typically use in the USA by OSHA to classify different soils that might be present during trench shoring. These soil types consist:

- **Soil Type A** includes firm to stiff clay (UCS>150kPa) and cohesive or cemented sands and gravels (hardpan) above the groundwater table which have no fissures, weak layers, or inclined layers that dip into the trench.
- **Soil Type B** include cohesive soils with an unconfined compressive strength between 50 -150kPa and include angular gravel, silt and soils that meet compressive strength requirements of Type A soil but that are fissured. Layered material sloping into the trench will also classify as Soil Type B.
- **Soft Type C** include cohesive soils with an unconfined compressive strength of <50kPa or soils that cannot stand on a slope of 3horizontal:1vertical without slumping. Type C soils typically consist gravel, sand and submerged soil, soil from which water freely seeps and submerged rock.

Trench shoring is a positive ground support system that can be used when the location and depth of the excavation makes battering or benching non-feasible. These systems are typically employed up to a maximum of 6m. Shoring solutions should be designed for the specific location and subsurface profile by a competent person (Professional Geotechnical Engineer / Technologist or Structural Engineer / Technologist with relevant design experience).

15.6.1 Design of trench shoring

Trench shoring are normally considered to form part of temporary works. Therefore, the Contractor often undertakes the design. This design shall include the design of all elements, including sheets, uprights, props, struts, walers, etc. The Consultant on a consultant-design project should however ensure that sufficient subsurface information is available over the full depth of the required shoring for the Contractor to design such works (See Section 15.4.6). This information typically includes:

- Boreholes or test pits depending on the depth at an interval discussed under 15.4
- Penetration testing with depth,
- Laboratory testing of soil (including foundation indicator tests and shear strength tests).

The consultant shall undertake a concept design for the proposed temporary shoring solution to ensure effectiveness of available dewatering and shoring solutions. If required, certain shoring methods can be eliminated from the tender document if found to be unfeasible or if the risk is considered too high. This will ensure that the consultant will also be in a position to assess/vet the shoring solution proposed by the contractor during construction. Also, sufficient thought will be given to various options (optioneering), comparing conventional shoring, pipe jacking and micro-tunnelling.

15.6.2 Unsupported/battered trenches

The construction regulations (Part 13) are clear that the soils shall be battered to the maximum since some soils will have an originally steep angle of repose that could diminish with time. The safe batter angle should be assessed by a competent person during the geotechnical investigation stage and long-term effects considered (change in water table levels, saturation and drying out of soils). A competent person shall sign off the stability of an unsupported cut and daily pre-start checks and other inspections shall be undertaken to monitor signs of distress.

15.6.3 Timber shoring (Installed progressively as excavation deepens)

Timber shoring can consist numerous arrangements with the most common:

- Timber soldier sets or soldier uprights with walers and props,
- Closed timber sheeting with walers and props.

Struts or props shall be secured against dislodgement.

Timber soldier sets are typically used in Soil Types A and B, as these soils often has sufficient cohesion to arch between soldiers. Closed timber sheeting are often used in Type C soils due to low cohesion.

In completely dry or saturated sand, flow between the trench bottom and the shoring upright toe will often occur before driving the upright down with a sledge hammer. In these scenarios, and if dewatering is unworkable, a sheet piled solution installed prior to excavation, is considered the better option should equipment and space permit.

The maximum one drop between the base of timber uprights and trench bottom at any time shall be 600mm, but is often required to be shallower (See **Figure 15-15**).

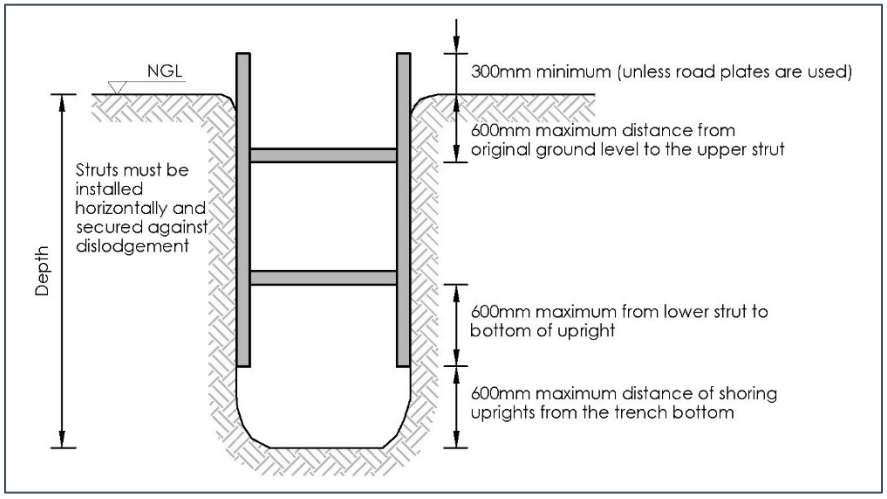


Figure 15-15: Timber shoring excavation procedure

Often the gaps between successive timber uprights needs to be plugged using geotextile, in order to prevent flow of material through the voids.

Shoring boxes, instead of linear timber shoring, are typically used up to 5x5m to eliminate the need for cross bracing, which would hinder and obstruct works within the excavation.

Timber shoring installation might pose a lesser risk to existing pipelines compared to sheet pile during driving, but sheet piles are considered a safer solution.

Manual work are often required due to working in close proximity to other pipes, services and within limited working space, etc. Risk associated with falls and hand operated tools shall be controlled. In addition, temporary stability sahll be assessed daily and during any excavation stage to prevent fatalities.

Excavated soils should not rest immediately above the trench and this should be moved preferable 1.5 times the height away from the edge. Similarly, large equipment should not be allowed immediately adjacent to the shoring system.

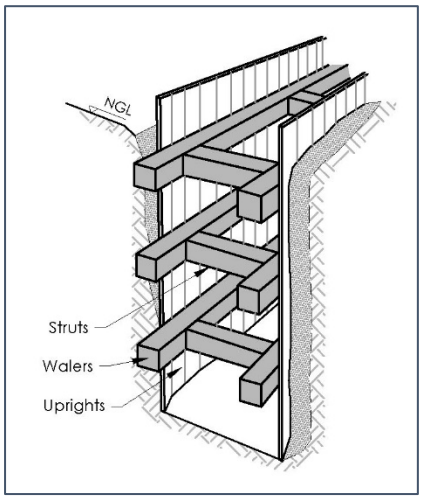


Figure 15-16: Closed timber sheeting uprights with walers and struts

15.6.4 Shore Dragbox

A shore dragbox (See **Figure 15-17**) is a structure manufactured from steel which can withstand forces should ground collapse occur. Dragboxes move along as work progresses, using specific lifting points for installation and removal but can also be installed permanently.

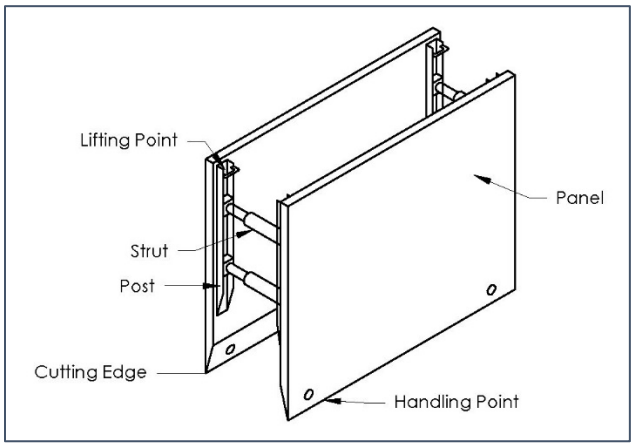


Figure 15-17: Schematic of dragbox

This system is typically used in open areas where access is available for an excavator or TLB. Trench boxes should not be subjected to pressures exceeding those the box has been designed for. Typically, earth pressures are reduced using benching and battering. The drag box should regularly be inspected for damage.

15.6.5 Sheet Piling (Installed before excavation)

Sheet piling is often used in ground that is unstable and where side walls will collapse during unsupported excavation. This is common in loose and running cohesionless sand. Sheet piles should be installed before the excavation commences. A TLB or excavator is required to drive the sheets and sufficient working space is required.

In a calcrete profile sheet, piles could potentially struggle to be driven through and predrilling or augering might be required to enable installing sheet piles. Shaping the sheet pile to have a sharp point at the driving toe might assist in driving through calcrete layers. This should preferably be tested before going out on tender. The UCS of Calcrete layers should be tested during subsurface investigation stage.

Vibrations could cause damage to adjacent properties and this requires consideration.

15.6.6 Dewatering

Dewatering measures are often employed during trench shoring in Cape Town. Wellpoints are typically only effective in lowering the groundwater table by 3-5m due to losses. Wellpoints cannot be jetted through Calcrete layers and might require predrilling/augering before installation.

The graph below in **Figure 15-18** provides guidance on applicable dewatering methods, considering drawdown required and soil permeability.

Permeability of typical soils on the Cape Flats are provided below (Stapelberg, 2005):

- Witzand Formation : $1x10^{-4}$ to $7x10^{-5}$ m/s
- Langebaan Formation : $1x10^{-4}$ to $4x10^{-8}$ m/s (higher range calcareous)
- Springfontein Formation: $1x10^{-4}$ to $1x10^{-7}$ m/s (calcium enriched)

This should preferably be tested or predicted from grading test results.

Calcretes typically have a permeability lower than $1x10^{-7}$m/s. Soils derived from weathering of basement rocks (Cape Granite & Tygerberg Formations) also have low permeabilities, making wellpointing unfeasible. If sands of Witzand, Langebaan and Springfontein formations are underlain by less permeable layers, wellpointing will often not be fully effective. Overbleed may occur just above the less permeable layer. This overbleed could often result in closed timber sheeting not being effective due to the temporary unsupported excavation required. Similarly, issues with dewatering often results immediately below a calcrete bank during excavation using equipment applying large pressures. This will result in undermining of the calcrete bank in places. Over-excavation and flow might occur as a result of large pressures applied by equipment to break through calcrete layers and associated overdig during breakthrough.

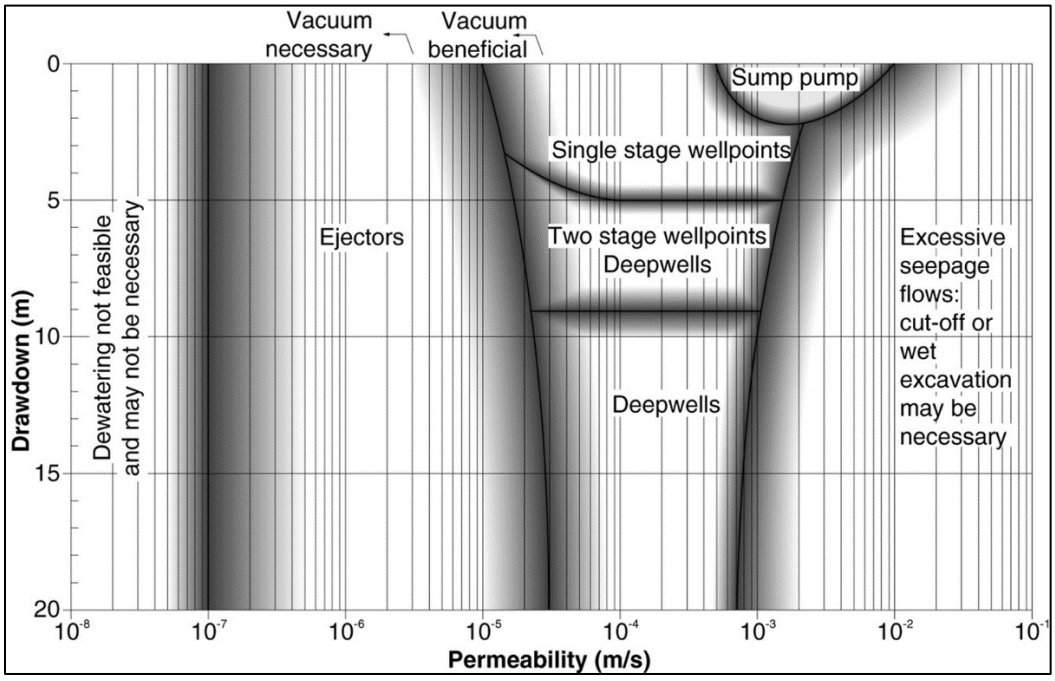


Figure 15-18: Range of application of dewatering techniques (CIRIA C750, London 2016)

Sump dewatering might be used in certain application, should the materials not excessively seep during excavation, causing collapse in the unsupported scenario.

The groundwater table often varies significantly between winter and summer months due to rainfall and perched groundwater tables that develop. The effect of changes in the water table can be assessed by installing a standpipe consisting a geotextile wrapped uPVC pipe with drilled holes installed into boreholes or backfilled test pits. Water table levels shall be measured during the wet season to confirm how the phreatic levels are affected due by rainfall and/or regional phreatic surface.

15.7 Deep Excavations/Lateral Support Investigation and Design

Deep Excavations are commonly undertaken in the City of Cape Town for underground parking basements or on steep terrains, to create level platforms. Often, these excavations are vertical and deep (>3m), next to the City's roads, footways and services. SANS10400-G, Annex A, states that a local authority can dictate what is considered adequate precautionary measures to ensure safety and stability of property or services. The discussion below provides guidance on what is considered good practice. In certain cases, the documentation noted below shall be provided by the developer, to the City, for review, to ensure due diligence and to limit events that may cause damage to the City's infrastructure or to that of others.

A few deep excavations in the City have in recent years resulted in significant movement and damage to adjacent properties and services. The use by developers, and competitive nature of the design-build component of lateral support works under conventional employer design contracts, often results in lateral support designs being undertaken without any or inadequate geotechnical subsurface investigation or vetting by a professional service provider (consultant). Some developers also excavate without any support measure in place, often resulting in damage to neighbouring properties or services. This practice is considered irresponsible and could result in damage to adjacent property or failure and loss of life.

Support systems typically used in the City consist of soil nail walls (**Figure 15-19**), anchored or propped soldier pile walls (**Figure 15-20**) and diaphragm or contiguous pile walls with jet grouting (**Figure 15-21**). More impermeable solutions are typically used in saturated conditions, where quick groundwater recharge occurs. The use of a design-build component of Lateral Support by developers should at minimum be accompanied by a reference design from the Developer's Consulting team for purposes of expanding on the employer's requirements. This will ensure sufficient and correct subsurface and laboratory investigation methods have been employed.

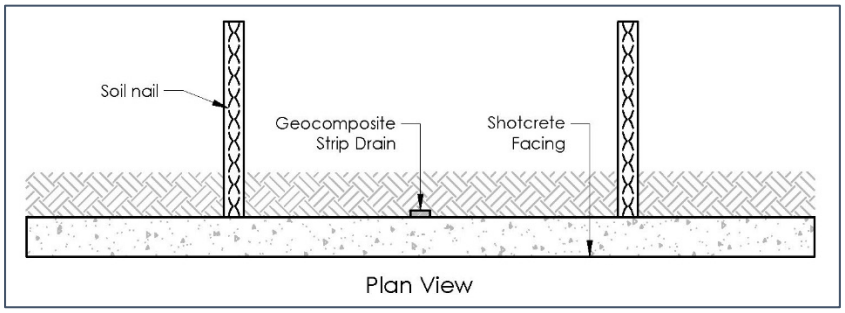


Figure 15-19: Soil Nail Wall

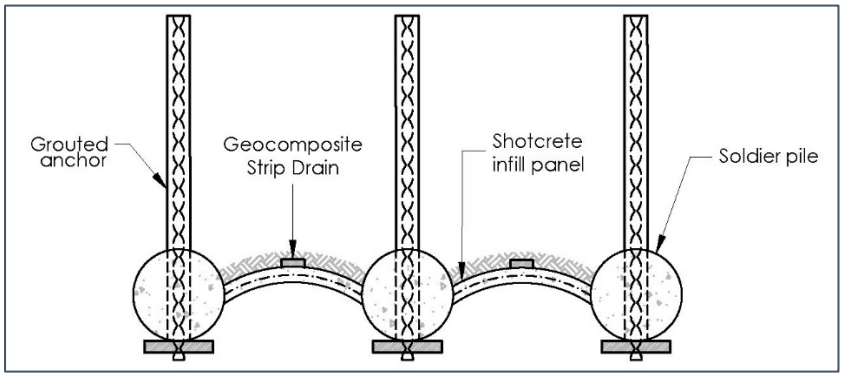


Figure 15-20: Soldier Pile Walls

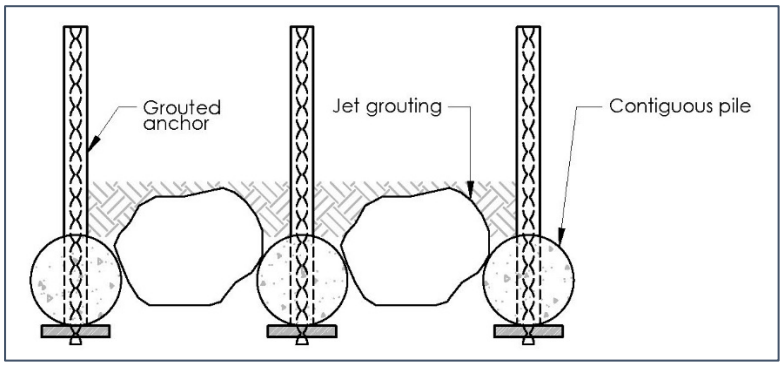


Figure 15-21: Contiguous Pile wall with jet-grouted gaps

15.7.1 Geotechnical Category

The design of lateral support systems is complex and therefore **Table 15.8** provides guidance on the Geotechnical Category for different types of lateral support structures (function of height, water table, rock, etc.) and recommended lateral support design lead/signoff requirements.

Table 15-8: Lateral Support Geotechnical Categories and recommended design lead

Geotechnical Category	Description	Recommended Design Lead Requirement
GC1	• Lateral support systems less than 2.0m in height with no large surcharge • Trenching for pipelines <2.0m which does not intercept the ground water table	Professionally registered Civil Engineer/Technologist (Pr Eng/Pr Tech) with at least 5 years post registration experience, Professionally registered Civil Engineering Technologist (PrTech) with at least 7 years post registration experience
GC2	• Lateral support systems up to 6m in height	Professionally registered Civil Engineer/Technologist (Pr Eng/Pr Tech)) with at least 10 years post registration experience, Professionally registered Civil Engineering Technologist (PrTech) with at least 12 years post registration experience
GC3	• Lateral Support Systems of up to 15m in height • Lateral support systems next to existing and settlement sensitive structures	Professionally registered Civil Engineer/Technologist (Pr Eng/Pr Tech) with more than 10 years post registration experience
GC4	• Lateral support systems below the ground water table • Lateral support systems in exceedance of 15m in height • Lateral support systems with portions on rock and portions in soil	Professionally registered Civil Engineer/Technologist (Pr Eng/Pr Tech) with more than 10 years post registration experience. This type of lateral support system should typically require vetting by a peer review third party.

These design lead qualification requirements are provided as guidance and can be modified by the client, depending on the individual's proven experience.

15.7.2 Minimum Site Investigation

For deep excavations, the City requires that investigation points should be spaced at a minimum grid spacing of 40mx40m (investigation point on each point of the grid) for medium sized excavations (up to 4 000m^2) and 60mx60m (one each point of the grid) for large sized excavations. For sites smaller than 1000m ^{2}, a minimum of three points shall be applicable. A minimum of five investigation points per site is required for sites >1000m ^{2,} unless a valid reason for a reduced number can be motivated. A valid reason could include the reference of nearby site profiles and consistencies, which shows similar proven conditions.

For embedded pile walls in dry conditions (i.e. water table below base excavation line), the minimum investigation depth (d) shall be to the largest value of:

d=h+0.4h or d=h+t+2

For a wet excavation (in accordance with EN1997-2), this shall be to the largest of:

d=h+w+2 or d=h+t+2

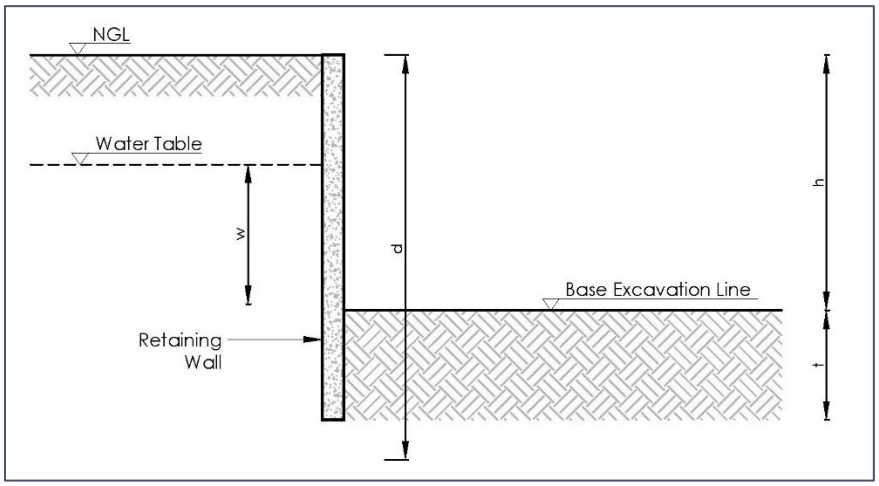


Figure 15-22: Guidance on depth of investigation

The investigation should consist either of rotary core boreholes (d>5m) or open auger hole (not typically undertaken in Cape Town) and should include test pits by Excavator, supplemented with piezometric readings of at least one wet and one dry season.

Investigation points for shallow excavations (<5m) could potentially partly be replaced by DPSH tests, but a minimum of 3 excavation points (rotary core, open auger holes or test pits) are still required. All DPSH results shall be recorded as N_{20SB} blowcounts and not over 300mm, as conventionally done in SA (Redrive will also occur). If the DPSH refuses before applicable depth, the need for additional excavation methods should be considered or appropriate conclusions made from excavation test results. The water table level should be measured during rod extraction by reviewing moisture on the rods. If water tables are said to be perched, this must be proven by exclusion standpipes or testing (bulk density and moisture content on undisturbed samples) to establish degree of saturation of material below the said perched groundwater table.

15.7.3 Design of wall

The design of the lateral support system shall be in accordance with SAICE's Lateral Support in Surface Excavation Code of Practice (1989). A minimum surcharge of 10kPa shall be used in the design, unless structures are immediately adjacent, which will require careful assessment of the surcharge imposed. A design report for a lateral support system shall typically include the following:

- Need for underpinning of adjacent structures,
- Factor of Safety(FoS) of system,
- Assumed soil strength parameters,
- Assumed groundwater table levels and dewatering measures,
- Design methods employed,
- Structural forces and structural design,
- Predicted displacements,
- Durability considerations, and
- Recommended construction checks.

If an unsupported excavation is planned, even if temporary, for depths >3m, the safety of such excavation shall be substantiated by a letter from a competent person, stating why shoring measures are not required. This letter shall include written permission from the competent person for labourers to enter the excavation, in compliance with the Construction Regulations (2014).

15.7.4 Due diligence design review check by CCT ESU

The following documents shall be provided, as applicable, to the Engineering Services Unit before commencing with construction:

- Letter by professional Geotechnical Engineer approving unsupported cut,
- Geotechnical Investigation report or borehole logs, assumed parameters, groundwater table on drawings,
- Lateral Support/retaining wall drawings, showing location and permanency of grouted anchors and location of the lateral support elements relative to services,
- Expected lateral support system displacements,
- Proof of Lateral support insurance.

This information will be reviewed and commented on. Cantilever systems or systems with internal propping shall also be forwarded for comment as movement could affect CCT property.

15.7.5 Grouted Anchors/Soil Nails

In all scenarios, the owner of an excavation must request written permission to install grouted anchors or soil nails below neighbouring properties or road reserves. When using permanent grouted anchors or soil nails below neighbouring properties, changes should preferably be made to title deeds to ensure agreement is given in perpetuity and that no damage occurs to lateral support systems should excavation occur on adjacent sites. Services shall be detected and confirmed as detailed in Section 15.8.

All anchors shall be proof tested, as detailed in the SAICE's Lateral Support in Surface Excavations Code of Practice (1989).

Typically, grouted anchors shall be installed with a vertical clearance equal or greater than 2.0m from the existing grade, to prevent clashes with services (electricity, fibre, stormwater, etc.). A minimum vertical clearance of 1m is required between the lowest placed service and grouted anchors. Soil nailed structures normally require a smaller initial drop, to prevent a large cantilevered facing over the top. Care should be taken when using such systems. The applicant shall apply for wayleaves and provide more detail during application as to the actual depths of services on site.

In the case of permanent anchors, these shall be provided with Double Corrosion Protection (DCP). No Self-Drilling Anchors (SDAs) will be permitted in permanent scenarios. All anchor positions shall be shown on Construction Drawings.

In the case of temporary anchors (2 years maximum), these shall be de-stressed after being propped by the permanent building slabs and all voids left over the anchor length, if any, fully grouted.

If temporary anchors remain in place for longer than 2years due to delay in the development, these shall regularly be inspected by the contractor for any corrosion, preferably by lift-off tests and by applying additional protection over the exposed anchor.

If permanent grouted anchors are employed, some of these shall be left exposed and monitored by the developer every 5 years.

15.7.6 Movements and Performance Monitoring

The maximum permitted movement of an excavation is 35mm in the Serviceability Limit State, in accordance to the SAICE's Lateral Support in Surface Excavation Code of Practice. Movements can be measured by placing survey targets on locations at the top of the wall. System movements can be predicted using Finite Element Analysis, considering appropriate stiffness properties derived during subsurface and laboratory investigation.

15.7.7 Removal of Lateral Support Insurance

Irrespective of whether lateral support measures are provided or the excavation only battered, the owner of the works shall take out sufficient Insurance Cover for Removal of Lateral Support when within the zone of influence (2 times the height of the proposed excavation) from adjacent infrastructure (**Figure 5-14**). This shall include for all failure mechanisms that can occur during excavation, including global stability failures (i.e. deep seated).

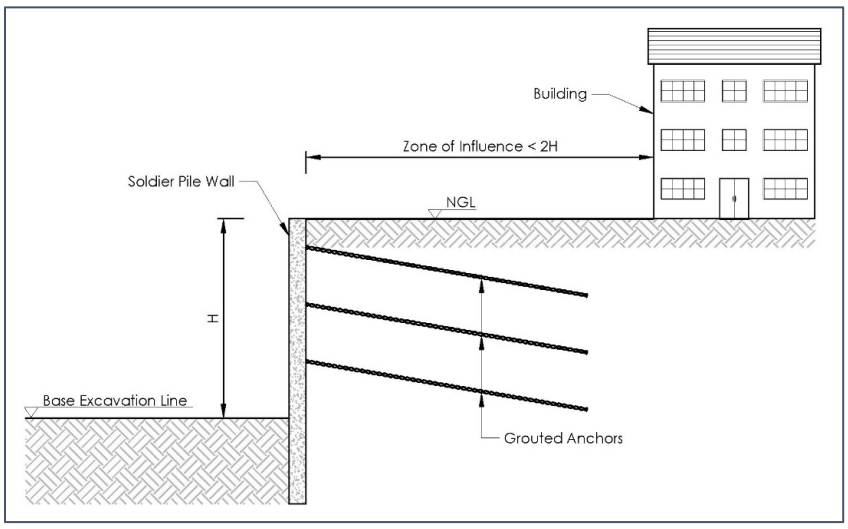


Figure 15-23: Zone of influence for deep excavation

15.7.8 Blasting

Only controlled blasting is permitted with Peak Particle Velocity (PPV) readings taken during blasting, within permissible tolerance as provided in the SAICE Lateral Support in Surface Excavation Code of Practice. Urban blasting experts shall be consulted.

15.7.9 Required details and documentation

The following details are required to be in place as a minimum before commencing with excavation:

- Geotechnical Investigation report,
- Geotechnical Design report of Lateral Support System or letter from competent person indicating why lateral support measures are not required,
- Signed drawings (by professionally registered Civil Engineer) of the lateral support system, including grouted anchor or prop details. If no support is provided, the bulk excavation lines and cross sections shall be detailed on the drawings,
- Drawings shall include cross sections of the lateral support, extending horizontally up to twice the height of the excavation from the top of the wall. These cross sections shall provide details of neighbouring structures and shall include, but not limited to: building height, foundation dimensions, foundation pressures assumed, adjacent excavations, grouted anchors, etc. This will ensure neighbouring properties has been duly considered in the design of the lateral support system.
- Drawings shall also include details on grouted anchor levels and permanent slabs and RC beams providing lateral support in the permanent scenario,
- Known services indicated on drawings, with proof of approved wayleave application and permit to work,
- All hidden services to be located by careful hand excavation prior to the commencement of mechanical excavation and installation of grouted anchors,
- Lateral Support Insurance.

During Construction, the following needs to be examined and approved:

- Approval of Method Statements,
- Subsurface profile comparison to that of Geotechnical Investigation (Profile and water levels),
- Lateral support movement measurements,
- Proof-test results,
- Lift-off tests.

On completion, the following is required to conclude the project:

- Performance Review report of the lateral support system, in particular displacements;
- Updated as-built drawings;
- Any claims against Lateral Support Insurance.

15.7.10 Vegetation and drainage measures

Vegetation growth, especially trees, could result in voids forming between shotcrete and retained material due to root growth. This could result in direct hydrostatic build-up behind the facing. Vegetation growth shall be carefully monitored and trees removed if considered to pose a threat. This is considered especially problematic where rock masses are being retained (such as Clifton).

The construction of crest interception drains are crucial for lateral support systems, especially in steep profiles where lots of surface run-off may be expected. Such drains should preferably be connected to the crest of the shotcrete, with a plastic sheeting extending below and 2m behind the crest of the wall. These drains shall be cleaned regularly.

In residual rock masses or rock masses, water flow often occur within permeable relict joints. Although these masses might be stable during excavation the use of a single strip drain behind a shotcrete arch, or at a spacing of 1.5m c/c, might not intercept all relict joints. This often results in waterlogged shotcrete infill panels attracting significant additional hydrostatic forces. These lateral support system are typically not designed for these hydrostatic forces. In these cases and in very wet masses, additional strip drains or a cuspated drainage sheet should be installed behind the shotcrete to intercept all relict joints. If it is noted too late or during another season and the shotcrete is waterlogged, small weepholes must be drilled to relieve hydrostatic pressures.

15.8 Service Detection

Buried services pose a great health and safety hazard during ground investigations and construction. When services are damaged, significant delays can occur and are often expensive to repair (financial risk). Ground investigation should therefore incorporate the following on developed sites:

- Wayleave application through the City and/or service providers,
- On-site investigations with service providers,
- Surveys, to locate and trace services on site,
- Hand-excavated starter pits.

Typically, non-intrusive tests, such as CAT Scanning, Ground Penetrating Radar (GPR) and EM or RF testing can be undertaken prior to intrusive investigation. Tracing services should include lifting manhole covers and inducing signals (conductive mode) whilst tracing at surface.

Cable Avoidance Technology (CAT), Electro-Magnetic(EM), Radio Frequency (RF) or Ground Penetrating Radar (GPR) equipment can be used to determine service locations. These methods aren't always effective in establishing where all services are and can therefore not be relied on exclusively. It is often better to use more than one method to confirm service positions.

Ferro-Magnetic equipment can be used to locate manhole covers.

GPR is well suited to detecting non-conductive pipes and ducts, but it is often difficult to detect the top and bottom of the pipes. Ground truthing is the only way to establish the exact pipe diameter. Service detectors should therefore only be used to get an indication.

The following should typically be included in service locating reports:

- Details of proposed development,
- Details of appointment,
- Area of detection/scanning,
- Detection hindrances (weather, vegetation, access),
- Details of equipment utilised and limitations thereof (accuracy of results),
- Factual results of what was detected,
- Figure showing the layout, proposed works and existing services.

A hand-excavated test pit shall be carried out at each borehole and trial pit location, to confirm the existence of services.

Only sites with approved wayleave applications should be permitted to proceed with work.

Any trenchless technologies or grouted anchors should be installed with at least 1m clearance from any services. In certain instances, the accuracy of the method employed might require increased clearances.

15.9 Free design services and Freeware provided by suppliers and contractors

The use of free design services and software, which favours proprietary products or solutions as part of their outcome, shall not be used on City consultant-design projects. This is due to the possible ethical conflict of interest that could result in specifying proprietary products or solutions that are only available from certain suppliers or contractors. Designs shall comply to applicable codes of practice and defended if justification is sought.

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CHAPTER 16

TRENCHLESS TECHNOLOGIES

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CHAPTER 16: TRENCHLESS TECHNOLOGIES

16.1 Horizontal Directional Drilling

16.1.1 General

Horizontal Directional Drilling (HDD) is a trenchless steerable drilling/boring method used for the installation of underground pipes. Drilling takes places along a predetermined drill path, with the use of a surface-mounted drilling rig/machine.

HDD is used to install underground pipes in areas not amenable for open cut construction (trenching), such as roadways (medium to higher order), railways, watercourse or major water bodies, environmentally sensitive areas, structures, etc. This method can be carried out with minimal to no disruption to the surrounding area or features being crossed, including minimum or no disruption to traffic. Safety risks are also minimised, compared to open trenching.

This section will focus on the application of HDD under medium to higher order roadways (i.e. road crossings), with the installation of product pipes up to 300mm diameter, which is carried out using mini-HDD (small) rigs.

Designers can also consult the following technical standard for further details regarding horizontal directional drilling:

- *SASTT Technical Standard, Trenchless Construction Works, Part TT3: Horizontal Directional Drilling (SASTT-TS-TT3-2017 Edition1)*, published by Southern African Society for Trenchless Technology.

16.1.2 Drilling Operation Overview

A brief overview is provided below regarding the HDD operation. For a more comprehensive description, the SASTT Technical Standard can be consulted.

Horizontal Directional Drilling generally consists of three primary stages, namely pilot drill/bore, reaming stages and the product pipe installation (pull-back) stage.

Stage 1: Pilot Drill/Bore

Once the drilling machine and equipment are set up at the entry point, a small diameter hole is drilled along a pre-determined drill path (i.e. drill plan). The drill head, which is connected to the drilling machine via drill rods (i.e. drill string), sends a signal to the locating unit via a sonde, which is located inside the drill head. The sonde transfers information (such as pitch, line and level/depth) to the receiver. The drill operator is uses this information to steer the drill head, along the designed drill path, in order to reach the target/exit point.

During the pilot bore, a bentonite suspension (drill fluid) is pumped through the nozzles of the drill head, where it hydraulically removes the drilled material (cuttings) from the bore hole. The drill fluids suspend the cuttings and transfers it back to the surface at the entry point, where a small entry pit is excavated at the front of the drill rig, in order to collect the drilling fluid returns. The drilling fluids may then be recycled and re-used or spoiled at an approved dump site. Apart from assisting in removal of cuttings, the drilling fluids also serve to stabilise the bore, keep the tunnel open, cool the cutting tools and lubricate the drill strings.

When the drill head exits the ground surface on the far side of the crossing (target point), the pilot bore of the installation process is complete. It is recommended that the correctness of the pilot bore is checked and approved by the Engineer's Representative or Project Manager before the reaming stage can commence.

Where parallel installations are required, it is recommended to first complete the pilot drills for each installation before proceeding with the reaming process.

Where designers want to plot a drill path as part of a feasibility study, an entry or exit angle of 20 to 25 degrees may be used, provided that these angles accommodate the intended services to be installed. If sufficient space is available, the pilot drill can be designed in a way that the drill head enters the entry pit at a level gradient at the design depth. In such an event, the service will be installed parallel to the road surface at the required cover. In the event of a grade drill (e.g. gravity dependent services), the entry and exit angles shall adhere to the required design gradient of the service to be installed.

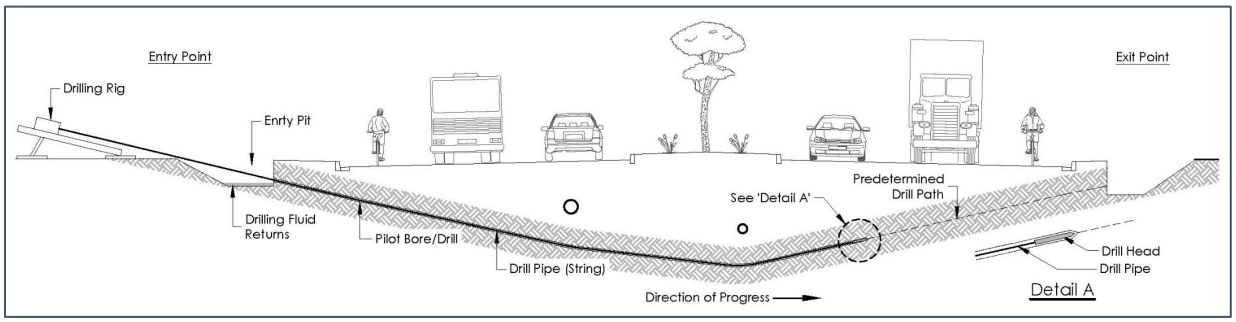


Figure 16-1: HDD Pilot Drill/Bore Stage

Stage 2: Reaming

Once the pilot drill is completed successfully, the tunnel is enlarged by a process called reaming. a process called reaming. The reamer is attached to the drill string and pulled back, from the exit pit, towards the drill rig. The reamer rotates as it is pulled back and sprays out a bentonite mix, to transport the cuttings and keep the tunnel open.

Depending on the diameter of the product pipe, multiple passes with reamers with increasing diameters may be required, to incrementally enlarge the pilot bore to its final desired diameter. The final bore diameter is in general 1.25 to 1.5 times the diameter of the product pipe (not more than 50%), in order to provide clearance for the pipe grip or pulling head, to allow flow of cuttings and to reduce the required loads during the pipe pullback operation.

The percentage overcut should be increased with an increase in the installation length. **Table 16-1** below can be used as a guide to determine the percentage overcut required. Please note that this is a guide and the reamer size closest to this calculation will be selected.

Table 16-1: Hole size related to installation length

Installation Length	Overcut
0 > 50m	20%
50m > 100m	30%
100m > 300m	40%
> 300m	50%

Similar to the pilot bore process, drilling fluids are continuously pumped through the drill pipe to the cutting tools. Drill fluids, with the cuttings, return to both sides of the crossing. A small exit pit is excavated at the exit point, in order to collect the drilling fluid returns.

Once the bore hole has reached its desired diameter, the reaming process is complete.

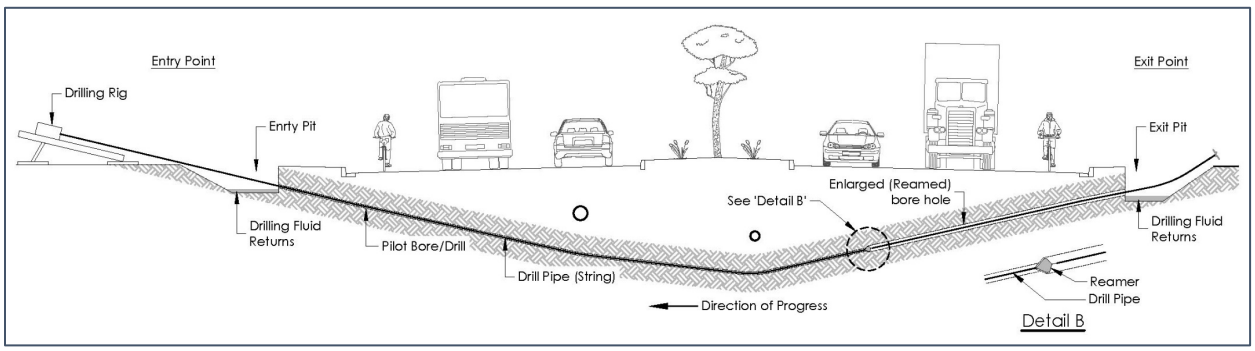


Figure 16-2: HDD Reaming Stage

Stage 3: Pipe Installation

Once the reaming process is complete, the product pipe installation (pullback) can commence.

The product pipes are welded together at the exit point, to form a pipe string. If required, the string shall be pressure tested with water. For sewer pipe installations, the internal beads need to be removed.

A swivel shall be provided between the reamer and the ensuing product pipe (at the pipe grip or pulling head), in order to prevent rotation of the product pipe and the transmission of torsion loads to the pipe.

The product pipe has to enter the bore hole without exceeding its maximum bending radius. Therefore, the front part of the product pipe will be adjusted/positioned to match the exit angle of the bore hole.

The drill string is then pulled back, from the exit point, along the pre-reamed path, rod by rod. The HDD installation is complete once the product pipe emerges at the exit point.

For product pipes with smaller diameters (i.e. not exceeding 300mm), the reaming and pipe pullback are often performed simultaneously.

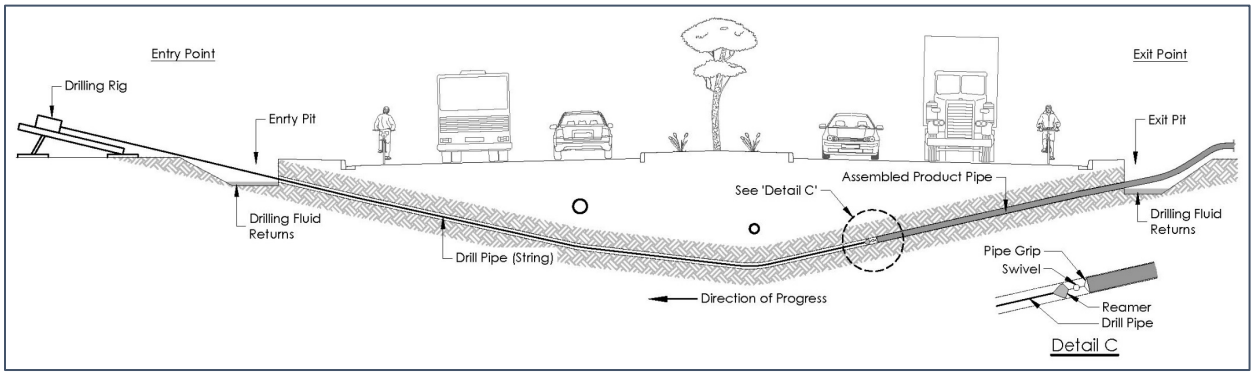


Figure 16-3: HDD Pipe Installation

16.1.3 Basic Requirements

16.1.3.1 Application

Horizontal directional drilling shall be approved prior to construction, via a Wayleave/Permit application submitted to the relevant District Office. Designer can also refer to the City's *Wayleave Process and Standards for The Installation of Services In Road Reserves*.

16.1.3.2 Existing Services and Investigations

Geotechnical investigation shall be required, in order to determine geological foundations and soil conditions. The geotechnical information shall also be used to assist with the preparation of the drill plan, selecting the suitable drilling equipment/tools and drilling fluid design.

As part of the planning process, the exact position of above- and belowground services shall be determined. Methods for obtaining the location of services include, but are not limited to, the following:

i) Topographical survey;
ii) Request for GIS services information from City;
iii) Application for Wayleaves;
iv) Ground Penetrating Radar (GPR);
v) Cable location equipment
vi) Hand-excavated pits (not in the roadway). A permit shall be required from the District Office.

The depth and position of all existing services shall be determine, in order to ensure HDD is feasible (i.e. achievable drill path).

16.1.3.3 Position and Clearances

Drilling shall be perpendicular across the road, unless approved otherwise.

The table below provides the basic clearance criteria for HDD application, for **services with a maximum outside diameter of 300mm**.

Table 16-2: HDD Clearance Requirements

Characteristic		Dimensions (greater of)	
		Unstable Soil Conditions [6]	Stable Soil Conditions [6]
Minimum Cover	Pipes under roadways [1]	10 x ROD **or** 1.2m	7 x ROD **or** 1.2m
	Pipes under sidewalks	10 x ROD **or** 1.0m	7 x ROD **or** 1.0m
	Elsewhere [2]	900mm	900mm
Minimum setback from road edge [3]		1.5m	1.5m
Min. clearance to existing service [4][5]	Crossings (vertical)	1m	750mm
	Parallel (lateral)	10 x PD	10 x PD
Minimum clearance between parallel bores[5]		10 x PD	10 x PD

ROD = Reamer Outside Diameter

PD = Pilot Diameter

[1] Clear distance between the lowest point on the roadway and the outside of the largest reamer diameter to be used in the installation.

[2] Locations where surface disruption is not important or a concern

[3] Setback measured from the road edge, to any drill pits, equipment or plant.

[4] Clear distance between the outside of the nearest existing service and the outside of the largest reamer diameter to be used in the installation. Wayleave conditions shall also be considered and adhered to.

[5] These dimensions are only a guide and is dependable on the ground conditions, position of other services and the type of services to be crossed or drilled parallel to. The contractor's HDD manager needs to be consulted for guidance during the pilot bore design stage.

[6] Soil Condition examples: Unstable Soil = Sand (also consider water table); Stable Soil = Clay, Gravel.

The clearances stipulated in the above table are subject to change, should a service department require increased clearances due to the nature of the existing service (e.g. size or material).

16.1.3.4 Dealing with cutting fluids

As explained above, a bentonite and water mixture are used during the pilot bore and reaming stages, in order to keep the cutting tools cool, transport the cuttings to the drilling pits and to keep the tunnel open. This process creates a slurry material that accumulates in the drilling pits. This slurry material needs to be removed from the pits, in order to remove the cutting tools and to access the installed pipe.

Since bentonite is a natural clay material, there is no need to dispose of it at a hazardous spoil site. It can therefore be disposed of on-site, if the required space is available. In such a case, a temporary holding pond can be constructed to accommodate the slurry material. After completion of the HDD installation, this slurry can be mixed in with the excavated material from the drilling pits and the holding ponds, allowed to dry out and be used as part of the backfilling material.

If no space is available to deal with the material on site, like in urban areas, the contractor needs to dispose of the material by transporting it to either an accredited landfill site or a disposal site. In such a case, a Vacuum truck will be used to pump the slurry material from the drilling pits and transport and dispose of the material at a disposal site.

The volume of cuttings would be approximately 3 times the volume of the tunnel, due to the bulking factor and the addition of bentonite and water.

16.1.3.4 Product Pipes

End caps shall be installed on empty pipes/ducts, in order to prevent the ingress of water and soil. Where cables are inserted, the remaining annulus, i.e. space between the outside of the pipe and the inside of the bored hole at the pipe ends, shall be sealed with an appropriate compound.

If required by the Approval Authority, draw wires shall be inserted through the length of pipe installed, after testing is complete. The draw wires shall extent at least 500mm past the pipe ends.

Ducts marking shall be provided as per Section 13.5. Where requested, permanent markers shall be installed/placed at the pipe ends, at the locations specified by the Approval Authority.

Once the pipe installation is complete, it shall be inspected using CCTV equipment and the footage submitted for assessment. The aforementioned inspection is required, in order to ensure that the pipe is continuous over its entire length (i.e. no breakages) and has no leaks, deformations or other defects that will affect the performance of structural integrity of the pipe.

16.1.3.5 Site

The construction site shall be properly demarcated, in order to avoid pedestrian movement through the construction activities and possible injuries to pedestrians.

If required, dust control shall be implemented during the construction phase. After the installation is complete and the drilling equipment and machinery has been de-established, the site shall be properly cleaned and the disturbed soil reinstated to its original condition.

16.1.4 Drill Failure

During the pilot bore, it is possible that a local rock formation or boulders may be encountered, which was not identified during the geotechnical investigation. This may result in the drill operation being aborted. In such a scenario, the drill rods will be retracted and bentonite will typically be pumped into the tunnel, simultaneously, unless required otherwise by the Approval Authority.

Should any specific site conditions (e.g. high water table) raise a concern that the tunnel might collapse, the tunnel shall be filled with a drill grout. The aforementioned shall be submitted for approval prior to the commencement of any drill operations.

16.1.5 HDD Not Possible

Scenarios could arise where HDD is not possible due to existing site conditions, which might include, but are not limited to, the following:

- Presence of bulk underground services (e.g. bulk water or pressurised sewer main);
- Clash with existing underground services, which results in impossible drilling angles or insufficient cover or clearances;
- Insufficient space for drill plant and equipment (on the verge).
- Soil conditions, in which the pilot bore cannot be installed (example rock or cobble stones).

If HDD is not possible, an application shall be submitted to the relevant District Office for a trenched road crossing. The following shall be submitted as part of the application/submission documents:

1) An application letter, including a locality plan and list of all the locations of road crossings, for the proposed open trenching.
2) Drawing(s), illustrating the proposed road crossings(s) to be open trenched. An additional 160mm diameter spare duct shall be installed in each trench, equipped with a draw wire and end caps.
3) A schedule of quantities of all the proposed road crossings, which shall include the number of crossings, length thereof, including the type of road. The roads shall be differentiated according to its class, i.e. Major (Class 2/3/4) and Minor (Class 4/5). The length shall be measured in linear metre, from 500mm behind the kerb face or road edge (where no roadway kerb is present).

4) Technical motivation/report, detailing the reasons why HDD is not feasible. The following shall be included (whichever are applicable):
    - Description of each service encountered, along with the surveyed depth, position in the road reserve and size/diameter.
    - Drill Plan of the proposed road crossing(s) (plan view and cross section), illustrating the depth and position of all surveyed services, including the proposed drill path and conflict with the aforementioned services.
    - Description of the space constraints on site to accommodate the drill plant and equipment.
5) Any associated letters, such as a signed letter from the drilling company, bulk water letter, other service department letters, etc.
6) Reinstatement detail of the road layer works, for all the relevant road classes.
7) A Traffic Management Plan, in accordance with Chapter 13 of Volume 2 of South African Road and Traffic Signs Manual, stamped and signed off by Traffic Services.
8) Proposed construction programme, which shall include the following dates:
    - Commencement of works;
    - Re-instatement start;
    - End date.
9) Method Statement.

In certain instances, specifically at intersections, where open trenching is approved, the City may require the provision of a spare duct/sleeve, to accommodate future services.

16.2 Pneumatic Horizontal Boring ("Moling")

16.2.1 General

Pneumatic horizontal boring (a.k.a. "moling") is a cost-effective trenchless method for the installation of underground services. The operation involves the creation of an underground tunnel by means of a pneumatically/compressor driven hammer/rocket ("mole"). As the hammer move forward, the soil is displaced into the surrounding soil. A tunnel is created, through which pipes can be pulled or pushed through.

Moling is ideally suited for the installation of small diameter pipes, in compressible soil types, over short distances of up to 60m. Due to the relatively low disruptive nature of moling, there is a reduced risk of damages occurring to the road layer works or other services.

For purpose of this document, this section will only focus on the application of moling for the installation of telecommunication (fibre optic) services. Should moling be intended to be used for the installation of any other service types, the installation requirements shall be discussed with the Approval Authority.

Designers can refer to *Addendum 1: Technical Procedure for the Installation of Optic Fibre Ducts in Middle- and Low-Income Areas (Moling)* to *Wayleave Process and Standards for The Installation of Services in Road Reserves), dated February 2021*.

16.2.2 Application Criteria and Specifications

Moling for road crossings shall only be considered on lower order roads, i.e. Class 5 Local Streets. Where service crossings are required on Class 1 to Class 4 roads, horizontal directional drilling shall be used.

Due to the current minimum installation requirements (i.e. insufficient space available on the verge to accommodate the equipment), moling for road crossings will not be possible on Class 5 roads with an 8m road reserve and a 5m roadway. For 10m road reserves with a 5.5m roadway, sufficient space is available to accommodate the moling operation. It is therefore important to determine the dimensions of each road reserves and roadway, in order to confirm whether sufficient space is available for the moling device.

The minimum spacing for road crossings shall not be less than 50m, unless approved otherwise by the Approval Authority due to site conditions.

Longitudinal moling (i.e. parallel with the road) in verges will be permitted on 8m road reserves, e.g. to cross driveways, provided that no existing underground services are impacted.

The minimum vertical or lateral clearance between existing and new services shall be 300mm.

Moling shall also not be considered where the groundwater table is within 1m from the road surface. The groundwater depth shall thus be determined as part of the planning process and again prior to construction. Once constructed has commenced, the groundwater depth shall be visually monitored and documented on a continuous basis.

16.2.3 Installation Requirements

Below are the minimum installation/operation requirements for moling:

i) Entry and target pits shall always be excavated directly behind the kerb backing.
ii) The minimum space required to accommodate the moling equipment (in the above-mentioned pits) is as follows:
    - Length: 1.2m (measured perpendicular to the road)
    - Width: 500mm
    - Depth: 1m preferred (Min: 600mm below lowest point of road surface)
iii) The moling depth shall always be deeper than the road layerworks.
iv) In order to prevent collapsing of the side walls, shoring shall be placed on either side of the pit walls (parallel to the road). The shoring shall consist of 18mm thick shutterboard (a.k.a. shutterply boards, pine ply boards).
v) The two boards should be propped, in order to ensure stability.

vi) The board behind the kerb backing shall have an opening at the bottom, in order to accommodate the moling device, which has a diameter of 63mm.

vii) Where a boundary wall exists, moling pits shall not be positioned at/near boundary wall columns, in order to ensure that the column foundation is not undermined.

viii) The installed duct shall extent at least 1m behind the road edge.

The above-mentioned moling installation are summarised on the table below and illustrated on **Figure 16-4**.

Table 16-3: Moling Pit Requirements

Feature	Requirement
Size	Length: 1.2m (measured perpendicular to road) Width: 500mm Depth: Preferred = 1m [1] Minimum = 600mm below lowest point of road surface [2]
Position	Directly behind the kerb backing. Not near boundary wall column (where applicable)
Stability	18mm Shutterboard (shutterply, pine ply board) against each side wall, propped.
Device	Provide an opening at the bottom of the shutterboard behind the kerb backing, to accommodate the moling device of 62mm in diameter.

[1] *Depending on other services*

[2] *Shall always be deeper than road layer works*

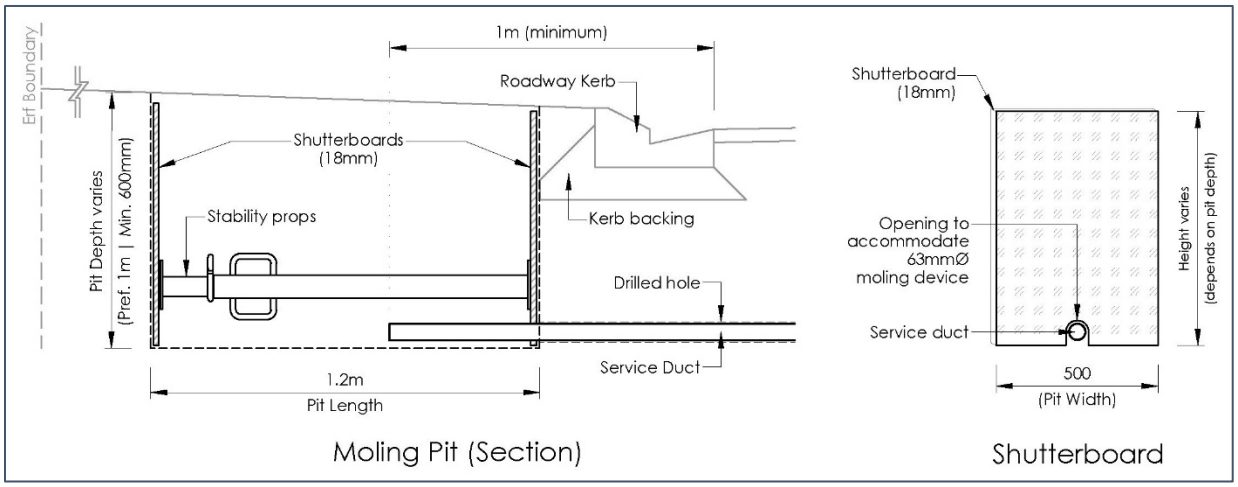


Figure 16-4: Moling Pit and Shuttterboard

In order to ensure no/insignificant impact of traffic during the moling process, the traffic shall be accommodated as per an approved Traffic Management Plan. Only one-way traffic is recommended to cross the area where the moling process is in operation. A 3m wide thoroughfare shall be created in the centre of the road, by means of placing delineators at the required offset from the road edge.

Designers can refer to Drawing GE11 for a layout and cross section of a typical moling operation.

16.2.4 Planning Procedures and Requirements

Prior to the commencement of the works, the following planning procedures shall be followed and requirements adhere to:

a) Determine the following for all the applicable roads:
   - Road classification
   - Road reserve width, including roadway width (surfaced width)
   - Verge width on either side of road (measured from back of kerb to erf boundary)

b) Obtain as-built information of the roads and existing services from the City and other service providers.

c) Conduct a geotechnical investigation. The aforementioned, including the determination of the groundwater depth (if visible) shall be carried out within 14 days from the commencement of the works.

d) Decide along which roads the moling method is feasible. On a plan, indicate the roads where moling will be carried out and the roads where moling is not possible.

e) Obtain information regarding potential future services from the City.

f) Conduct a site visit to confirm existing above- and below-ground services and, where/if required, a survey to confirm the location/position of the services.

g) Where road crossing is proposed, a drill plan shall be submitted for each crossing and shall include the following:
   - Existing services and the clearances (lateral and vertical),
   - Proposed drill path,
   - Dimensions of the road, road reserve and verge (both sides).

h) Prepare Optic Fibre Network Layout for the area, indicating all existing and future services.

i) Compile a proposal for the reinstatement and testing of water-, sewer- and electrical services, the various pavement types for roads, sidewalks, verges, lawns, paving, etc., within the application area.

j) Prepare a Traffic Management Plan (TMP) for typical construction scenarios. The TMP shall be submitted to the relevant Traffic Services department for approval/sign-off.

k) Submit the Site/Area Layout Plan and Traffic Management Plan (signed off by Traffic Services), including a Method Statement for the installation of the proposed services/network, to the City for approval.

l) Inform the City and the residents (in the area of the intended installation) at least one (1) week before commencement of construction works.

16.2.5 Remedial Measures

In the event of an unsuccessful crossing attempt or damage to the municipal roadway, the following remedial procedure shall be followed:

- For an **unsuccessful crossing attempt**, the cavity caused by the moling device shall be repaired by one of the following options:
  - Option 1: Fill the void with low strength soil-cement. The soil-cement should have a 4% cement content (by dry mass of soil) and an unconfined compressive strength of between 0.5 MPa and 1.0 MPa at 7 days. The fines/sand shall be non-plastic. The water-cement ratio should be between 3 and 4. If the soil-cement slurry is to be pumped, the addition of bentonite should be considered, in order to improve the flow characteristics of the slurry through the delivery hose.
  - Option 2: Reconstruction of the layer works, from the void up to the road surface, to the requirements and specifications set by the Approval Authority. The payment of a road crossing fee shall be made prior to the commence of the remedial action.

- Where the **road surface was damaged**, the entire affected area shall be reconstructed to the requirements and specifications set by the Approval Authority.

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CHAPTER 17

MISCELLANEOUS

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CHAPTER 17: MISCELLANEOUS

17.1 Public Transport (Bus/Taxi) Stops and Embayments

Public transport (i.e. bus or taxi) stops or embayments shall be provided as per Section 2.4.6.

Refer to Drawings RD8.2 and RD8.3 for the typical details of public transport embayments.

Designers should take note of the following regarding public transport embayments:

- The use of double-flat channels ("v-channel") is not allowed.
- A combination channel and dropped barrier kerb shall be constructed, with a 40mm vertical face height on the barrier kerb. Refer to Drawing RD2.1 detail "*Type A*".
- Where an embayment will act as a shared facility (buses and minibus taxis):
    - The R327 traffic sign shall be installed.
    - The corresponding RM7.1 "Bus" and "Minibus Taxi" symbols shall be painted in the roadway, adjacent to the embayment.

17.2 Refuse Collection (Solid Waste)

17.2.1 General

Designers should refer to the following City of Cape Town documents, which contain the complete list of requirements and specifications for refuse removal facilities:

- Solid Waste Management: "*Waste / Recycling Storage Area / Rooms: Standards and Guidelines*".
- Solid Waste Management: "*New Developments: Minimum Requirements for Vehicle Access/Waste Collections*".

17.2.2 Vehicle Access

The following will be applicable with regards to access for refuse removal vehicles:

- The refuse removal vehicles should be able to perform a continuous forward movement.
- The minimum required road width is 5m.
- Bellmouth radii shall not be smaller than 5m.
- Where the length of cul-de-sac roads exceed 20m or three (3) erven, a turning circle shall be provided, taking the following into consideration:
    - Minimum turning circle radius: 12.3m (outer wheel track)
    - Unobstructed width of 1m on the road verge (adjacent to the kerbline), to accommodate the overhang of the refuse vehicle (based on the swept path).

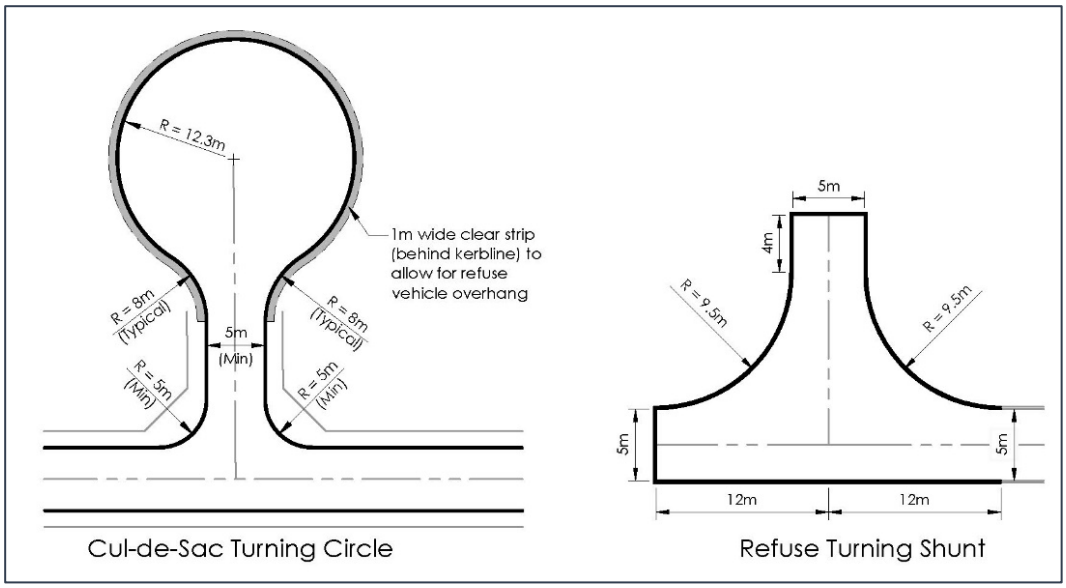


Figure 17-1: Turning Circle and Shunt dimensions for Refuse Vehicles

Designers can use the following data for the turning movements of refuse vehicles:

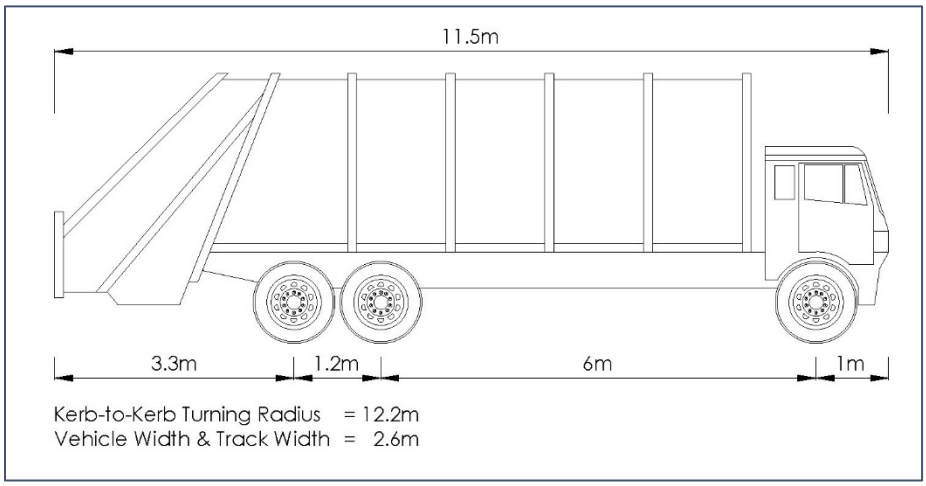


Figure 17-2: Refuse Vehicles Turning Data

17.2.3 Refuse Rooms/Points

Refuse rooms/points shall be provided as per the City's *Solid Waste Management department* standards and guidelines.

In certain instances, a level hardened surface should be provided on the road verge, to create a stacking area specifically for refuse bins (on refuse collection day).

17.2.4 Refuse Embayments

In certain situations, the position of refuse points and presence of the stationary refuse vehicle in the roadway severely impacts the safety of the traffic and mobility of the road. In such situations, refuse embayments are required. Refer to Section 2.4.5 for further clarification.

In relation to the refuse points, refuse embayments shall be provided at the following locations:

i) On mixed or higher order roads;
ii) Where the vehicle sight lines are hindered.

The position of embayments should be carefully considered, taking the following into consideration:

i) Impact on traffic;
ii) Existing street furniture and services;
iii) Pedestrian walkways;
iv) Proximity to adjacent carriageway crossings and intersections.

Standalone Embayment Specification

The typical requirements of a refuse embayment are as follows:

i) Minimum embayment dimensions:
   - Length = 12.5m (excluding tapers)
   - Width = 3.1m (minimum), 3.5m (preferred).
ii) The embayment length of 12.5m is based on a refuse vehicle length of 11.5m. Where larger refuse vehicles need to be accommodated, the embayment length shall be taken as the *refuse vehicle length + 1m*.
iii) The entry and exit tapers shall both be designed at a rate of 1:2.
iv) The layerworks shall be similar to the adjacent public roadway (as a minimum requirement).
v) The embayment shall have a cross-fall of 2.5% towards the public roadway.
vi) The use of double-flat channels ("v-channel") is not allowed.
vii) A combination channel and dropped barrier kerb shall be constructed, with a 40mm vertical face height on the barrier kerb.

The embayment specifications are illustrated in the figure below. Designers can refer to Drawing RD8.4 for further details on refuse embayments.

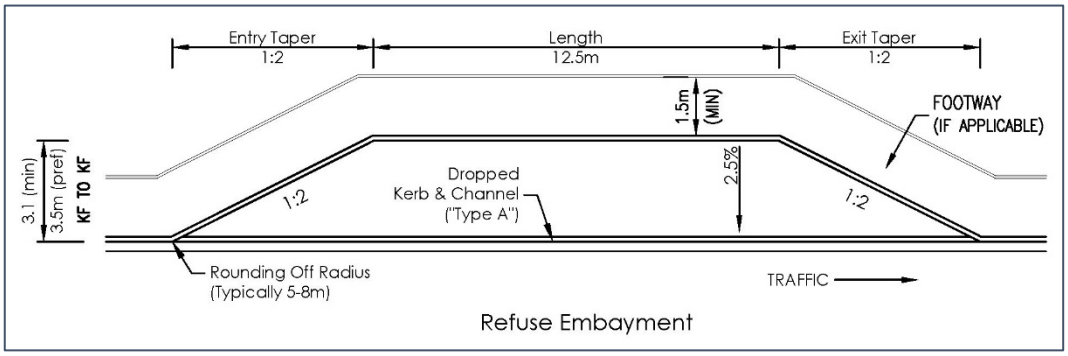


Figure 17-3: Refuse Embayment

Embayment adjacent to development access

Where a gated development's refuse room/area is situated near the access and a refuse embayment is required, a suitable position for said embayment is directly downstream of the development's access. In such a situation, the dropped kerbs for the carriageway crossing shall be extended to include the portion of the refuse embayment, i.e. have a continuous dropped kerb for both the carriageway crossing (access to development) and the refuse embayment.

Since the embayment is "open" on the entry side, refuse vehicles will be able to transition with greater ease into the embayment. The embayment length can therefore be reduced to 11.5m, but shall never be less than the actual length of the refuge vehicle that needs to be accommodated. The exit taper and embayment width shall remain as specified above.

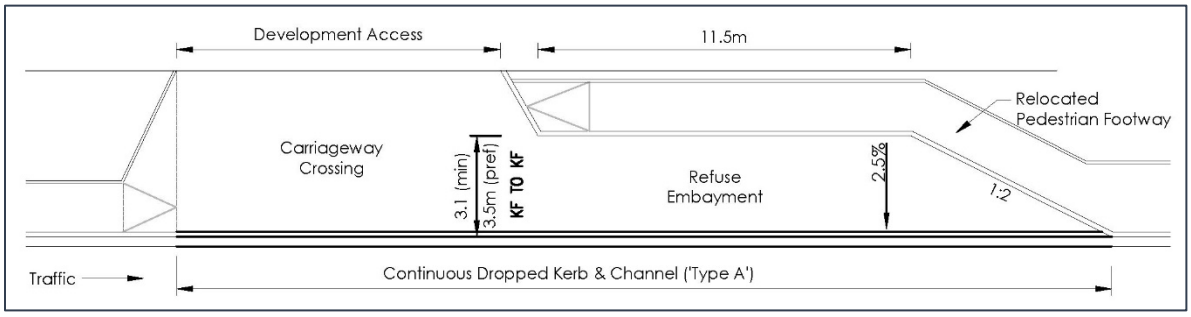


Figure 17-4: Typical example of Refuse embayment adjacent to development access

17.2.5 Accommodation of footways and services

Should refuse embayments be required along roadways where footways are present, the footway shall be relocated around the embayment. The footway should match the existing footway width, but shall never be less than 1.5m around the embayment.

Where a refuse embayment is provided on a Class 5 Residential Street (or low traffic volumes), the embayment width may be reduced to 2.5m, in order to accommodate the minimum footway width.

If the remaining road verge is unable to accommodate the relocated footway, pedestrian movement should be accommodated through the refuse embayment. To achieve the aforementioned, pedestrian ramps shall be constructed on either side of the embayment, in order to provide universal access. Refer to Section 5.5 for further details regarding universal access.

Any street furniture and services affected by a refuse embayment, both underground and and above ground, shall be relocated

17.3 Fuel Containment Areas/Embayments

17.3.1 Fuel Containment Slabs on Private Property

Fuel filling stations/points are often provided on developments.

Above ground fuel tanks shall conform to the specifications of SANS10131

The following will be applicable to an on-site fuel filling point (not roofed):

- A fuel "spill slab" to be provided. The spill slab will act as a containment area and ensure that any fuel spillages are contained within the area.
- Mountable kerbs shall be provided along the perimeter of the spill slab, in order to 1) contain any spillages and 2) accommodate traversing of filling vehicles.
- A grid shall be provided at the low point of the containment area, in order to drain any potential fuel spillages.
- Spillages shall then be directed to an oil separation system (oil interceptor). The oil interceptor shall have the same capacity as the fuel tanker truck, in order to accommodate a "full spillage" of said truck. A minimum capacity of 6000L is required. Thereafter it shall be discharged via an underground pipe to the property's stormwater connection manhole (and ultimately to the municipal stormwater system).
- Regular checks shall be conducted to ensure that no oily water to be discharged into the municipal stormwater system.
- A valve should be located on the outlet side of the oil separation system, connecting into the stormwater system. In the event of heavy rainfall and a tank burst, this valve should be closed immediately.

17.3.2 Fuel Containment Slabs inside the Road Reserve

Even though fuel filling points are generally provided inside private properties, a situation might arise where a fuel filling point will be located within the road reserve (with the fuel tanks situated inside the private property).

The following requirements will be applicable for filling points situated inside the road reserve:

- An embayment shall be provided, in order to ensure that the fuel tanker truck is taken off the roadway during the filling process.
- A spill slab shall be provided for any fuel filling point. The embayment shall be "bunded", in order to contain any fuel spillages within the area. The "bunded" area shall be designed according to professional consultant specifications.
- A dropped barrier kerb shall be constructed between the embayment and the roadway, in order to act as a barrier. Refer to Drawing RD2.1 detail "*Type A*".
- The embayment shall have a cross-fall away from the public roadway.
- A grid shall be provided at the low point of the containment area, in order to drain any potential fuel spillages.
- Any spillages shall drain to an oil separation system (oil interceptor), which shall be constructed inside the private property. The oil interceptor to have the same capacity as the fuel tanker truck, in order to accommodate a "full spillage" of said truck. A minimum capacity of 6000L is required.
- From the oil separation system, the discharge shall be discharged via an underground pipe to the property's stormwater connection manhole (and ultimately to the municipal stormwater system).
- Regular checks shall be conducted to ensure that no oily water to be discharged into the municipal stormwater system.
- A valve should be located on the outlet side of the oil separation system, connecting into the stormwater system. In the event of heavy rainfall and a tank burst, this valve should be closed immediately.

17.4 Wash Bays

Wash bays are not generally situated within the road reserve, but may be included as part of a commercial development. It is therefore important to stipulate the basic design requirement these facilities shall adhere to.

Requirements for wash bays are as follows:

i) Wash bays shall not discharge to the stormwater system.
ii) The wash bay shall be roofed, kerbed and provided with screening (walls) on three sides to prevent the ingress of rain water. No shade cloth is allowed for the roof.
iii) The entrance to the wash bay shall be provided with a roll-over kerb.
iv) Effluent generated from the wash bay shall be discharged to the sewerage system via a sand trap petrol/oil interceptor and sampling chamber.
v) All hosepipes used in the wash bay shall be fitted with automatic shut-off nozzles and the water supply to the wash bay shall be sub-metered.
vi) All taps to be located inside the wash bay.
vii) No washing of vehicles to be conducted outside the confines of the wash bay.

A detailed plan to be submitted to the *Development Management: Planning & Building Development Management* branch for approval prior construction.

17.5 Telecommunication

The following section provides a brief overview of the basic requirements relating to the installation of new City telecommunication ("telecoms") infrastructure.

Designers and Contractors shall liaise with the City's *Telecommunications Infrastructure* department prior to the commencement of any work, in order obtain approval for the proposed infrastructure to be installed.

17.5.1 Standard Reference Documents

The following documents shall be applicable to the installation of City telecommunication services:

- City of Cape Town (Telecommunications), *Trenching Specification, Document TRC-002-STD*
- City of Cape Town (Telecommunications), *Manhole Specification, Document MHS-003-STD*

17.5.2 Manholes

The two manhole types accepted for telecoms services are:

i) Prefabricated Glassfibre Reinforced Concrete (GRC) Cylindrical Manholes;
ii) Brick manholes.

Where space constraints are present (e.g. narrow verges, existing services, etc.), a reduction in the manhole chamber size for brick manholes shall be considered. However, brick manhole chambers shall never be less than 800x800mm (internal dimensions).

The cover and frame requirements for telecoms manholes are stipulated in the table below:

Table 17-1: Telecoms Manhole Cover and Frame Requirements

Manholes Location	Cover and Frame Specification
Manholes situated within roadway	Ductile Iron, Class D400 (as per SANS 50124). Cover fitted with lock assembly
Other manholes situated inside or outside road reserve	Polymer-Concrete, Type 2A, Class H (heavy duty & withstand 135kN force, as per SANS 1886). Cover fitted with lock assembly

Notes:

SANS 50124 - Gully tops and manhole tops for vehicular and pedestrian areas — Design requirements, type testing, marking, quality control

SANS 1886 - Polymer concrete surface boxes, manhole and inspection covers, gully gratings and frames

17.5.3 Installation of Ducts

The width of telecoms trenches depends on the number of ducts to be installed. Single, double and four 110mm ducts shall require a trench width of 450mm. For eight (8) 110mm ducts, a trench width of 690mm is required. Ducts shall be positioned as per *Document TRC-002-STD*.

Services shall be installed at a depth of 1m. Any deviation from the aforementioned installation depth (i.e. shallower installation) shall be discussed with the City's *Telecoms* department. Where the cover to the top most duct(s) is less than 600mm, the ducts shall be encased with concrete, as per the requirements of the City's *Telecoms* department.

17.6 Town Survey Markers (TSMs)

The City utilises two types of Town Survey Marks (TSMs) or Reference Marks, namely:

- The traditional Town Survey Mark "box", which consists of a frame, brass pin installed in concrete and a lid (as per detail drawing GE5). The aforementioned is generally constructed within the roadway.
- Brass studs, which are typically installed behind roadway kerbs or channels.

17.6.1 Relocation, Reconstruction or Removal of Existing TSMs

TSMs are often located along roadways where upgrades or alterations are undertaken. In such instances, if the TSMs are not removed prior to construction, they may be damaged by the construction works or even destroyed.

Where TSMs will be affected by construction works, the City's *Geomatics Section, of the Information & Knowledge Management Department, Corporate Services,* shall be contacted prior to the commencement of the construction works, in order to be notified of the affected TSMs and to advise on the handling thereof (i.e. reinstated, replaced or complete removal).

Reinstatement

If a "box" type TSM has to be reinstated, the "box" material shall be carefully removed, in order to prevent damages to the materials. The "box" shall then be reinstated by the contractor during the appropriate construction stage/phase, as advised and supervised by the *Geomatics Section*.

The Geomatics Section shall be contacted a week before final servicing, to establish dates for the construction/reinstatement of the TSMs and to establish the locations thereof. The City afterwards will perform the survey of the "new" TSM.

Where Brass studs has to be reinstated, the studs shall be carefully removed and kept safe at the contractor's site camp. The *Geomatics Section* shall be contacted in order to collect the material. After completion of road construction, new studs will be installed and surveyed by the City.

Complete Removal

Where the *Geomatics Section* advises that TSMs are no longer required at a certain location, the material shell be carefully removed and kept safe at the contractor's site camp. The *Geomatics Section* shall thereafter be contacted in order to collect the material.

17.6.2 Provision of new TSMs

Where new municipal roads are constructed, the City's *Geomatics Section* shall be contacted prior to the commencement of the construction works, in order to stipulate their requirements in terms of new/additional TSMs along the new roadway(s).

If there are enough "boxes" situated in the area, then brass studs are generally installed along new roadways. However, if there are no "boxes" close by, then new "boxes" will be constructed with brass studs in between.

Brass studs will be installed and surveyed by the City.

If new "boxes" are required, the installation/construction thereof will be carried out by the contractor. The material (i.e. frame, brass pin, lid, etc.) will be supplied by the City. The contractor will be responsible for the provision/casting of the concrete (which the brass pin will be placed in). The installation/construction shall be done in conjunction with the *Geomatics Section*, who will supervise the installation and stipulate the locations of the TSMs. The City will then perform the survey of the new TSMs.

The *Geomatics Section* shall be contacted a week before the installation, in order to establish dates for the installation/construction of the TSMs and to establish the locations thereof.

17.6 Trench Reinstatement

Trench reinstatement shall be carried out as per Drawing RD16.

The reinstatement proposal shall be submitted and approved by the Approval Authority, prior to construction.

Where concrete is not used around the services (e.g. for ducts), special care shall be taken to ensure that the material underneath and surrounding the services is properly compacted.

17.7 Fencing and Handrails

17.7.1 Handrails

Unless instructed otherwise, steel handrail shall be provided. Refer to Drawings GE2. Steel handrails are generally provided along sidewalks or islands, in order to direct pedestrian movement or act as safety measure against steep vertical drops or unsafe embankments.

In areas where there is a high likelihood of theft, alternatives to steel handrailing shall be discussed with the relevant RIM District.

17.7.2 Fencing

Various types of fencing are accepted within the City. The basic requirements are given below.

Designers shall submit any fencing proposals to the Approval Authority prior to construction.

The provision of any type of fencing shall be discussed with the relevant City department that will be undertaking maintenance thereon.

Welded Mesh-panel (High Security) Fencing

- Panels & Mesh:
  - Height (above ground level): 2.1m minimum (2.4m preferred).
  - Wire diameter: 3mm minimum
  - Aperture (WxH): 76.2x12.7mm or 75x12.5mm c/c of wires
- Corrosion Protection:
  - All steel to be galvanised.
  - Mesh to have a zinc-aluminium coating (Zincalu).
  - Additional coating may be required to the mesh.
- Spiked toppings or barbed wires should be considered as climb-over preventions.
- Fastenings/fittings should be vandal-resistant.

Timber Post and Rail Fence

- Post and rail fencing shall comprise of lathe-turned pine.
- The posts shall have a nominal diameter of 150mm and pre-socketed (90 mm diameter) for 1 or 2 rails. The rail shall be 1.8m long and 90mm in diameter.

Refer to Drawing series GE10 for more details.

Steel Palisade

- Galvanized steel palisade fence shall consist of 76mm x 76mm x 3.0mm thick post, with welded post cap. A 40mm x 40mm x 3.0mm thick L-bracket to be welded to post and drilled with hole for bearer bolts.
- Where the base of the pole has a welded cap, a hole shall be drilled in the post above the level of the concrete base cast. The post shall be set in 300mm x 300mm x 650mm deep 25MPa concrete base.
- Rail/horizontal bearers shall be 40 mm x 60 mm x 3.0 mm thick and punched at 170mm centres to accommodate the pales.
- Steel palisade shall be 40 mm x 40 mm x 3.0 mm thick and placed at 170mm centres.

Concrete Palisade

- Concrete elements shall be Class 40/14 (40MPa strength at 28 days).
- Posts shall be 3m long, with slots to accommodate the horizontal rails.
- Rails shall be 1.98m long.
- Pales shall be 2.4m long.
- The post foundations shall be concrete Class 25/20.

Refer to Drawing GE3 for more details.

To: *Part A Overview*

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CHAPTER 18

APPROVAL OF ENGINEERING DRAWINGS

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CHAPTER 18: APPROVAL OF ENGINEERING DRAWINGS

18.1 General

The detailed design shall be in accordance with the requirements of this document, unless advised otherwise.

The design shall be carried out and certified by an Engineering Professional, registered with the Engineering Council of South Africa (ECSA) in terms of the Engineering Professionals Act, 46 of 2000, with competence in the relevant field.

The contents of this document shall be applicable to the following cases:

- Provision of new infrastructure and/or services in the public road reserve;
- Alterations or upgrades to existing infrastructure and/or services in the public road reserve
- Connection or link services from private developments;
- Any other infrastructure and/or services that will be taken over by the City at completion of the works.

18.2 Approval of Detailed Engineering Drawings

Engineering drawings shall be approved by the Approval Authority, i.e. District Engineer (Roads and Stormwater Branch).

The various Roads and Stormwater district areas can be found on the *"RIM Districts"* Map (refer to Part C).

The following will be required to obtain approval:

i) Submission of one (1) set of hard copy drawings, printed to scale.
ii) Drawings shall be signed by a Professionally Registered person.
iii) Cover letter, listing all the drawings requiring approval, including the latest revision number(s).

Where approvals from other City departments are required (e.g. Traffic Signals, Stormwater Management Plans, etc.), such approvals shall be obtained prior to the submission of the detail design drawings to the District Engineer.

Designers can refer to Section 19.1 regarding the required information that shall be included in the drawing submission.

The approval of detailed engineering drawings will be valid for a period of twelve (12) months. If construction has not commenced within said period, the aforementioned approval shall be renewed, at which time the Approval Authority reserves the right for revised comments and conditions.

18.3 Construction Monitoring & Testing

An adequate level of supervision by a Registered Professional Engineer or Engineering Technologist shall be provided for the full duration of the works. In this regard, a proposal for construction supervision shall be submitted to the City for approval before construction commences. The proposal shall include the name (or names where a team is required) of the individuals proposed, their CV's and the time that they will devote to site supervision on the project.

The necessary testing, as prescribed in the relevant specification documents (e.g. SANS 1200 or COTO), shall be carried out and the results thereof be made available to the City.

18.4 Construction

No construction work may commence before an approval of the detailed design (in writing) is obtained from the Approval Authority. No work may commence without wayleaves and permits from the various Departments for stormwater, sewer, water, electricity and telecommunication services. Wayleave applications can be submitted via the electronic Wayleave Management System (https://wayleave.capetown.gov.za). The Developer's contractor shall be acquainted with the exact positions of all existing and proposed underground and aboveground services before commencing any construction work.

The City shall be informed in writing not less than five (5) working days before construction is due to commence.

The Developer shall be held responsible for all project related defects in respect of any infrastructure inside the public road reserve, up to the issuing of the Certificate of Completion. Thereafter, the liability will be limited to project related defects only, for a period of twelve months.

18.5 Inspection

Prior to the handover of infrastructure, the City shall be invited to a site inspection in order to ensure the following:

- The works were constructed as per the approved engineering drawings;
- Identify any "snags", which shall be rectified prior to the issuing of the Certificate of Completion.

18.6 Submission of As-Built information

The submission of as-built drawings and information, including relevant test results, shall be submitted prior to the issuing of the Certificate of Completion.

Refer to Chapter 19.2 for further requirements.

18.7 Proclaimed Main Roads

Construction works on Proclaimed Main Roads requires the approval from the Western Cape Government (i.e. the Administrator) in terms of Section 17 of the Roads Ordinance (No 19 of 1976).

Engineering drawings, along with the City's approval letter, shall be submitted to the *Western Cape Government: Department of Infrastructure, Transport Infrastructure branch* for approval.

Designers can also refer to City's latest *Guideline for The Approval of Engineering Drawings On Proclaimed Main Roads in The City of Cape Town Metropolitan Area*.

Maps of importance (refer to Part C):

- *WCG: Assignment of Roads in the City of Cape Town Area* Map.
- *WCG: City of Cape Town – National, Trunk, Main, Divisional & Minor Road Network* Map.

18.8 Private Developments

Developers are responsible for ensuring compliance with all the applicable legislation, including City of Cape Town's policies, by-laws, etc. Certain activities may require the consent or permit approvals by national and/or provincial government departments.

Where link/connecting infrastructure and/or services (e.g. access roads, stormwater connections, etc.) are required for private developments, engineering drawings thereof shall also be submitted for approval to the relevant Approval Authority.

To: ***Part A Overview***

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CHAPTER 19

DRAWING AND AS-BUILT REQUIREMENTS

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CHAPTER 19: DRAWING AND AS-BUILT REQUIREMENTS

19.1 Drawing Requirements

19.1.1 General

Any detail engineering drawings submitted for approval shall adhere to the drawing requirements as stipulated in this section.

Where drawings should be drawn in accordance with City standards, designers should contact the Geometric Design Office for the necessary drafting standards.

The section provides an overview of the general drawing requirements. Designers can also refer to the Design Checklist (as per *Annexure B*) for detailed requirements.

19.1.2 General Requirements

Drawings shall adhere to the following general requirements:

- Drawing shall be plotted on the standard paper sizes (A0, A1, A2, A3 and A4), to an appropriate scale.
- Conventional scales shall be used (e.g. 1:50, 1:100, 1:200, 1:250, 1:500). Odd scales will not be accepted (e.g. 1:45).
- The drawing number, including the latest revision number, description and date, shall be included on each drawing.
- Revisions to be "clouded" on the layout drawing, with the relevant revision number.

19.1.3 Plan Layouts and Information

Plan layouts shall include the following information:

- Survey information and contours of existing surfaces;
- Proposed roadways, including relevant sections, setting out details and intersection grading layouts.
- Pavement design;
- Finished road surface contours and setting out details of all intersections;
- Proposed NMT facilities;
- Proposed road marking and road signs;
- All existing service (underground and aboveground);
- Proposed conduit sizes, materials, classes and gradients;
- Manhole numbers, cover levels and invert levels of all services (existing and proposed);
- Co-ordinate list of all features/entities;
- Legend for Services;
- Grid positions (y, x) at regular intervals;
- Cadastral information;
- North sign;
- Locality plan, with sufficient information to uniquely identify the location.

Where possible, the aforementioned information should be separated and provided on the following layout types:

Table 19-1: Recommended Drawing Layouts

Layout	Information
Roads Layout	New roadways and NMT facilities. Includes edgings, kerbs, channels, road center and edge lines, universal access (if applicable)
Road Longitudinal Sections	See Section 19.1.4
Intersections	Setting out and road grading (contours) for all intersections; universal access.
Cross Sections	Refer to Section 19.1.5
Typical Cross Section	• Typical Cross Section of roadway and/or NMT facilities, including the services (underground and aboveground). • Proposed pavement design(s) • Also refer to Section 19.1.5
Stormwater	• Conduits - type; sizes; material; class; gradients • Manholes (incl. subsoil manholes) - cover & invert (sump) levels; depths • Catchpits - cover & invert (sump) levels; depths • Subsoil Drainage - type; size; depths
Stormwater Conduit Longitudinal Sections	• Proposed stormwater - conduit size, material, length and slope. • Manholes – Cover & invert levels; depth. • Other crossing services. • Also refer to Section 19.1.4
Road Markings	Road markings and road signs, including specifications schedule
Typical Details	Typical details (applicable to project)
Survey	Site survey, including existing underground and aboveground services and structures (floor levels, where applicable)

Depending on the extent of design (i.e. proposed works), certain information may be combined on layouts, provided that the information does not appear cluttered.

It should be noted that the Sewer, Water and other services should be provided on separate layouts. The aforementioned may be included with the engineering drawing submission, but will be for information purposes only.

19.1.4 Longitudinal Sections

Longitudinal sections of all proposed underground services and roads are required and shall include the following:

Roadways

- Stake values and final center line road levels at regular intervals, including all vertical and horizontal curve details (including left and right edge levels).
- Existing ground profile;
- Horizontal scale to be the same scale as the plan view and drawn in the same direction.
- Stake Value zero (0) shall always be on the left side of the drawing;
- Vertical exaggerations shall conform to appropriate metric scales e.g. 1:2,1:5 or 1:10, etc.

Services

- Depth of existing and proposed services;
- Proposed stormwater conduits, including conduit size, material, length and slope;
- Proposed structures, with invert and sump levels (if applicable). Reference numbers to be included as well.
- Any crossing services (e.g. sewer mains, water mains).
- Carriageway crossing positions and levels (where applicable).
- Vertical exaggerations shall conform to appropriate metric scales e.g. 1:2,1:5 or 1:10, etc.

19.1.5 Cross Sections

Actual cross sections shall be provided at all significant changes, at regular intervals (not more than 20 metres apart) and include the following:

- Road reserve location;
- Final road profile and levels;
- Proposed and existing services and levels;
- Conform to metric scales and have an appropriate vertical exaggeration, e.g. 1:2, 1:5 & 1:10;
- Commence with zero distance at the bottom of the page so that the observer can visualise the change in profile;

A "Typical cross sections" shall also be provided and include the following:

- Proposed roadway, including widths of the road lanes and parking/shoulder/cycle facility;
- Proposed layer works (thickness and full specifications);
- Edge restraints (kerbs, channels, edgings, etc.);
- NMT Facilities (e.g. pedestrian footways and cycle ways), including widths thereof;
- Proposed underground services (stormwater, sub-surface drains, sewer, water, telecommunications, etc.);
- Mole barriers (where applicable).

19.2 As-Built Requirements

The as-built information, including relevant test results and CCTV footage, shall be submitted prior to the issuing of the Certificate of Completion and shall be in accordance with the requirements described hereafter.

19.2.1 As-Built Drawing Submission

The following requirements will be applicable regarding the submission of as-built drawings:

i) As-Built drawings and information shall be submitted to the office of the relevant District Engineer (roads and stormwater section).

ii) As-Built drawings/data shall be provided electronically on a USB Flash Drive. Data may also be shared via online platforms, provided that the City can access the data/website.

iii) Hard copies shall be submitted, if requested by the relevant District Engineer. The name of the development, parent erf number (where applicable) and engineering consultant/ company name and contact details shall be provided on a cover letter.

The hard copies shall be plotted on standard sheet sizes. No oversized copies will be accepted. Standard sheet sizes are as follows:

Table 19-2: Page Dimensions

Sheet Size	Dimensions
A0	841 X 1189
A1	594 X 841
A2	420 X 594
A3	297 X 420
A4	210 X 297

No Telkom or electrical data should be shown on the civil as-built drawings or digital data, unless requested by the City.

19.2.2 As-Built Drawing Information

Services shall be separated on the drawings as follows:

- Roads Layout;
- Road longitudinal sections;
- Typical Cross Section, including Pavement Designs;
- Stormwater Layout [including contours];
- Road Markings and Road Signs Layout;
- Combined Services (stormwater, water & sewer, etc.) [excluding contours];
- Duct Layout (if applicable).

The following information needs to be clearly indicated on the drawings:

a) All appropriate Layout features, i.e.
   i) Title Block;
   ii) Legends;
   iii) North Sign;
   iv) Scale;
   v) Grid positions (y, x) at regular intervals (where applicable).

b) The dates of all revisions should be indicated, including the final As- Built date.

c) The first As-Built submission shall be revision "Z1". However, if further amendments are required, the subsequent revisions shall be "Z2", "Z3", etc.

d) The status of the final plan(s) shall be clearly marked as "AS-BUILT", with revision number Zx (as described above).

e) The name of the Development/ Suburb.

f) If the development consists of multiple phases, it should be shown clearly on a Phasing Layout (or Locality map).

g) Street names (if available).

h) Cadastral information (including individual erf numbers and parent erf number, where applicable).

i) Servitudes and widths thereof.

j) The ownership of all services should be clearly indicated, i.e. "Municipal" or "Private", including the extent thereof.

k) The full name and signature of the responsible project manager, contact details, as well as the names of the clients, consultants, contractors and project number should be on the As-Built drawings.

l) Any proposed infrastructure as shown on the construction drawings, shall be indicated as "new" on the As-Built drawings (and not "proposed").

m) All features and attribute data shall be provided on the drawings and include the following:
   i) Conduits – Type, size, class, lengths, slopes, materials;
   ii) Manholes – Cover and Invert levels (including all conduit incoming and outgoing invert levels), depths, cover type and frame type;
   iii) Catchpits – Catchpit type (e.g. single, double, kerb inlet, grid inlet, combination, etc.), Cover and Invert levels, depths, cover type and frame type
   iv) Sub-soils – Invert levels, type, size, length, slopes, depths, material.
   v) A co-ordinate list (Label, X, Y) of all manholes and catchpits shall be provided on the drawings. The aforementioned shall also be submitted electronically (ASCII/Excel file) to the City of Cape Town.

n) Surveyor stamp and signature to be present on all As-Built drawings.

19.2.3 Electronic As-Built Data

The following requirements will be applicable to the electronic as-built data:

a) As mentioned in Section 19.2.1, As-Built drawings/data shall be provided electronically, on a USB Flash Drive.
b) Drawings shall be provided in PDF and DWG (AutoCAD, version 2013 or later) formats. Where possible, the Stormwater Layout and Combined Services Layout should be provided in TIFF format.
c) No faded/light colours shall be used on hard copy drawings (e.g. yellow).
d) CAD Drawings:
   - Drawings shall be referenced in the WGS84 co-ordinate system.
   - drawings should be drawn BY LAYER (and not BY COLOR). Layer names to be descriptive.
   - Each theme type to be drawn on a different layer.
   - Drawings should not contain external references (x-ref). If applicable, all references shall be bound to the main drawing.
e) Survey:
   - Where requested, surveys shall be submitted in ASCII or Excel format.
   - LandXML files of all as-built roads and above and below ground services (3D model).
   - Reference points, such as "Town Survey Markers" and "Working Stations", used during As-Built survey, shall be provided, including the following information: Name, Y-coordinate, X-coordinate, Z-value, Description.
   - Height values must be referenced to Mean Sea Level (MSL), if MSL control points are available.

19.2.4 Geographic Information System (GIS) Data Format

Where applicable (or requested), GIS-data shall be submitted in accordance with the requirements specified below.

Data Format

The GIS data must be produced and provided in the following format:

- Map Projection: Gauss Conformal (Transverse Mercator)
- Datum: Hartebeeshoek 94
- Spheroid: WGS 84
- Scale Factor: 1
- Central Meridian: 19
- Units: International Metre

Spatial Data

Spatial Data should be supplied to the City of Cape Town as follows:

- GIS ESRI formats, i.e. ArcGIS File Geodatabase or Personal Geodatabase or Shape files (*.shp).
- Attributes must contain pipe diameters, class, length, capacity, material and CL/IL (height values must be referenced to Mean Sea Level;
- All field names must be understandable and, if provided as a Shapefile, the field names must be shorter than eight characters;
- If the field name is more than one word, underscores must be used e.g. Facility_Name;
- Metadata explaining the field names and field parameters must be provided.
- The shape files shall also contain the additional information as detailed in Section 19.2.5.

Topology

All data supplied to the City should have spatial topology and must adhere to the following:

- The capturing direction of line features (conduits) must reflect the gravity (flow) direction of the conduit (i.e. capture in the Flow Direction of the conduit).
- Connectivity must be complete, ensuring that all connected features snap accurately to one another, with no under- or over shoots, point-to-line and line-to-line;
- The drawing must be "topologically clean" with no duplication of features.

19.2.5 Quantification and Valuation of new City infrastructure/assets

Along with all the above-mentioned as-built drawings and information, consultants shall also provide the City with a detailed schedule of the newly created infrastructure (assets) which will be taken over by the City upon completion of the works (private services excluded).

The consultant shall provide a full asset breakdown and the necessary information as per *Annexure A*. Where infrastructure was provided as part of a Services Agreement, the cost of the infrastructure provided in lieu of Development Charges must be specified separately. The asset information (schedule) shall be provided in Microsoft Excel format (as per *Annexure A*).

The schedule shall include the following asset information:

- Description of the asset (Type, Material, Class);
- Extent of the asset;
- Value of the asset, including the unit rate;
- Location of the asset;
- Date of commissioning (i.e. handover to City).

The asset types to be reported on shall include the following:

- Roadways (road classes) and footways;
- Stormwater (Conduits, Structures, Ponds);
- Water (Pipes, Valves, Fire Hydrants);
- Sewer (Pipes, Manholes).

19.2.6 Pavement Test Results and CCTV Footage

Along with the as-built drawings and GIS information, the pavement test results and CCTV footage of the stormwater shall be submitted to the Approval Authority prior to hand-over of the infrastructure.

Pavement Test results

All test result relating to the pavement structures shall be submitted in pdf format and shall, inter alia, include the following:

- Mix designs (asphalt layers, granular layers, stabilised layers, etc.)
- Compaction results (asphalt layers, granular layers, stabilised layers, etc.)
- Strength results (Stabilised layers, concrete, segmented block paving)

Stormwater CCTV Footage

As stipulated in Section 10.6, all stormwater conduits taken over by the City shall be inspected by means of a CCTV inspection camera and a report submitted to the relevant District Office (Roads and Stormwater branch). A copy of the recorded footage shall also be included and shall be *MS Windows Media Player* compatible.

If any faults were detected during the inspection and were rectified afterwards, it shall be included in a separate report, with proof of the rectified works.

Water and Sanitation

The as-built requirements for water and sewer infrastructure shall be confirmed with the officials of the relevant departments during the design approval stage.

To: *Part A Overview*

To: *Chapter Overview*

CHAPTER 20

DOCUMENT REFERENCES

CHAPTER 20: DOCUMENT REFERENCES

#	Document Description	Chapter Relevance
1	***Boundary Walls and Fences Policy*** (January 2009)	2
2	***By-Law Relating to Streets, Public Places and the Prevention of Noise Nuisances*** (2007). Approved 30 May 2007 (C 24/05/07).	1
3	Comprehensive **Integrated Transport Plan** 2018-2023	2, 4, 5
4	***Development Management Scheme*** (Schedule 3 of the Municipal Planning By-Law).	1, 2, 6, 7
5	***Floodplain and River Corridor Management Policy*** (2009). Version 2.1. Approved 27 May 2009 (C58/05/09)	10
6	***Gated Development Policy*** (2007). Approved 28 November 2007 (SPPLAN 03/11/07).	2
7	Guidelines for the Provision of Carriageway Crossings	2, 6
8	***Guidelines for Designing or Approving Hard and Soft Landscaping in the Urban Road Reserve*** (2020)	2, 4
9	***Guideline for the Approval of Engineering Drawings on Proclaimed Main Roads in the City of Cape Town Metropolitan Area*** (January 2020). Version 1.0	15
10	***Guidelines for the Erection of Balconies, Canopies and Columns on the Verge*** (2006)	2
11	***Guidelines for the Formalising of Parking Areas on Verges*** (2003).	2
12	***Informal Trading By-Law*** (2009). Approved 20 March 2009 (C 66/03/09).	1
13	***Management of Urban Stormwater Impacts Policy*** (2009). Version 1.1. Approved 27 May 2009 (C58/05/09)	10
14	***Municipal Planning Amendment By-Law*** (2019). Approved 31 October 2019 (C26/10/19).	1, 2, 6
15	***NMT Policy and Strategy, Volume 1: Status Quo Assessment*** (October 2005)	2, 5
16	***NMT Policy and Strategy, Volume 2: Policy Framework*** (29 May 2014)	2, 5
17	***Outdoor Advertising and Signage By-law No 5801 of 2001, First Amendment By-law 2013*** (2013). Approved 28 August 2013 (C 04/08/13).	1
18	***Parking By-law*** (2010). Approved 9 December 2010 (C 17/12/10).	1
19	***Parking Policy*** *(Policy Number 17913)* (2014). Approved 24 April 2014 (C 62/04/14).	1
20	*Road Network, Metropolitan Area* - ***Public Right of Way Map*** (2023)	2
21	***Services Guidelines & Standards for Water and Sanitation Department*** (20 Jun 2019). Version 3.3	11, 12
22	Solid Waste Management, ***New Developments: Minimum Requirements for Vehicle Access/Waste Collection***s (April 2020)	2, 14
23	Solid Waste Management, ***Waste / Recycling Storage Area / Rooms: Standards and Guidelines*** (November 2018)	2, 14
24	***Stormwater Management By-Law*** (2005). Approved 9 December 2010 (C 35/08/05).	1,10
25	***Stormwater Management on Slopes Adjacent to Natural Areas*** (November 2003). Version 1.0	10
26	***Stormwater Management Planning and Design Guidelines for New Developments*** (July 2002). Version 1.0	10
27	***Street Naming and Numbering Policy*** (Policy Number 21288) (2014). Approved 25 June 2014 (C62/06/14).	2
28	***Sustainable Urban Drainage Systems – Landscape and Indigenous Plant Species Guidelines*** (February 2011). Version 1.0, by Catchment, Stormwater and River Management Branch	10
29	***Traffic Calming Policy*** *(Policy Number 45396)* (2016). Approved 28 January 2016 (C 26/01/16)	2
30	***Traffic Signals Construction Procedure*** (2016)	9
31	***Tree Management Policy*** *(Policy Number 34933)* (2015). Approved 25 March 2015 (C 31/03/15).	2, 4
32	***Universal Access Policy for Transport for Cape Town*** (Policy Number 17958) (2014). Approved 29 May 2014 (C38/05/14)	5, 6
33	***Wayleave Process and Standards for the Installation of Services in Road Reserves*** (Feb 2024)	4, 16

34	Province of Cape of Good Hope, Roads and Traffic Administration Branch (1996). ***Geometric Design Manual***	2, 3
35	Western Cape Government, ***Access Management Guidelines***, 2nd Edition, 2020.	2, 3, 6
36	Western Cape Government, ***Roundabout Framework,*** Volume 1: Status Quo Analysis, March 2018.	3
37	Western Cape Government, ***Roundabout Framework,*** Volume 2: Evaluation and Implementation Guideline, May 2018.	3
38	***Constitution of the Republic of South Africa*** *(108 of 1996)* (1996). Promulgated on 18 December 1996.	1
39	*Department of Labour.* ***Construction Regulations (2014)***	
40	***Municipal Systems Act*** *(32 of 2000)* (2000). Promulgated on 20 November 2000.	1
41	***Municipal Systems Amendment Act*** *(7 of 2011)* (2011). Promulgated on 5 July 2011.	1
42	***Municipal Structures Act*** *(117 of 1998)* (1998). Promulgated on 18 December 1998.	1
43	***Municipal Structures Amendment Act*** *(58 of 1999)* (1998). Promulgated on 14 January 2000.	1
44	National Department of Housing, *Generic Specification* ***GFSH-2: Geotechnical Site Investigations for Housing Developments***, September 2002	15
45	National Department of Transport, ***National Technical Requirements 1 (NTR1): Pedestrian Crossing - Part 1*** (2016). Version 6, November 2016	5
46	National Department of Transport, ***National Technical Requirements 1 (NTR1): Pedestrian Crossing - Part 2*** (2016). Version 6, November 2016	5
47	National Department of Transport, ***NMT Facility Guidelines*** (2014)	4, 5
48	National Department of Transport, ***Pedestrian and Bicycle Facilities Guidelines*** (August 2003)	2, 4, 5
49	National Department of Transport, ***Position Paper on Tactile Ground Surface Indicators (TGSI's)*** (April 2016)	5
50	***National Road Traffic Act*** *(93 of 1996)* (1996). Promulgated 22 November 1996.	1, 9
51	***Roads Ordinance*** *(No. 19 of 1976)* (1976). Promulgated 3 November 1976.	1, 2
52	South African National Standard ***(SANS 32): Internal and/or external protective coatings for steel tubes — Specification for hot dip galvanized coatings applied in automatic plants***	12
53	South African National Standard ***(SANS 121): Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods***	12
54	South African National Standard ***(SANS 533): Black polyethylene pipes for the conveyance of liquids Part 1: Low density black polyethylene pressure pipes***	12
55	South African National Standard ***(SANS 634): Geotechnical Investigations for Township Development***	15
56	South African National Standard ***(SANS 664): Wedge gate and resilient seal valves for waterworks***	12
57	South African National Standard ***(SANS 677): Concrete non-pressure pipes***	11
58	South African National Standard ***(SANS 731-1): Single-Pack Solvent Bourne paints***	9
59	South African National Standard ***(SANS 791): Unplasticized poly (vinyl chloride) (PVC-U) sewer and drain pipes and pipe fittings***	11
60	South African National Standard ***(SANS 966-1): Components of pressure pipe systems Part 1: Unplasticized poly (vinyl chloride) (PVC-U) pressure pipe systems***	12
61	South African National Standard ***(SANS 1058): Concrete Paving Blocks***	8
62	South African National Standard ***(SANS 1200 LD): Standardized specification for civil engineering construction Section LD: Sewers***	11
63	South African National Standard ***(SANS 1223): Fibre-cement pressure pipes and couplings***	12
64	South African National Standard ***(SANS 1529-1): Water meters for cold and hot potable water, Part 1: Metrological characteristics of mechanical water meters of nominal bore not exceeding 100 mm***	12
65	South African National Standard ***(SANS 1575): Burnt Clay Paving Units***	8

66	South African National Standard ***(SANS 1601): Structured wall pipes and fittings of unplasticized poly (vinyl chloride) (PVC-U) for buried drainage and sewerage systems***	11
67	South African National Standard ***(SANS 1886): Polymer concrete surface boxes, manhole and inspection covers, gully gratings and frames***	17
68	South African National Standard ***(SANS 8006-1). Code of practice for strengthened/reinforced soils and other fills***	15
69	South African National Standard **(SANS 10400):** ***National Building Regulations***	2, 6
70	South African National Standard **(SANS 10400-G):** ***The Application of the National Building Regulations, Part G – Excavations***	15
71	South African National Standard **(SANS 10400-H):** ***The Application of the National Building Regulations, Part H – Foundations***	15
72	South African National Standard **(SANS 10400-S):** ***The Application of the National Building Regulations, Part S – Facilities for persons with disabilities***	5
73	South African National Standard ***(SANS 51423): Drop on materials – Glass beads, antiskid aggregates and mixtures of the two***	9
74	South African National Standard ***(SANS 51424): Road marking materials - Premix glass beads***	9
75	South African National Standard ***(SANS 50124): Gully tops and manhole tops for vehicular and pedestrian areas* - Design requirements, type testing, marking, quality control**	10, 11, 17
76	South African National Standard ***(SANS 50197-1): Cement, Part 1: Composition, specifications and conformity criteria for common cements***	11
77	South African National Standard ***(SANS 52842): Ductile iron fittings for PVC-U or PE piping systems — Requirements and test methods***	12
78	AEG, SAICE and SAIEG. ***Guideline for Soil and Rock Logging in South Africa***, 2002	15
79	British Standard **(BS 8004): Code of practice for foundations**	15
80	Cape Institute for Architecture, ***City of Cape Town Parking Standards*** (22 September 2017). Newsflash	7
81	Committee of State Road Authorities, ***TRH4: Structural Design of Flexible Pavements for Inter-urban and Rural Roads*** (1996)	8, 15
82	Committee of State Road Authorities, ***TRH14: Guidelines for Road Construction Materials*** (1985)	8
83	Committee of State Road Authorities, ***TRH15: Subsurface Drainage for Roads*** (1994)	10
84	Committee of Transport Officials (COTO), ***TMH16****: South African Traffic Impact and Site Traffic Assessment Standards and Requirements Manual* (February 2014). Version 1.01	2
85	Committee of Transport Officials (COTO), ***TRH26****: South African Road Classification and Access Management Manual* (August 2012). Version 1.0	2
86	Committee of Transport Officials (COTO), ***TRH27****: South African Manual* for Permitting Services in Road Reserves (August 2012). Version 1.0	4
87	European Standards ***(EN 1436:2018): Road marking materials. Road marking performance for road users and test methods***	9
88	European Standards ***(EN 1997):* Eurocode 7: Geotechnical Design -Part 1: General rules**	15
89	European Standards ***(EN 1997):* Eurocode 7: Geotechnical Design -Part 2: Ground Investigation and testing**	15
90	***Interim Guideline for the Design of Hot Mix Asphalt in South Africa*** (September 2001)	8
91	*International Organization for Standardization* ***(ISO 8501-1): Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings***	12
92	*International Organization for Standardization* ***(ISO 21542): Building construction - Accessibility and usability of the built environment***	5
93	***Roundabouts: An Informational Guide*** (2010), 2nd Edition, Transportation Research Board of the National Academics (National Cooperative Highway Research Program, Report 672)	2, 3
94	Sabita, ***Manual 35/TRH8: Design and Use of Asphalt in Road Pavements*** (February 2019). Revised 2nd Edition	8

95	Sabita, Technical Guideline ***(TG1): The Use of Modified Bituminous Binder in Road Construction*** (January 2019). 4th Edition	8
96	Sabita, Technical Guideline ***(TG2): Bitumen Stabilised Materials*** (June 2020). 3rd Edition	8
97	South African Institution of Civil Engineering ***(SAICE). The Safety of Persons Working in Small Diameter Shafts and Test Pits for Geotechnical Engineering Purposes***	15
98	South African Institution of Civil Engineering ***(SAICE). Site Investigation Code of Practice***, January 2010	15
99	South African Institution of Civil Engineering ***(SAICE). Lateral Support in Surface Excavations Code of Practice***, 1989	15
100	*Southern African Development Community, Road Traffic Signs Manual Volume 1 ("**SADC-RTSM-VOL1**"): Uniform Traffic Control Devices (2012). 3rd Edition, Digitised Version – May 2012*	5, 9
101	*Southern African Road Traffic Signs Manual Volume 2 ("**SARTSM-VOL2**"): Road Traffic Sign Application* (2012). 3rd Edition, Digitised Version - May 2012	2, 4, 5, 7, 9
102	*Southern African Road Traffic Signs Manual Volume 3 ("**SARTSM-VOL3**"): Traffic Signal Design* (2012). 3rd Edition, Digitised Version - May 2012	9
103	*Southern African Development Community, Road Traffic Signs Manual Volume 4 ("**SADC-RTSM-VOL4**"): Traffic Sign Design (2012). 3rd Edition, Digitised Version – May 2012*	9
104	South African National Roads Agency Limited (SANRAL), ***Geometric Design Guidelines***	2, 3
105	South African National Roads Agency Limited (SANRAL), ***Drainage Manual*** (October 2014). 6th Edition	8
106	South African National Roads Agency Limited (SANRAL), ***South African Pavement Engineering Manual (SAPEM), Chapter 7 Geotechnical Investigations and Design Considerations*** (2014). Second Edition	15
107	South African National Roads Agency Limited (SANRAL), ***South African Pavement Engineering Manual (SAPEM), Chapter 10 Pavement Design*** (2013). Second Edition	10
108	South African National Roads Agency Limited (SANRAL), ***Standard Specification for Subsurface Investigations*** (2010)	15
109	***The Neighbourhood Planning and Design Guide* ("Red Book")** (2019), Department of Human Settlements	2, 3, 4, 8, 10
110	*Urban Transport Guidelines (**UTG1): Guidelines for the Design of Urban Arterial Roads*** (1986), Committee of Urban Transport Authorities	2
111	*Urban Transport Guidelines (**UTG5): Geometric Design of Urban Collector Roads*** (1988), Committee of Urban Transport Authorities	2, 6
112	*Urban Transport Guidelines (**UTG7): Geometric Design of Urban Residential Streets*** (1989), Committee of Urban Transport Authorities	2, 6
113	*Urban Transport Guidelines (**UTG10): Geometric Design of Commercial and Industrial Local Streets*** (1990), Committee of Urban Transport Authorities	2, 6
114	University of Cape Town (May 2013). ***Alternative Technology for Stormwater Management - The South African Guidelines for Sustainable Drainage Systems***, Report to the Water Research Commission	10

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To: ***Document Structure***

PART B

BOOK OF DRAWINGS

List of Detail Drawings

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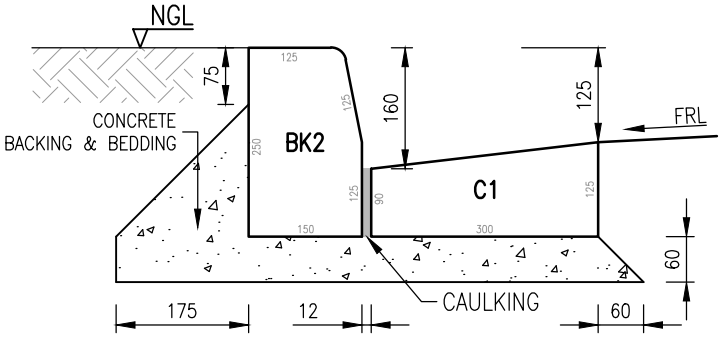
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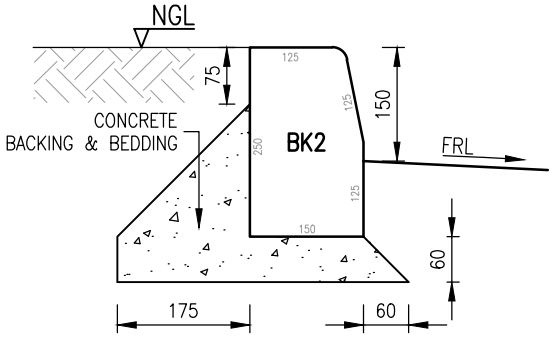
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Detail Drawings

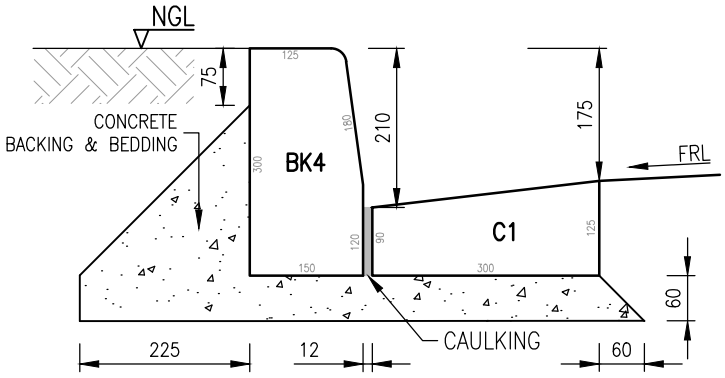
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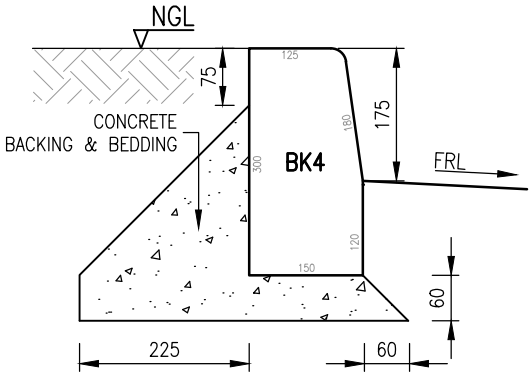
BK2 BARRIER KERB & C1 CHANNEL



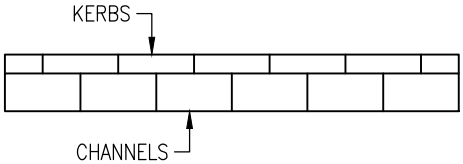
BK2 BARRIER KERB ONLY



BK4 BARRIER KERB & C1 CHANNEL



BK4 BARRIER KERB ONLY



STAGGERING OF KERBS AND CHANNELS

NOTES:

1. ALL UNITS MUST BE LAID WITH CLASS 20/20 CONCRETE BEDDING/BACKING,
2. UNLESS SHOWN OTHERWISE, ON SUBGRADE/SUBBASE COMPACTED TO THE REQUIRED SPECIFICATIONS.
3. CHANNELS SHALL BE INFALL. NO OUTFALL CHANNELS PERMITTED.
4. KERBS AND CHANNELS SHALL CONFORM TO SANS 927.
5. ALL RADII < 20m SHALL BE BUILT WITH 300/330mm LONG ELEMENTS.
6. ALL PRECAST UNITS LAID LONGITUDINALLY NEXT TO ONE ANOTHER SHALL BE STAGGERED.
7. ALL KERB JOINTS TO BE WATER SPRAYED BEFORE CAULKING.
8. CAULKING BETWEEN KERBS TO HAVE A CEMENT:SAND RATIO OF 1:3.
9. EXPANSION JOINTS ON KERBING:
   - SHALL BE 10mm WIDE, SPACED AT 10m c/c.
   - FILLED WITH FOAMED POLYSTYRENE (OR EQUIVALENT APPROVED)
   - SEALED WITH 20mm X 10mm SILICONE SEALANT (OR EQUIVALENT APPROVED)
10. REFER TO **DRAWING RD1.10** FOR REMOVABLE BARRIER KERBS.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

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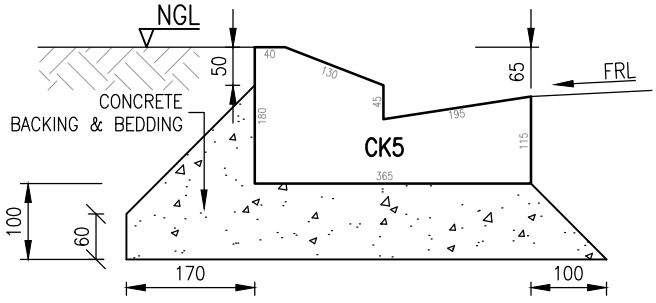
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BARRIER KERBS AND CHANNELS

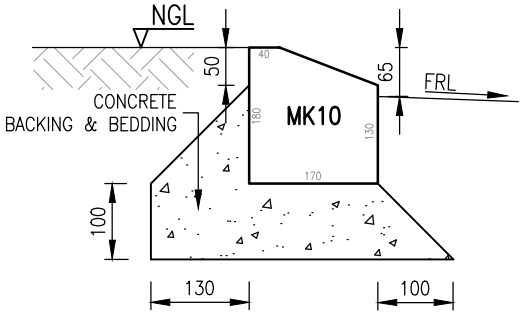
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DRAWING No.	REV
RD1.1	C

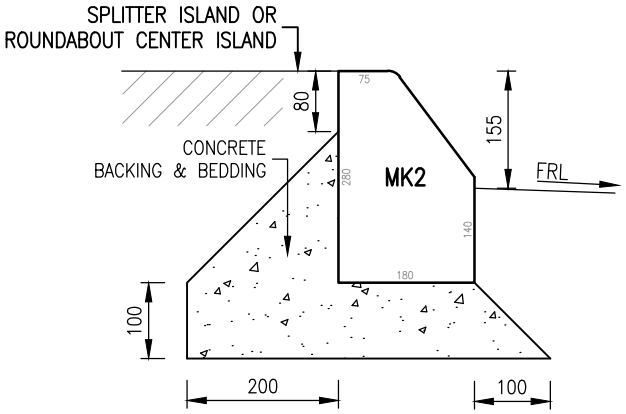
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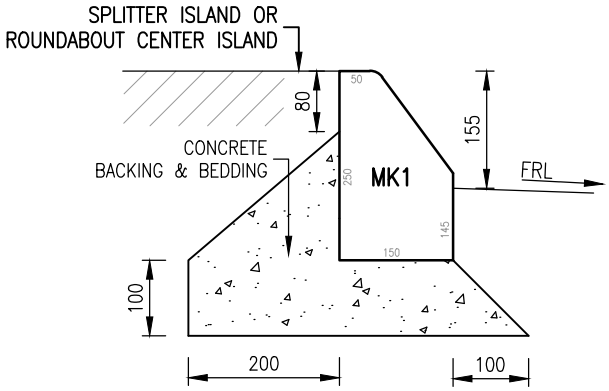
CK5 MOUNTABLE KERB & CHANNEL COMBINATION



MK10 MOUNTABLE KERB ONLY

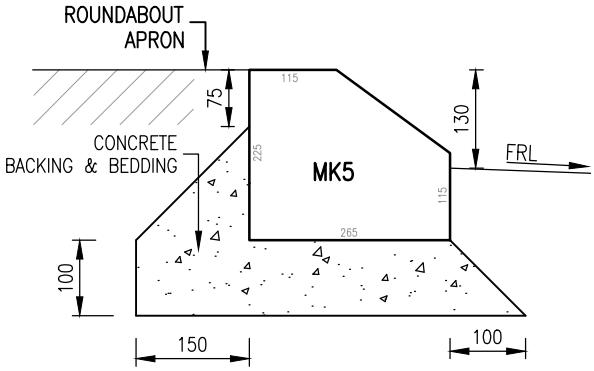


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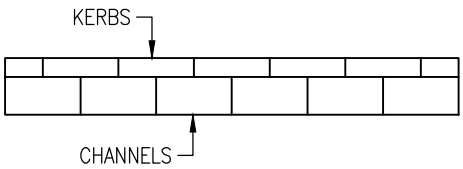


MK1

SEMI–MOUNTABLE KERB ONLY
(FOR SPLITTER ISLANDS AND CENTER ISLAND AT ROUNDABOUTS)



MK5 MOUNTABLE KERB
(FOR APRON AT ROUNDABOUTS)



STAGGERING OF KERBS AND CHANNELS

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

NOTES:

1. ALL UNITS MUST BE LAID WITH CLASS 20/20 CONCRETE BEDDING/BACKING,
2. UNLESS SHOWN OTHERWISE, ON SUBGRADE/SUBBASE COMPACTED TO THE REQUIRED SPECIFICATIONS.
3. CHANNELS SHALL BE INFALL. NO OUTFALL CHANNELS PERMITTED.
4. KERBS AND CHANNELS SHALL CONFORM TO SANS 927.
5. ALL RADII < 20m SHALL BE BUILT WITH 300/330mm LONG ELEMENTS.
6. ALL PRECAST UNITS LAID LONGITUDINALLY NEXT TO ONE ANOTHER SHALL BE STAGGERED.
7. ALL KERB JOINTS TO BE WATER SPRAYED BEFORE CAULKING.
8. CAULKING BETWEEN KERBS TO HAVE A CEMENT:SAND RATIO OF 1:3.
9. EXPANSION JOINTS ON KERBING:
   - SHALL BE 10mm WIDE, SPACED AT 10m c/c.
   - FILLED WITH FOAMED POLYSTYRENE (OR EQUIVALENT APPROVED)
   - SEALED WITH 20mm X 10mm SILICONE SEALANT (OR EQUIVALENT APPROVED)

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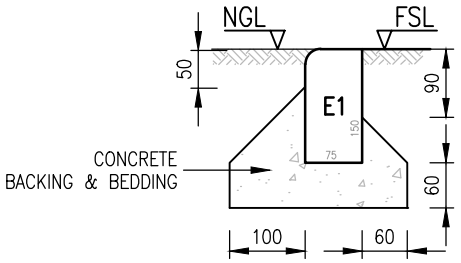
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MOUNTABLE AND SEMI-MOUNTABLE KERBS AND CHANNELS

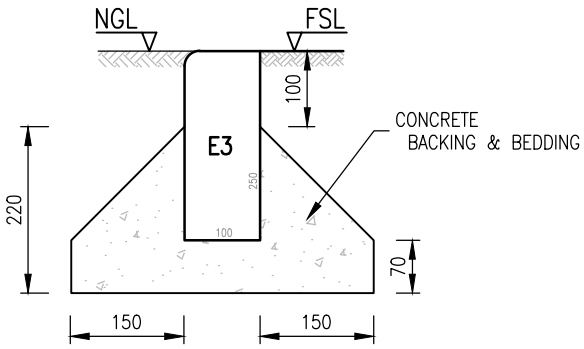
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LIGHT DUTY EDGING



HEAVY DUTY EDGING

NOTES:

1. ALL UNITS MUST BE LAID WITH CLASS 20/20 CONCRETE BEDDING/BACKING, UNLESS SHOWN OTHERWISE, ON SUBGRADE/SUBBASE COMPACTED TO THE REQUIRED SPECIFICATIONS.
2. ALL RADII < 20m MUST BE BUILT WITH 300/330mm LONG ELEMENTS.
3. EDGINGS USAGE SHALL BE IN ACCORDANCE WITH **SECTION 3.2.9**.
4. KERBS AND CHANNELS SHALL CONFORM TO SANS 927.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

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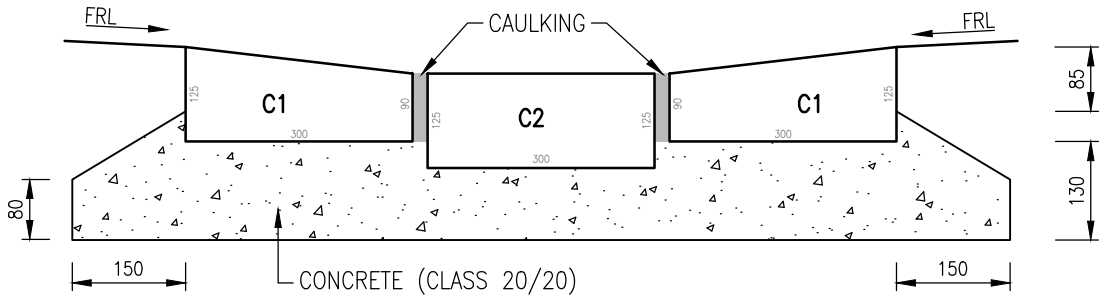
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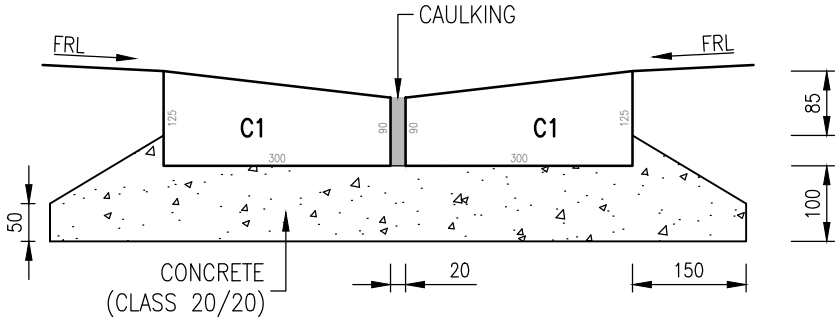
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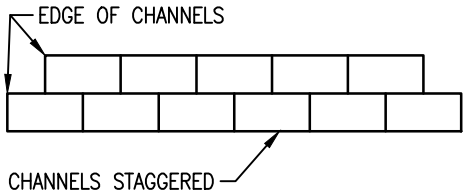
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TRIPLE FLAT CHANNEL



DOUBLE FLAT CHANNEL (V-CHANNEL)



NOTES:

1. ALL UNITS MUST BE LAID WITH A CLASS 20/20 CONCRETE BEDDING/BACKING, UNLESS SHOWN OTHERWISE, ON SUBGRADE/SUBBASE COMPACTED TO THE REQUIRED SPECIFICATIONS
2. EDGINGS SHALL CONFORM TO SANS 927.
3. ALL RADII < 20m MUST BE BUILT WITH 300/330mm LONG ELEMENTS.
4. ALL PRECAST UNITS LAID LONGITUDINALLY NEXT TO ONE ANOTHER MUST BE STAGGERED.
5. ALL JOINTS TO BE WATER SPRAYED BEFORE CAULKING.
6. CAULKING TO HAVE A CEMENT:SAND RATIO OF 1:3.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

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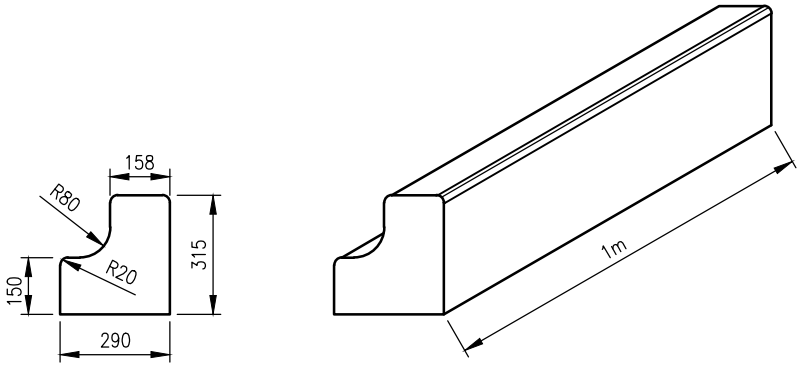
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DOUBLE & TRIPLE FLAT CHANNELS

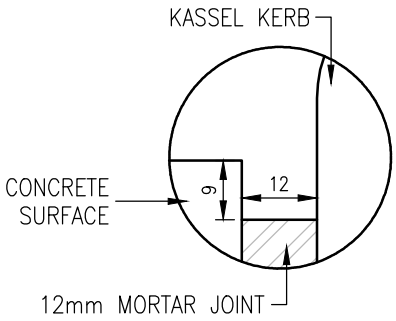
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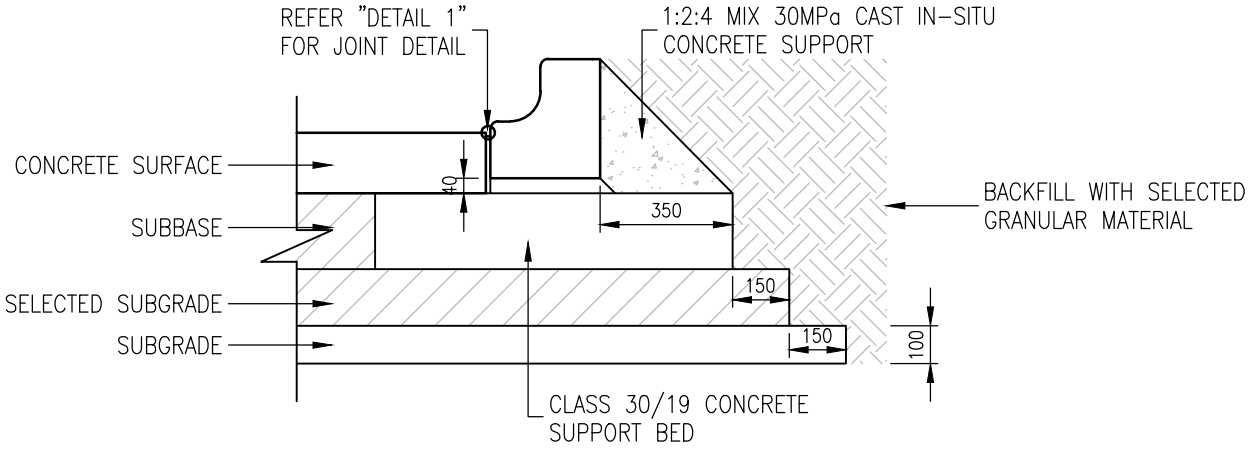
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KASSEL KERB TYPICAL DIMENSIONS



DETAIL 1



KASSEL KERB ALONG ROADWAY

NOTES:

1. REFER TO CHAPTER 8 FOR ROAD PAVEMENT DESIGN REQUIREMENTS.

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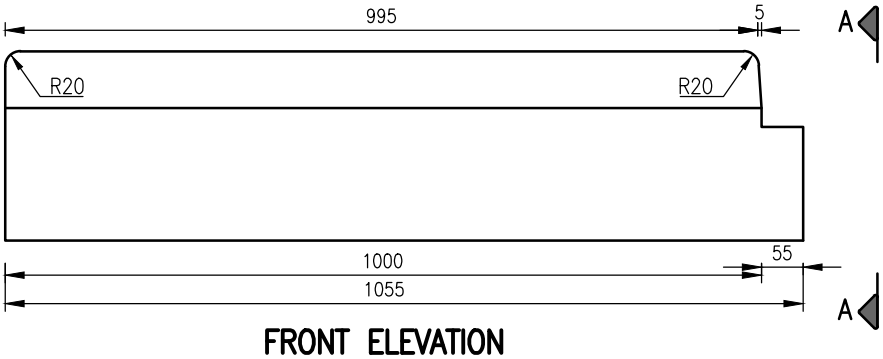
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KASSEL KERB

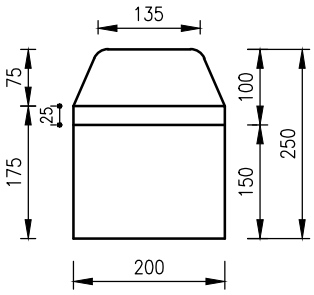
STANDARDS AND GUIDELINES DETAILS

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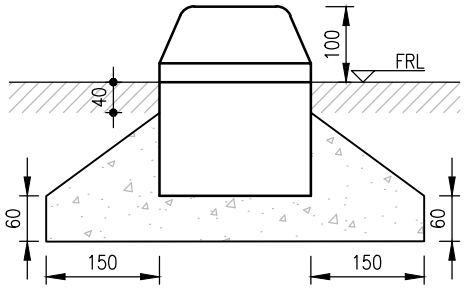
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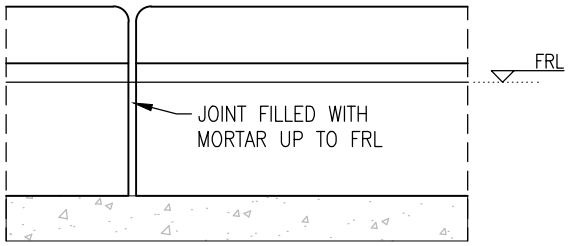
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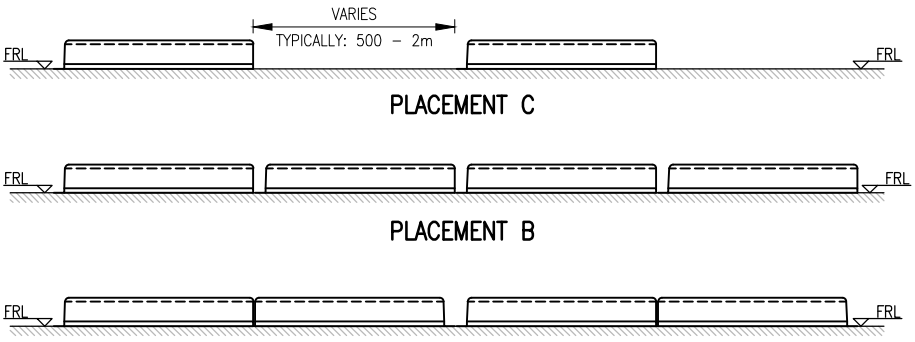
SECTION A–A



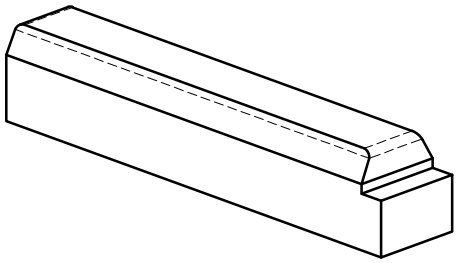
TYPICAL INSTALLATION DETAILS
(NOT FOR IRT SYSTEMS)



PLACEMENT A: JOINT DETAIL



TYPICAL PLACEMENT OPTIONS
SCALE 1:40



ISOMETRIC VIEW
N.T.S.

NOTES:

1. UNITS SHALL BE LAID WITH CLASS 30/20 CONCRETE BEDDING/BACKING, UNLESS SHOWN OTHERWISE, ON SUBGRADE/SUBBASE COMPACTED TO THE REQUIRED SPECIFICATIONS.
2. THE TOP EDGES SHALL BE ROUNDED WITH A RADIUS OF 20mm. FOR ALL OTHER EDGES, A ROUNDING RADIUS OF 3mm MAY BE CONSIDERED, IF SPALLING IS A CONCERN.
3. KERB SHALL CONFORM TO SANS 927.
4. WHERE DELINEATOR KERBS ARE USED INSIDE ROADS OR ADJACENT TO TRAFFIC LANES, IT SHALL BE PAINTED WITH A RETRO-REFLECTIVE YELLOW PAINT.
5. THE USE OF DELINEATOR KERBS TO SEGREGATE TRAFFIC LANES SHALL ADHERE TO THE FOLLOWING:
   - TRAVEL SPEEDS UP TO 65km/h : DK3 TYPE (KERB HEIGHT OF 150mm)
   - TRAVEL SPEEDS EXCEEDING 65km/h : DK2 TYPE (KERB HEIGHT OF 100mm)

FRL: FINAL ROAD LEVEL

SHEET INDEX:
SHEET 1: DELINEATOR KERB: DK2 (100mm HEIGHT)
SHEET 2: DELINEATOR KERB: DK3 (150mm HEIGHT)

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TITLE

DELINEATOR KERB: DK2

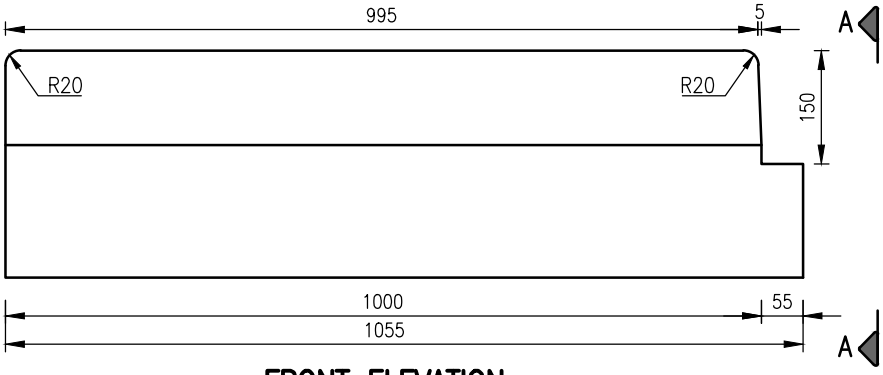
(100mm HEIGHT)

STANDARDS AND GUIDELINES DETAILS

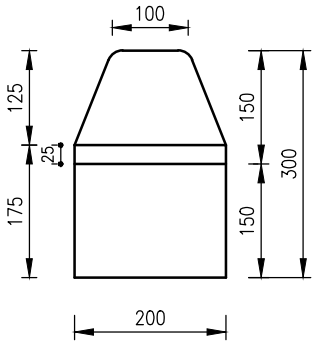
SHEET 1

SCALE	PAPER
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DRAWING No.	REV
RD1.6A	A

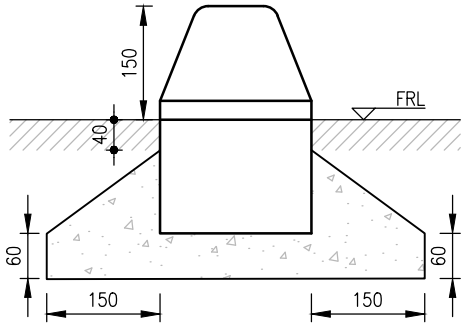
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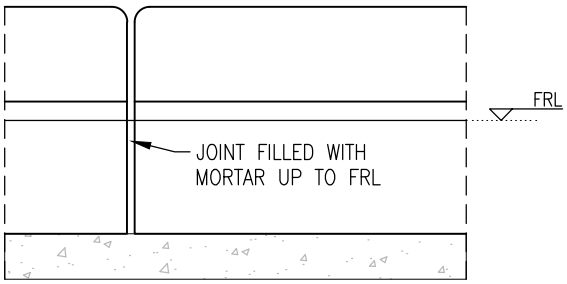
FRONT ELEVATION



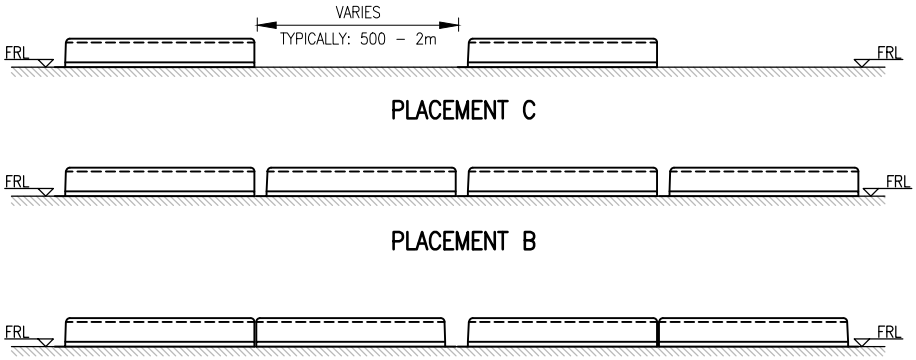
SECTION A–A



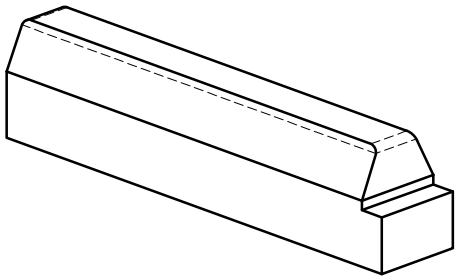
TYPICAL INSTALLATION DETAILS
(NOT FOR IRT SYSTEMS)



PLACEMENT A: JOINT DETAIL



TYPICAL PLACEMENT OPTIONS
SCALE 1:40



ISOMETRIC VIEW
N.T.S.

NOTES:

1. UNITS SHALL BE LAID WITH CLASS 30/20 CONCRETE BEDDING/BACKING, UNLESS SHOWN OTHERWISE, ON SUBGRADE/SUBBASE COMPACTED TO THE REQUIRED SPECIFICATIONS.
2. THE TOP EDGES SHALL BE ROUNDED WITH A RADIUS OF 20mm. FOR ALL OTHER EDGES, A ROUNDING RADIUS OF 3mm MAY BE CONSIDERED, IF SPALLING IS A CONCERN.
3. KERB SHALL CONFORM TO SANS 927.
4. WHERE DELINEATOR KERBS ARE USED INSIDE ROADS OR ADJACENT TO TRAFFIC LANES, IT SHALL BE PAINTED WITH A RETRO–REFLECTIVE YELLOW PAINT.
5. THE USE OF DELINEATOR KERBS TO SEGREGATE TRAFFIC LANES SHALL ADHERE TO THE FOLLOWING:
   - TRAVEL SPEEDS UP TO 65km/h : DK3 TYPE (KERB HEIGHT OF 150mm)
   - TRAVEL SPEEDS EXCEEDING 65km/h : DK2 TYPE (KERB HEIGHT OF 100mm)

FRL: FINAL ROAD LEVEL

SHEET INDEX:
SHEET 1: DELINEATOR KERB: DK2 (100mm HEIGHT)
SHEET 2: DELINEATOR KERB: DK3 (150mm HEIGHT)

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CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

DELINEATOR KERB: DK3

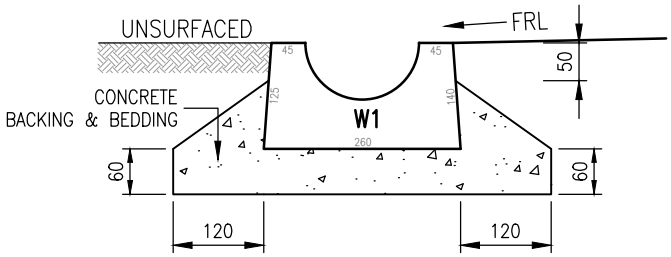
(150mm HEIGHT)

STANDARDS AND GUIDELINES DETAILS

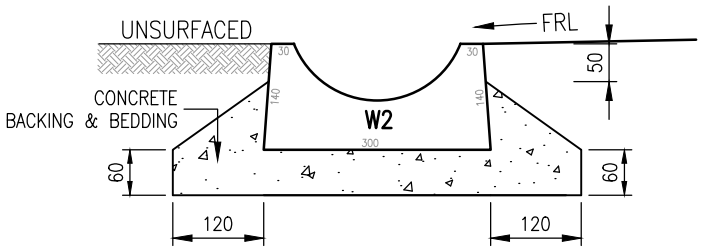
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DRAWING No.	REV
RD1.6B	A

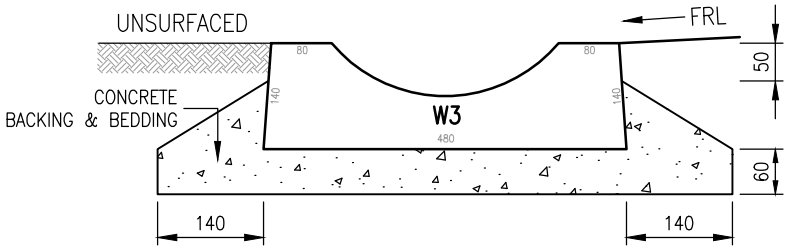
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W1 WATER CHANNEL



W2 WATER CHANNEL



W3 WATER CHANNEL

NOTES:

1. ALL UNITS MUST BE LAID WITH A CLASS 20/20 CONCRETE BEDDING/BACKING, UNLESS SHOWN OTHERWISE, ON SUBGRADE/SUBBASE COMPACTED TO THE REQUIRED SPECIFICATIONS.
2. ALL JOINTS TO BE WATER SPRAYED BEFORE CAULKING.
3. CAULKING TO HAVE A CEMENT:SAND RATIO OF 1:3.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

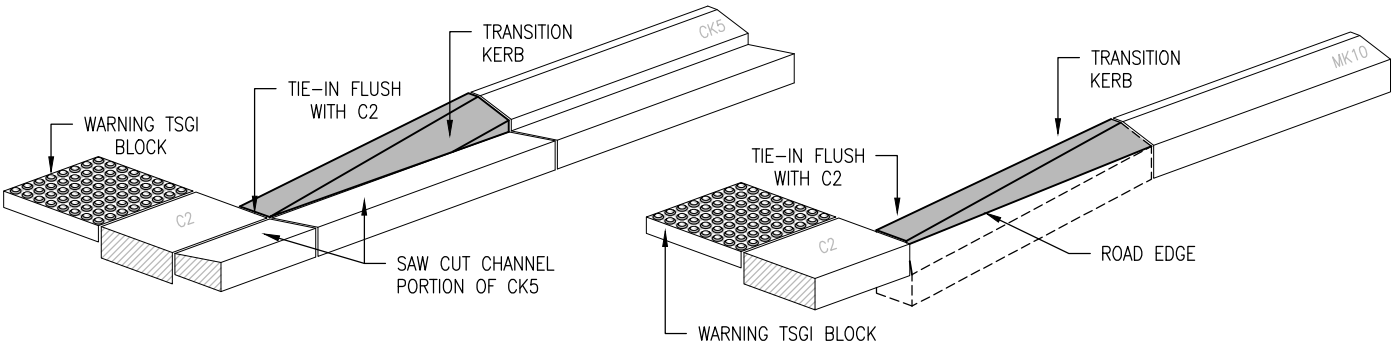
TITLE

WATER CHANNELS

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:10	A4
DRAWING No.	REV
RD1.7	B

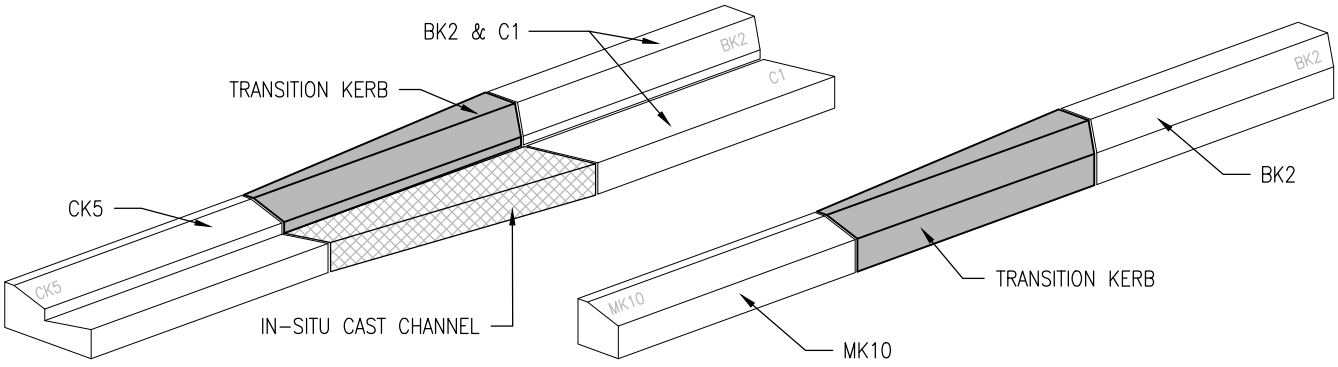
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KERB AND CHANNEL PRESENT **KERB ONLY**

APPLICATION OF TRANSITION KERB AT UNIVERSAL ACCESS RAMP

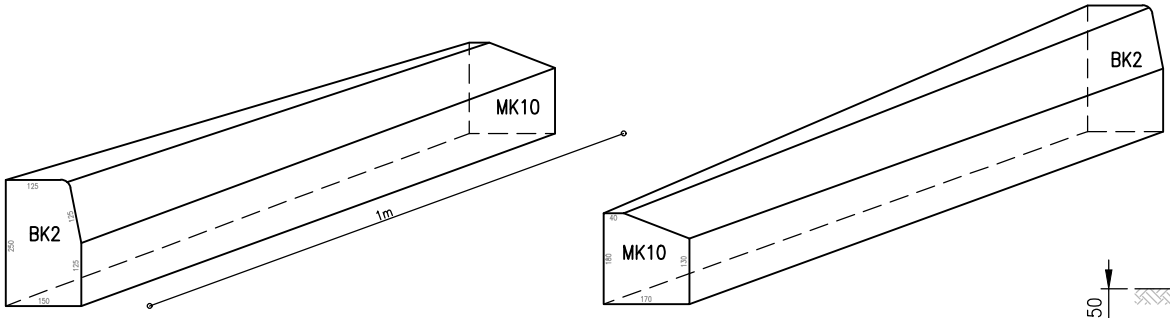
TRANSITION KERBS ONLY SHOWN IN SINGLE DIRECTION



KERB AND CHANNEL PRESENT **KERB ONLY**

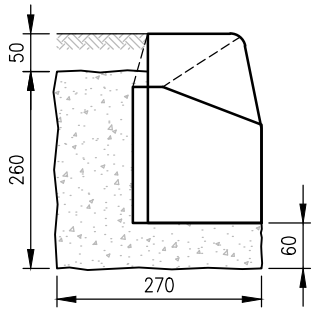
APPLICATION OF TRANSITION KERB ALONG NORMAL ROADWAY KERBLINE

DETAILS



BK2 to MK10 **MK10 to BK2**

ISOMETRIC ILLUSTRATION OF TRANSITION KERB



BEDDING & BACKING DETAILS

NOTES:

1. TRANSITION KERBS SHALL BE MANUFACTURED OR CASTED OFF-SITE AND INSTALLED AS PRECAST UNITS.
2. TRANSITION KERBS SHALL BE CONCRETE CLASS 25/20.
3. ALL UNITS MUST BE LAID WITH CLASS 20/20 CONCRETE BEDDING/BACKING, UNLESS SHOWN OTHERWISE.
4. TRANSITION KERB SHALL NOT BE USED ON RADII.
5. IN-SITU CASTED CHANNELS SHALL BE CONCRETE CLASS 30/20.
6. DRAWING TO BE READ IN CONJUNCTION WITH DRAWINGS: RD1.1 , RD1.2, RD 4 series

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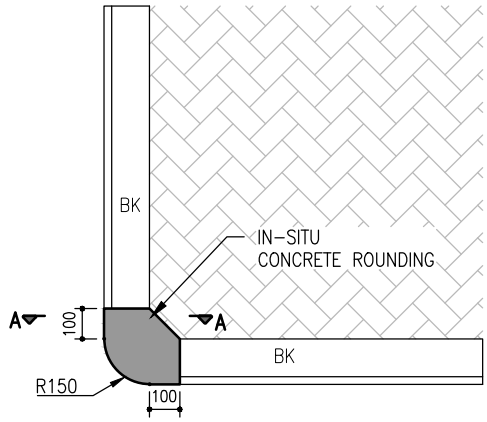
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TRANSITION KERB

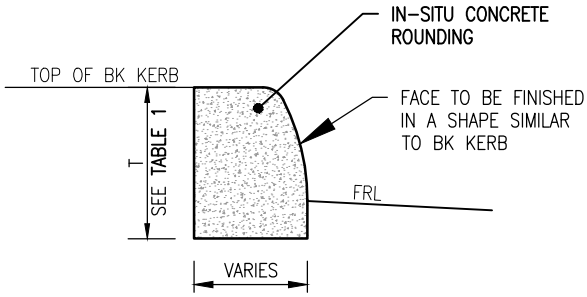
STANDARDS AND GUIDELINES DETAILS

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DRAWING No.	REV
RD1.8	A

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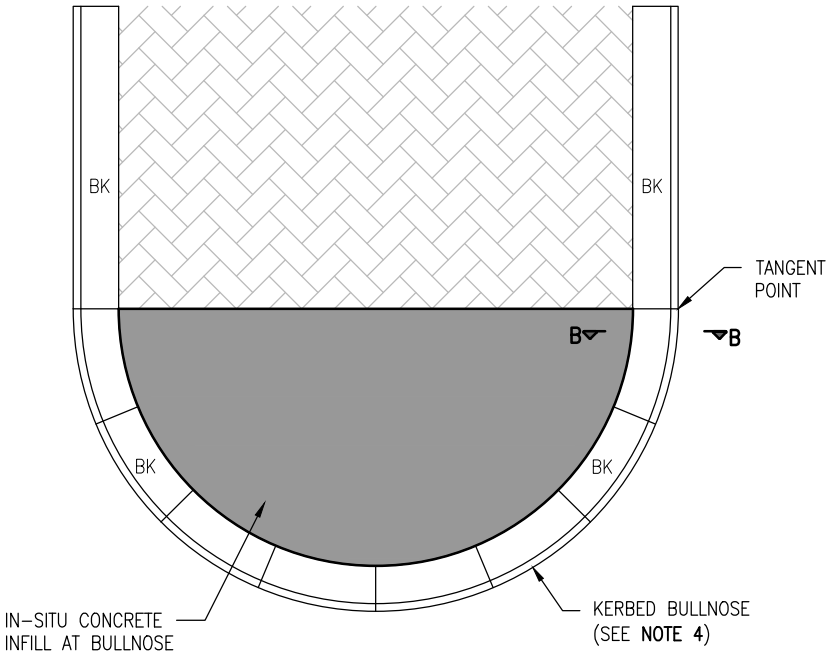


PLAN VIEW
1:25

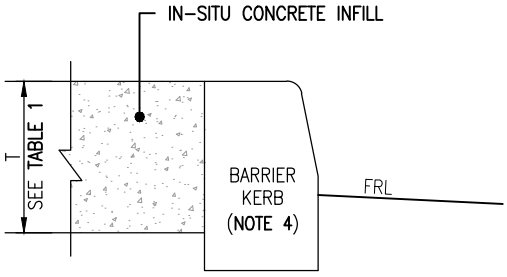


SECTION A-A
1:10

KERB ROUNDING



PLAN VIEW
1:25



SECTION B-B
1:10

KERB BULLNOSE INFILL

TABLE 1	
KEBR TYPE	CONCRETE THICKNESS (T)
BK2	200
BK4	250

NOTES:

1. ALL IN-SITU CONCRETE SHALL BE CLASS 35/20.
2. THE THICKNESS OF THE CONCRETE SHALL DEPEND ON THE TYPE OF BARRIER KERB PRESENT. SEE TABLE 1.
3. WHERE TRAFFIC SIGN SUPPORTS (POLES) MUST BE INSTALLED INSIDE THE CONCRETE INFILL SECTION AT A KERBED BULLNOSE, SUCH SUPPORTS SHALL BE INSTALLED PRIOR TO THE PLACEMENT OF THE IN-SITU CONCRETE.
4. THE KERBED BULLNOSE MAY ALSO BE CONSTRUCTED AS IN-SITU CONCRETE, SIMILAR TO "KERB ROUNDING" DETAIL ABOVE.

FRL: FINISHED ROAD LEVEL

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CITY OF CAPE TOWN
URBAN MOBILITY

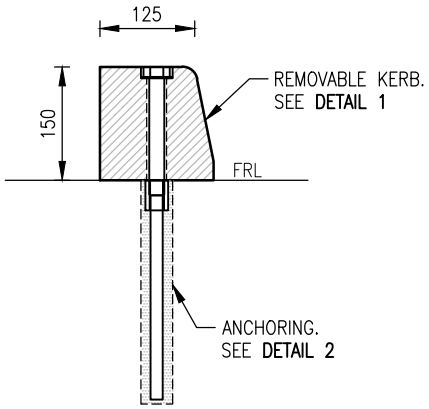
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KERB ROUNDING & BULLNOSE

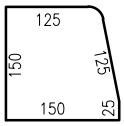
STANDARDS AND GUIDELINES DETAILS

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RD1.9	A

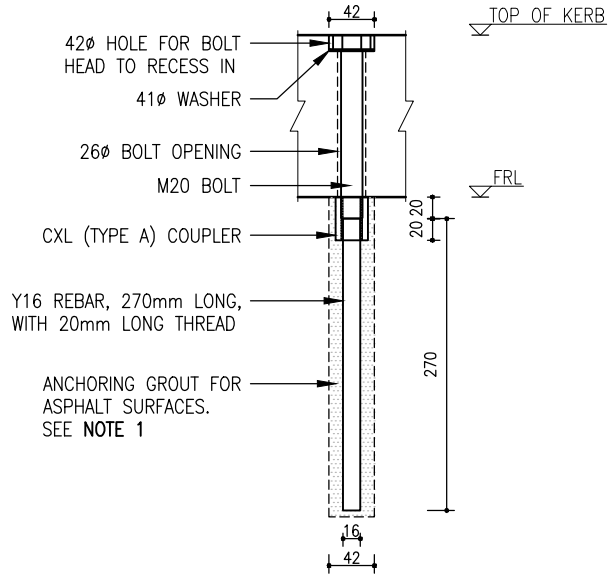
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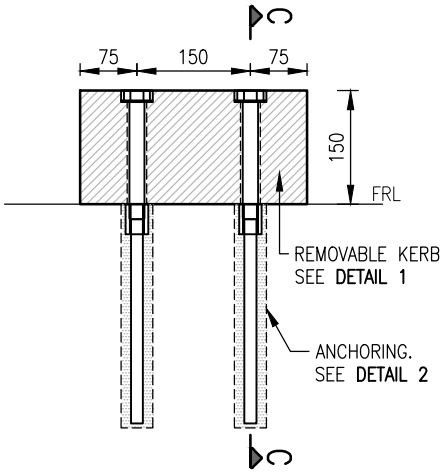
SECTION C–C
1:10



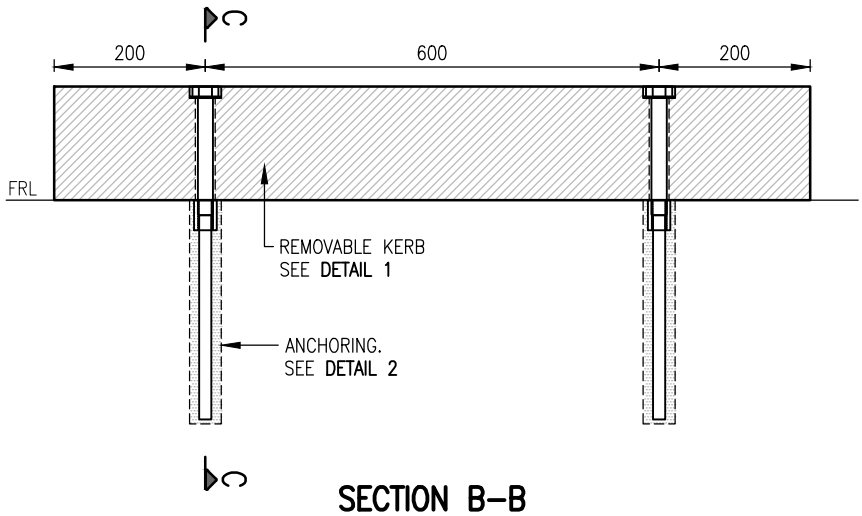
DETAIL 1:
KERB DIMENSIONS
1:5



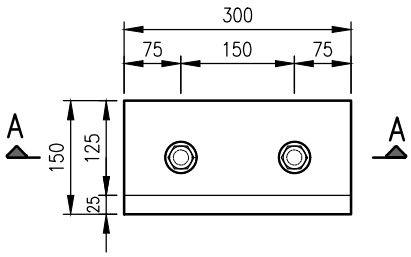
DETAIL 2:
ANCHORING
N.T.S.



SECTION A–A
1:10

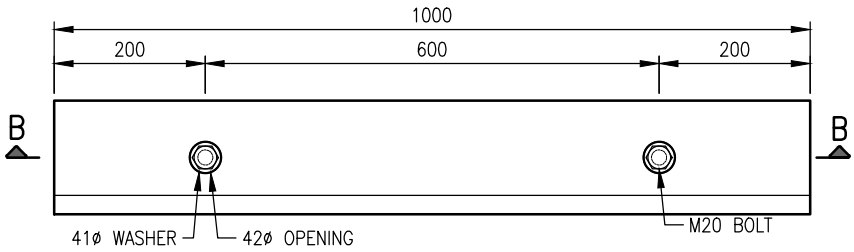


SECTION B–B
1:10



PLAN VIEW
1:10

300mm LONG UNIT



PLAN VIEW
1:10

1000mm LONG UNIT

NOTES:

1. THE PROPOSED ANCHORING GROUT SHALL BE SUBMITTED TO THE APPROVAL AUTHORITY PRIOR TO CONSTRUCTION.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

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CITY OF CAPE TOWN
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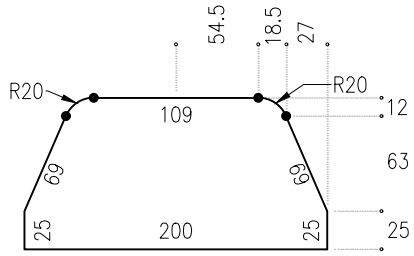
TITLE

REMOVABLE BARRIER KERBS

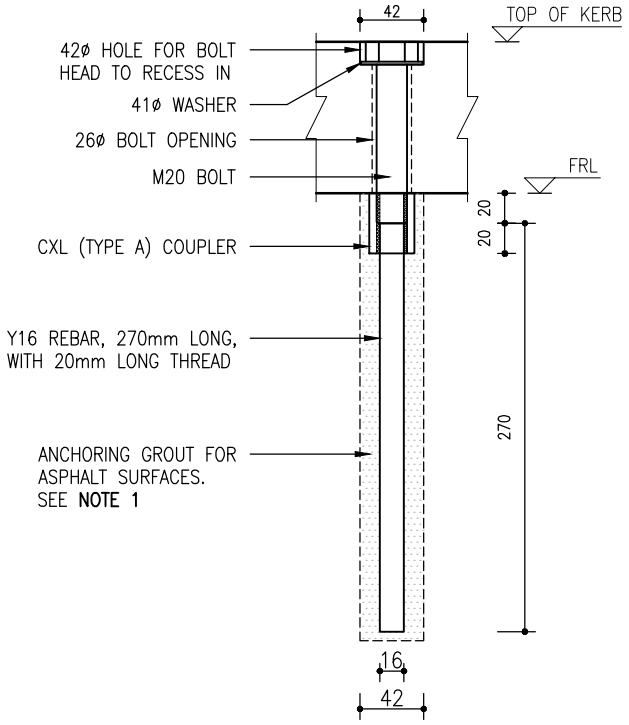
STANDARDS AND GUIDELINES DETAILS

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RD1.10	A

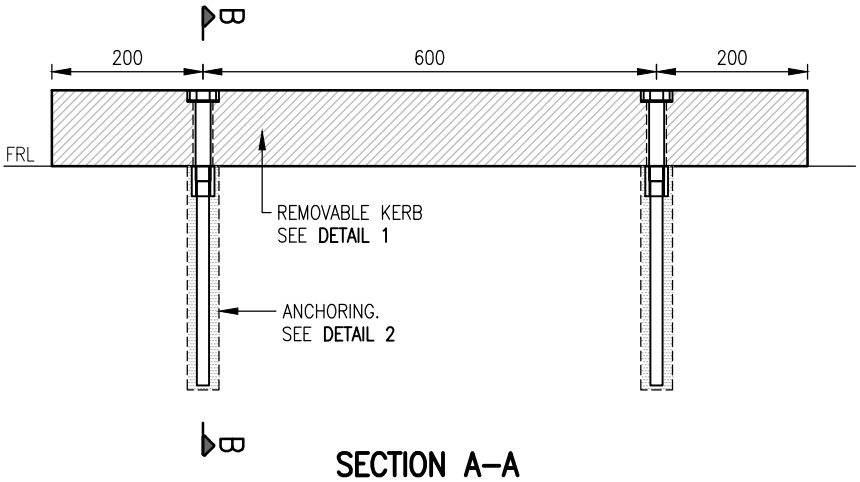
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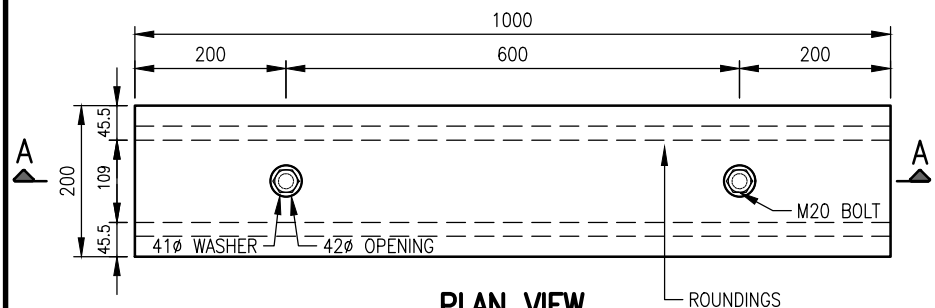
DETAIL 1: KERB DIMENSIONS
1:5



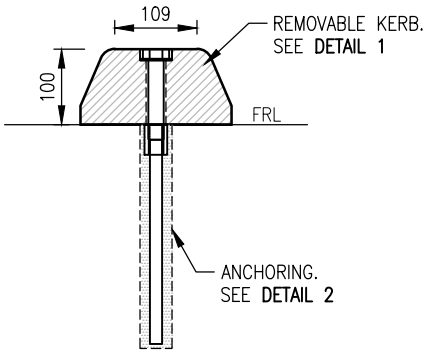
DETAIL 2: ANCHORING
N.T.S.



SECTION A–A
1:10



PLAN VIEW
1:10



SECTION B–B
1:10

NOTES:

1. THE TOP EDGES SHALL BE ROUNDED WITH A RADIUS OF 20mm.
2. FOR ALL OTHER EDGES, A ROUNDING RADIUS OF 3mm MAY BE CONSIDERED, IF SPALLING IS A CONCERN.
3. KERB SHALL CONFORM TO SANS 927.
4. THE PROPOSED ANCHORING GROUT SHALL BE SUBMITTED TO THE APPROVAL AUTHORITY PRIOR TO CONSTRUC
5. KERBS THAT ARE NO LONGER REQUIRED SHALL BE REMOVED AND THE VOIDS FILLED WITH A BITUMEN RUBBE CRACK SEALANT.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:
SHEET 1: REMOVABLE DELINEATOR KERB (DK2)
SHEET 2: REMOVABLE DELINEATOR KERB (DK3)

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CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

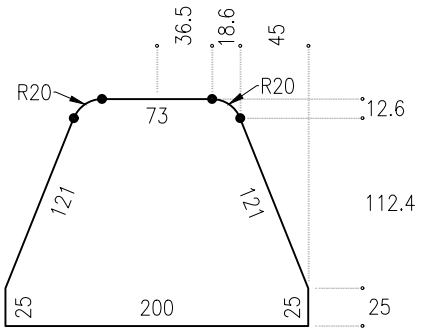
REMOVABLE DELINEATOR KERB TYPE: DK2

STANDARDS AND GUIDELINES DETAILS

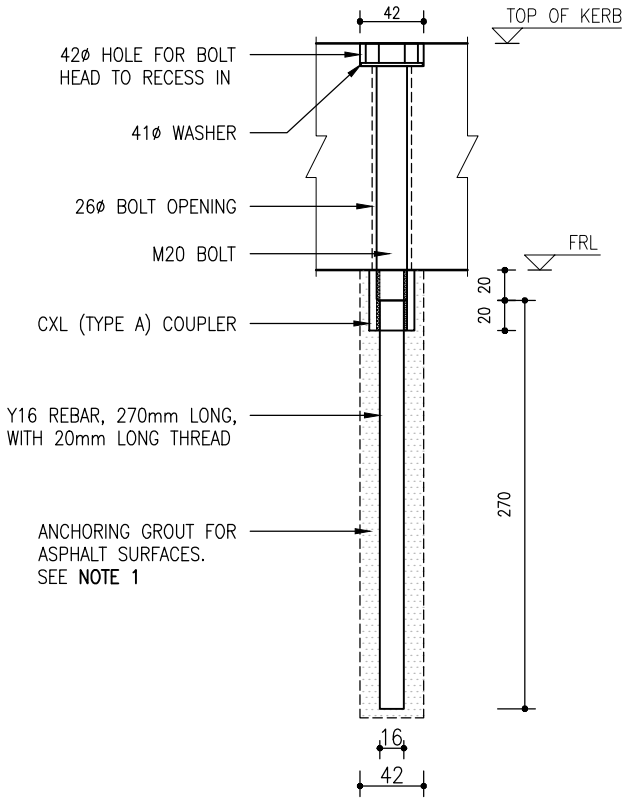
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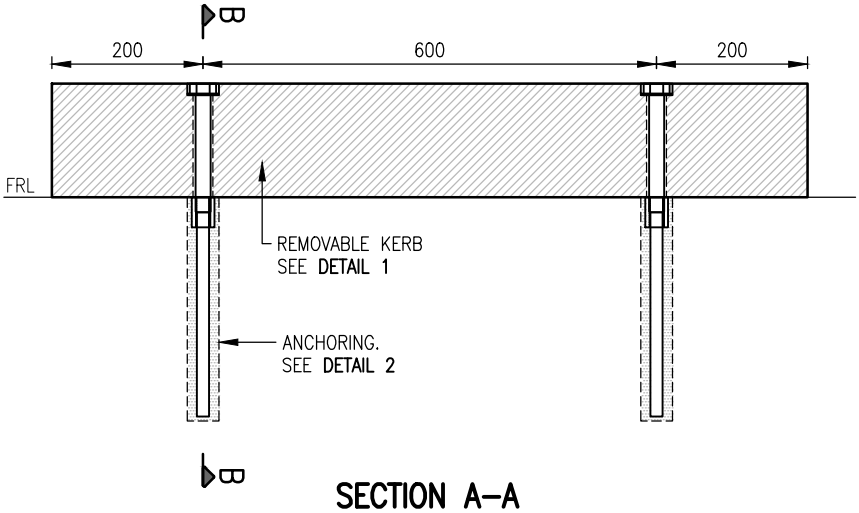
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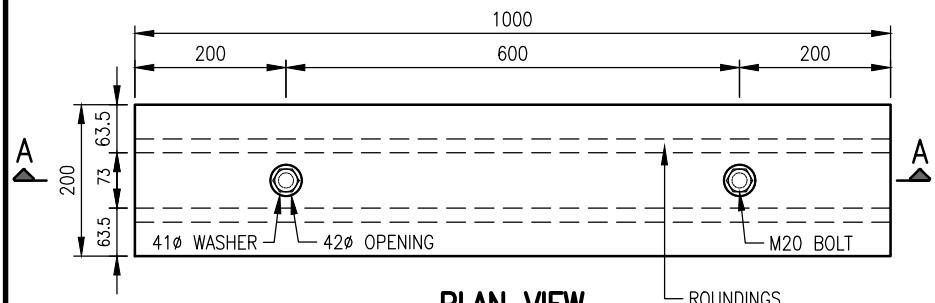
DETAIL 1: KERB DIMENSIONS
1:5



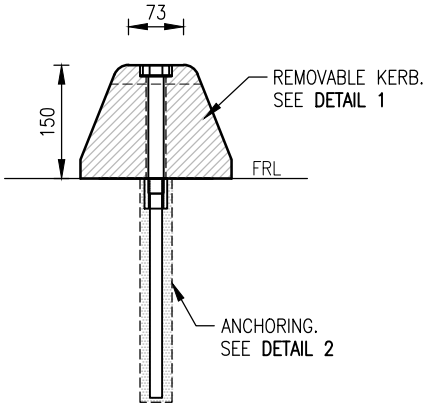
DETAIL 2: ANCHORING
N.T.S.



SECTION A–A
1:10



PLAN VIEW
1:10



SECTION B–B
1:10

NOTES:
1. THE TOP EDGES SHALL BE ROUNDED WITH A RADIUS OF 20mm.
2. FOR ALL OTHER EDGES, A ROUNDING RADIUS OF 3mm MAY BE CONSIDERED, IF SPALLING IS A CONCERN.
3. KERB SHALL CONFORM TO SANS 927.
4. THE PROPOSED ANCHORING GROUT SHALL BE SUBMITTED TO THE APPROVAL AUTHORITY PRIOR TO CONSTRUCTION.
5. KERBS THAT ARE NO LONGER REQUIRED SHALL BE REMOVED AND THE VOIDS FILLED WITH A BITUMEN RUBBER CRACK SEALANT.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:
SHEET 1: REMOVABLE DELINEATOR KERB (DK2)
SHEET 2: REMOVABLE DELINEATOR KERB (DK3)

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

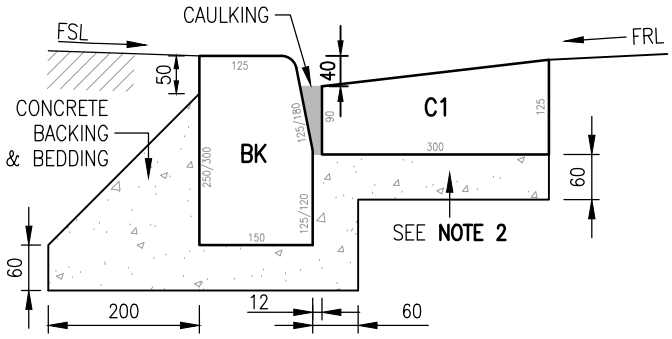
REMOVABLE DELINEATOR KERB TYPE: DK3

STANDARDS AND GUIDELINES DETAILS

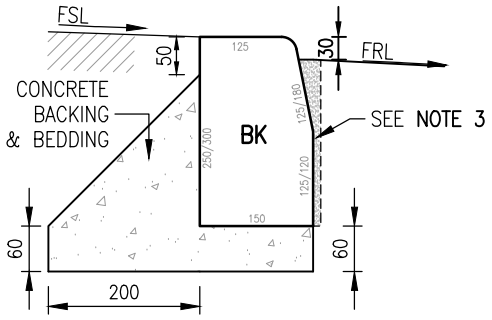
SHEET 2

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD1.11B	A

P:\CAD\R&SD\ITL_01 Design\T_1000B Standards\T_1000RS DESIGN_Roads and Stormwater\0002 Drawings_Version4.0\01 RD\RD1.11B - Removable Delineator Kerbs DK3_RevA.dwg



TYPE A1
BARRIER KERB & CHANNEL



TYPE A2
BARRIER KERB ONLY

BARRIER KERBS

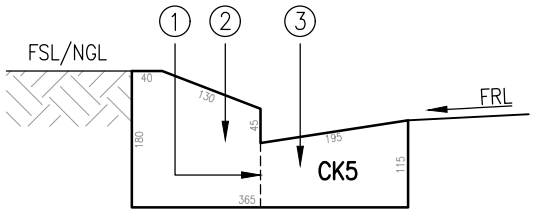
'TYPE A' NOTES:

TYPE A1

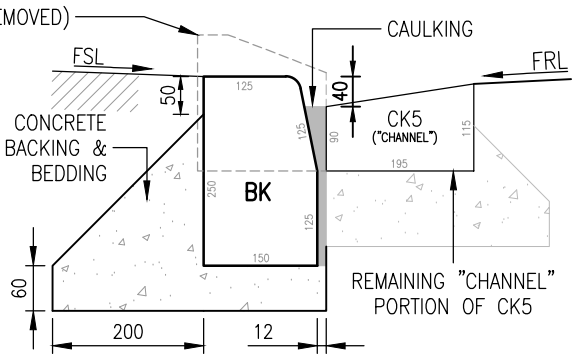
1. WHERE EXISTING BARRIER KERBS MUST BE DROPPED TO PROVIDE ACCESS FOR AN EMBAYMENT, OFF-STREET PARKING OR CARRIAGEWAY CROSSING, ONLY THE BARRIER KERB MUST BE LOWERED TO THE REDUCED HEIGHT. THE CHANNELS AND ROAD EDGE TO REMAIN UNDISTURBED.
2. WHERE NEW CHANNELS MUST BE LAID FOR AN EMBAYMENT, OFF-STREET PARKING OR CARRIAGEWAY CROSSING, THE THICKNESS OF THE BEDDING UNDERNEATH THE CHANNEL SHALL BE INCREASED TO 100mm ALONG THE ENTIRE LENGTH OF THE DROPPED SECTION.

TYPE A2

3. THE BARRIER KERB SHALL BE CAREFULLY REMOVED, WITHOUT DISTURBING THE ADJACENT ROAD PAVEMENT, AND INSTALLED AT THE REDUCED HEIGHT. THE REMAINING GAP SHALL BE ADEQUATELY FILLED WITH A CEMENTITIOUS GROUT. WHERE THE ROAD PAVEMENT IS DISTURBED, 300mm OF THE EXISTING ASPHALT SURFACE SHALL BE CUT (WITH A MECHANICAL SAW CUTTER, IN A NEAT AND STRAIGHT LINE) AND REINSTATED USING ASPHALT AS PER THE REQUIREMENTS OF THE APPROVAL AUTHORITY .



SAWING OF CK5 KERB



LAYING OF DROPPED BARRIER KERB

'TYPE B' NOTES: SAWING OF CK5 KERB

(1) MECHANICALLY SAW CK5 KERB ALONG VERTICAL FACE.
(2) REMOVE "KERB" PORTION OF CK5.
(3) "CHANNEL" PORTION OF CK5, INCLUDING ROAD EDGE, TO REMAIN INTACT/UNDISTURBED.

TYPE B
EXISTING MOUNTABLE KERBS

GENERAL NOTES:

1. ALL UNITS MUST BE LAID WITH A CLASS 20/20 CONCRETE BEDDING/BACKING, UNLESS SHOWN OTHERWISE, ON SUBGRADE/SUBBASE COMPACTED TO THE REQUIRED SPECIFICATIONS.
2. ALL KERB JOINTS TO BE WATER SPRAYED BEFORE CAULKING.
3. CAULKING BETWEEN KERBS TO HAVE A CEMENT:SAND RATIO OF 1:3.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:
SHEET 1: VEHICULAR TRAVERSAL
SHEET 2: PEDESTRIAN RAMPS

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

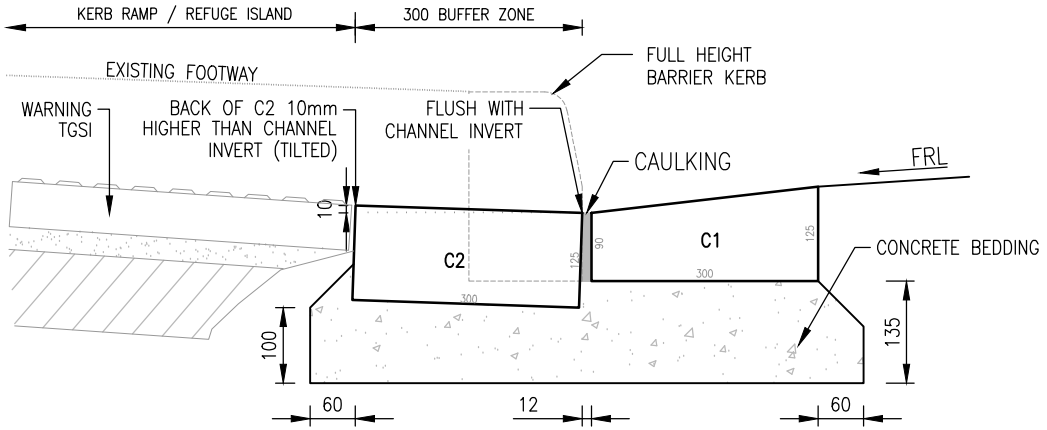
DROPPED KERB TYPES
VEHICULAR TRAVERSAL

STANDARDS AND GUIDELINES DETAILS

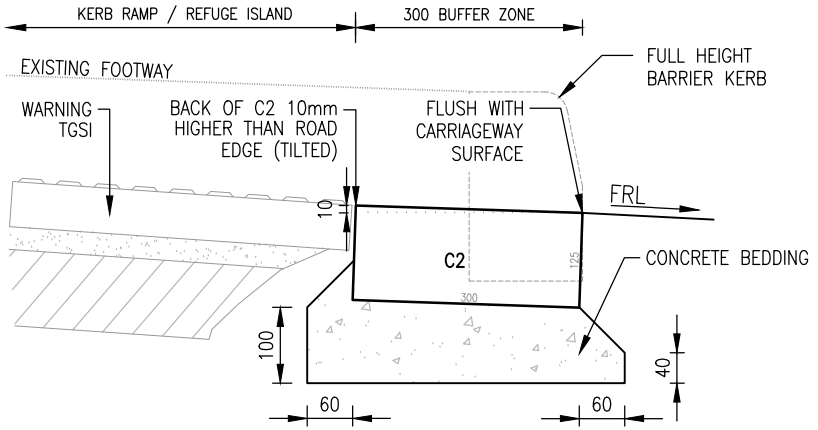
SHEET 1

SCALE	PAPER
1:10	A4
DRAWING No.	REV
RD2.1	B

P:\CAD\R&SD\ITI_01 Design\T_1000B Standards\T_1000RS DESIGN_Roads and Stormwater\0002 Drawings_Version4.0\01 RD\RD2.1 – Dropped Kerb Types – Vehicular Traversal_RevB.dwg

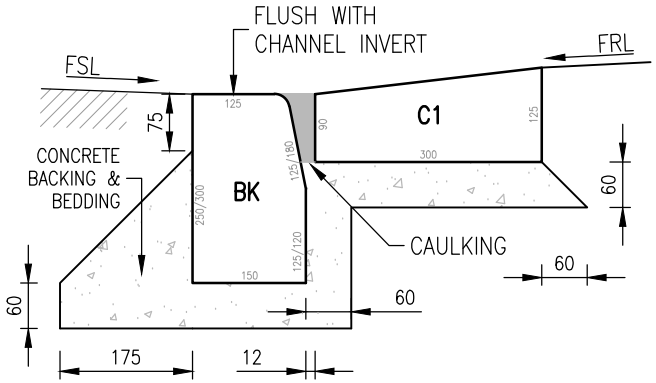


TYPE E: C2 AND C1 CHANNELS

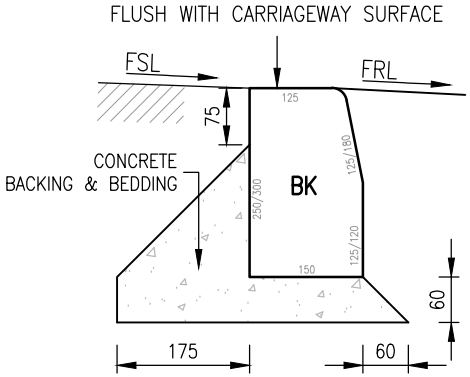


TYPE F: C2 CHANNEL ONLY

PEDESTRIAN RAMP



TYPE C: BARRIER KERB & CHANNEL



TYPE D: BARRIER KERB ONLY

NOTES:

General

1. ALL UNITS MUST BE LAID ON CLASS 20/20 CONCRETE BEDDING/BACKING, UNLESS SHOWN OTHERWISE, ON SUBGRADE/SUBBASE COMPACTED TO THE REQUIRED SPECIFICATIONS.
2. ALL KERB JOINTS TO BE WATER SPRAYED BEFORE CAULKING.
3. CAULKING BETWEEN KERBS TO HAVE A CEMENT:SAND RATIO OF 1:3.
4. REFER TO DRAWING SERIES **RD3** FOR DETAILS PERTAINING TO WHEELCHAIR, LOADING AND BICYCLE RAMPS.
5. REFER TO DRAWING SERIES **RD4** FOR DETAILS PERTAINING TO PEDESTRIAN RAMPS.

Type C

6. WHERE EXISTING BARRIER KERBS AND CHANNELS ARE PRESENT, THE BARRIER KERBS SHALL BE LOWERED TO THE REQUIRED HEIGHT WITHOUT DISTURBING THE ADJACENT CHANNELS AND ROAD EDGE.

Type E

7. WHERE EXISTING BARRIER KERBS AND CHANNELS ARE PRESENT, THE BARRIER KERBS SHALL BE CAREFULLY REMOVED TO ENSURE THE CHANNELS AND ROAD EDGE REMAIN UNDISTURBED.

FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

WHEELCHAIR, LOADING AND BICYCLE RAMP

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

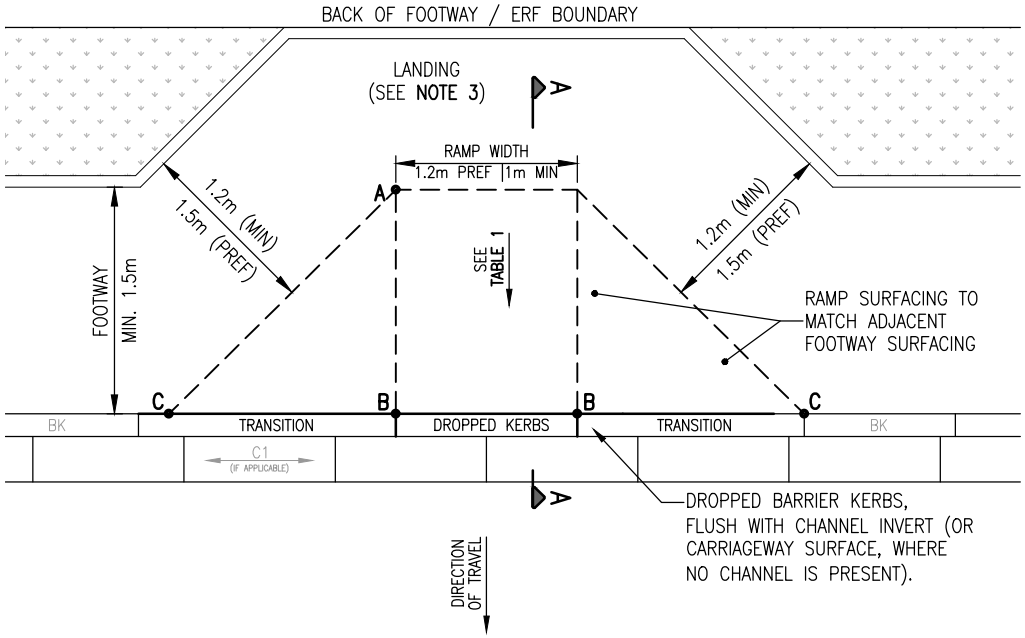
TITLE

DROPPED KERB TYPES
PEDESTRIAN, WHEELCHAIR, LOADING & BICYCLE RAMPS

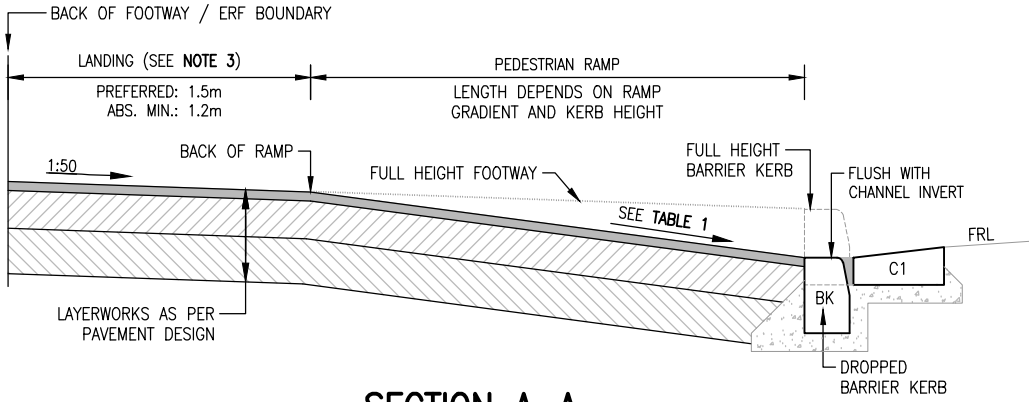
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:10	A4
DRAWING No.	REV
RD2.2	D

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PLAN VIEW
SCALE 1:50



SECTION A–A
SCALE 1:25

TABLE 1 RAMP GRADIENT	
PREFERENCE	GRADIENT
PREFERRED	1:20 (5%)
ACCEPTABLE	1:15 (6.7%)
ABSOLUTE MAXIMUM	1:12 (8.3%)

NOTES:

1. REFER TO **SECTION 5.5 AND 5.6** FOR FURTHER DETAILS ON UNIVERSAL DESIGN AND ACCESS.
2. A MAXIMUM SLOPE OF 1:12 BETWEEN POINTS "B–C" (ALONG THE TRANSITIONS) IS PREFERRED. WHERE THE AFOREMENTIONED SLOPE IS NOT POSSIBLE, THE LENGTH OF THE TRANSITIONS SHALL NEVER BE LESS THAN 1m.
3. WHERE THERE IS INSUFFICIENT SPACE AVAILABLE ON THE VERGE TO PROVIDE A MINIMUM LANDING OF 1.2m, LONGITUDINAL RAMPS SHALL BE CONSTRUCTED. REFER DRAWING **RD3.1B**.
4. REFER TO DRAWING **RD2.2** (TYPE 'C' & 'D') FOR THE DROPPED KERB DETAILS.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

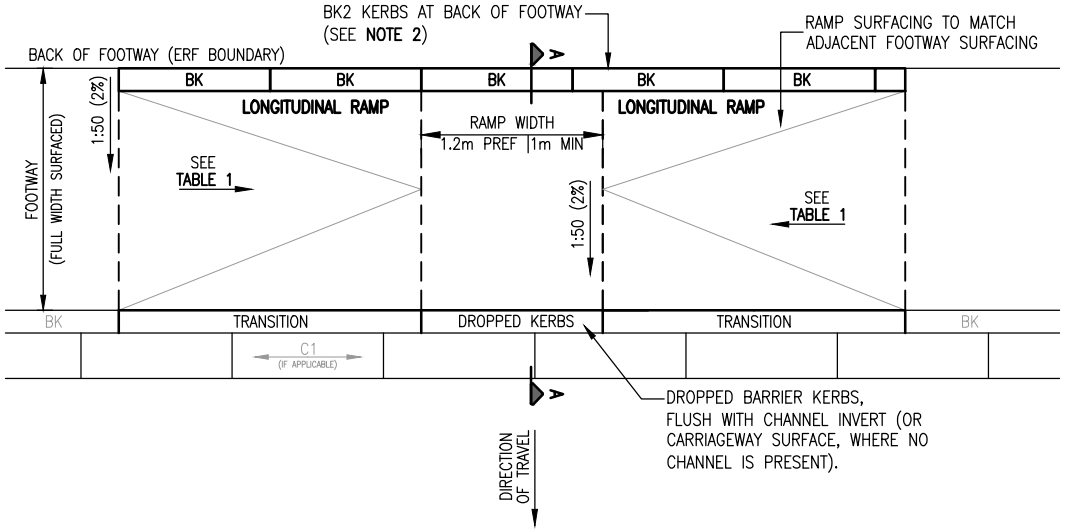
TITLE

MISCELLANEOUS RAMPS
TYPE A: WHEELCHAIR RAMP WITH LANDING
(PREFERRED)

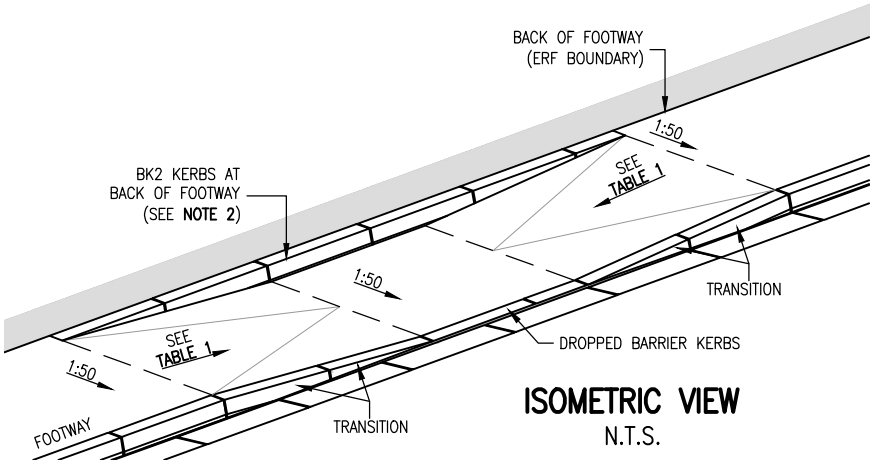
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD3.1A	A

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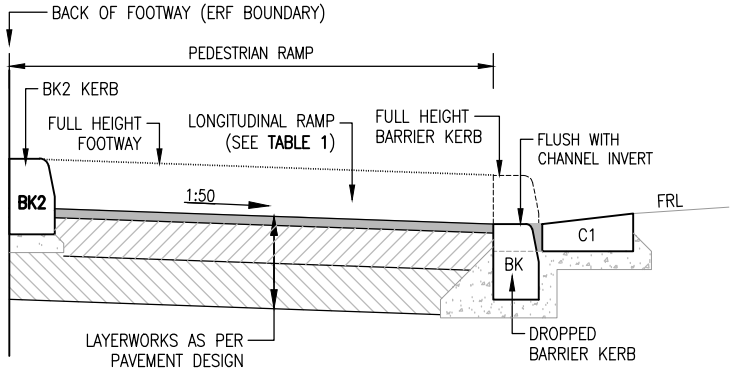


PLAN VIEW
SCALE 1:50



ISOMETRIC VIEW
N.T.S.

TABLE 1 SIDE RAMP GRADIENT	
PREFERENCE	GRADIENT
PREFERRED	1:20 (5%)
ACCEPTABLE	1:15 (6.7%)
ABSOLUTE MAXIMUM	1:12 (8.3%)



SECTION A–A
SCALE 1:25

NOTES:

1. THIS OPTION IS NOT PREFERRED AND SHOULD BE USED AS A LAST ALTERNATIVE.
2. IF A SOLID BOUNDARY WALL IS PRESENT OR THERE IS NO FLOODING RISK TO THE ADJACENT PROPERTY. THE BARRIER KERBS MAY BE OMITTED.
3. REFER TO **SECTION 5.5 AND 5.6** FOR FURTHER DETAILS ON UNIVERSAL DESIGN AND ACCESS.
4. REFER TO DRAWING **RD2.2** (TYPE 'C' & 'D') FOR THE DROPPED KERB DETAILS.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

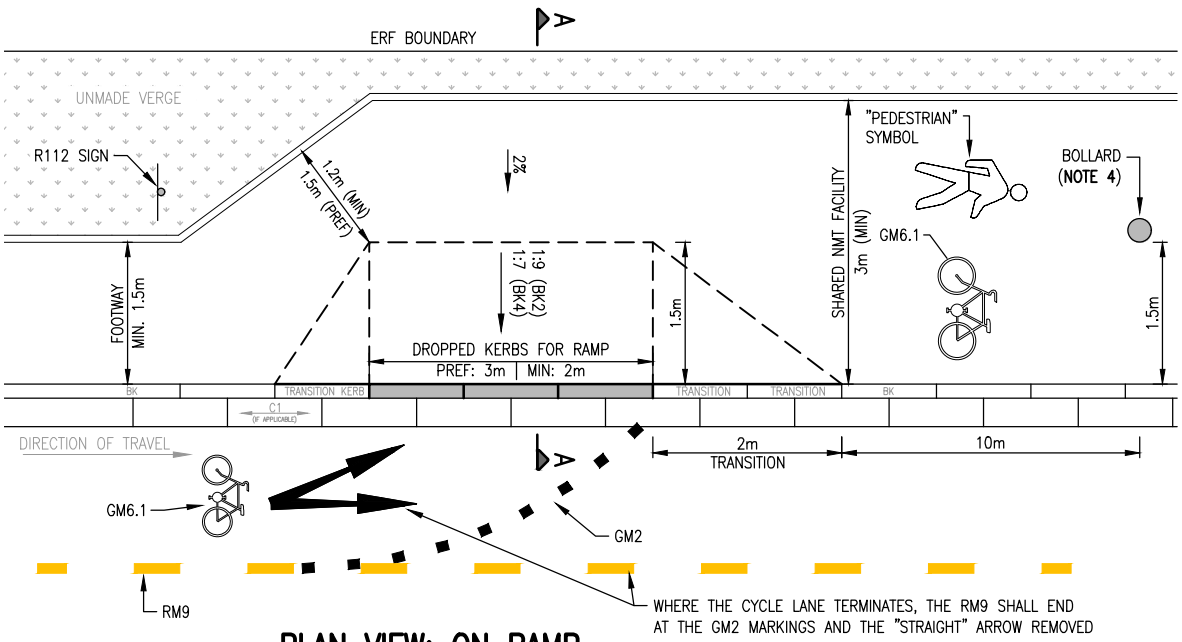
TITLE

MISCELLANEOUS RAMPS
TYPE B: WHEELCHAIR RAMP FOR NARROW FOOTWAYS/VERGES
(NOT PREFERRED)

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD3.1B	A

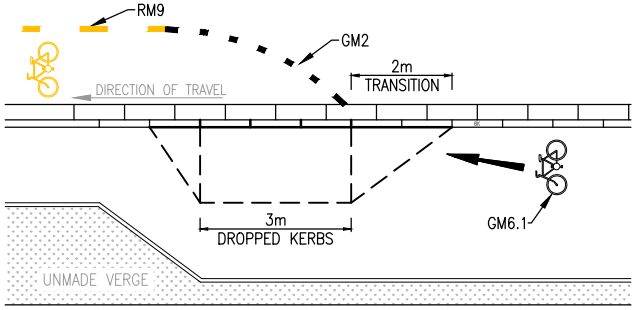
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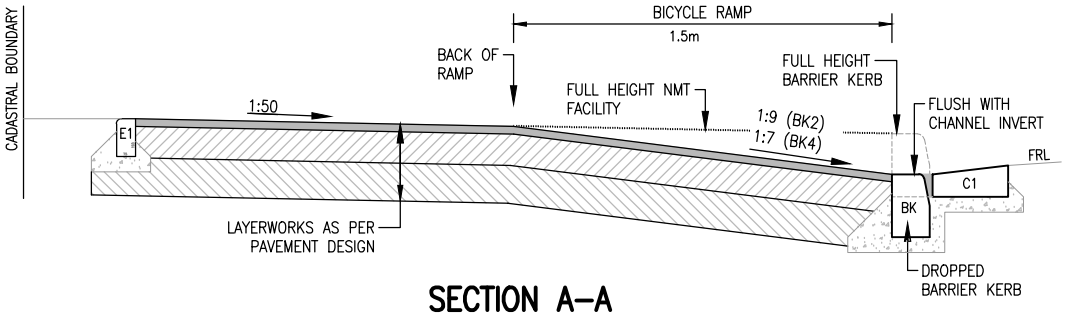
PLAN VIEW: ON RAMP

NOTES:

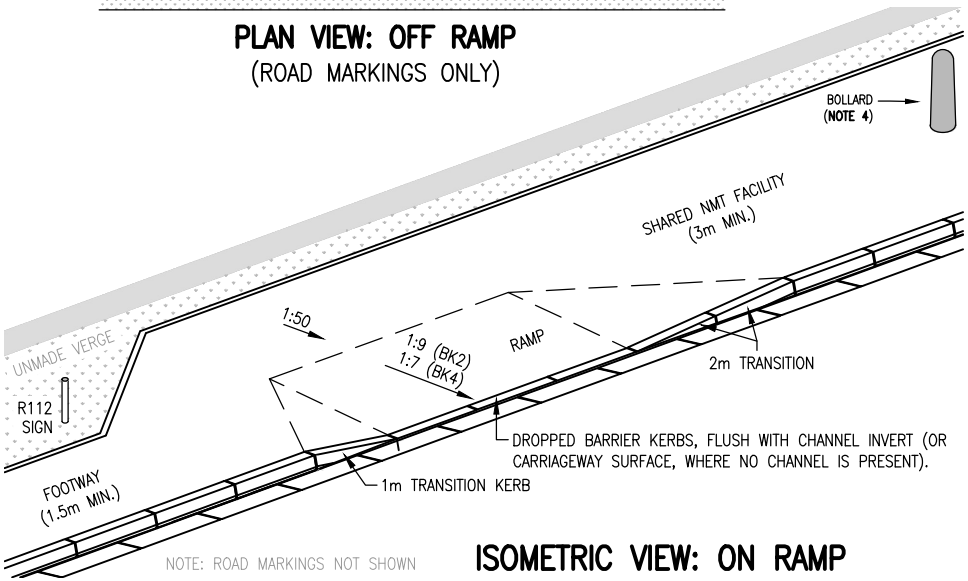
1. THIS OPTION MAY BE USED ON THE LOW OR HIGH SIDE OF THE CARRIAGEWAY.
2. REFER TO DRAWING **RD2.2** FOR THE DROPPED KERB DETAILS (**TYPE 'C' & 'D'**).
3. ROAD MARKING SHALL CONFORM TO SADC RTSM VOL1.
4. WHERE THERE IS A POSSIBILITY OF ILLEGAL VEHICULAR BEHAVIOR OCCURRING ON THE SHARED NMT FACILITY, A CONCRETE BOLLARD MAY BE PLACED 10m DOWNSTREAM OF THE BICYCLE RAMP. BOLLARD TO BE PAINTED AS PER DRAWING GE1 AND POSITIONED TO ALLOW 1.5m CLEAR WIDTH BETWEEN BACK OF KERB AND BOLLARD EDGE.



PLAN VIEW: OFF RAMP
(ROAD MARKINGS ONLY)



SECTION A–A



ISOMETRIC VIEW: ON RAMP

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

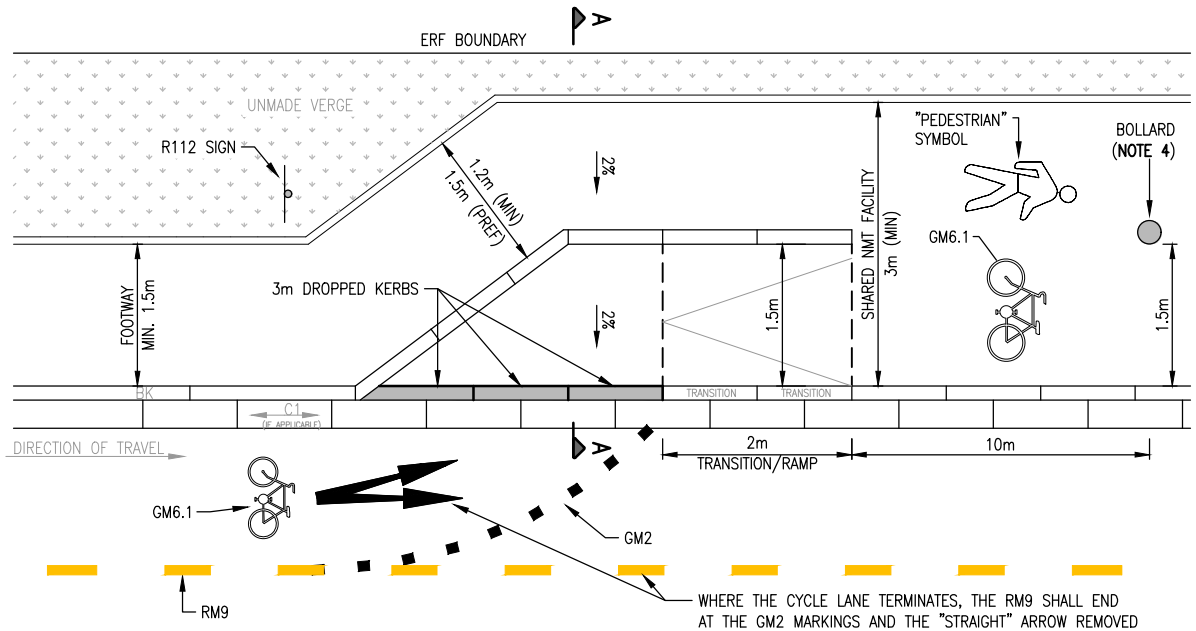
TITLE

MISCELLANEOUS RAMPS
TYPE A: BICYCLE RAMP

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RD3.2A	A

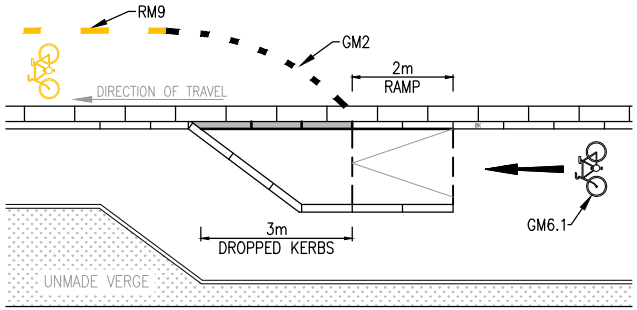
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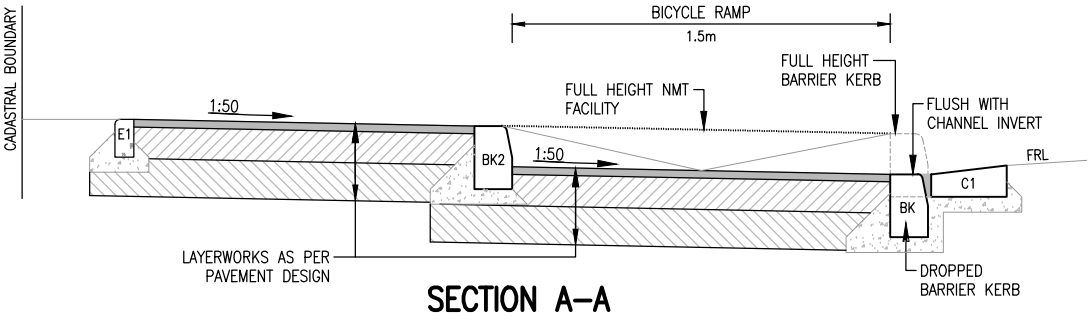
PLAN VIEW: ON RAMP

NOTES:

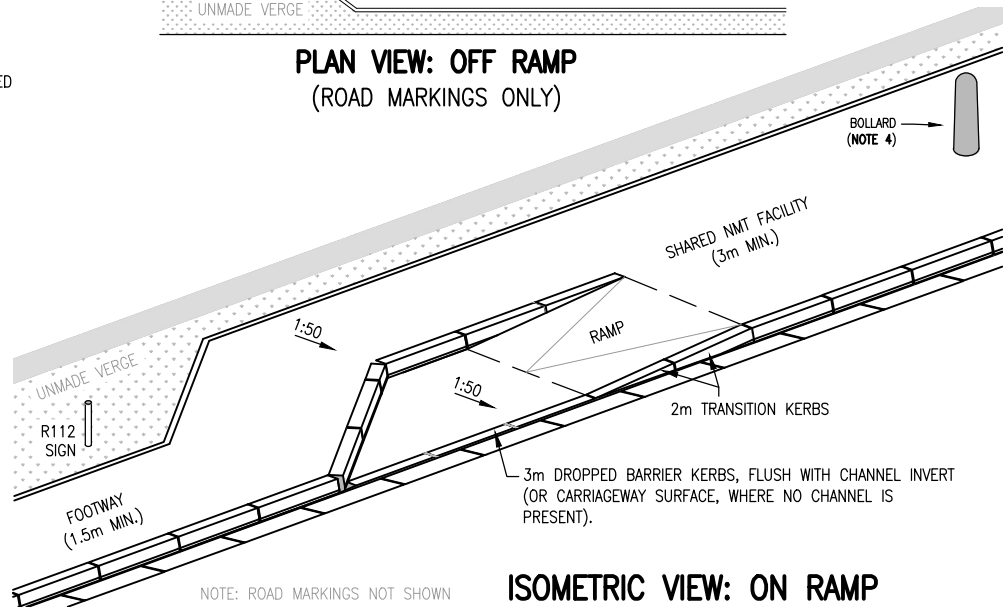
1. THIS OPTION MAY BE USED ON THE LOW OR HIGH SIDE OF THE CARRIAGEWAY.
2. REFER TO DRAWING **RD2.2** FOR THE DROPPED KERB DETAILS (**TYPE 'C' & 'D'**).
3. ROAD MARKING SHALL CONFORM TO SADC RTSM VOL1.
4. WHERE THERE IS A POSSIBILITY OF ILLEGAL VEHICULAR BEHAVIOR OCCURRING ON THE SHARED NMT FACILITY, A CONCRETE BOLLARD MAY BE PLACED 10m DOWNSTREAM OF THE BICYCLE RAMP. BOLLARD TO BE PAINTED AS PER DRAWING GE1 AND POSITIONED TO ALLOW 1.5m CLEAR WIDTH BETWEEN BACK OF KERB AND BOLLARD EDGE.



PLAN VIEW: OFF RAMP
(ROAD MARKINGS ONLY)



SECTION A–A



ISOMETRIC VIEW: ON RAMP

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

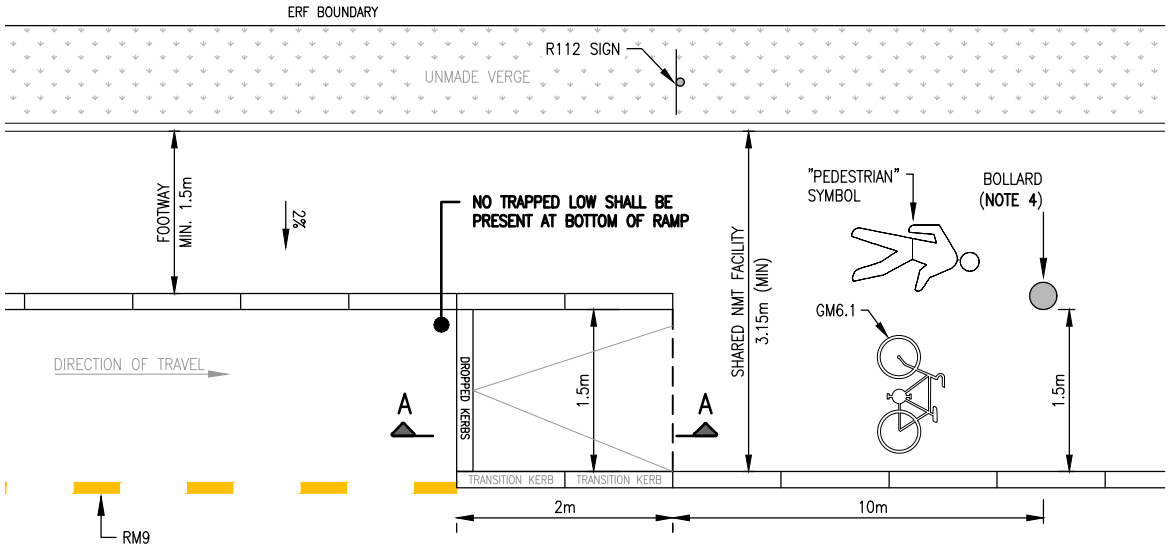
TITLE

MISCELLANEOUS RAMPS
TYPE B: BICYCLE RAMP

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RD3.2B	A

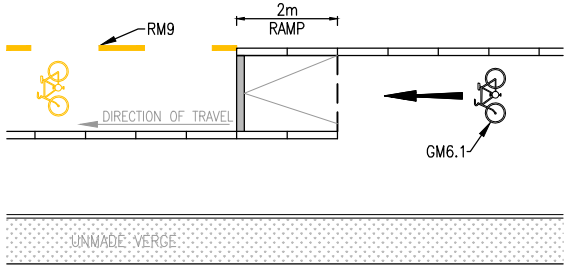
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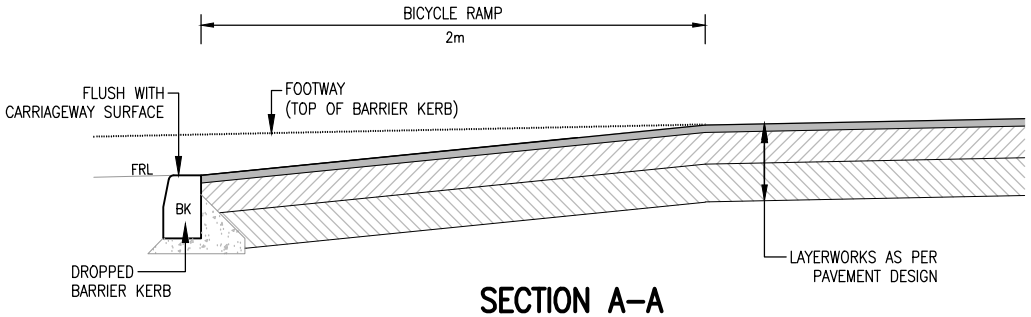
PLAN VIEW: ON RAMP

NOTES:

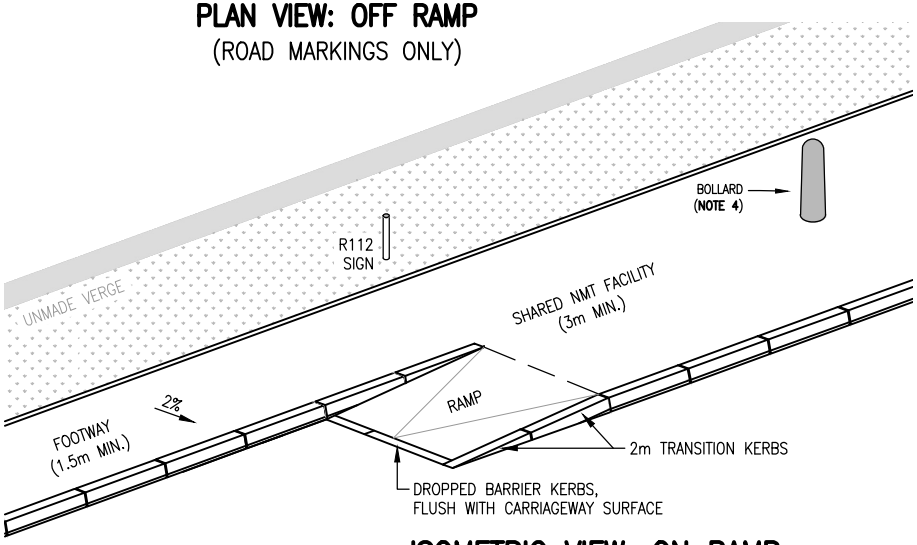
1. **STORMWATER DRAINAGE TO CONSIDERED. THIS OPTION SHALL ONLY BE USED WHERE NO TRAPPED LOW POINT IS CREATED AT THE BOTTOM OF THE RAMP.**
2. REFER TO DRAWING **RD2.2** FOR THE DROPPED KERB DETAILS (**TYPE 'C' & 'D'**).
3. ROAD MARKING SHALL CONFORM TO SADC RTSM VOL1.
4. WHERE THERE IS A POSSIBILITY OF ILLEGAL VEHICULAR BEHAVIOR OCCURRING ON THE SHARED NMT FACILITY, A CONCRETE BOLLARD MAY BE PLACED 10m DOWNSTREAM OF THE BICYCLE RAMP. BOLLARD TO BE PAINTED AS PER DRAWING GE1 AND POSITIONED TO ALLOW 1.5m CLEAR WIDTH BETWEEN BACK OF KERB AND BOLLARD EDGE.



PLAN VIEW: OFF RAMP
(ROAD MARKINGS ONLY)



SECTION A–A



NOTE: ROAD MARKINGS NOT SHOWN

ISOMETRIC VIEW: ON RAMP

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

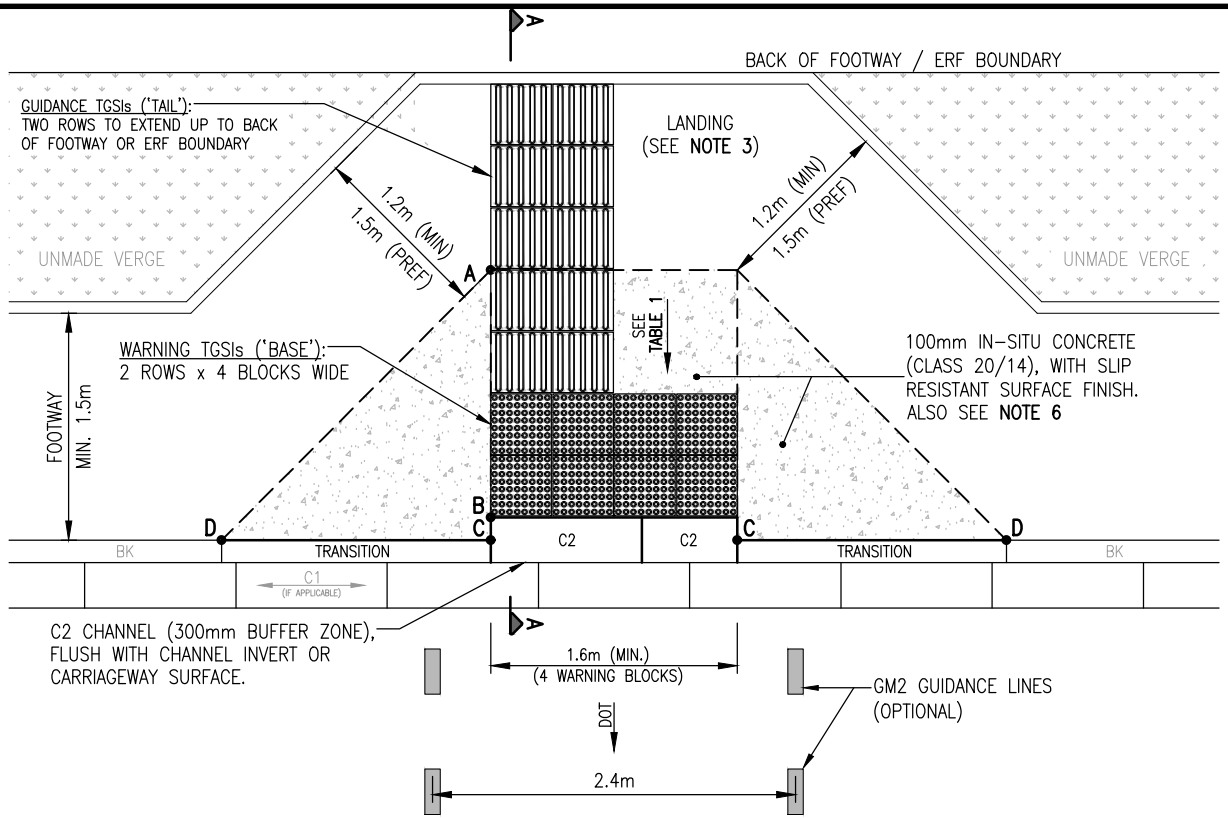
TITLE

MISCELLANEOUS RAMPS
TYPE C: BICYCLE RAMP

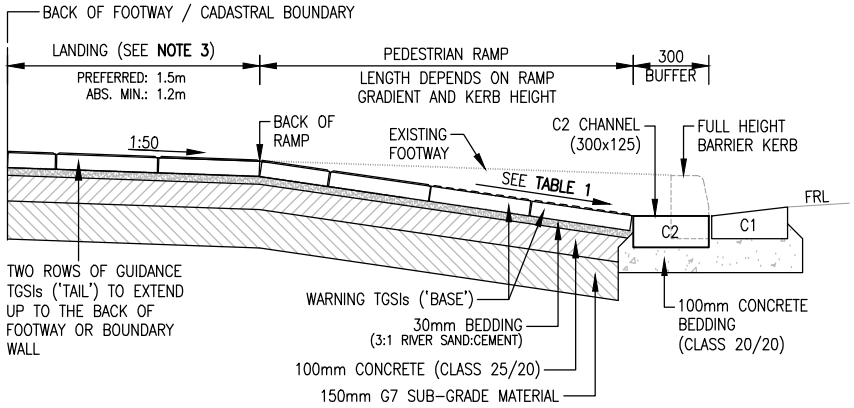
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RD3.2C	A

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PLAN VIEW
SCALE 1:50



SECTION A–A
N.T.S.

TABLE 1
RAMP GRADIENT

PREFERENCE	GRADIENT
PREFERRED	1:20 (5%)
ACCEPTABLE	1:15 (6.7%)
ABSOLUTE MAXIMUM	1:12 (8.3%)

NOTES:

1. REFER TO SECTION **5.6** AND **5.7** FOR FURTHER DETAILS ON PEDESTRIAN RAMPS AND TGSIs.
2. A MAXIMUM SLOPE OF 1:12 BETWEEN POINTS "C–D" (ALONG THE TRANSITIONS) IS PREFERRED. WHERE THE AFOREMENTIONED SLOPE IS NOT POSSIBLE, THE LENGTH OF THE TRANSITIONS SHALL NEVER BE LESS THAN 1m.
3. WHERE THERE IS INSUFFICIENT SPACE AVAILABLE ON THE VERGE TO PROVIDE A MINIMUM LANDING OF 1.2m, LONGITUDINAL RAMPS SHALL BE CONSTRUCTED. AS A FIRST ALTERNATIVE, DESIGNERS SHALL APPLY THE "COMBINATION DROP" AS PER DRAWING **RD4.3**. WHERE THIS OPTION IS NOT POSSIBLE, THE "FULL DROP" OPTION SHALL BE APPLIED AS PER DRAWING **RD4.4**.
4. TGSIs TO BE PLACED PARALLEL WITH THE DIRECTION OF TRAVEL OF THE PEDESTRIAN CROSSING.
5. REFER TO DRAWING **RD2.2** FOR THE DROPPED KERB DETAILS (TYPE 'E' OR 'F').
6. ALTERNATIVE SURFACE TREATMENTS MAY BE APPLIED, SUBJECT TO APPROVAL AUTHORITY.

FRL: FINISHED ROAD LEVEL
DOT: DIRECTION OF TRAVEL

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

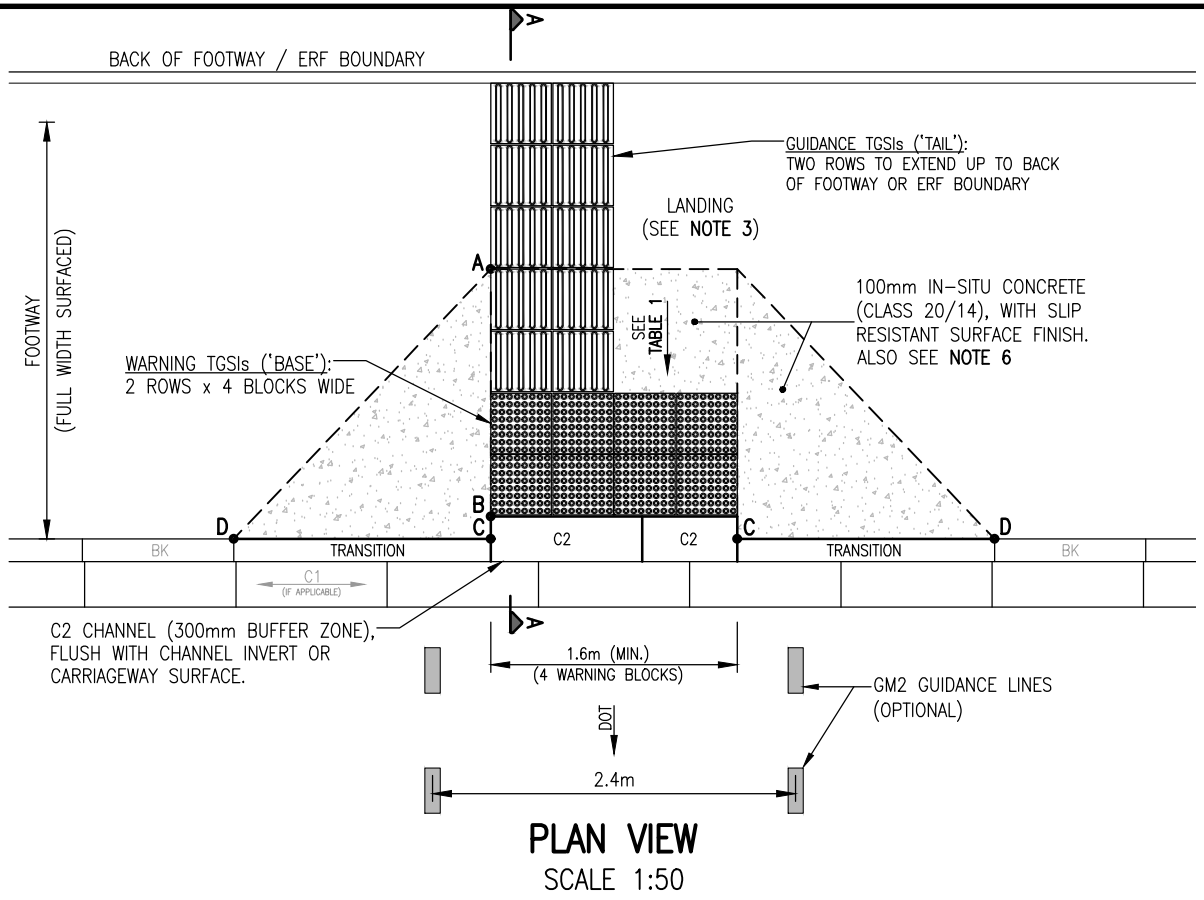
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PEDESTRIAN RAMPS: UNCONTROLLED PEDESTRIAN CROSSINGS
WIDE VERGE - SIDEWALK WITH UNMADE VERGE
(PREFERRED)

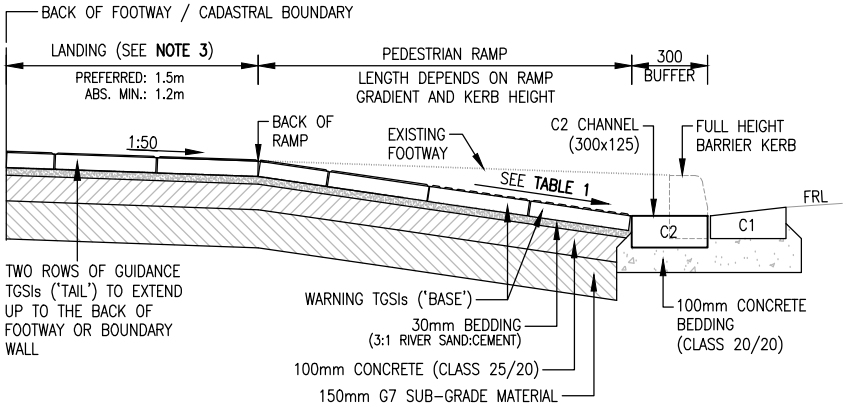
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD4.1	C

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PLAN VIEW
SCALE 1:50



SECTION A–A
N.T.S.

TABLE 1
RAMP GRADIENT

PREFERENCE	GRADIENT
PREFERRED	1:20 (5%)
ACCEPTABLE	1:15 (6.7%)
ABSOLUTE MAXIMUM	1:12 (8.3%)

NOTES:

1. REFER TO SECTION **5.6** AND **5.7** FOR FURTHER DETAILS ON PEDESTRIAN RAMPS AND TGSIs.
2. A MAXIMUM SLOPE OF 1:12 BETWEEN POINTS "C–D" (ALONG THE TRANSITIONS) IS PREFERRED. WHERE THE AFOREMENTIONED SLOPE IS NOT POSSIBLE, THE LENGTH OF THE TRANSITIONS SHALL NEVER BE LESS THAN 1m.
3. WHERE THERE IS INSUFFICIENT SPACE AVAILABLE ON THE VERGE TO PROVIDE A MINIMUM LANDING OF 1.2m, LONGITUDINAL RAMPS SHALL BE CONSTRUCTED. AS A FIRST ALTERNATIVE, DESIGNERS SHALL APPLY THE "COMBINATION DROP" AS PER DRAWING **RD4.3**. WHERE THIS OPTION IS NOT POSSIBLE, THE "FULL DROP" OPTION SHALL BE APPLIED AS PER DRAWING **RD4.4**.
4. TGSIs TO BE PLACED PARALLEL WITH THE DIRECTION OF TRAVEL OF THE PEDESTRIAN CROSSING.
5. REFER TO DRAWING **RD2.2** FOR THE DROPPED KERB DETAILS (TYPE 'E' OR 'F').
6. ALTERNATIVE SURFACE TREATMENTS MAY BE APPLIED, SUBJECT TO APPROVAL AUTHORITY.

FRL: FINISHED ROAD LEVEL
DOT: DIRECTION OF TRAVEL

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

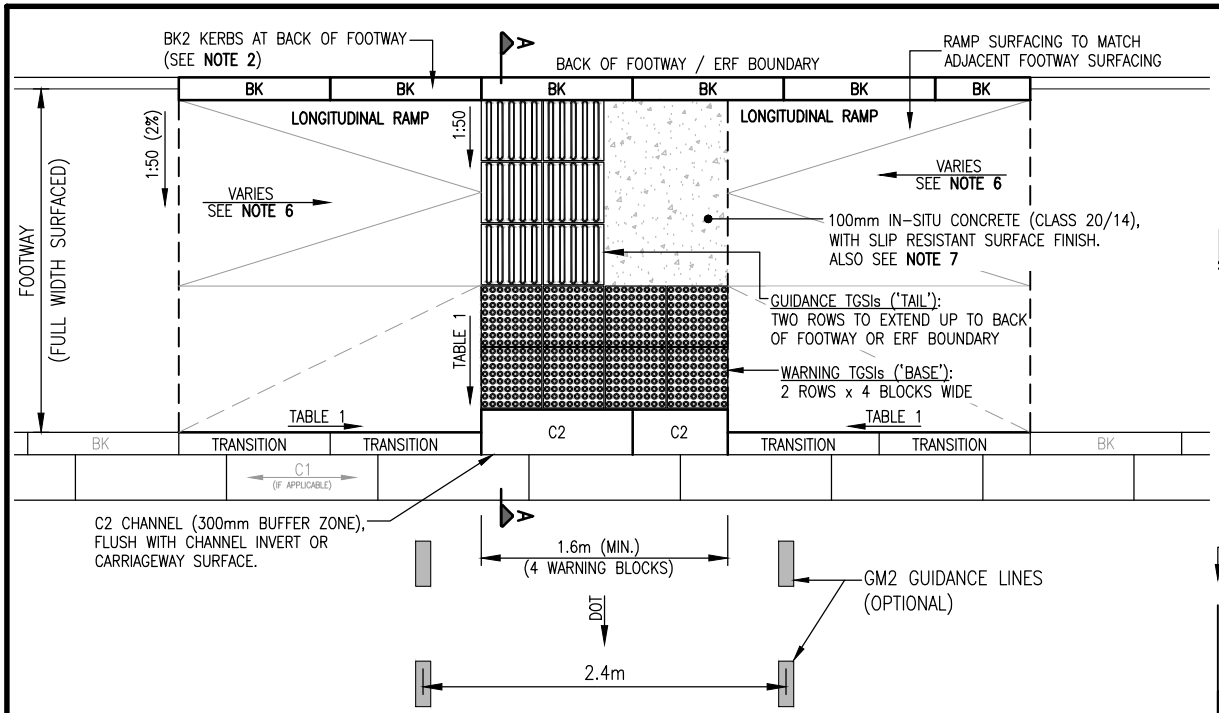
CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

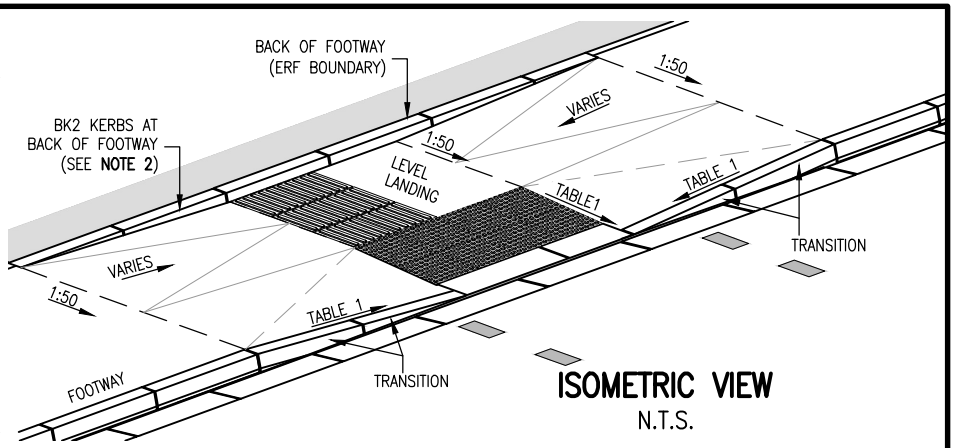
PEDESTRIAN RAMPS: UNCONTROLLED PEDESTRIAN CROSSINGS WIDE VERGE - FULL VERGE SURFACED

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD4.2	C

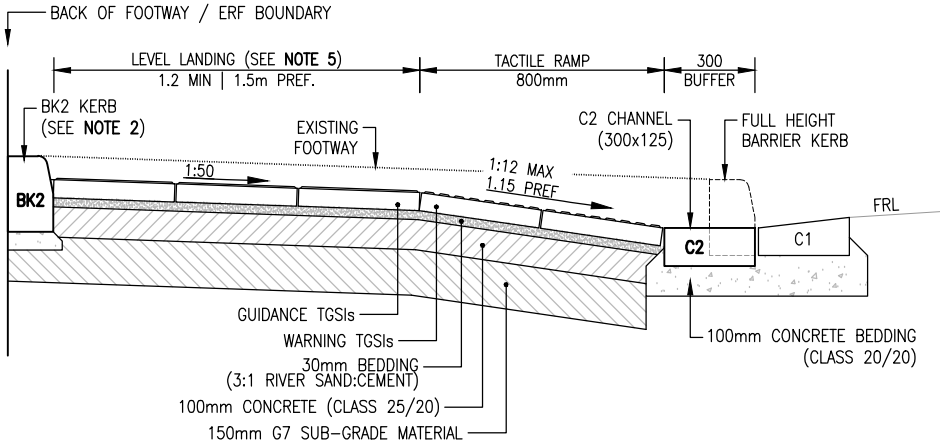


PLAN VIEW
SCALE 1:50



ISOMETRIC VIEW
N.T.S.

TABLE 1 RAMP GRADIENT	
PREFERENCE	GRADIENT
PREFERRED	1:20 (5%)
ACCEPTABLE	1:15 (6.7%)
ABSOLUTE MAXIMUM	1:12 (8.3%)



SECTION A–A
SCALE 1:25

NOTES:

1. REFER TO SECTION **5.6** AND **5.7** FOR FURTHER DETAILS ON PEDESTRIAN RAMPS AND TGSIs.
2. IF A SOLID BOUNDARY WALL IS PRESENT OR THERE IS NO FLOODING RISK TO THE ADJACENT PRIVATE PROPERTY, THE BARRIER KERBS MAY BE OMITTED.
3. TGSIs TO BE PLACED PARALLEL WITH THE DIRECTION OF TRAVEL OF THE PEDESTRIAN CROSSING.
4. REFER TO DRAWING **RD2.2** FOR THE DROPPED KERB DETAILS (TYPE 'E' OR 'F').
5. WHERE A MINIMUM LANDING OF 1.2m IS NOT POSSIBLE, THE "FULL DROP" OPTION SHALL BE APPLIED AS PER DRAWING **RD4.4**.
6. GRADIENT DEPENDENT ON KERB HEIGHT AND TRANSITION LENGTH, BUT SHALL NEVER EXCEED 1:12.
7. ALTERNATIVE SURFACE TREATMENTS MAY BE APPLIED, SUBJECT TO APPROVAL AUTHORITY.

FRL: FINISHED ROAD LEVEL
DOT: DIRECTION OF TRAVEL

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

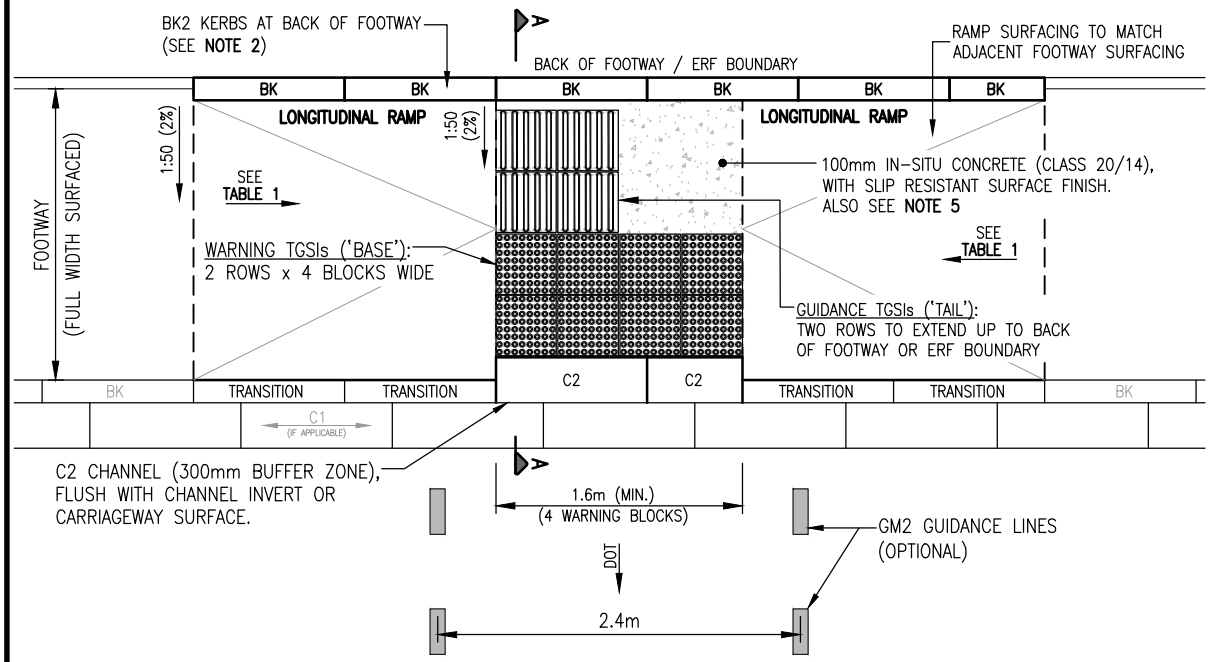
CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

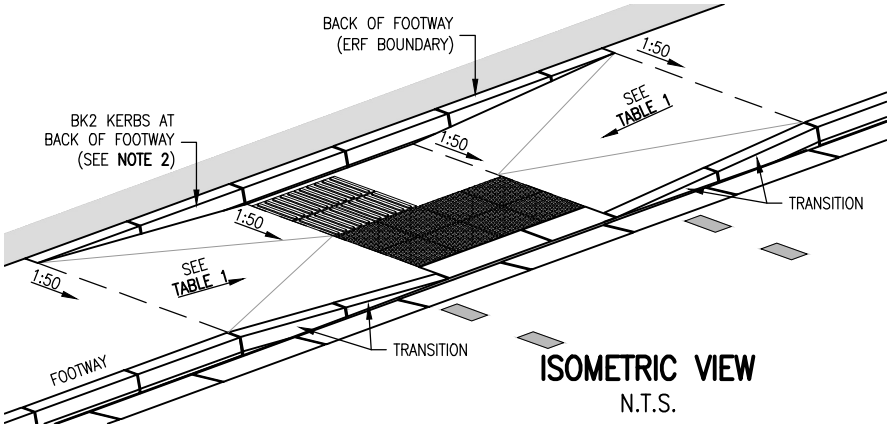
PEDESTRIAN RAMPS: UNCONTROLLED PEDESTRIAN CROSSINGS
NARROW VERGE (SPACE CONSTRAINT)
COMBINATION DROP (PARTIAL DROP) (NOT IDEAL, BUT ACCEPTABLE)

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD4.3	C

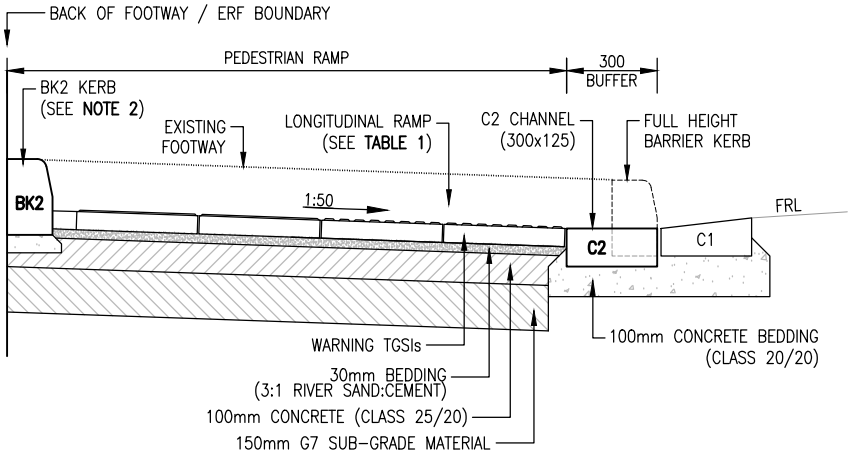


PLAN VIEW
SCALE 1:50



ISOMETRIC VIEW
N.T.S.

TABLE 1 RAMP GRADIENT	
PREFERENCE	GRADIENT
PREFERRED	1:20 (5%)
ACCEPTABLE	1:15 (6.7%)
ABSOLUTE MAXIMUM	1:12 (8.3%)



SECTION A–A
SCALE 1:25

NOTES:

1. REFER TO SECTION **5.6** AND **5.7** FOR FURTHER DETAILS ON PEDESTRIAN RAMPS AND TGSIs.
2. IF A SOLID BOUNDARY WALL IS PRESENT OR THERE IS NO FLOODING RISK TO THE ADJACENT PRIVATE PROPERTY, THE BARRIER KERBS MAY BE OMITTED.
3. TGSIs TO BE PLACED PARALLEL WITH THE DIRECTION OF TRAVEL OF THE PEDESTRIAN CROSSING.
4. REFER TO DRAWING **RD2.2** FOR THE DROPPED KERB DETAILS (TYPE 'E' OR 'F').
5. ALTERNATIVE SURFACE TREATMENTS MAY BE APPLIED, SUBJECT TO APPROVAL AUTHORITY.
6. THIS OPTION IS NOT PREFERRED AND SHOULD BE USED AS A LAST ALTERNATIVE.

FRL: FINISHED ROAD LEVEL
DOT: DIRECTION OF TRAVEL

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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

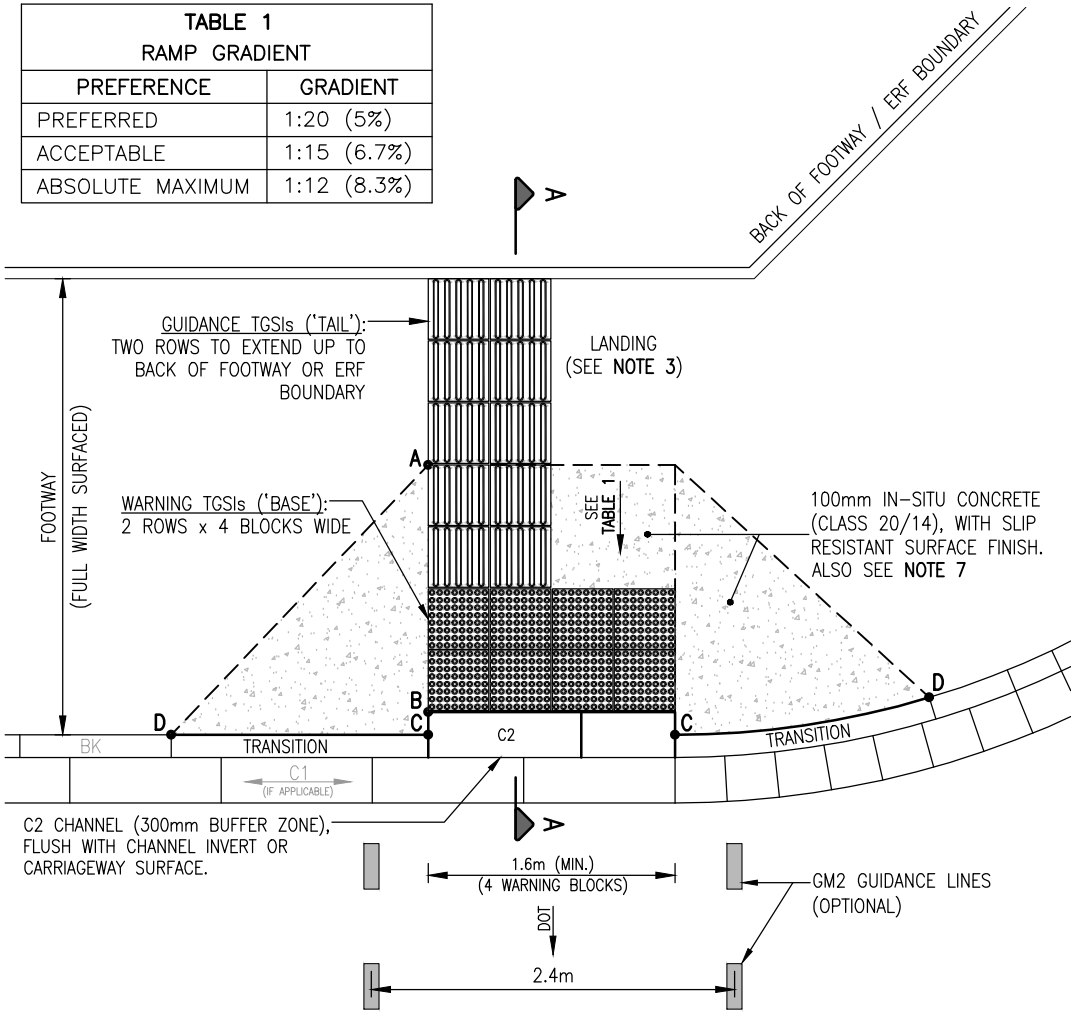
PEDESTRIAN RAMPS: UNCONTROLLED PEDESTRIAN CROSSINGS
NARROW VERGE (SPACE CONSTRAINT)
FULL DROP (ACCEPTABLE, BUT NOT PREFERRED)

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD4.4	C

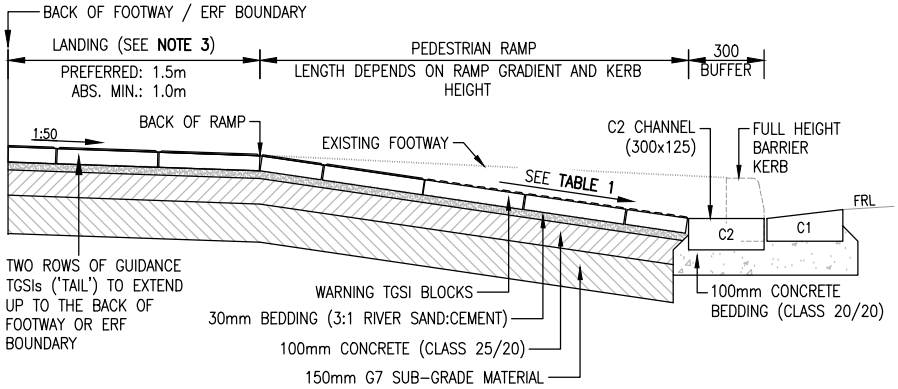
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TABLE 1 RAMP GRADIENT	
PREFERENCE	GRADIENT
PREFERRED	1:20 (5%)
ACCEPTABLE	1:15 (6.7%)
ABSOLUTE MAXIMUM	1:12 (8.3%)



PLAN VIEW
1:50

FRL: FINISHED ROAD LEVEL
DOT: DIRECTION OF TRAVEL



SECTION A–A
N.T.S.

NOTES:

1. REFER TO SECTION **5.6** AND **5.7** FOR FURTHER DETAILS ON PEDESTRIAN RAMPS AND TGSIs.
2. A MAXIMUM SLOPE OF 1:12 BETWEEN POINTS "C–D" (ALONG THE TRANSITIONS) IS PREFERRED. WHERE THE AFOREMENTIONED SLOPE IS NOT POSSIBLE, THE LENGTH OF THE TRANSITIONS SHALL NEVER BE LESS THAN 1m.
3. WHERE THERE IS INSUFFICIENT SPACE AVAILABLE ON THE VERGE TO PROVIDE A MINIMUM LANDING OF 1.2m, LONGITUDINAL RAMPS SHALL BE CONSTRUCTED. AS A FIRST ALTERNATIVE, DESIGNERS SHALL APPLY THE "COMBINATION DROP" AS PER DRAWING **RD4.3**. WHERE THIS OPTION IS NOT POSSIBLE, THE "FULL DROP" OPTION SHALL BE APPLIED AS PER DRAWING **RD4.4**.
4. TGSIs TO BE PLACED PARALLEL WITH THE DIRECTION OF TRAVEL OF THE PEDESTRIAN CROSSING.
5. REFER TO DRAWING **RD2.2** FOR THE DROPPED KERB DETAILS (TYPE 'E' OR 'F').
6. STOP LINES TO BE SET BACK 1.5m FROM THE PEDESTRIAN CROSSING PATHWAY.
7. ALTERNATIVE SURFACE TREATMENTS MAY BE APPLIED, SUBJECT TO APPROVAL AUTHORITY.

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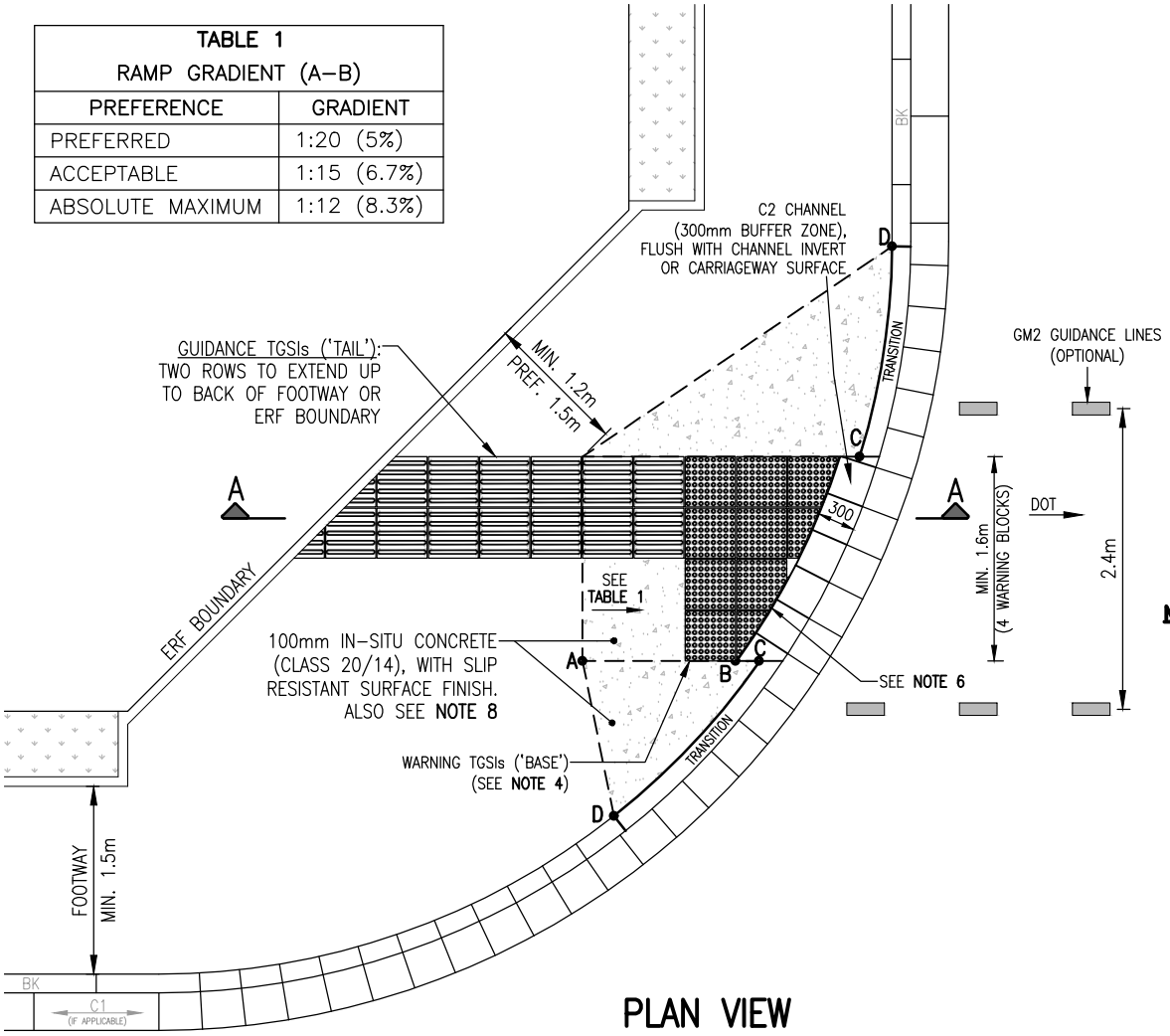
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PEDESTRIAN RAMPS: UNCONTROLLED PEDESTRIAN CROSSINGS ON STRAIGHT EDGE AT INTERSECTION (PREFERRED)

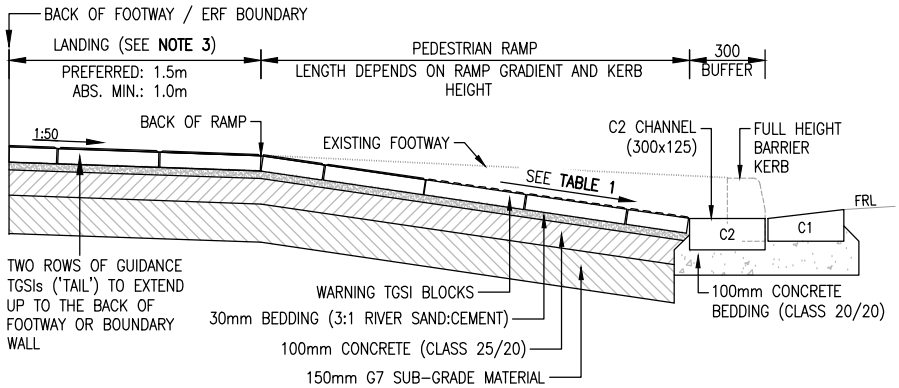
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD4.5	C

TABLE 1 RAMP GRADIENT (A–B)	
PREFERENCE	GRADIENT
PREFERRED	1:20 (5%)
ACCEPTABLE	1:15 (6.7%)
ABSOLUTE MAXIMUM	1:12 (8.3%)



PLAN VIEW
N.T.S



SECTION A–A
N.T.S.

NOTES:

1. REFER TO SECTION **5.6** AND **5.7** FOR FURTHER DETAILS ON PEDESTRIAN RAMPS AND TGSIs
2. A MAXIMUM SLOPE OF 1:12 BETWEEN POINTS "C–D" (ALONG THE TRANSITIONS) IS PREFERRED. WHERE THE AFOREMENTIONED SLOPE IS NOT POSSIBLE, THE LENGTH OF THE TRANSITIONS SHALL NEVER BE LESS THAN 1m.
3. WHERE THERE IS INSUFFICIENT SPACE AVAILABLE ON THE VERGE TO PROVIDE A MINIMUM LANDING OF 1.2m, LONGITUDINAL RAMPS SHALL BE CONSTRUCTED. AS A FIRST ALTERNATIVE, DESIGNERS SHALL APPLY THE "COMBINATION DROP" AS PER DRAWING **RD4.3**. WHERE THIS OPTION IS NOT POSSIBLE, THE "FULL DROP" OPTION SHALL BE APPLIED AS PER DRAWING **RD4.4**.
4. MAXIMUM DISTORTION OF WARNING TGSIs (ALSO REFER TO SECTION **5.7.4**):
   - LONG SIDE: 3 BLOCKS
   - SHORT SIDE: 1 BLOCK
4. TGSIs TO BE PLACED PARALLEL WITH THE DIRECTION OF TRAVEL OF THE PEDESTRIAN CROSSING.
5. ONLY MECHANICAL CUTTING OF TGSIs ARE PERMITTED.
6. REFER TO DRAWING **RD2.2** FOR THE DROPPED KERB DETAILS (TYPE 'E' OR 'F').
7. STOP LINES TO BE SET BACK 1.5m FROM THE PEDESTRIAN CROSSING PATHWAY.
8. ALTERNATIVE SURFACE TREATMENTS MAY BE APPLIED, SUBJECT TO APPROVAL AUTHORITY.

FRL: FINISHED ROAD LEVEL
DOT: DIRECTION OF TRAVEL

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

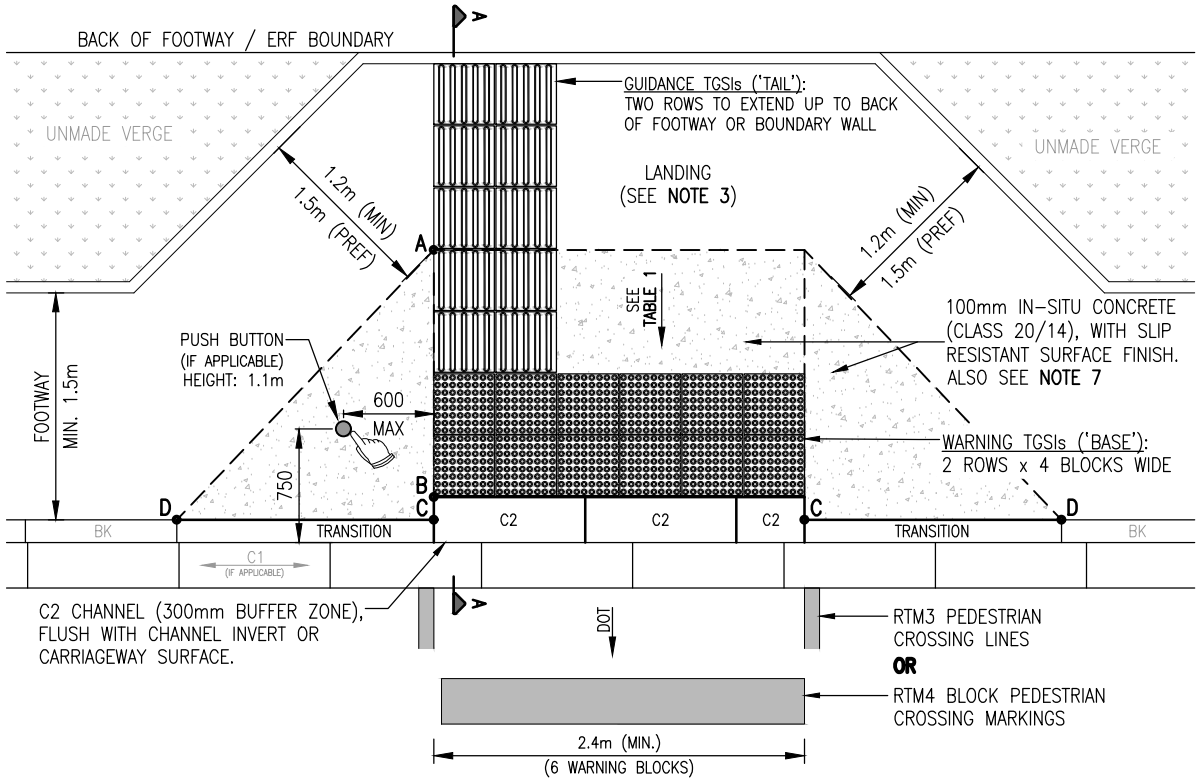
TITLE

PEDESTRIAN RAMPS: UNCONTROLLED PEDESTRIAN CROSSINGS
OBLIQUE RAMP (SINGLE DIRECTION) (NOT PREFERRED)

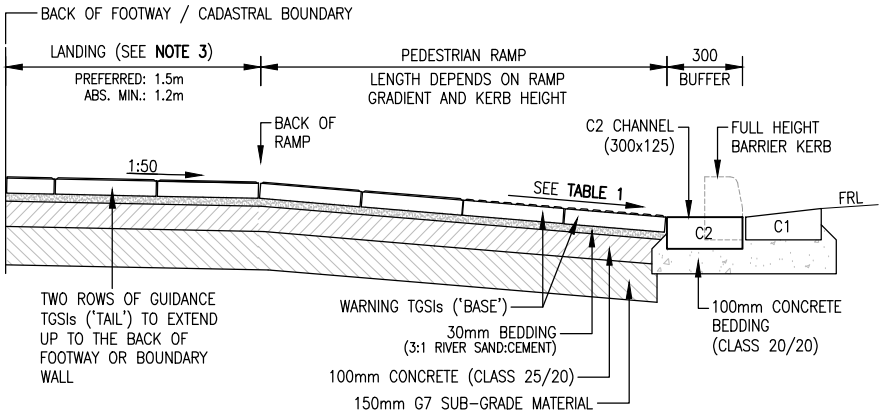
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD4.6	C

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PLAN VIEW
SCALE 1:50



SECTION A–A
N.T.S.

TABLE 1
RAMP GRADIENT

PREFERENCE	GRADIENT
PREFERRED	1:20 (5%)
ACCEPTABLE	1:15 (6.7%)
ABSOLUTE MAXIMUM	1:12 (8.3%)

NOTES:

1. REFER TO SECTION **5.6** AND **5.7** FOR FURTHER DETAILS ON PEDESTRIAN RAMPS AND TGSIs.
2. A MAXIMUM SLOPE OF 1:12 BETWEEN POINTS "C–D" (ALONG THE TRANSITIONS) IS PREFERRED. WHERE THE AFOREMENTIONED SLOPE IS NOT POSSIBLE, THE LENGTH OF THE TRANSITIONS SHALL NEVER BE LESS THAN 1m.
3. WHERE THERE IS INSUFFICIENT SPACE AVAILABLE ON THE VERGE TO PROVIDE A MINIMUM LANDING OF 1.2m, LONGITUDINAL RAMPS SHALL BE CONSTRUCTED. AS A FIRST ALTERNATIVE, DESIGNERS SHALL APPLY THE "COMBINATION DROP" AS PER DRAWING **RD4.9**. WHERE THIS OPTION IS NOT POSSIBLE, THE "FULL DROP" OPTION SHALL BE APPLIED AS PER DRAWING **RD4.10**.
4. TGSIs TO BE PLACED PARALLEL WITH THE DIRECTION OF TRAVEL OF THE PEDESTRIAN CROSSING.
5. REFER TO DRAWING **RD2.2** FOR THE DROPPED KERB DETAILS (TYPE 'E' OR 'F').
6. THIS EXAMPLE IS BASED ON A CBD ENVIRONMENT, WHERE THE FULL WIDTH OF THE ROAD VERGE IS TYPICALLY SURFACED.
7. ALTERNATIVE SURFACE TREATMENTS MAY BE APPLIED, SUBJECT TO APPROVAL AUTHORITY.

FRL: FINISHED ROAD LEVEL
DOT: DIRECTION OF TRAVEL

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

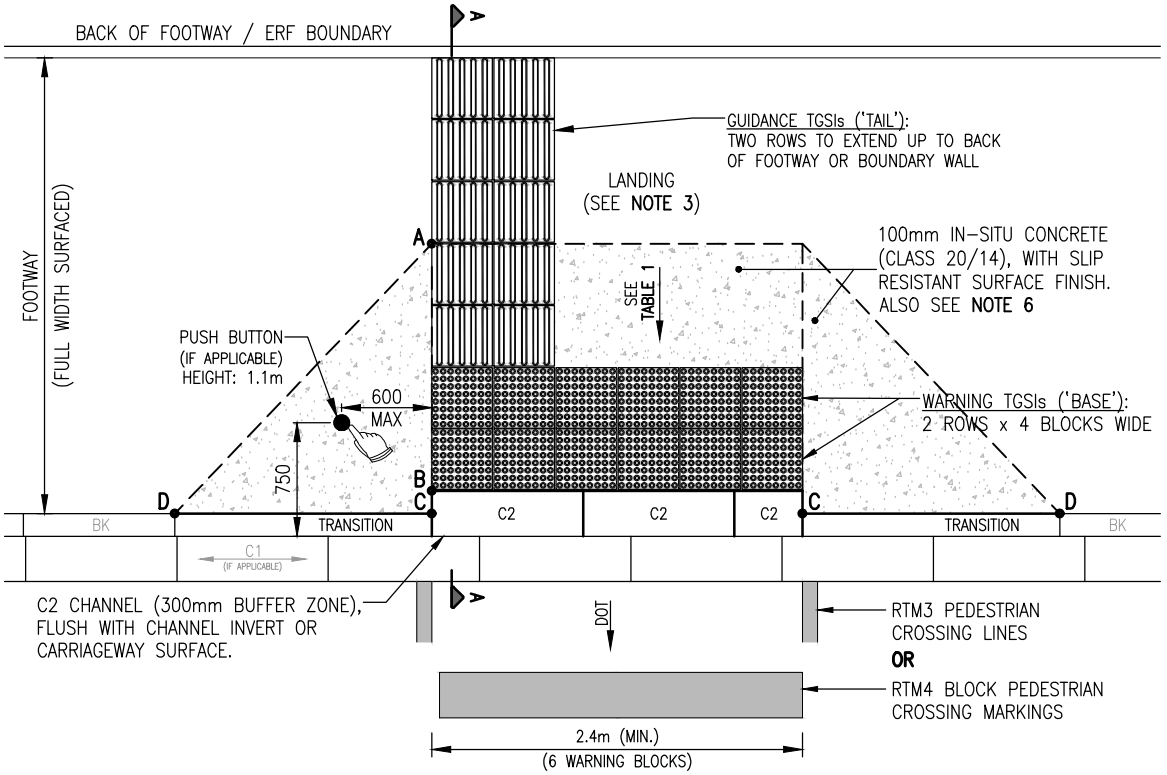
TITLE

PEDESTRIAN RAMPS: CONTROLLED PEDESTRIAN CROSSING BLOCK AND SIGNALISED CROSSINGS WIDE VERGE - SIDEWALK WITH UNMADE VERGE (PREFERRED)

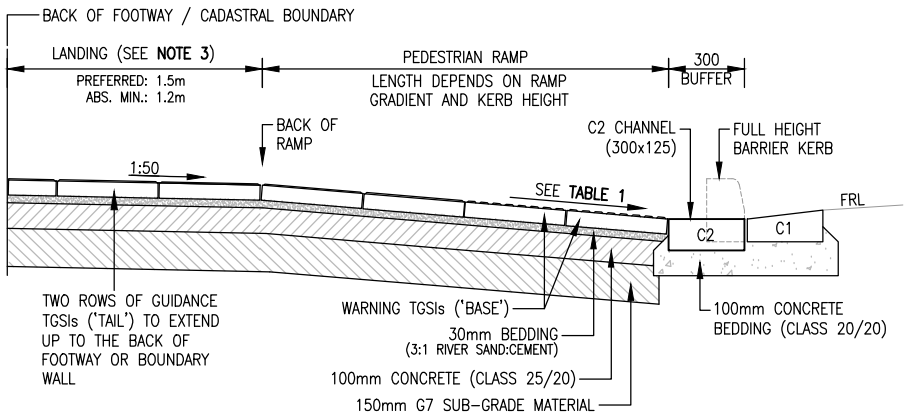
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD4.7	D

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PLAN VIEW
SCALE 1:50



SECTION A-A
N.T.S.

TABLE 1
RAMP GRADIENT

PREFERENCE	GRADIENT
PREFERRED	1:20 (5%)
ACCEPTABLE	1:15 (6.7%)
ABSOLUTE MAXIMUM	1:12 (8.3%)

NOTES:

1. REFER TO SECTION **5.6** AND **5.7** FOR FURTHER DETAILS ON PEDESTRIAN RAMPS AND TGSIs.
2. A MAXIMUM SLOPE OF 1:12 BETWEEN POINTS "C–D" (ALONG THE TRANSITIONS) IS PREFERRED. WHERE THE AFOREMENTIONED SLOPE IS NOT POSSIBLE, THE LENGTH OF THE TRANSITIONS SHALL NEVER BE LESS THAN 1m.
3. WHERE THERE IS INSUFFICIENT SPACE AVAILABLE ON THE VERGE TO PROVIDE A MINIMUM LANDING OF 1.2m, LONGITUDINAL RAMPS SHALL BE CONSTRUCTED. AS A FIRST ALTERNATIVE, DESIGNERS SHALL APPLY THE "COMBINATION DROP" AS PER DRAWING **RD4.9**. WHERE THIS OPTION IS NOT POSSIBLE, THE "FULL DROP" OPTION SHALL BE APPLIED AS PER DRAWING **RD4.10**.
4. TGSIs TO BE PLACED PARALLEL WITH THE DIRECTION OF TRAVEL OF THE PEDESTRIAN CROSSING.
5. REFER TO DRAWING **RD2.2** FOR THE DROPPED KERB DETAILS (TYPE 'E' OR 'F').
6. ALTERNATIVE SURFACE TREATMENTS MAY BE APPLIED, SUBJECT TO APPROVAL AUTHORITY.

FRL: FINISHED ROAD LEVEL
DOT: DIRECTION OF TRAVEL

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

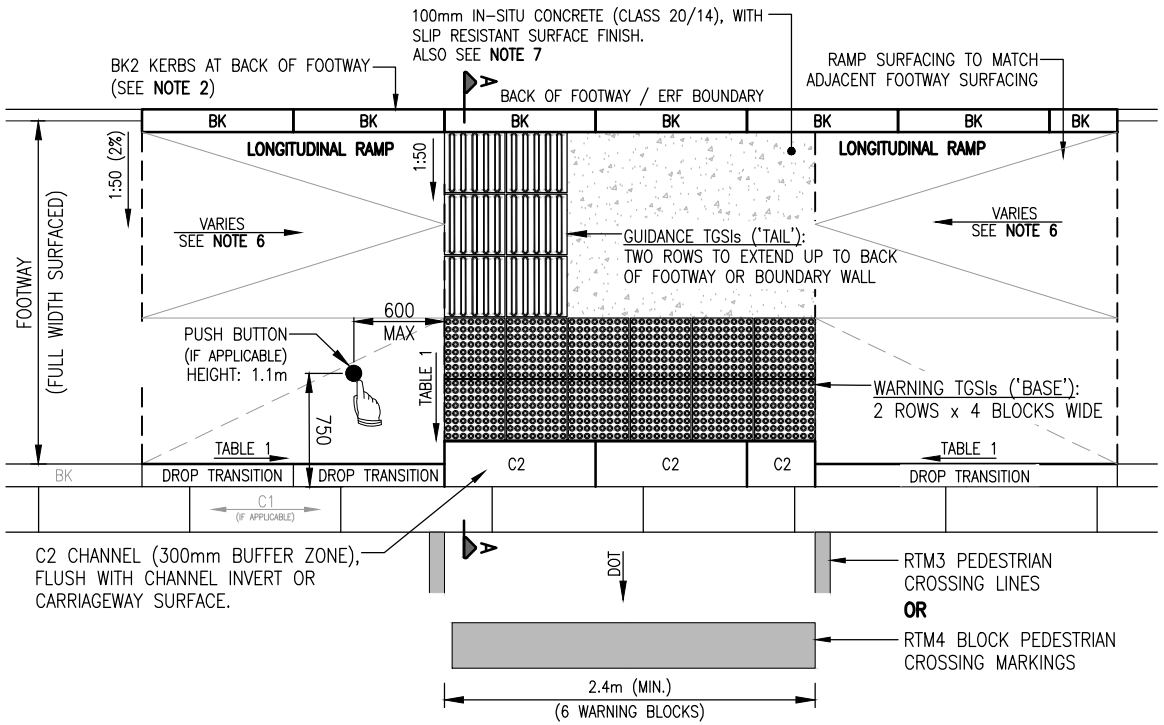
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PEDESTRIAN RAMPS: CONTROLLED PEDESTRIAN CROSSINGS BLOCK AND SIGNALISED CROSSINGS WIDE VERGE - FULL VERGE SURFACED (PREFERRED)

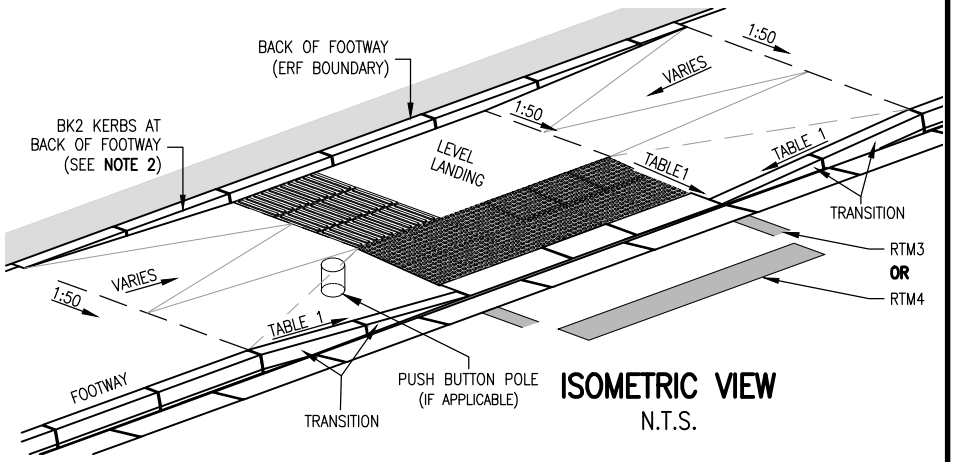
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD4.8	C

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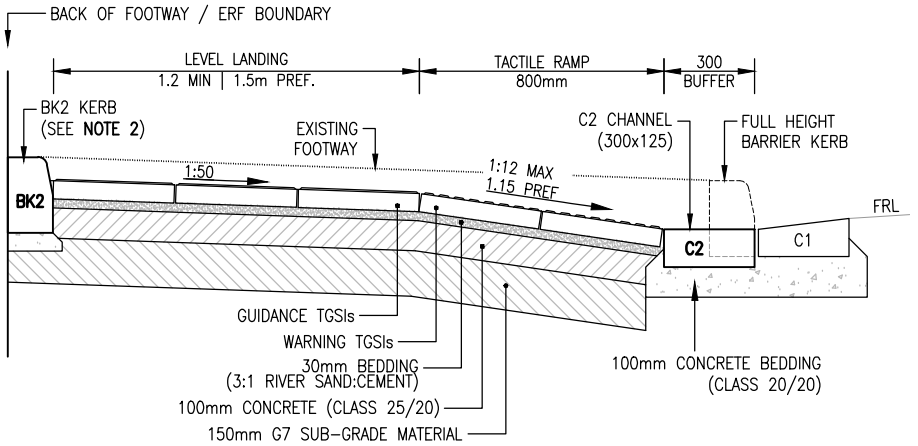


PLAN VIEW
SCALE 1:50



ISOMETRIC VIEW
N.T.S.

TABLE 1 RAMP GRADIENT	
PREFERENCE	GRADIENT
PREFERRED	1:20 (5%)
ACCEPTABLE	1:15 (6.7%)
ABSOLUTE MAXIMUM	1:12 (8.3%)



SECTION A–A
SCALE 1:25

NOTES:

1. REFER TO SECTION **5.6** AND **5.7** FOR FURTHER DETAILS ON PEDESTRIAN RAMPS AND TGSIs.
2. IF A SOLID BOUNDARY WALL IS PRESENT OR THERE IS NO FLOODING RISK TO THE ADJACENT PRIVATE PROPERTY, THE BARRIER KERBS MAY BE OMITTED.
3. TGSIs TO BE PLACED PARALLEL WITH THE DIRECTION OF TRAVEL OF THE PEDESTRIAN CROSSING.
4. REFER TO DRAWING **RD2.2** FOR THE DROPPED KERB DETAILS (TYPE 'E' OR 'F').
5. WHERE A MINIMUM LANDING OF 1.2m IS NOT POSSIBLE, THE "FULL DROP" OPTION SHALL BE APPLIED AS PER DRAWING **RD4.10**.
6. GRADIENT DEPENDENT ON KERB HEIGHT AND TRANSITION LENGTH, BUT SHALL NEVER EXCEED 1:12.
7. ALTERNATIVE SURFACE TREATMENTS MAY BE APPLIED, SUBJECT TO APPROVAL AUTHORITY.

FRL: FINISHED ROAD LEVEL
DOT: DIRECTION OF TRAVEL

CITY OF CAPE TOWN
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STAD KAAPSTAD

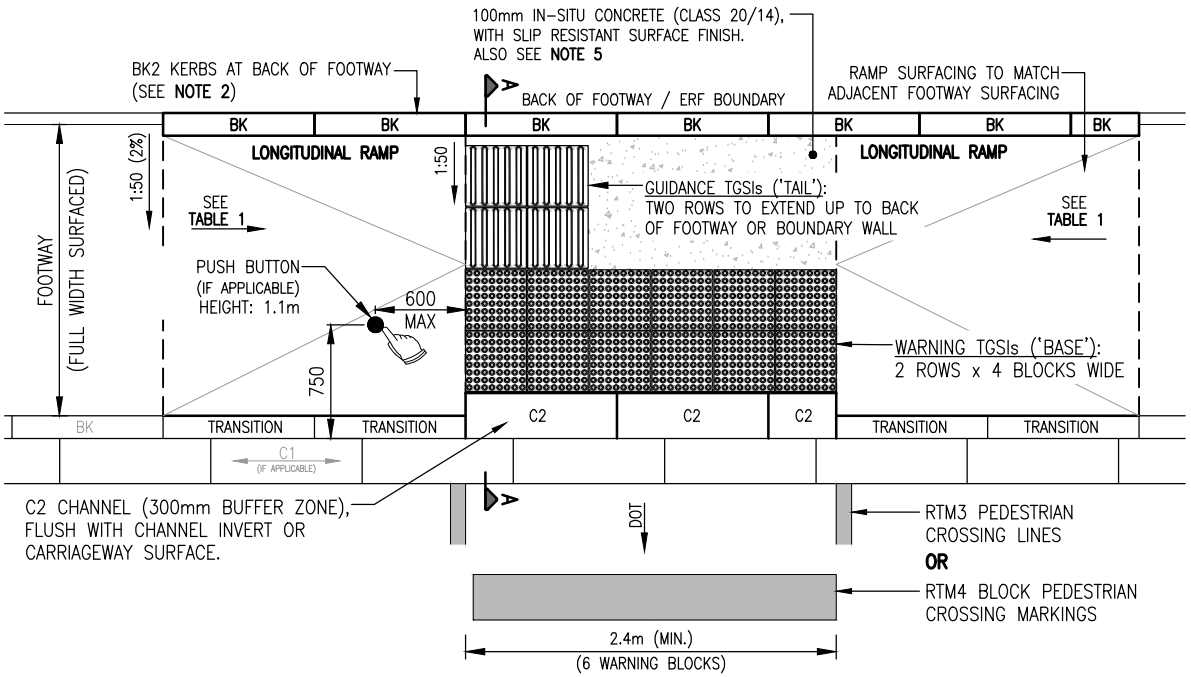
CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

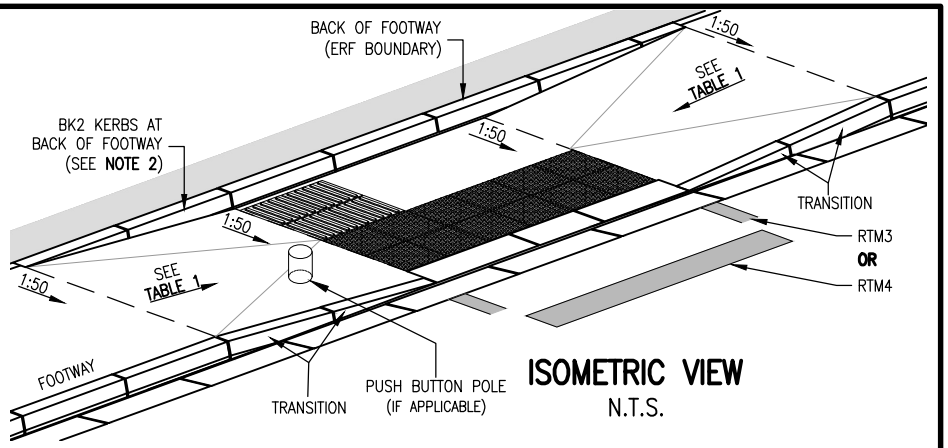
PEDESTRIAN RAMPS: BLOCK & SIGNAL CONTROLLED PEDESTRIAN CROSSINGS NARROW VERGE (SPACE CONSTRAINT) COMBINATION DROP (PARTIAL DROP) (NOT IDEAL, BUT ACCEPTABLE)

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD4.9	D

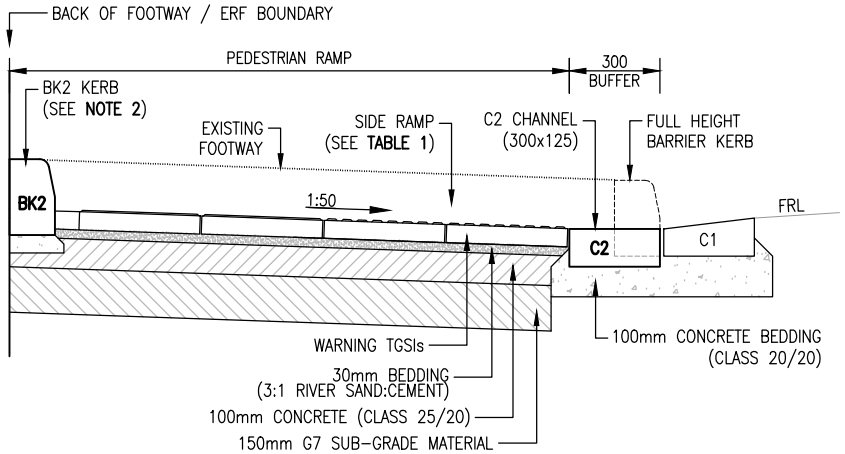


PLAN VIEW
SCALE 1:50



ISOMETRIC VIEW
N.T.S.

TABLE 1 RAMP GRADIENT	
PREFERENCE	GRADIENT
PREFERRED	1:20 (5%)
ACCEPTABLE	1:15 (6.7%)
ABSOLUTE MAXIMUM	1:12 (8.3%)



SECTION A–A
SCALE 1:25

NOTES:

1. REFER TO SECTION **5.6** AND **5.7** FOR FURTHER DETAILS ON PEDESTRIAN RAMPS AND TGSIs.
2. IF A SOLID BOUNDARY WALL IS PRESENT OR THERE IS NO FLOODING RISK TO THE ADJACENT PRIVATE PROPERTY, THE BARRIER KERBS MAY BE OMITTED.
3. TGSIs TO BE PLACED PARALLEL WITH THE DIRECTION OF TRAVEL OF THE PEDESTRIAN CROSSING.
4. REFER TO DRAWING **RD2.2** FOR THE DROPPED KERB DETAILS (TYPE 'E' OR 'F').
5. ALTERNATIVE SURFACE TREATMENTS MAY BE APPLIED, SUBJECT TO APPROVAL AUTHORITY.
6. THIS OPTION IS NOT PREFERRED AND SHOULD BE USED AS A LAST ALTERNATIVE.

FRL: FINISHED ROAD LEVEL
DOT: DIRECTION OF TRAVEL

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

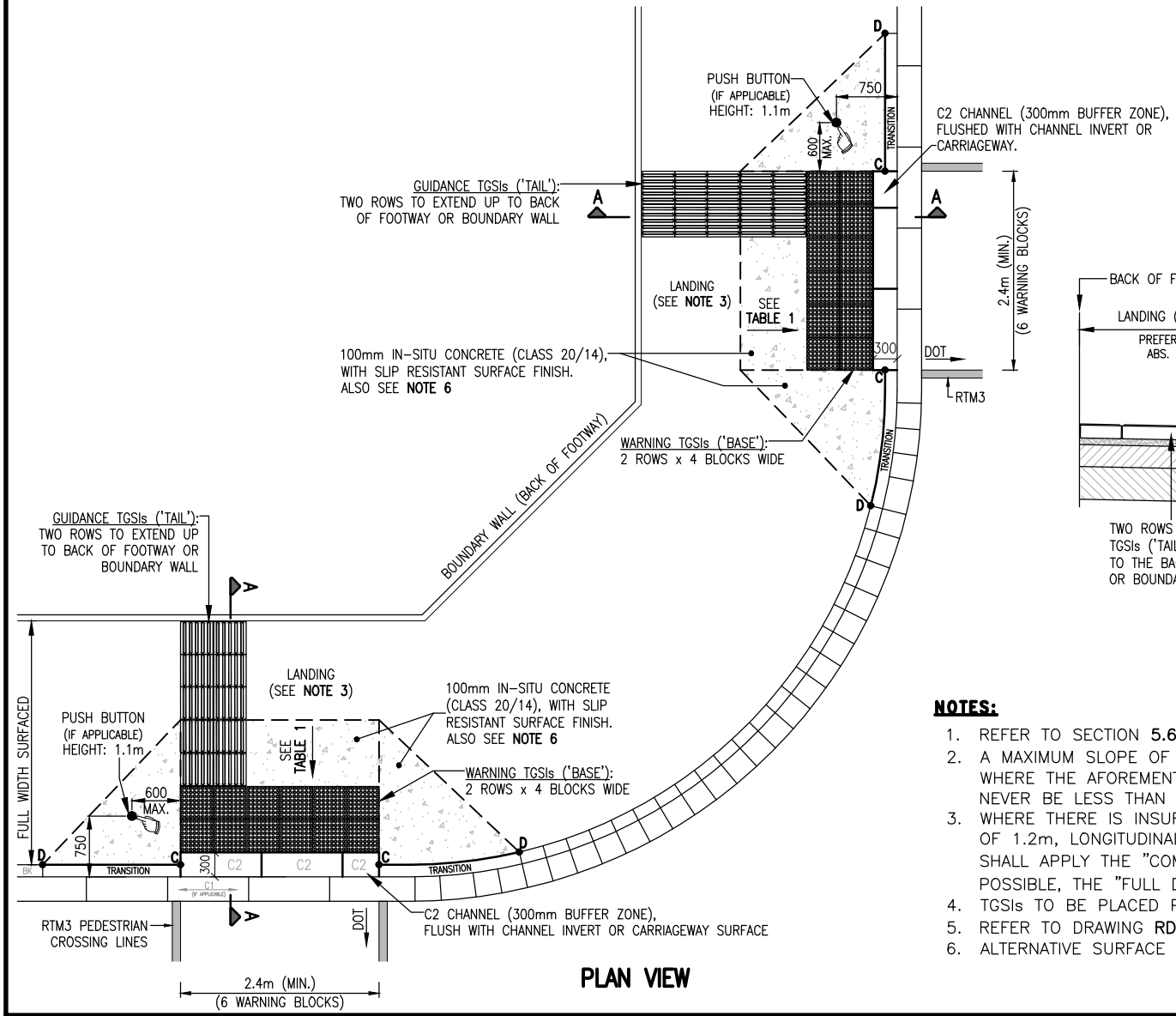
TITLE

PEDESTRIAN RAMPS: BLOCK & SIGNAL CONTROLLED PEDESTRIAN CROSSINGS
NARROW VERGE (SPACE CONSTRAINT)
FULL DROP (ACCEPTABLE, BUT NOT PREFERRED)

STANDARDS AND GUIDELINES DETAILS

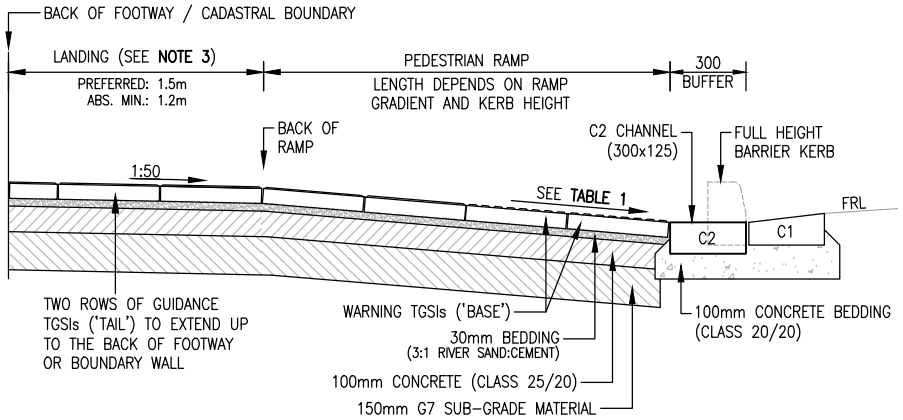
SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD4.10	B

P:\CAD\R&SD\ITI_01 Design\T_1000B Standards\T_1000RS DESIGN_Roads and Stormwater\0002 Drawings_Version4.0\01 RD\RD4.10 – Pedestrian Ramps – Controlled_RevB.dwg



PLAN VIEW

TABLE 1 RAMP GRADIENT	
PREFERENCE	GRADIENT
PREFERRED	1:20 (5%)
ACCEPTABLE	1:15 (6.7%)
ABSOLUTE MAXIMUM	1:12 (8.3%)



SECTION A–A

NOTES:

1. REFER TO SECTION **5.6** AND **5.7** FOR FURTHER DETAILS ON PEDESTRIAN RAMPS AND TGSIs.
2. A MAXIMUM SLOPE OF 1:12 BETWEEN POINTS "C–D" (ALONG THE TRANSITIONS) IS PREFERRED. WHERE THE AFOREMENTIONED SLOPE IS NOT POSSIBLE, THE LENGTH OF THE TRANSITIONS SHALL NEVER BE LESS THAN 1m.
3. WHERE THERE IS INSUFFICIENT SPACE AVAILABLE ON THE VERGE TO PROVIDE A MINIMUM LANDING OF 1.2m, LONGITUDINAL RAMPS SHALL BE CONSTRUCTED. AS A FIRST ALTERNATIVE, DESIGNERS SHALL APPLY THE "COMBINATION DROP" AS PER DRAWING **RD4.9**. WHERE THIS OPTION IS NOT POSSIBLE, THE "FULL DROP" OPTION SHALL BE APPLIED AS PER DRAWING **RD4.10**.
4. TGSIs TO BE PLACED PARALLEL WITH THE DIRECTION OF TRAVEL OF THE PEDESTRIAN CROSSING.
5. REFER TO DRAWING **RD2.2** FOR THE DROPPED KERB DETAILS (TYPE 'E' OR 'F').
6. ALTERNATIVE SURFACE TREATMENTS MAY BE APPLIED, SUBJECT TO APPROVAL AUTHORITY.

FRL: FINISHED ROAD LEVEL
DOT: DIRECTION OF TRAVEL

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

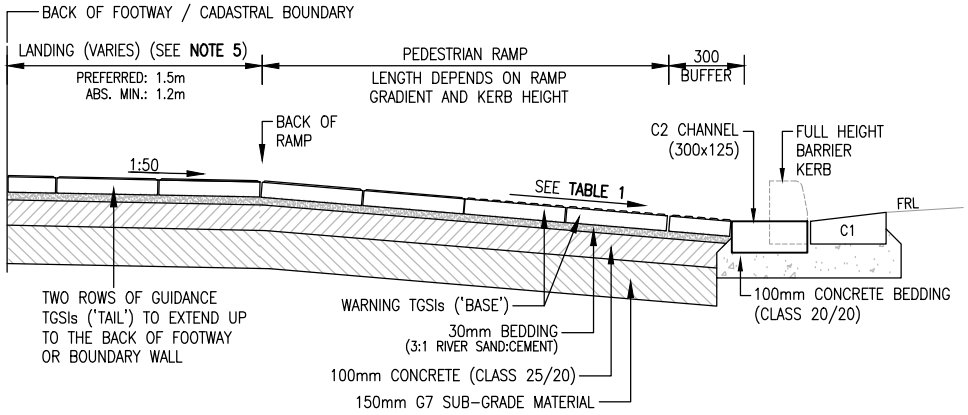
CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

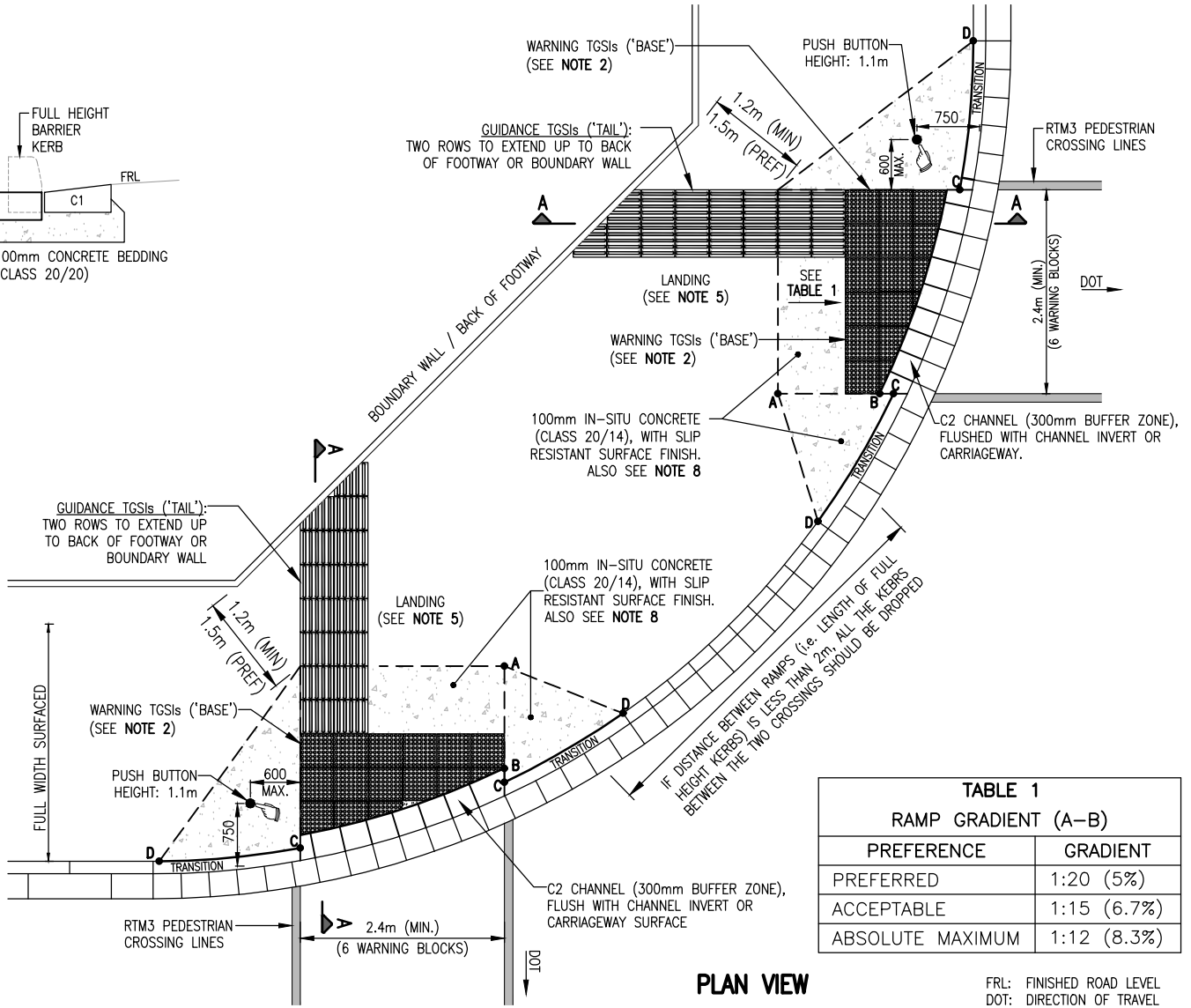
PEDESTRIAN RAMPS: CONTROLLED PEDESTRIAN CROSSINGS
SIGNALISED INTERSECTION
PEDESTRIAN CROSSINGS ON STRAIGHT EDGES (PREFERRED)

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RD4.11	B



SECTION A–A



PLAN VIEW

FRL: FINISHED ROAD LEVEL
DOT: DIRECTION OF TRAVEL

NOTES:

1. REFER TO SECTION **5.6** AND **5.7** FOR FURTHER DETAILS ON PEDESTRIAN RAMPS AND TGSIs.
2. MAXIMUM DISTORTION OF WARNING TGSIs (ALSO REFER TO SECTION **5.7.4**):
   - LONG SIDE: 3 BLOCKS
   - SHORT SIDE: 1 BLOCK
3. ONLY MECHANICAL CUTTING OF TGSIs ARE PERMITTED.
4. A MAXIMUM SLOPE OF 1:12 BETWEEN POINTS "C–D" (ALONG THE TRANSITIONS) IS PREFERRED. WHERE THE AFOREMENTIONED SLOPE IS NOT POSSIBLE, THE LENGTH OF THE TRANSITIONS SHALL NEVER BE LESS THAN 1m.
5. WHERE THERE IS INSUFFICIENT SPACE AVAILABLE ON THE VERGE TO PROVIDE A MINIMUM LANDING OF 1.2m, LONGITUDINAL RAMPS SHALL BE CONSTRUCTED. AS A FIRST ALTERNATIVE, DESIGNERS SHALL APPLY THE "COMBINATION DROP" AS PER DRAWING **RD4.9**. WHERE THIS OPTION IS NOT POSSIBLE, THE "FULL DROP" OPTION SHALL BE APPLIED AS PER DRAWING **RD4.10**.
6. TGSIs TO BE PLACED PARALLEL WITH THE DIRECTION OF TRAVEL OF THE PEDESTRIAN CROSSING.
7. REFER TO DRAWING **RD2.2** FOR THE DROPPED KERB DETAILS (TYPE 'E' OR 'F').
8. ALTERNATIVE SURFACE TREATMENTS MAY BE APPLIED, SUBJECT TO APPROVAL AUTHORITY.

TABLE 1
RAMP GRADIENT (A–B)

PREFERENCE	GRADIENT
PREFERRED	1:20 (5%)
ACCEPTABLE	1:15 (6.7%)
ABSOLUTE MAXIMUM	1:12 (8.3%)

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

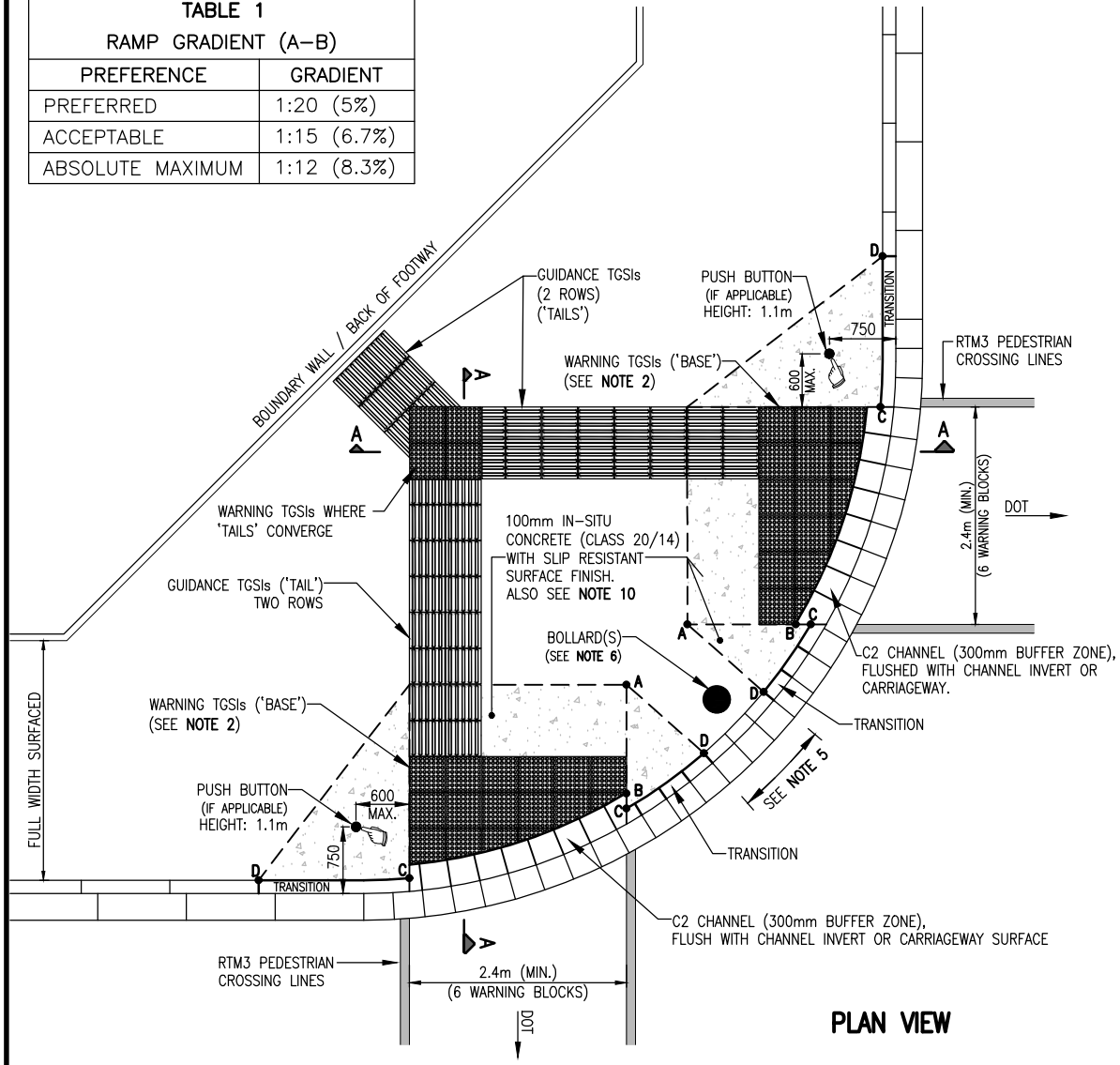
PEDESTRIAN RAMPS: CONTROLLED PEDESTRIAN CROSSINGS SIGNALISED INTERSECTION OBLIQUE RAMPS (ACCEPTABLE , BUT NOT PREFERRED)

STANDARDS AND GUIDELINES DETAILS

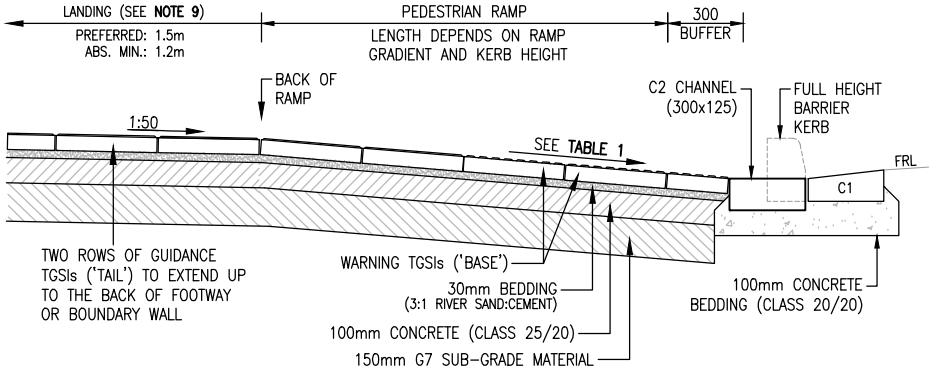
SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RD4.12	C

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TABLE 1 RAMP GRADIENT (A–B)	
PREFERENCE	GRADIENT
PREFERRED	1:20 (5%)
ACCEPTABLE	1:15 (6.7%)
ABSOLUTE MAXIMUM	1:12 (8.3%)



PLAN VIEW



PARTIAL SECTION A–A
N.T.S.

NOTES:

1. REFER TO SECTION **5.6** AND **5.7** FOR FURTHER DETAILS ON PEDESTRIAN RAMPS AND TGSIs.
2. MAXIMUM DISTORTION OF WARNING TGSIs (ALSO REFER TO SECTION **5.7.4**):
   - LONG SIDE: 3 BLOCKS
   - SHORT SIDE: 1 BLOCK
3. REFER TO DRAWING **RD2.2** FOR THE DROPPED KERB DETAILS (TYPE 'E' OR 'F').
4. TGSIs TO BE PLACED PARALLEL WITH THE DIRECTION OF TRAVEL OF THE PEDESTRIAN CROSSING.
5. IF THE DISTANCE BETWEEN RAMPS (i.e. LENGTH OF FULL HEIGHT KERBS) IS LESS THAN 1.5m, ALL THE KERBS BETWEEN THE TWO CROSSINGS SHOULD BE DROPPED.
6. IF THE KERBS BETWEEN THE CROSSINGS ARE DROPPED FLUSH WITH THE ROADWAY OR CHANNEL INVERT, THE INSTALLATION OF BOLLARDS SHOULD BE CONSIDERED, IN ORDER TO PROVIDE PROTECTION FOR PEDESTRIAN AND THE TRAFFIC SIGNAL INFRASTRUCTURE AND PREVENT VEHICLES MOUNTING THE VERGE ILLEGALLY. BOLLARD(S) SHALL BE PAINTED AS PER DRAWING **GE1**.
7. ONLY MECHANICAL CUTTING OF TGSIs ARE PERMITTED.
8. A MAXIMUM SLOPE OF 1:12 BETWEEN POINTS "C–D" (ALONG THE TRANSITIONS) IS PREFERRED. WHERE THE AFOREMENTIONED SLOPE IS NOT POSSIBLE, THE LENGTH OF THE TRANSITIONS SHALL NEVER BE LESS THAN 1m.
9. WHERE THERE IS INSUFFICIENT SPACE AVAILABLE ON THE VERGE TO PROVIDE A MINIMUM LANDING OF 1.2m, LONGITUDINAL RAMPS SHALL BE CONSTRUCTED. AS A FIRST ALTERNATIVE, DESIGNERS SHALL APPLY THE "COMBINATION DROP" AS PER DRAWING **RD4.9**. WHERE THIS OPTION IS NOT POSSIBLE, THE "FULL DROP" OPTION SHALL BE APPLIED AS PER DRAWING **RD4.10**.
10. ALTERNATIVE SURFACE TREATMENTS MAY BE APPLIED, SUBJECT TO APPROVAL

FRL: FINISHED ROAD LEVEL
DOT: DIRECTION OF TRAVEL

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

PEDESTRIAN RAMPS: CONTROLLED PEDESTRIAN CROSSINGS
SIGNALISED INTERSECTION
OBLIQUE RAMPS IN CLOSE PROXIMITY (NOT PREFERRED)

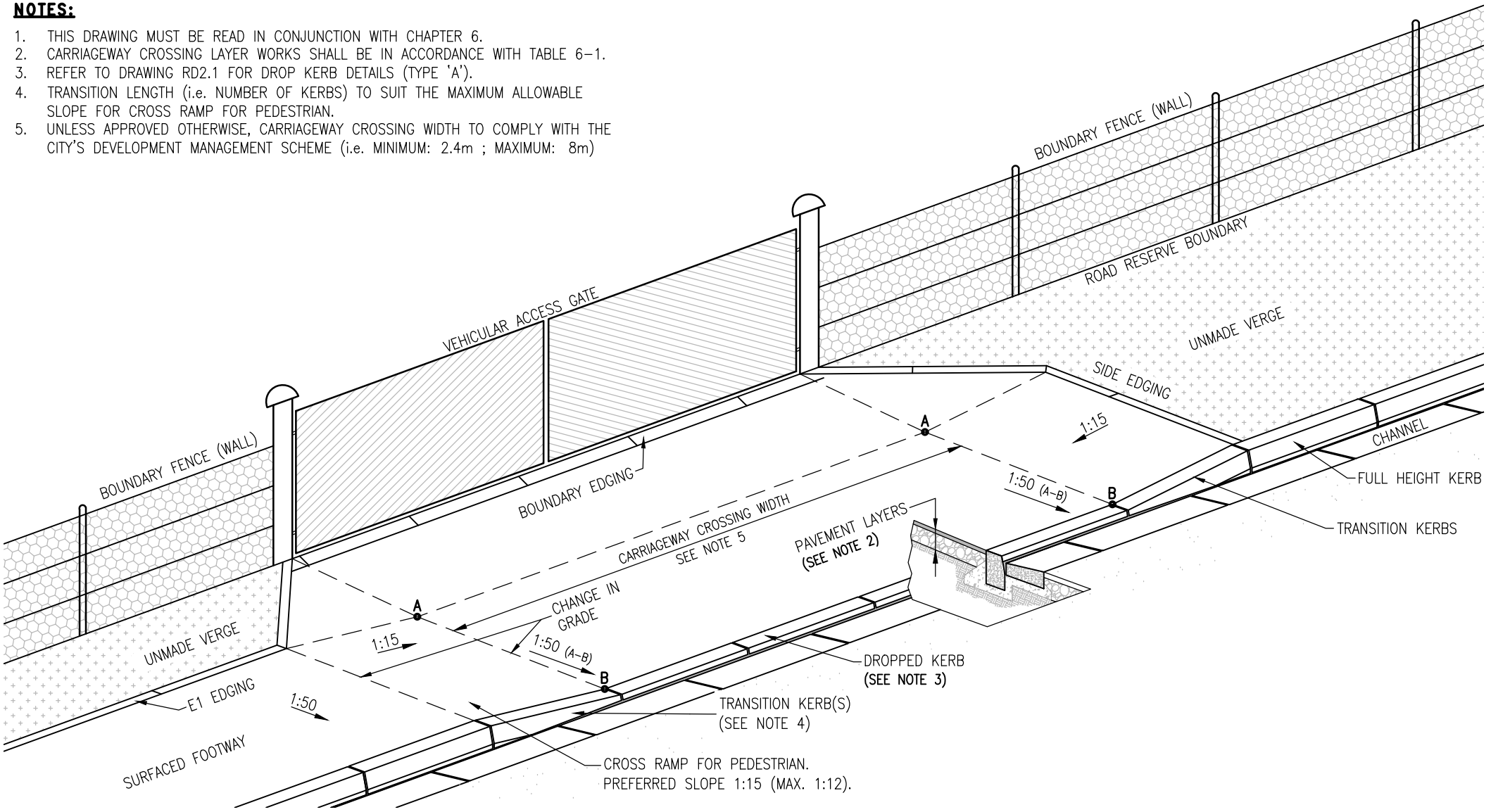
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RD4.13	C

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NOTES:

1. THIS DRAWING MUST BE READ IN CONJUNCTION WITH CHAPTER 6.
2. CARRIAGEWAY CROSSING LAYER WORKS SHALL BE IN ACCORDANCE WITH TABLE 6–1.
3. REFER TO DRAWING RD2.1 FOR DROP KERB DETAILS (TYPE 'A').
4. TRANSITION LENGTH (i.e. NUMBER OF KERBS) TO SUIT THE MAXIMUM ALLOWABLE SLOPE FOR CROSS RAMP FOR PEDESTRIAN.
5. UNLESS APPROVED OTHERWISE, CARRIAGEWAY CROSSING WIDTH TO COMPLY WITH THE CITY'S DEVELOPMENT MANAGEMENT SCHEME (i.e. MINIMUM: 2.4m ; MAXIMUM: 8m)



CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

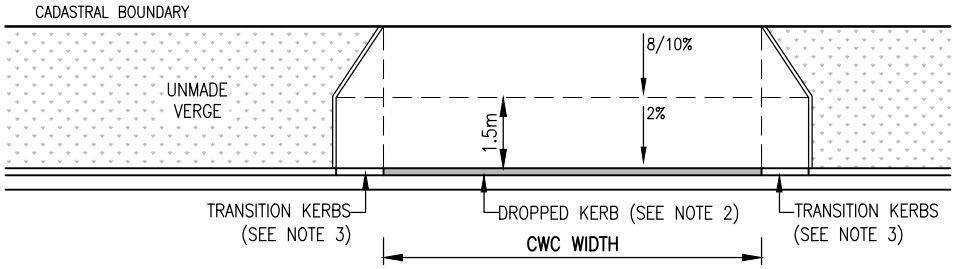
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TYPICAL CARRIAGEWAY CROSSING DETAILS (VEHICULAR ACCESS)

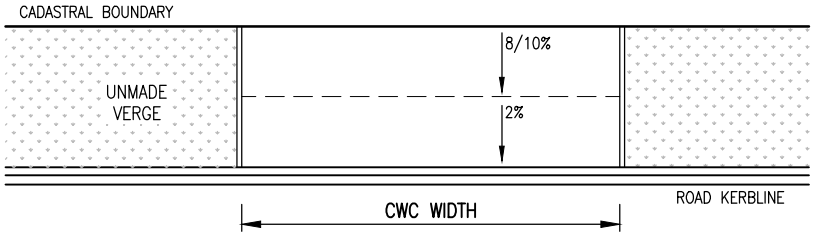
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RD5.1	B

P:\CAD\R&SD\ITI_01 Design\T_1000B Standards\T_1000RS DESIGN_Roads and Stormwater\0002 Drawings_Version4.0\01 RD\RD5.1 – Typical Carriageway Crossing Details_RevB.dwg

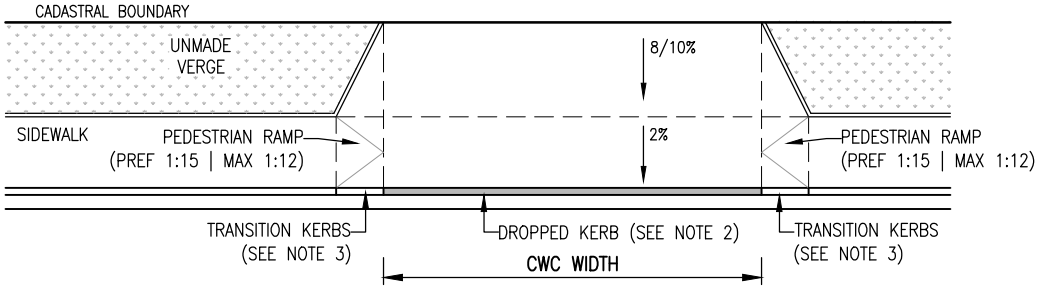


TYPE B1

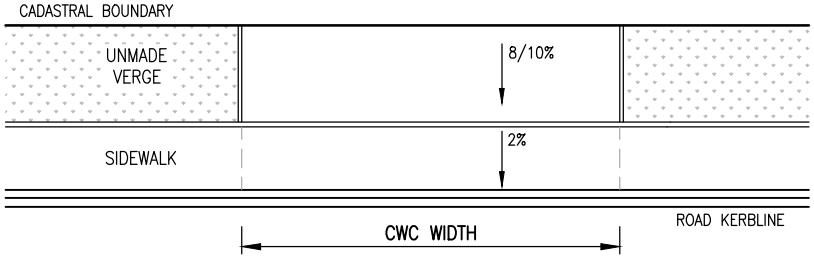


TYPE M1

UNMADE VERGE

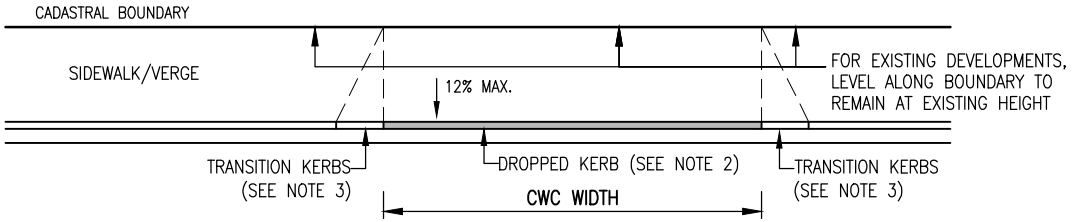


TYPE B2

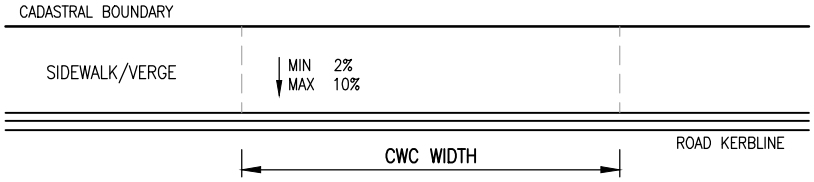


TYPE M2

WIDE VERGE WITH SURFACED SIDEWALK



TYPE B3



TYPE M3

NARROW VERGE AND FULL WIDTH SURFACED SIDEWALK

BARRIER KERBS

MOUNTABLE KERBS

TABLE 1 CWC Width	
Minimum	2.4m
Maximum	8m

CWC: CARRIAGEWAY CROSSING

NOTES:

1. THIS DRAWING MUST BE READ IN CONJUNCTION WITH CHAPTER 6 (SPECIFICALLY SECTION 6.3.4 W.R.T. GRADIENTS).
2. REFER TO DRAWING RD2.1 FOR DROPPED KERB DETAILS (TYPE 'A').
3. TRANSITION LENGTH (i.e. NUMBER OF KERBS) TO SUIT THE MAXIMUM ALLOWABLE SLOPE FOR THE PEDESTRIANS RAMP (PREF 1:15 ; MAX 1:12).
4. UNLESS APPROVED OTHERWISE, THE CARRIAGEWAY CROSSING WIDTH TO COMPLY WITH THE CITY'S DEVELOPMENT MANAGEMENT SCHEME (SEE TABLE 1).

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

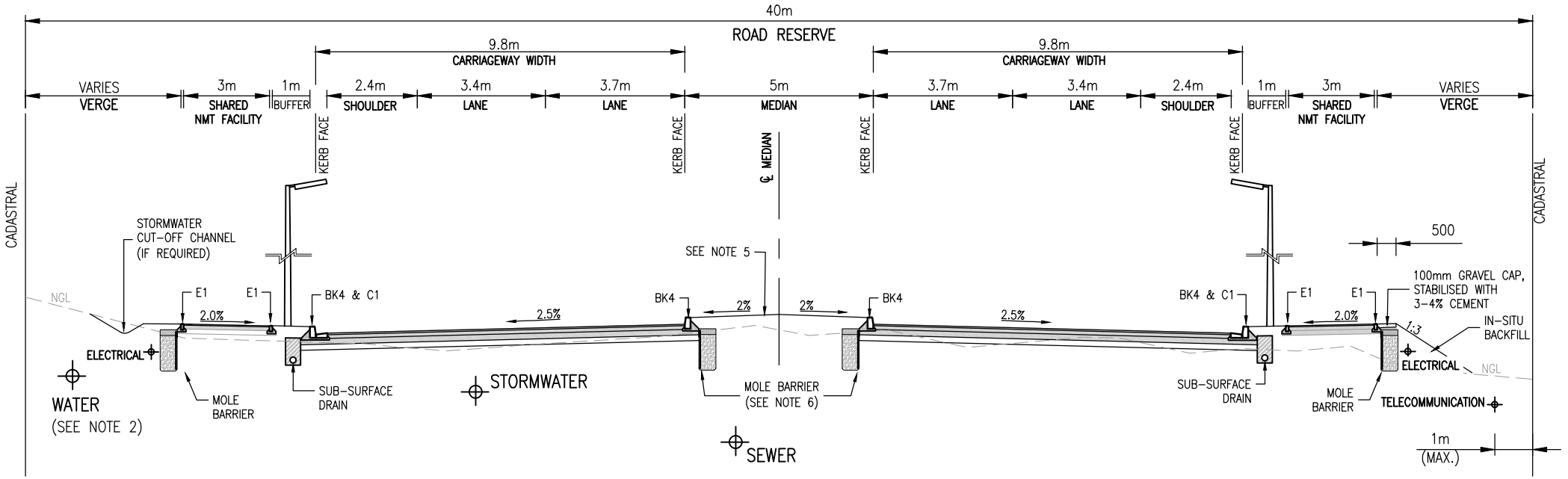
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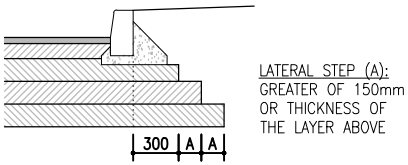
VARIOUS CARRIAGEWAY CROSSING TYPES

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RD5.2	B

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LAYER STEP DETAIL
(NO SUB–SURFACE DRAIN PRESENT)

NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. STREET LIGHT POLES (AND OTHER STREET FURNITURE) MUST BE PLACED TO ALWAYS LEAVE A MINIMUM 1.1m LATERAL CLEARANCE SPACE ON FOOTWAYS.
4. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
5. MEDIAN ISLAND TREATMENT AS PER APPROVAL AUTHORITY'S REQUIREMENTS.
6. IF THE MEDIAN IS SURFACED, THEN MOLE BARRIERS IN THE MEDIAN WILL NOT BE REQUIRED.
7. POSITION OF UNDERGROUND STORMWATER AND SEWER SERVICES TO BE DISCUSSED WITH APPROVAL AUTHORITY. NO MANHOLES ALLOWED IN VEHICLE WHEEL TRACKS.
8. NO OUTFALL CHANNELS ARE ALLOWED ON THE HIGH SIDE OF THE CARRIAGEWAY. IF CIRCUMSTANCES REQUIRE THE PROVISION OF A CHANNEL ON THE HIGH SIDE OF THE CARRIAGEWAY (e.g. DRAINAGE OR CONSTRUCTABILITY), IT SHALL BE INFALL CHANNELS. THE PROVISION OF THESE INFALL CHANNELS SHALL BE MOTIVATED AND DISCUSSED WITH THE APPROVAL AUTHORITY. IN SUCH INSTANCES, A STORMWATER SYSTEM SHALL BE PROVIDED TO ACCOMMODATED THE RUNOFF ON THE HIGH SIDE.
9. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.1**.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:
SHEET 1: SHOULDER AND SHARED NMT FACILITY
SHEET 2: CLASS 2 CYCLE LANE (NO SHOULDER)

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

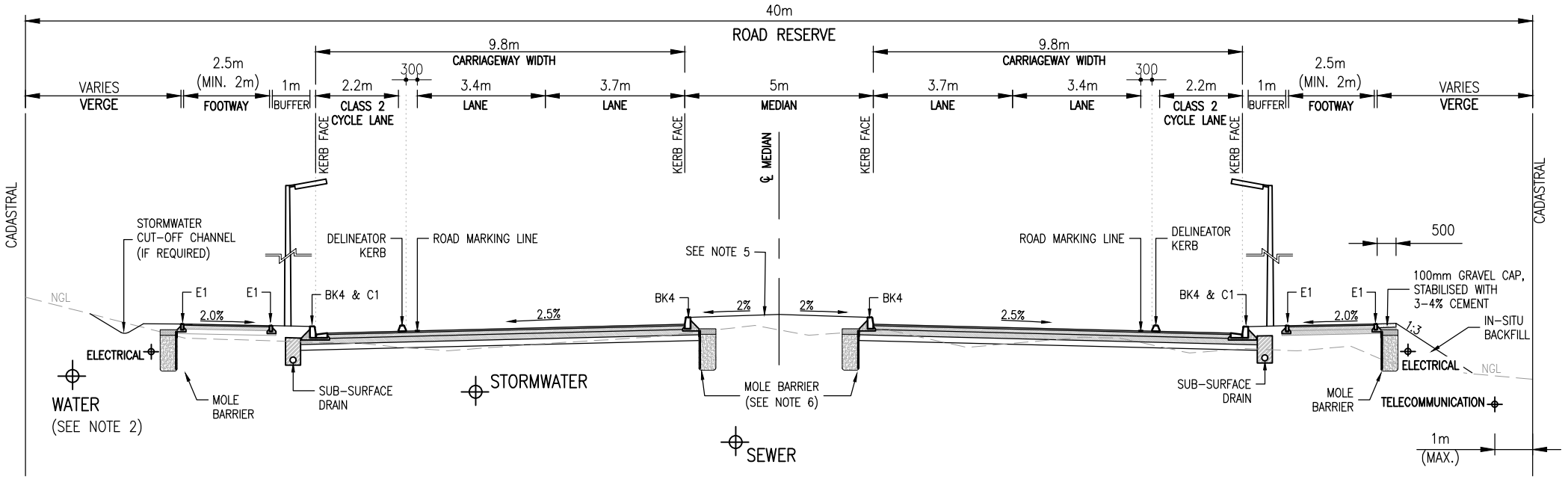
TYPICAL ROAD CROSS SECTION
CLASS 2 MAJOR ARTERIAL (40m ROAD RESERVE)
SHOULDER AND SHARED NMT FACILITY

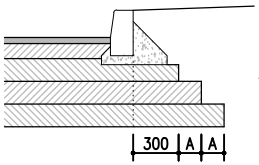
STANDARDS AND GUIDELINES DETAILS

SHEET 1

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RD6.1A	A

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LATERAL STEP (A):
GREATER OF 150mm
OR THICKNESS OF
THE LAYER ABOVE

LAYER STEP DETAIL
(NO SUB-SURFACE DRAIN PRESENT)

NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. STREET LIGHT POLES (AND OTHER STREET FURNITURE) MUST BE PLACED TO ALWAYS LEAVE A MINIMUM 1.1m LATERAL CLEARANCE SPACE ON FOOTWAYS.
4. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
5. MEDIAN ISLAND TREATMENT AS PER APPROVAL AUTHORITY'S REQUIREMENTS.
6. IF THE MEDIAN IS SURFACED, THEN MOLE BARRIERS IN THE MEDIAN WILL NOT BE REQUIRED.
7. POSITION OF UNDERGROUND STORMWATER AND SEWER SERVICES TO BE DISCUSSED WITH APPROVAL AUTHORITY. NO MANHOLES ALLOWED IN VEHICLE WHEEL TRACKS.
8. NO OUTFALL CHANNELS ARE ALLOWED ON THE HIGH SIDE OF THE CARRIAGEWAY. IF CIRCUMSTANCES REQUIRE THE PROVISION OF A CHANNEL ON THE HIGH SIDE OF THE CARRIAGEWAY (e.g. DRAINAGE OR CONSTRUCTABILITY), IT SHALL BE INFALL CHANNELS. THE PROVISION OF THESE INFALL CHANNELS SHALL BE MOTIVATED AND DISCUSSED WITH THE APPROVAL AUTHORITY. IN SUCH INSTANCES, A STORMWATER SYSTEM SHALL BE PROVIDED TO ACCOMMODATED THE RUNOFF ON THE HIGH SIDE.
9. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.1**.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:
SHEET 1: SHOULDER AND SHARED NMT FACILITY
SHEET 2: CLASS 2 CYCLE LANE (NO SHOULDER)

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

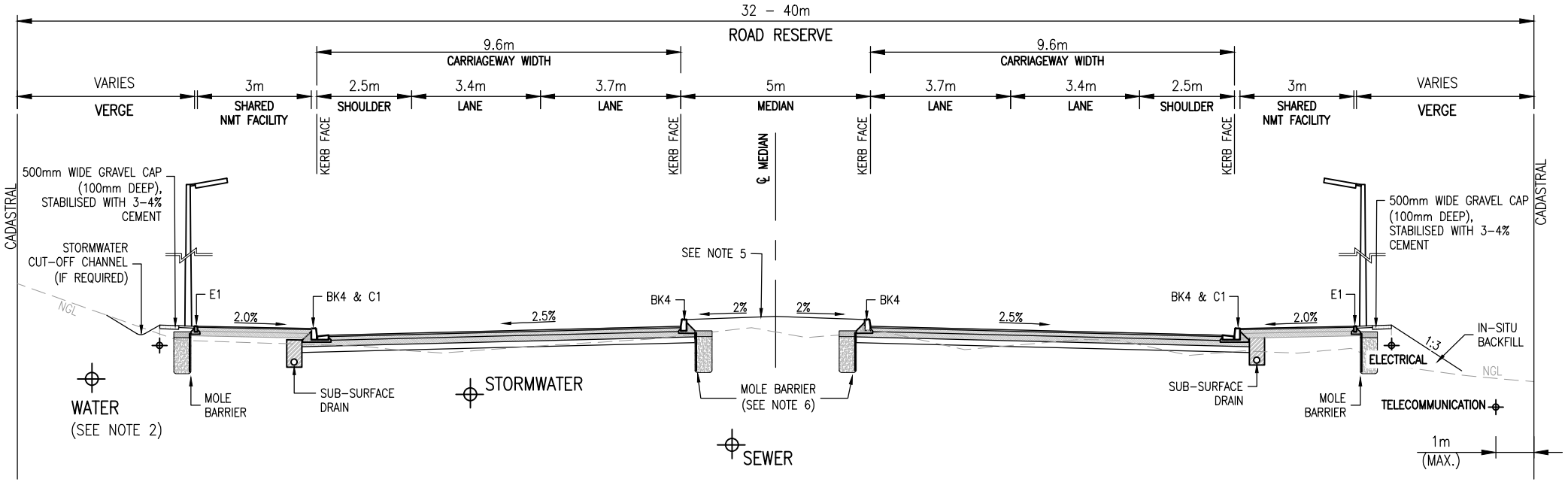
TYPICAL ROAD CROSS SECTION
CLASS 2 MAJOR ARTERIAL (40m ROAD RESERVE)
CLASS 2 CYCLE LANE (NO SHOULDER)

STANDARDS AND GUIDELINES DETAILS

SHEET 2

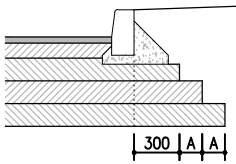
SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RD6.1B	A

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NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. STREET LIGHT POLES (AND OTHER STREET FURNITURE) MUST BE PLACED TO ALWAYS LEAVE A MINIMUM 1.1m LATERAL CLEARANCE SPACE ON FOOTWAYS.
4. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
5. MEDIAN ISLAND TREATMENT AS PER APPROVAL AUTHORITY'S REQUIREMENTS.
6. IF THE MEDIAN IS SURFACED, THEN MOLE BARRIERS IN THE MEDIAN WILL NOT BE REQUIRED.
7. POSITION OF UNDERGROUND STORMWATER AND SEWER SERVICES TO BE DISCUSSED WITH APPROVAL AUTHORITY. NO MANHOLES ALLOWED IN VEHICLE WHEEL TRACKS.
8. NO OUTFALL CHANNELS ARE ALLOWED ON THE HIGH SIDE OF THE CARRIAGEWAY. IF CIRCUMSTANCES REQUIRE THE PROVISION OF A CHANNEL ON THE HIGH SIDE OF THE CARRIAGEWAY (e.g. DRAINAGE OR CONSTRUCTABILITY), IT SHALL BE INFALL CHANNELS. THE PROVISION OF THESE INFALL CHANNELS SHALL BE MOTIVATED AND DISCUSSED WITH THE APPROVAL AUTHORITY. IN SUCH INSTANCES, A STORMWATER SYSTEM SHALL BE PROVIDED TO ACCOMMODATED THE RUNOFF ON THE HIGH SIDE.
9. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.2**.



LATERAL STEP (A):
GREATER OF 150mm OR THICKNESS OF THE LAYER ABOVE

LAYER STEP DETAIL
(NO SUB–SURFACE DRAIN PRESENT)

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:

SHEET 1: SHOULDER ONLY (NO ON–STREET PARKING
SHEET 2: ON–STREET PARKING WITH CLASS 2 CYCLE FACILITY
SHEET 3: CLASS 2/3 CYCLE FACILITY (NO SHOULDER OR ON–STREET PARKING)

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

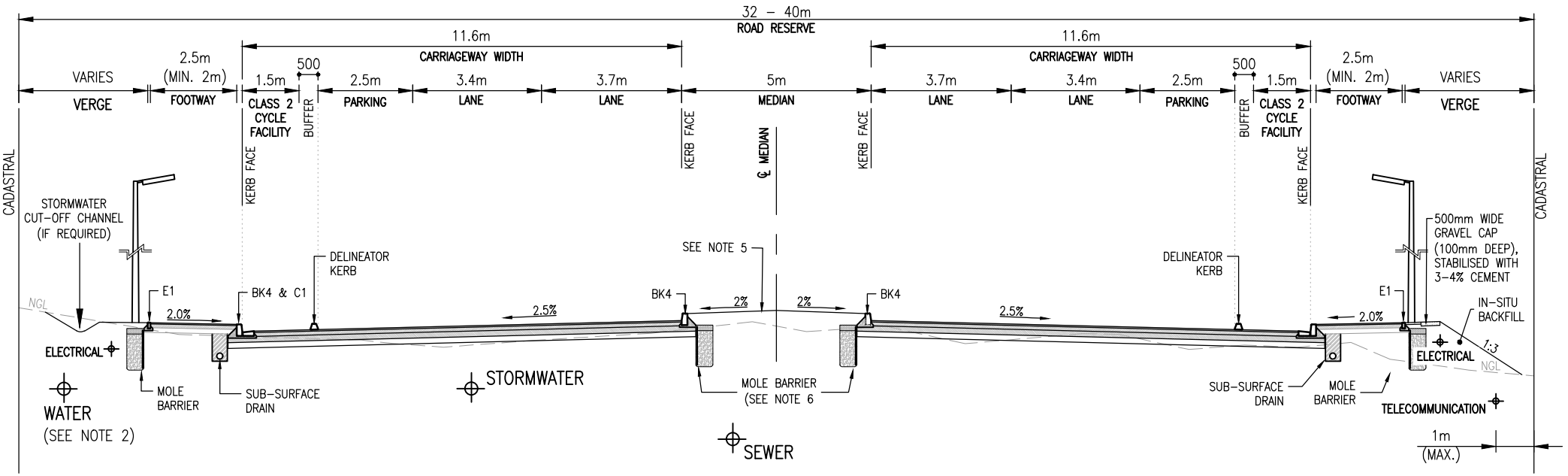
TYPICAL ROAD CROSS SECTION
CLASS 3 MINOR ARTERIAL (40m ROAD RESERVE)
SHOULDER ONLY (NO ON-STREET PARKING)

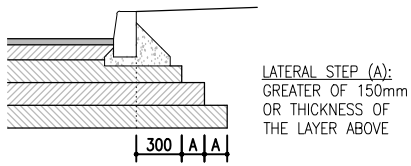
STANDARDS AND GUIDELINES DETAILS

SHEET 1

SCALE	PAPER
1:150	A4
DRAWING No.	REV
RD6.2A	D

P:\CAD\R&SD\ITI_01 Design\T_1000B Standards\T_1000RS DESIGN_Roads and Stormwater\0002 Drawings_Version4.0\01 RD\RD6.2A – Typical Section Class 3 Road (32–40m RR)_RevD.dwg





LAYER STEP DETAIL
(NO SUB–SURFACE DRAIN PRESENT)

NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. STREET LIGHT POLES (AND OTHER STREET FURNITURE) MUST BE PLACED TO ALWAYS LEAVE A MINIMUM 1.1m LATERAL CLEARANCE SPACE ON FOOTWAYS.
4. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
5. MEDIAN ISLAND TREATMENT AS PER APPROVAL AUTHORITY'S REQUIREMENTS.
6. IF THE MEDIAN IS SURFACED, THEN MOLE BARRIERS IN THE MEDIAN WILL NOT BE REQUIRED.
7. POSITION OF UNDERGROUND STORMWATER AND SEWER SERVICES TO BE DISCUSSED WITH APPROVAL AUTHORITY. NO MANHOLES ALLOWED IN VEHICLE WHEEL TRACKS.
8. NO OUTFALL CHANNELS ARE ALLOWED ON THE HIGH SIDE OF THE CARRIAGEWAY. IF CIRCUMSTANCES REQUIRE THE PROVISION OF A CHANNEL ON THE HIGH SIDE OF THE CARRIAGEWAY (e.g. DRAINAGE OR CONSTRUCTABILITY), IT SHALL BE INFALL CHANNELS. THE PROVISION OF THESE INFALL CHANNELS SHALL BE MOTIVATED AND DISCUSSED WITH THE APPROVAL AUTHORITY. IN SUCH INSTANCES, A STORMWATER SYSTEM SHALL BE PROVIDED TO ACCOMMODATED THE RUNOFF ON THE HIGH SIDE.
9. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.2.**

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:

SHEET 1: SHOULDER ONLY (NO ON–STREET PARKING
SHEET 2: ON–STREET PARKING WITH CLASS 2 CYCLE FACILITY
SHEET 3: CLASS 2/3 CYCLE FACILITY (NO SHOULDER OR ON–STREET PARKING)

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

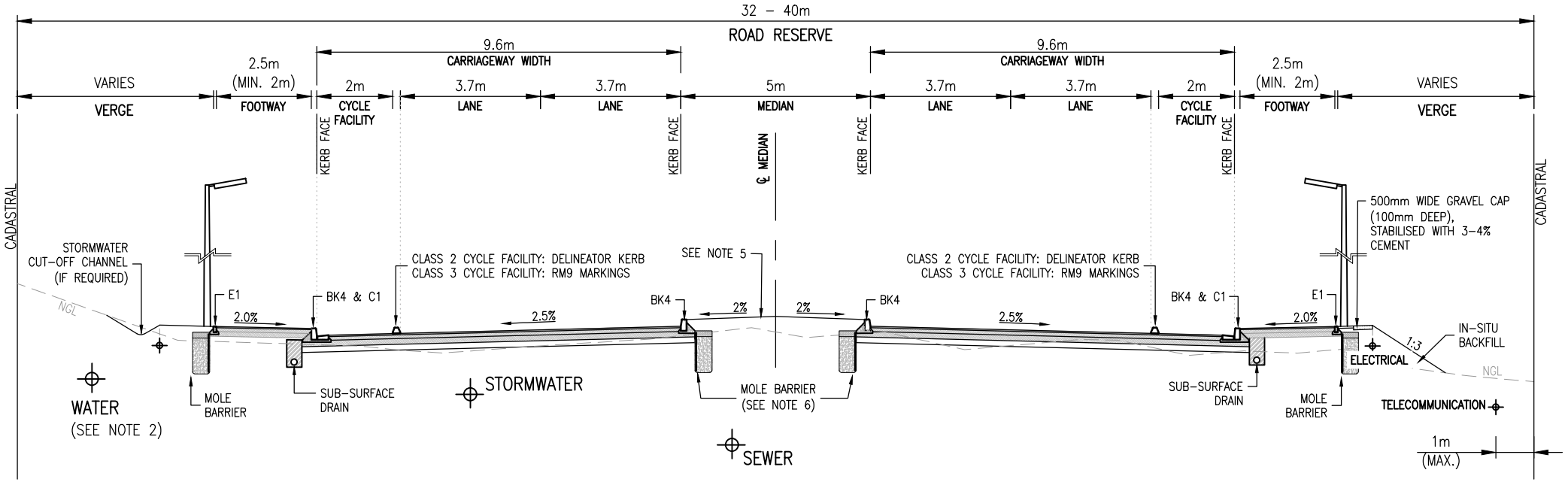
TYPICAL ROAD CROSS SECTION
CLASS 3 MINOR ARTERIAL (40m ROAD RESERVE)
ON-STREET PARKING WITH CLASS 2 CYCLE FACILITY

STANDARDS AND GUIDELINES DETAILS

SHEET 2

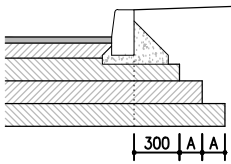
SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RD6.2B	D

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NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. STREET LIGHT POLES (AND OTHER STREET FURNITURE) MUST BE PLACED TO ALWAYS LEAVE A MINIMUM 1.1m LATERAL CLEARANCE SPACE ON FOOTWAYS.
4. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
5. MEDIAN ISLAND TREATMENT AS PER APPROVAL AUTHORITY'S REQUIREMENTS.
6. IF THE MEDIAN IS SURFACED, THEN MOLE BARRIERS IN THE MEDIAN WILL NOT BE REQUIRED.
7. POSITION OF UNDERGROUND STORMWATER AND SEWER SERVICES TO BE DISCUSSED WITH APPROVAL AUTHORITY. NO MANHOLES ALLOWED IN VEHICLE WHEEL TRACKS.
8. NO OUTFALL CHANNELS ARE ALLOWED ON THE HIGH SIDE OF THE CARRIAGEWAY. IF CIRCUMSTANCES REQUIRE THE PROVISION OF A CHANNEL ON THE HIGH SIDE OF THE CARRIAGEWAY (e.g. DRAINAGE OR CONSTRUCTABILITY), IT SHALL BE INFALL CHANNELS. THE PROVISION OF THESE INFALL CHANNELS SHALL BE MOTIVATED AND DISCUSSED WITH THE APPROVAL AUTHORITY. IN SUCH INSTANCES, A STORMWATER SYSTEM SHALL BE PROVIDED TO ACCOMMODATED THE RUNOFF ON THE HIGH SIDE.
9. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.2**.



LATERAL STEP (A):
GREATER OF 150mm OR THICKNESS OF THE LAYER ABOVE

LAYER STEP DETAIL
(NO SUB–SURFACE DRAIN PRESENT)

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:

SHEET 1: SHOULDER ONLY (NO ON–STREET PARKING
SHEET 2: ON–STREET PARKING WITH CLASS 2 CYCLE FACILITY
SHEET 3: CLASS 2/3 CYCLE FACILITY (NO SHOULDER OR ON–STREET PARKING)

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

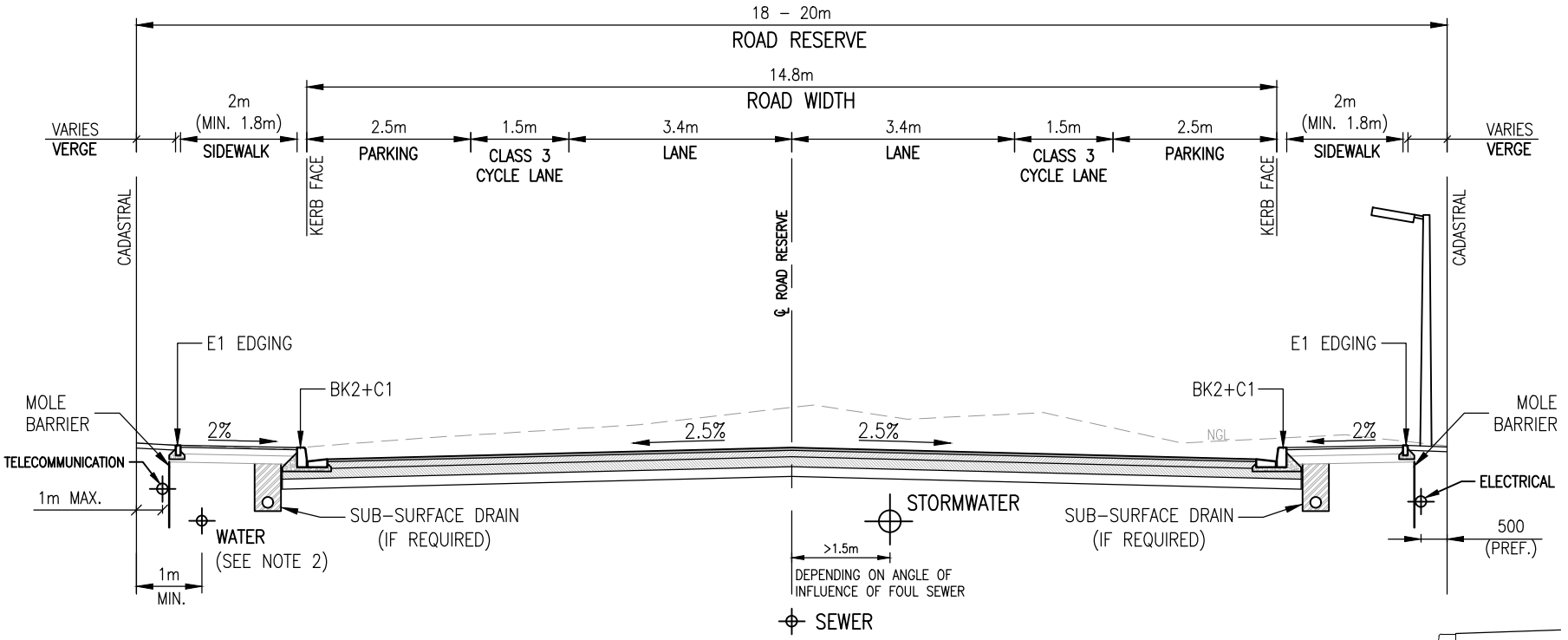
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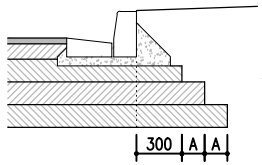
TYPICAL ROAD CROSS SECTION
CLASS 3 MINOR ARTERIAL (40m ROAD RESERVE)
CLASS 2/3 CYCLE FACILITY (NO SHOULDER OR ON–STREET PARKING)

STANDARDS AND GUIDELINES DETAILS

SHEET 3

SCALE	PAPER
1:150	A4
DRAWING No.	REV
RD6.2C	A





LATERAL STEP (A):
GREATER OF 150mm
OR THICKNESS OF
THE LAYER ABOVE

LAYER STEP DETAIL
(NO SUB–SURFACE DRAIN PRESENT)

NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. STREET LIGHT POLES (AND OTHER STREET FURNITURE) MUST BE PLACED TO ALWAYS LEAVE A MINIMUM 1.1m LATERAL CLEARANCE SPACE ON FOOTWAYS.
4. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
5. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.3.**

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:

SHEET 1: CLASS 3 CYCLE FACILITY WITH ON–STREET PARKING (PARKING SLOPES AWAY FROM ROAD)
SHEET 2: CLASS 3 CYCLE FACILITY WITH ON–STREET PARKING (PARKING SLOPES TOWARDS ROAD)
SHEET 3: CLASS 3 CYCLE FACILITY (NO ON–STREET PARKING)
SHEET 4: NO CYCLE FACILITY OR ON–STREET PARKING
SHEET 5: CLASS 2 CYCLE FACILITY WITH ON–STREET PARKING

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

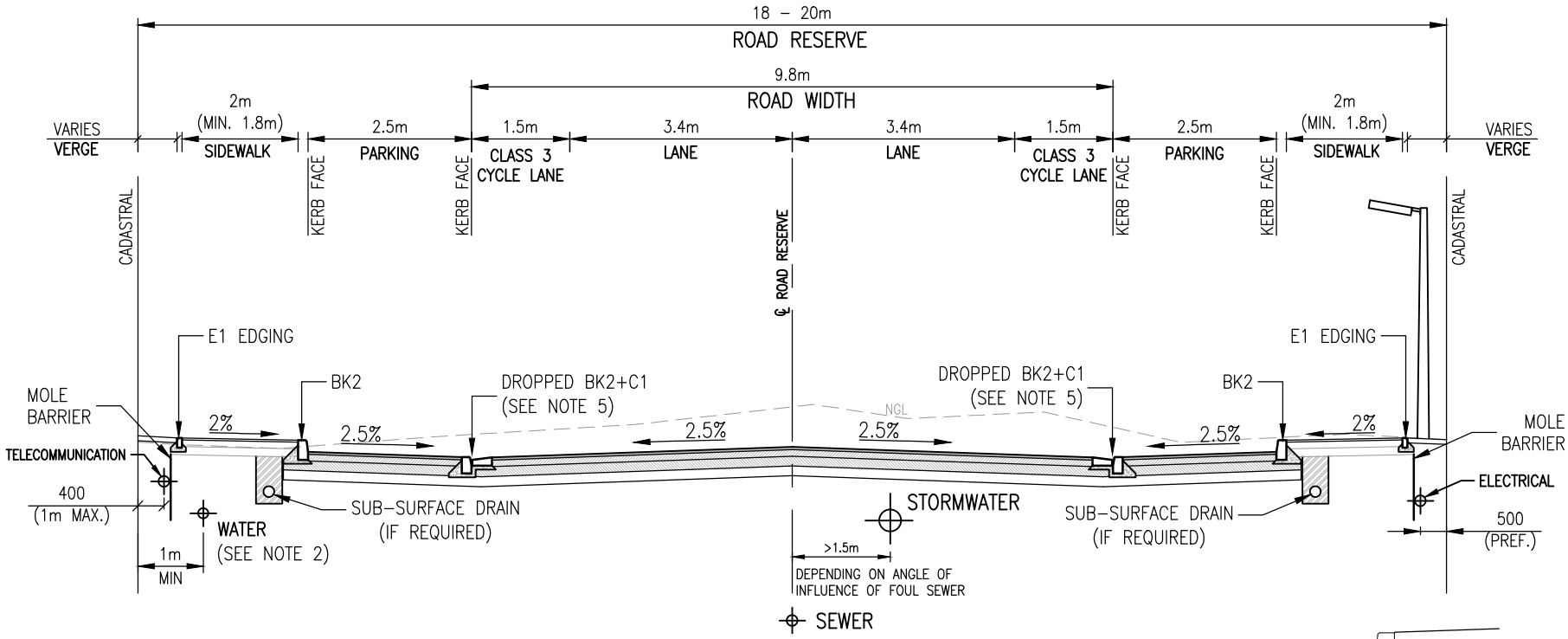
TYPICAL ROAD CROSS SECTION
CLASS 4 COLLECTOR (20m/18m ROAD RESERVE)
CLASS 3 CYCLE LANE WITH ON-STREET PARKING

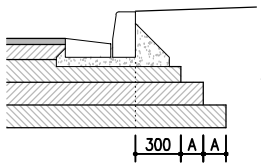
STANDARDS AND GUIDELINES DETAILS

SHEET 1

SCALE	PAPER
1:100	A4
DRAWING No.	REV
RD6.3A	D

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LATERAL STEP (A):
GREATER OF 150mm
OR THICKNESS OF
THE LAYER ABOVE

LAYER STEP DETAIL
(NO SUB-SURFACE DRAIN PRESENT)

NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. STREET LIGHT POLES (AND OTHER STREET FURNITURE) MUST BE PLACED TO ALWAYS LEAVE A MINIMUM 1.1m LATERAL CLEARANCE SPACE ON FOOTWAYS.
4. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
5. REFER TO DRAWING RD2.1 FOR DETAILS ON THE DROPPED KERB AND CHANNEL (TYPE 'A').
6. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.3.**

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:

SHEET 1: CLASS 3 CYCLE FACILITY WITH ON-STREET PARKING (PARKING SLOPES AWAY FROM ROAD)
SHEET 2: CLASS 3 CYCLE FACILITY WITH ON-STREET PARKING (PARKING SLOPES TOWARDS ROAD)
SHEET 3: CLASS 3 CYCLE FACILITY (NO ON-STREET PARKING)
SHEET 4: NO CYCLE FACILITY OR ON-STREET PARKING
SHEET 5: CLASS 2 CYCLE FACILITY WITH ON-STREET PARKING

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

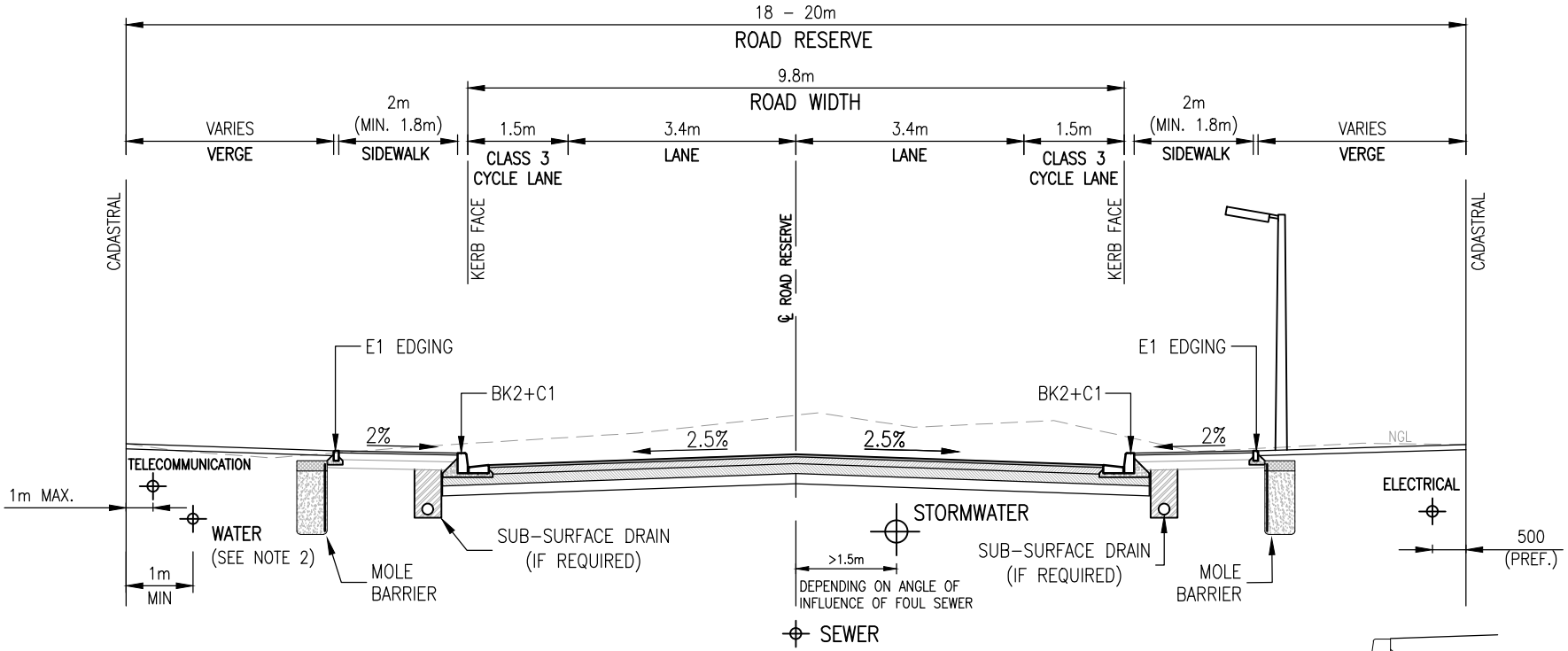
TYPICAL ROAD CROSS SECTION
CLASS 4 COLLECTOR (20/18m ROAD RESERVE)
CLASS 3 CYCLE LANE WITH ON-STREET PARKING

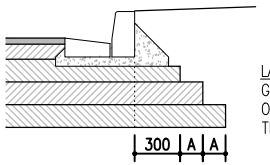
STANDARDS AND GUIDELINES DETAILS

SHEET 2

SCALE	PAPER
1:100	A4
DRAWING No.	REV
RD6.3B	D

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LATERAL STEP (A):
GREATER OF 150mm
OR THICKNESS OF
THE LAYER ABOVE

LAYER STEP DETAIL
(NO SUB–SURFACE DRAIN PRESENT)

NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. STREET LIGHT POLES (AND OTHER STREET FURNITURE) MUST BE PLACED TO ALWAYS LEAVE A MINIMUM 1.1m LATERAL CLEARANCE SPACE ON FOOTWAYS.
4. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
5. DRAWING TO BE READ IN CONJUNCTION WITH SECTION 3.2.2.3.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:

SHEET 1: CLASS 3 CYCLE FACILITY WITH ON–STREET PARKING (PARKING SLOPES AWAY FROM ROAD)
SHEET 2: CLASS 3 CYCLE FACILITY WITH ON–STREET PARKING (PARKING SLOPES TOWARDS ROAD)
SHEET 3: CLASS 3 CYCLE FACILITY (NO ON–STREET PARKING)
SHEET 4: NO CYCLE FACILITY OR ON–STREET PARKING
SHEET 5: CLASS 2 CYCLE FACILITY WITH ON–STREET PARKING

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

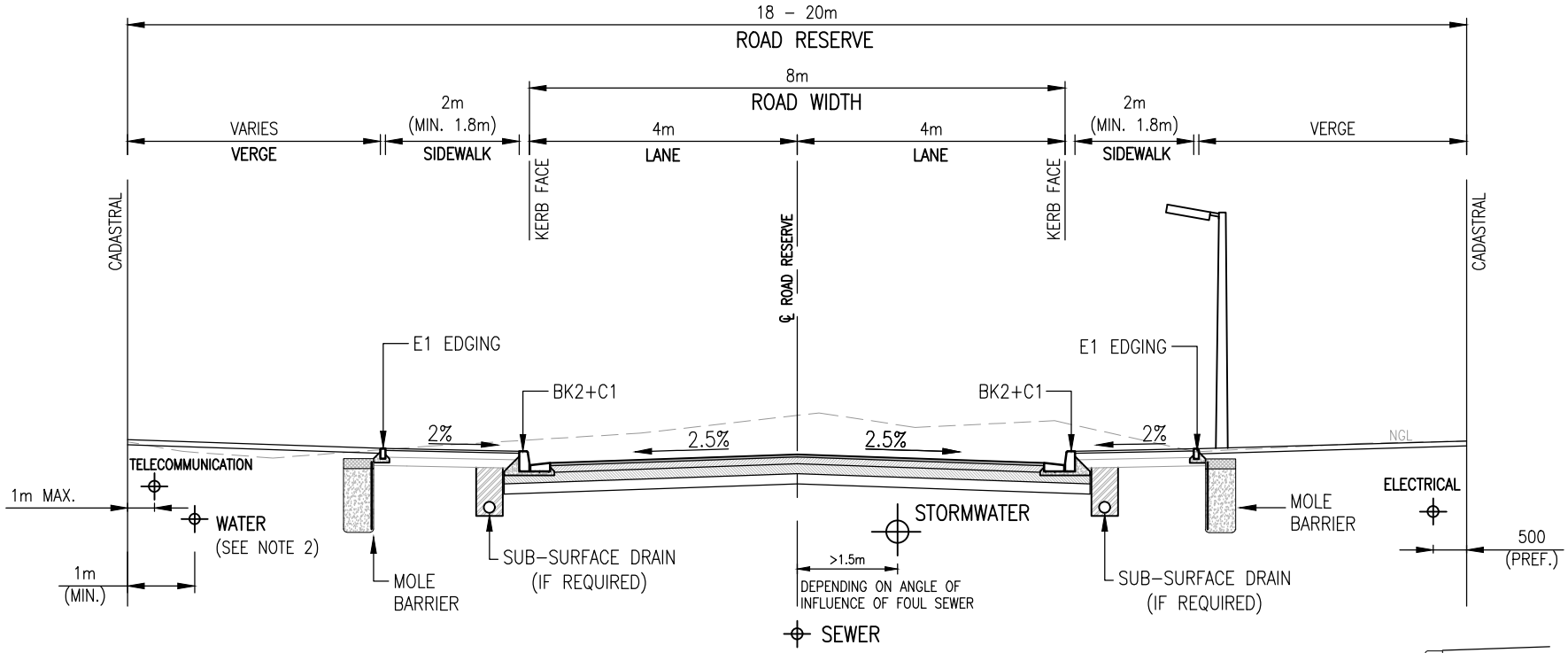
TYPICAL ROAD CROSS SECTION
CLASS 4 COLLECTOR (20/18m ROAD RESERVE)
CLASS 3 CYCLE LANE WITHOUT ON-STREET PARKING

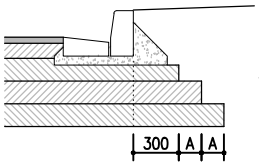
STANDARDS AND GUIDELINES DETAILS

SHEET 3

SCALE	PAPER
1:100	A4
DRAWING No.	REV
RD6.3C	D

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LATERAL STEP (A):
GREATER OF 150mm
OR THICKNESS OF
THE LAYER ABOVE

LAYER STEP DETAIL
(NO SUB–SURFACE DRAIN PRESENT)

NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. STREET LIGHT POLES (AND OTHER STREET FURNITURE) MUST BE PLACED TO ALWAYS LEAVE A MINIMUM 1.1m LATERAL CLEARANCE SPACE ON FOOTWAYS.
4. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
5. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.3.**

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:

SHEET 1: CLASS 3 CYCLE FACILITY WITH ON–STREET PARKING (PARKING SLOPES AWAY FROM ROAD)
SHEET 2: CLASS 3 CYCLE FACILITY WITH ON–STREET PARKING (PARKING SLOPES TOWARDS ROAD)
SHEET 3: CLASS 3 CYCLE FACILITY (NO ON–STREET PARKING)
SHEET 4: NO CYCLE FACILITY OR ON–STREET PARKING
SHEET 5: CLASS 2 CYCLE FACILITY WITH ON–STREET PARKING

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

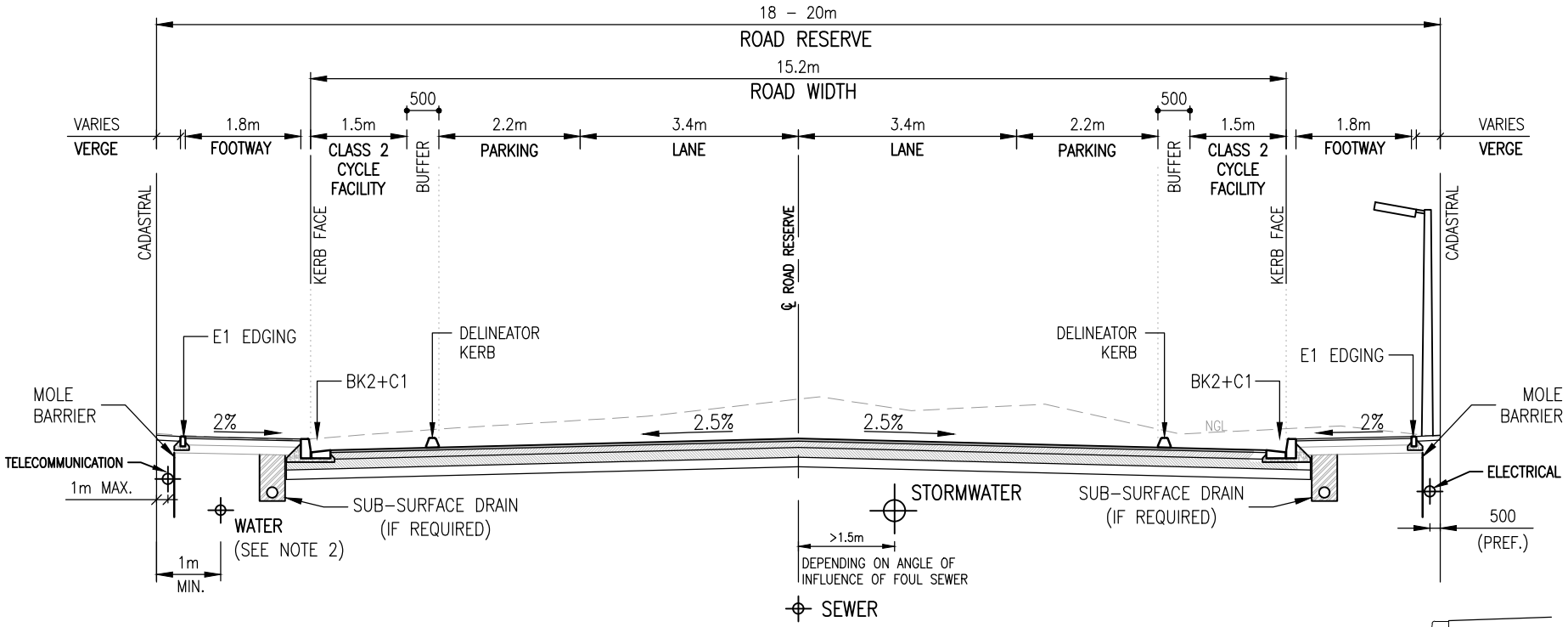
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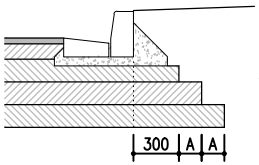
TYPICAL ROAD CROSS SECTION
CLASS 4 COLLECTOR (20/18m ROAD RESERVE)
NO CYCLE FACILITY OR ON-STREET PARKING

STANDARDS AND GUIDELINES DETAILS

SHEET 4

SCALE	PAPER
1:100	A4
DRAWING No.	REV
RD6.3D	D





LATERAL STEP (A):
GREATER OF 150mm
OR THICKNESS OF
THE LAYER ABOVE

LAYER STEP DETAIL
(NO SUB–SURFACE DRAIN PRESENT)

NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. STREET LIGHT POLES (AND OTHER STREET FURNITURE) MUST BE PLACED TO ALWAYS LEAVE A MINIMUM 1.1m LATERAL CLEARANCE SPACE ON FOOTWAYS.
4. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
5. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.3.**

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:

SHEET 1: CLASS 3 CYCLE FACILITY WITH ON–STREET PARKING (PARKING SLOPES AWAY FROM ROAD)
SHEET 2: CLASS 3 CYCLE FACILITY WITH ON–STREET PARKING (PARKING SLOPES TOWARDS ROAD)
SHEET 3: CLASS 3 CYCLE FACILITY (NO ON–STREET PARKING)
SHEET 4: NO CYCLE FACILITY OR ON–STREET PARKING
SHEET 5: CLASS 2 CYCLE FACILITY WITH ON–STREET PARKING

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

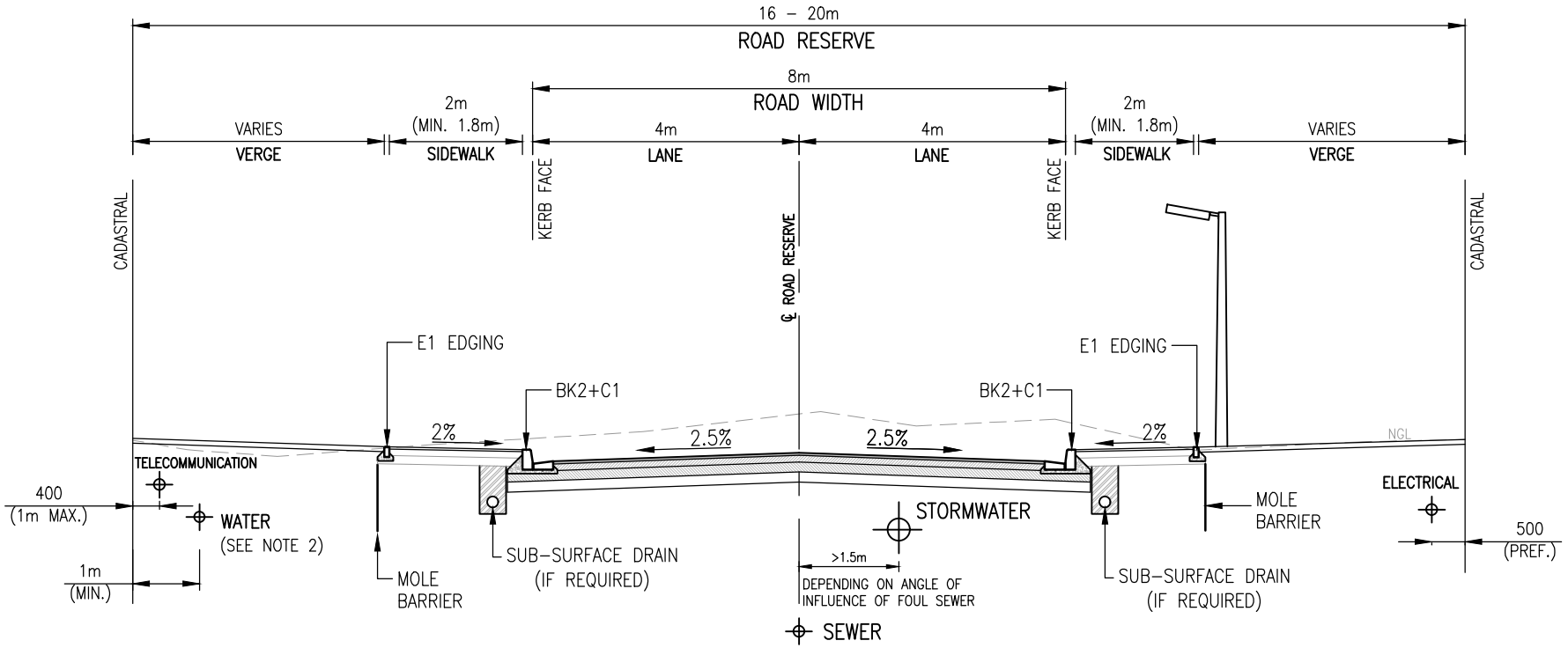
TYPICAL ROAD CROSS SECTION
CLASS 4 COLLECTOR (20m/18m ROAD RESERVE)
CLASS 2 CYCLE FACILITY WITH ON-STREET PARKING

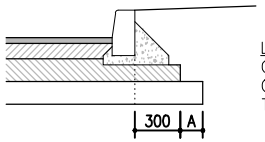
STANDARDS AND GUIDELINES DETAILS

SHEET 5

SCALE	PAPER
1:100	A4
DRAWING No.	REV
RD6.3E	A

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LATERAL STEP (A):
GREATER OF 150mm
OR THICKNESS OF
THE LAYER ABOVE

LAYER STEP DETAIL
(NO SUB–SURFACE DRAIN PRESENT)

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. STREET LIGHT POLES (AND OTHER STREET FURNITURE) MUST BE PLACED TO ALWAYS LEAVE A MINIMUM 1.1m LATERAL CLEARANCE SPACE ON FOOTWAYS.
4. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
5. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.4**.

SHEET INDEX:

SHEET 1: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, ONE–LANE SINGLE CARRIAGEWAY
SHEET 2: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, TWO–LANE SINGLE CARRIAGEWAY
SHEET 3: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, TWO–LANE DUAL CARRIAGEWAY
SHEET 4: CLASS 5B LOCAL RESIDENTIAL ROAD, 12m ROAD RESERVE (CAMBERED) (PREFERRED)
SHEET 5: CLASS 5B LOCAL RESIDENTIAL ROAD, 12m ROAD RESERVE (CROSSFALL) (NOT PREFERRED)
SHEET 6: CLASS 5C LOCAL RESIDENTIAL ROAD, 10m ROAD RESERVE
SHEET 7: CLASS 5D LOCAL RESIDENTIAL ROAD, 8m ROAD RESERVE

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

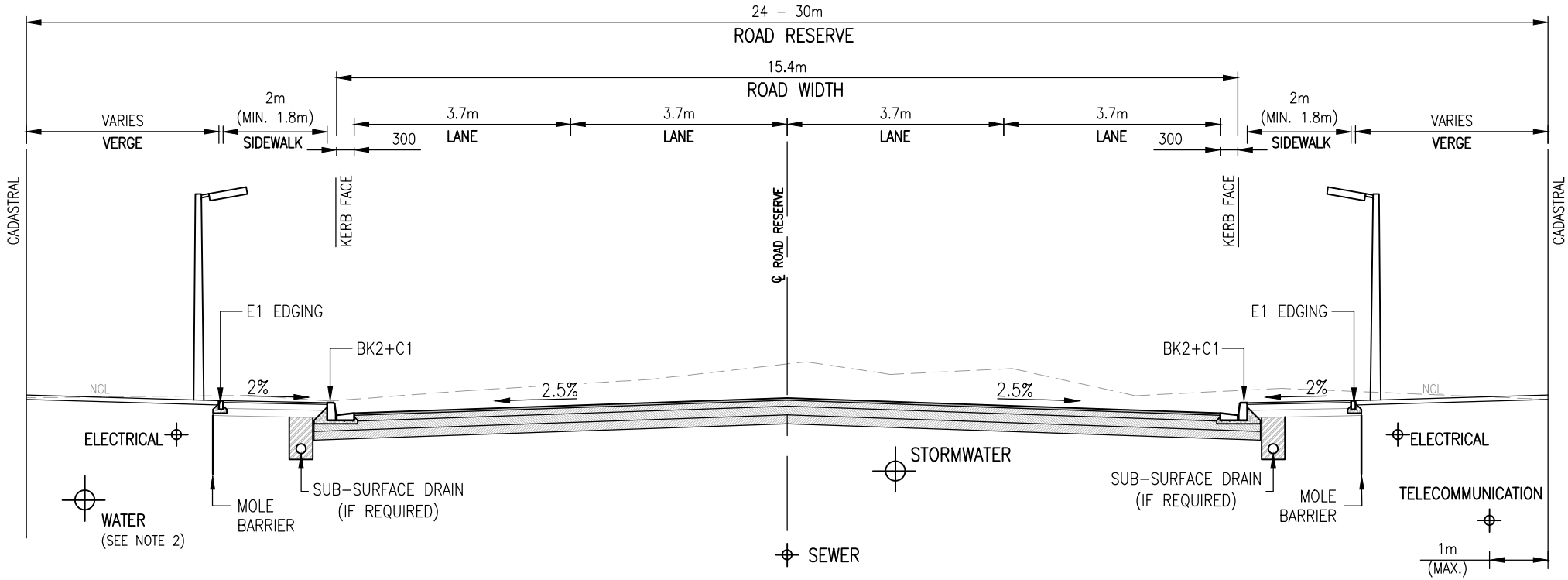
TYPICAL ROAD CROSS SECTION
CLASS 5A COMMERCIAL AND INDUSTRIAL ROAD
ONE-LANE SINGLE CARRIAGEWAY (16-20m ROAD RESERVE)

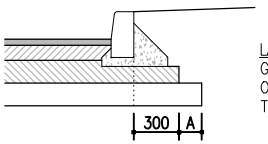
STANDARDS AND GUIDELINES DETAILS

SHEET 1

SCALE	PAPER
1:100	A4
DRAWING No.	REV
RD6.4A	D

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LATERAL STEP (A):
GREATER OF 150mm
OR THICKNESS OF
THE LAYER ABOVE

LAYER STEP DETAIL
(NO SUB–SURFACE DRAIN PRESENT)

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. STREET LIGHT POLES (AND OTHER STREET FURNITURE) MUST BE PLACED TO ALWAYS LEAVE A MINIMUM 1.1m LATERAL CLEARANCE SPACE ON FOOTWAYS.
4. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
5. POSITION OF UNDERGROUND STORMWATER AND SEWER SERVICES TO BE DISCUSSED WITH APPROVAL AUTHORITY. NO MANHOLES ALLOWED IN VEHICLE WHEEL TRACKS.
6. TYPICAL LANE WIDTHS ARE GIVEN. FINAL LANE WIDTHS TO BE AGREED WITH APPROVAL AUTHORITY.
7. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.4**.

SHEET INDEX:

SHEET 1: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, ONE–LANE SINGLE CARRIAGEWAY
SHEET 2: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, TWO–LANE SINGLE CARRIAGEWAY
SHEET 3: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, TWO–LANE DUAL CARRIAGEWAY
SHEET 4: CLASS 5B LOCAL RESIDENTIAL ROAD, 12m ROAD RESERVE (CAMBERED) (PREFERRED)
SHEET 5: CLASS 5B LOCAL RESIDENTIAL ROAD, 12m ROAD RESERVE (CROSSFALL) (NOT PREFERRED)
SHEET 6: CLASS 5C LOCAL RESIDENTIAL ROAD, 10m ROAD RESERVE
SHEET 7: CLASS 5D LOCAL RESIDENTIAL ROAD, 8m ROAD RESERVE

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

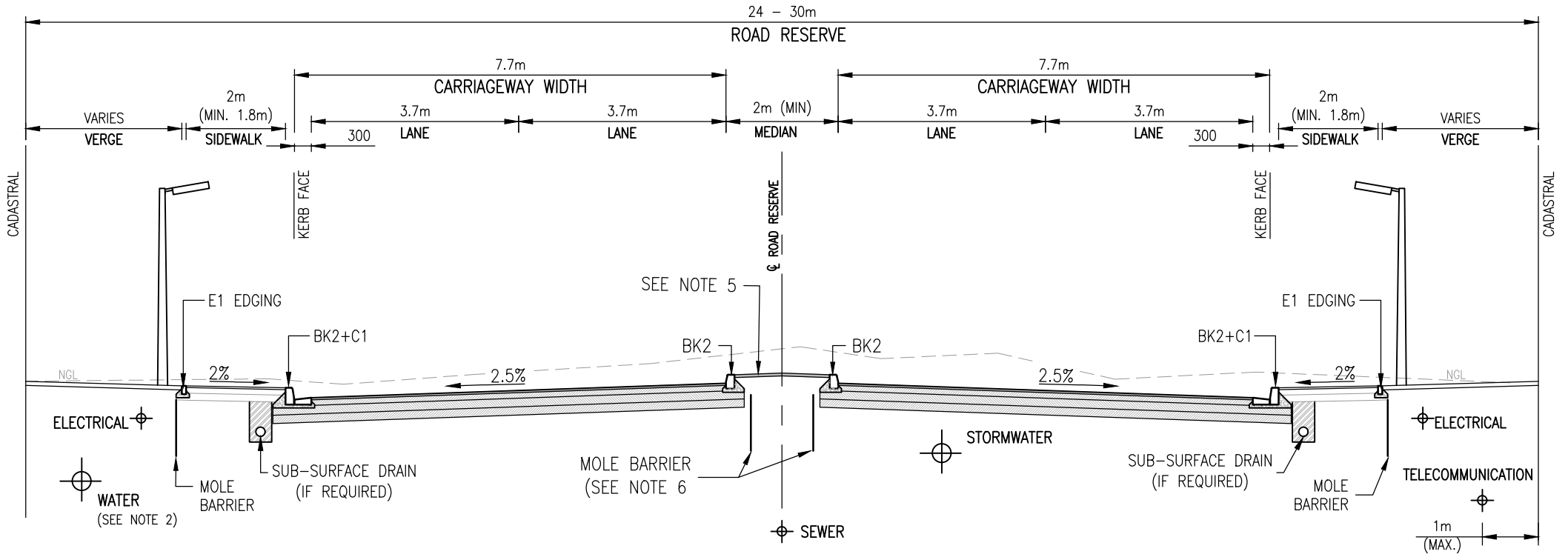
TYPICAL ROAD CROSS SECTION
CLASS 5A COMMERCIAL AND INDUSTRIAL ROAD
TWO-LANE SINGLE CARRIAGEWAY (24-30m ROAD RESERVE)

STANDARDS AND GUIDELINES DETAILS

SHEET 2

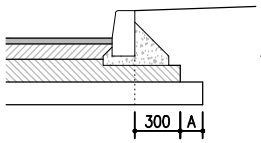
SCALE	PAPER
1:100	A4
DRAWING No.	REV
RD6.4B	D

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NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. STREET LIGHT POLES (AND OTHER STREET FURNITURE) MUST BE PLACED TO ALWAYS LEAVE A MINIMUM 1.1m LATERAL CLEARANCE SPACE ON FOOTWAYS.
4. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
5. MEDIAN ISLAND TREATMENT AS PER APPROVAL AUTHORITY'S REQUIREMENTS.
6. IF THE MEDIAN IS SURFACED, THEN MOLE BARRIERS IN THE MEDIAN WILL NOT BE REQUIRED.
7. POSITION OF UNDERGROUND STORMWATER AND SEWER SERVICES TO BE DISCUSSED WITH APPROVAL AUTHORITY. NO MANHOLES ALLOWED IN VEHICLE WHEEL TRACKS.
8. NO OUTFALL CHANNELS ARE ALLOWED ON THE HIGH SIDE OF THE CARRIAGEWAY. IF CIRCUMSTANCES REQUIRE THE PROVISION OF A CHANNEL ON THE HIGH SIDE OF THE CARRIAGEWAY (e.g. DRAINAGE OR CONSTRUCTABILITY), IT SHALL BE INFALL CHANNELS. THE PROVISION OF THESE INFALL CHANNELS SHALL BE MOTIVATED AND DISCUSSED WITH THE APPROVAL AUTHORITY. IN SUCH INSTANCES, A STORMWATER SYSTEM SHALL BE PROVIDED TO ACCOMMODATED THE RUNOFF ON THE HIGH SIDE.
9. TYPICAL LANE WIDTHS ARE GIVEN. FINAL LANE WIDTHS TO BE AGREED WITH APPROVAL AUTHORITY.
10. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.4.**



LATERAL STEP (A):
GREATER OF 150mm
OR THICKNESS OF
THE LAYER ABOVE

LAYER STEP DETAIL
(NO SUB–SURFACE DRAIN PRESENT)

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:

SHEET 1: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, ONE–LANE SINGLE CARRIAGEWAY
SHEET 2: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, TWO–LANE SINGLE CARRIAGEWAY
SHEET 3: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, TWO–LANE DUAL CARRIAGEWAY
SHEET 4: CLASS 5B LOCAL RESIDENTIAL ROAD, 12m ROAD RESERVE (CAMBERED) (PREFERRED)
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SHEET 7: CLASS 5D LOCAL RESIDENTIAL ROAD, 8m ROAD RESERVE

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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

TYPICAL ROAD CROSS SECTION
CLASS 5A COMMERCIAL AND INDUSTRIAL ROAD
TWO-LANE DUAL CARRIAGEWAY (24-30m ROAD RESERVE)

STANDARDS AND GUIDELINES DETAILS

SHEET 3

SCALE	PAPER
1:100	A4
DRAWING No.	REV
RD6.4C	D

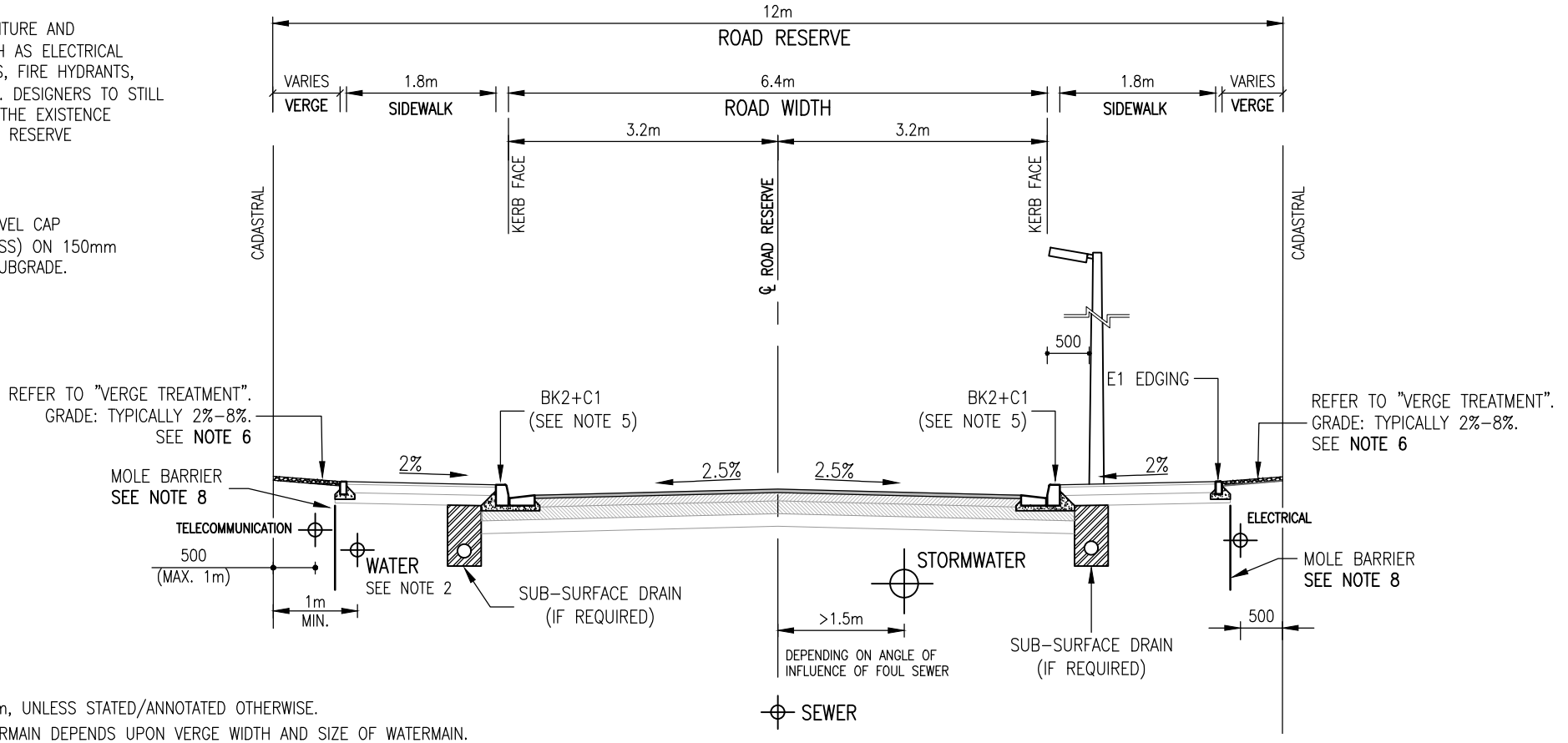
P:\CAD\R&SD\ITI_01 Design\T_1000B Standards\T_1000RS DESIGN_Roads and Stormwater\0002 Drawings_Version4.0\01 RD\RD6.4C – Typical Section Class 5A Comm Ind Rd (24–30m RR)_RevD.dwg

NOTE:

AD–HOC STREET FURNITURE AND INFRASTRUCTURE (SUCH AS ELECTRICAL KIOSKS, WATER METERS, FIRE HYDRANTS, ETC.) ARE NOT SHOWN. DESIGNERS TO STILL TAKE COGNISANCE OF THE EXISTENCE THEREOF IN THE ROAD RESERVE

VERGE TREATMENT

75mm STABILISED GRAVEL CAP (3–4% CEMENT BY MASS) ON 150mm COMPACTED IN–SITU SUBGRADE.
OR
ASPHALT SURFACING



NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. STREET LIGHT POLES (AND OTHER STREET FURNITURE) MUST BE PLACED TO ALWAYS LEAVE A MINIMUM 1.1m LATERAL CLEARANCE SPACE ON FOOTWAYS.
4. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
5. WHERE THE GENERAL ERF FRONTAGE IS LESS THAN 10m, THE USE OF MOUNTABLE KERBS MAY BE CONSIDERED.
6. THE ASPHALT SURFACING OF ROAD VERGES MAY BE REQUIRED BY THE APPROVAL AUTHORITY.
7. ALL RADII AT INTERSECTIONS MUST BE CONSTRUCTED WITH BARRIER KERBS.
8. WHERE THE ROAD IS SITUATED IN A SANDY AREA AND/OR WHERE THERE IS A HIGH RISK OF MOLE ACTIVITY, MOLE BARRIERS SHALL BE PROVIDED.
9. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.4.**

SHEET INDEX:

SHEET 1: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, ONE–LANE SINGLE CARRIAGEWAY
SHEET 2: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, TWO–LANE SINGLE CARRIAGEWAY
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SHEET 4: CLASS 5B LOCAL RESIDENTIAL ROAD, 12m ROAD RESERVE (CAMBERED) (PREFERRED)
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SHEET 7: CLASS 5D LOCAL RESIDENTIAL ROAD, 8m ROAD RESERVE

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

TYPICAL ROAD CROSS SECTION
CLASS 5B LOCAL RESIDENTIAL STREET (CAMBERED) (12m ROAD RESERVE) (PREFERRED)

STANDARDS AND GUIDELINES DETAILS

SHEET 4

SCALE	PAPER
N.T.S.	**A4**
DRAWING No.	REV
RD6.4D	**D**

NOTE:

AD-HOC STREET FURNITURE AND INFRASTRUCTURE (SUCH AS ELECTRICAL KIOSKS, WATER METERS, FIRE HYDRANTS, ETC.) ARE NOT SHOWN. DESIGNERS TO STILL TAKE COGNISANCE OF THE EXISTENCE THEREOF IN THE ROAD RESERVE

VERGE TREATMENT

(SEE **NOTE 6**)

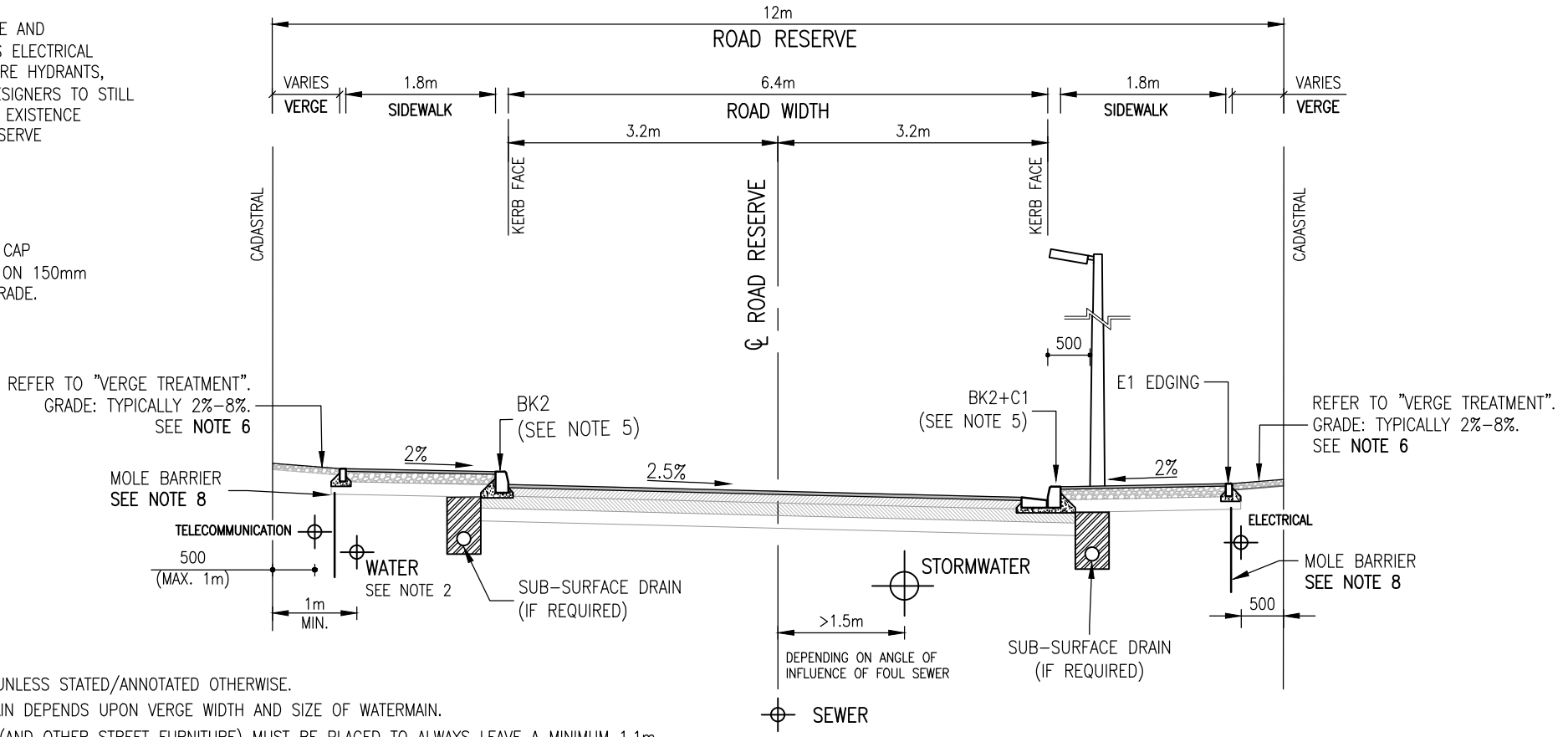
75mm STABILISED GRAVEL CAP (3-4% CEMENT BY MASS) ON 150mm COMPACTED IN-SITU SUBGRADE.

OR

NORMAL TOPSOIL

OR

ASPHALT SURFACING



NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. STREET LIGHT POLES (AND OTHER STREET FURNITURE) MUST BE PLACED TO ALWAYS LEAVE A MINIMUM 1.1m LATERAL CLEARANCE SPACE ON FOOTWAYS.
4. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
5. WHERE THE GENERAL ERF FRONTAGE IS LESS THAN 10m, THE USE OF MOUNTABLE KERBS MAY BE CONSIDERED.
6. THE VERGE TREATMENT REQUIREMENTS TO BE CONFIRMED WITH APPROVAL AUTHORITY.
7. ALL RADII AT INTERSECTIONS MUST BE CONSTRUCTED WITH BARRIER KERBS.
8. WHERE THE ROAD IS SITUATED IN A SANDY AREA AND/OR WHERE THERE IS A HIGH RISK OF MOLE ACTIVITY, MOLE BARRIERS SHALL BE PROVIDED.
9. NO OUTFALL CHANNELS ALLOWED.
10. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.4.**

SHEET INDEX:

SHEET 1: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, ONE-LANE SINGLE CARRIAGEWAY
SHEET 2: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, TWO-LANE SINGLE CARRIAGEWAY
SHEET 3: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, TWO-LANE DUAL CARRIAGEWAY
SHEET 4: CLASS 5B LOCAL RESIDENTIAL ROAD, 12m ROAD RESERVE (CAMBERED) (PREFERRED)
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SHEET 7: CLASS 5D LOCAL RESIDENTIAL ROAD, 8m ROAD RESERVE

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

TYPICAL ROAD CROSS SECTION
CLASS 5B LOCAL RESIDENTIAL STREET (CROSSFALL) (12m ROAD RESERVE) (NOT PREFERRED)

STANDARDS AND GUIDELINES DETAILS

SHEET 5

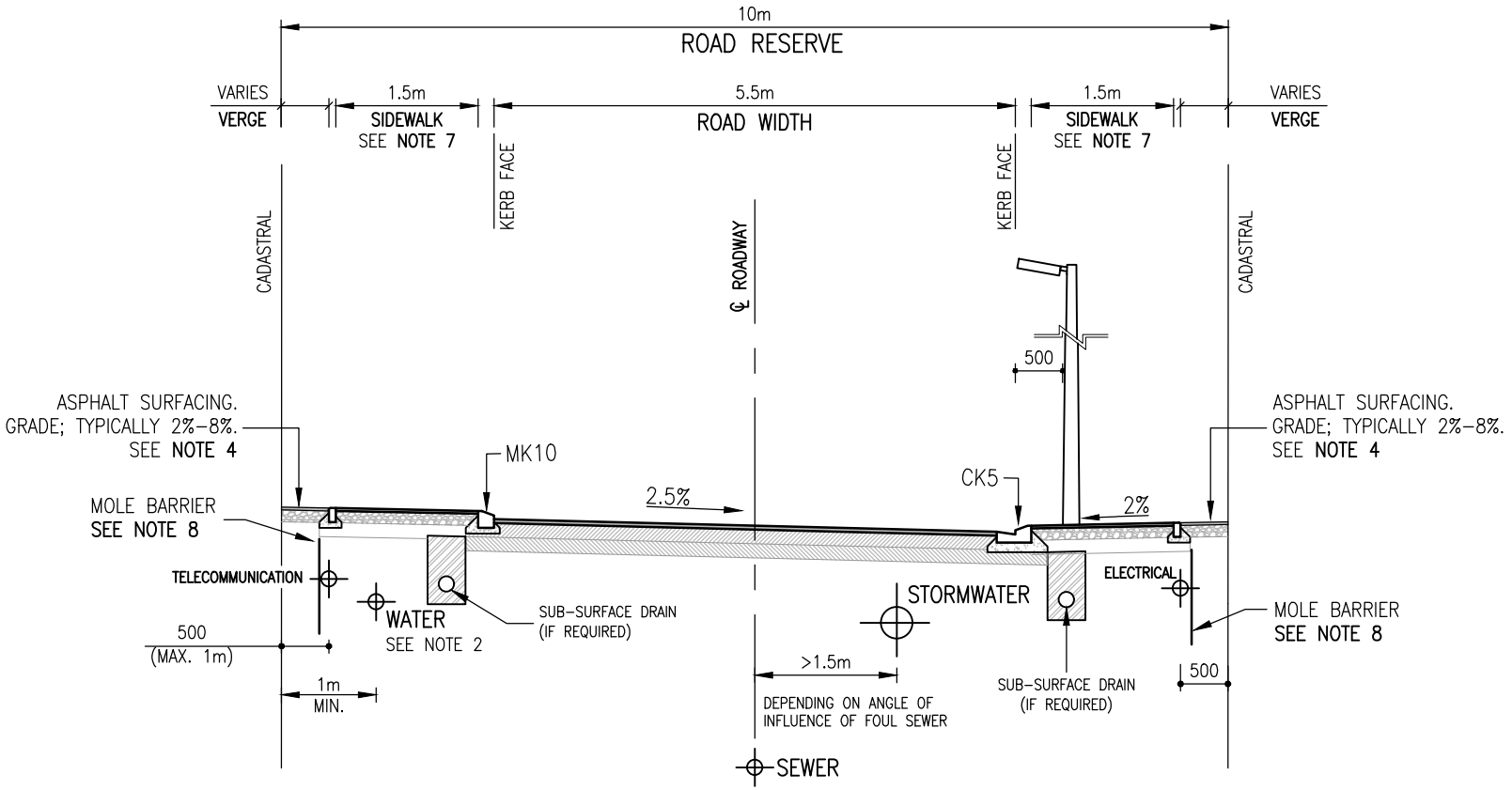
SCALE	PAPER
N.T.S.	**A4**
DRAWING No.	REV
RD6.4E	**B**

NOTE:

AD-HOC STREET FURNITURE AND INFRASTRUCTURE (SUCH AS ELECTRICAL KIOSKS, WATER METERS, FIRE HYDRANTS, ETC.) ARE NOT SHOWN. DESIGNERS TO STILL TAKE COGNISANCE OF THE EXISTENCE THEREOF IN THE ROAD RESERVE

VERGE ALTERNATIVE

75mm STABILISED GRAVEL CAP (3-4% CEMENT BY MASS) ON 150mm COMPACTED IN-SITU SUBGRADE. SEE **NOTE 4**



NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
4. ROAD VERGES SHALL BE ASPHALT SURFACED, UNLESS REQUIRED OTHERWISE BY THE APPROVAL AUTHORITY.
5. ALL RADII AT INTERSECTIONS TO BE CONSTRUCTED WITH BARRIER KERBS.
6. STREET LIGHT POLES (AND OTHER STREET FURNITURE) MUST BE PLACED TO ALWAYS LEAVE A MINIMUM 1.1m LATERAL CLEARANCE SPACE ON FOOTWAYS.
7. SIDEWALKS SHALL BE PROVIDED ON BOTH SIDES OF THE ROADWAY. HOWEVER, WHERE THIS IS NOT POSSIBLE, AT LEAST ONE SIDEWALK SHALL BE PROVIDED.
8. WHERE THE ROAD IS SITUATED IN A SANDY AREA AND/OR WHERE THERE IS A HIGH RISK OF MOLE ACTIVITY, MOLE BARRIERS SHALL BE PROVIDED.
9. NO OUTFALL CHANNELS ALLOWED.
10. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.4.**

SHEET INDEX:

SHEET 1: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, ONE-LANE SINGLE CARRIAGEWAY
SHEET 2: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, TWO-LANE SINGLE CARRIAGEWAY
SHEET 3: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, TWO-LANE DUAL CARRIAGEWAY
SHEET 4: CLASS 5B LOCAL RESIDENTIAL ROAD, 12m ROAD RESERVE (CAMBERED) (PREFERRED)
SHEET 5: CLASS 5B LOCAL RESIDENTIAL ROAD, 12m ROAD RESERVE (CROSSFALL) (NOT PREFERRED)
SHEET 6: CLASS 5C LOCAL RESIDENTIAL ROAD, 10m ROAD RESERVE
SHEET 7: CLASS 5D LOCAL RESIDENTIAL ROAD, 8m ROAD RESERVE

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

TYPICAL ROAD CROSS SECTION
CLASS 5C LOCAL RESIDENTIAL STREET (10m ROAD RESERVE)

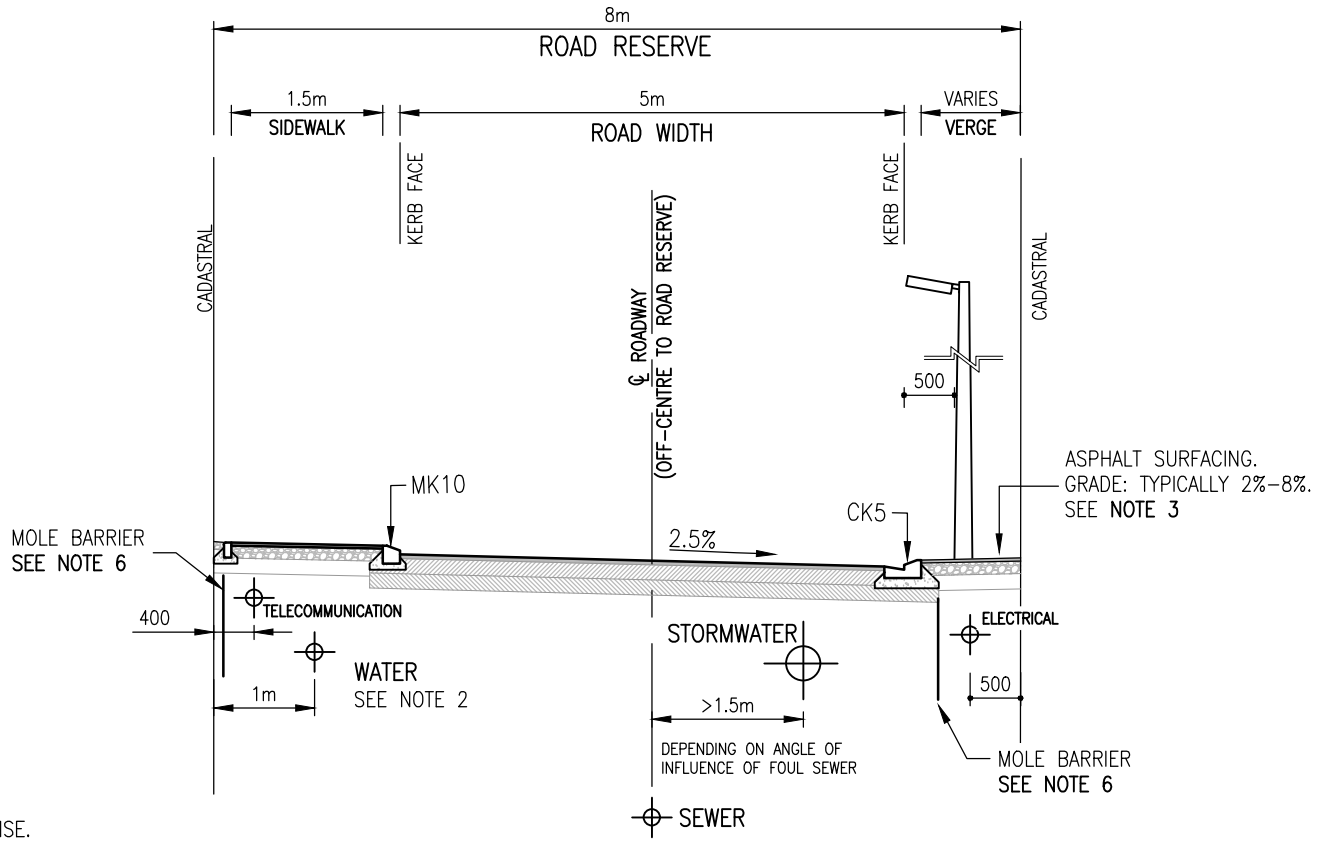
STANDARDS AND GUIDELINES DETAILS

SHEET 6

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RD6.4F	B

NOTE:

AD-HOC STREET FURNITURE AND INFRASTRUCTURE (SUCH AS ELECTRICAL KIOSKS, WATER METERS, FIRE HYDRANTS, ETC.) ARE NOT SHOWN. DESIGNERS TO STILL TAKE COGNISANCE OF THE EXISTENCE THEREOF IN THE ROAD RESERVE



NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF WATERMAIN DEPENDS UPON VERGE WIDTH AND SIZE OF WATERMAIN.
3. ROAD VERGES SHALL BE ASPHALT SURFACED, UNLESS REQUIRED OTHERWISE BY THE APPROVAL AUTHORITY.
4. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
5. ALL RADII AT INTERSECTIONS TO BE CONSTRUCTED WITH BARRIER KERBS.
6. WHERE THE ROAD IS SITUATED IN A SANDY AREA AND/OR WHERE THERE IS A HIGH RISK OF MOLE ACTIVITY, MOLE BARRIERS SHALL BE PROVIDED.
7. NO OUTFALL CHANNELS ALLOWED.
8. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.4.**
9. THE PROVISION OF CLASS 5D ROADS SHOULD ONLY BE FOR SPECIAL CIRCUMSTANCES AND MUST BE SUPPORTED BY THE APPROVAL AUTHORITY. IF SUPPORTED, ROADS SHALL BE LIMITED TO SHORT LENGTHS AND STRAIGHTS.

SHEET INDEX:

SHEET 1: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, ONE-LANE SINGLE CARRIAGEWAY
SHEET 2: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, TWO-LANE SINGLE CARRIAGEWAY
SHEET 3: CLASS 5A LOCAL COMMERCIAL & INDUSTRIAL ROAD, TWO-LANE DUAL CARRIAGEWAY
SHEET 4: CLASS 5B LOCAL RESIDENTIAL ROAD, 12m ROAD RESERVE (CAMBERED) (PREFERRED)
SHEET 5: CLASS 5B LOCAL RESIDENTIAL ROAD, 12m ROAD RESERVE (CROSSFALL) (NOT PREFERRED)
SHEET 6: CLASS 5C LOCAL RESIDENTIAL ROAD, 10m ROAD RESERVE
SHEET 7: CLASS 5D LOCAL RESIDENTIAL ROAD, 8m ROAD RESERVE

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

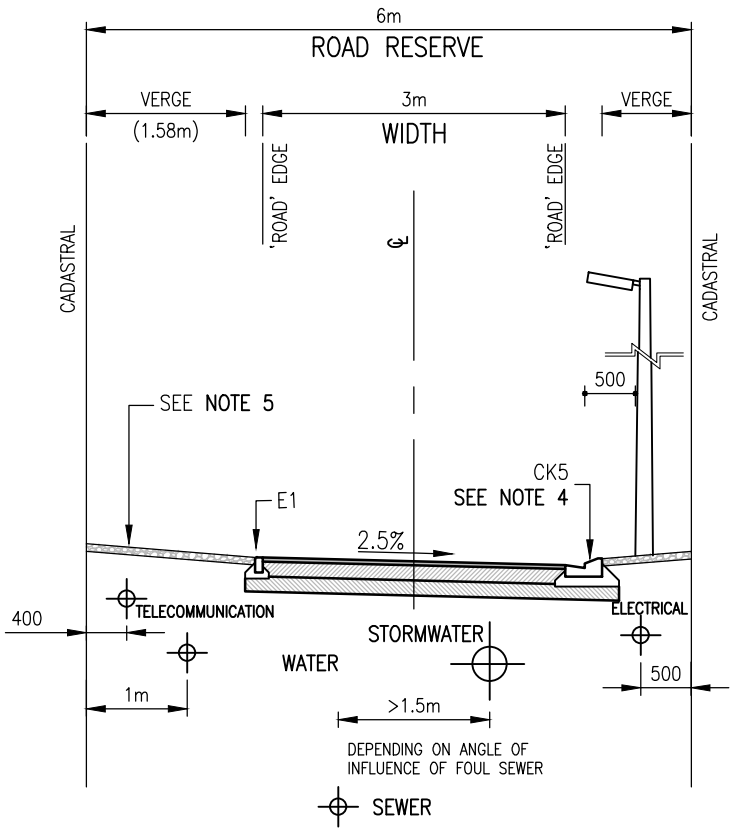
TYPICAL ROAD CROSS SECTION
CLASS 5D LOCAL RESIDENTIAL STREET (8m ROAD RESERVE)

STANDARDS AND GUIDELINES DETAILS

SHEET 7

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RD6.4G	B

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NOTES:

1. DIMENSIONS IN mm, UNLESS STATED/ANNOTATED OTHERWISE.
2. POSITION OF SERVICES IS INDICATED AS ANTICIPATED. THE FINAL POSITIONS TO BE DISCUSSED WITH SERVICE DEPARTMENTS.
3. PAVEMENT LAYERS SHALL BE DESIGNED AS PER CHAPTER 8.
4. PRECAST CONCRETE EDGINGS MAY ALSO BE USED AS EDGE RESTRAINTS WHERE THE ACCOMMODATION OF STORMWATER DRAINAGE IS NOT REQUIRED.
5. THE TREATMENT OF THE VERGE SHALL BE DISCUSSED WITH THE APPROVAL AUTHORITY.
6. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.2.2.5**.
7. THIS CROSS SECTION SHALL ONLY BE USED FOR NON-MOTORISED TRANSPORT LINKS. NO VEHICULAR ACCESS WILL BE ALLOWED.

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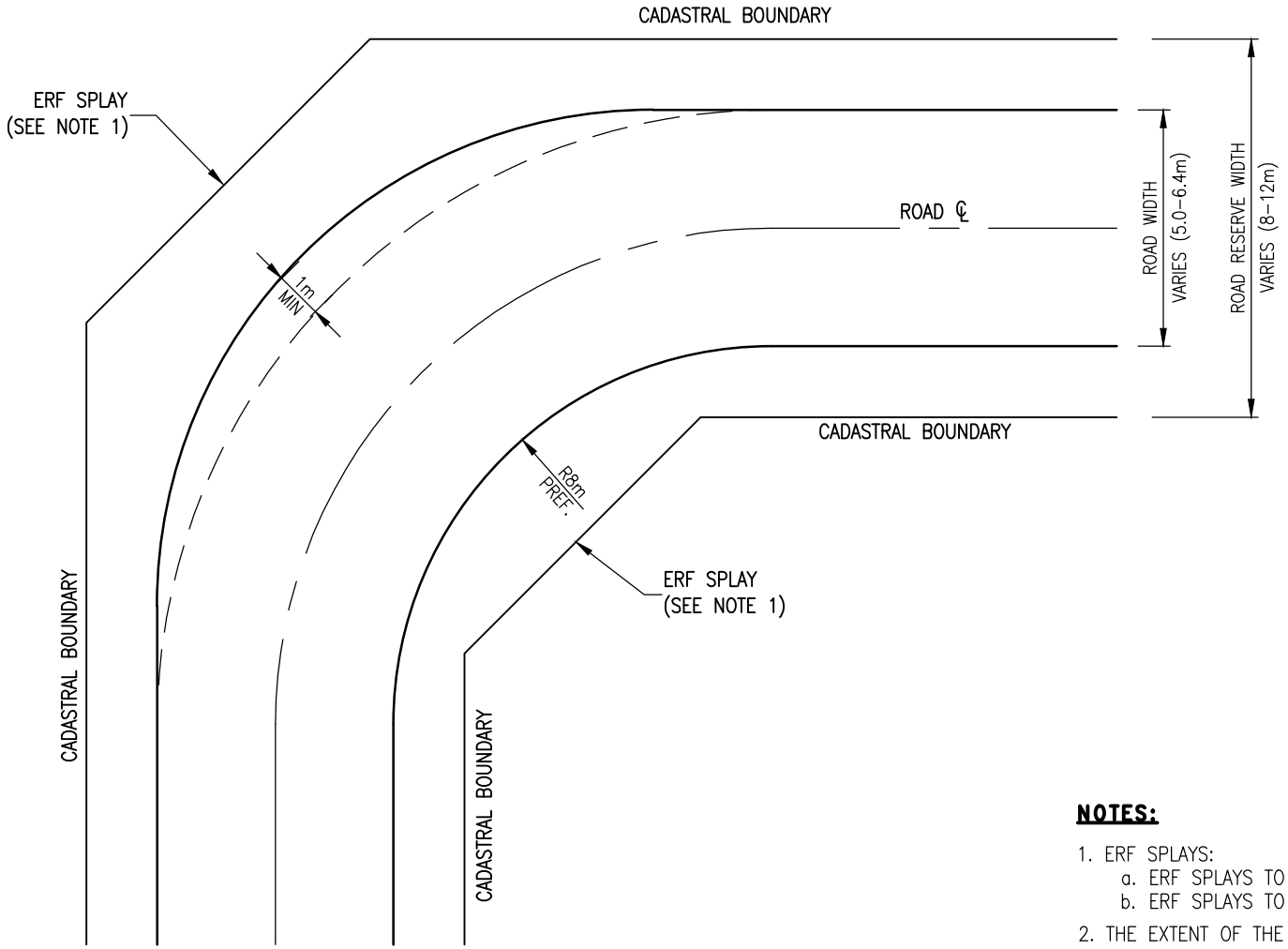
CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

TYPICAL CROSS SECTION
CLASS 6 PEDESTRIAN ONLY LINK (6m ROAD RESERVE)

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RD6.5	D



PLAN VIEW

NOTES:

1. ERF SPLAYS:
   a. ERF SPLAYS TO BE DETERMINED BY ROAD RESERVE WIDTH.
   b. ERF SPLAYS TO CONFORM TO THE APPLICABLE REGULATIONS AND POLICIES.
2. THE EXTENT OF THE ROAD WIDENING MUST BE BASED ON THE APPLICABLE DESIGN VEHICLE WHICH WILL BE USING THE ROAD.
3. THE MINIMUM ROAD WIDENING SHALL BE 1m.

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

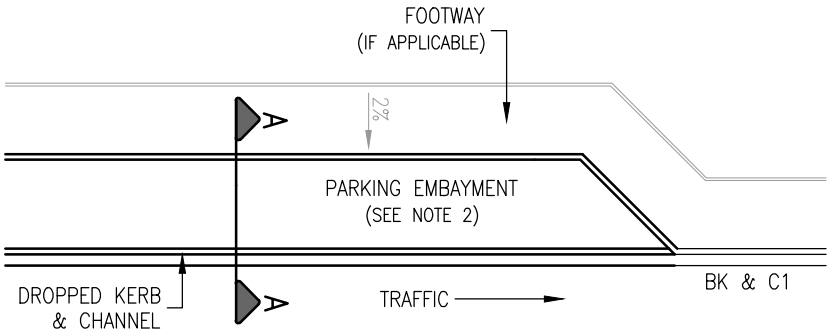
TITLE

HORIZONTAL CURVE WIDENING ON CLASS 5 ROAD RESERVES

STANDARDS AND GUIDELINES DETAILS

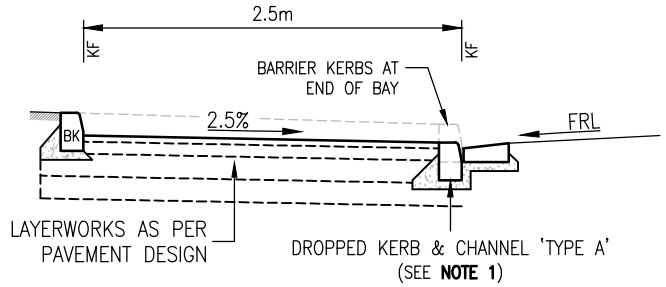
SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RD7	A

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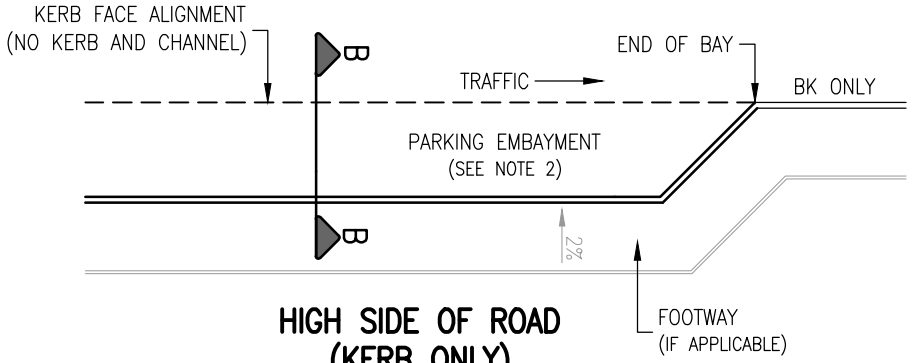
LOW SIDE OF ROAD (WITH KERB & CHANNEL)

SCALE 1:200



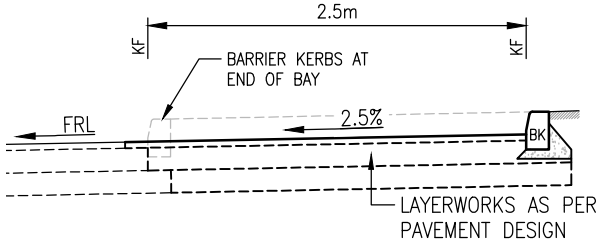
SECTION A–A

SCALE 1:50



HIGH SIDE OF ROAD (KERB ONLY)

SCALE 1:200



SECTION B–B

SCALE 1:50

NOTES:

1. REFER TO DRAWING RD2.1 FOR DROPPED KERB AND CHANNEL DETAILS (TYPE 'A').
2. REFER TO DRAWING RD9 FOR VARIOUS PARKING LAYOUTS.
3. REFER TO CHAPTER 8 FOR PAVEMENT DESIGN.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL
KF: KERB FACE

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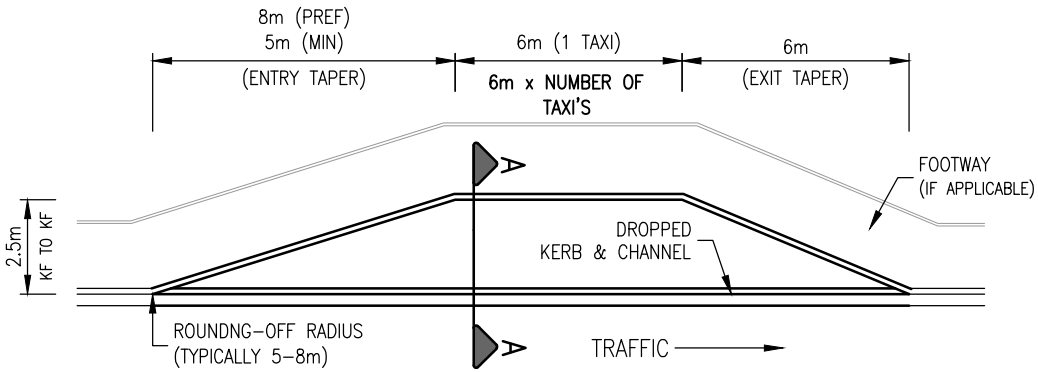
TITLE

TYPICAL EMBAYMENT PARALLEL PARKING

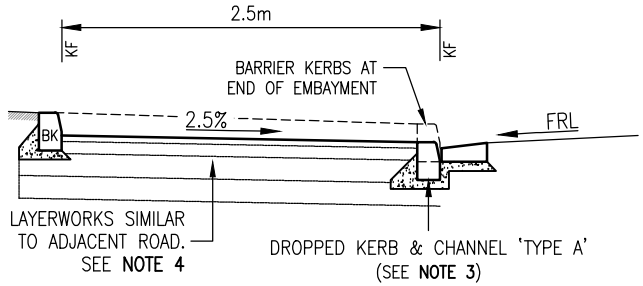
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD8.1	A

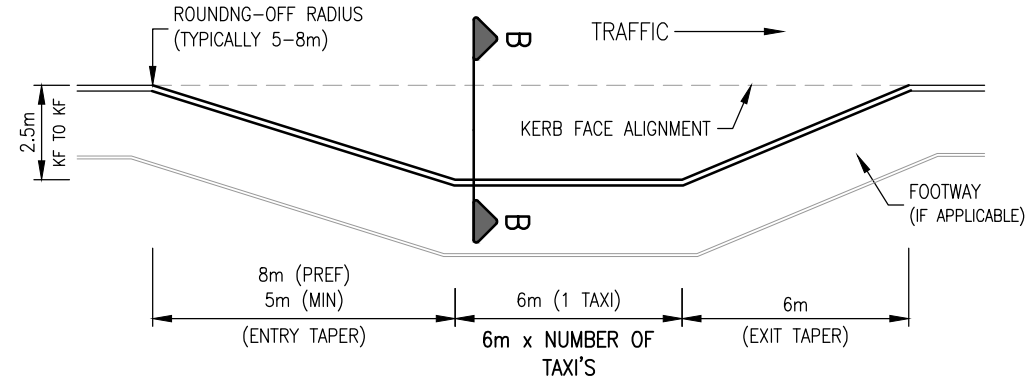
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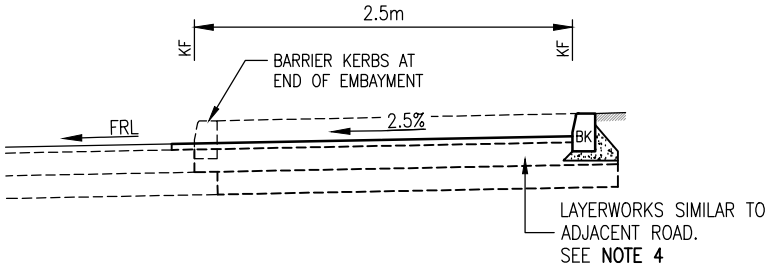
LOW SIDE OF ROAD (WITH KERB & CHANNEL)
SCALE 1:200



SECTION A–A
SCALE 1:50



HIGH SIDE OF ROAD (KERB ONLY)
SCALE 1:200



SECTION B–B
SCALE 1:50

NOTES:

1. WHERE A TAXI EMBAYMENT IS REQUIRED AT AN INTERSECTION, IT SHALL BE POSITIONED IMMEDIATELY DOWNSTREAM OF THE INTERSECTION.
2. AT PEDESTRIAN CROSSING POINTS, TAXI EMBAYMENTS SHALL BE POSITIONED IMMEDIATELY AFTER THE PEDESTRIAN CROSSING.
3. AN ENTRY TAPER LENGTH OF 8m IS PREFERRED. HOWEVER, WHERE SPACE CONSTRAINTS ARE APPLICABLE, A MINIMUM ENTRY LENGTH OF 5m WILL BE ACCEPTED.
4. REFER TO DRAWING RD2.1 FOR DROPPED KERB AND CHANNEL DETAILS (TYPE 'A').
5. REFER TO CHAPTER 8 FOR PAVEMENT DESIGN.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL
KF: KERB FACE

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

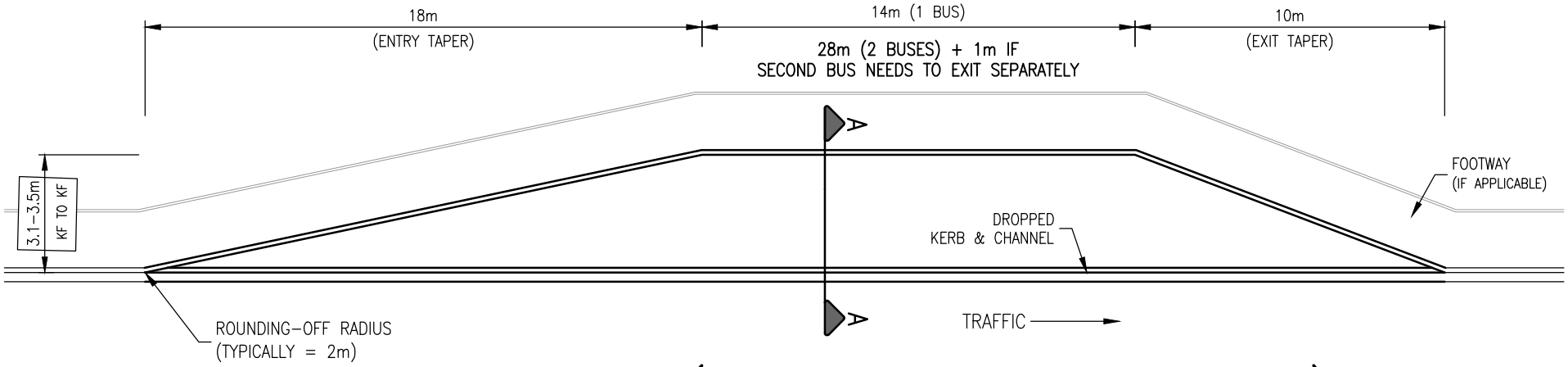
TITLE

TYPICAL EMBAYMENT
MINI-BUS TAXI

STANDARDS AND GUIDELINES DETAILS

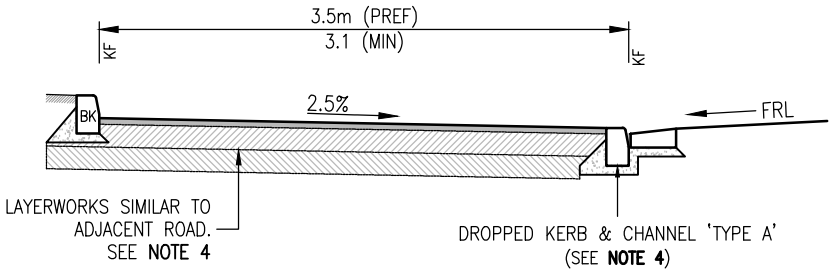
SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD8.2	A

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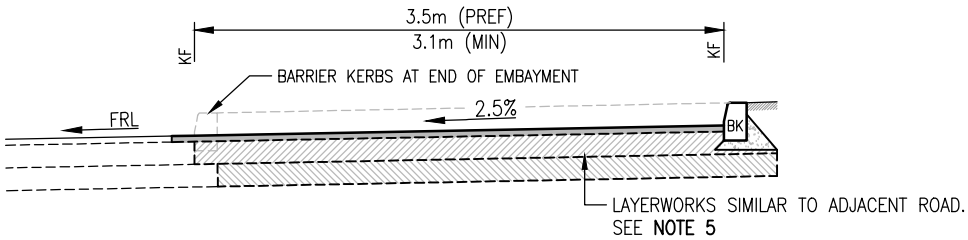
PLAN VIEW (EMBAYMENT ON LOW SIDE OF ROADWAY)

SCALE 1:200



SECTION A–A

SCALE 1:50



SECTION THROUGH EMBAYMENT SITUATED ON HIGH SIDE OF ROADWAY

SCALE 1:50

NOTES:

1. WHERE A BUS STOP IS REQUIRED AT AN INTERSECTION, IT SHALL BE POSITIONED IMMEDIATELY DOWNSTREAM OF THE INTERSECTION.
2. AT PEDESTRIAN CROSSING POINTS, BUS EMBAYMENTS SHALL BE POSITIONED IMMEDIATELY AFTER THE PEDESTRIAN CROSSING.
3. AN EMBAYMENT WIDTH IS 3.5m IS PREFERRED. HOWEVER, WHERE SPACE CONSTRAINTS ARE APPLICABLE, A MINIMUM WIDTH OF 3.1m WILL BE ACCEPTED.
4. REFER TO DRAWING RD2.1 FOR DROPPED KERB AND CHANNEL DETAILS (TYPE 'A').
5. REFER TO CHAPTER 8 FOR PAVEMENT DESIGN.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL
KF: KERB FACE

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

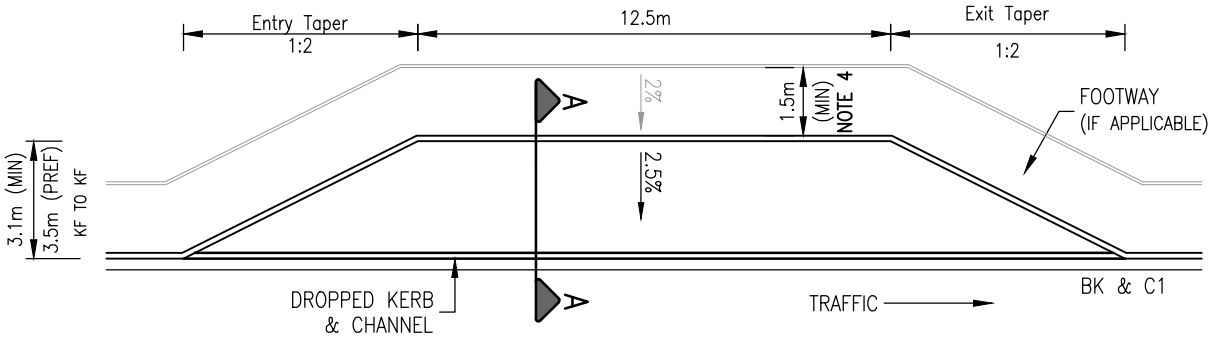
TYPICAL EMBAYMENT

BUS (NOT MY-CITY BUS)

STANDARDS AND GUIDELINES DETAILS

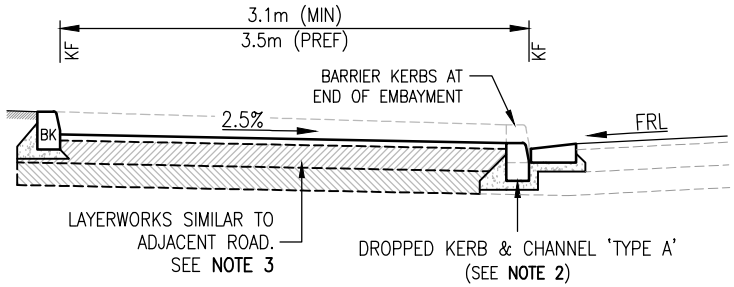
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SHOWN	**A4**
DRAWING No.	REV
RD8.3	**A**

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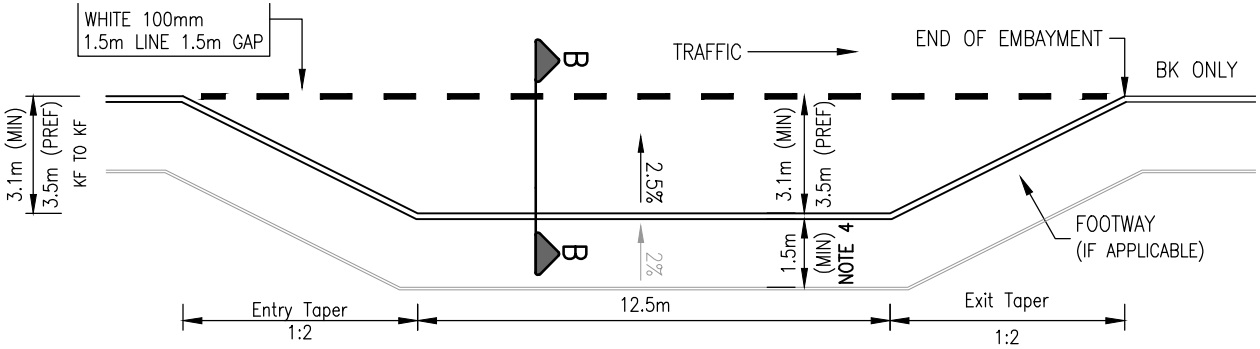
LOW SIDE OF ROAD (WITH KERB & CHANNEL)

SCALE 1:200



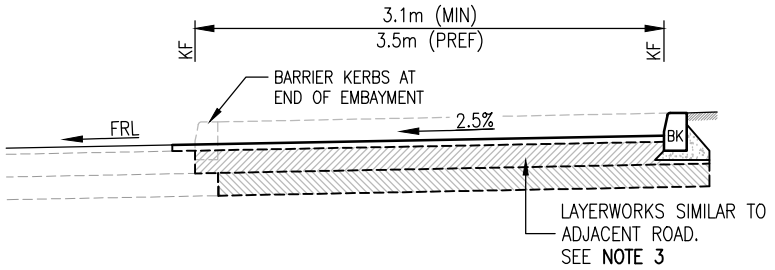
SECTION A–A

SCALE 1:50



HIGH SIDE OF ROAD (KERB ONLY)

SCALE 1:200



SECTION B–B

SCALE 1:50

NOTES:

1. DRAWING TO BE READ IN CONJUNCTION WITH SECTION 14.2 "REFUSE (SOLID WASTE) COLLECTION".
2. REFER TO DRAWING RD2.1 FOR DROPPED KERB AND CHANNEL DETAILS (TYPE 'A').
3. REFER TO CHAPTER 8 FOR PAVEMENT DESIGN.
4. THE FOOTWAY SHOULD MATCH THE EXISTING FOOTWAY WIDTH, BUT SHALL NEVER BE LESS THAN 1.5m AROUND THE EMBAYMENT. WHERE A REFUSE EMBAYMENT IS PROVIDED ON A CLASS 5 RESIDENTIAL STREET (OR LOW TRAFFIC VOLUMES), THE EMBAYMENT WIDTH MAY BE REDUCED TO 2.5m, IN ORDER TO ACCOMMODATE THE MINIMUM FOOTWAY WIDTH.

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KF: KERB FACE

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

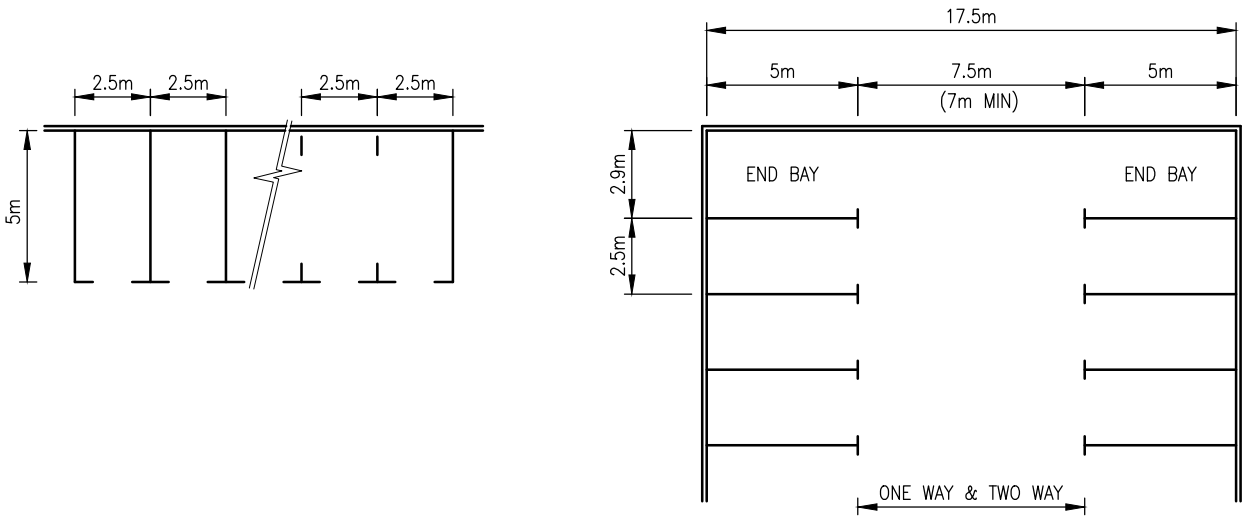
TITLE

TYPICAL EMBAYMENT REFUSE REMOVAL

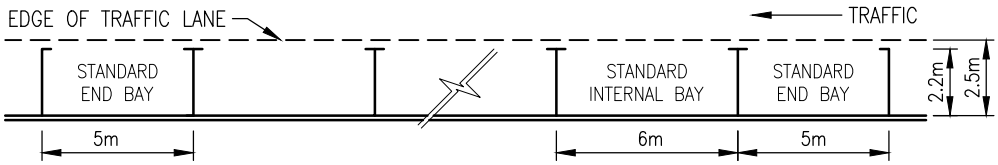
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD8.4	C

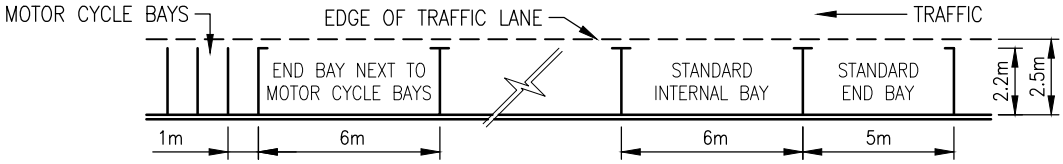
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90° PARKING

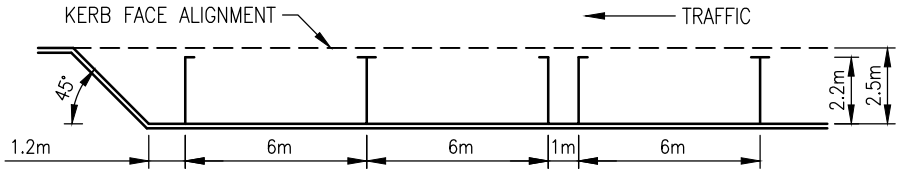


WITHOUT MOTOR CYCLE BAYS

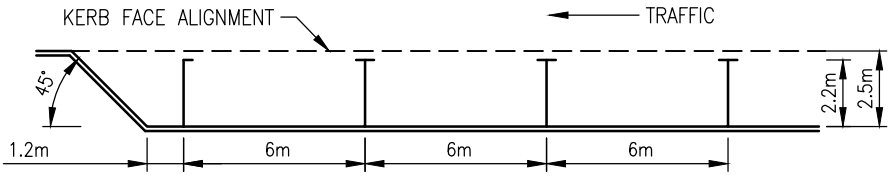


WITH MOTOR CYCLE BAYS

PARALLEL PARKING



HIGHER ORDER ROADS (CLASS 4 AND HIGHER)



LOWER ORDER ROAD (CLASS 5 RESIDENTIAL)

KERB–SIDE EMBAYMENT PARKING

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

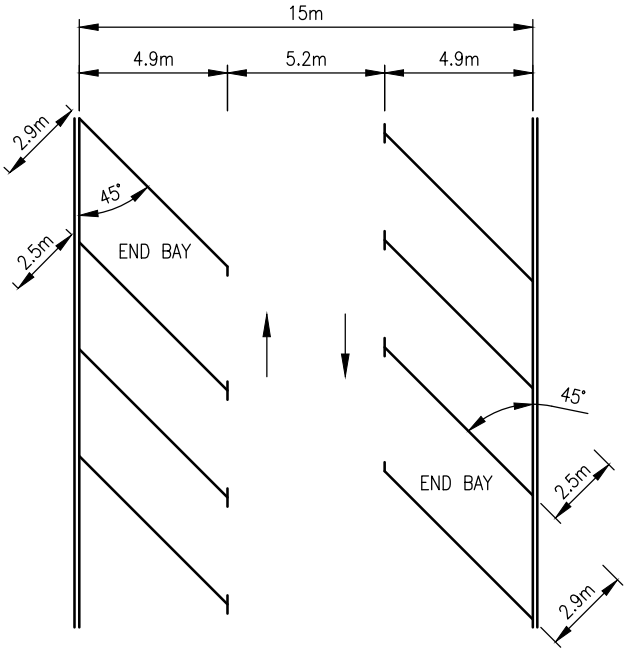
TITLE

PARKING LAYOUT
90°, PARALLEL & KERB-SIDE EMBAYMENT PARKING
STANDARDS AND GUIDELINES DETAILS

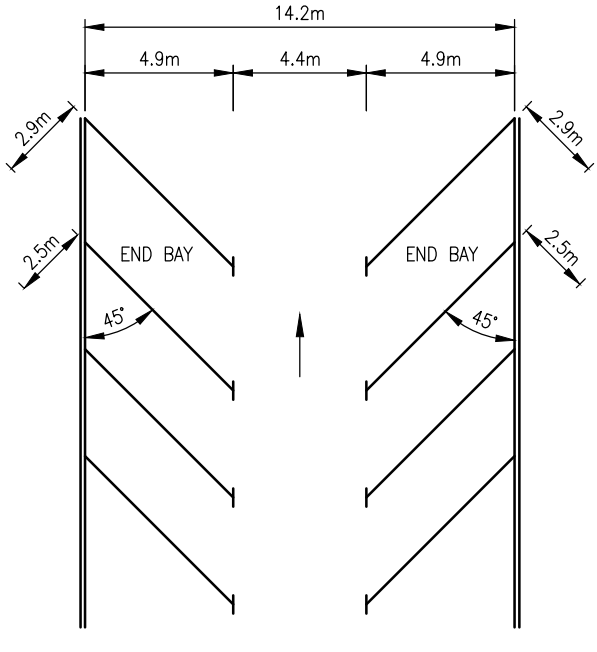
SHEET 1

SCALE	PAPER
1:250	A4
DRAWING No.	REV
RD9.1	B

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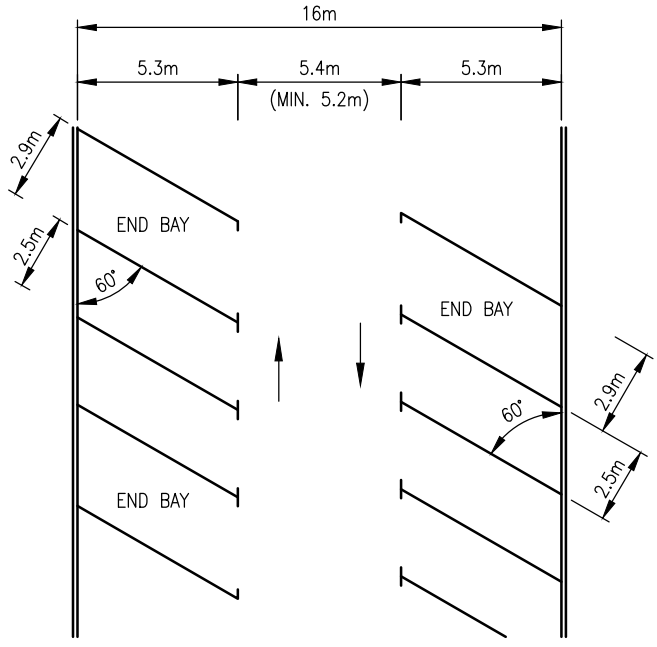


TWO-WAY AISLE

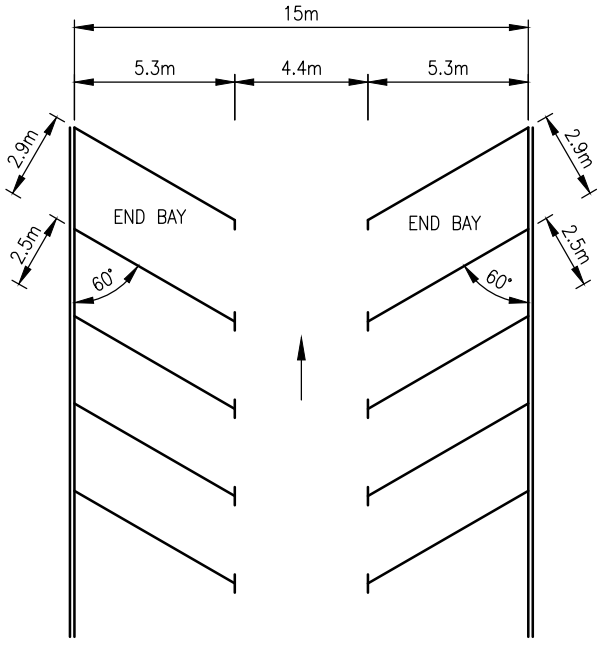


ONE-WAY AISLE

PARKING LAYOUT: 45° BAYS (NON-INTERLOCKING)



TWO-WAY AISLE



ONE-WAY AISLE

PARKING LAYOUT: 60° BAYS (NON-INTERLOCKING)

NOTES:

1. END BAYS ARE ILLUSTRATED FIGURATIVELY AND WILL DEPEND ON SITE SPECIFIC LAYOUT.

CITY OF CAPE TOWN
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CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

PARKING LAYOUT

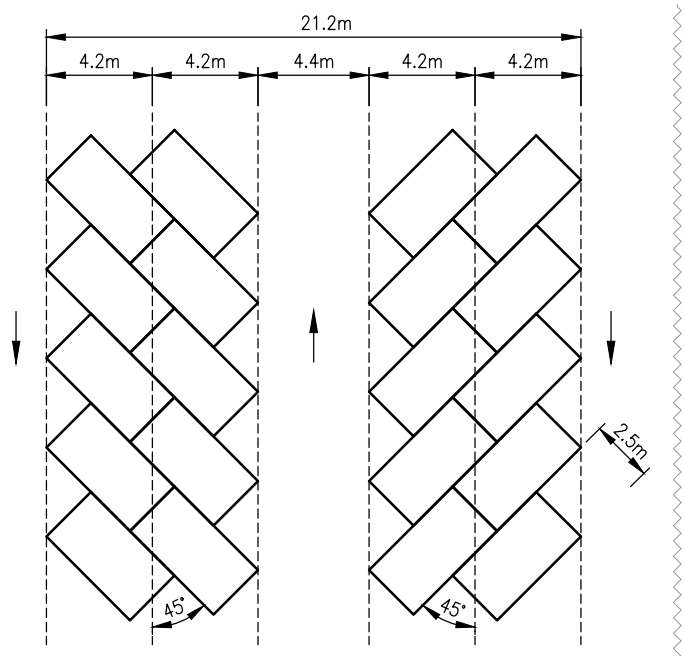
45° & 60° PARKING (NON-INTERLOCKING)

STANDARDS AND GUIDELINES DETAILS

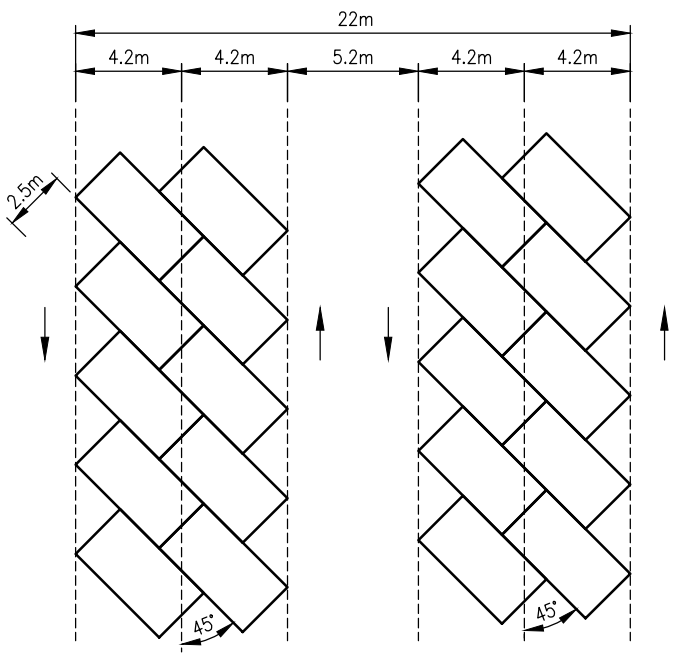
SHEET 2

SCALE	PAPER
1:250	A4
DRAWING No.	REV
RD9.2	A

P:\CAD\R&SD\ITL_01 Design\T_1000B Standards\T_1000RS DESIGN_Roads and Stormwater\0002 Drawings_Version4.0\01 RD\RD9.2 - Parking Layout - 45&60-degree (non_interlocking)_RevA.dwg

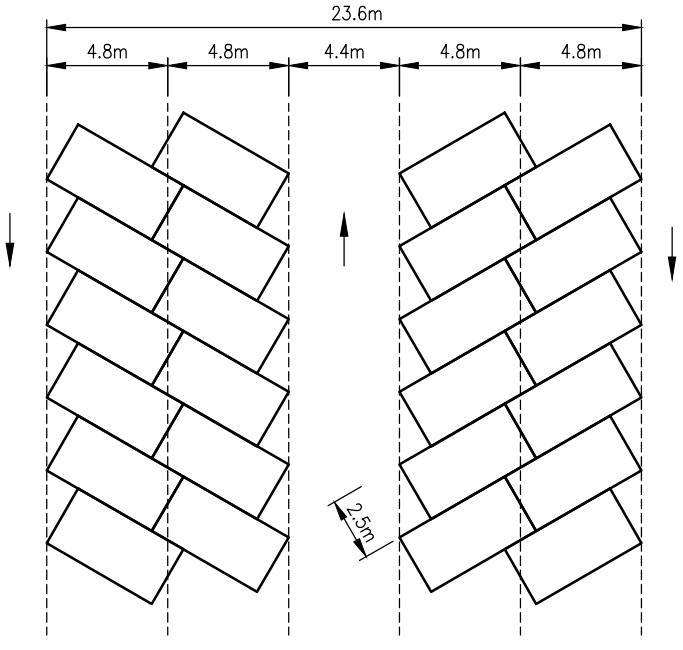


ONE-WAY

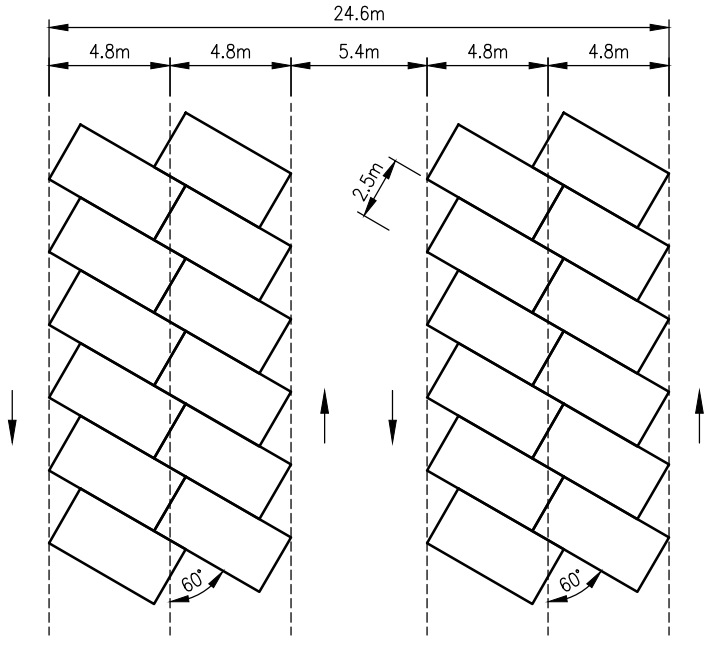


TWO-WAY

PARKING LAYOUT: 45° BAYS (INTERLOCKING)



ONE-WAY



TWO-WAY

PARKING LAYOUT: 60° BAYS (INTERLOCKING)

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

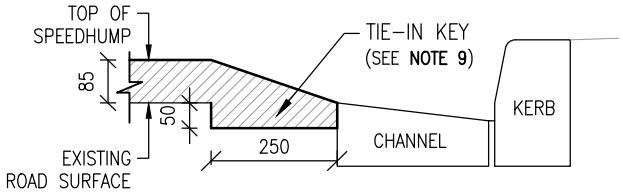
PARKING LAYOUT
45° & 60° PARKING (INTERLOCKING)

STANDARDS AND GUIDELINES DETAILS

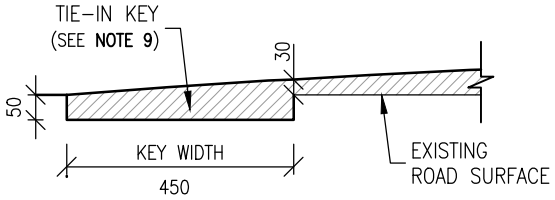
SHEET 3

SCALE	PAPER
N.T.S.	**A4**
DRAWING No.	REV
RD9.3	**A**

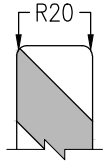
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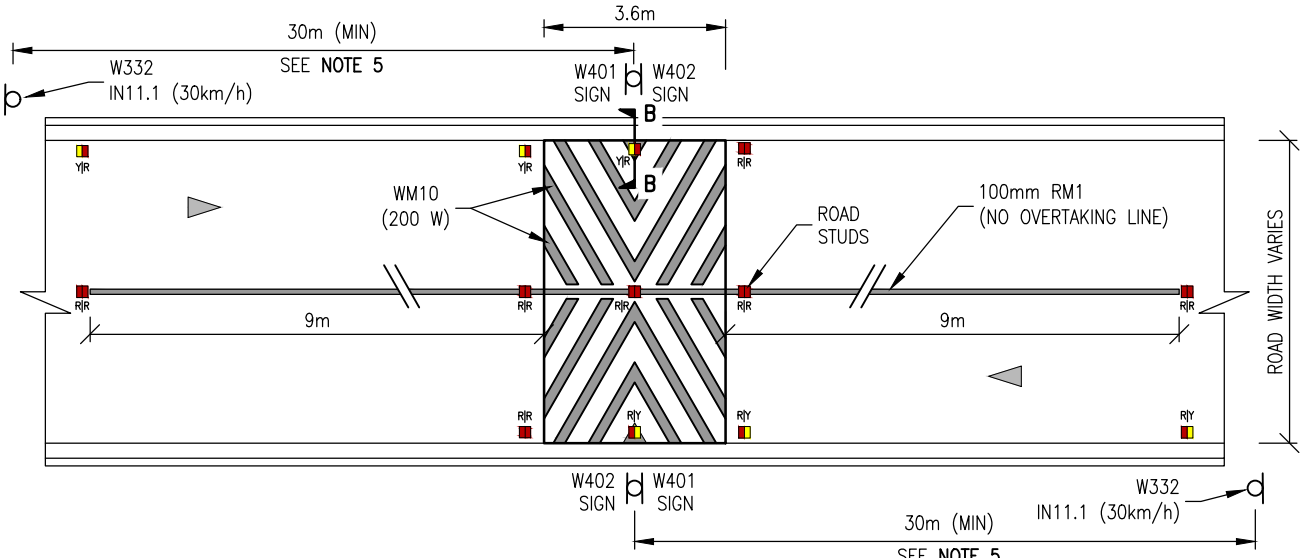
SECTION B–B



DETAIL A: TIE–IN KEY

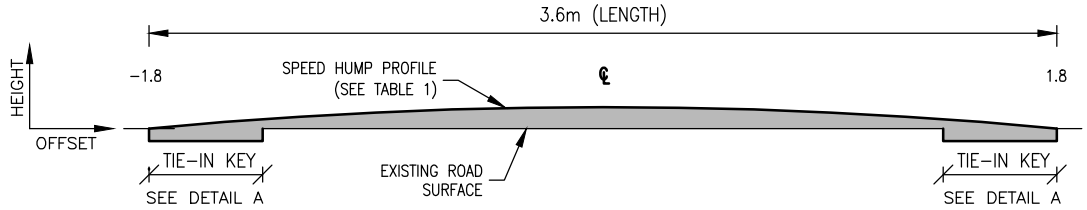


W401 CORNER FINISH



PLAN VIEW

TABLE 1: SPEED HUMP PROFILE																		
HEIGHT (mm)	0	18	34	47	59	68	76	81	84	**85**	84	81	76	68	59	47	34	10	0
OFFSET (m)	–1.8	–1.6	–1.4	–1.2	–1.0	–0.8	–0.6	–0.4	–0.2	**℄**	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8



LONGITUDINAL SECTION: SPEED HUMP (PROFILE)

NOTES:

1. ROAD MARKINGS AND ROAD SIGNS TO COMPLY WITH "SADC–RTSM–VOL1" & "SARTSM–VOL2".
2. SPEED HUMPS SHALL NOT BE PLACED AT DRIVEWAYS OR STORMWATER CATCHPITS OR LOCATED ON EXISTING MANHOLES/STRUCTURES.
3. ALL ROAD SIGNS MUST HAVE CLASS 3 RETRO–REFLECTIVE BACKGROUND MATERIAL.
4. CORNERS OF THE W401 SIGNS TO BE ROUNDED AT 20mm RADII, IN ORDER TO IMPROVE PEDESTRIAN SAFETY.
5. THE W332 SIGN SHALL BE PLACED AT LEAST 30m AHEAD OF THE SPEED HUMP. HOWEVER, THE SETBACK SHALL ADHERE TO THE REQUIREMENTS OF SADC–RTSM–VOL1 SECTION 3.2.26 AND SARTSM–VOL2 FIGURE 12.7.
6. SIGNS SHALL NOT BE INSTALLED IN FRONT OF DRIVEWAYS OR BE OBSTRUCTED BY LANDSCAPING OR OTHER SIGNS/STRUCTURES.
7. SIGNS SHALL BE ERECTED BEFORE THE SPEED HUMP IS CONSTRUCTED.
8. ROAD MARKINGS TO BE PAINTED WITH RETRO–REFLECTIVE ROAD MARKING PAINT.
9. ROAD MARKINGS TO BE PAINTED AFTER CONSTRUCTION IS COMPLETE, ALLOWING ENOUGH TIME FOR ASPHALT TO COOL.
10. WM10 ROAD MARKINGS SHALL BE PAINTED IMMEDIATELY AFTER CONSTRUCTION AND MAY REQUIRE REPAINTING IF "BROWNING EFFECT" OCCURS.
11. RM12 "NO STOPPING LINES" SHALL BE PROVIDED, IF REQUIRED BY APPROVAL AUTHORITY.
12. SPEEDHUMP TO BE CONSTRUCTED FROM ASPHALT. THE ASPHALT TYPE TO BE SPECIFIED BY THE APPROVAL AUTHORITY.
13. A MAXIMUM VERTICAL TOLERANCE OF 5mm SHALL APPLY TO THE PROFILE OF THE SPEED HUMP.
14. ALL TIE–IN KEYS TO BE MECHANICALLY (SAW) CUT.
15. REFER TO DRAWING RM4.1 FOR ROAD SIGN SUPPORT INSTALLATION DETAILS.
16. ROAD STUDS SHALL BE IN ACCORDANCE WITH THE LATEST VERSIONS OF SANS 1442, 1463–1 AND 1463–2. REFER TO **SECTION 9.4** FOR FURTHER DETAILS.

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

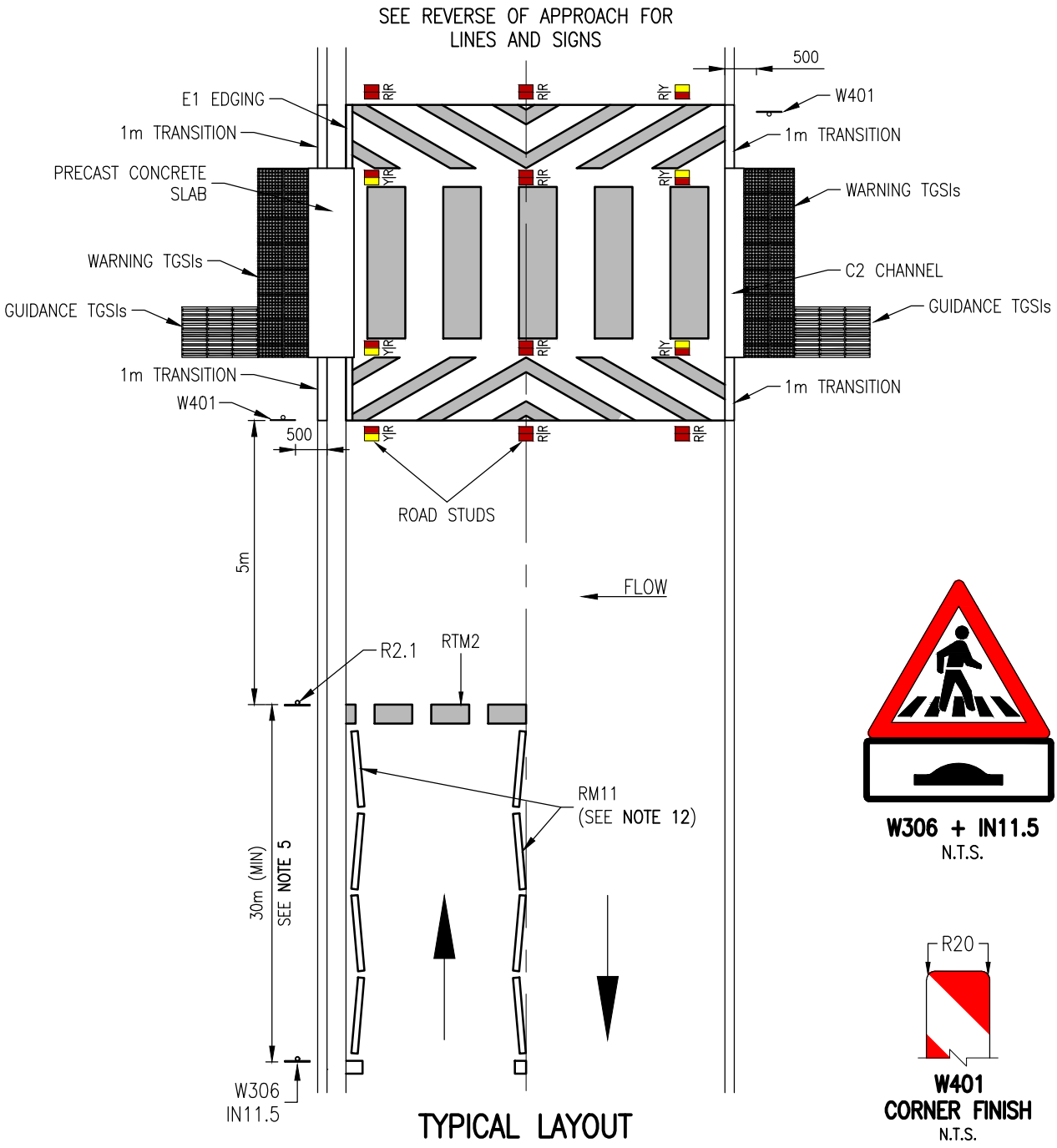
TITLE

SPEED HUMP

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	**A4**
DRAWING No.	REV
RD10	**D**

P:\CAD\R&SD\ITI_01 Design\T_1000B Standards\T_1000RS DESIGN_Roads and Stormwater\0002 Drawings_Version4.0\01 RD\RD10 – Speed Hump RevD.dwg



TYPICAL LAYOUT

W306 + IN11.5
N.T.S.

W401 CORNER FINISH
N.T.S.

NOTES:

1. ROAD MARKINGS AND SIGNS TO COMPLY WITH "SADC-RTSM-VOL1" & "SARTSM-VOL2".
2. RAISED PEDESTRIAN CROSSINGS SHALL NOT BE PLACED AT DRIVEWAYS OR STORMWATER CATCHPITS OR LOCATED ON EXISTING MANHOLES/STRUCTURES.
3. ALL ROAD SIGNS MUST HAVE CLASS 3 RETRO-REFLECTIVE BACKGROUND MATERIAL.
4. CORNERS OF THE W401 SIGNS TO BE ROUNDED AT 20mm RADII, IN ORDER TO IMPROVE PEDESTRIAN SAFETY.
5. THE PLACEMENT OF THE W306 SIGN IS DEPENDENT ON THE LOCATION OF THE PEDESTRIAN CROSSING, DISTANCE FROM STOP INTERSECTION, ROAD ALIGNMENT, ETC. THE SETBACK SHALL ADHERE TO THE REQUIREMENTS OF SADC-RTSM-VOL1 SECTION 3.4.6 AND SARTSM-VOL2 CHAPTER 14. IN AREAS WITH SHORT RESIDENTIAL BLOCK LEGNTHS OR MULTIPLE BENDS, THE W306 SIGNS SHALL BE PLACED AT LEAST 30m AHEAD OF THE RAISED PEDESTRIAN CROSSING.
6. THE W306 SIGNS SHOULD NOT BE INSTALLED IN FRONT OF DRIVEWAYS OR BE OBSTRUCTED BY LANDSCAPING OR OTHER SIGNS/STRUCTURES.
7. SIGNS MUST BE ERECTED PRIOR TO THE CONSTRUCTION OF THE CROSSING.
8. ROAD MARKINGS TO BE PAINTED WITH RETRO-REFLECTIVE ROAD MARKING PAINT.
9. ROAD MARKINGS TO BE PAINTED AFTER CONSTRUCTION IS COMPLETE, ALLOWING ENOUGH TIME FOR PREMIX TO COOL.
10. WM10 ROAD MARKINGS SHALL BE PAINTED IMMEDIATELY AFTER CONSTRUCTION AND MAY REQUIRE REPAINTING IF "BROWNING EFFECT" OCCURS.
11. RAISED PEDESTRIAN CROSSINGS SHALL BE CONSTRUCTED WITH ASPHALT. THE ASPHALT TYPE SHALL BE SPECIFIED BY THE APPROVAL AUTHORITY.
12. RM11 "ZIG-ZAG" MAY BE USED IN SITUATIONS WHICH ARE CONSIDERED POTENTIALLY DANGEROUS FOR PEDESTRIANS (e.g. POOR PEDESTRIAN VISIBILITY).
13. ASPHALT TABLE SHALL BE CONSTRUCTED IN TWO SEPARATE LAYERS OF EQUAL SIZE (THICKNESS). TACK COAT TO BE APPLIED ON SURFACE PRIOR TO PLACEMENT.
14. A MAXIMUM VERTICAL TOLERANCE OF 5mm SHALL APPLY TO THE "TABLE".
15. THE 375mm TIE-IN KEYS TO BE REMOVED BY MECHANICALLY (SAW) CUTTING THE EXISTING ROAD SURFACE.
16. REFER TO DRAWING RD2.2 FOR DROPPED KERB DETAILS.
17. REFER TO DRAWING RM4.1 FOR ROAD SIGN SUPPORT INSTALLATION DETAILS.
18. ROAD STUDS SHALL BE IN ACCORDANCE WITH THE LATEST VERSIONS OF SANS 1442, 1463-1 AND 1463-2. REFER TO **SECTION 9.4** FOR FURTHER DETAILS.
19. ALL NEW EDGINGS, CHANNELS AND KERBS MUST BE LAID WITH 20 MPa CONCRETE BEDDING/BACKING, UNLESS SHOWN OTHERWISE, ON SUBGRADE/SUBBASE COMPACTED TO THE REQUIRED SPECIFICATIONS.

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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

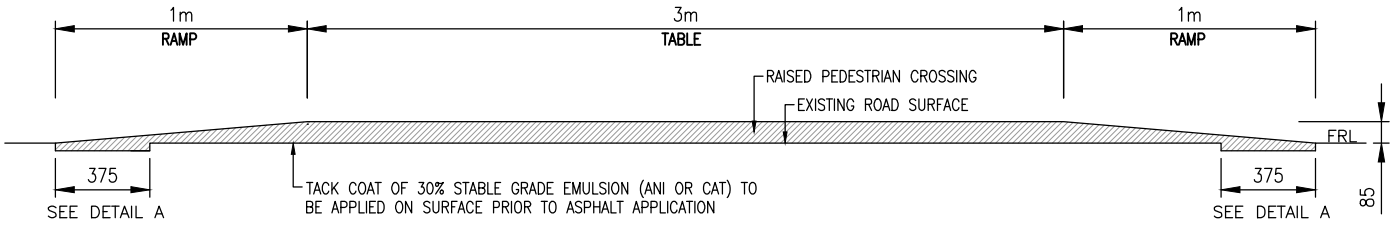
RAISED PEDESTRIAN CROSSING

STANDARDS AND GUIDELINES DETAILS

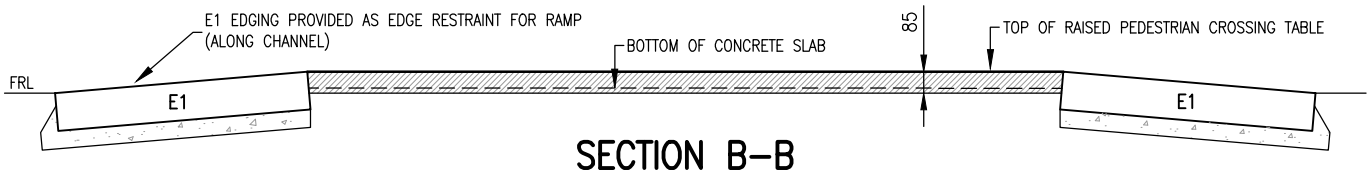
SHEET 1

SCALE	PAPER
N.T.S	A4
DRAWING No.	REV
RD11A	B

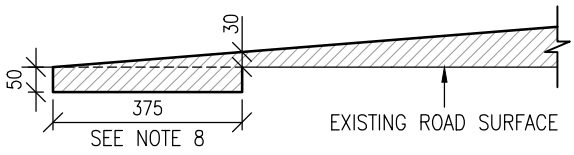
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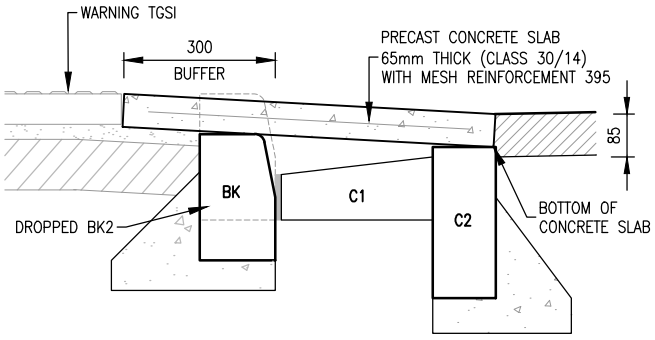
SECTION A–A: LONGITUDINAL SECTION



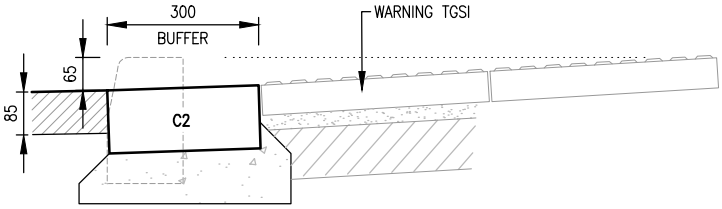
SECTION B–B



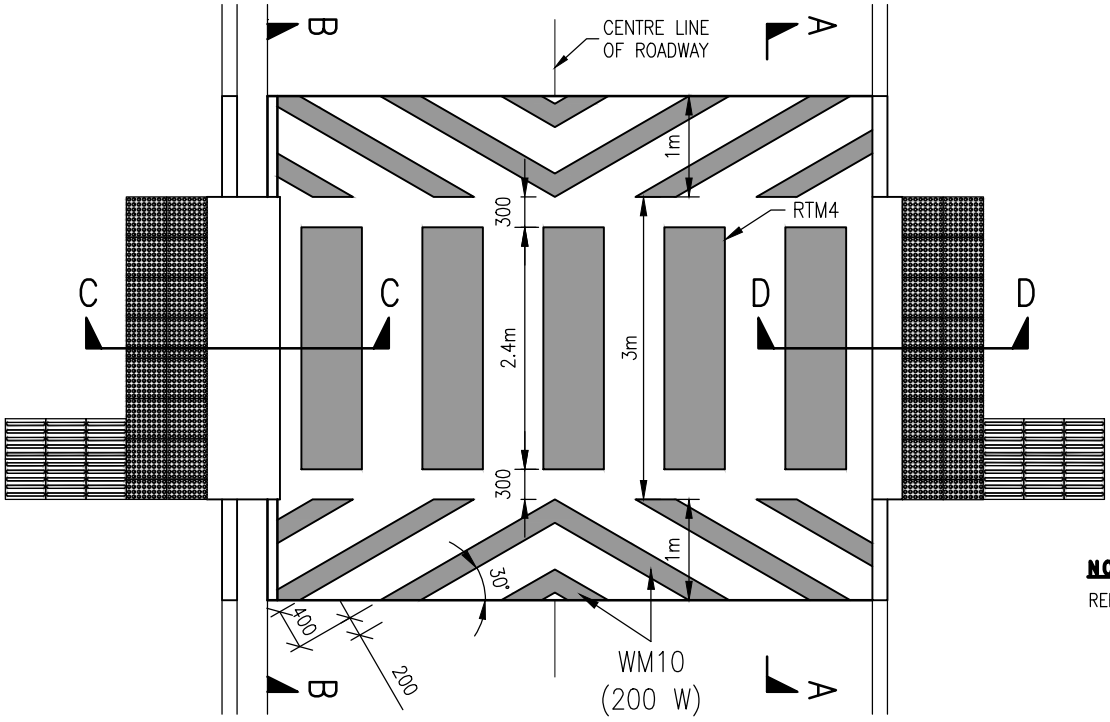
DETAIL A: TIE–IN KEY



SECTION C–C



SECTION D–D



TYPICAL PLAN VIEW

NOTES:

REFER TO SHEET 1 FOR NOTES.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

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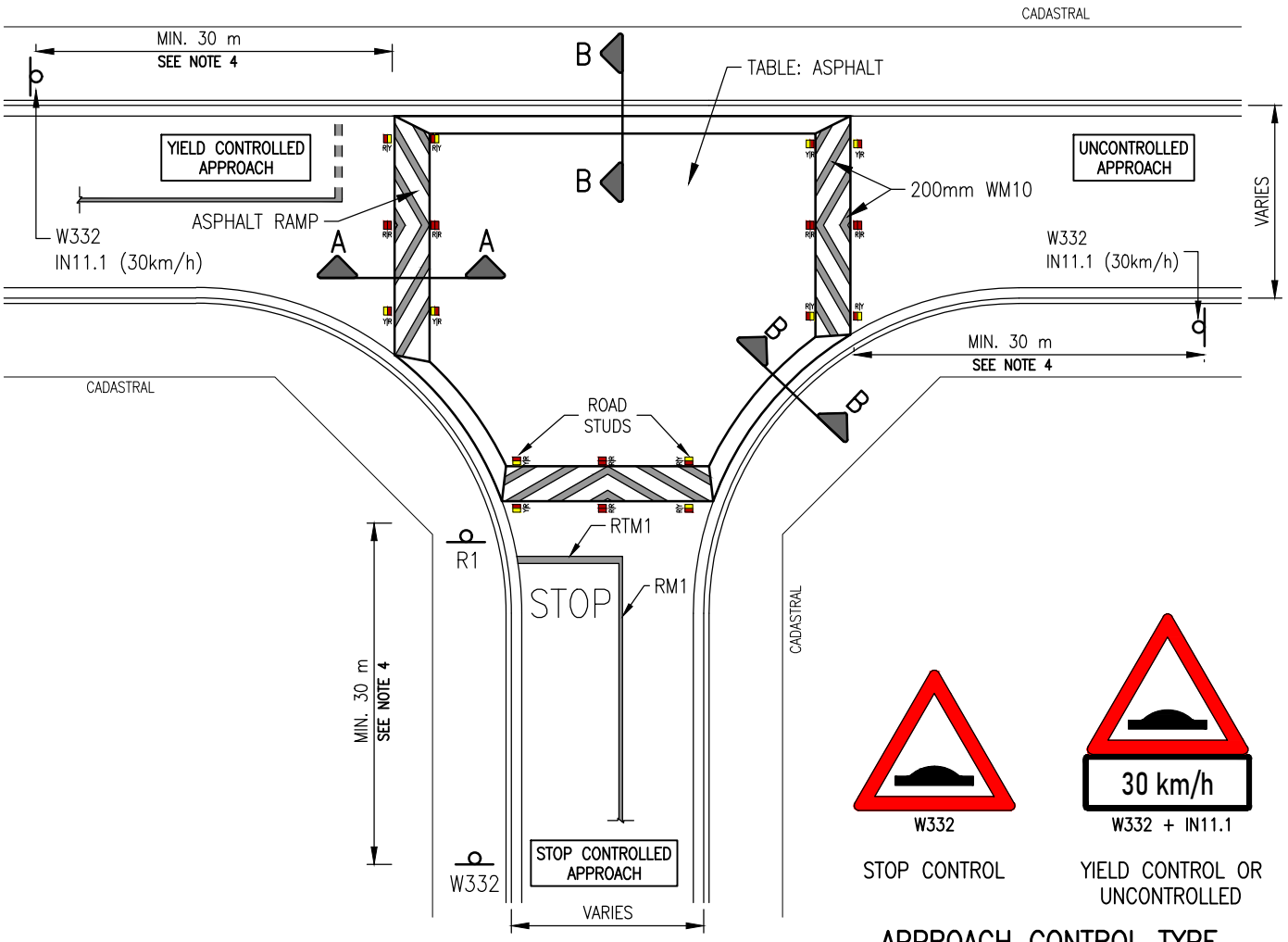
RAISED PEDESTRIAN CROSSING

STANDARDS AND GUIDELINES DETAILS

SHEET 2

SCALE	PAPER
N.T.S	A4
DRAWING No.	REV
RD11B	B

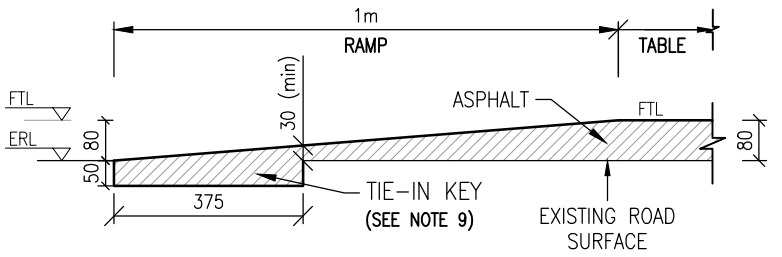
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TYPICAL LAYOUT

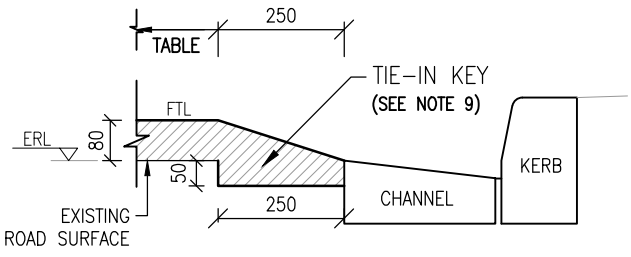
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APPROACH CONTROL TYPE



SECTION A–A

N.T.S.



SECTION B–B

N.T.S.

NOTES:

1. ROAD MARKINGS AND SIGNS TO COMPLY WITH "SADC RTSM–VOL1" AND "SARTSM–VOL2".
2. ALL ROAD SIGNS SHALL BE 600mm IN SIZE AND MUST HAVE CLASS 3 RETRO–REFLECTIVE BACKGROUND MATERIAL. REFER TO DRAWING RM4 FOR ROAD SIGN SUPPORT INSTALLATION DETAILS.
3. ROAD MARKINGS TO BE PAINTED WITH RETRO–REFLECTIVE ROAD MARKING PAINT.
4. THE W332 SIGNS SHOULD NOT BE INSTALLED IN FRONT OF DRIVEWAYS.
5. SIGNS MUST BE ERECTED PRIOR TO THE CONSTRUCTION OF THE RAISED INTERSECTION. ROAD MARKINGS TO BE PAINTED AFTER CONSTRUCTION IS COMPLETE, ALLOWING ENOUGH TIME FOR ASPHALT TO COOL.
6. RAISED INTERSECTION SHALL BE CONSTRUCTED WITH CONTINUOUSLY MEDIUM GRADED ASPHALT. THE ASPHALT TYPE TO BE SPECIFIED BY THE APPROVAL AUTHORITY.
7. THE TABLE HEIGHT SHOULD AT ALL POINTS BE A FIXED DISTANCE ABOVE THE UNDERLYING STREET LEVEL (i.e. THE SHAPE OF THE TABLE SHOULD RESEMBLE THE SHAPE OF THE UNDERLYING LAYER).
8. THE ASPHALT TABLE SHALL BE CONSTRUCTED IN TWO SEPARATE LAYERS OF 40mm THICKNESS EACH.
9. IF THE RAISED INTERSECTION FORMS PART OF THE ORIGINAL CONSTRUCTION OF ROADS, THE TOP OF THE BASE LAYER SHALL BE LOCATED 40mm BELOW THE FINAL TABLE LEVEL (FTL). REFER TO DRAWING RD12.1B.
10. ALL TIE–IN KEYS TO BE MECHANICALLY (SAW) CUT.
11. ANY EXISTING MANHOLES LOCATED WITHIN THE RAISED INTERSECTION SHALL BE ADJUSTED TO THE NEW TABLE HEIGHT. NO MANHOLES TO BE LOCATED ON RAMPS.

ERL: EXISTING ROAD LEVEL
FTL: FINAL TABLE LEVEL

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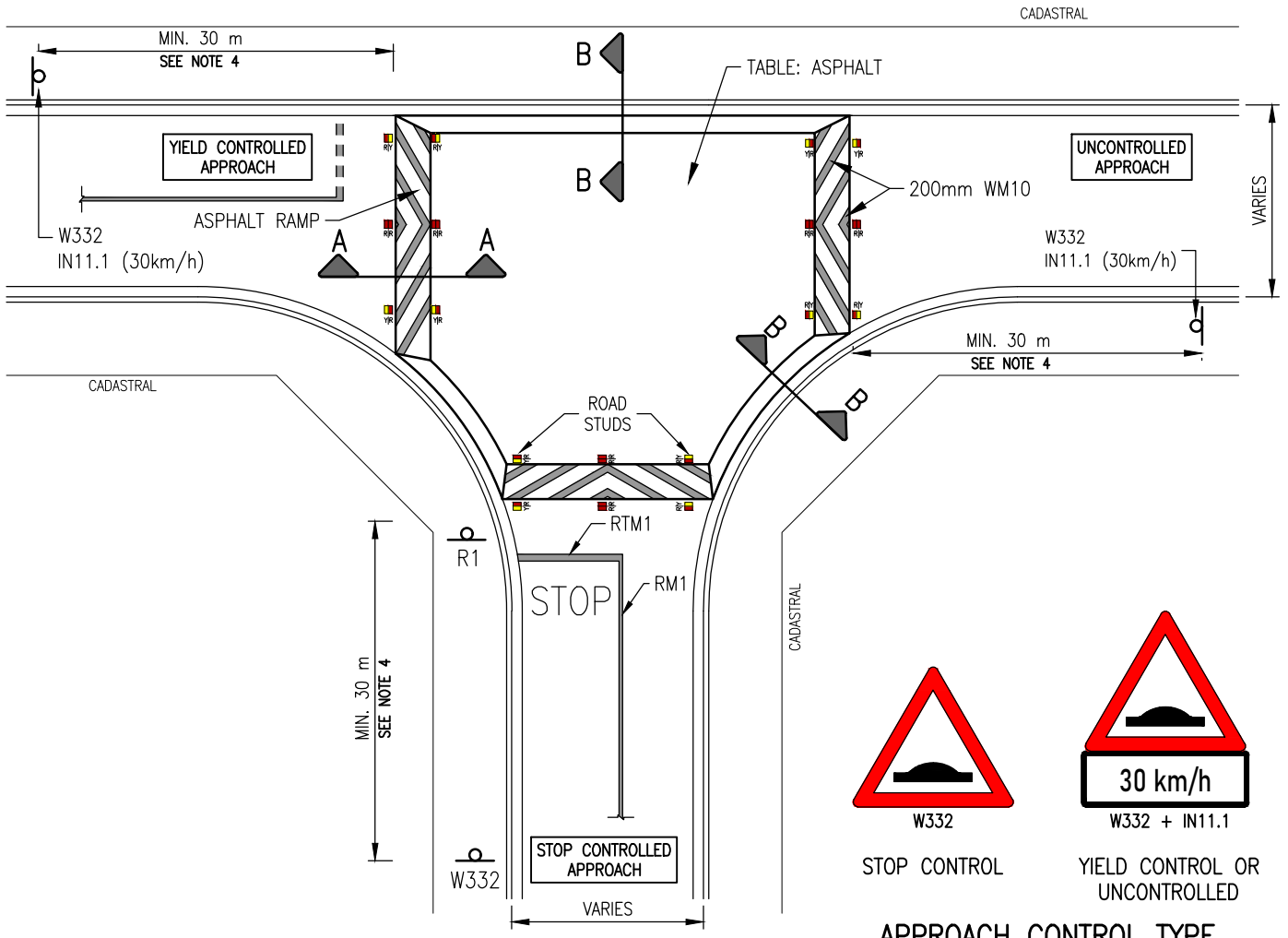
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RAISED INTERSECTION ASPHALT TABLE (FOR EXISTING ROADS)

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD12.1A	B

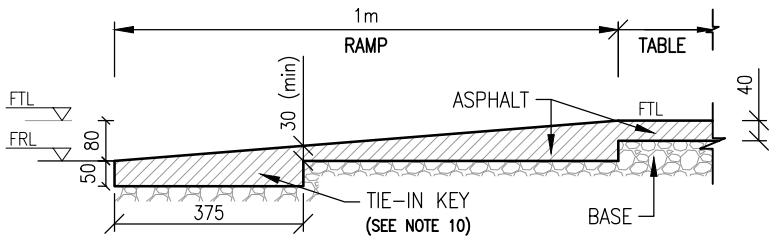
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TYPICAL LAYOUT

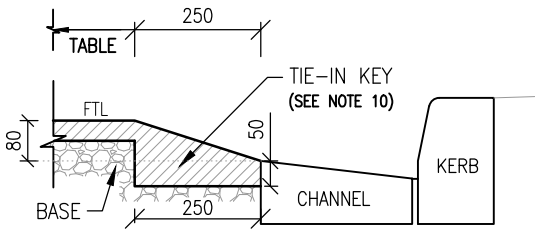
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APPROACH CONTROL TYPE



SECTION A–A

N.T.S.



SECTION B–B

N.T.S.

NOTES:

1. ROAD MARKINGS AND SIGNS TO COMPLY WITH "SADC RTSM–VOL1" AND "SARTSM–VOL2".
2. ALL ROAD SIGNS SHALL BE 600mm IN SIZE AND MUST HAVE CLASS 3 RETRO–REFLECTIVE BACKGROUND MATERIAL. REFER TO DRAWING RM4 FOR ROAD SIGN SUPPORT INSTALLATION DETAILS.
3. ROAD MARKINGS TO BE PAINTED WITH RETRO–REFLECTIVE ROAD MARKING PAINT.
4. THE W332 SIGNS SHOULD NOT BE INSTALLED IN FRONT OF DRIVEWAYS.
5. SIGNS MUST BE ERECTED PRIOR TO THE CONSTRUCTION OF THE RAISED INTERSECTION. ROAD MARKINGS TO BE PAINTED AFTER CONSTRUCTION IS COMPLETE, ALLOWING ENOUGH TIME FOR ASPHALT TO COOL.
6. RAISED INTERSECTION SHALL BE CONSTRUCTED WITH CONTINUOUSLY MEDIUM GRADED ASPHALT. THE ASPHALT TYPE TO BE SPECIFIED BY THE APPROVAL AUTHORITY.
7. THE FINAL TABLE LEVEL (FTL) OF THE RAISED INTERSECTION SHALL BE 80mm HIGHER THAN THE FINAL ROAD LEVEL (FRL), i.e. INTERSECTION TABLE SHALL HAVE A THICKNESS OF 80mm.
8. THE TABLE HEIGHT SHOULD AT ALL POINTS BE A FIXED DISTANCE ABOVE THE UNDERLYING STREET LEVEL (i.e. THE SHAPE OF THE TABLE SHOULD RESEMBLE THE SHAPE OF THE UNDERLYING LAYER).
9. THE BASE LAYER OF THE TABLE SHALL BE CONSTRUCTED IN TWO EQUAL LAYERS.
10. ALL TIE–IN KEYS TO BE MECHANICALLY (SAW) CUT.
11. MANHOLES LOCATED WITHIN THE RAISED INTERSECTIONS SHALL BE CONSTRUCTED TO THE FINAL TABLE LEVEL (FTL). NO MANHOLES TO BE LOCATED ON RAMPS.

FRL: FINAL ROAD LEVEL
FTL: FINAL TABLE LEVEL

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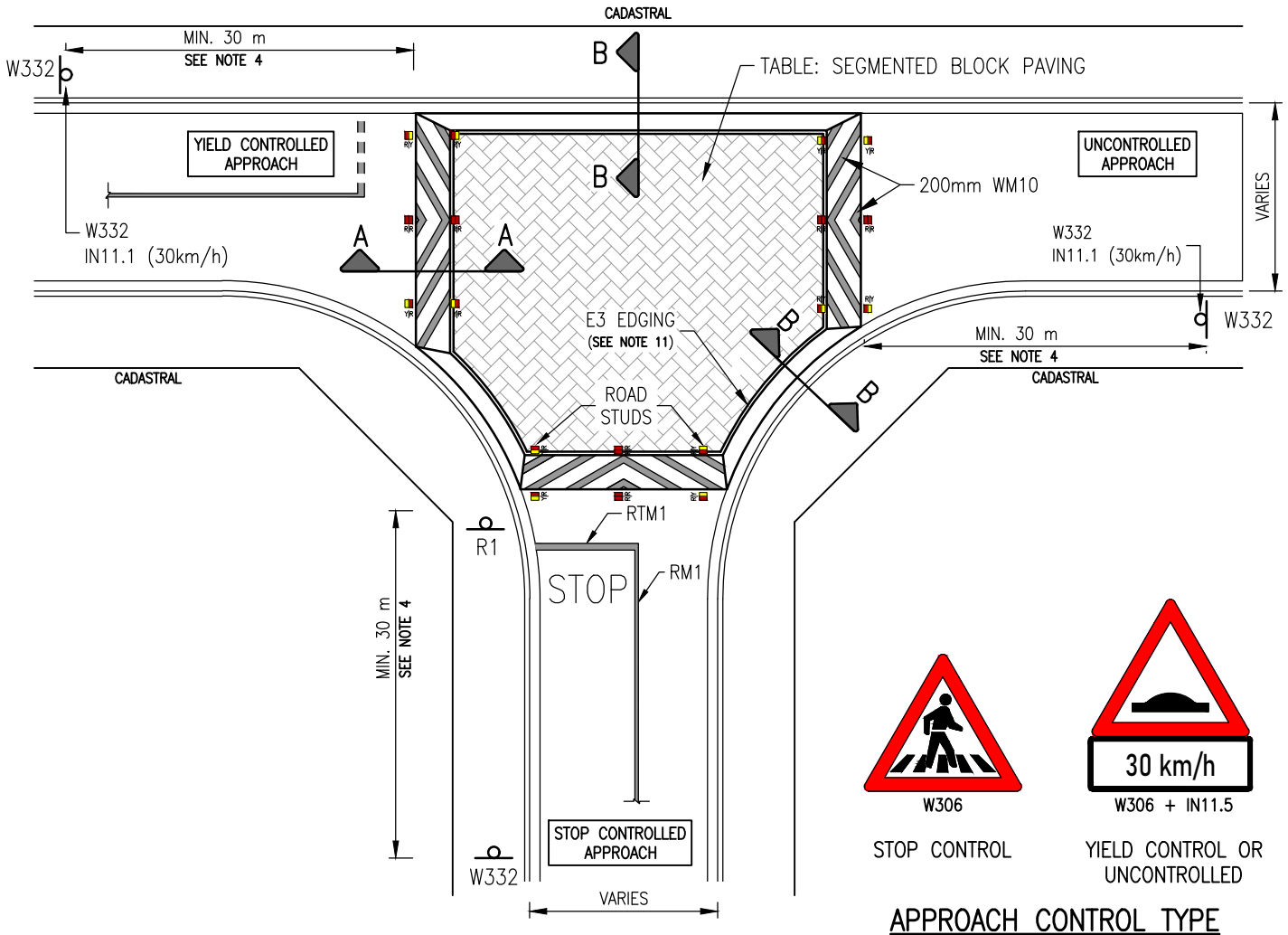
TITLE

RAISED INTERSECTION ASPHALT TABLE (FOR NEW ROADS)

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
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DRAWING No.	REV
RD12.1B	B

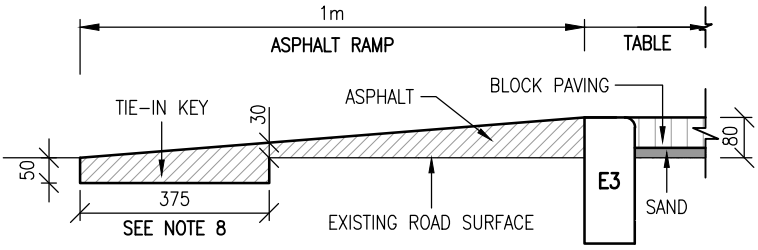
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APPROACH CONTROL TYPE

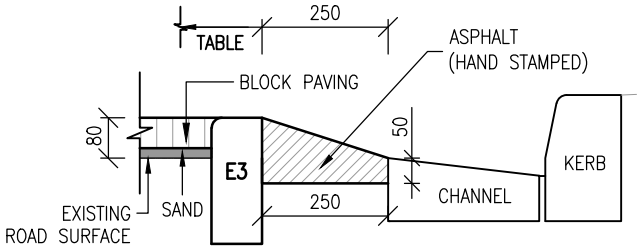
TYPICAL LAYOUT

SCALE 1:200



SECTION A–A

N.T.S.



SECTION B–B

N.T.S.

NOTES:

1. ROAD MARKINGS AND SIGNS TO COMPLY WITH "SADC–RTSM–VOL1" AND "SARTSM–VOL2".
2. ALL ROAD SIGNS SHALL BE 600mm IN SIZE AND MUST HAVE CLASS 3 RETRO–REFLECTIVE BACKGROUND MATERIAL. REFER TO DRAWING RM4 FOR ROAD SIGN SUPPORT INSTALLATION DETAILS.
3. ROAD MARKINGS TO BE PAINTED WITH RETRO–REFLECTIVE ROAD MARKING PAINT.
4. THE W332 SIGNS SHALL NOT BE INSTALLED IN FRONT OF DRIVEWAYS.
5. SIGNS MUST BE ERECTED PRIOR TO THE CONSTRUCTION OF THE RAISED INTERSECTION. ROAD MARKINGS TO BE PAINTED AFTER CONSTRUCTION IS COMPLETE, ALLOWING ENOUGH TIME FOR ASPHALT TO COOL.
6. THE RAMPS SHALL BE CONSTRUCTED WITH ASPHALT AND THE TABLE FROM SEGMENTED BLOCK PAVING, AS SPECIFIED BY THE APPROVAL AUTHORITY.
7. THE TABLE HEIGHT SHOULD AT ALL POINTS BE A FIXED DISTANCE ABOVE THE UNDERLYING STREET LEVEL (i.e. THE SHAPE OF THE TABLE SHOULD RESEMBLE THE SHAPE OF THE UNDERLYING LAYER).
8. ALL TIE–IN KEYS TO BE MECHANICALLY (SAW) CUT.
9. THE SLOPE OF THE ASPHALT RAMP SHALL NOT EXCEED 1:10.
10. ON RADII, E3 EDGINGS SHALL BE SAW CUT INTO 330mm LENGTHS.
11. REFER TO DRAWING RD1.3 FOR EDGING INSTALLATION DETAILS.
12. ANY EXISTING MANHOLES LOCATED WITHIN THE RAISED INTERSECTION SHALL BE RAISED TO THE NEW SURFACE HEIGHT.

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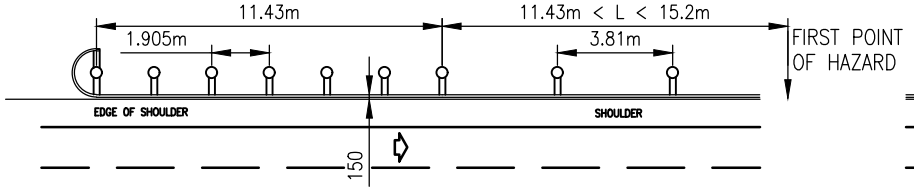
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RAISED INTERSECTION
SEGMENTED BLOCK PAVING TABLE

STANDARDS AND GUIDELINES DETAILS

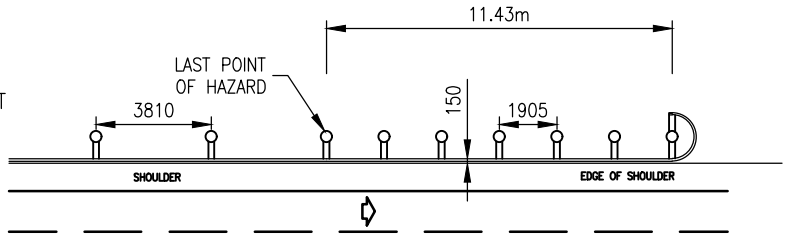
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DRAWING No.	REV
RD12.2	B

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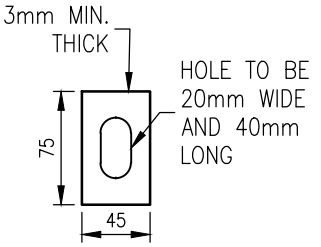
APPROACH END

SCALE 1:30



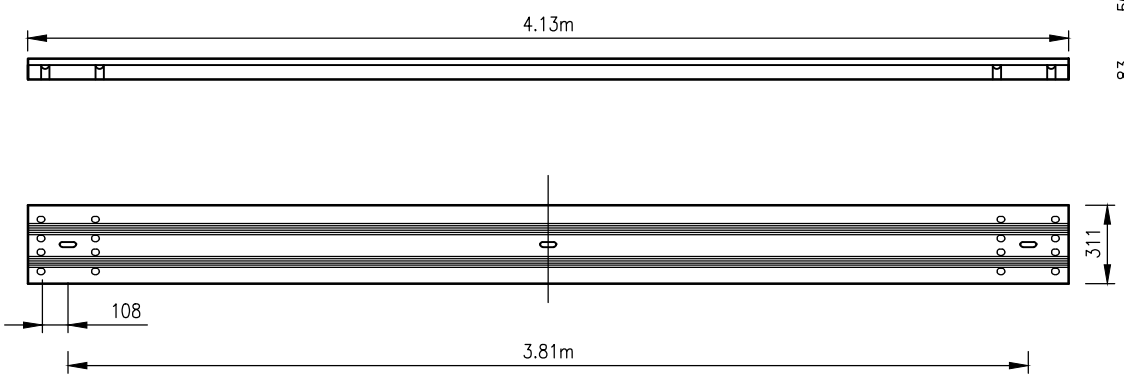
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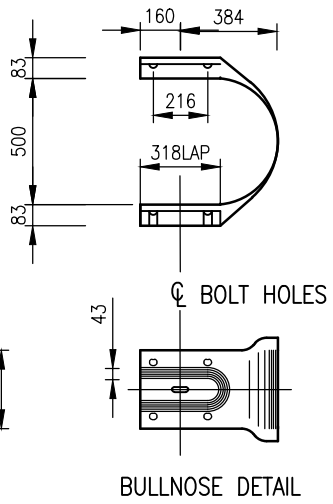
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REINFORCING PLATE

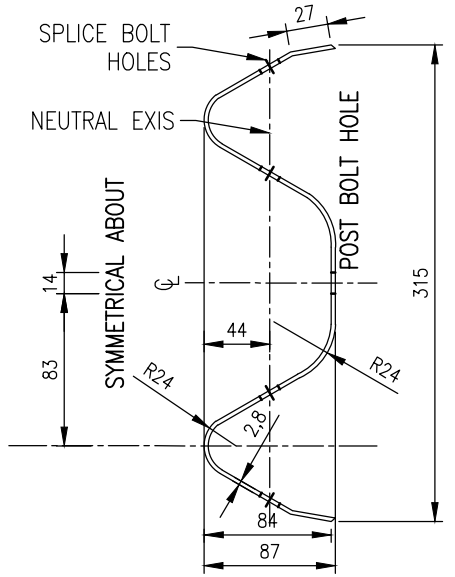
SCALE 1:5





GUARDRAIL DETAIL

SCALE 1:30



SECTION THROUGH GUARDRAIL

SCALE 1:5

NOTES:

1. GUARDRAILS AND DETAILS TO BE IN ACCORDANCE WITH SANS 1350 (2005).

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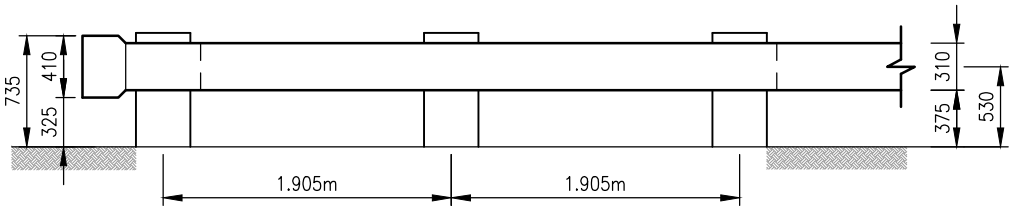
GUARDRAIL DETAILS

STANDARDS AND GUIDELINES DETAILS

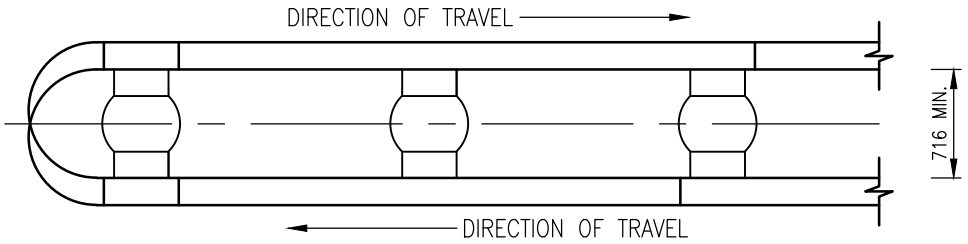
SHEET 1

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD13.1	A

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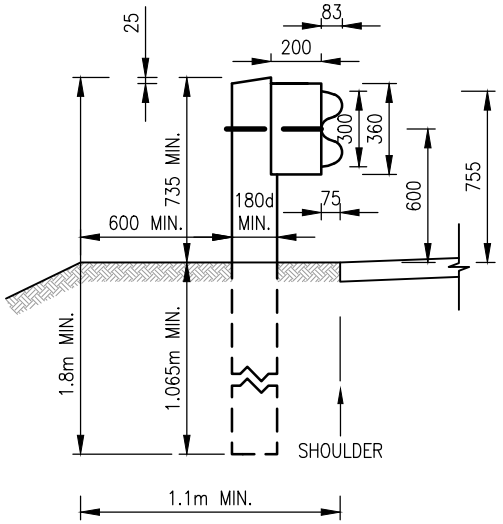
ELEVATION



PLAN

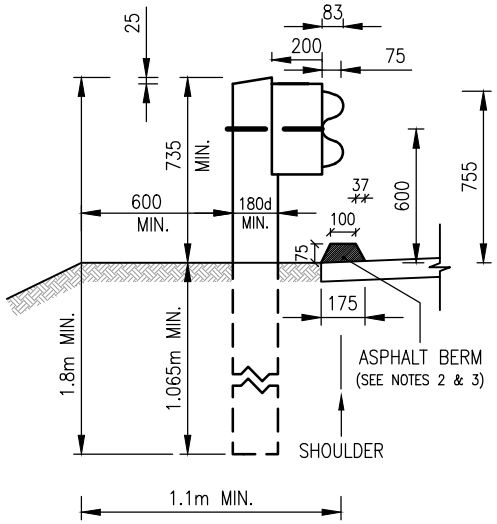
MEDIAN BARRIER TERMINAL

SCALE 1:50



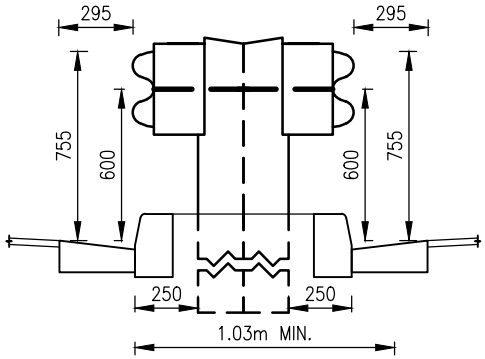
GUARDRAIL POSITION:
NORMAL CONDITION

SCALE 1:30



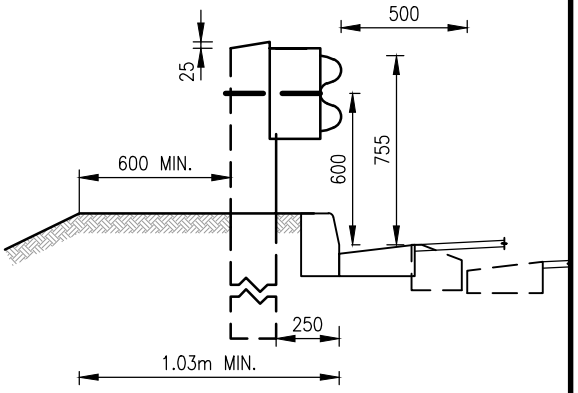
GUARDRAIL POSITION:
WITH PREMIX BERM

SCALE 1:30



GUARDRAIL POSITION
WITH KERB & CHANNEL

SCALE 1:30



GUARDRAIL POSITION:
WITH KERB & CHANNEL

SCALE 1:30

NOTES:

1. POST SPACING TO BE 1905mm FOR FIRST AND LAST THREE LENGTHS OF RAIL AND 3810mm IN BETWEEN.
2. AREA UNDER ASPHALT BERM TO BE PRIMED/TACKED.
3. IF THE LENGTH OF THE ASPHALT BERM EXCEEDS 20m, THEN 100mm GAPS TO BE PROVIDED EVERY 10m TO ACCOMMODATE STORMWATER RUNOFF.

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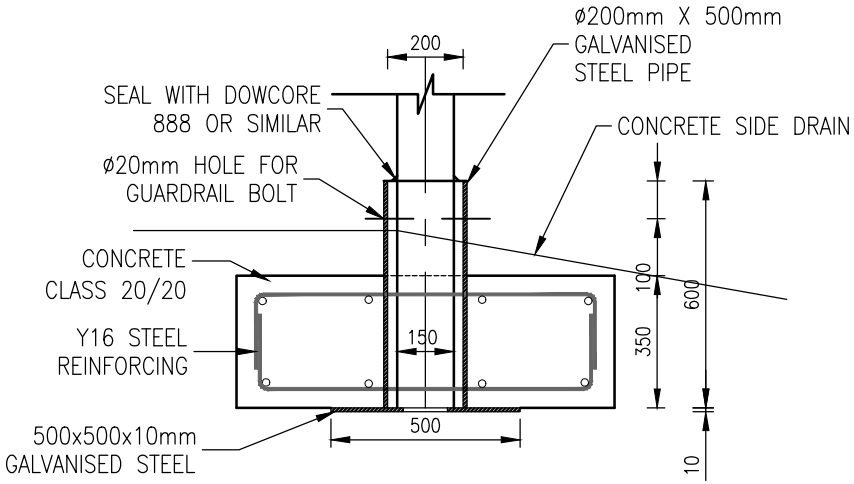
GUARDRAIL DETAILS

STANDARDS AND GUIDELINES DETAILS

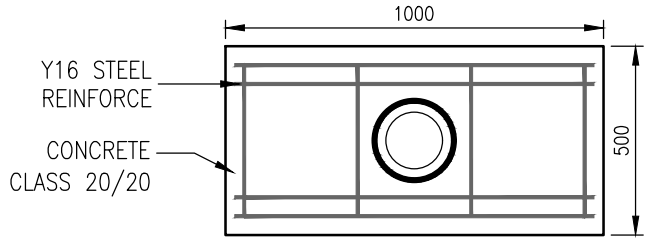
SHEET 2

SCALE	PAPER
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DRAWING No.	REV
RD13.2	B

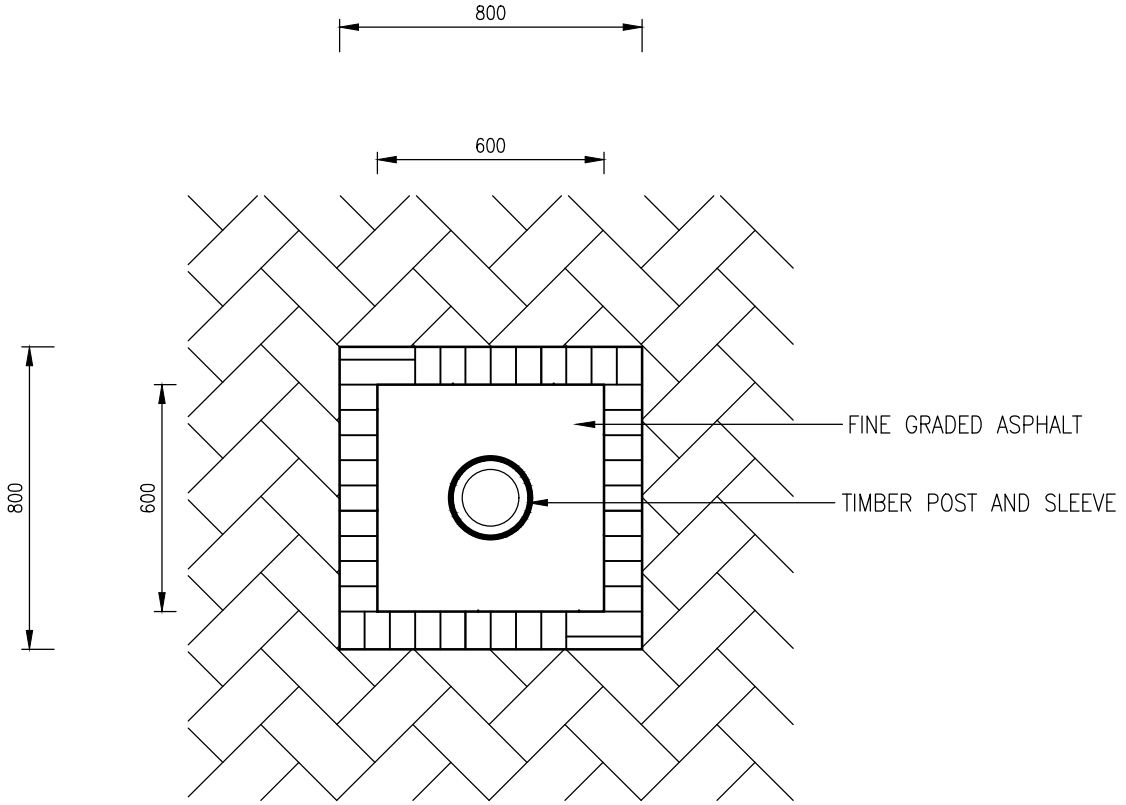
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ELEVATION: GUARDRAIL SLEEVE DETAIL



PLAN VIEW: GUARDRAIL FOUNDATION



PAVED AREAS

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CITY OF CAPE TOWN
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TITLE

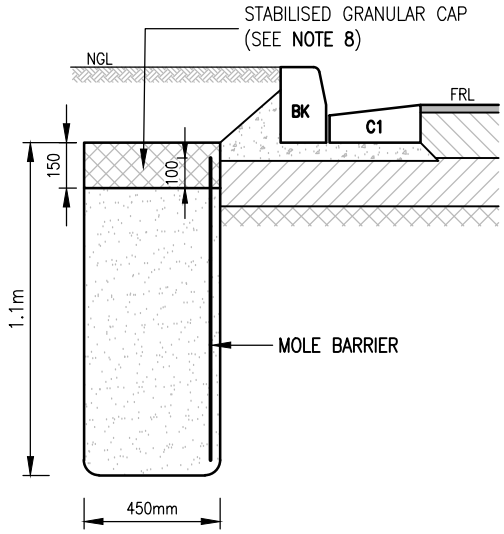
GUARDRAIL DETAILS

STANDARDS AND GUIDELINES DETAILS

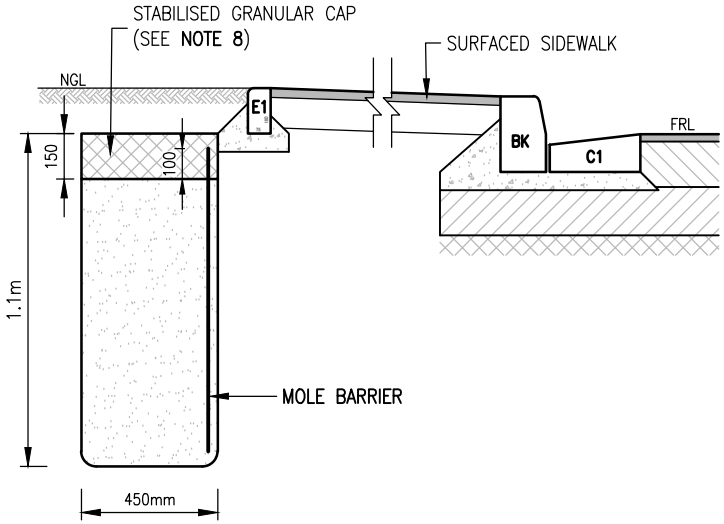
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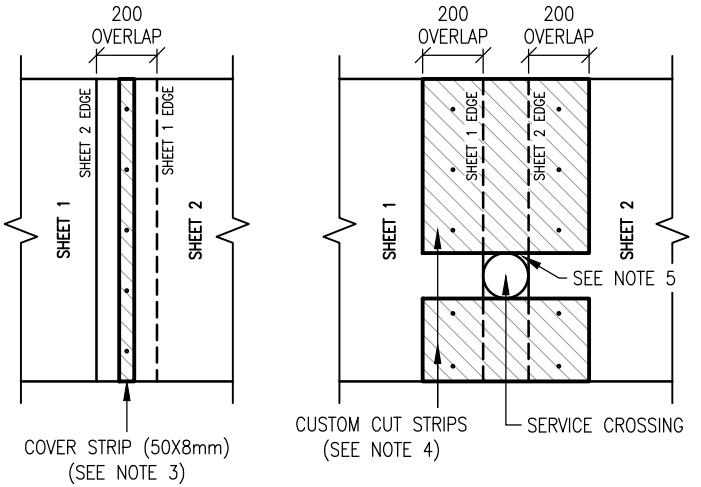
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TYPE A: BEHIND KERB
(NO SIDEWALK)



TYPE B: BEHIND EDGING
(SIDEWALK ADJACENT TO KERB)



SHEET ENDS AT SERVICE CROSSING
SHEET JOINTS

NOTES:

1. MOLE BARRIER SHEETS TO BE HDPE SHEETING, 2mm THICK, 1m IN HEIGHT (MINIMUM).
2. IF REQUIRED, PERFORATION SHALL BE MADE BY PUNCHING 8mm HOLES AT AN APPROXIMATE GRID SPACING OF 200x200mm.
3. SHEET ENDS:
   - 3.1. SHEET ENDS TO OVERLAP BY 200mm MINIMUM AND SECURED WITH A 50mm x 8mm COVER STRIP ON EITHER SIDE, JOINED WITH SCREWS.
   - 3.2. SHEET ENDS MAY ALSO BE BONDED BY MEANS OF PLASTIC WELDING (OR OTHER APPROVED METHODS), SUBJECT TO APPROVAL.
4. SERVICE CROSSINGS:
   - 4.1. AT SERVICE CROSSINGS, SHEETS TO BE MODIFIED TO ACCOMMODATE THE CROSSING SERVICES.
   - 4.2. CUSTOM CUT STRIPS SHALL BE USED TO JOIN THE SHEETS (200mm MINIMUM OVERLAP). STRIPS TO BE PROVIDED ON EITHER SIDE, JOINED WITH SCREWS.
5. WHEN THE SOFFIT OF THE SERVICE IS LESS THAN 1m DEEP, GAPS LARGER THAN 25mm DIAMETER TO BE PATCHED AND MORTARED OVER.
6. TRENCH WIDTH SHALL BE AT LEAST 450mm WIDE.
7. EXCAVATION TO BE BACKFILLED WITH SUITABLE GRANULAR MATERIAL, COMPACTED IN 150mm LAYERS TO 93% MOD AASHTO (100% FOR SAND) AT OPTIMUM MOISTURE CONTENT.
8. A 150mm THICK STABILISED GRANULAR CAP (5% CEMENT) SHALL BE PROVIDED AT THE UPPER PORTION OF THE TRENCH, COVERING AT LEAST THE UPPER 100mm OF THE BARRIER SHEETING. AN IN-SITU CASTED CONCRETE CAP WILL ALSO BE ACCEPTED.
9. WHERE A SUBSURFACE DRAIN IS LOCATED BEHIND THE ROADWAY KERB, THE MOLE BARRIER SHALL BE PROVIDED BEHIND THE SUBSURFACE DRAIN.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

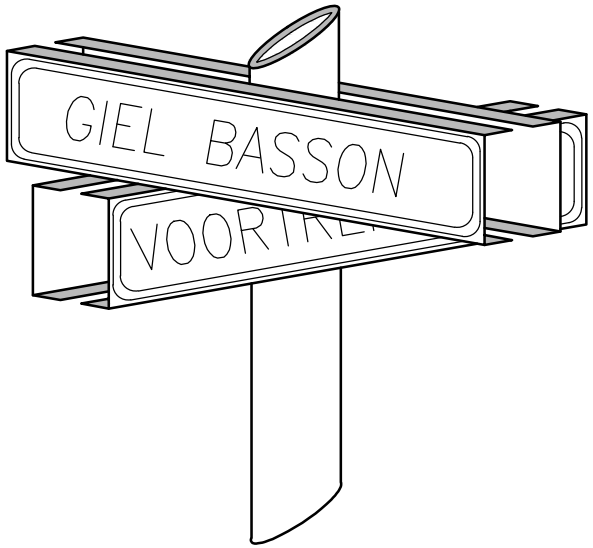
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MOLE BARRIER

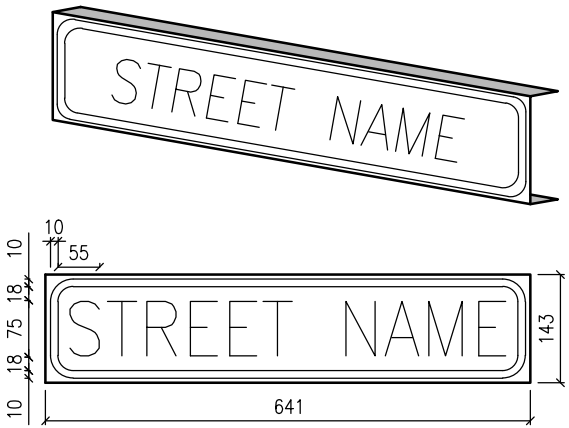
STANDARDS AND GUIDELINES DETAILS

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BRACKET MOUNTED PLATES
(BACK-TO-BACK)



FRONT ELEVATION



TOP MOUNTED PLATES

NOTES:

NAME PLATES
1. COLOUR: SEMI-MATT BLACK ON WHITE CLASS 3 BACKGROUND.
2. 1.4mm CHROMADEK PLATE, BENT TOP AND BOTTOM WITH A 25mm BEND FOR STRENGTHENING.

BRACKET MOUNTED PLATES
3. GALVANISED P4000 CHANNEL SECTION STAGGERED ON THE REAR OF EACH SIGN FOR CLAMPING TO SUPPORT (BRACKETS).
4. 60mm OR 76mm DIAMETER GALVANISED POLE, UNLESS APPROVED OTHERWISE.

TOP MOUNTED PLATES
5. GALVANISED MILD STEEL PIPE FITTING FOR MOUNTING ONTO A 60mm DIAMETER GALVANISED POLE.
6. THE FITTING IS RIVETED TO THE BOTTOM LIP OF THE SIGN AS INDICATED.
7. A CROSS IS SUPPLIED IN THE EVENT OF 2 SIGNS TO BE SUPPORTED ON THE SAME SUPPORT.

GENERAL
8. REFER TO DRAWING RM4 FOR ROAD SIGN SUPPORT INSTALLATION DETAILS.
9. LETTERING SHALL BE IN ACCORDANCE WITH SADC-RTSM VOL1&4. THE TYPEFACE SHALL BE DIN 1451 PART 2, STYLES "A" AND "B".

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

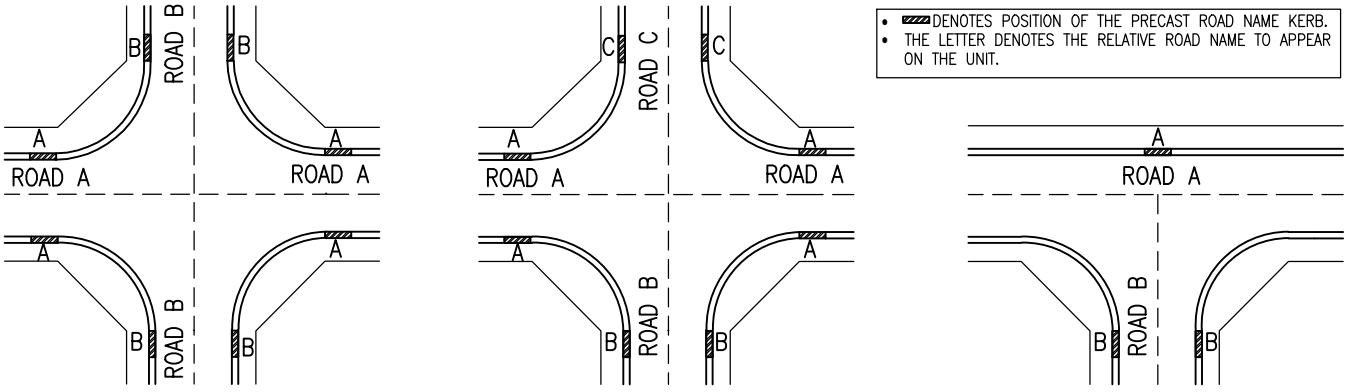
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STREET NAME PLATE

STANDARDS AND GUIDELINES DETAILS

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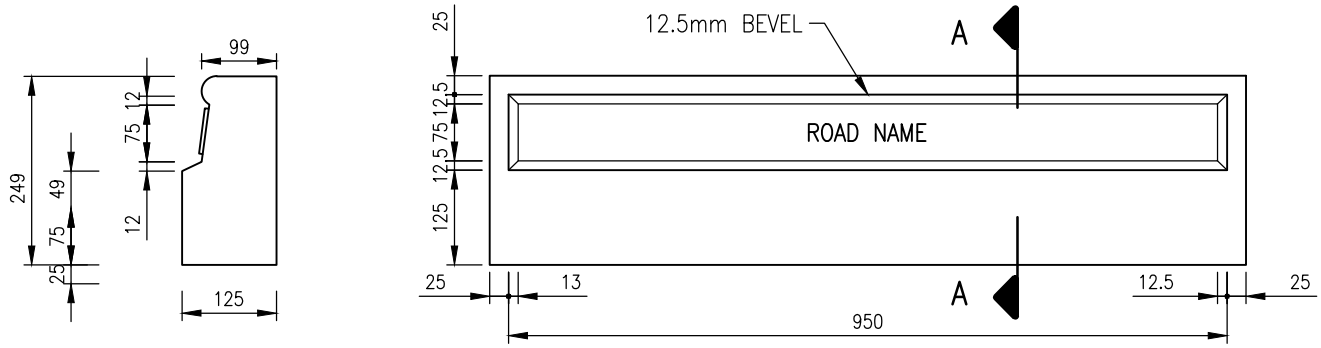


- DENOTES POSITION OF THE PRECAST ROAD NAME KERB.
- THE LETTER DENOTES THE RELATIVE ROAD NAME TO APPEAR ON THE UNIT.

2 ROAD NAMES | **3 ROAD NAMES** | **ROAD NAMES OPPOSITE INTERSECTING ROAD**

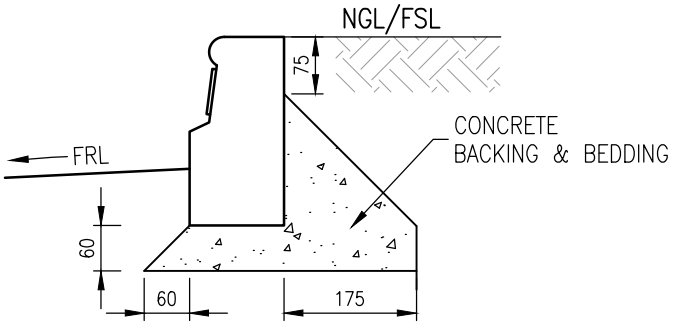
PLAN VIEW SHOWING ROAD NAME KERB POSITIONS

N.T.S



SECTION A–A | **FRONT ELEVATION**

TYPICAL ROAD NAME KERB



NAME KERB INSTALLATION

NOTES:

1. ROAD NAMES KERBS SHALL BE INSTALLED IN LINE WITH THE EXISTING KERBLINE.
2. ALL UNITS MUST BE LAID WITH A CLASS 20/20 CONCRETE BEDDING/BACKING, UNLESS SHOWN OTHERWISE, ON SUBGRADE/SUBBASE COMPACTED TO THE REQUIRED SPECIFICATIONS.
3. RECESSED LETTERS PAINTED BLACK AND THE REMAINDER OF THE KERB TO HAVE A WHITE BACKGROUND.
4. ALTERNATIVELY, ROAD NAMES MAY BE PAINTED ON THE KERBLINE BY MEANS OF A STENCIL. THE LETTERS SHALL BE PAINTED BLACK AND THE REMAINDER OF THE KERB TO HAVE A WHITE BACKGROUND.
5. LETTERING SHALL HAVE A HEIGHT OF 75mm AND SHALL BE IN TYPEFACE DIN 1451 PART 2, STYLES "A" AND "B".

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

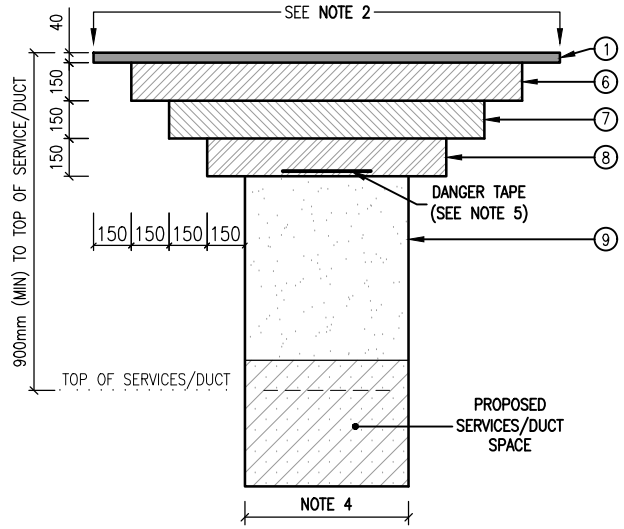
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ROAD NAME AND KERB DETAILS

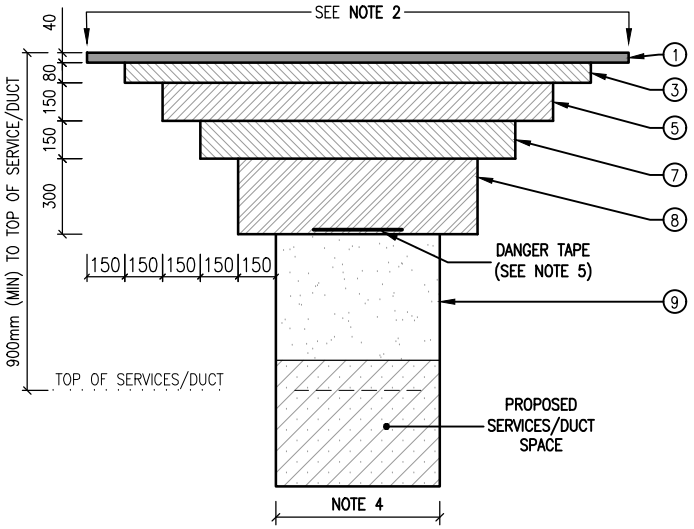
STANDARDS AND GUIDELINES DETAILS

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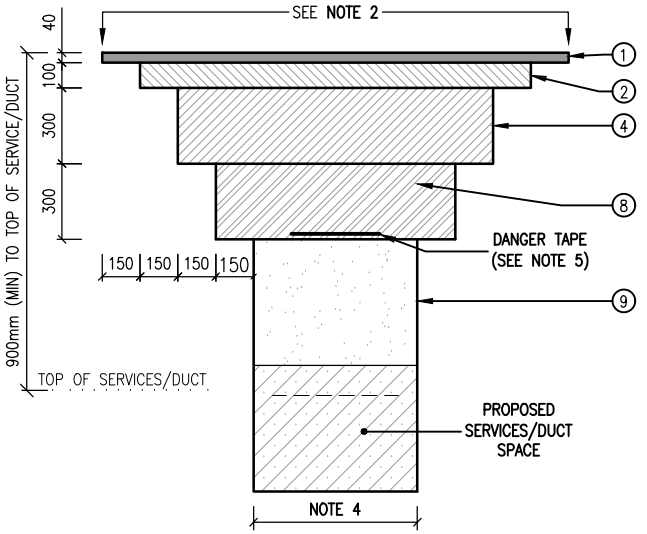
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TYPE A1
CLASS 5B–D ROADS
(LOCAL RESIDENTIAL STREETS)



TYPE A2
CLASS 5A & 4 ROADS
(LOCAL COMMERCIAL STREETS & COLLECTORS)



TYPE A3
CLASS 2 & 3 ROADS
(ARTERIALS)

NOTES:

1. THE SPECIFIED LAYER WORKS SHOULD BE CONSIDERED AS A GUIDELINE. ONCE THE EXISTING LAYER WORKS OF THE ROADWAY HAVE BEEN DETERMINED, THE ENGINEER SHALL SUBMIT A FINAL LAYER WORKS REINSTATEMENT PROPOSAL TO THE APPROVAL AUTHORITY.
2. ASPHALT SURFACE LAYERS SHALL BE MECHANICALLY SAW CUT PRIOR TO THE BREAKING UP OF THE EXISTING LAYERS AND AGAIN BEFORE THE PLACING OF THE FINAL ASPHALT LAYER.
3. ASPHALT JOINTS:
   - 3.1. JOINT SHALL BE CUT IN STRAIGHT LINES, PARALLEL OR AT RIGHT ANGLES TO THE CENTERLINE, USING A MECHANICAL SAW CUT.
   - 3.2. LONGITUDINAL ASPHALT JOINTS SHALL NOT BE POSITIONED IN ANY VEHICLE WHEEL–PATHS. JOINTS SHALL BE POSITIONED ON THE LANE MARKING (OR MAX. 150mm OFFSET THEREFROM)..
   - 3.3. CUT EDGES OF ASPHALT JOINTS SHALL RECEIVE A COAT OF RUBBERIZED BITUMEN EMULSION ALONG THE ENTIRE VERTICAL FACE, PRIOR TO THE ASPHALT BEING PLACED.
   - 3.4. REFER TO **SECTION 8.5.3** FOR FURTHER DETAILS.
   - 3.5. ALL "COLD" ASPHALT JOINTS TO BE PROPERLY SEALED WITH A WATERPROOFING SEALANT TO PREVENT THE INGRESS OF WATER. THE SEALANT SHALL BE UNDILUTED AND BRUSH–APPLIED AT 0.71L/m^2, AT A MINIMUM WIDTH OF 100mm.
4. TRENCH WIDTH SHALL DEPEND ON THE REQUIRED SERVICE TO BE INSTALLED.
   - 4.1. FOR STORMWATER, SEWER AND WATER SERVICES, SUFFICIENT SIDE ALLOWANCE SHALL BE PROVIDED, TO ENSURE ADEQUATE COMPACTION.
   - 4.2. FOR SERVICE DUCTS, REFER TO **CHAPTER 13** FOR THE VARIOUS DUCT TYPE REQUIREMENTS AND SPECIFICATIONS.
5. THE PROVISION OF DANGER TAPE MAY BE REQUIRED FOR ELECTRICAL AND TELECOMMUNICATION SERVICES. PROVISION THEREOF TO BE DISCUSSED/CONFIRMED WITH THE SERVICE OWNER.
6. REINSTATEMENTS NOT COVERED IN THIS DRAWING SHALL BE DISCUSSED AND APPROVED BY THE APPROVAL AUTHORITY.

ROAD LAYER WORKS:

1. 40mm CONTINUOUSLY GRADED ASPHALT SURFACING (93% MAX. VOIDLESS DENSITY)
2. 100mm CONTINUOUSLY GRADED BTB (93% MAX. VOIDLESS DENSITY)
3. 80mm CONTINUOUSLY GRADED BTB (93% MAX. VOIDLESS DENSITY)
4. 300mm C3/C4 CEMENT STABILIZED SUBBASE, CONSTRUCTED IN TWO LAYERS OF 150mm (97% MDD)
5. 150mm G3 BASE (100% MDD)
6. 150mm G4 BASE (100% MDD)
7. 150mm G5 SUBBASE (98% MDD)
8. G7 SELECTED LAYER, CONSTRUCTED IN 150mm LAYERS (95% MDD, 100% FOR SAND) (or 10mm/BLOW FOR DCP TESTING)
9. EXCAVATED MATERIAL (IF SUITABLE – MINIMUM G9 QUALITY), COMPACTED IN 150mm LAYERS (93% MDD, 100% FOR SAND) (or ≤20mm/BLOW FOR DCP TESTING)

NOTES: AGGREGATE SAND OR GRANULAR MATERIAL, ALL OF NON–CONHESIVE NATURE AND FREE FROM ALL ORGANIC MATERIAL OF WHICH THE GRADING ANALYSES SHOWS 100% PASSING A 13,2MM SIEVE AND NOT MORE THAN 5% PASSING A 0,075MM SIEVE. BINDER TYPE FOR ASPHALT LAYERS (SURFACING & BASE) SHALL BE SPECIFIED IN FINAL PROPOSAL.

ROAD CLASSES

CLASS 2 : MAJOR ARTERIAL
CLASS 3 : MINOR ARTERIAL
CLASS 4 : COLLECTOR
CLASS 5A : LOCAL COMMERCIAL STREET
CLASS 5B–D: LOCAL RESIDENTIAL STREETS

SHEET INDEX:

SHEET 1: ROADWAY REINSTATEMENT SPECIFICATIONS
SHEET 2: PEDESTRIAN FOOTWAY REINSTATEMENT SPECIFICATIONS

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

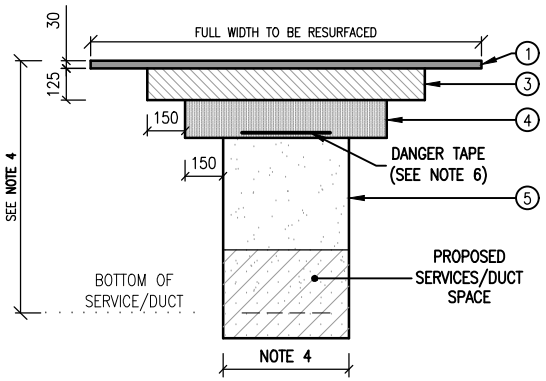
REINSTATEMENT OF SHALLOW TRENCHES IN ROAD RESERVES TRENCHES IN ROADWAYS

STANDARDS AND GUIDELINES DETAILS

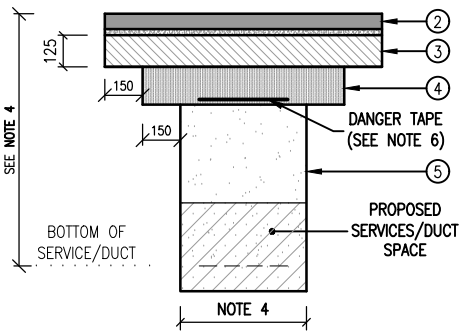
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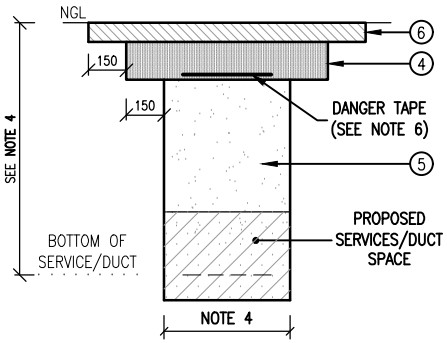
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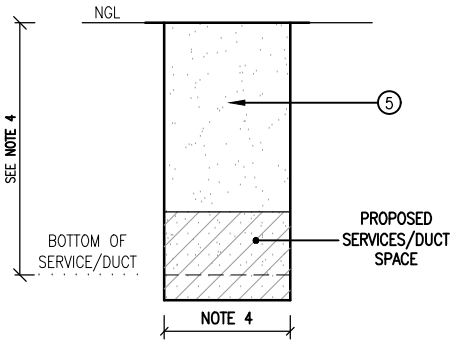
TYPE B1:
PEDESTRIAN FOOTWAY
(ASPHALT)



TYPE B2:
PEDESTRIAN FOOTWAY
(SEGMENTED PAVING)



TYPE B3:
STABILISED GRAVEL WC



TYPE B4:
UNMADE VERGE

NOTES:

1. THE SPECIFIED LAYER WORKS SHOULD BE CONSIDERED AS A GUIDELINE. ONCE THE EXISTING LAYER WORKS OF THE ROADWAY HAVE BEEN DETERMINED, THE ENGINEER SHALL SUBMIT A FINAL LAYER WORKS REINSTATEMENT PROPOSAL TO THE APPROVAL AUTHORITY.
2. WHERE THE WIDTH OF THE FOOTWAY IS LESS THAN 2m, THE ENTIRE WIDTH OF THE SURFACING SHALL BE REPLACED (ONLY APPLICABLE TO ASPHALT FOOTWAYS).
3. ASPHALT JOINTS:
   - 3.1. ALL JOINTS SHALL BE SAW CUT PRIOR TO THE PLACING OF THE NEW ASPHALT LAYER.
   - 3.2. ALL JOINTS SHALL BE CUT PERPENDICULAR ACROSS THE FOOTWAY (NO DIAGONAL JOINTS SHALL BE ACCEPTED).
   - 3.3. REFER TO **SECTION 8.5.3** FOR FURTHER DETAILS.
   - 3.4. ALL "COLD" ASPHALT JOINTS TO BE PROPERLY SEALED WITH A WATERPROOFING SEALANT TO PREVENT THE INGRESS OF WATER. THE SEALANT SHALL BE UNDILUTED AND BRUSH-APPLIED AT 0.71L/m^2, AT A MINIMUM WIDTH OF 100mm.
4. TRENCH WIDTH SHALL DEPEND ON THE REQUIRED SERVICE TO BE INSTALLED.
   - 4.1. FOR STORMWATER, SEWER AND WATER SERVICES, SUFFICIENT SIDE ALLOWANCE SHALL BE PROVIDED, TO ENSURE ADEQUATE COMPACTION.
   - 4.2. FOR SERVICE DUCTS, REFER TO **CHAPTER 13** FOR THE VARIOUS DUCT TYPE REQUIREMENTS AND SPECIFICATIONS.
5. TRENCH DEPTH:
   - 5.1. SHALL BE LIMITED TO 1m FOR TELECOMMUNICATION SERVICES.
   - 5.2. WHERE UNSTABLE GROUND CONDITIONS EXIST, SHORING/PROTECTION SHOULD BE APPLIED IN ORDER TO PROTECT ADJACENT STRUCTURES.
6. THE PROVISION OF DANGER TAPE MAY BE REQUIRED FOR ELECTRICAL AND TELECOMMUNICATION SERVICES. THE PROVISION THEREOF TO BE DISCUSSED/CONFIRMED WITH THE SERVICE OWNER.
7. REINSTATEMENTS NOT COVERED IN THIS DRAWING SHALL BE DISCUSSED AND APPROVED BY THE APPROVAL AUTHORITY.

PEDESTRIAN FOOTWAY LAYER WORKS:

1. 30mm CONTINUOUSLY FINE GRADED ASPHALT SURFACING
2. CONCRETE/CLAY PAVING BLOCKS ON 20mm SAND
3. 125mm G5 SUBBASE COMPACTED TO 98% MDD (or 5mm/BLOW FOR DCP TESTING)
4. 150mm G7 COMPACTED COMPACTED TO 95% MDD (100% FOR SAND) (or 10mm/BLOW FOR DCP TESTING)
5. EXCAVATED MATERIAL (IF SUITABLE – MINIMUM G9 QUALITY), COMPACTED IN 150mm LAYERS (93% MDD, 100% FOR SAND) (or 20mm/BLOW FOR DCP TESTING)
6. 75mm STABILISED GRAVEL WEARING COURSE (3-4% CEMENT BY MASS)

NOTES: AGGREGATE SAND OR GRANULAR MATERIAL, ALL OF NON-CONHESIVE NATURE AND FREE FROM ALL ORGANIC MATERIAL OF WHICH THE GRADING ANALYSES SHOWS 100% PASSING A 13,2MM SIEVE AND NOT MORE THAN 5% PASSING A 0,075MM SIEVE.
BINDER TYPE FOR ASPHALT SURFACING SHALL BE SPECIFIED IN FINAL PROPOSAL.

SHEET INDEX:

SHEET 1: ROADWAY REINSTATEMENT SPECIFICATIONS
SHEET 2: PEDESTRIAN FOOTWAY REINSTATEMENT SPECIFICATIONS

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

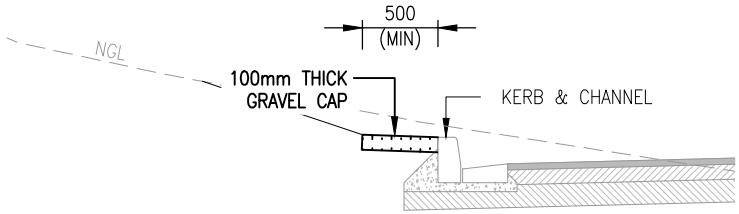
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TRENCHES IN PEDESTRIAN FOOTWAYS AND VERGES

STANDARDS AND GUIDELINES DETAILS

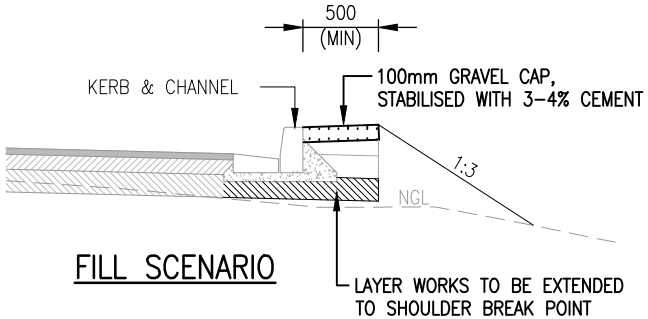
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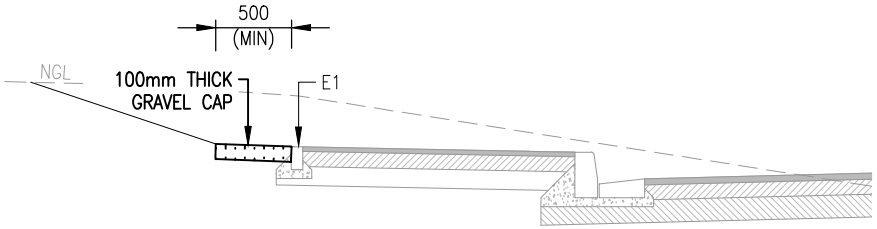


CUT SCENARIO

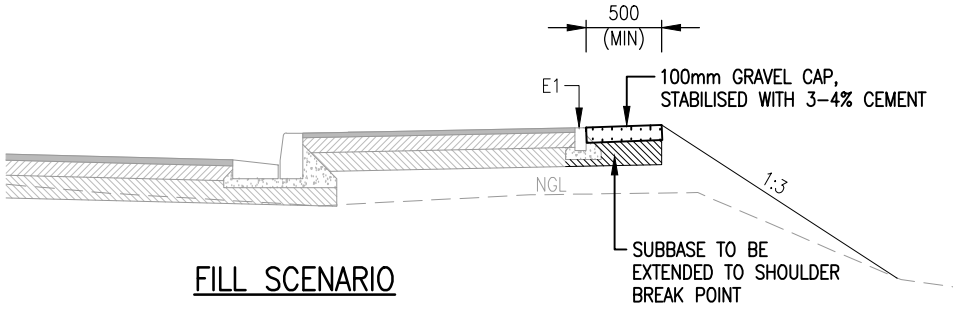


FILL SCENARIO

PROTECTION OF ROAD EDGE



CUT SCENARIO



FILL SCENARIO

PROTECTION OF FOOTWAY

NOTES:

1. WHERE ROADS OR FOOTWAYS ARE CONSTRUCTED IN FILL, A 500mm WIDE GRAVEL CAP, STABILISED WITH 3–4% CEMENT, SHALL BE CONSTRUCTED BEHIND THE ROAD EDGE OR BACK OF FOOTWAY, AT A DEPTH OF 100mm.
2. WHERE ROADS OR FOOTWAYS ARE CONSTRUCTED IN CUT, A 500mm WIDE GRAVEL CAP SHALL BE CONSTRUCTED BEHIND THE ROAD EDGE OR BACK OF FOOTWAY, AT A DEPTH OF 100mm.
3. ROADWAY AND FOOTWAY LAYERS WORKS SHALL BE DESIGNED IN ACCORDANCE WITH CHAPTER 8.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

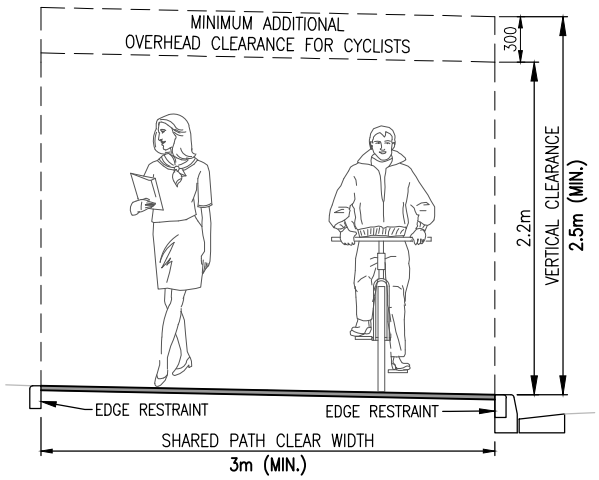
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TYPICAL PROTECTION DETAIL OF ROAD EDGE OR BACK OF FOOTWAY

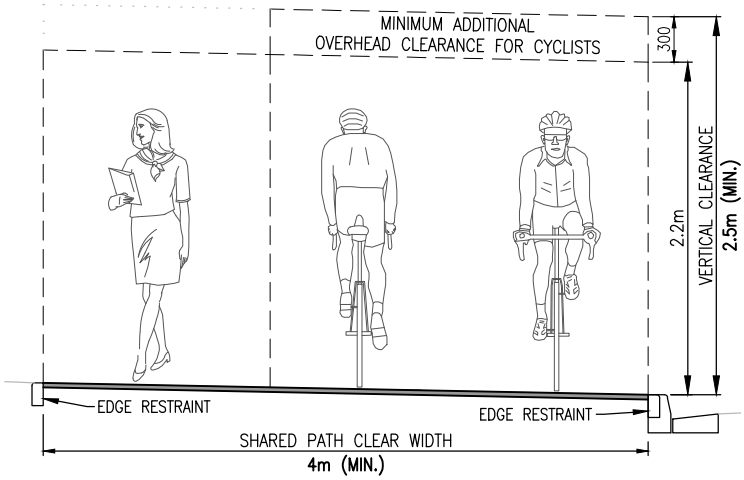
STANDARDS AND GUIDELINES DETAILS

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ONE-WAY CYCLIST MOVEMENT

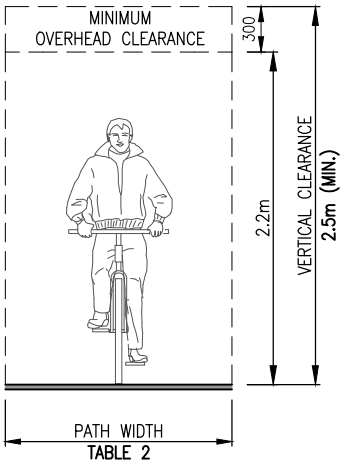


TWO-WAY CYCLIST MOVEMENT

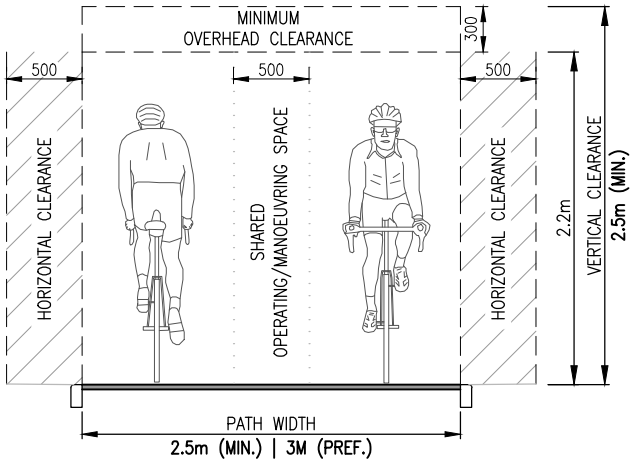
SHARED PEDESTRIAN-CYCLE FACILITIES

TABLE 2
ONE-WAY CYCLE PATH WIDTH

CYCLE CLASS	MIN. WIDTH
CLASS 1	1.5m
CLASS 2	1.5m
CLASS 3 (60KM/H ROAD SPEED LIMIT)	1.5m
CLASS 3 (80KM/H ROAD SPEED LIMIT)	1.8m



ONE-WAY CYCLE PATH

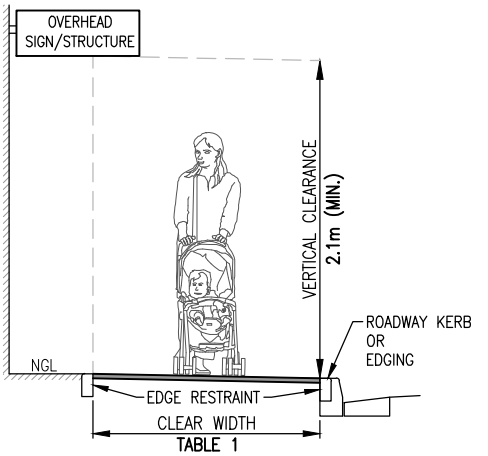


TWO-WAY CYCLE PATH

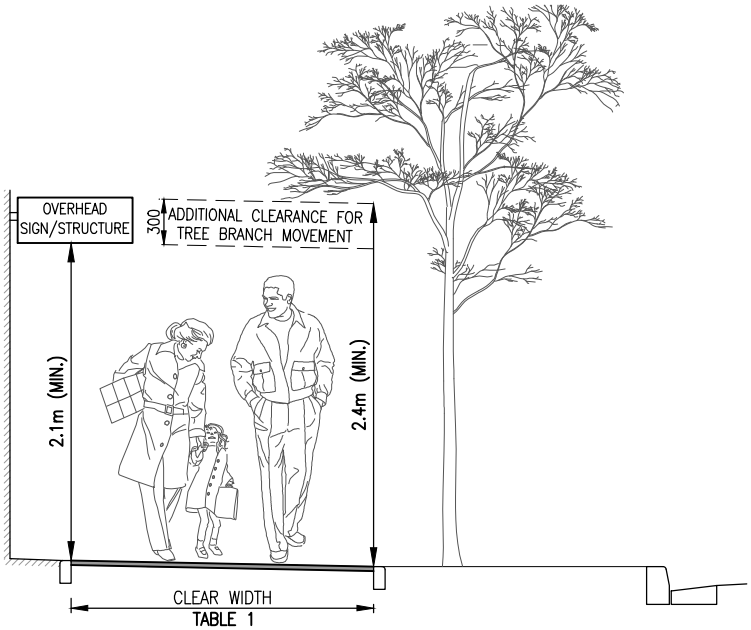
CYCLE FACILITIES

TABLE 1
PEDESTRIAN PATH WIDTHS

ROAD CLASS	MIN. WIDTH
CLASS 2: MAJOR ARTERIAL	2m
CLASS 3: MINOR ARTERIAL	2m
CLASS 4: COLLECTOR	1.8m
CLASS 5A: LOCAL COM + IND STREET	1.8m
CLASS 5B: LOCAL RES STREET (12m RR)	1.8m
CLASS 5C-D: LOCAL RES STREET (8/10m RR)	1.5m



PEDESTRIAN FOOTWAY



PEDESTRIAN FOOTWAY WITH OVERHANGING TREE

PEDESTRIAN FACILITIES

NOTES:

1. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 5.3 & 5.4.**

CITY OF CAPE TOWN
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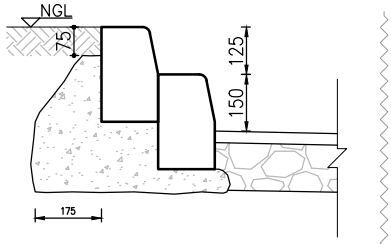
CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

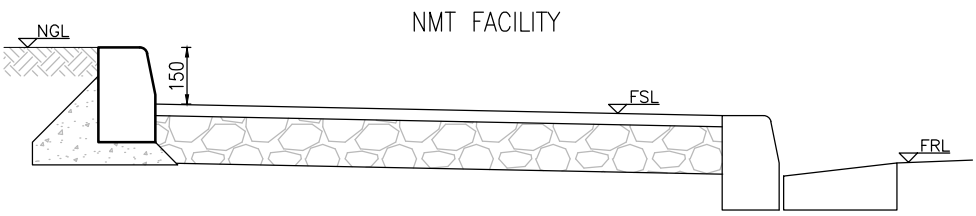
NON-MOTORISED TRANSPORT FACILITIES
WIDTHS AND CLEARANCES
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:50	A4
DRAWING No.	REV
RD18.1	A

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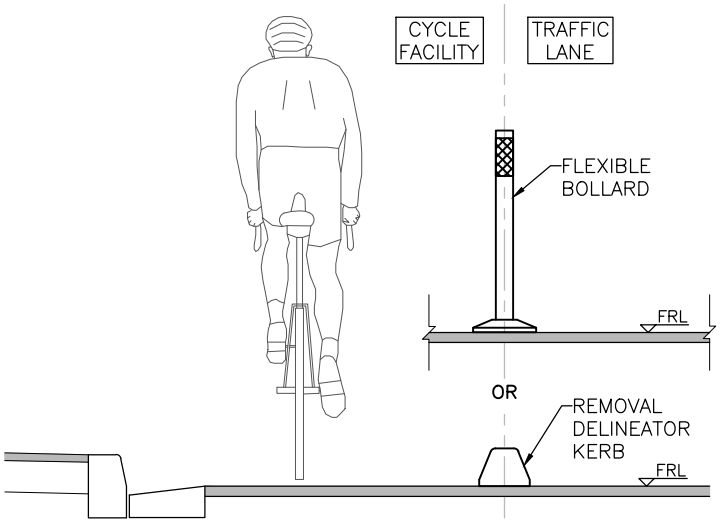
DOUBLE BARRIER KERBS



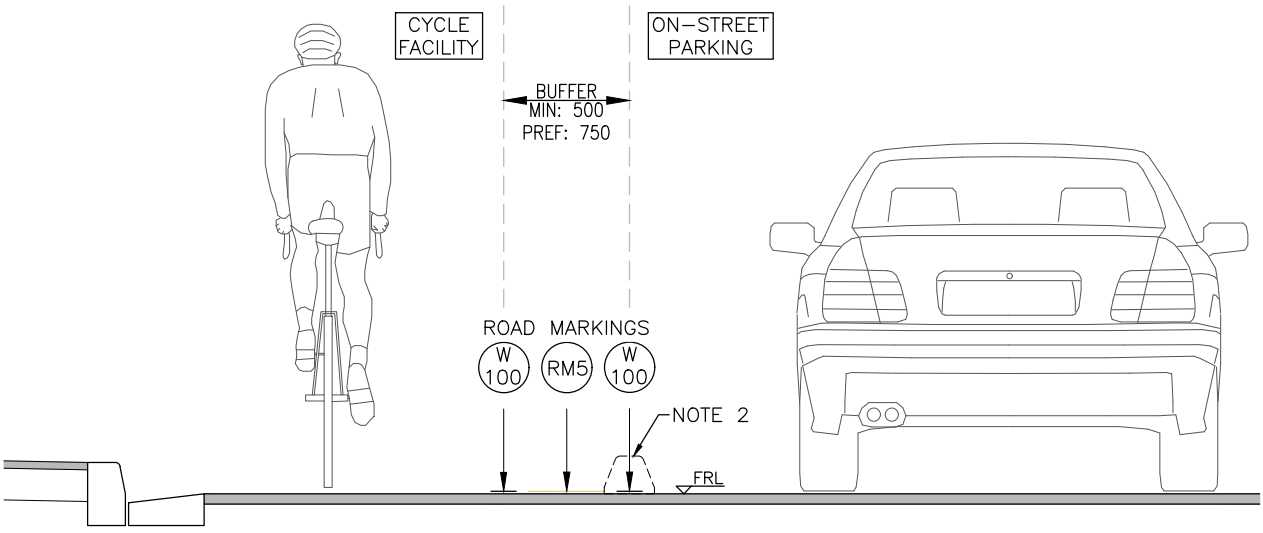
SINGLE BARRIER KERB

FULL HEIGHT BARRIER KERB AS EDGE RESTRAINT

1:20



ADJACENT TRAFFIC LANE



ADJACENT ON-STREET PARKING

PROTECTED AT-GRADE CYCLE FACILITIES

1:30

NOTES:

1. DRAWING TO BE READ IN CONJUNCTION WITH SECTION 5.4.5.
2. DELINEATOR KERB CAN BE PROVIDED AS ADDITIONAL PARKING DELINEATION.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

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CITY OF CAPE TOWN
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TITLE

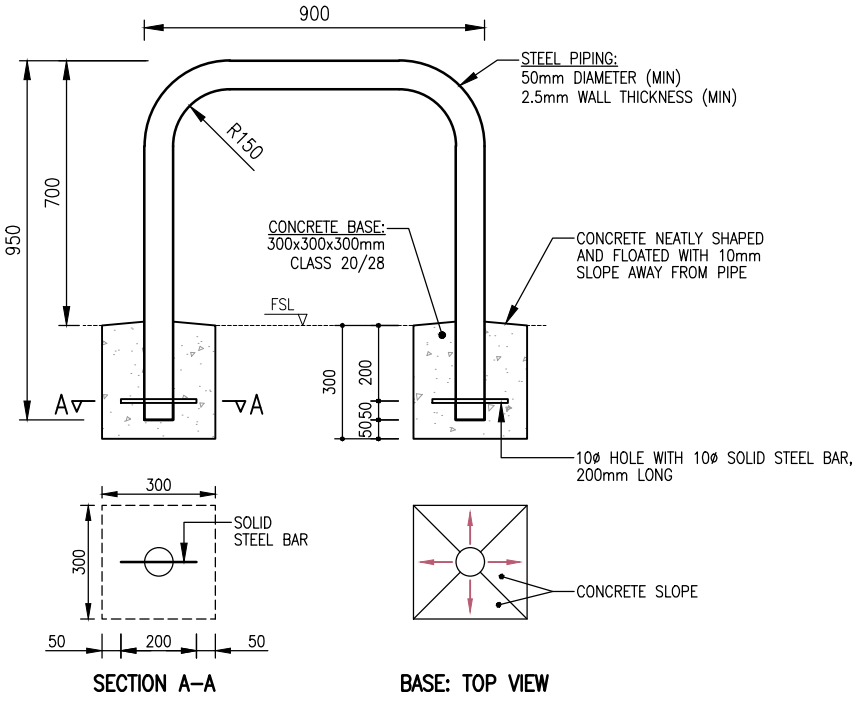
NON-MOTORISED TRANSPORT FACILITIES

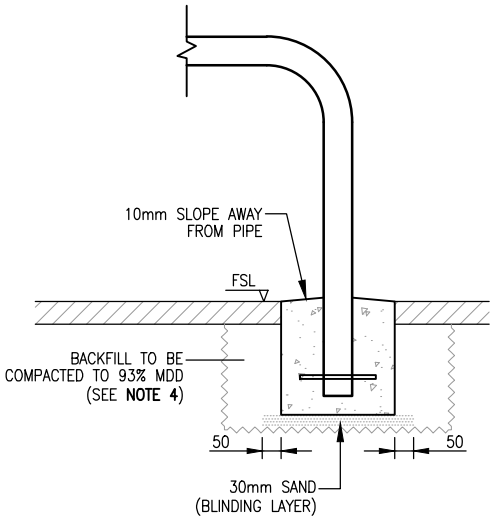
MISCELLANEOUS APPLICATION DETAILS 1

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD18.2	A

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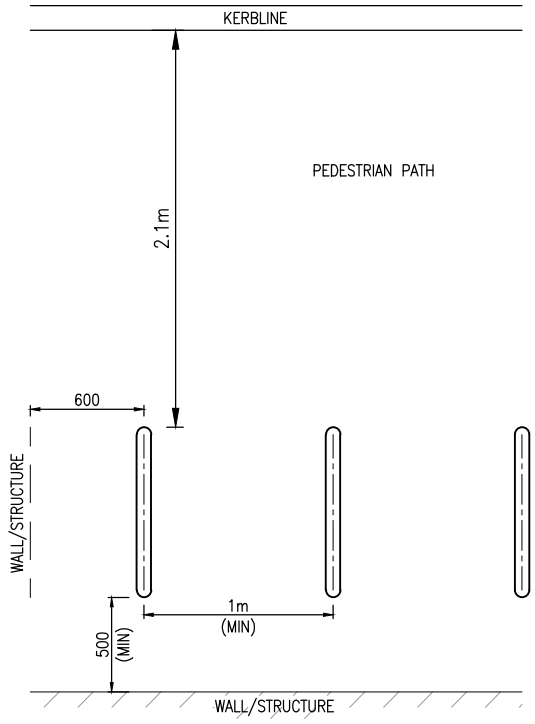




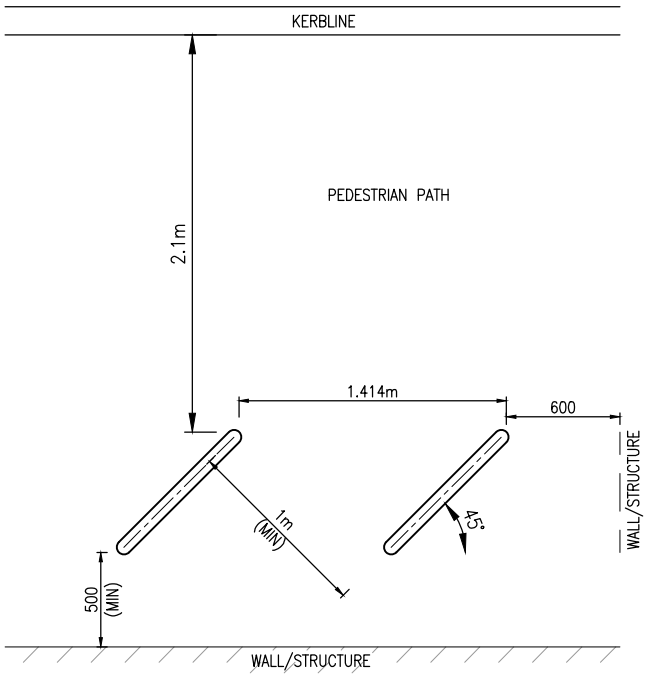
DETAIL A: PIPE AND BASE **DETAIL B: INSTALLATION**

MANUFACTURING AND INSTALLATION DETAILS

SCALE 1:20



90° TO PEDESTRIAN PATH AND ROADWAY



45° TO PEDESTRIAN PATH AND ROADWAY

SPACING AND ORIENTATION OF BICYCLE STANDS

N.T.S.

NOTES:

1. ALL DIMENSIONS IN mm, UNLESS SHOWN OTHERWISE.
2. ALL STEEL SHALL BE HOT–DIPPED GALVANISED.
3. IN HIGH THEFT AREAS, THE PIPING AND CONCRETE BASES SHALL BE CONSTRUCTED OFF–SITE (DETAIL A). CONCRETE SHALL BE LEFT TO CURE FOR A MINIMUM OF 7 DAYS. THEREAFTER, INSTALLATION SHALL BE CARRIED OUT, AS A COMPLETE UNIT, AS PER DETAIL B.
4. WHERE BICYCLE STANDS ARE CONSTRUCTED AS PART OF NEW NMT FACILITIES, THE LAYERS ADJACENT TO THE CONCRETE SLAB SHALL BE THE SAME AS THE PAVEMENT STRUCTURE OF THE NMT FACILITY.

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TITLE

BICYCLE STAND

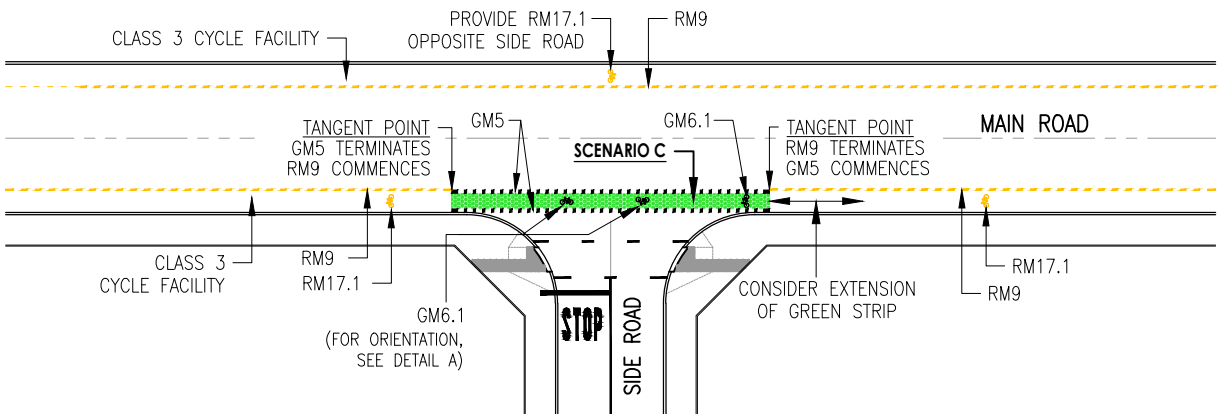
STANDARDS AND GUIDELINES DETAILS

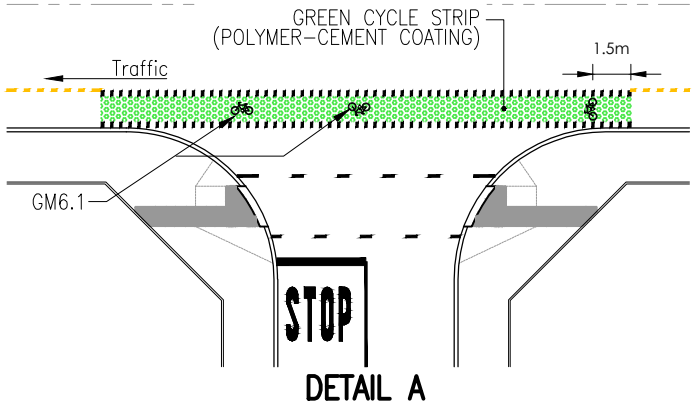
SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RD19	B

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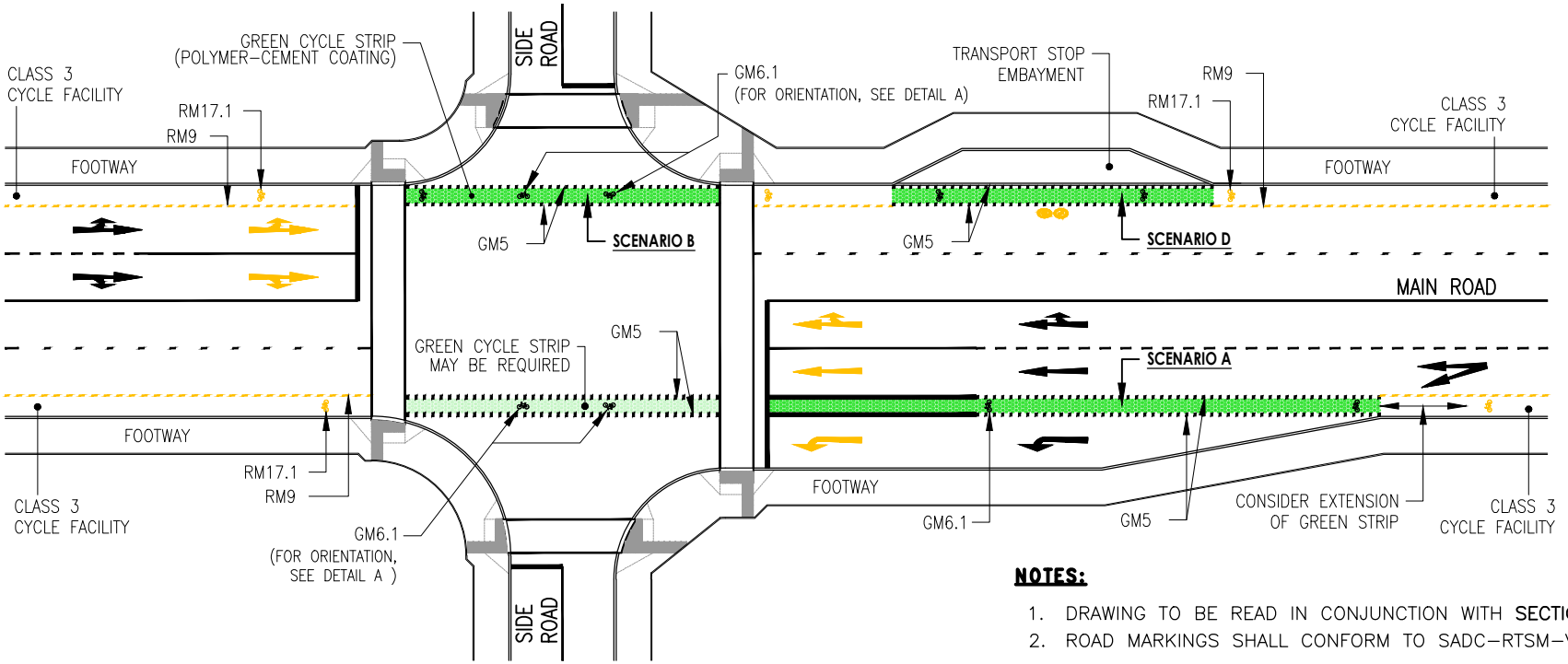
Detail Drawings

ROAD MARKINGS & ROAD SIGNS





DETAIL A



NOTES:

1. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 5.4.4.1.**
2. ROAD MARKINGS SHALL CONFORM TO SADC–RTSM–VOL1 AND SARTSM–VOL2

CITY OF CAPE TOWN
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CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

ACCOMMODATION OF CYCLISTS: PROVISION OF GREEN CYCLE STRIPS AT INTERSECTIONS

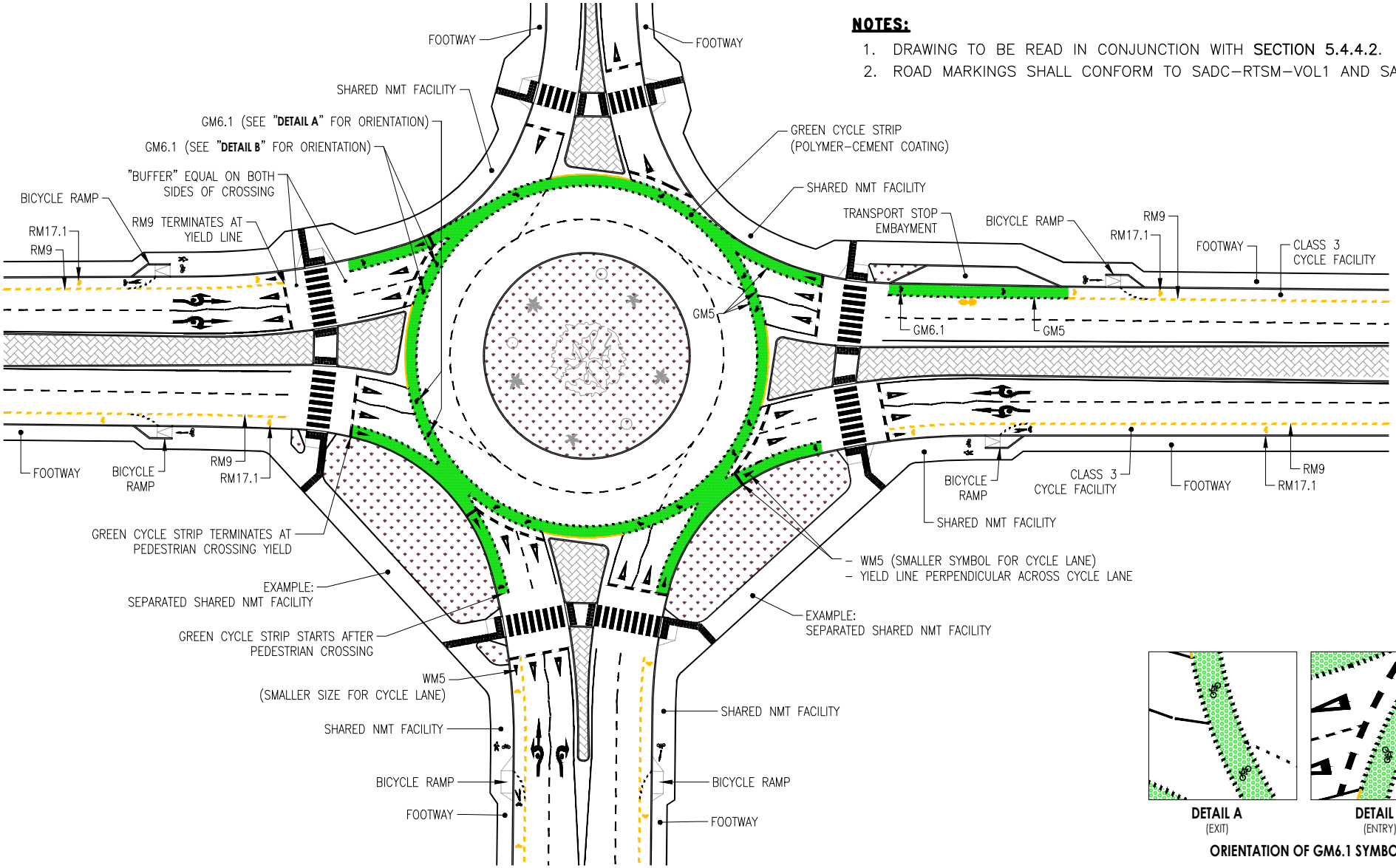
STANDARDS AND GUIDELINES DETAILS

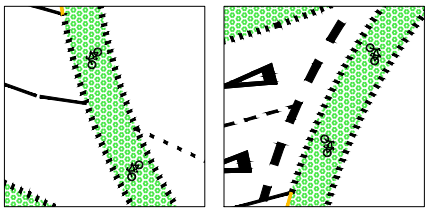
SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RM1.1	B

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NOTES:

1. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 5.4.4.2.**
2. ROAD MARKINGS SHALL CONFORM TO SADC–RTSM–VOL1 AND SARTSM–VOL2.





DETAIL A (EXIT)

DETAIL B (ENTRY)

ORIENTATION OF GM6.1 SYMBOLS

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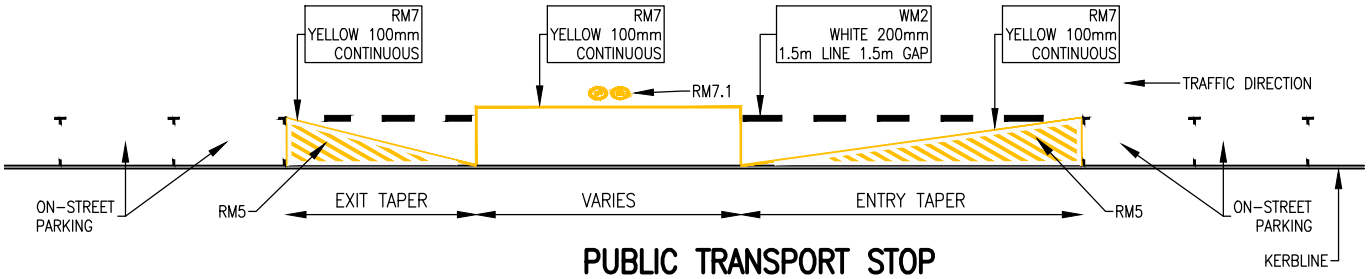
TITLE

ACCOMMODATION OF CYCLISTS: PROVISION OF GREEN CYCLE STRIPS THROUGH ROUNDABOUTS

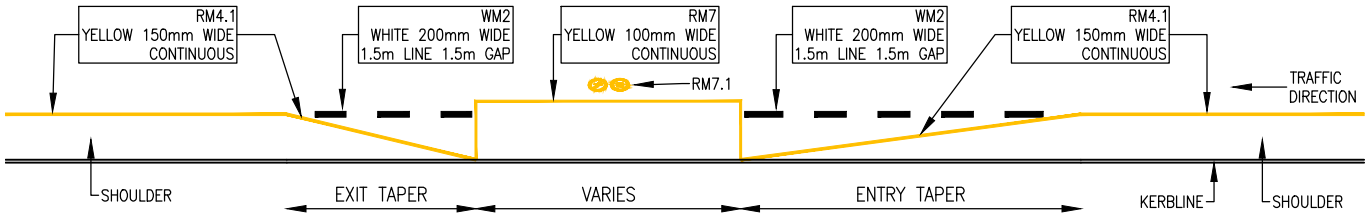
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RM1.2	B

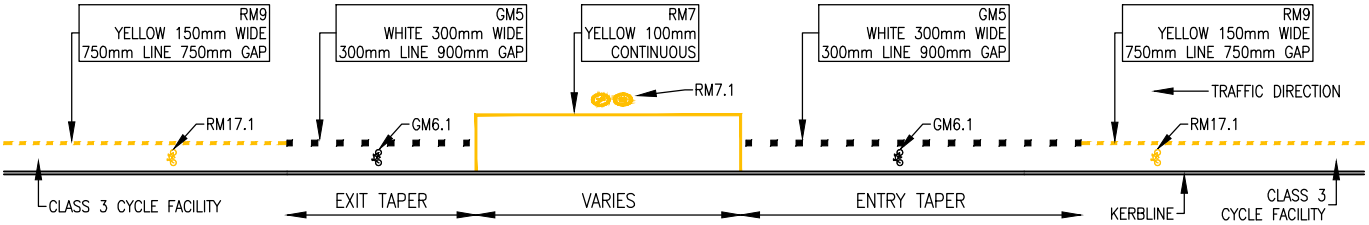
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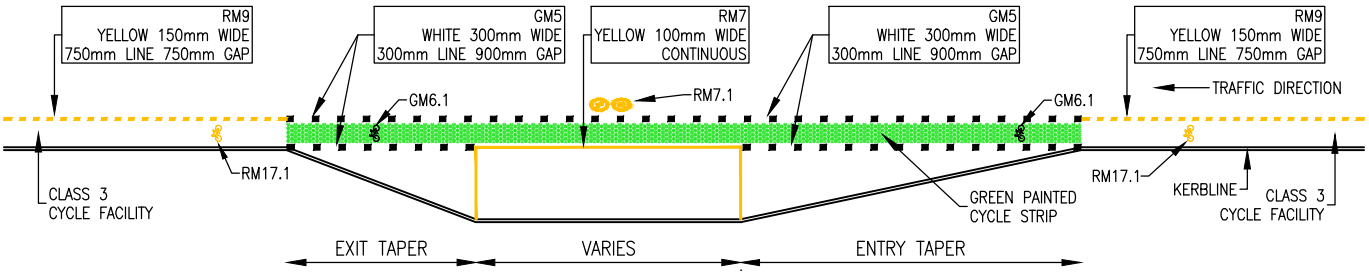
PUBLIC TRANSPORT STOP
(ADJACENT TO ON-STREET PARKING)



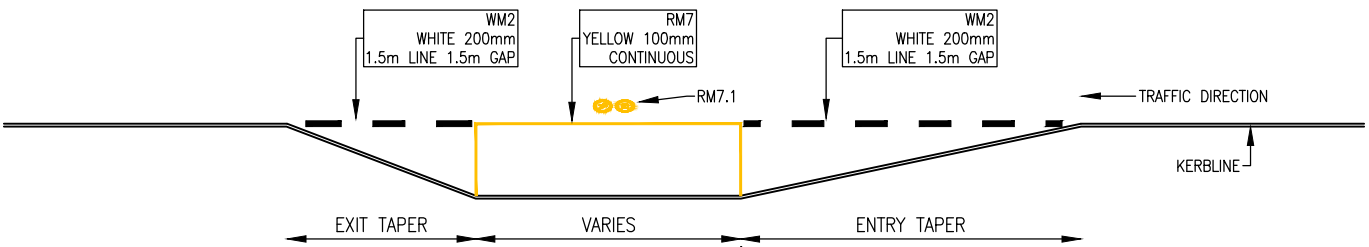
PUBLIC TRANSPORT STOP
(WITH SHOULDER)



PUBLIC TRANSPORT STOP
(WITH CLASS 3 CYCLE FACILITY)



PUBLIC TRANSPORT EMBAYMENT
(WITH CLASS 3 CYCLE FACILITY)



PUBLIC TRANSPORT EMBAYMENT

NOTES:

1. ASSUME EMBAYMENTS ARE SITUATED ON HIGH SIDE OF ROADWAY.
2. ROAD MARKINGS MUST CONFORM TO SADC-RTSM-VOL1 & SARTSM-VOL2.
3. REFER TO DRAWINGS RD8.2 & RD8.3 FOR EMBAYMENT DETAILS AND REQUIREMENTS.

SHEET INDEX:

SHEET 1: PUBLIC TRANSPORT: NORMAL STOPS & EMBAYMENTS
SHEET 2: PUBLIC TRANSPORT: HYBRID STOP-EMBAYMENTS

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

TYPICAL ROAD MARKINGS FOR PUBLIC TRANSPORT STOPS AND EMBAYMENTS

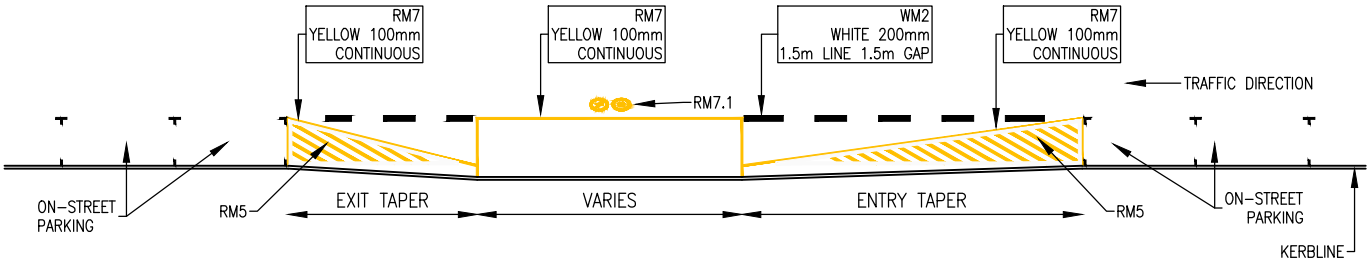
NORMAL STOPS AND EMBAYMENTS

STANDARDS AND GUIDELINES DETAILS

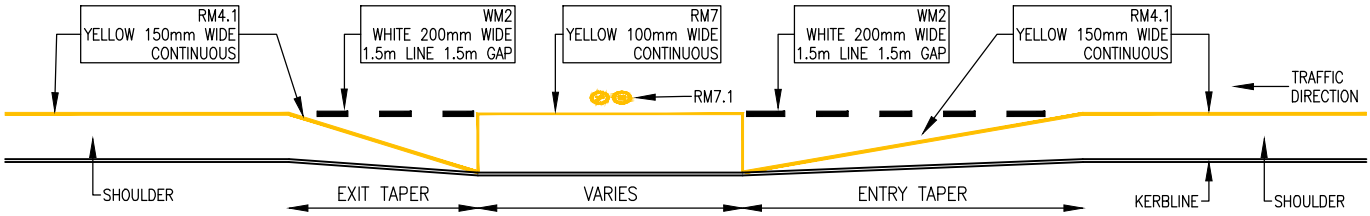
SHEET 1

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RM2A	B

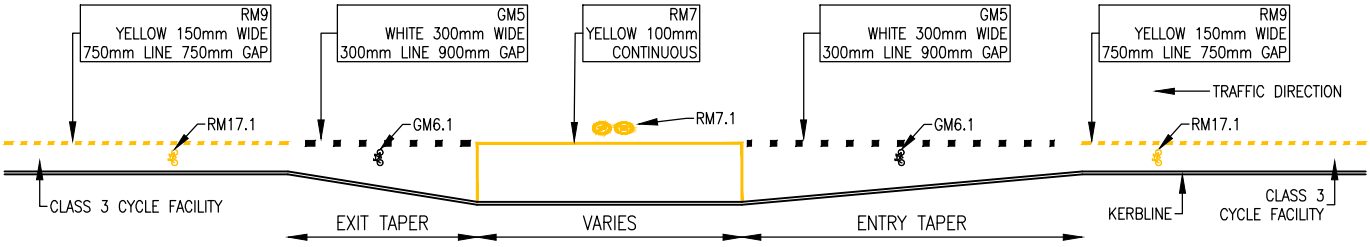
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PUBLIC TRANSPORT STOP-EMBAYMENT (HYBRID)
(ADJACENT TO ON-STREET PARKING)



PUBLIC TRANSPORT STOP-EMBAYMENT (HYBRID)
(WITH SHOULDER)



PUBLIC TRANSPORT STOP-EMBAYMENT (HYBRID)
(WITH CLASS 3 CYCLE FACILITY)

NOTES:

1. ASSUME EMBAYMENTS ARE SITUATED ON HIGH SIDE OF ROADWAY.
2. ROAD MARKINGS MUST CONFORM TO SADC-RTSM-VOL1 & SARTSM-VOL2.
3. REFER TO DRAWINGS RD8.2 & RD8.3 FOR EMBAYMENT DETAILS AND REQUIREMENTS.

SHEET INDEX:

SHEET 1: PUBLIC TRANSPORT: NORMAL STOPS & EMBAYMENTS
SHEET 2: PUBLIC TRANSPORT: HYBRID STOP-EMBAYMENTS

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

TYPICAL ROAD MARKINGS FOR PUBLIC TRANSPORT STOPS AND EMBAYMENTS

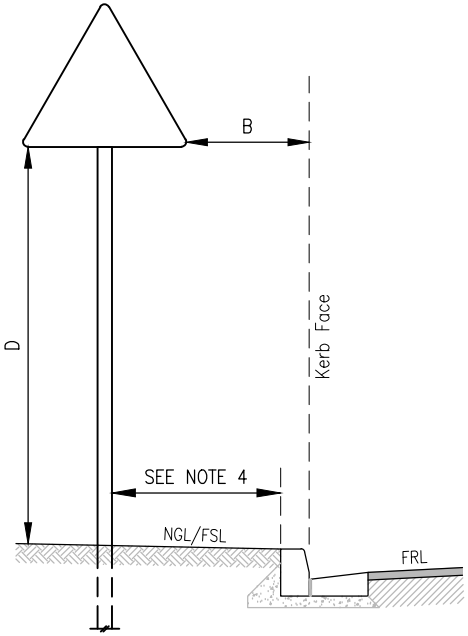
HYBRID STOP-EMBAYMENTS

STANDARDS AND GUIDELINES DETAILS

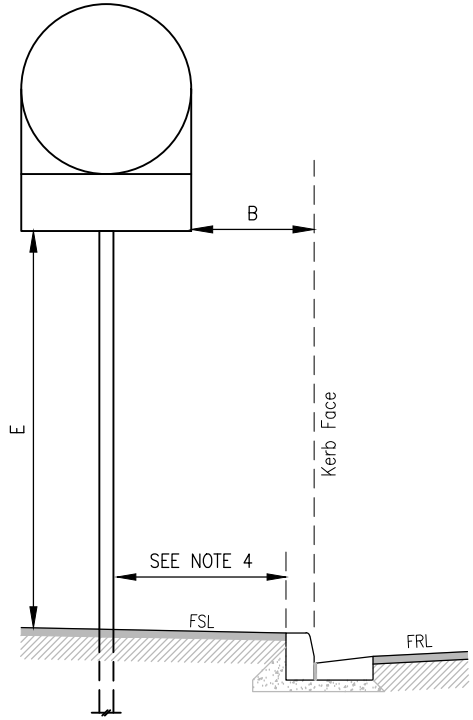
SHEET 2

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RM2B	B

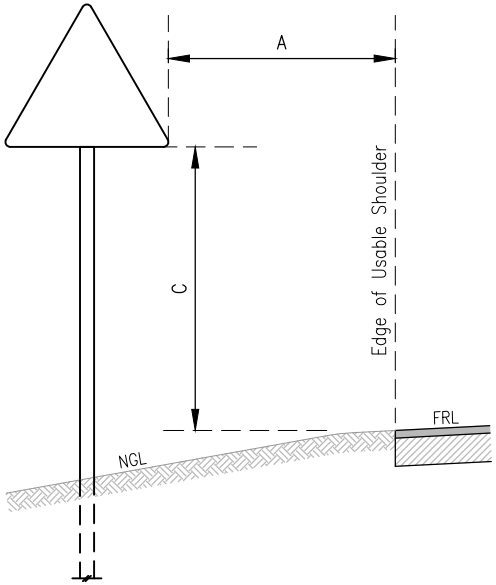
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KERB: VERGE OR PEDESTRIAN FOOTWAY



KERB: SHARED NMT FACILITY



NO KERB (SHOULDER)

NOTES:

1. DRAWING TO BE READ IN CONJUNCTION WITH SECTION 9.2.
2. REFER TO DRAWING RM4 FOR ROAD SIGN INSTALLATION DETAILS.
3. SIGN PLACEMENT TO COMPLY WITH SARTSM–VOL2 CHAPTER 15.
4. WHERE SIGNS ARE SITUATED ON SURFACED FOOTWAYS, A MINIMUM LATERAL CLEARANCE OF 1.1m IS REQUIRED BETWEEN THE BACK OF ROADWAY KERB AND OUTER EDGE OF SIGN POLE, IN ORDER TO ACCOMMODATE WHEELCHAIR USERS.

TABLE 1
PERMANENT SIGN PLACEMENT DIMENSIONS

DESCRIPTION	POSITION REF.		DIMENSION (mm)		
	VERTICAL	LATERAL	MINIMUM	PREFERRED	MAXIMUM
KERB: UNMADE VERGE OR PEDESTRIAN FOOTWAY		B [1]	500	750	–
	D		2100	2500	3000
KERB: SHARED NMT FACILITY		B [1]	500	750	–
	E		2500	–	3000
NO KERB (SHOULDER)		A	1200	1500	2000
	C		600	2100	2500

[1] SEE NOTE 4

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URBAN MOBILITY

TITLE

LATERAL AND VERTICAL CLEARANCE REQUIREMENTS FOR SMALL SINGLE SUPPORT SIGNS

STANDARDS AND GUIDELINES DETAILS

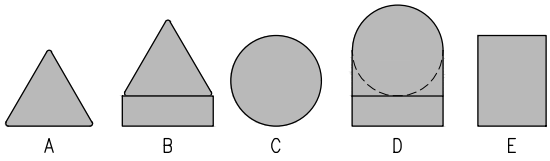
SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RM3	C

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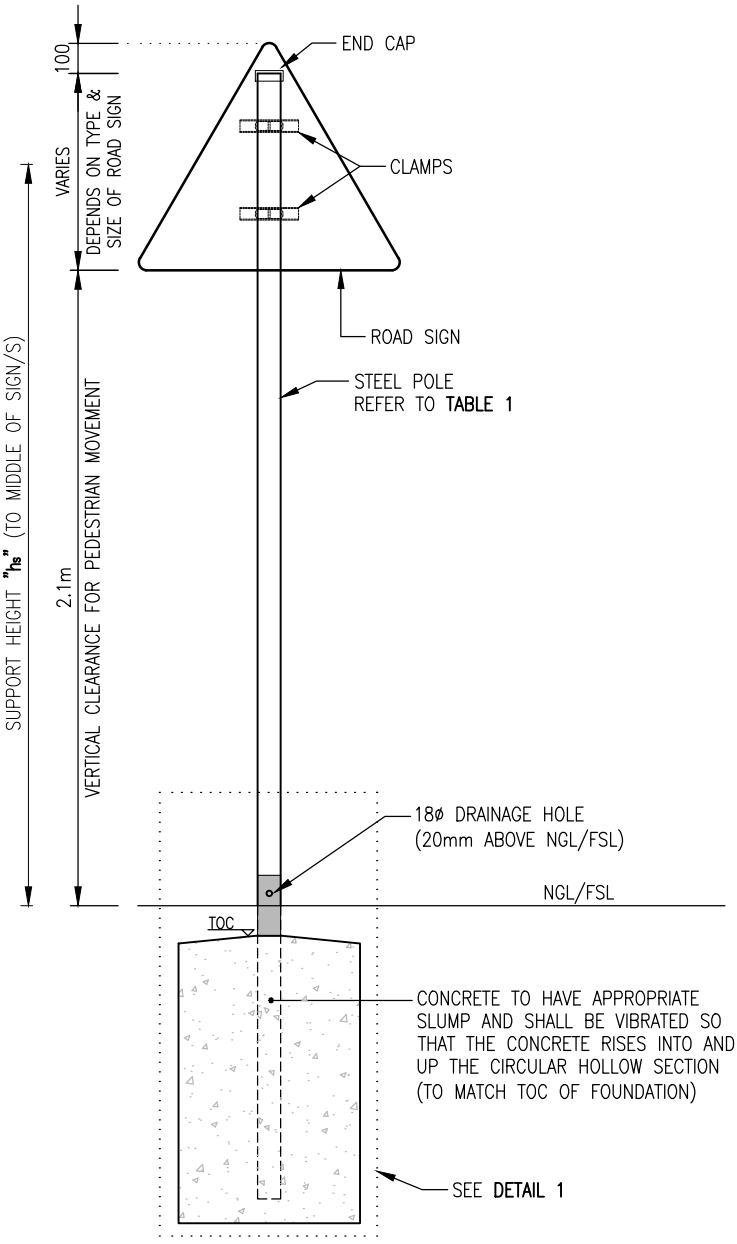
TABLE 1
POLE SIZE AND FOUNDATION REQUIREMENTS

SIGN TYPE	SMALL SIGNS			MEDIUM SIGNS		
	SIGN AREA	POLE SIZE	FOUNDATION (Fw)	SIGN AREA	POLE SIZE	FOUNDATION (Fw)
	m^2	mm	mm	m^2	mm	mm
A	0.16	60x3.5	500	0.35	60x3.5	600
B	0.28	60x3.5	600	0.62	76x3.5	700
C	0.28	60x3.5	500	0.64	60x3.5	500
D	0.44	76x3.5	700	0.99	89x3.5	800
E	0.48	63x3.5	600	0.61	76x3.5	700
A+A	0.31	63x3.5	600	0.70	76x3.5	800
C+C	0.57	60x3.5	500	1.28	63x3.5	600

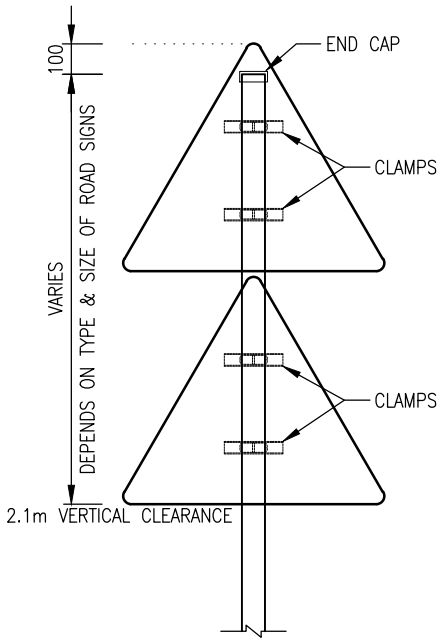
BASED ON SUPPORT HEIGHT (h_s) OF 2.45m FOR A–E AND 3.0m FOR A+A & C+C



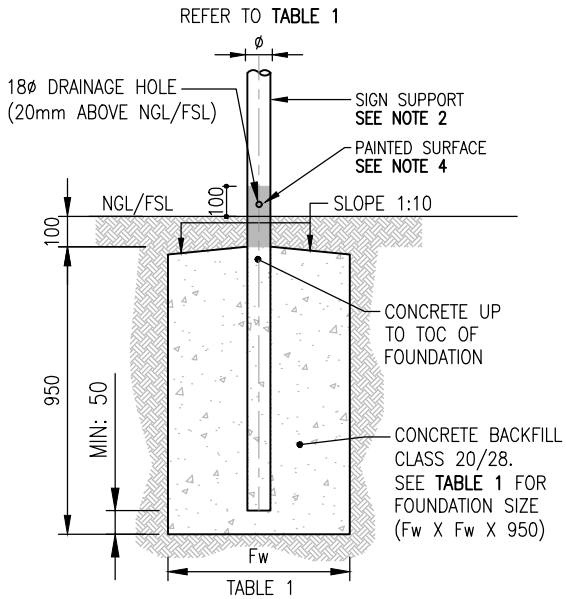
SIGN TYPE



FRONT ELEVATION
SCALE 1:25



DOUBLE SIGNS
SCALE 1:25



DETAIL 1
SCALE 1:25

NOTES:

1. DRAWING TO BE READ IN CONJUNCTION WITH SECTION 9.2 AND SARTSM–VOL2 CHAPTER 15.
2. TABLE 1 CAN BE USED AS A GUIDE TO DETERMINE THE POLE DIAMETER, THICKNESS AND FOUNDATION.
3. IN AREAS WITH A HIGH PROBABILITY OF THEFT, TIMBER POSTS SHOULD BE CONSIDERED.
4. MINIMUM REQUIREMENTS FOR SUPPORTS:
   - STEEL: CIRCULAR HOLLOW SECTION (GRADE S355 – EN 10025). HOT–DIP GALVANISED. DIAMETER AND THICKNESS AS PER **TABLE 1**.
   - TIMBER POST: 100mm ø (TOP). CLASS H4 "TANALITH" TREATER OR EQUIVALENT (SANS 10005).
4. PAINTING SHALL CONSIST OF ONE COAT EPOXY PRIMER, FOLLOWED BY ONE COAT POLYURETHANE TOP COAT (COLOUR: GREY). STEEL SURFACE SHALL BE CHEMICALLY CLEANED PRIOR TO PAINTING.
5. TWO BREAKAWAY HOLES SHALL BE PROVIDED FOR CHS SUPPORTS GREATER THAN 76mm AND TIMBER POSTS GREATER THAN 100mm, AS PER SARTSM–VOL2 CHAPTER 15.

NGL: NATURAL GROUND LEVEL
FSL: FINISHED SURFACE LEVEL
TOC: TOP OF CONCRETE

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

ROAD SIGN SUPPORT STANDARD TYPE

STANDARDS AND GUIDELINES DETAILS

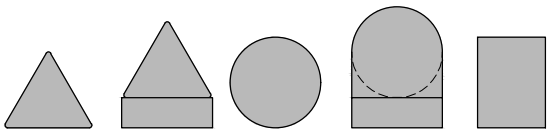
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DRAWING No.	REV
RM4.1	A

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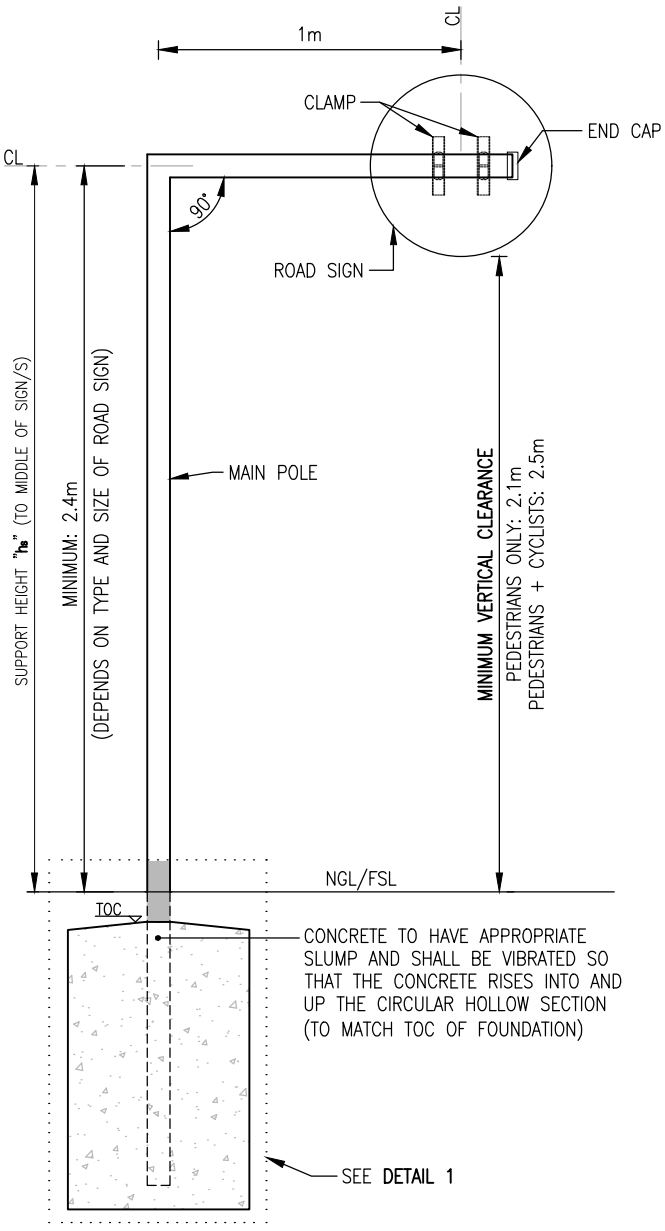
TABLE 1
POLE SIZE AND FOUNDATION REQUIREMENTS

SIGN TYPE	SMALL SIGNS			MEDIUM SIGNS		
	SIGN AREA	POLE SIZE	FOUNDATION (Fw)	SIGN AREA	POLE SIZE	FOUNDATION (Fw)
	m^2	mm	mm	m^2	mm	mm
A	0.16	76x3.5	500	0.35	76x3.5	600
B	0.28	76x3.5	600	0.62	76x3.5	700
C	0.28	76x3.5	500	0.64	76x3.5	500
D	0.44	76x3.5	700	0.99	89x3.5	800
E	0.48	76x3.5	700	0.61	76x3.5	700

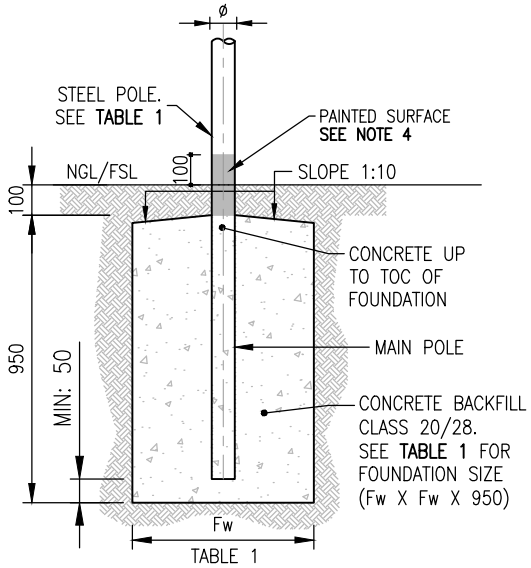
BASED ON SUPPORT HEIGHT (h_s) OF 2.55m



SIGN TYPE



FRONT ELEVATION
SCALE 1:25



DETAIL 1
SCALE 1:25

NOTES:

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   - STRUCTURAL STEEL SHALL BE CIRCULAR HOLLOW SECTION (GRADE S355 – EN 10025) AND BOLTS HDG GRADE 8.8 (SANS 135).
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NGL: NATURAL GROUND LEVEL
FSL: FINISHED SURFACE LEVEL
TOC: TOP OF CONCRETE

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

CANTILEVER ROAD SIGN SUPPORT
SQUARE TYPE
SHORT ARM - SINGLE SIGN

STANDARDS AND GUIDELINES DETAILS

SHEET 1

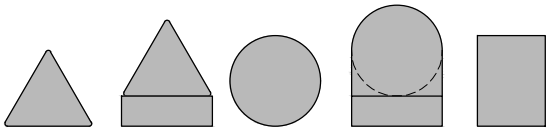
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SHOWN	A4
DRAWING No.	REV
RM4.2A	A

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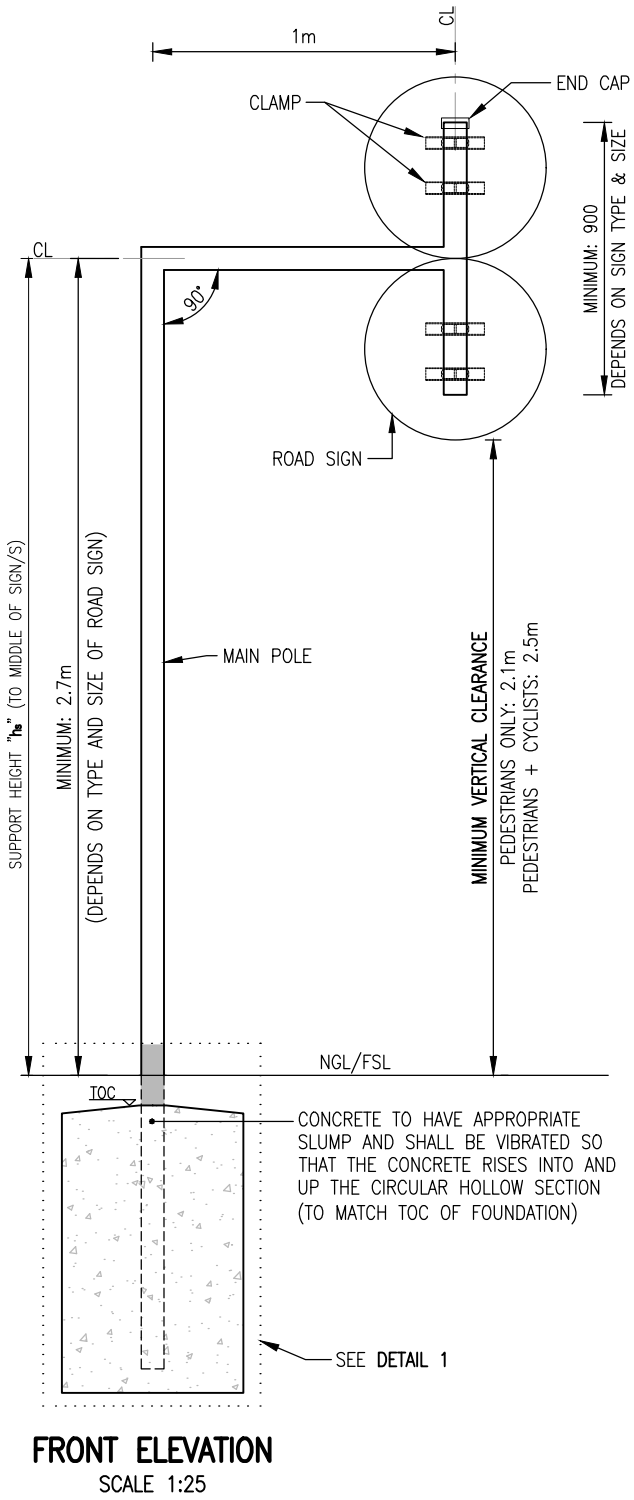
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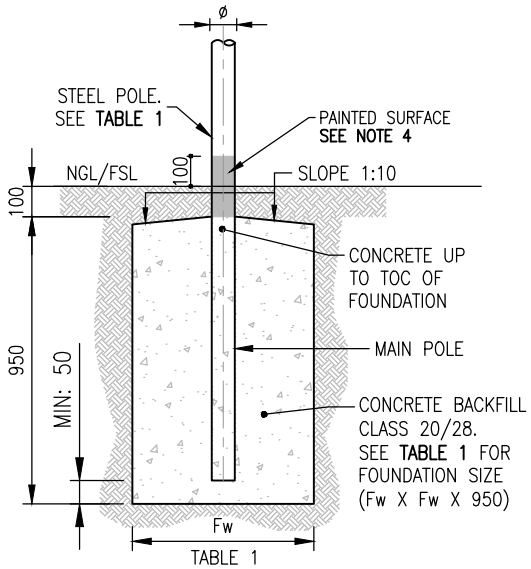
BASED ON SUPPORT HEIGHT (h_s) OF 3.1m



SIGN TYPE



FRONT ELEVATION
SCALE 1:25



DETAIL 1
SCALE 1:25

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NGL: NATURAL GROUND LEVEL
FSL: FINISHED SURFACE LEVEL
TOC: TOP OF CONCRETE

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

CANTILEVER ROAD SIGN SUPPORT
SQUARE TYPE
SHORT ARM - MULTIPLE SIGNS

STANDARDS AND GUIDELINES DETAILS

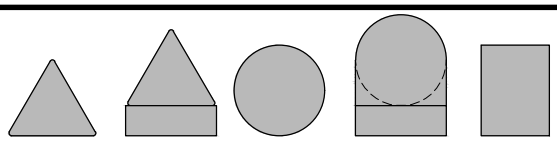
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SCALE	PAPER
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DRAWING No.	REV
RM4.2B	A

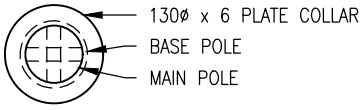
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TABLE 1: POST SIZE REQUIREMENTS								
SIGN TYPE	SMALL SIGNS				MEDIUM SIGNS			
	SIGN AREA	POLE SIZE BASE	POLE SIZE MAIN	FOUNDATION	SIGN AREA	POLE SIZE BASE	POLE SIZE MAIN	FOUNDATION
	m^2	mm	mm	mm	m^2	mm	mm	mm
A	0.16	89x6	76x3.5	500	0.35	89x6	76x3.5	600
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C	0.28	89x6	76x3.5	500	0.64	89x6	76x3.5	500
D	0.44	102x6	89x3.5	800	0.99	114x6	102x3.5	900
E	0.48	102x6	89x3.5	800	0.61	102x6	89x3.5	800

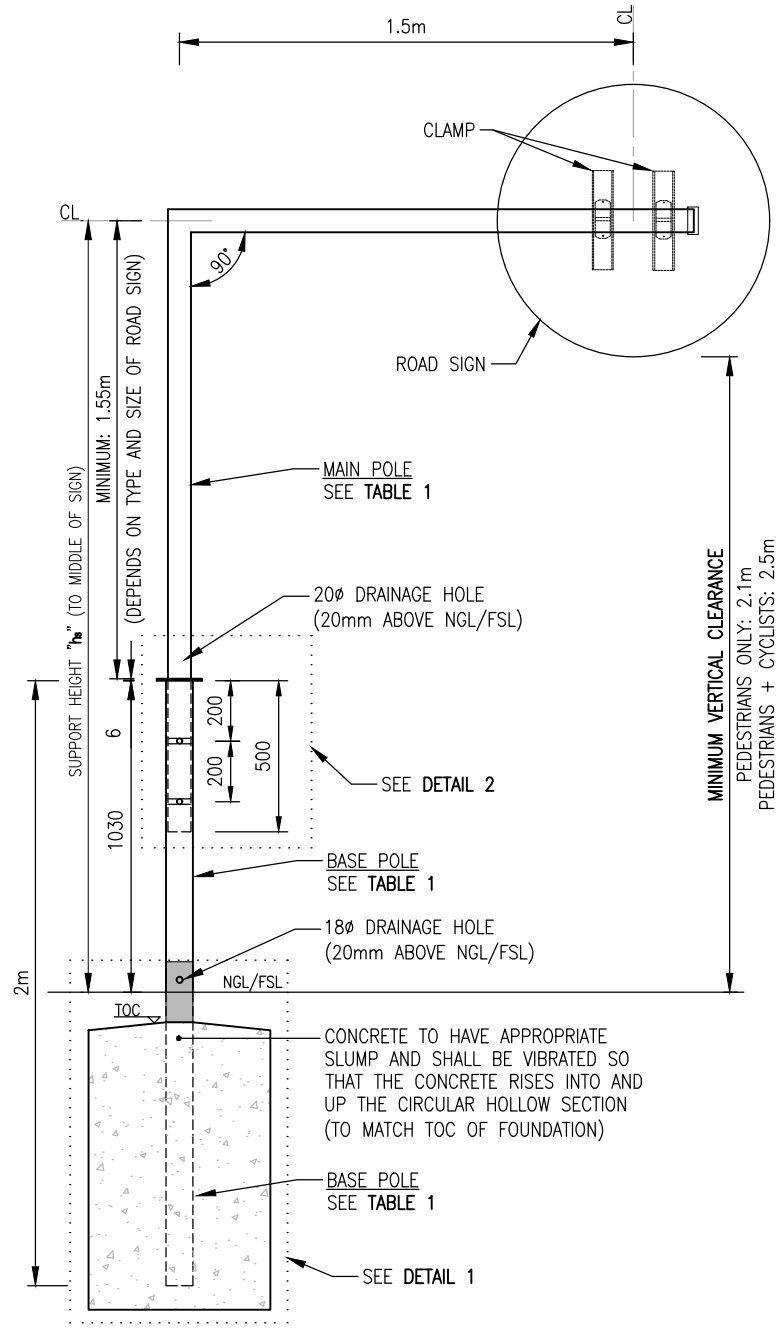
BASED ON SUPPORT HEIGHT (h_s) OF 3m



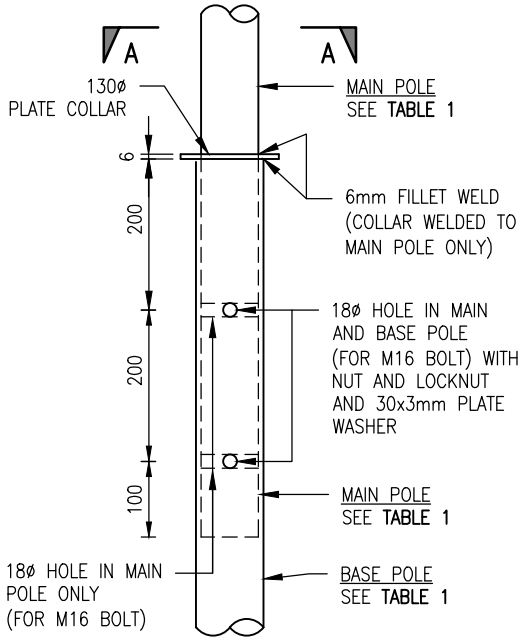
SIGN TYPE



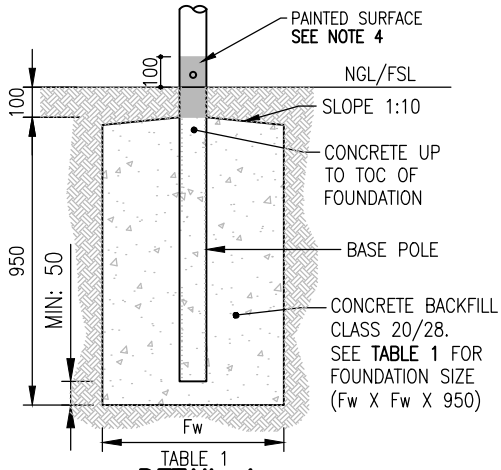
SECTION A–A
SCALE 1:10



FRONT ELEVATION
SCALE 1:25



DETAIL 2
SCALE 1:10



DETAIL 1
SCALE 1:25

NOTES:

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NGL: NATURAL GROUND LEVEL
FSL: FINISHED SURFACE LEVEL
TOC: TOP OF CONCRETE

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

CANTILEVER ROAD SIGN SUPPORT
SQUARE TYPE
LONG ARM - SINGLE SIGN

STANDARDS AND GUIDELINES DETAILS

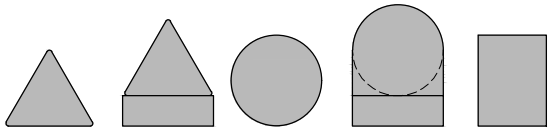
SHEET 1

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DRAWING No.	REV
RM4.3A	A

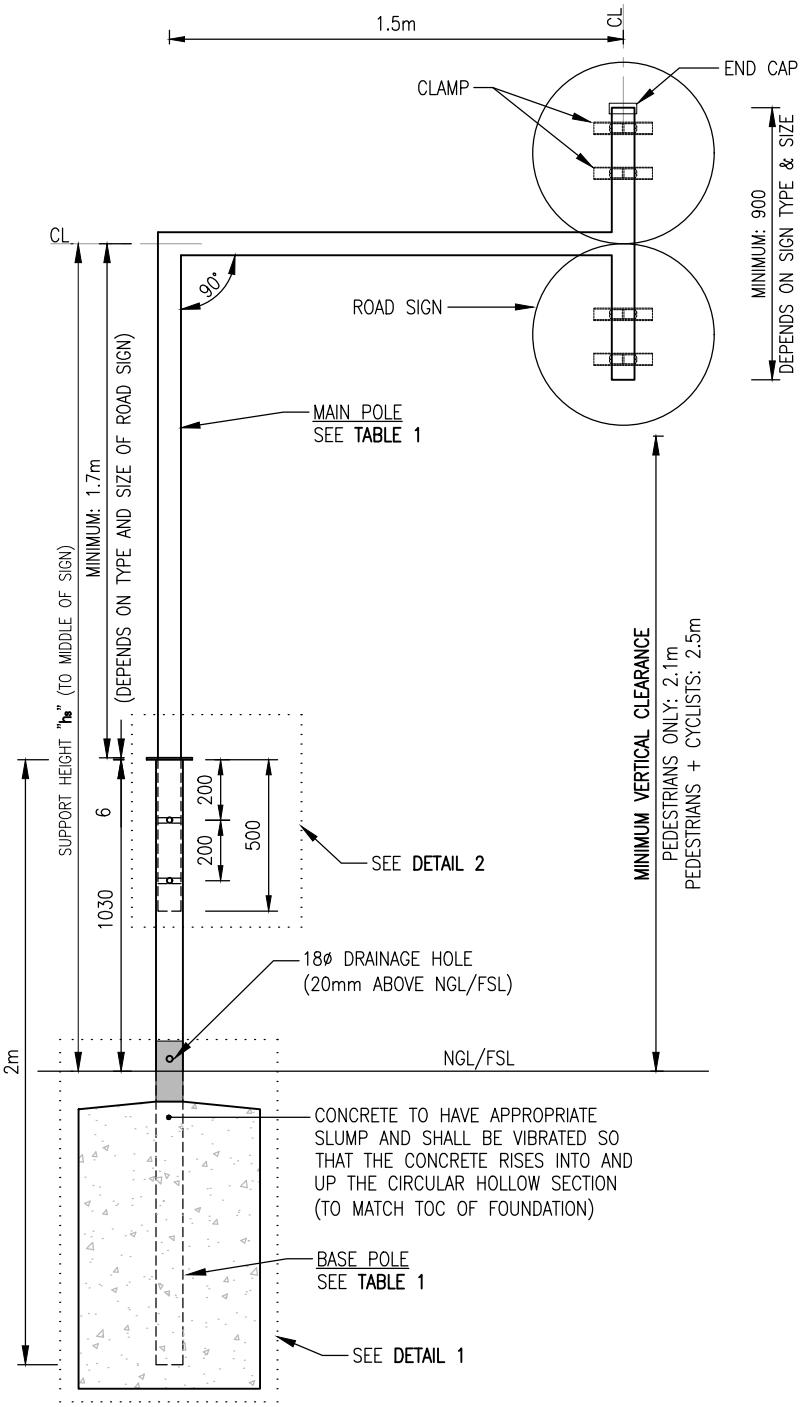
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TABLE 1: POST SIZE REQUIREMENTS								
SIGN TYPE	SMALL SIGNS				MEDIUM SIGNS			
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C+C	0.57	102x6	89x3.5	800	1.28	114x6	102x3.5	1000

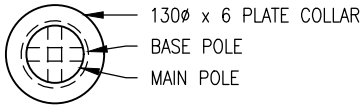
BASED ON SUPPORT HEIGHT (h_s) OF 3.45m



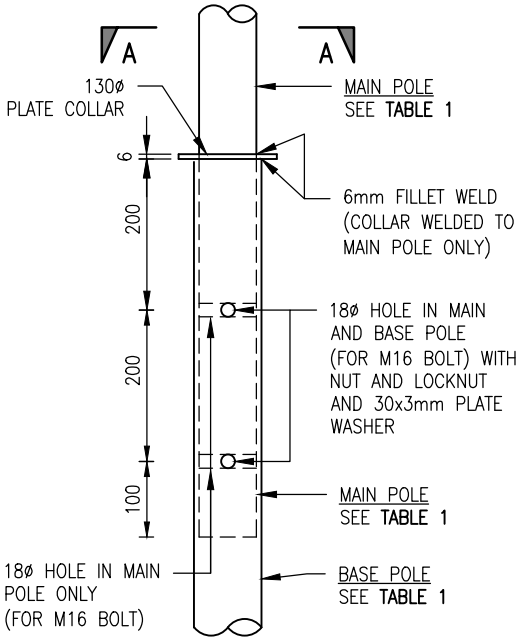
SIGN TYPE



FRONT ELEVATION
SCALE 1:25



SECTION A–A
SCALE 1:10



DETAIL 2
SCALE 1:10

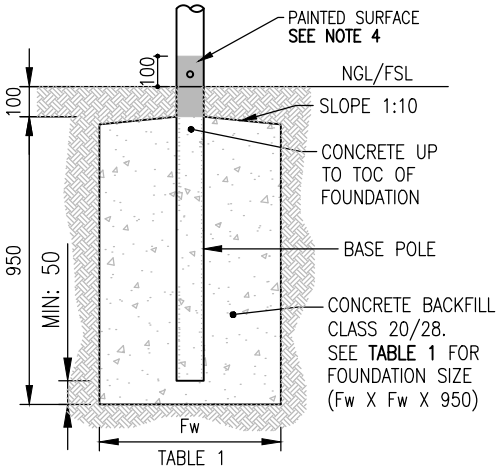


TABLE 1

DETAIL 1
SCALE 1:25

NOTES:

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NGL: NATURAL GROUND LEVEL
FSL: FINISHED SURFACE LEVEL
TOC: TOP OF CONCRETE

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

CANTILEVER ROAD SIGN SUPPORT
SQUARE TYPE
LONG ARM - MULTIPLE SIGNS

STANDARDS AND GUIDELINES DETAILS

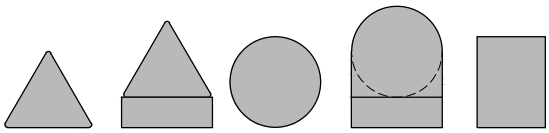
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RM4.3B	A

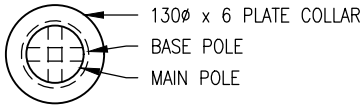
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TABLE 1: POST SIZE REQUIREMENTS								
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	SIGN AREA	POLE SIZE BASE	POLE SIZE MAIN	FOUNDATION	SIGN AREA	POLE SIZE BASE	POLE SIZE MAIN	FOUNDATION
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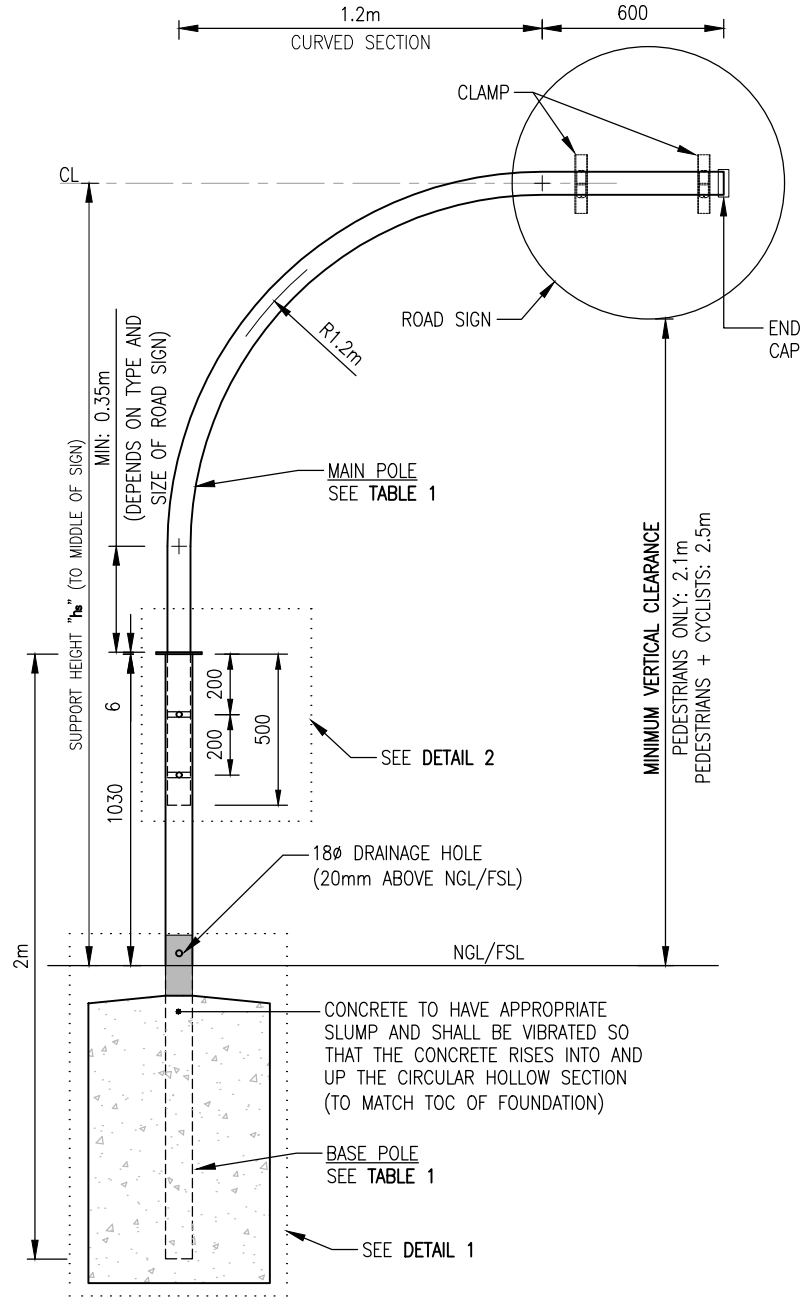
BASED ON SUPPORT HEIGHT (h_s) OF 2.95m



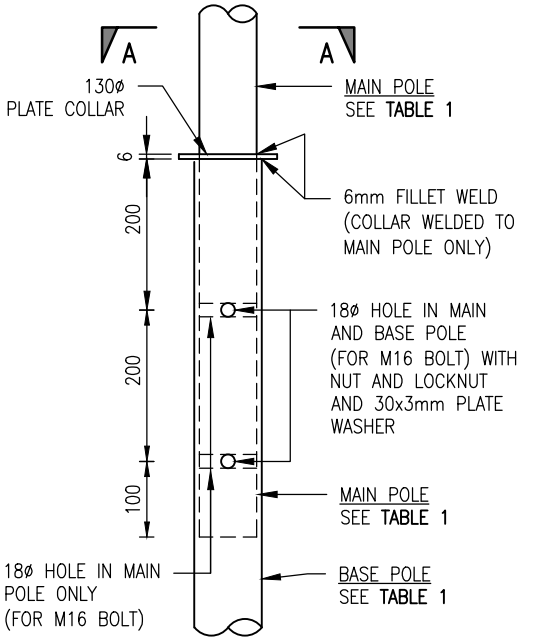
SIGN TYPE



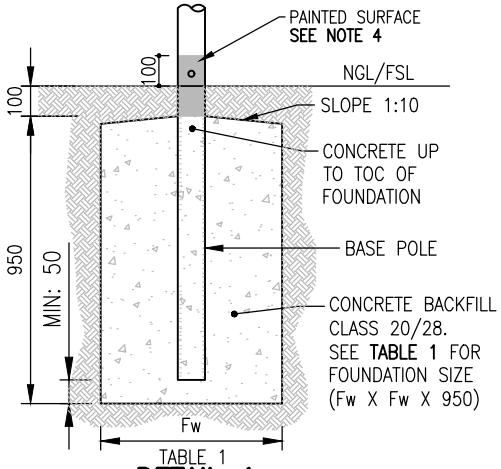
SECTION A–A
SCALE 1:10



FRONT ELEVATION
SCALE 1:25



DETAIL 2
SCALE 1:10



DETAIL 1
SCALE 1:25

NOTES:

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FSL: FINISHED SURFACE LEVEL
TOC: TOP OF CONCRETE

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

CANTILEVER ROAD SIGN SUPPORT
CURVED TYPE
SINGLE SIGN

STANDARDS AND GUIDELINES DETAILS

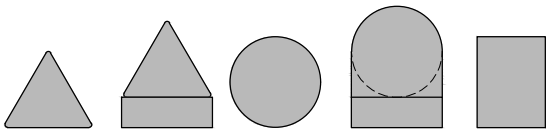
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RM4.4A	A

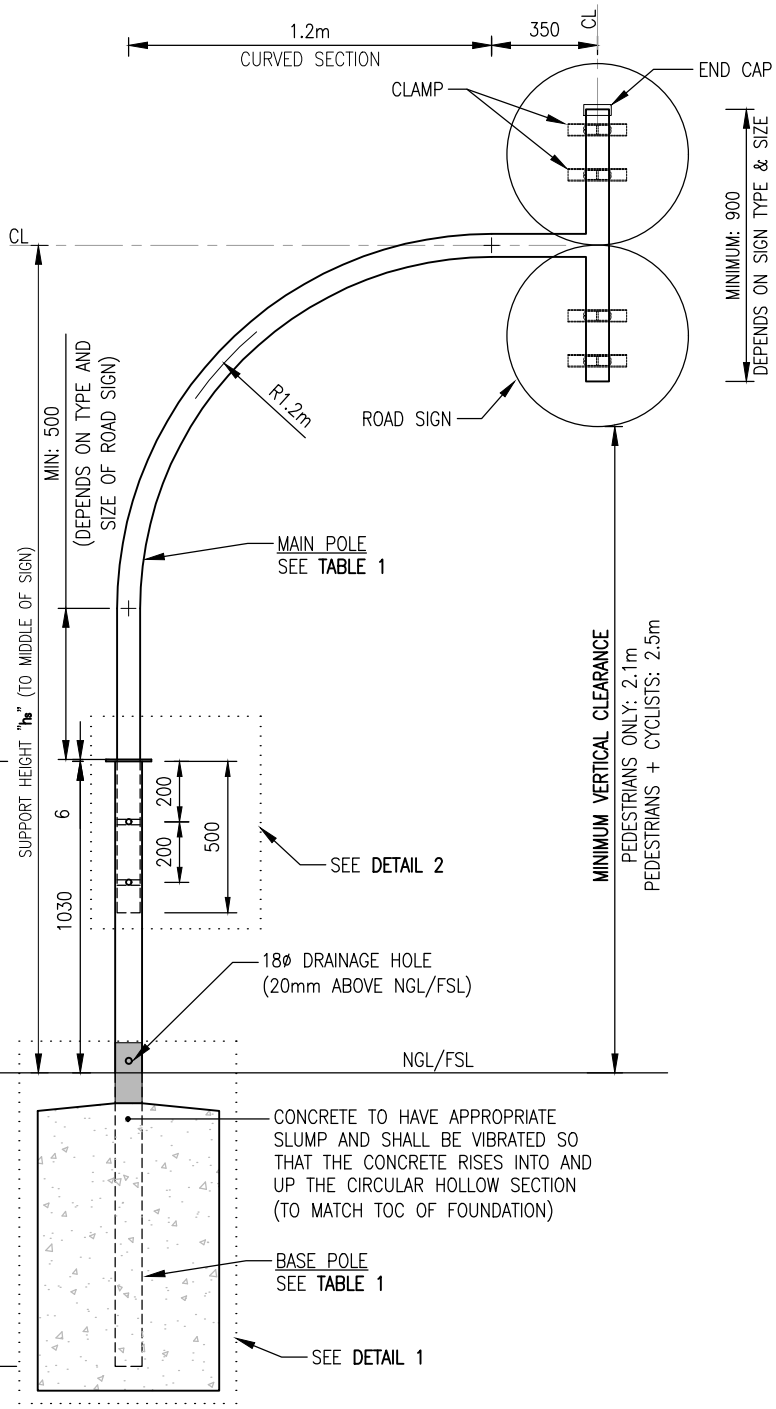
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TABLE 1: POST SIZE REQUIREMENTS								
SIGN TYPE	SMALL SIGNS				MEDIUM SIGNS			
	SIGN AREA	POLE SIZE BASE	POLE SIZE MAIN	FOUNDATION	SIGN AREA	POLE SIZE BASE	POLE SIZE MAIN	FOUNDATION
	m^2	mm	mm	mm	m^2	mm	mm	mm
A+A	0.16	89x6	76x3.5	600	0.7	114x6	102x3.5	800
C+C	0.28	89x6	76x3.5	500	1.28	102x6	89x3.5	700

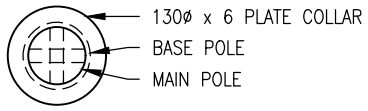
BASED ON SUPPORT HEIGHT (h_s) OF 3.45m



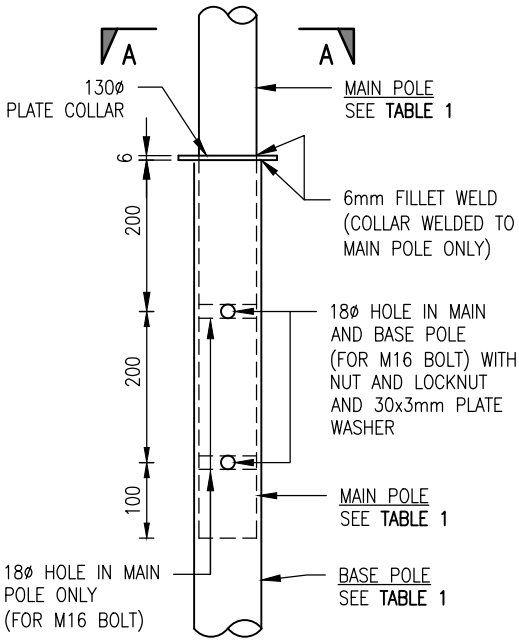
SIGN TYPE



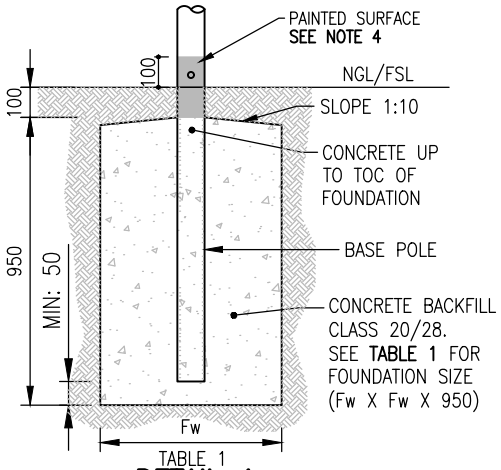
FRONT ELEVATION
SCALE 1:25



SECTION A–A
SCALE 1:10



DETAIL 2
SCALE 1:10



DETAIL 1
SCALE 1:25

NOTES:

1. DRAWING TO BE READ IN CONJUNCTION WITH SECTION 9.2 AND SARTSM–VOL2 CHAPTER 15.
2. TABLE 1 CAN BE USED AS A GUIDE TO DETERMINE THE POLE DIAMETER & THICKNESS, INCLUDING FOUNDATION SIZE.
3. MINIMUM REQUIREMENTS:
   - STRUCTURAL STEEL SHALL BE CIRCULAR HOLLOW SECTION (GRADE S355 – EN 10025).
   - BOLTS: M16, HDG GRADE 8.8 (SANS 135), UNLESS SPECIFIED OTHERWISE.
   - ALL BURR AND SHARP EDGES TO BE REMOVED PRIOR TO WELDING. ALL WELDS TO BE 6mm FILLET WELDS. ALL WELD SCALE TO BE REMOVED PRIOR TO GALVANISING. ALL STEELWORK SHALL BE HOT–DIP GALVANISED TO SANS 121 (ISO 1461) (HEAVY DUTY) PASSIVATION.
4. PAINTING SHALL CONSIST OF ONE COAT EPOXY PRIMER, FOLLOWED BY ONE COAT POLYURETHANE TOP COAT (COLOUR: GREY). STEEL SURFACE SHALL BE CHEMICALLY CLEANED PRIOR TO PAINTING.
5. TWO BREAKAWAY HOLES SHALL BE PROVIDED FOR CHS SUPPORTS GREATER THAN 76mm AND TIMBER POSTS GREATER THAN 100mm, AS PER SARTSM–VOL2 CHAPTER 15.
6. SHOULD THE USE OF A CONTINUOUS SUPPORT BE PREFERRED (AS OPPOSED TO A BASE + MAIN POLE), THE MAIN POLE DIAMETER SHOULD BE USED.

NGL: NATURAL GROUND LEVEL
FSL: FINISHED SURFACE LEVEL
TOC: TOP OF CONCRETE

CITY OF CAPE TOWN
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CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

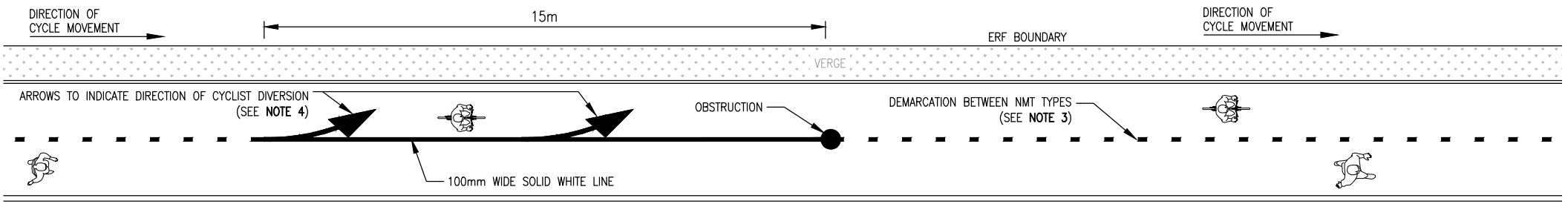
CANTILEVER ROAD SIGN SUPPORT
CURVED TYPE
MULTIPLE SIGNS

STANDARDS AND GUIDELINES DETAILS

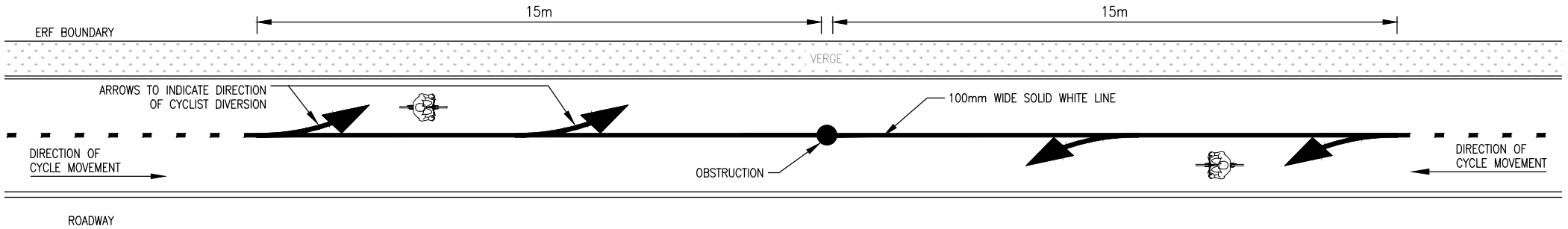
SHEET 2

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
RM4.4B	A

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ONE–DIRECTIONAL CYCLE MOVEMENT



BI–DIRECTIONAL CYCLE MOVEMENT

NOTES:

1. OBSTRUCTIONS MAY INCLUDE STREET LIGHT POLES, ROAD SIGNS, BOLLARDS OR OTHER DEVICES INTENTIONALLY PLACED IN THE NMT FACILITY WITH A VIEW TO PREVENT VEHICULAR TRAFFIC.
2. WHERE THE OBSTRUCTION IS A BOLLARD, IT SHALL BE PAINTED AS PER DRAWING GE1.
3. THE SAME DIVERSION PRINCIPLES SHALL BE APPLIED WHERE THERE IS NO MARKED DEMARCATION BETWEEN THE NMT TYPES ON A SHARED FACILITY.
4. WHERE UPSTREAM MARKINGS HAVE BEEN PROVIDED, THE DIVERSION ARROWS SHALL BE APPLIED ACCORDINGLY (i.e. IF UPSTREAM MARKING CONSISTENTLY INDICATES THAT CYCLISTS SHOULD KEEP RIGHT, THE ARROWS SHALL DIVERT CYCLIST TO THE RIGHT OF THE OBSTRUCTION).
5. WHERE BOLLARDS ARE PROVIDED AT SIDE ROADS, YIELD SYMBOLS SHALL BE PROVIDED ON THE APPROACHES TO THE AFOREMENTIONED.

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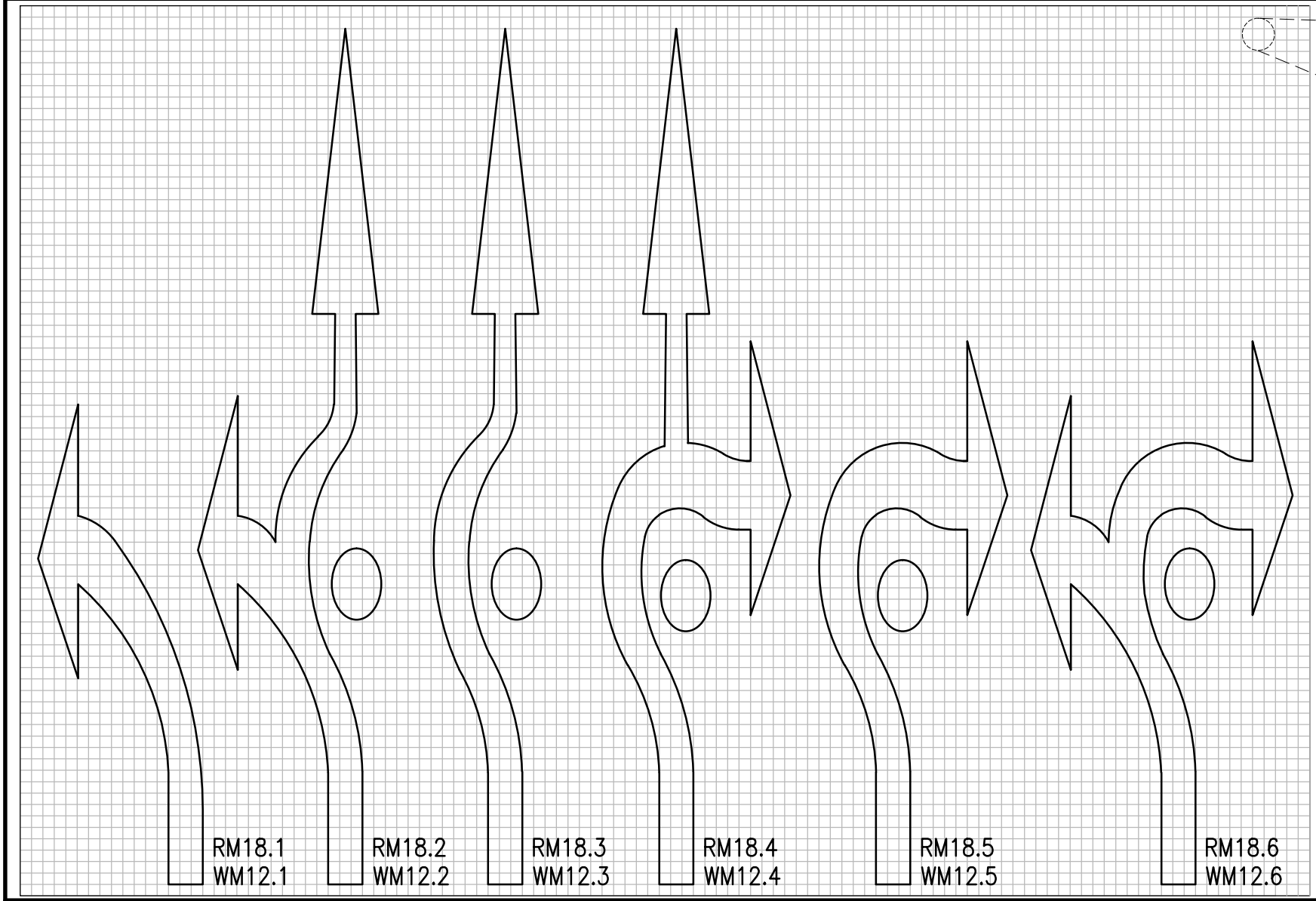
CITY OF CAPE TOWN
URBAN MOBILITY

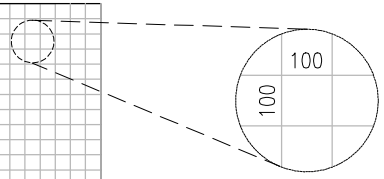
TITLE

ADVANCE WARNING FOR OBSTRUCTIONS IN SHARED NMT FACILITIES (FOR CYCLISTS)

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RM5	A





GRID SIZE

NOTES

DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 3.3.8.**

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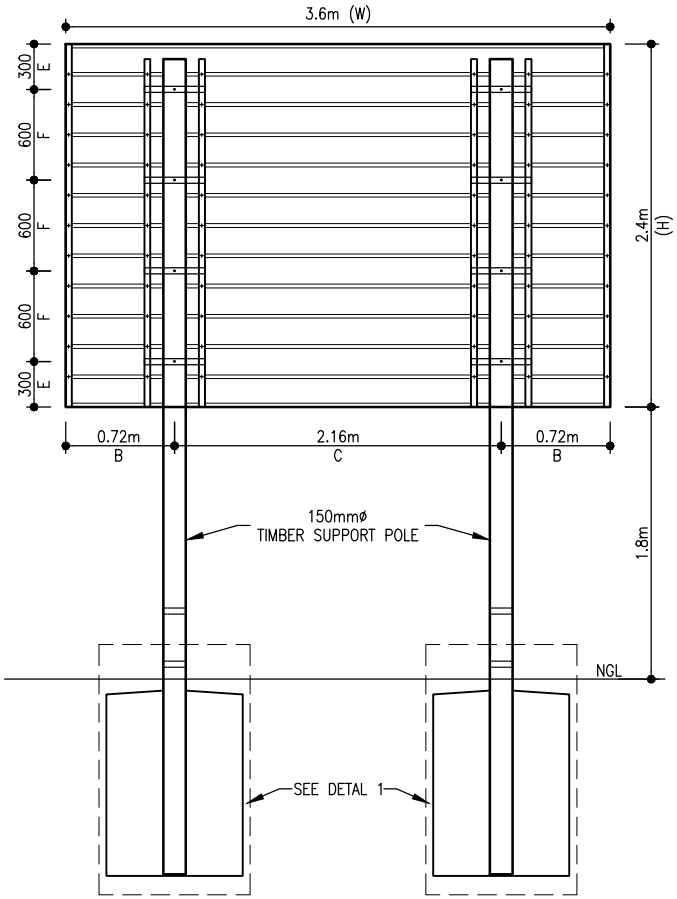
TITLE

ROUNDABOUT "FISH HOOK" APPROACH ARROWS

STANDARDS AND GUIDELINES DETAILS

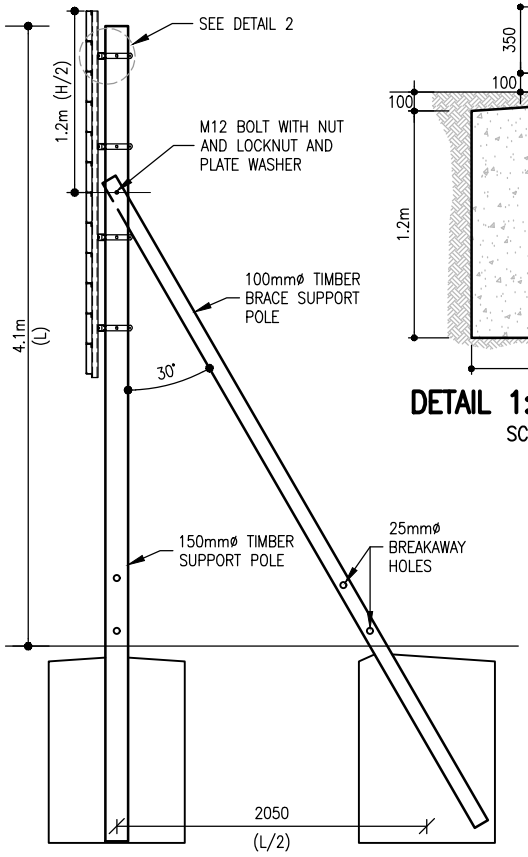
SCALE	PAPER
1:50	A4
DRAWING No.	REV
RM6	A

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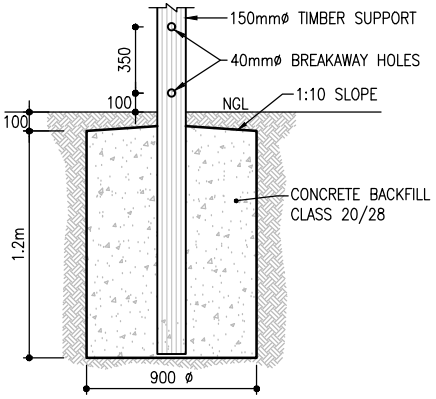
REAR ELEVATION: SUPPORTS POSITIONING

SCALE 1:50



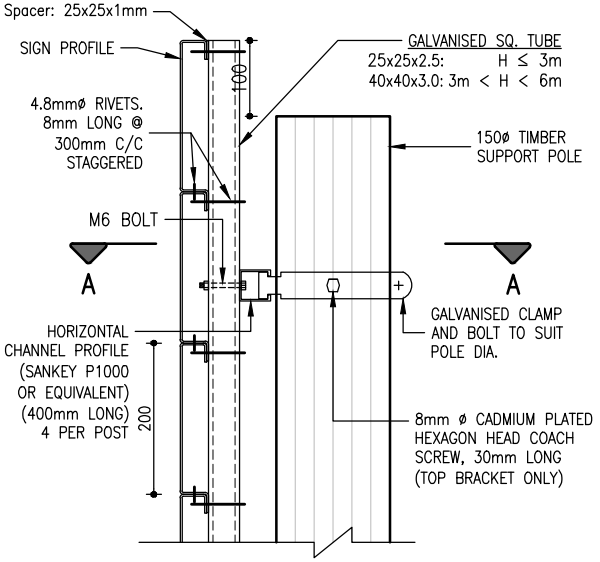
SIDE ELEVATION: BRACE DETAILS

SCALE 1:50



DETAIL 1: FOUNDATION

SCALE 1:30

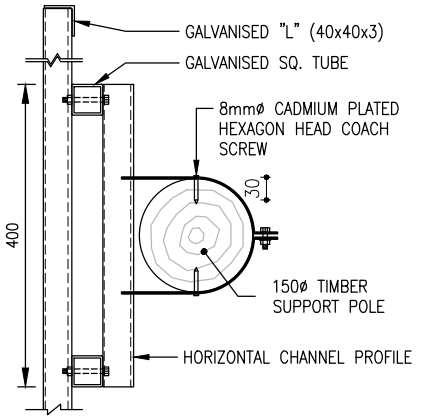


DETAIL 2: SUPPORT FIXING

SCALE 1:10



CONSTRUCTION SIGN EXAMPLE



SECTION A–A: TOP ELEVATION

SCALE 1:10

NOTES:

1. CONSTRUCTION SIGN SHALL COMPLY WITH SARTSM–VOL2 SECTION 15.
2. THE POSITION OF CONTRACT SIGN BOARDS SHALL BE DISCUSSED WITH THE APPROVAL AUTHORITY PRIOR TO CONSTRUCTION.
3. FINAL DIMENSIONS OF THE SIGN MAY VARY.
4. THE DESIGN OF THE CONSTRUCTION SIGN BOARD SHALL BE SUBMITTED TO THE CITY'S COMMUNICATIONS DEPARTMENT FOR APPROVAL, PRIOR TO FINALISATION AND PRINTING.
5. MINIMUM REQUIREMENTS:
   - STEEL PROFILE: 200mm SECTIONS, 1.0mm THICKNESS, Z275 GALVANISED.
   - RECTANGULAR HOLLOW SECTIONS AND CHANNEL PROFILES: COLD FORMED OF COMMERCIAL QUALITY MILD STEEL.
   - BOLTS, NUTS AND WASHERS: HDG GRADE 8.8 (SANS 135).
   - ALL STEELWORK, INCLUDING BOLTS, NUTS AND WASHERS, SHALL BE HOT–DIP GALVANISED TO SANS 121 (ISO 1461) (HEAVY DUTY) PASSIVATION.
   - TIMBER POLES: CLASS H4 "TANALITH" TREATER OR EQUIVALENT (SANS 10005).

TABLE 1: DESIGN PARAMETERS		
REF	VALUE	NOTES
B	W/5	W < 4m
C	3W/5	W < 4m
E	400 MAX	25x25x2.5 SQ TUBE
	600 MAX	40x40x3.0 SQ TUBE
F	800 MAX	25x25x2.5 SQ TUBE
	1200 MAX	40x40x3.0 SQ TUBE
H	2400	MAX: 3100
L	4100	MAX: 5000

NGL: NATURAL GROUND LEVEL

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CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

CONSTRUCTION SIGN BOARD

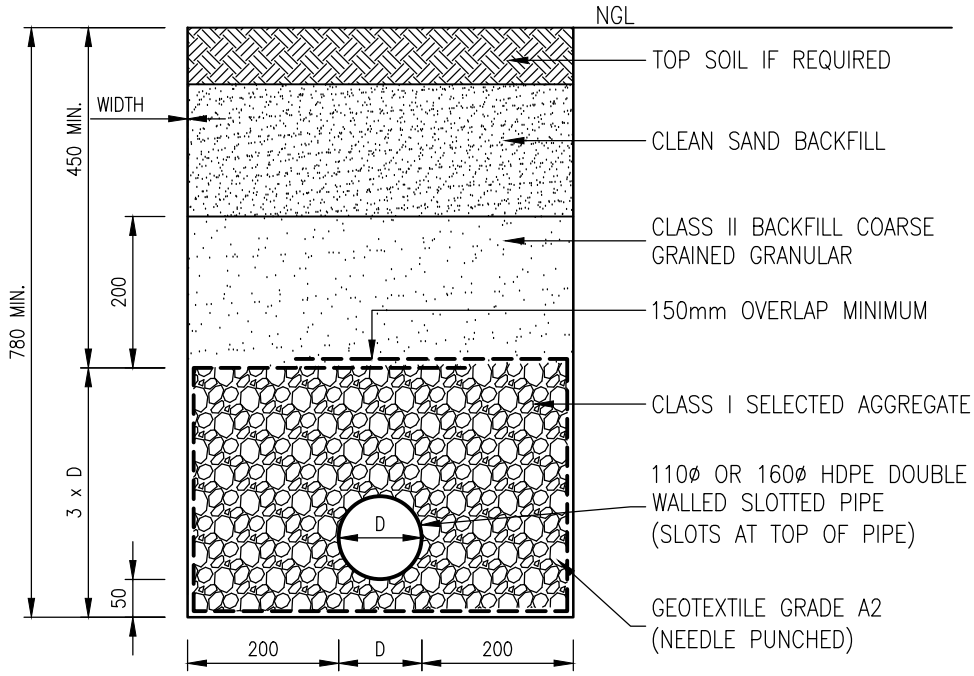
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
RM7	A

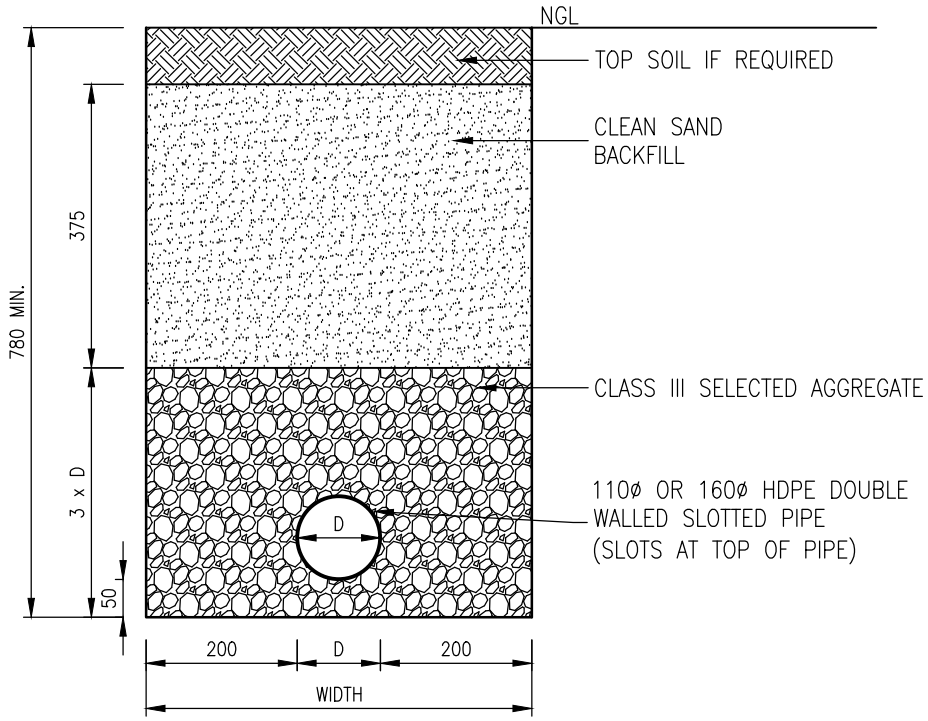
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Detail Drawings

STORMWATER



GENERAL CONDITIONS



CLAY CONDITIONS

NOTES:

PIPE BACKFILL:

- CLASS I: CRUSHED ROCK STONE AGGREGATE WITH LITTLE OR NO FINES (9–38mm).
- CLASS II: COARSE GRAINED FREE DRAINING NON–COHESIVE GRANULAR SOILS (0.6–38mm, FINES < 5%).
- CLASS III: WELL MIXED & COMPACTED CRUSHED STONE, GRADED AS FOLLOWS:
  - 50% – 13mm CUBICAL
  - 25% – 6.75mm CUBICAL
  - 25% – 4.75mm TO DUST (WASHED CRUSHER DUST)

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

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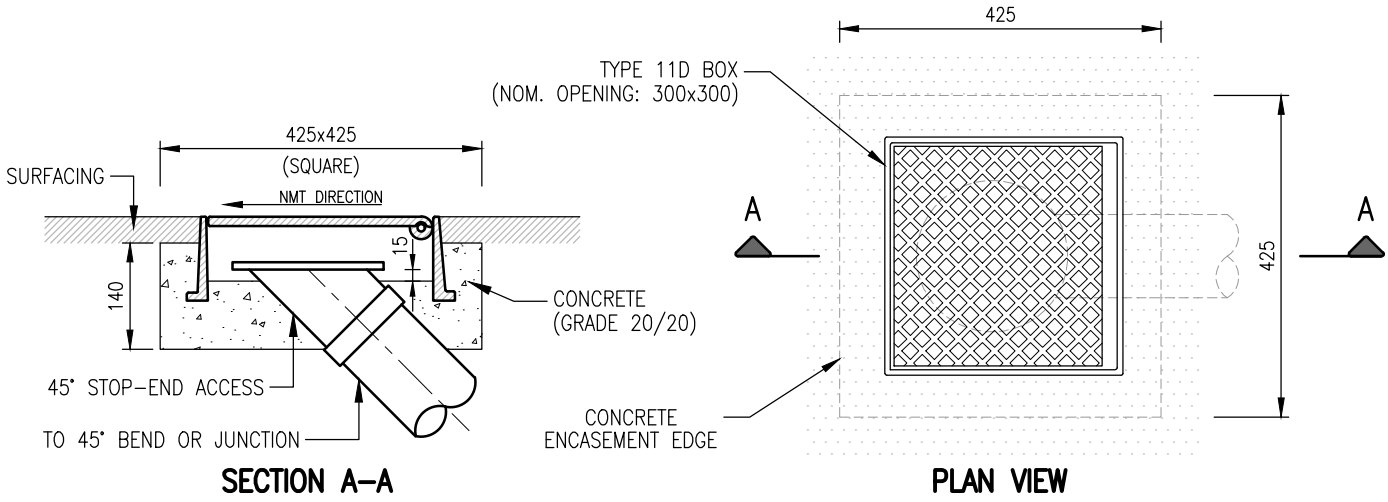
TITLE

SUB-SURFACE DRAIN: MAIN LINE

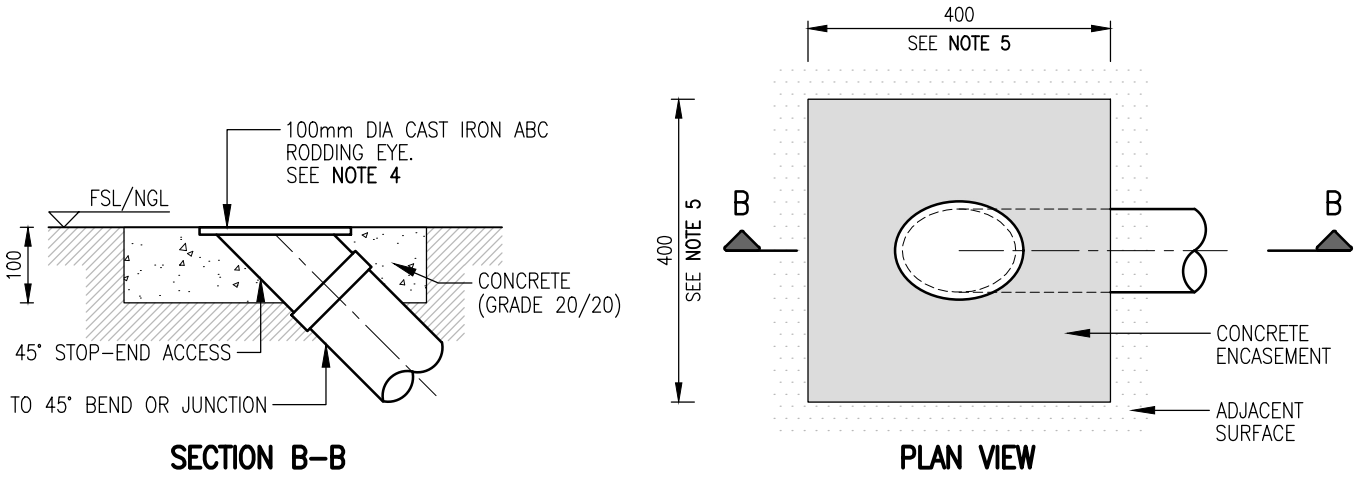
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:20	A4
DRAWING No.	REV
SW1.1	C

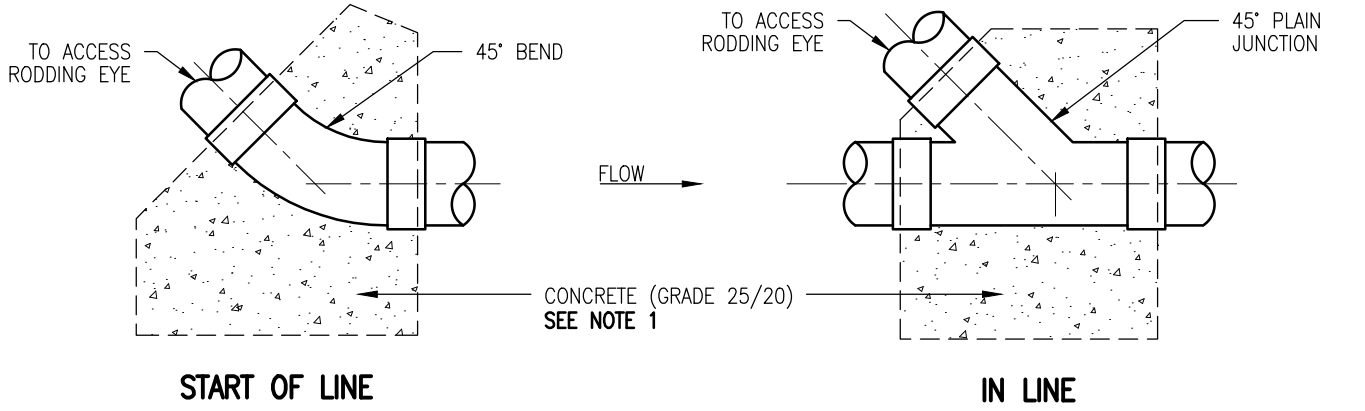
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RODDING EYE WITH ACCESS BOX



RODDING EYE (NO ACCESS BOX)



JUNCTION TO MAIN (IN SECTION)

NOTES:

1. CONCRETE ENCASEMENT AT JUNCTION:
   - REQUIRED WHEN DEPTH TO INVERT LEVEL EXCEEDS 1.5m.
   - ALL COUPLINGS TO BE FLEXIBLE.
2. THE ACCESS BOX SHALL BE TYPE 11D (AS PER THE LATEST SANS 558) IN COLOUR "BLACK". THE ACCESS BOX SHALL NOT BE PAINTED, UNLESS REQUIRED BY THE APPROVAL AUTHORITY.
3. RODDING EYES SHALL NOT BE LOCATED WITHIN CARRIAGEWAY CROSSINGS OR ANY OTHER AREAS SUBJECTED TO VEHICULAR TRAFFIC.
4. ALTERNATIVE RODDING EYE MATERIALS MAY BE CONSIDERED BY THE APPROVAL AUTHORITY.
5. WHERE RODDING EYES ARE NOT LOCATED IN SURFACED AREAS, THE CONCRETE SURFACE ENCASEMENT SHALL BE INCREASED TO 600x600x100mm.
6. DRAWING TO BE READ IN CONJUNCTION WITH SECTION 10.4.4.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

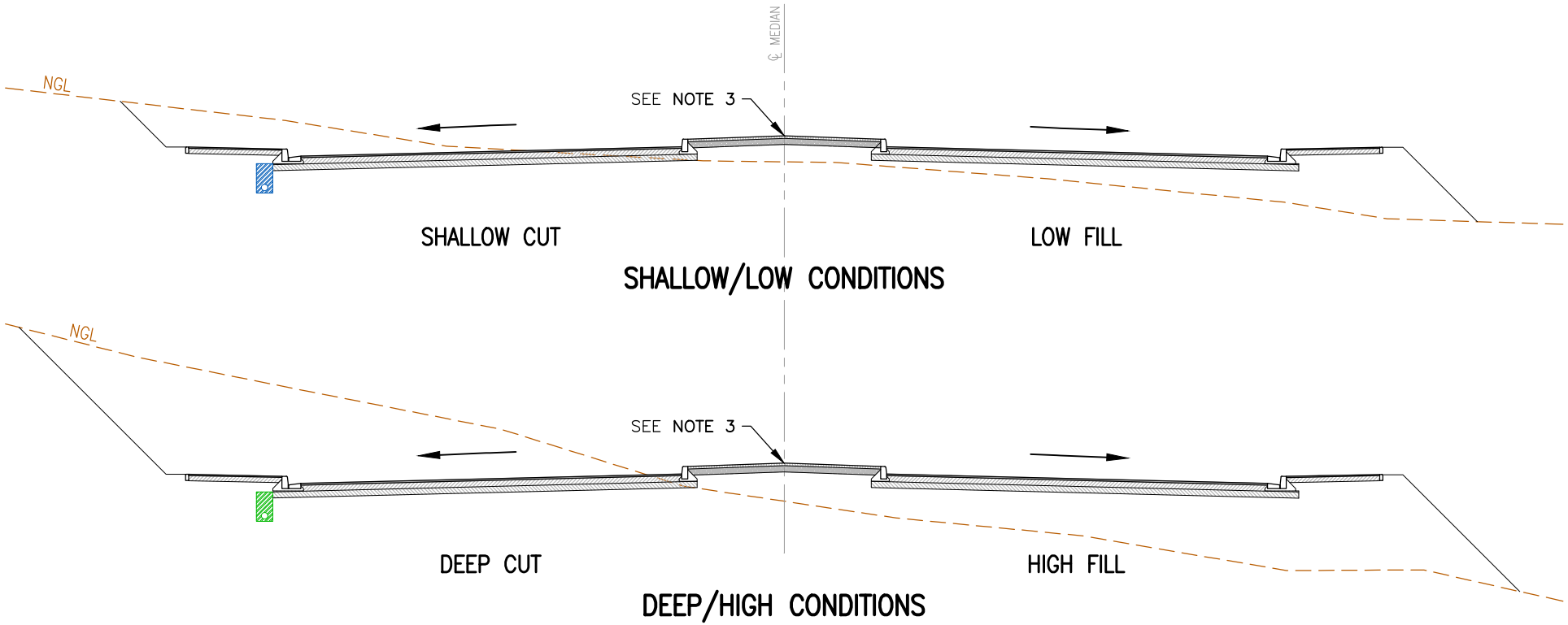
TITLE

SUB-SURFACE DRAIN: RODDING EYE & JUNCTION

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:10	A4
DRAWING No.	REV
SW1.2	B

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NOTES:

1. THE INDICATION OF SUB–SURFACE DRAINAGE IN THIS DRAWING SHOULD BE USED AS A GUIDELINE. ULTIMATELY, THE RESPONSIBILITY REMAINS WITH THE DESIGNER TO ENSURE THAT ADEQUATE SUB–SURFACE DRAINAGE IS PROVIDED FOR THE SITE SPECIFIC CONDITIONS.
2. THE PROVISION OF SUB–SURFACE DRAINS WILL DEPEND ON SITE SPECIFIC CONDITIONS, I.E. SOIL TYPE, WATER TABLE IN RAIN SEASON, NATURAL DRAINAGE DIRECTION, PRESENCE OF IRRIGATION, INFILTRATION, ETC.
3. MEDIAN ISLANDS;
   - 3.1. DESIGNS SHALL ADHERE TO THE REQUIREMENTS OF SECTION 4.2.4.3 OF TRH15. RAISED MEDIANS SHALL BE DESIGNED TO PREVENT INFILTRATION OF WATER. WHERE THE AFOREMENTIONED IS NOT POSSIBLE, EFFECTIVE SUBSURFACE DRAINAGE SHALL BE PROVIDED.
   - 3.2. MEDIAN ISLANDS SHALL BE GRADED TOWARDS THE CARRIAGEWAY(S) AND SHALL NOT HAVE A DEPRESSION (TO AVOID THE CONGREGATION OF WATER).
   - 3.3. SUB–SURFACE DRAINS SHALL TYPICALLY NOT BE REQUIRED WHEN THE MEDIAN ISLAND IS SURFACED. HOWEVER, **NOTE 2, 3.1 & 3.2** ABOVE SHALL STILL PREVAIL.
4. DRAWING TO BE READ IN CONJUNCTION WITH **SECTION 10.4.4.**

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

LEGEND:
SUB–SURFACE DRAIN PROVISION

REQUIRED

TYPICALLY REQUIRED

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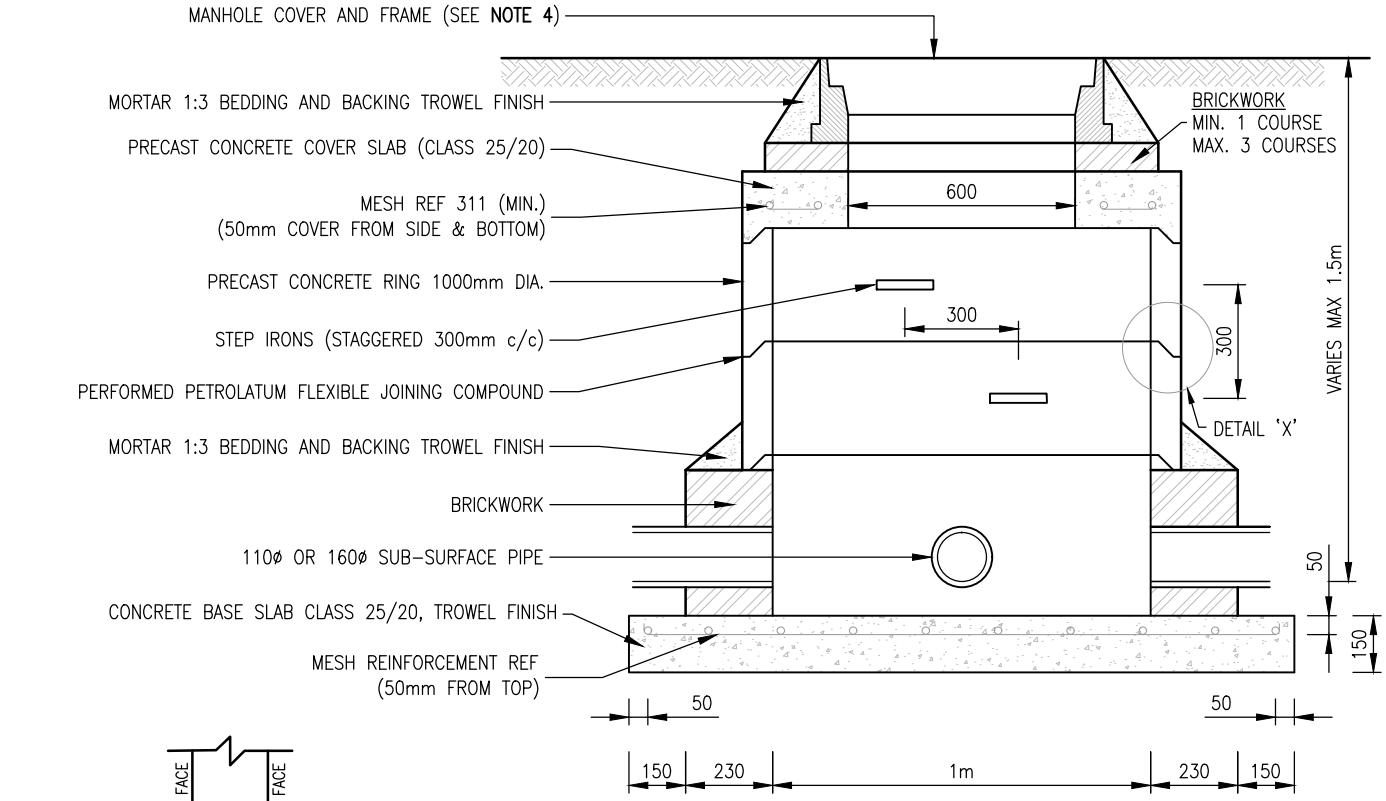
TITLE

PROVISION OF SUB-SURFACE DRAINS

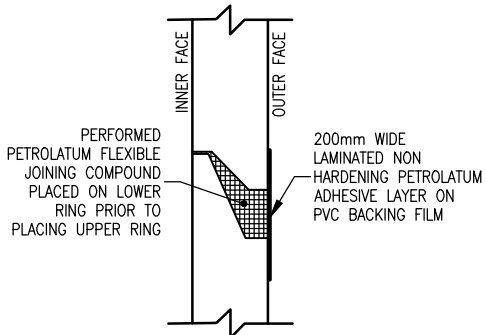
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:150	A4
DRAWING No.	REV
SW1.3	A

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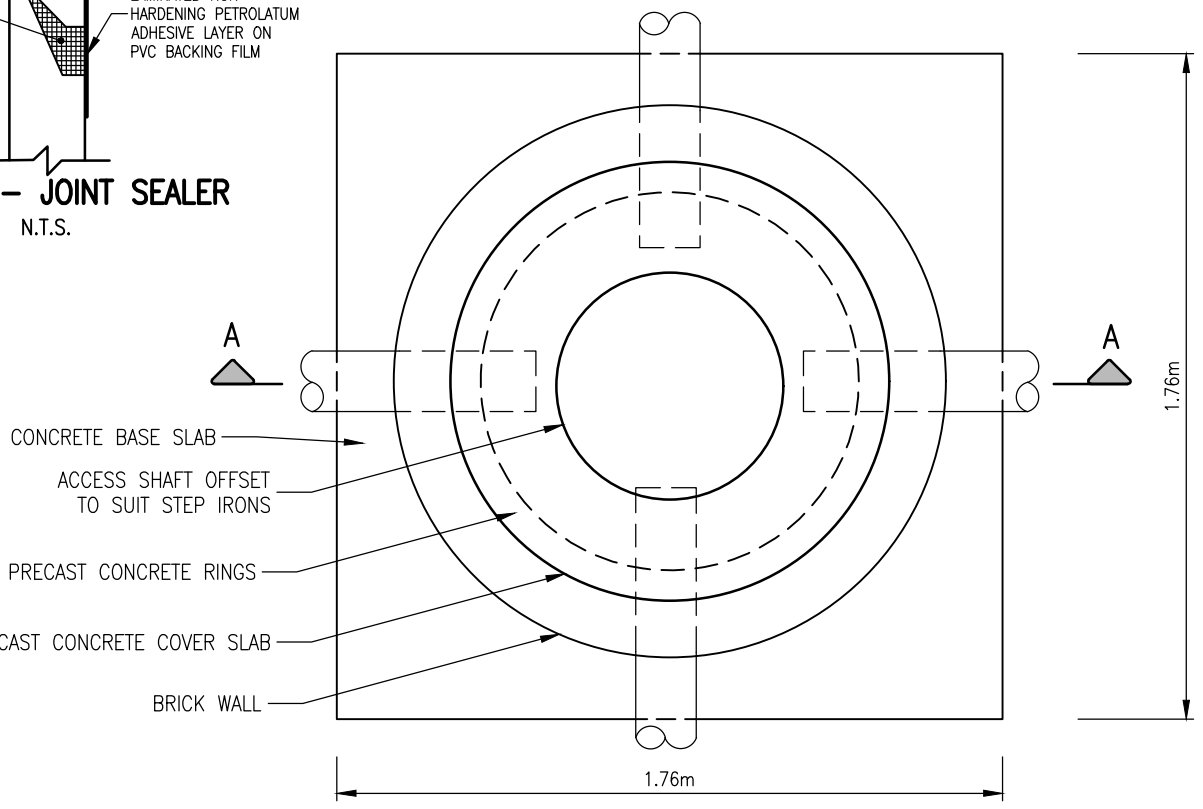


SECTION A–A



DETAIL 'X'– JOINT SEALER

N.T.S.



PLAN VIEW

NOTES:

1. BENCHING REQUIRED TO PREVENT STANDING WATER.
2. BRICKWORK: REFER TO SECTION **10.4.10** "SPECIFICATIONS FOR MASONRY UNITS".
3. MORTAR FOR BRICKWORK TO BE 1:3.
4. REFER TO SECTION **10.4.3** FOR MANHOLE COVER AND FRAME REQUIREMENTS.

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URBAN MOBILITY

TITLE

MANHOLE FOR SUB-SURFACE DRAINS

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:20	A4
DRAWING No.	REV
SW2.1	C

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TABLE 1
MANHOLE CHAMBER DIAMETER

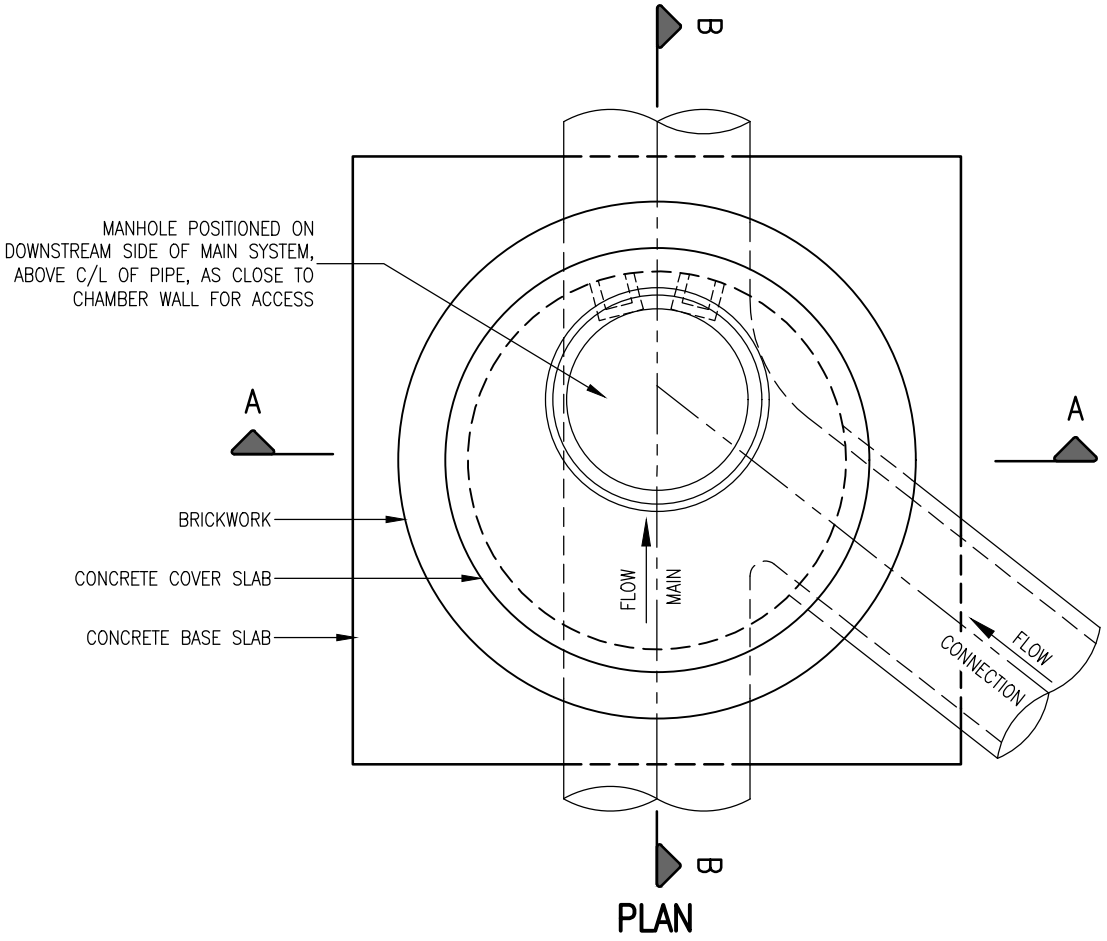
NOM. PIPE DIA. (mm)	DEPTH 'y' (m)		
	y ≤ 2.5	2.6 < y ≤ 4.0	y > 4.0
	CHAMBER DIAMETER ø (mm)		
375	1000	1250	1500
450			
525	1250		
600			
675			
750	1500	1500	
825			
900			
1050	1800	1800	1800
1200			
1350	1950	1950	1950

TABLE 2
BRICKWORK & FLOOR/BASE SLAB

DEPTH "y" (m)	BRICKWORK (mm)	BASE/FLOOR SLAB		
		THICKNESS (mm)	CONCRETE CLASS	REINFORCING
y ≤ 2.5	230	150	25/20	NONE
2.5 < y ≤ 4.0	350	200	25/20	MESH 311
y > 4.0	350	250	25/20	MESH 395

TABLE 3
PRECAST CONCRETE RING: MINIMUM WALL THICKNESS

RING DIAMETER	WALL THICKNESS
1000	65
1250	75
1500	85
1800	95
1950	115



PLAN

NOTES:

1. REFER TO SECTION **10.4.3** FOR MANHOLE COVER AND FRAME REQUIREMENTS.
2. HINGED MANHOLE COVERS SITUATED IN THE ROAD SHALL OPEN TOWARDS ONCOMING TRAFFIC.
3. MANHOLE COVER LEVEL:
   - ROADWAY OR FOOTWAY: LEVEL WITH FRL/FSL.
   - OPEN SPACES: 500mm ABOVE NGL (UNLESS DIRECTED OTHERWISE).MINIMUM CENTER LINE RADIUS OF BENCHING: 2.5 X PIPE DIAMETER.
4. CHIMNEY OPENING TO BE PLACED AS CLOSE TO CENTER LINE OF THE MAIN INCOMING AND OUTGOING PIPE AS POSSIBLE.
5. BRICKWORK: SEE "SPECIFICATION FOR MASONRY UNITS", SECTION **10.4.10**.
6. ALL INTERNAL BRICKWORK TO HAVE SMOOTH FINISH (12mm PLASTERED WITH 1:3 MORTAR).
7. MANHOLES MUST CATER FOR ANY SITE SPECIFIC GROUND CONDITIONS. SHOULD THE MANHOLE DESIGN REQUIRE ALTERATIONS/AMENDMENTS FOR SUCH CONDITIONS, THE DESIGN MUST BE DISCUSSED WITH THE APPROVAL AUTHORITY.
8. REFER TO **DRAWING SW2.3** FOR MANHOLE WITH AN ACCESS SHAFT (DEEP TYPE).
9. MANHOLES FOR PIPE DIAMETERS GREATER THAN 1350mm SHALL REQUIRE A SPECIAL DESIGN.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEETS INFO:
SHEET 1: GENERAL NOTES, TABLES 1, 2 & 3
SHEET 2: SECTION A–A & B–B

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

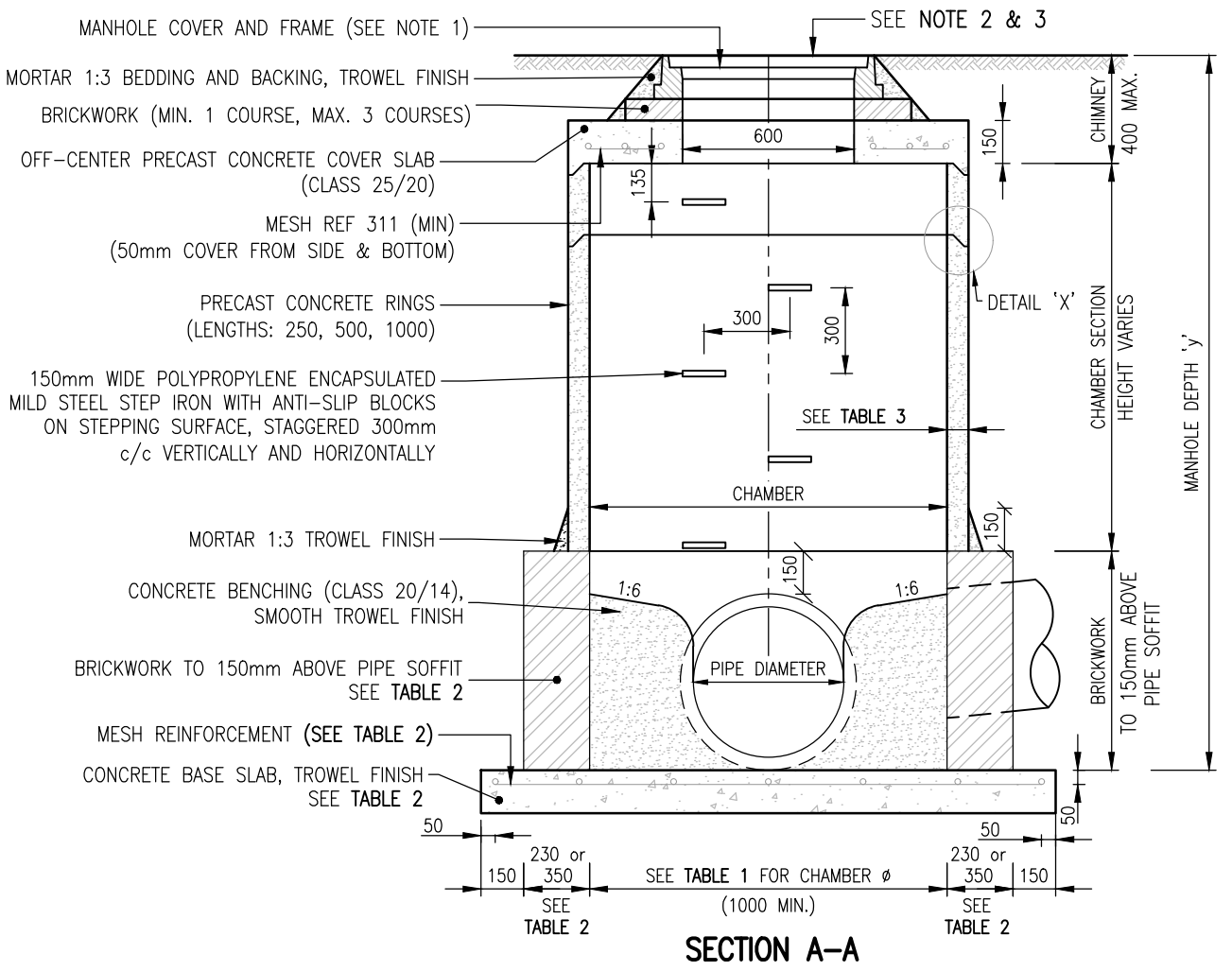
STORMWATER MANHOLE WITHOUT ACCESS SHAFT (SHALLOW TYPE)

STANDARDS AND GUIDELINES DETAILS

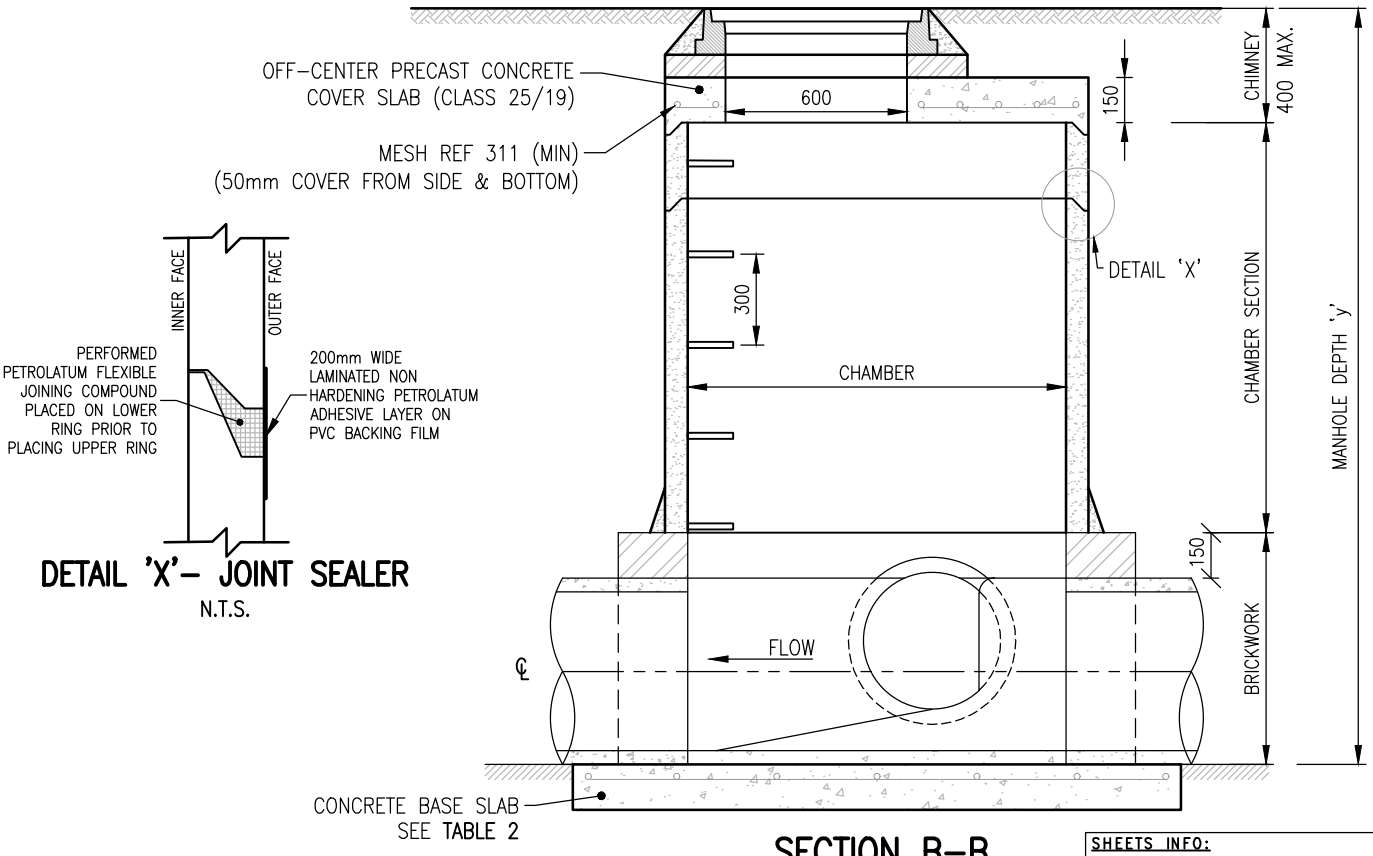
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DRAWING No.	REV
SW2.2A	C

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SECTION A–A



SECTION B–B

DETAIL 'X'– JOINT SEALER

N.T.S.

SHEETS INFO:

SHEET 1: GENERAL NOTES, TABLES 1, 2 & 3
SHEET 2: SECTION A–A & B–B

CITY OF CAPE TOWN
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URBAN MOBILITY

TITLE

STORMWATER MANHOLE WITHOUT ACCESS SHAFT (SHALLOW TYPE)

STANDARDS AND GUIDELINES DETAILS

SHEET 2

SCALE	PAPER
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DRAWING No.	REV
SW2.2B	D

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TABLE 1
MANHOLE CHAMBER DIAMETER

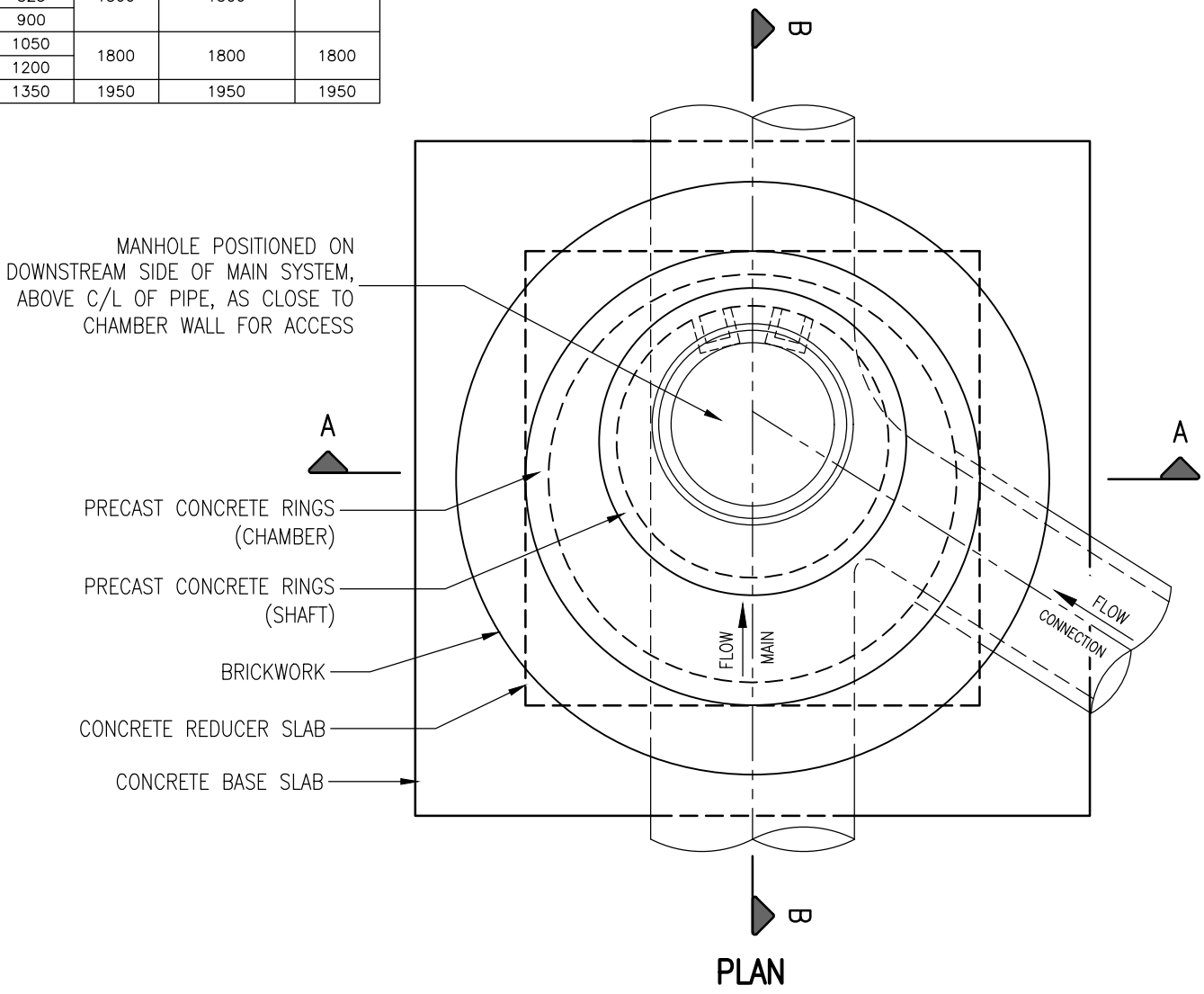
NOM. PIPE DIA. (mm)	DEPTH 'y' (m)		
	y ≤ 2.5	2.6 < y ≤ 4.0	y > 4.0
	CHAMBER DIAMETER ø (mm)		
375	1000	1250	1500
450			
525	1250		
600			
675			
750	1500	1500	
825			
900			
1050	1800	1800	1800
1200			
1350	1950	1950	1950

TABLE 2
BRICKWORK & FLOOR/BASE SLAB

DEPTH "y" (m)	BRICKWORK (mm)	BASE/FLOOR SLAB		
		THICKNESS (mm)	CONCRETE CLASS	REINFORCING
y ≤ 2.5	230	150	25/20	NONE
2.5 < y ≤ 4.0	350	200	25/20	MESH 311
y > 4.0	350	250	25/20	MESH 395

TABLE 3
PRECAST CONCRETE RING: MINIMUM WALL THICKNESS

RING DIAMETER	WALL THICKNESS
1000	65
1250	75
1500	85
1800	95
1950	115



PLAN

NOTES:

1. REFER TO SECTION **10.4.3** FOR MANHOLE COVER AND FRAME REQUIREMENTS.
2. HINGED MANHOLE COVERS SITUATED IN THE ROAD SHALL OPEN TOWARDS ONCOMING TRAFFIC.
3. MANHOLE COVER LEVEL:
   - ROADWAY OR FOOTWAY: LEVEL WITH FRL/FSL.
   - OPEN SPACES: 500mm ABOVE NGL (UNLESS DIRECTED OTHERWISE).MINIMUM CENTER LINE RADIUS OF BENCHING: 2.5 X PIPE DIAMETER.
4. MINIMUM CENTER LINE RADIUS OF BENCHING: 2.5 X PIPE DIAMETER.
5. CHIMNEY OPENING TO BE PLACED AS CLOSE TO CENTER LINE OF THE MAIN INCOMING AND OUTGOING PIPE AS POSSIBLE.
3. BRICKWORK: SEE SECTION **10.4.10** "SPECIFICATION FOR MASONRY UNITS".
4. ALL INTERNAL BRICKWORK TO HAVE SMOOTH FINISH (12mm PLASTERED WITH 1:3 MORTAR).
6. MANHOLES MUST CATER FOR ANY SITE SPECIFIC GROUND CONDITIONS. SHOULD THE MANHOLE DESIGN REQUIRE ALTERATIONS/AMENDMENTS FOR SUCH CONDITIONS, THE DESIGN MUST BE DISCUSSED WITH THE APPROVAL AUTHORITY.
7. REFER TO **DRAWING SW2.2** FOR MANHOLE WITHOUT AN ACCESS SHAFT (SHALLOW TYPE).
8. MANHOLES FOR PIPE DIAMETERS GREATER THAN 1350mm SHALL REQUIRE A SPECIAL DESIGN.
9. REFER TO SECTION **10.4.3** FOR SAFETY IMPROVEMENTS FOR DEEP MANHOLES.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEETS INFO:
SHEET 1: GENERAL NOTES, TABLES 1, 2 & 3
SHEET 2: SECTION A–A
SHEET 3: SECTION B–B

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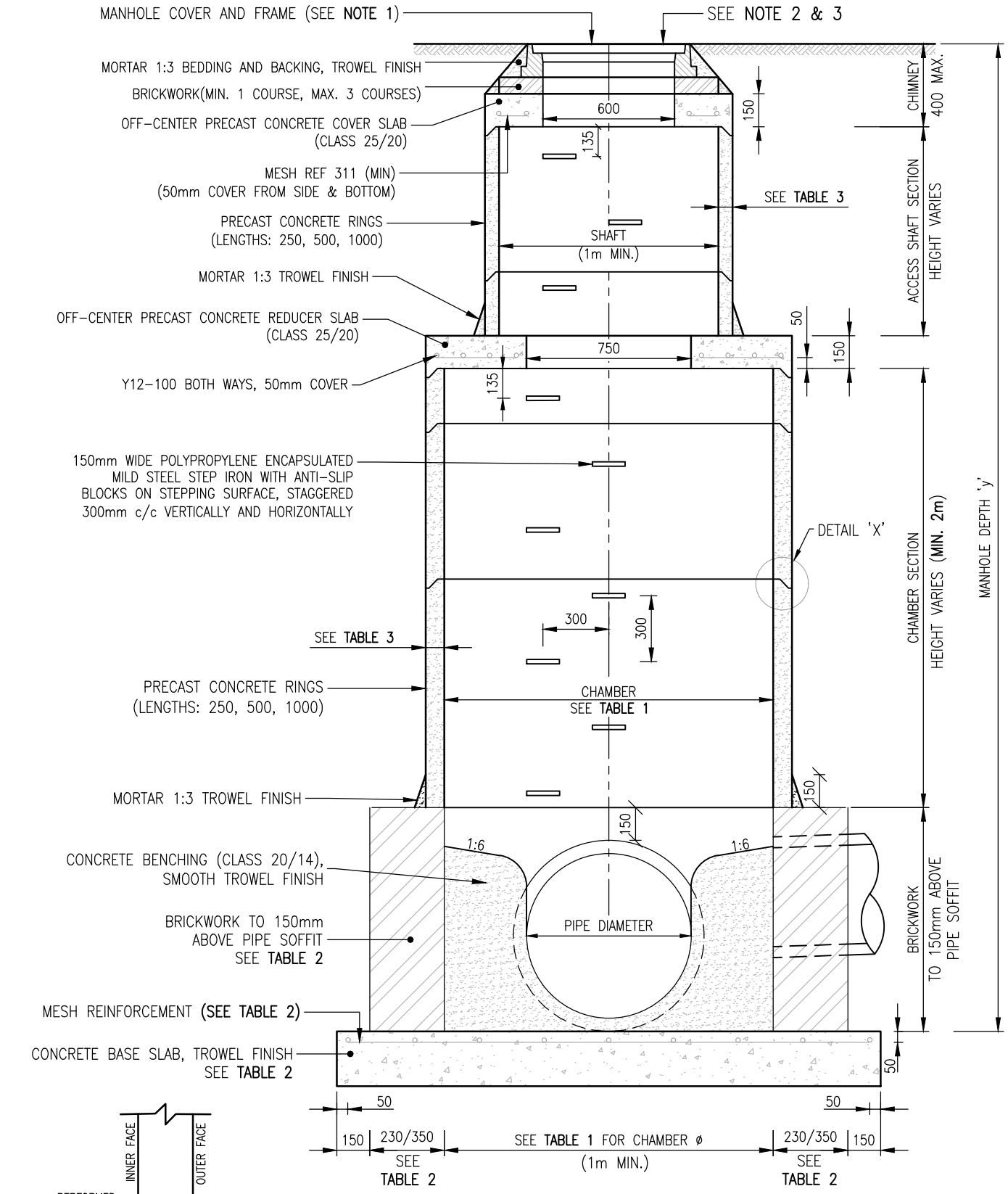
STORMWATER MANHOLE WITH ACCESS SHAFT (DEEP TYPE)

STANDARDS AND GUIDELINES DETAILS

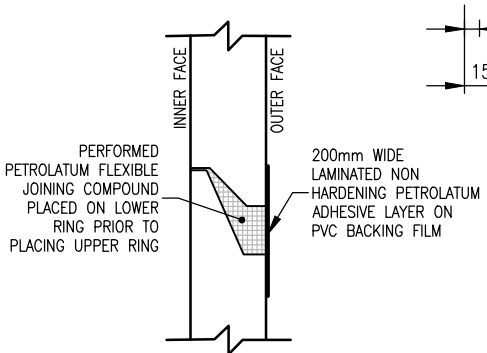
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SCALE	PAPER
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DRAWING No.	REV
SW2.3A	C

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SECTION A-A



DETAIL 'X'- JOINT SEALER

N.T.S.

SHEETS INFO:

SHEET 1: GENERAL NOTES, TABLES 1, 2 & 3
SHEET 2: SECTION A-A
SHEET 3: SECTION B-B

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TITLE

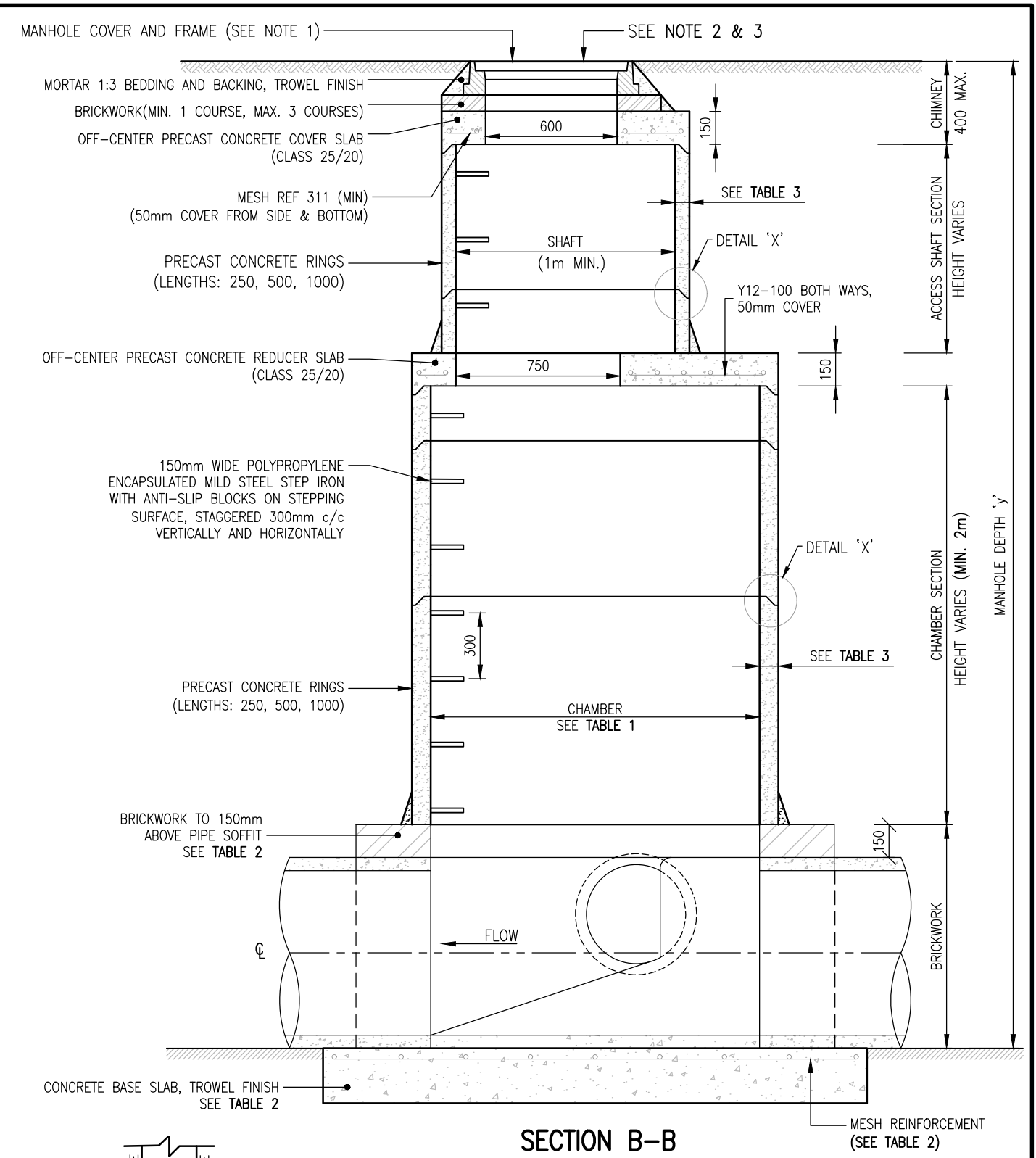
STORMWATER MANHOLE WITH ACCESS SHAFT (DEEP TYPE)

STANDARDS AND GUIDELINES DETAILS

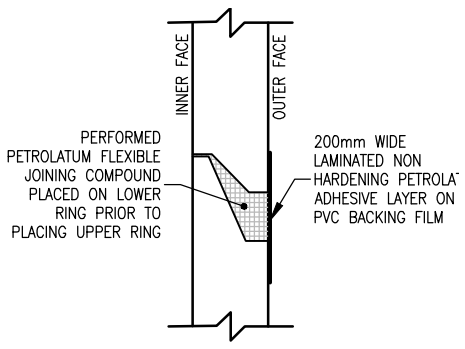
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DRAWING No.	REV
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SECTION B-B



DETAIL 'X'- JOINT SEALER

N.T.S.

NOTES:

1. SEE SHEET 2 "SECTION A-A" FOR COMPLETE ANNOTATIONS.

SHEETS INFO:

SHEET 1: GENERAL NOTES TABLES 1, 2 & 3
SHEET 2: SECTION A-A
SHEET 3: SECTION B-B

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CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

STORMWATER MANHOLE WITH ACCESS SHAFT (DEEP TYPE)

STANDARDS AND GUIDELINES DETAILS

SHEET 3

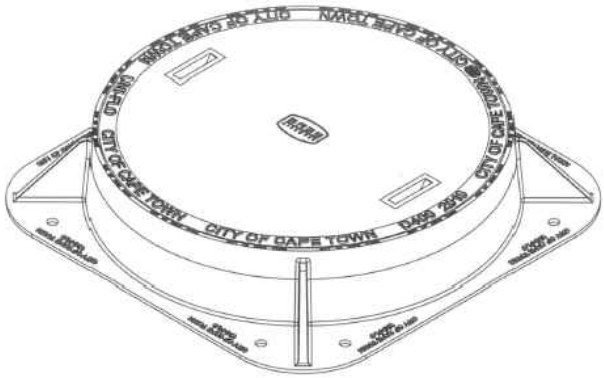
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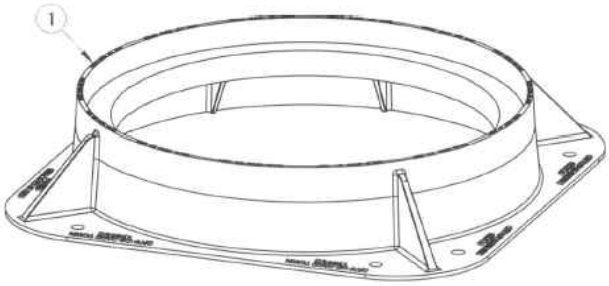
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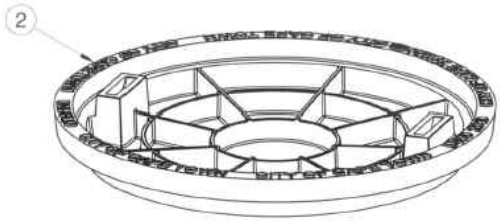
RENDERED COVER AND FRAME



ASSEMBLED COVER AND FRAME



COMPONENT 1: FRAME



COMPONENT 2: COVER



COMPONENT 3: CONCRETE INFILL

COMPONENT DETAILS & SPECIFICATIONS					
#	Component	APPROXIMATE MASS	SIZE	MATERIAL	CLASSIFICATION
1	Frame	48kg	800x800x150mm (L x W x H)	Ductile Iron	Class D400 (400kN)
2	Cover	48kg	694mm ø ; 100mm (H)	Ductile Iron	Class D400 (400kN)
3	Concrete Infill	53kg	Volume = 0.022m^3	Concrete	(45MPa 28-day Compressive Strength)

NOTES:

1. THE COVER AND FRAME SHALL CONFORM TO THE LATEST SANS 50124.
2. DUCTILE IRON SHALL CONFORM TO THE LATEST SANS 936.

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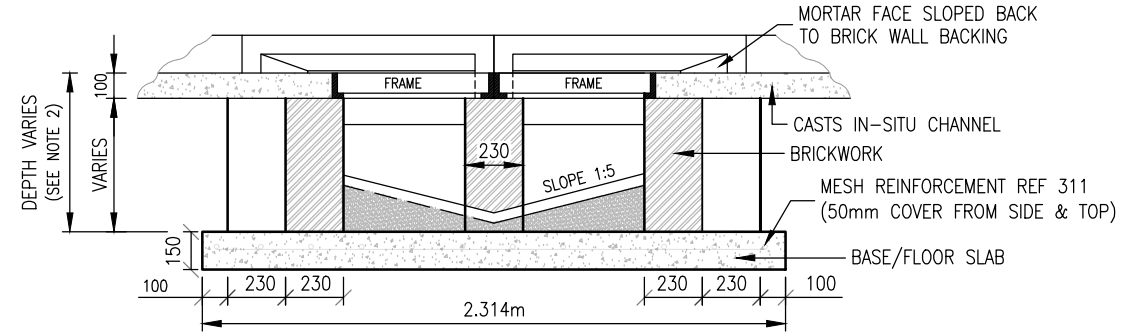
CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

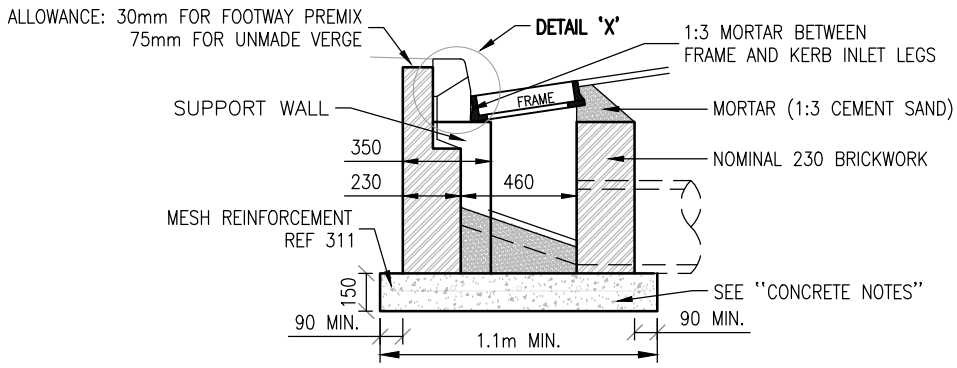
DUCTILE IRON MANHOLE COVER AND FRAME, WITH CONCRETE INFILL

STANDARDS AND GUIDELINES DETAILS

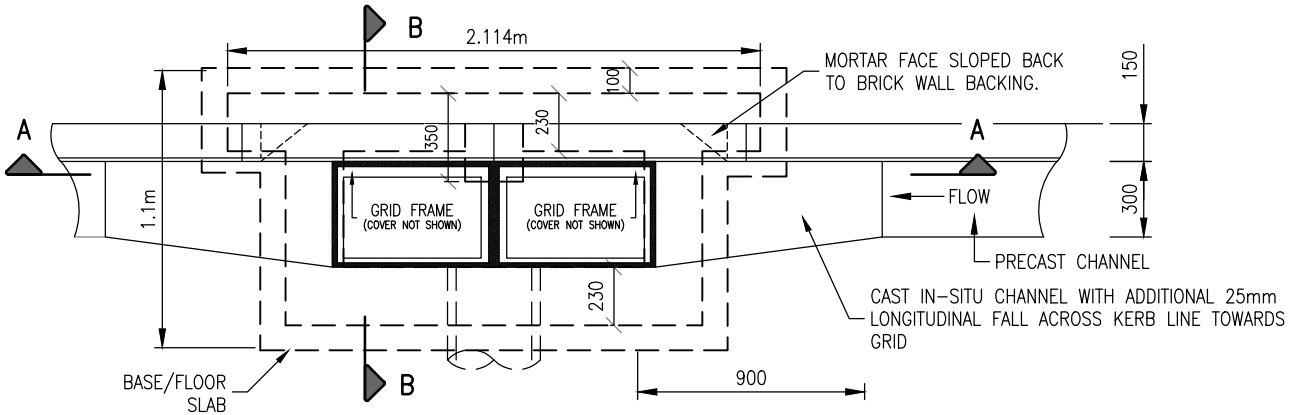
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NTS	A4
DRAWING No.	REV
SW2.4	A



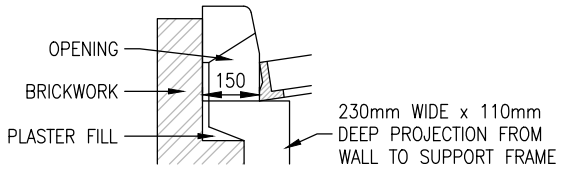
SECTION A–A



SECTION B–B



PLAN



DETAIL 'X'

NOTES: CONCRETE CLASS

BASE/FLOOR	25/20
BENCHING	20/14
IN-SITU CAST CHANNEL	30/20

GENERAL NOTES:

1. HINGED COVERS ARE TO OPEN TOWARDS SIDEWALK AND NOT THE ROAD.
2. CATCHPIT DEPTH:
   - MINIMUM = 0.75m
   - MAXIMUM = 1.20m
3. BRICKWORK: SEE SECTION 10.4.10 "SPECIFICATION FOR MASONRY UNITS".
4. ALL INTERNAL BRICKWORK TO HAVE SMOOTH FINISH.
5. REFER TO DRAWING SW4 FOR INLET KERB DETAILS.

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CITY OF CAPE TOWN
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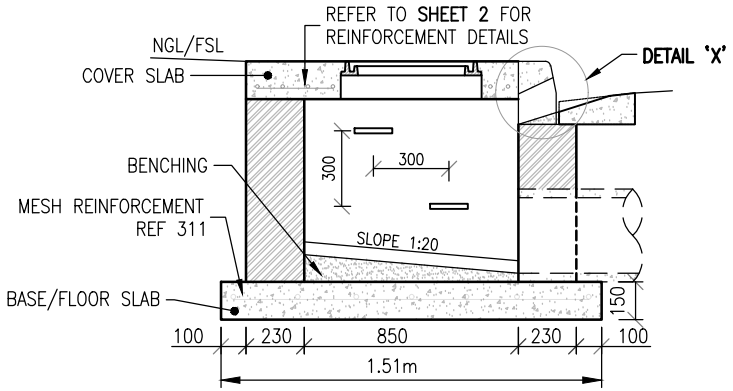
TITLE

STORMWATER CATCHPIT
TYPE A: DOUBLE KERB & GRID INLET COMBINATION

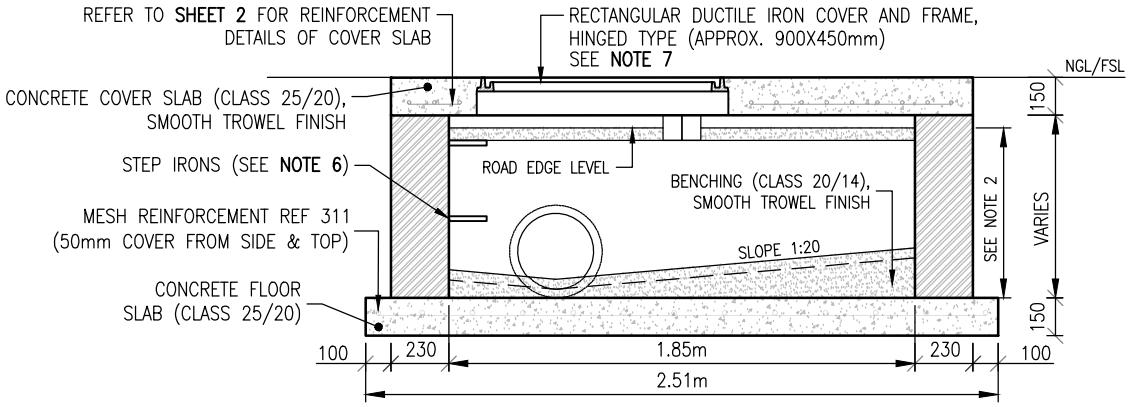
STANDARDS AND GUIDELINES DETAILS

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DRAWING No.	REV
SW3.1	D

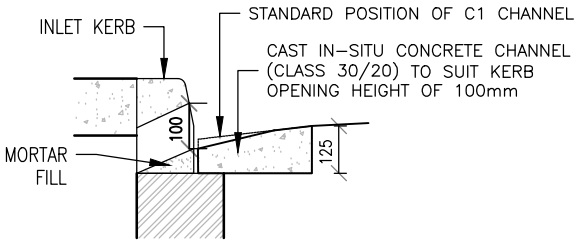
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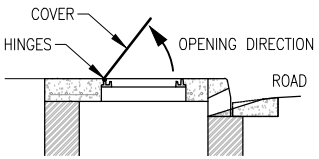
SECTION B–B



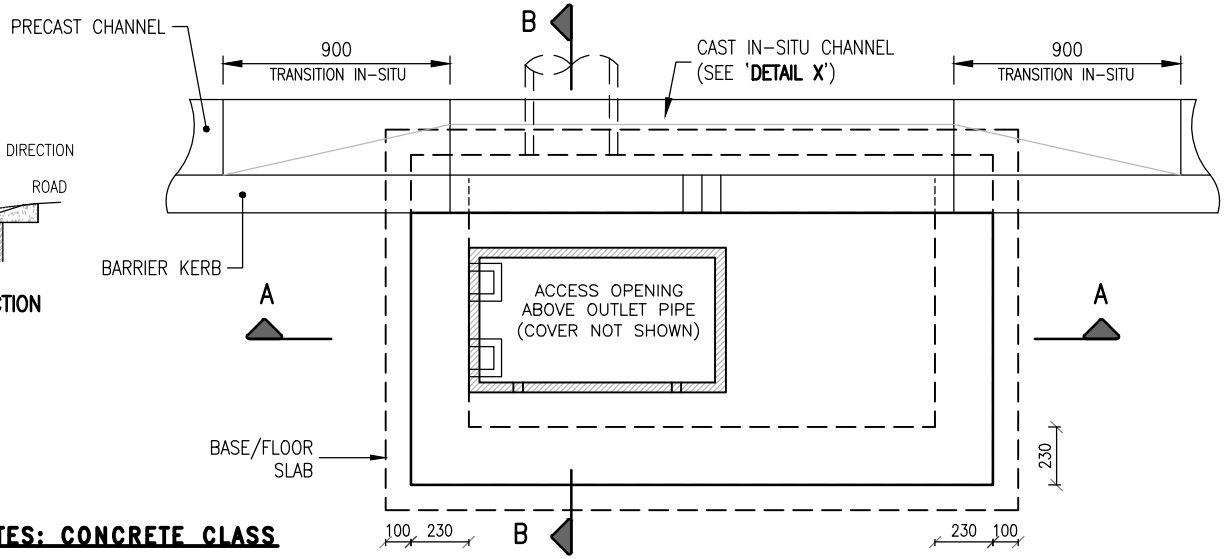
SECTION A–A



DETAIL 'X'



DETAIL 1: COVER OPENING DIRECTION



PLAN VIEW

GENERAL NOTES:

1. HINGED COVER TO OPEN AWAY FROM ROADWAY. SEE **DETAIL 1**.
2. CATCHPIT DEPTH (RELATIVE TO ROAD EDGE LEVEL):
   - MINIMUM = 0.75m
   - MAXIMUM = 1.20m
3. BRICKWORK: SEE SECTION **10.4.10** "SPECIFICATION FOR MASONRY UNITS".
4. ALL INTERNAL BRICKWORK TO HAVE SMOOTH FINISH.
5. REFER TO DRAWING SW4 FOR INLET KERB DETAILS.
5. STEP IRONS TO BE PROVIDED WHERE CATCHPIT DEPTH EXCEEDS 1m. TYPE: 150mm WIDE POLYPROPYLENE ENCAPSULATED MILD STEEL, WITH ANTI–SLIP BLOCKS ON STEPPING SURFACE.

NOTES: CONCRETE CLASS

BASE/FLOOR	25/20
COVER SLAB	25/20
BENCHING	20/14
IN–SITU CAST CHANNEL	30/20

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:

SHEET 1: CATCHPIT DETAILS
SHEET 2: REINFORCEMENT DETAILS

CITY OF CAPE TOWN
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URBAN MOBILITY

TITLE

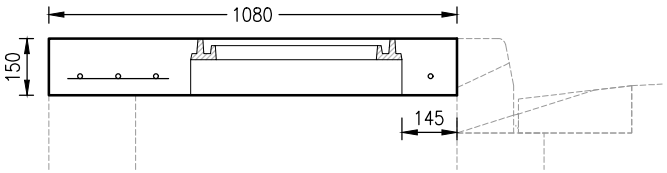
STORMWATER CATCHPIT
TYPE B: DOUBLE KERB INLET (2 x 1m INLETS)
CATCHPIT DETAILS

STANDARDS AND GUIDELINES DETAILS

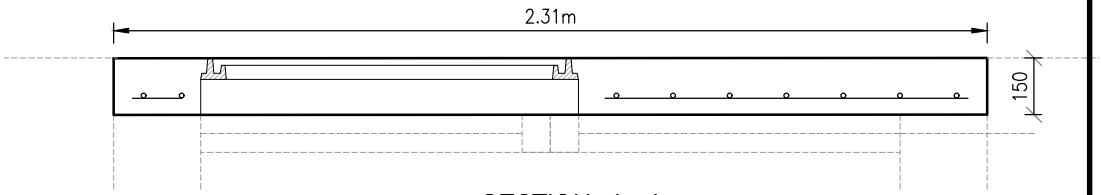
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DRAWING No.	REV
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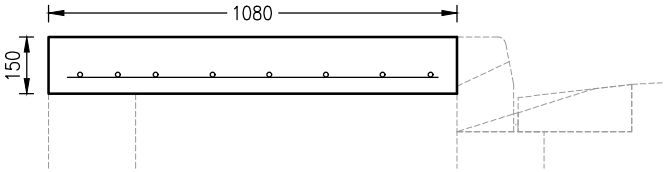
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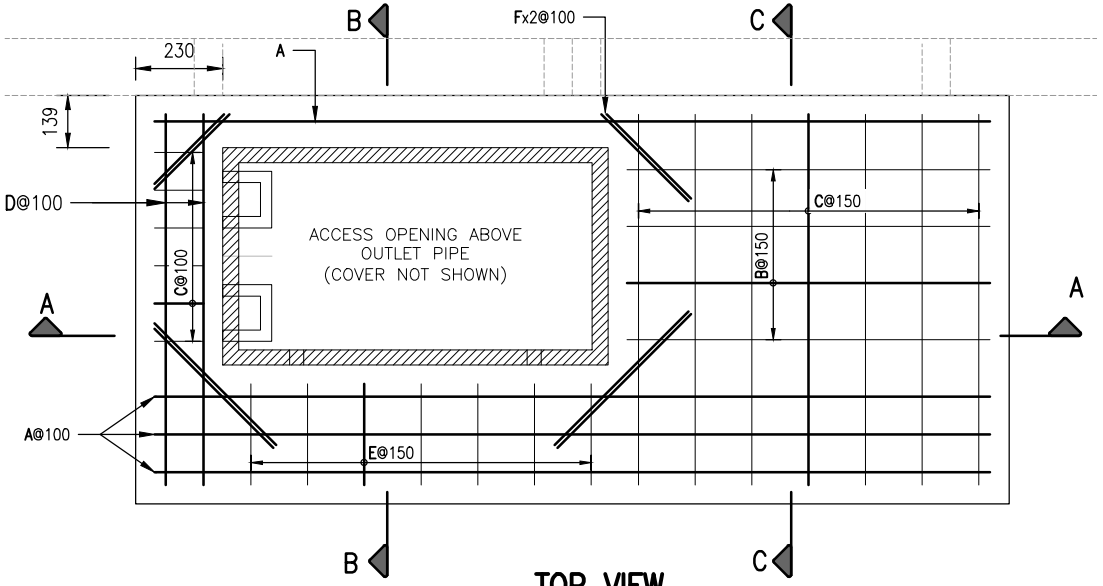
SECTION B–B



SECTION A–A



SECTION C–C



TOP VIEW

BENDING SCHEDULE					
COVER SLAB					
BAR	No.	DIA	LENGTH	SKETCH	SLAB POSITION
A	4	Y12	2210		BOTTOM
B	4	Y12	960		BOTTOM
C	6	Y12	130		BOTTOM
D	9	Y12	980		BOTTOM
E	7	Y12	260		BOTTOM
F	16	Y12	500 (CUT TO SUIT)		TOP & BOTTOM

GENERAL NOTES

1. COVER SLAB SHALL BE CONCRETE CLASS 25/20.
2. THE COVER SLAB SHALL BE PRECAST, WITH THE COVER AND FRAME TO BE CAST WITH SLAB.
3. MINIMUM COVER FOR STEEL REINFORCEMENT SHALL BE 50mm, UNLESS INDICATED OTHERWISE.
4. BARS SHALL BE BENT IN ACCORDANCE WITH SANS 82.

SHEET INDEX:

SHEET 1: CATCHPIT DETAILS
SHEET 2: REINFORCEMENT DETAILS

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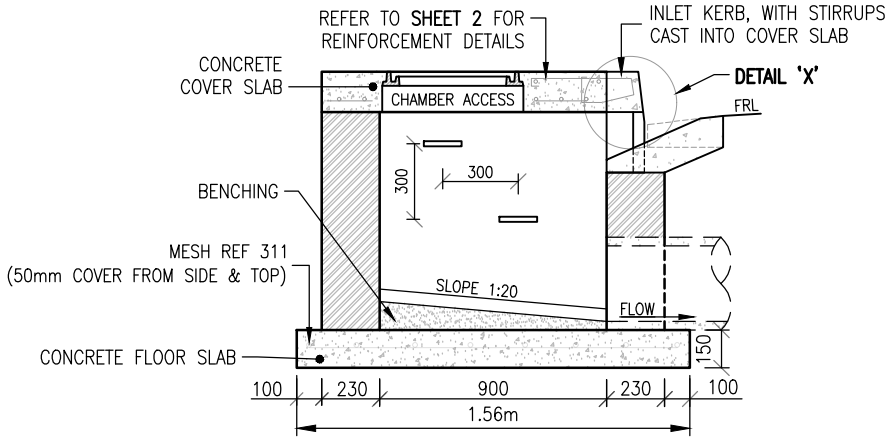
STORMWATER CATCHPIT
TYPE B: DOUBLE KERB INLET (2 x 1m INLETS)
COVER SLAB REINFORCEMENT DETAILS

STANDARDS AND GUIDELINES DETAILS

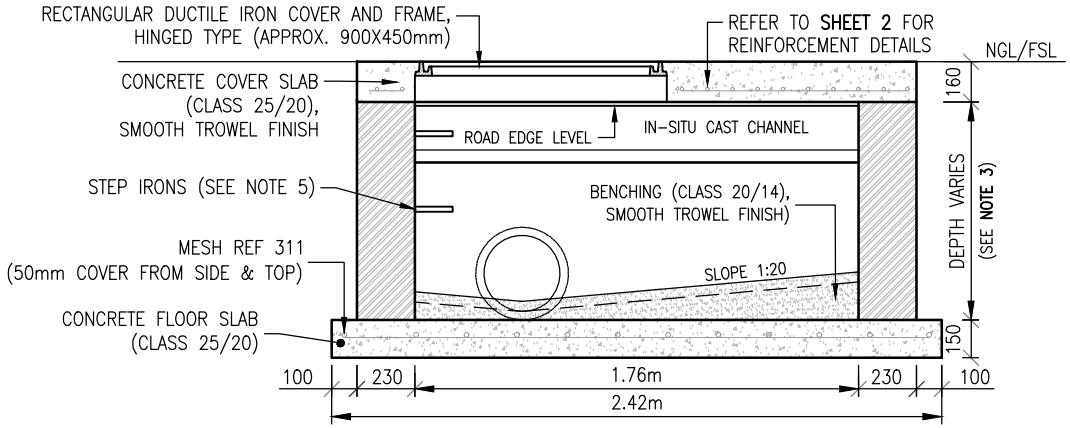
SHEET 2

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DRAWING No.	REV
SW3.2B	A

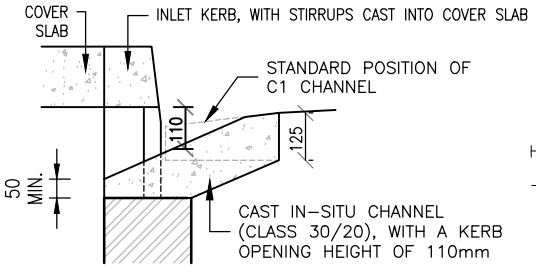
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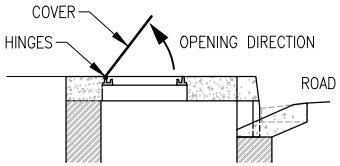
SECTION B–B



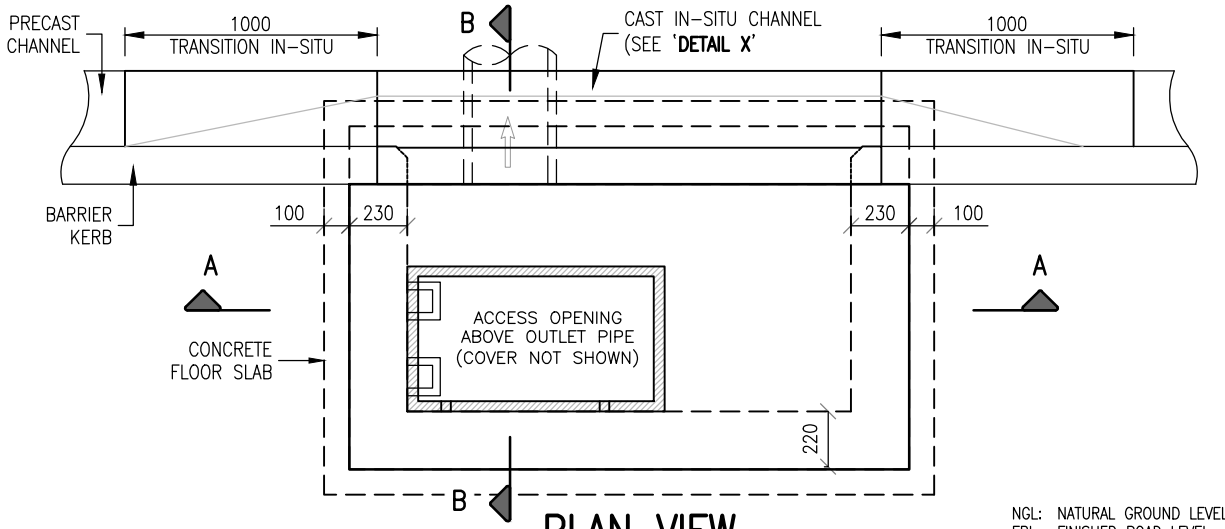
SECTION A–A



DETAIL 'X'



DETAIL 1:
COVER OPENING DIRECTION



PLAN VIEW

GENERAL NOTES:

1. HINGED COVER TO OPEN AWAY FROM ROADWAY.
2. ALL INTERNAL BRICKWORK TO HAVE SMOOTH FINISH.
3. CATCHPIT DEPTH (RELATIVE TO ROAD EDGE LEVEL):
   - MINIMUM = 0.75m
   - MAXIMUM = 1.20m
4. BRICKWORK: SEE **SECTION 10.4.10** "SPECIFICATION FOR MASONRY UNITS".
5. STEP IRONS TO BE PROVIDED WHERE CATCHPIT DEPTH EXCEEDS 1m. TYPE: 150mm WIDE POLYPROPYLENE ENCAPSULATED MILD STEEL, WITH ANTI-SLIP BLOCKS ON STEPPING SURFACE.
6. COVER & FRAME TO BE CASE IN WITH COVER SLAB.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:

SHEET 1: CATCHPIT DETAILS
SHEET 2: REINFORCEMENT DETAILS

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

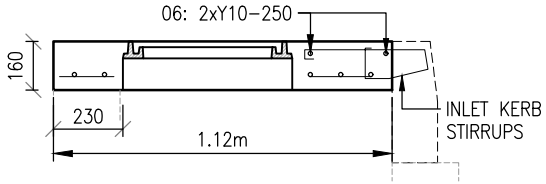
STORMWATER CATCHPIT TYPE C: EXTENDED KERB INLET CATCHPIT DETAILS

STANDARDS AND GUIDELINES DETAILS

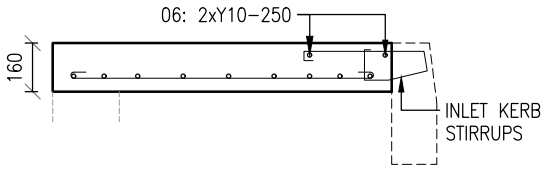
SHEET 1

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
SW3.3A	D

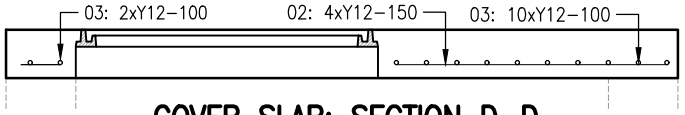
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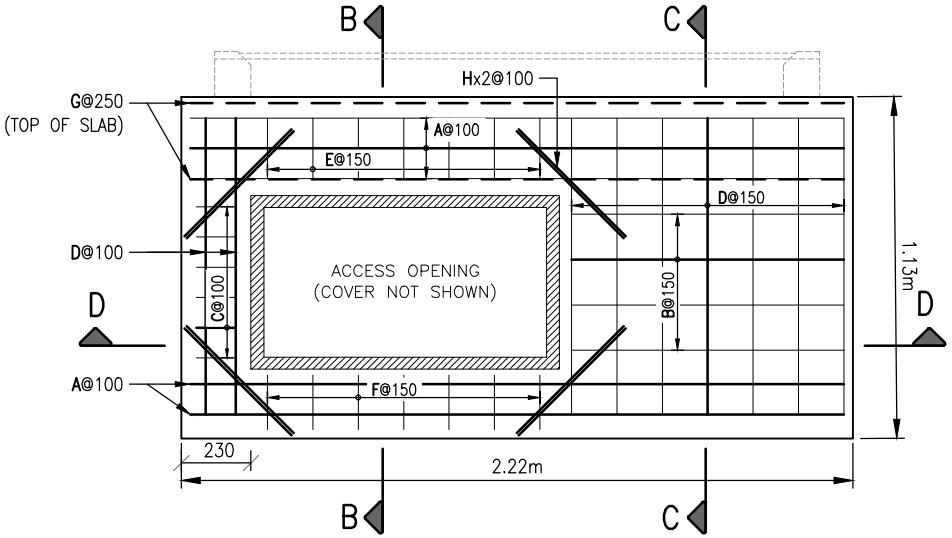
COVER SLAB: SECTION B-B



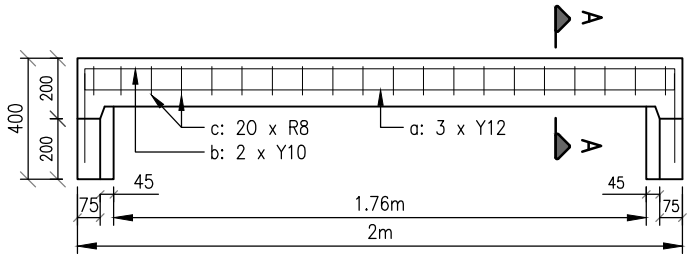
COVER SLAB: SECTION C-C



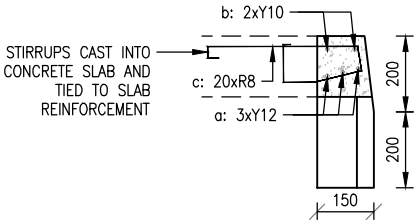
COVER SLAB: SECTION D-D



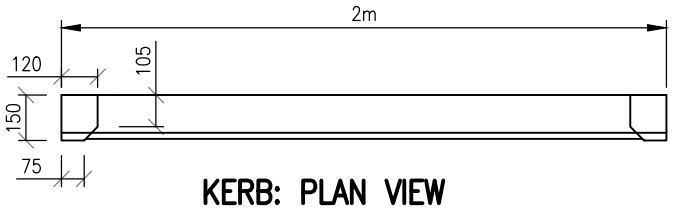
COVER SLAB: PLAN VIEW



KERB: FRONT ELEVATION



KERB: SECTION A-A



KERB: PLAN VIEW

BENDING SCHEDULE			
PRECAST INLET KERB			
BAR	No.	DIA	SKETCH
a	3	Y12	160, 1930
b	2	Y10	310, 1950
c	20	R8	10, 410, 65, 95, 30, 130, 80

BENDING SCHEDULE					
COVER SLAB					
BAR	No.	DIA	LENGTH	SKETCH	SLAB POSITION
A	5	Y12	2160		BOTTOM
B	4	Y12	900		BOTTOM
C	6	Y12	130		
D	9	Y12	980		BOTTOM
E	7	Y12	200		BOTTOM
F	7	Y12	180		BOTTOM
G	2	Y10	2160		BOTTOM
H	16	Y12	500		TOP & BOTTOM

REINFORCEMENT NOTES:

1. COVER SLAB TO BE CAST IN-SITU, WITH REINFORCEMENT TIED TO STIRRUPS OF INLET KERB.
2. MINIMUM COVER TO STEEL REINFORCEMENT SHALL BE 50mm, UNLESS INDICATED OTHERWISE.
3. STIRRUPS (BAR "c") SHALL BE CAST IN CONCRETE OF COVER SLAB.
4. BARS SHALL BE BENT IN ACCORDANCE WITH SANS 82.

SHEET INDEX:

SHEET 1: CATCHPIT DETAILS
SHEET 2: REINFORCEMENT DETAILS

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

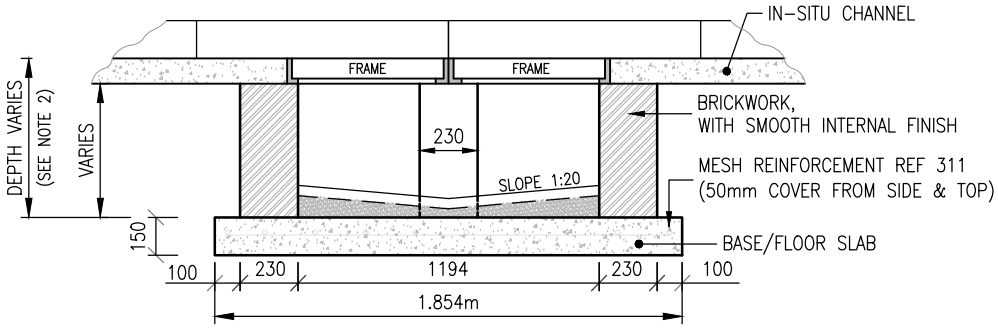
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STORMWATER CATCHPIT
TYPE C: EXTENDED KERB INLET
REINFORCEMENT DETAILS

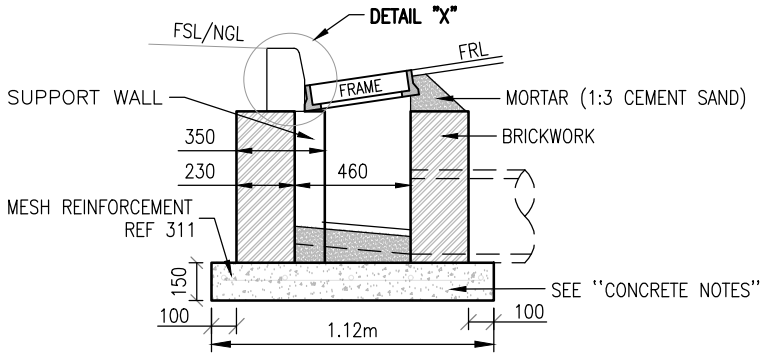
STANDARDS AND GUIDELINES DETAILS

SHEET 2

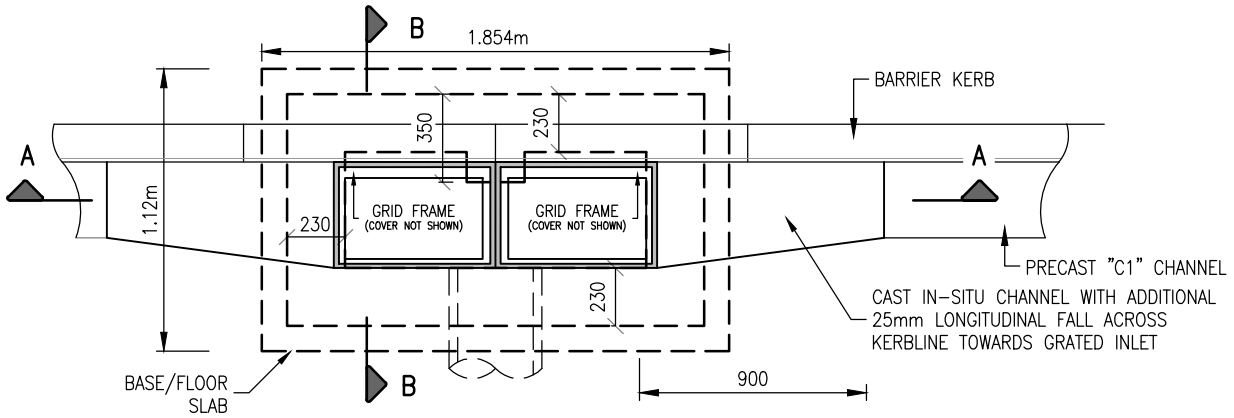
SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
SW3.3B	C



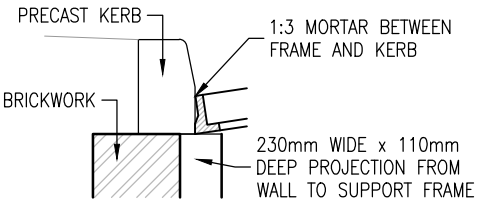
SECTION A–A



SECTION B–B



PLAN



DETAIL X

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

NOTES: CONCRETE GRADES

BASE/FLOOR	25/20
BENCHING	20/14
IN-SITU CAST CHANNEL	30/20

GENERAL NOTES:

1. HINGED COVERS ARE TO OPEN TOWARDS SIDEWALK AND NOT THE ROAD.
2. CATCHPIT DEPTH:
   - MINIMUM = 0.75m
   - MAXIMUM = 1.20m
3. BRICKWORK: SEE **SECTION 10.4.10** "SPECIFICATION FOR MASONRY UNITS".
4. ALL INTERNAL BRICKWORK TO HAVE SMOOTH FINISH.

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

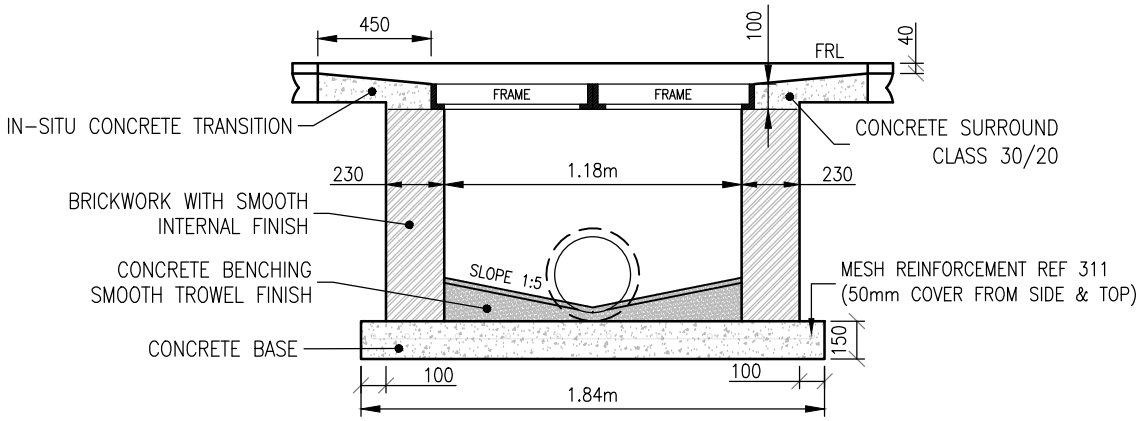
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STORMWATER CATCHPIT
TYPE D1: DOUBLE GRID INLET
(with Kerb & Channel)

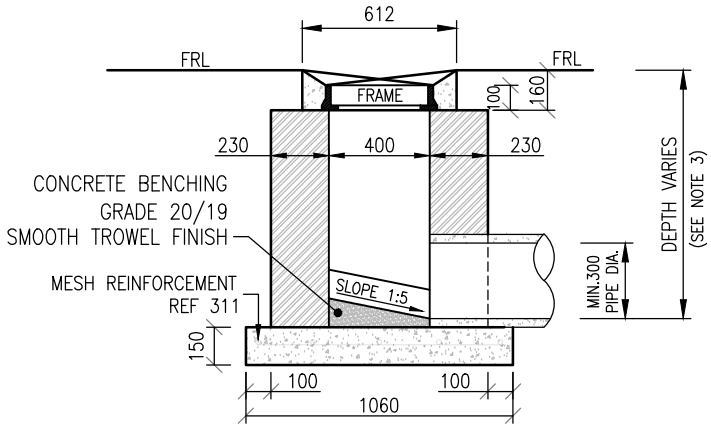
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
SW3.4	C

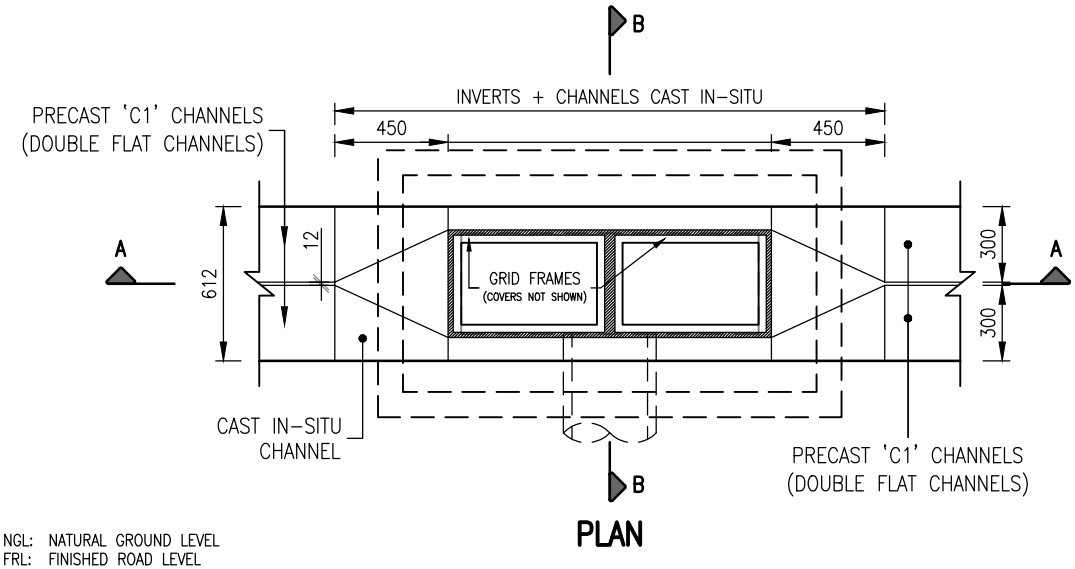
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SECTION A–A



SECTION B–B



PLAN

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

NOTES: CONCRETE CLASS

BASE/FLOOR	25/20
BENCHING	20/14
IN-SITU CAST CHANNEL	30/20

GENERAL NOTES:

1. HINGED COVERS ARE TO OPEN TOWARDS SIDEWALK AND NOT THE ROAD.
2. BENCHING NOT REQUIRED IN SANDY AREAS.
3. CATCHPIT DEPTH:
   - MINIMUM = 0.75m
   - MAXIMUM = 1.20m
3. BRICKWORK: SEE SECTION 10.4.10 "SPECIFICATION FOR MASONRY UNITS".
4. ALL INTERNAL BRICKWORK TO HAVE SMOOTH FINISH.

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

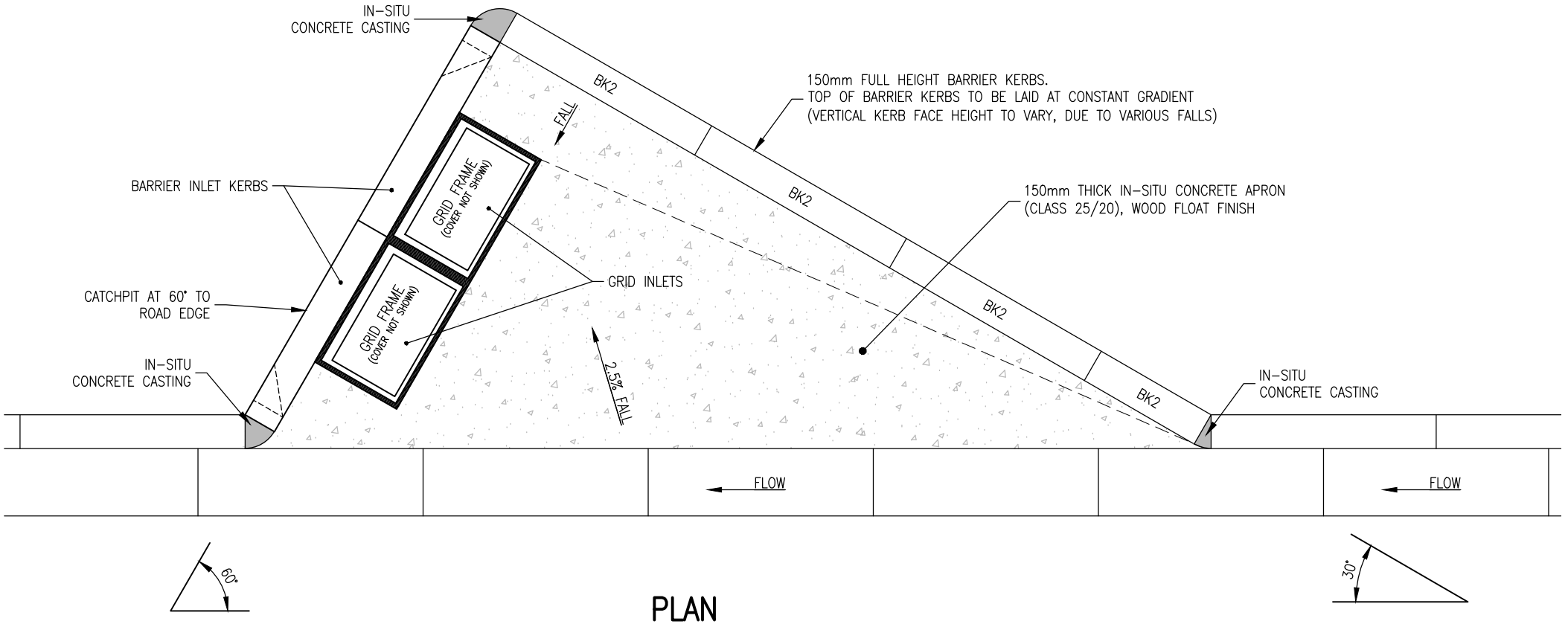
CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

STORMWATER CATCHPIT
TYPE D2: DOUBLE GRID INLET
(with double flat channel)

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
SW3.5	C



PLAN

NOTES:

1. CATCHPIT BASED ON "TYPE B: DOUBLE KERB & GRID INLET COMBINATION CATCHPIT". REFER TO **DRAWING SW3.1**
2. CATCHPIT TO BE USED ON ROADS WITH GRADIENTS GREATER THAN 8%, WHERE SUFFICIENT SPACE IS AVAILABLE ON THE ROAD VERGE.
3. REFER TO **DRAWING SW4** FOR INLET KERB DETAILS.

NOTES: CONCRETE GRADES

BASE/FLOOR	25/20
BENCHING	20/14
IN-SITU APRON	25/20

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

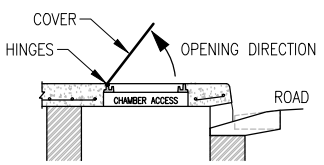
CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

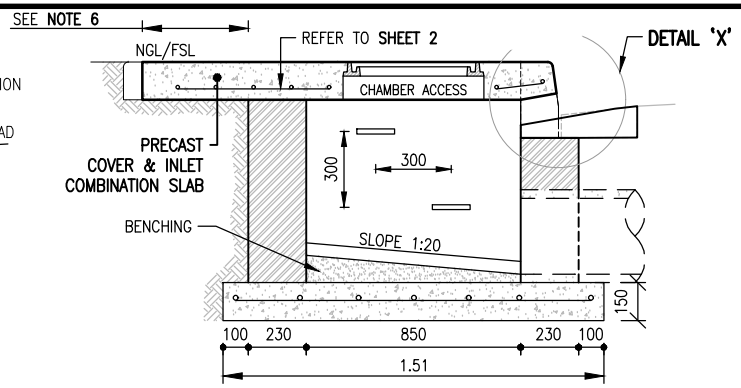
STORMWATER CATCHPIT
TYPE E: STEEP SLOPES
(EXAMPLE)

STANDARDS AND GUIDELINES DETAILS

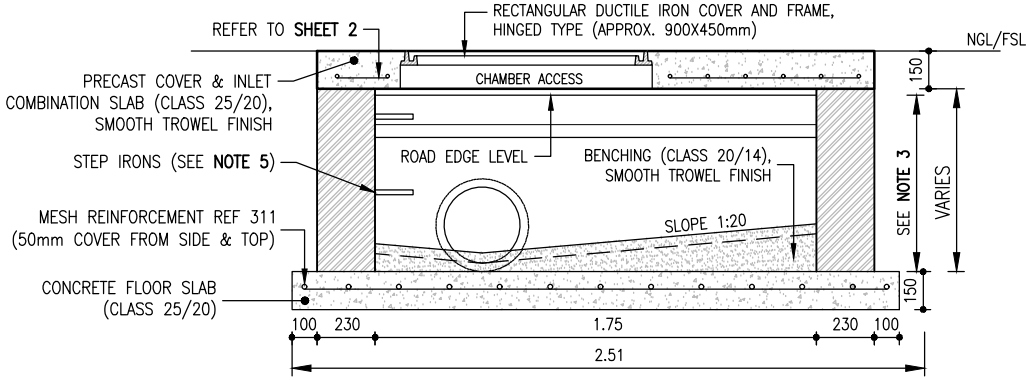
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DRAWING No.	REV
SW3.6	B



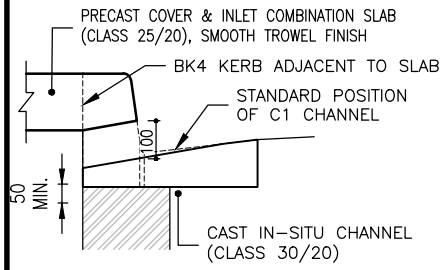
DETAIL 1:
COVER OPENING DIRECTION



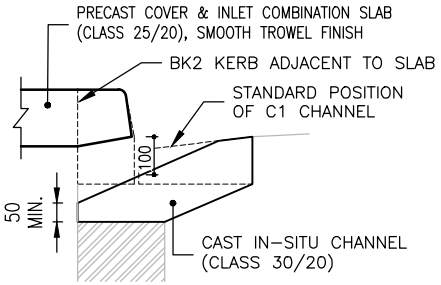
SECTION B–B



SECTION A–A

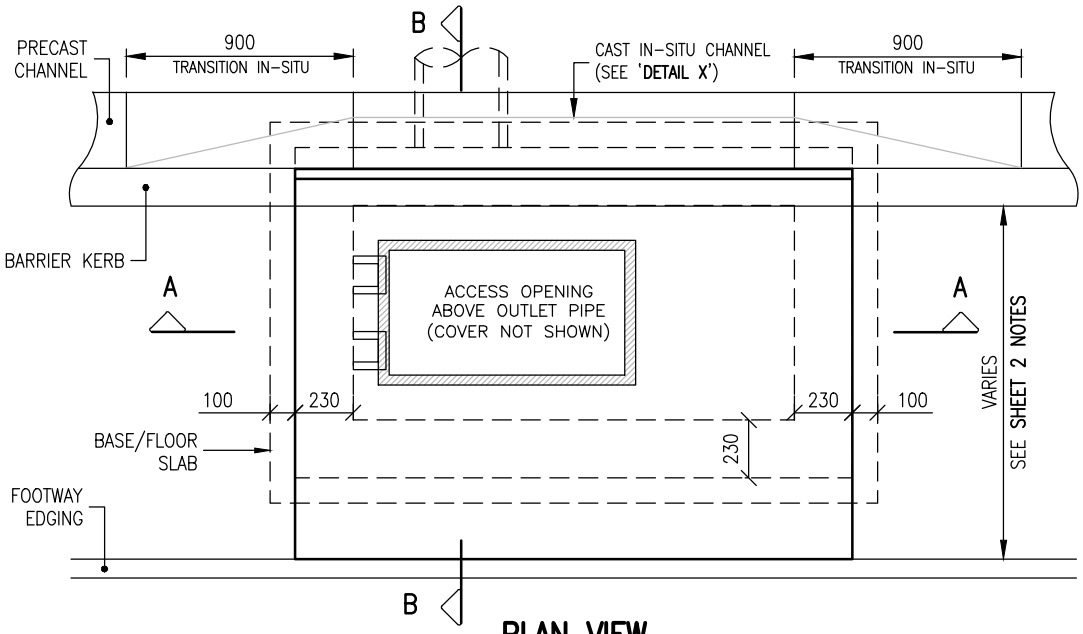


TYPE 1
(BK4 TIE–IN)



TYPE 2
(BK2 TIE–IN)

DETAIL X



PLAN VIEW

GENERAL NOTES

1. HINGED COVER TO OPEN AWAY FROM ROADWAY. SEE **DETAIL 1**.
2. ALL INTERNAL BRICKWORK TO HAVE SMOOTH FINISH.
3. CATCHPIT DEPTH (RELATIVE TO ROAD EDGE LEVEL): MIN. = 0.75m | MAX. = 1.20m
4. BRICKWORK: SEE SECTION **10.4.10** "SPECIFICATION FOR MASONRY UNITS".
5. STEP IRONS TO BE PROVIDED WHERE CATCHPIT DEPTH EXCEEDS 1m. TYPE: 150mm WIDE POLYPROPYLENE ENCAPSULATED MILD STEEL, WITH ANTI–SLIP BLOCKS ON STEPPING SURFACE.
6. REFER TO NOTE 4 ON SHEET 2 REGARDING WIDTH OF THE COVER SLAB.

NOTES: CONCRETE CLASS

CONCRETE SLABS	25/20
BENCHING	20/14
IN–SITU CHANNEL	30/20

NGL: NATURAL GROUND LEVEL
FSL: FINISHED SURFACE LEVEL

SHEET INDEX:

SHEET 1: CATCHPIT DETAILS
SHEET 2: COVER SLAB AND REINFORCEMENT DETAILS

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

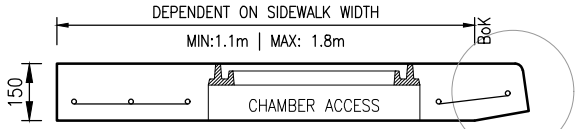
STORMWATER CATCHPIT
TYPE F: WITH PRECAST COVER-INLET COMBINATION SLAB
CATCHPIT DETAILS

STANDARDS AND GUIDELINES DETAILS

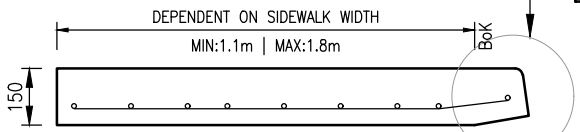
SHEET 1

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
SW3.7A	A

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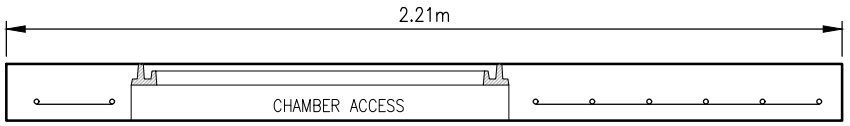


SECTION B–B

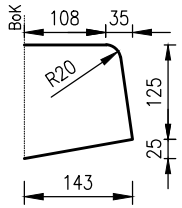


SECTION C–C

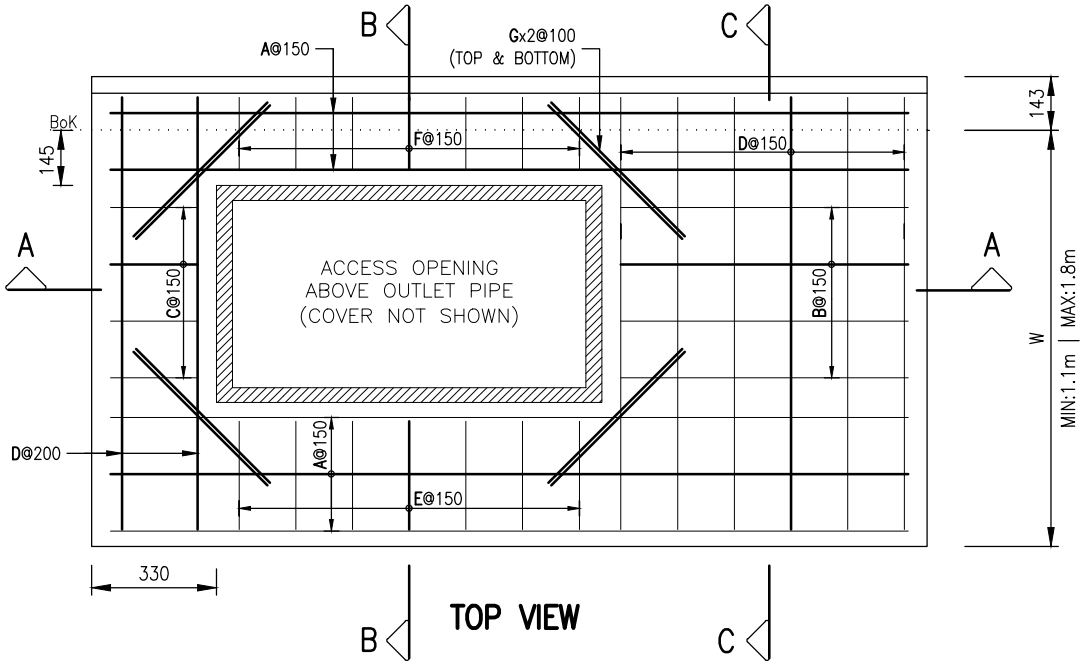
DETAIL 'Y'



SECTION A–A



DETAIL Y:
SLAB FRONT FACE



BENDING SCHEDULE						
ITEM	BAR	No.	DIA	LENGTH	SKETCH	SLAB POSITION
COVER SLAB	A	MIN:5 MAX:9	Y12	2110		BOTTOM
	B	4	Y12	760		BOTTOM
	C	4	Y12	230		BOTTOM
	D	8	Y12	MIN: 1100 MAX: 1800		BOTTOM
	E	7	Y12	MIN: 280 MAX: 980		BOTTOM
	F	7	Y12	190		BOTTOM
	G	16	Y12	500		TOP & BOTTOM

GENERAL NOTES

1. COVER SLAB SHALL BE CONCRETE CLASS 25/20.
2. THE COVER SLAB SHALL BE PRECAST, WITH THE COVER AND FRAME TO BE CAST WITH SLAB.
3. MINIMUM COVER FOR STEEL REINFORCEMENT SHALL BE 50mm, UNLESS INDICATED OTHERWISE.
4. THE WIDTH (W) OF THE SLAB WILL DEPEND ON THE SIDEWALK SURFACING AND CLEAR WIDTH. A MINIMUM WIDTH OF 700mm IS REQUIRED BETWEEN THE BACK OF THE COVER SLAB AND THE FOOTWAY EDGING FOR THE LAYER WORKS, TO ENSURE PROPER COMPACTION. IF THE AFOREMENTIONED SPACE IS LESS THAN 700mm, THE COVER SLAB SHALL EXTEND TO THE FOOTWAY EDGING.
5. THE PROVISION OF BARS "A", "D" AND "E" WILL DEPEND ON ITEM 4 ABOVE AND SHALL BE ADJUSTED ACCORDINGLY.

BoK: BACK OF KERB
FSL: FINISHED SURFACE LEVEL
NGL: NATURAL GROUND LEVEL

SHEET INDEX:

SHEET 1: CATCHPIT DETAILS
SHEET 2: COVER SLAB AND REINFORCEMENT DETAILS

CITY OF CAPE TOWN
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CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

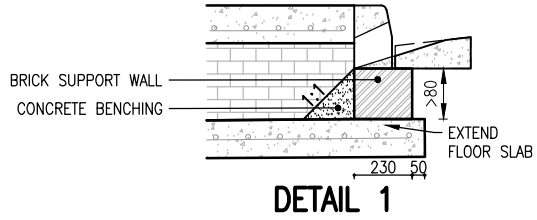
STORMWATER CATCHPIT
TYPE F: WITH PRECAST COVER-INLET COMBINATION SLAB
COVER SLAB AND REINFORCEMENT DETAILS

STANDARDS AND GUIDELINES DETAILS

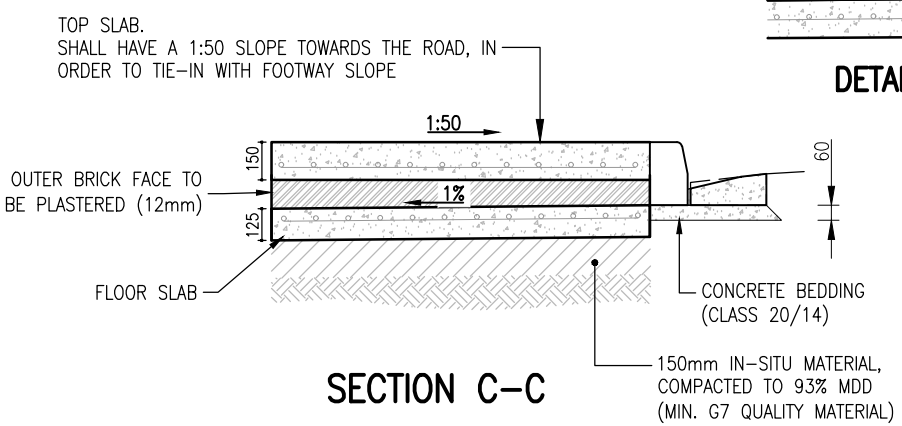
SHEET 2

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
SW3.7B	A

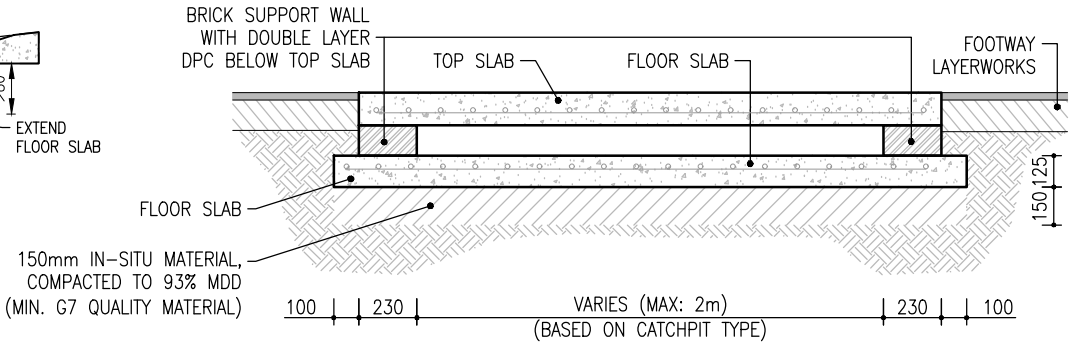
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DETAIL 1

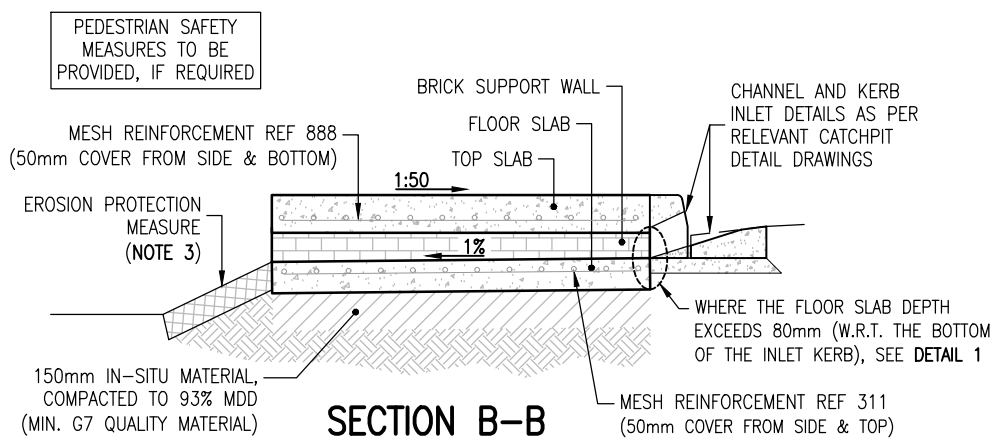


SECTION C-C

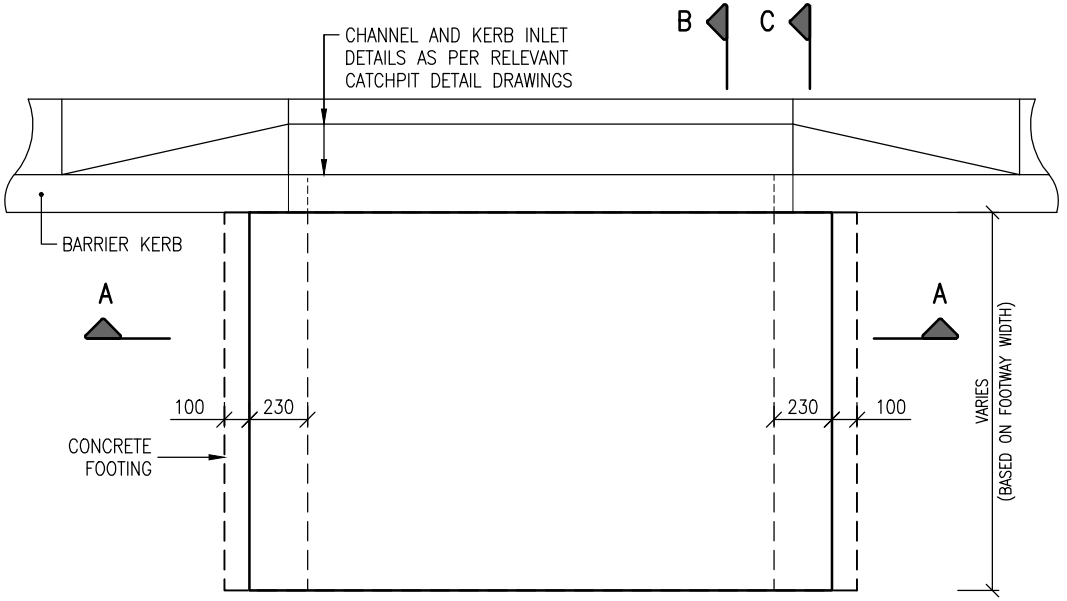


SECTION A-A

PEDESTRIAN SAFETY MEASURES TO BE PROVIDED, IF REQUIRED



SECTION B-B



PLAN VIEW

B C

NGL: NATURAL GROUND LEVEL
FSL: FINISHED SURFACE LEVEL

NOTES: GENERAL

1. BRICKWORK: SEE **SECTION 10.4.10.**
2. EROSION CONTROL MEASURES: **SECTION 10.5.4.**
3. ALL EXPOSED BRICKWORK TO BE RENDERED IN 12mm PLASTER (CEMENT:SAND RATIO 1:3).

NOTES: CONCRETE CLASS

CONCRETE SLABS	25/20
BENCHING	20/14

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

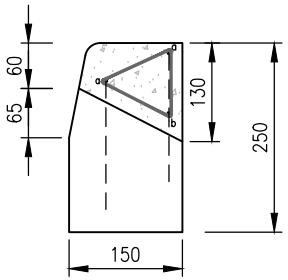
TITLE

STORMWATER CATCHPIT
TYPE G: SHALLOW FLOW CHAMBER

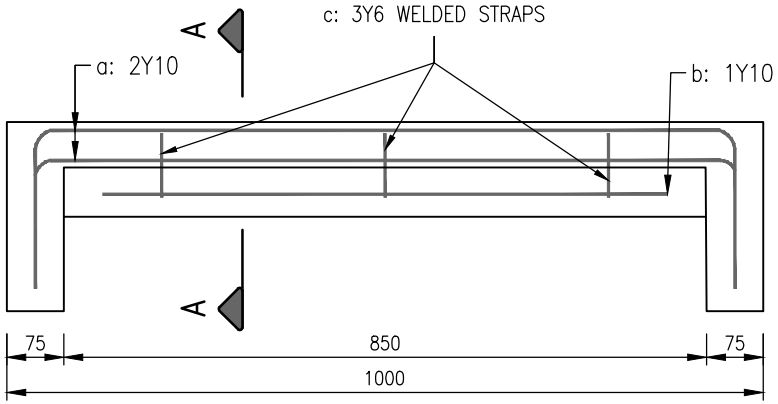
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
SW3.8	A

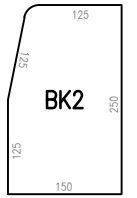
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SECTION A–A



FRONT ELEVATION



BK2 KERB

BENDING SCHEDULE					
ITEM	BAR	No.	DIA	SKETCH	LENGTH
PRECAST INLET KERB	a	2	Y10	190, 925	1305
	f	1	Y10	925	925
	g	3	Y6	100, 110, 80	470

NOTES:

1. KERBS TO BE MANUFACTURED FROM CONCRETE CLASS 25/20.

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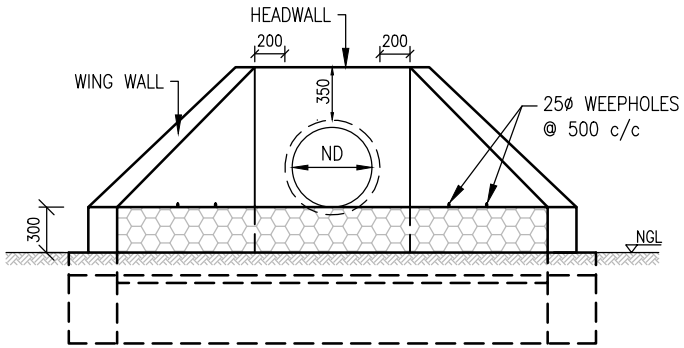
TITLE

STANDARD PRECAST INLET KERB (1m TYPE)

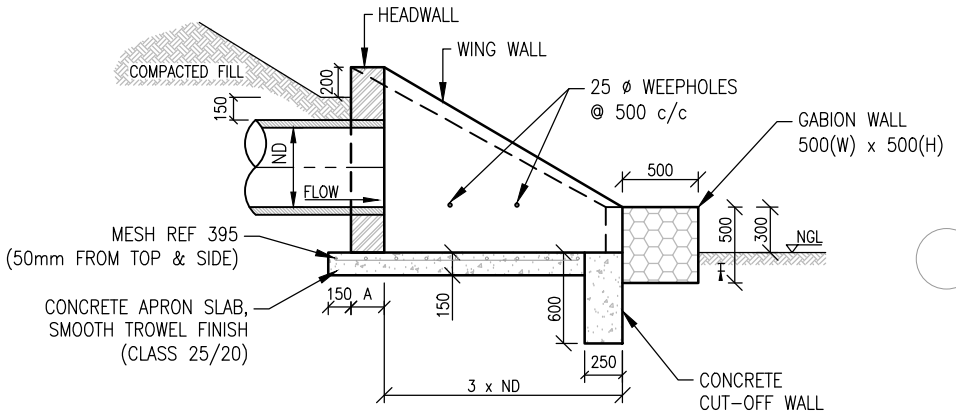
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
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DRAWING No.	REV
SW4	B

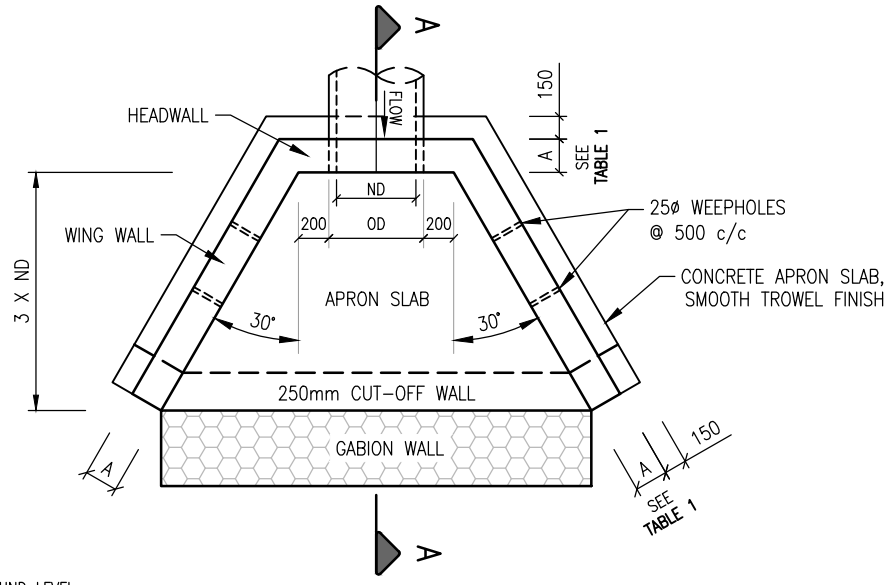
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FRONT ELEVATION



SECTION A–A



PLAN VIEW

NGL: NATURAL GROUND LEVEL
ND: NOMINAL PIPE DIAMETER
OD: OUTSIDE PIPE DIAMETER

TABLE 1
HEADWALL & WING WALL THICKNESS

NOMINAL PIPE DIAMETER (ND)	WALL THICKNESS "A"	
	BRICKWORK	CONCRETE
300 – 600	230	150
675 – 1350	350	200

NOTES:

1. ALL CONCRETE SHALL BE CLASS 25/20.
2. HEADWALL AND WING WALLS MAY BE CONSTRUCTED FROM EITHER BRICKWORK OR CONCRETE. IF CONCRETE IS CHOSEN, THE REINFORCING SHALL BE DESIGNED BY THE ENGINEERING AND SUBMITTED FOR APPROVAL.
3. BRICKWORK: SEE **SECTION 10.4.10** "SPECIFICATION FOR MASONRY UNITS".
4. ALL EXPOSED BRICKWORK TO BE RENDERED IN 12mm PLASTER (CEMENT:SAND RATIO 1:3).
5. A SPECIAL DETAIL TO BE DRAWN FOR PIPE DIAMETERS LARGER THAN 1350mm.
6. WEEP HOLES TO BE PROVIDED WHERE REQUIRED.

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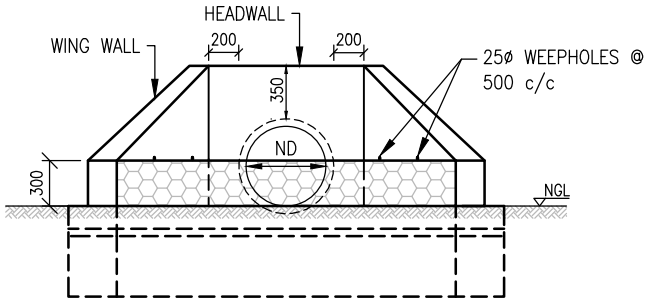
TITLE

TYPICAL INLET STRUCTURE FOR EXISTING PONDS

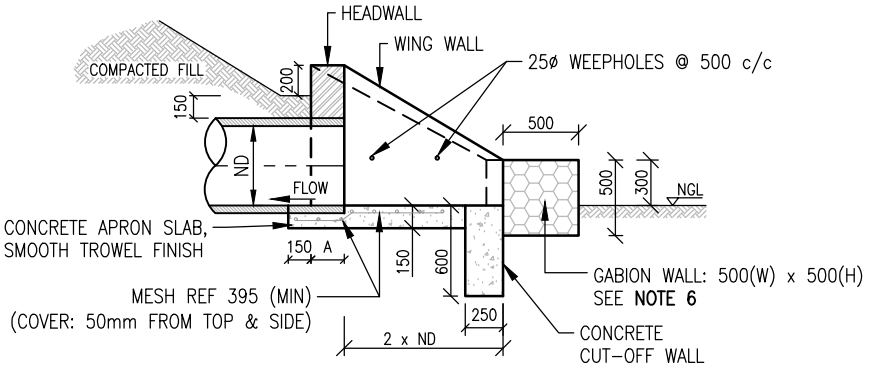
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:50	A4
DRAWING No.	REV
SW5.1	B

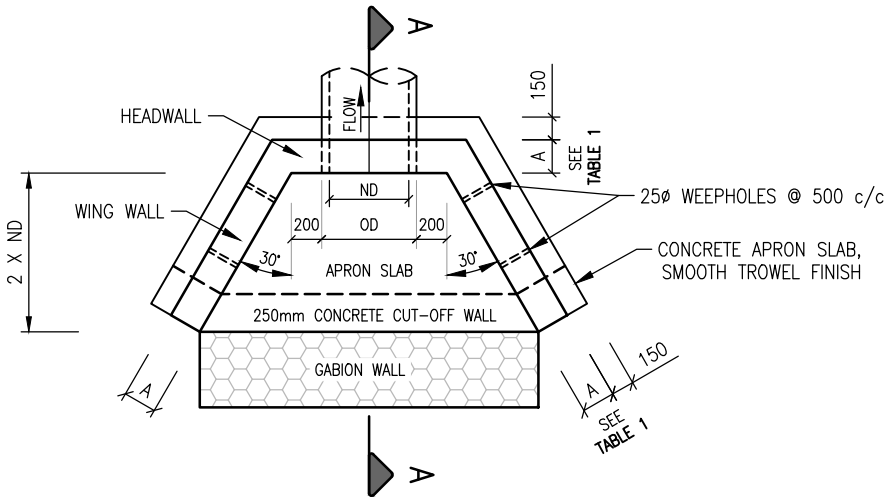
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FRONT ELEVATION



SECTION A–A



PLAN VIEW

TABLE 1
HEADWALL & WING WALL THICKNESS

NOMINAL PIPE DIAMETER (ND)	WALL THICKNESS "A"	
	BRICKWORK	CONCRETE
300 – 600	230	150
675 – 1350	350	200

NGL: NATURAL GROUND LEVEL
ND: NOMINAL PIPE DIAMETER
OD: OUTSIDE PIPE DIAMETER

NOTES:

1. ALL CONCRETE SHALL BE CLASS 25/20.
2. HEADWALL AND WING WALLS MAY BE CONSTRUCTED FROM EITHER BRICKWORK OR CONCRETE. IF CONCRETE IS CHOSEN, THE REINFORCING SHALL BE DESIGNED BY THE ENGINEERING AND SUBMITTED FOR APPROVAL.
3. BRICKWORK: SEE **SECTION 10.4.10** "SPECIFICATION FOR MASONRY UNITS".
4. ALL EXPOSED BRICKWORK TO BE RENDERED IN 12mm PLASTER (CEMENT:SAND 1:3).
5. A SPECIAL DETAIL TO BE DRAWN FOR PIPE DIAMETERS LARGER THAN 1350mm.
6. THE GABION WALL MAY BE REPLACED WITH A 300mm HIGH CONCRETE "UPSTAND", SHOULD THE SITE CONDITION REQUIRES IT. IN SUCH A SCENARIO, THE CUT-OFF WALL CAN BE EXTENDED VERTICALLY TO A HEIGHT OF 300mm ABOVE TO APRON SLAB, TO ACT AS THE "UPSTAND".
7. WEEP HOLES TO BE PROVIDED WHERE REQUIRED.

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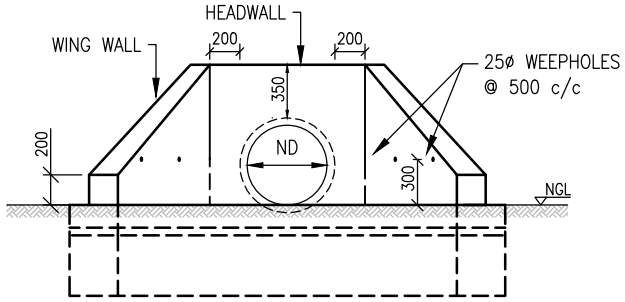
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TYPICAL OUTLET STRUCTURE FOR EXISTING PONDS

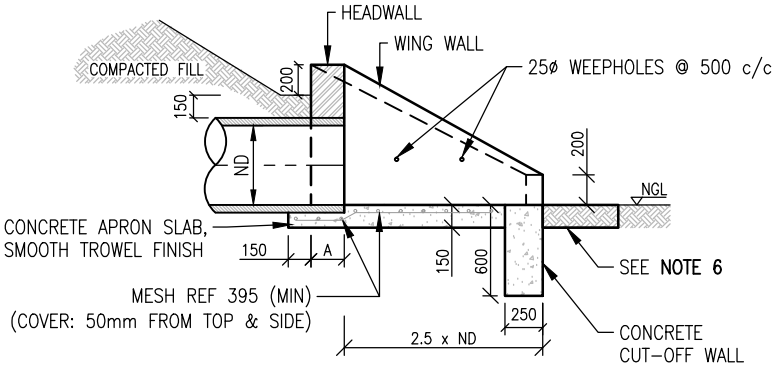
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:50	A4
DRAWING No.	REV
SW5.2	C

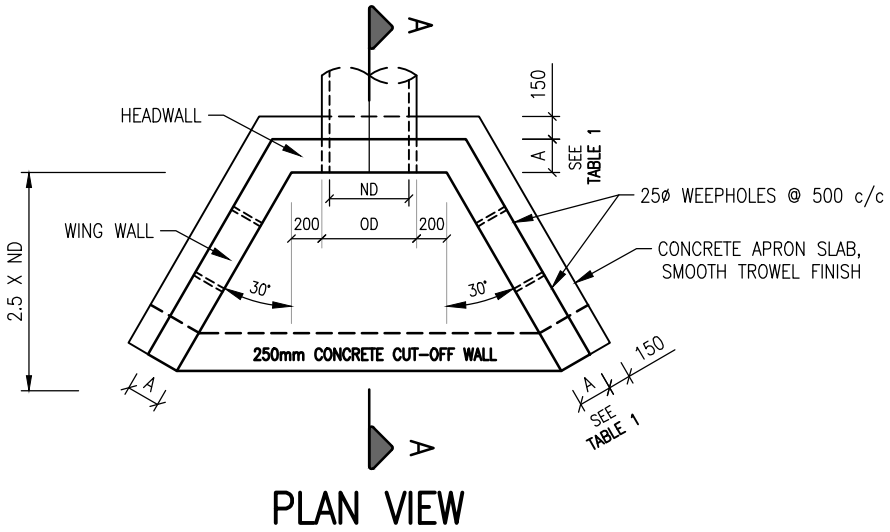
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FRONT ELEVATION



SECTION A–A



PLAN VIEW

TABLE 1
HEADWALL & WING WALL THICKNESS

NOMINAL PIPE DIAMETER (ND)	WALL THICKNESS 'A'	
	BRICKWORK	CONCRETE
300 – 600	230	150
675 – 1350	350	200

NOTES:

1. ALL CONCRETE SHALL BE CLASS 25/20.
2. HEADWALL AND WING WALLS TO BE CONSTRUCTED FROM EITHER BRICKWORK OR CONCRETE. IF CONCRETE IS CHOSEN, THE REINFORCING SHALL BE DESIGNED BY THE ENGINEERING AND SUBMITTED FOR APPROVAL.
3. BRICKWORK: SEE **SECTION 10.4.10** "SPECIFICATION FOR MASONRY UNITS".
4. ALL EXPOSED BRICKWORK TO BE RENDERED IN 12mm PLASTER (CEMENT:SAND RATIO 1:3).
5. A SPECIAL DETAIL TO BE DRAWN FOR PIPE DIAMETERS LARGER THAN 1350mm.
6. STONE PITCHING OR RENO–MATTRESS MAY BE PROVIDED AT CERTAIN OUTLET STRUCTURES, IF REQUIRED BY THE APPROVAL AUTHORITY.
7. WEEP HOLES TO BE PROVIDED WHERE REQUIRED.

NGL: NATURAL GROUND LEVEL
ND: NOMINAL PIPE DIAMETER
OD: OUTSIDE PIPE DIAMETER

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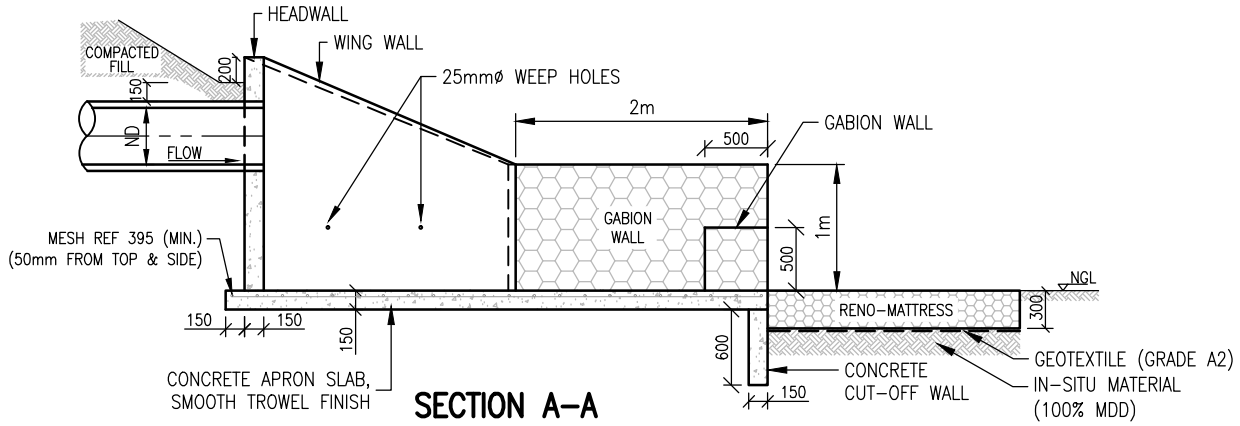
TITLE

ORDINARY INLET/OUTLET STRUCTURE

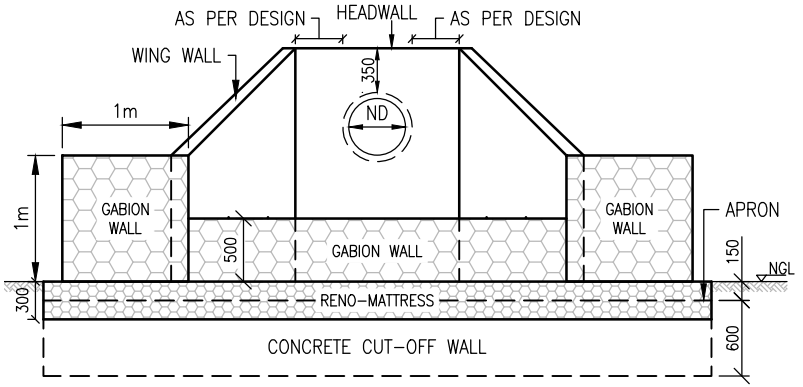
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
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DRAWING No.	REV
SW5.3	C

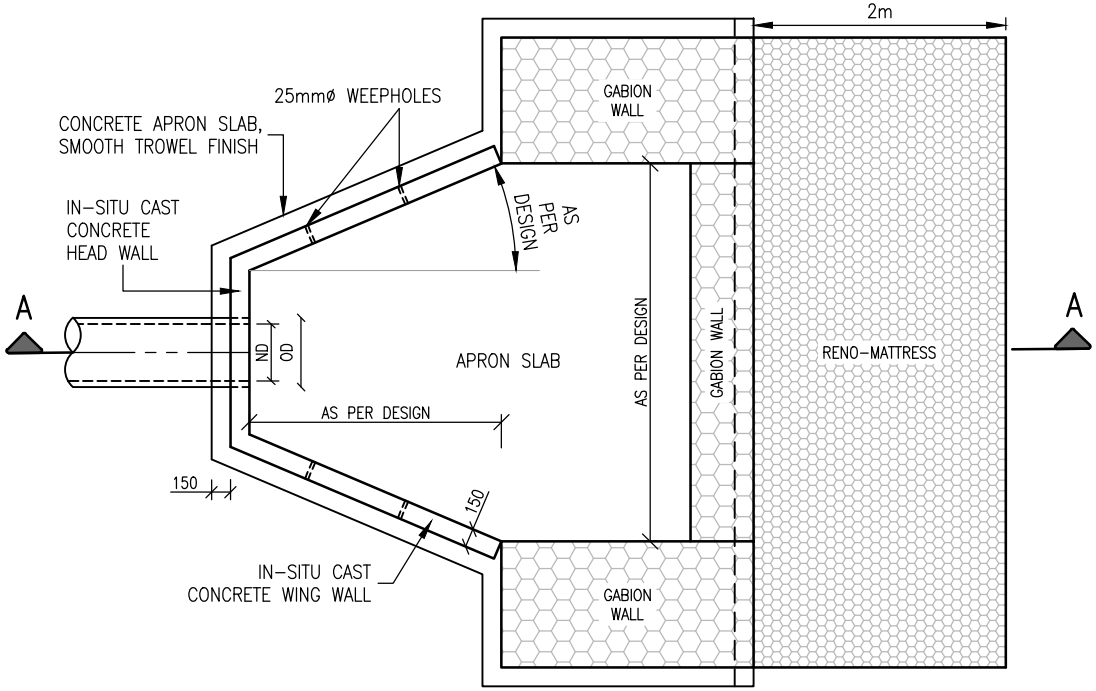
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SECTION A-A



FRONT ELEVATION



PLAN VIEW

NOTES:

1. THE DETAILS IN THIS DRAWING ARE GIVEN AS AN EXAMPLE. ALL FINAL DIMENSIONS AND DETAILS TO BE AS PER SPECIALIST DESIGN.
2. ALL CONCRETE SHALL BE CLASS 25/20.
3. MORTAR SHALL HAVE A CEMENT:SAND RATIO OF 1:3
4. ALL EXPOSED CORNERS TO BE CHAMFERED.
5. CONCRETE REINFORCEMENT TO BE AS PER SPECIALIST DESIGN.
6. WEEP HOLES TO BE PROVIDED WHERE REQUIRED.

NGL: NATURAL GROUND LEVEL
ND: NOMINAL PIPE DIAMETER
OD: OUTSIDE PIPE DIAMETER

CITY OF CAPE TOWN
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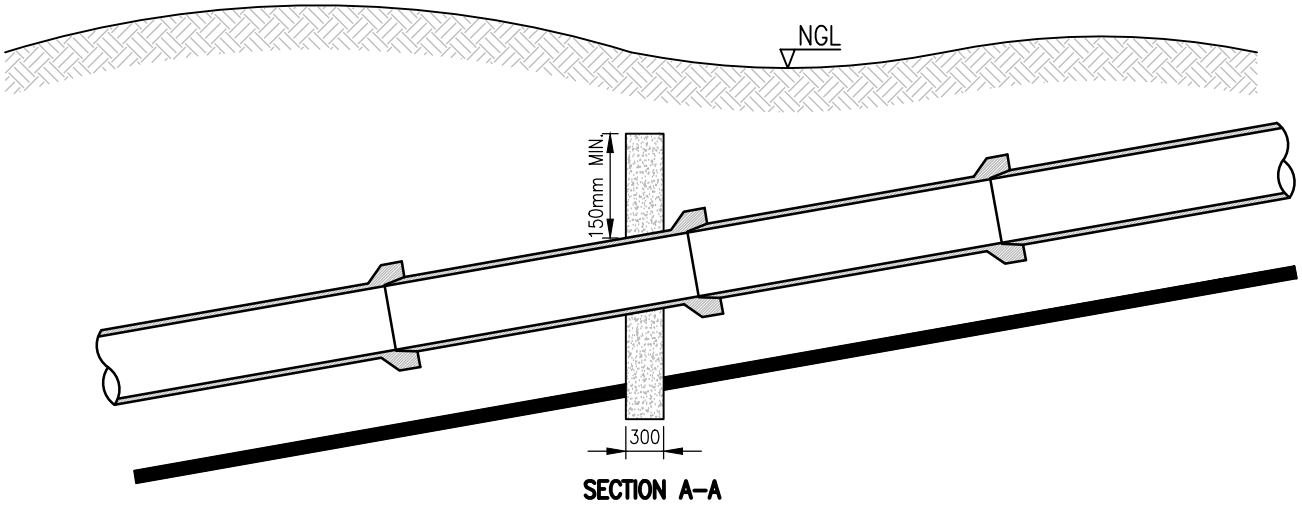
CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

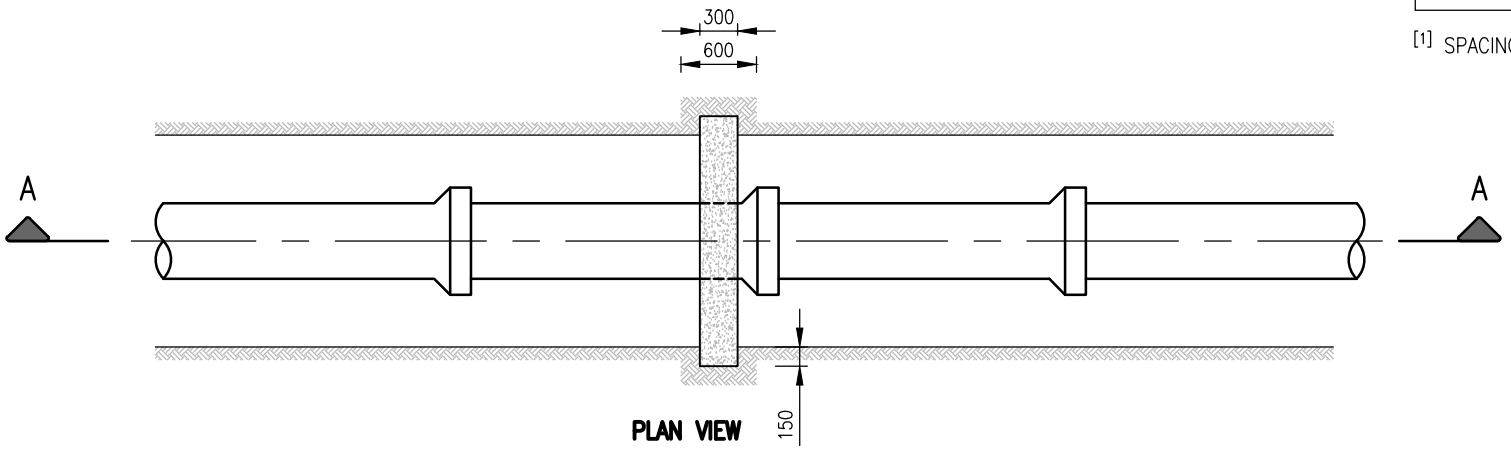
EXAMPLE OF A POND INLET STRUCTURE WITH SEDIMENT TRAP

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
SW5.4	B



SECTION A–A



PLAN VIEW

GRADE (%)	SPACING FOR 2.44 PIPE LENGTHS [1]
OVER 50%	EVERY JOINT
30% TO 50%	ALTERNATE JOINT
20% TO 30%	EVERY FOURTH JOINT
10% TO 20%	EVERY EIGHTH JOINT

[1] SPACING FOR INTERMEDIATE GRADES CAN BE INTERPOLATED.

NOTES:

1. ANCHOR BLOCKS SHALL BE CONCRETE CLASS 20/20.
2. ANCHOR BLOCKS TO BE KEYED INTO UNDISTURBED GROUND.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

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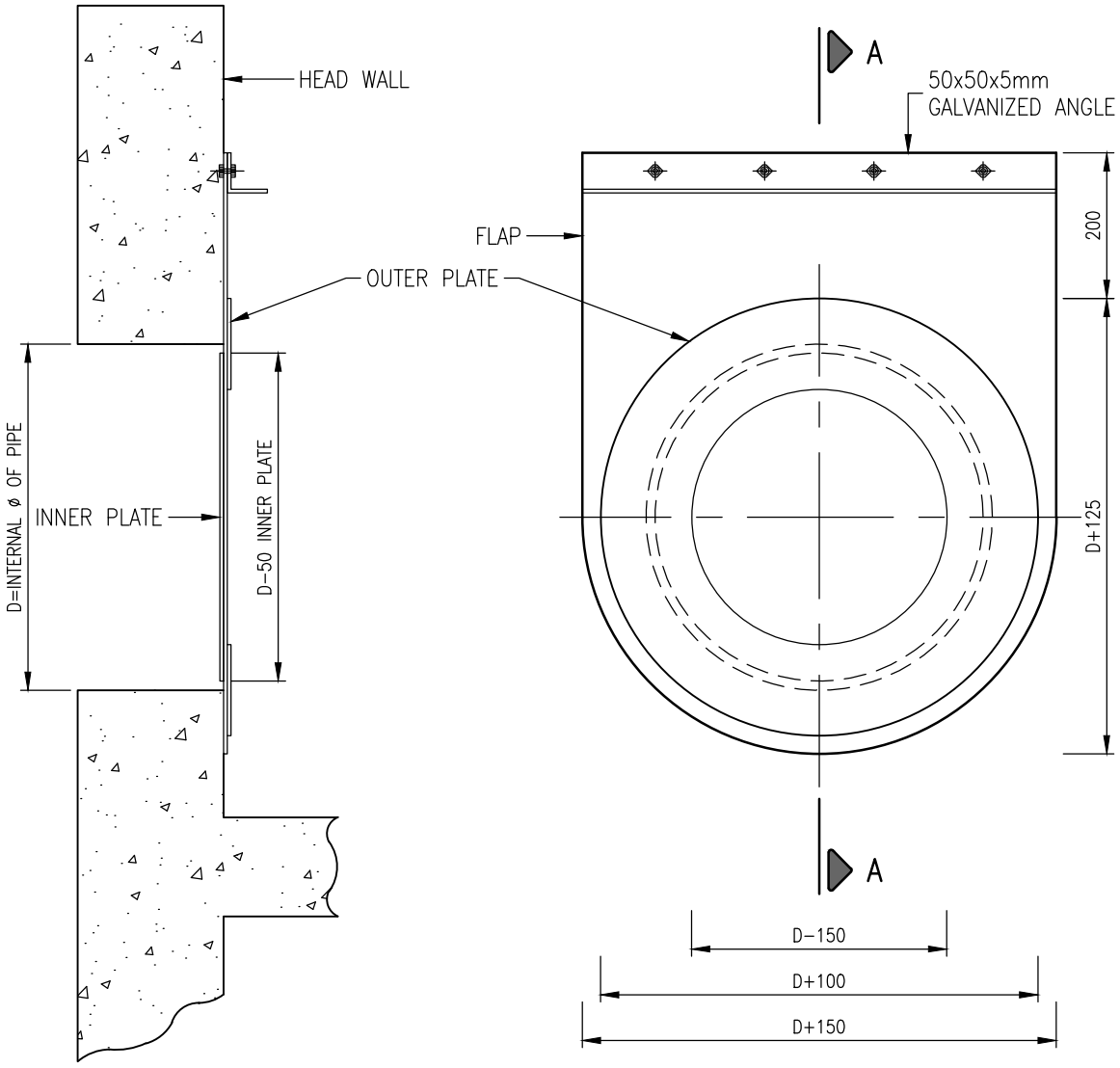
TITLE

ANCHOR BLOCKS FOR STORMWATER PIPES ON STEEP SLOPES

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
SW6	B

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SECTION A-A

FONT ELEVATION

NOTES:

1. D = INTERNAL DIAMETER OF STORMWATER PIPE.
2. PLATES TO BE GALVANIZED 6mm PLATE.
3. OUTER PLATE: O.D. = D+100mm
   I.D. = D-150mm
4. INNER PLATE: O.D. = D-150mm
5. FLAP MATERIAL TO BE 4PLY CANVASS REINFORCED RUBBERISED SHEET "CONVEYER BELTING"
6. INNER AND OUTER PLATES TO BE BOLTED TOGETHER OVER BELTING WITH GALVANIZED 6mm ø BOLTS AT APPROX. 150mm SPACING.
7. 50x50x5mm GALVANIZED ANGLE TO BE BOLTED TO HEAD WALL WITH 8mm GALVANIZED PROJECTING OR STUD TYPE ANCHORS AT APPROX. 200mm CENTERS.

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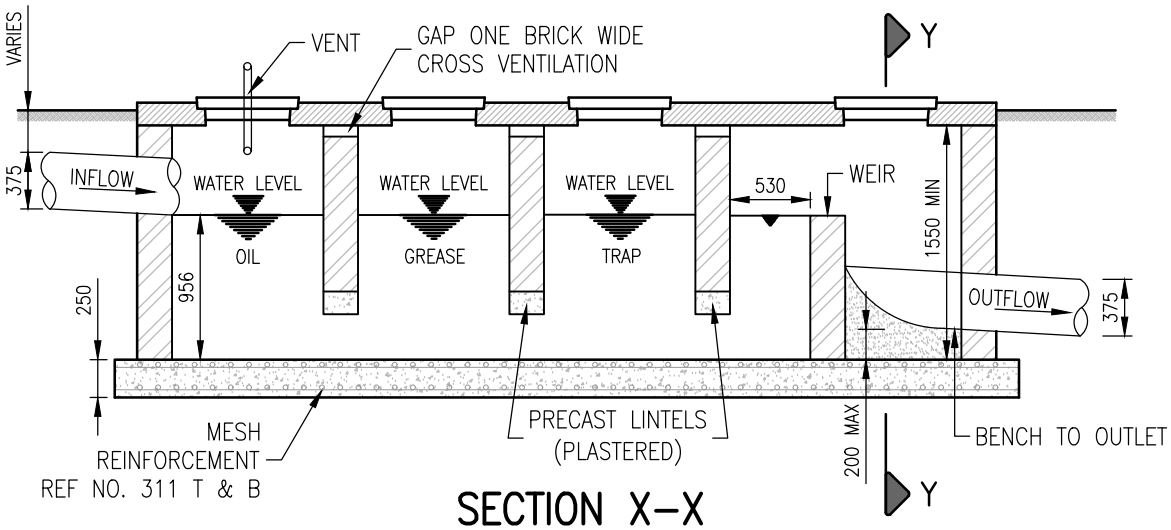
TITLE

LIGHT DUTY STORMWATER NON-RETURN FLAP

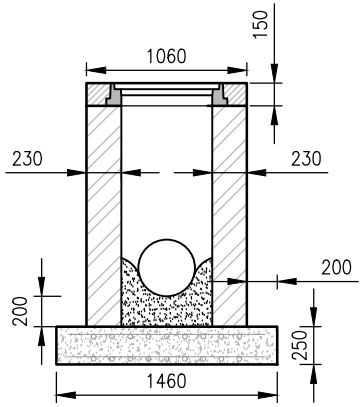
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:10	A4
DRAWING No.	REV
SW7	A

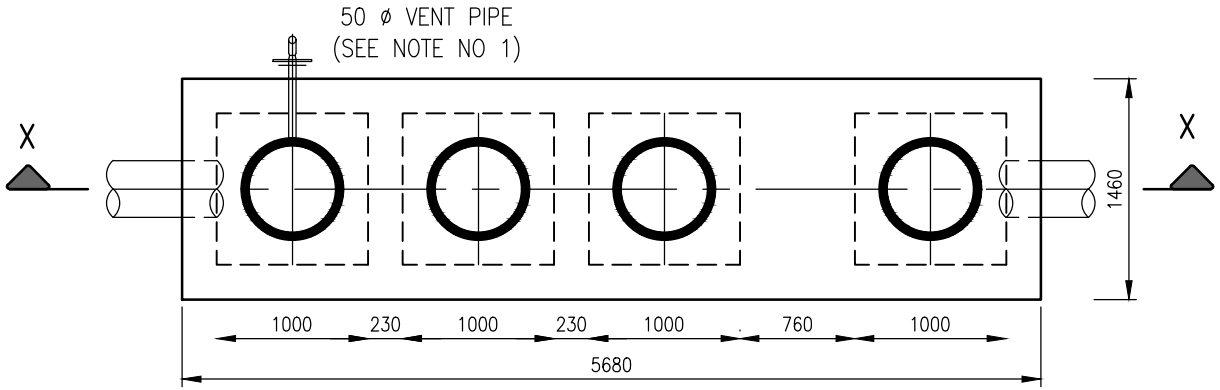
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SECTION X–X



SECTION Y–Y



PLAN

NOTES:

1. THE DETAILS ON THIS DRAWING ILLUSTRATES A TYPICAL EXAMPLE OF AN OIL/FUEL SEPARATOR SYSTEM. DESIGNERS MAY PROPOSE AN ALTERNATIVE DESIGN, PROVIDED THAT THE DESIGN CONFORMS TO THE SPECIFICATIONS OF SANS 50858–1 AND 50858–2 AND MEETS THE REQUIREMENTS OF THE RELEVANT APPROVAL AUTHORITY.
2. EXTERNAL 50mm DIAMETER VENT PIPE TO DISCHARGE IN AN AREA APPROVED BY AND TO FIRE REGULATIONS OF THE LOCAL AUTHORITY.
3. ALL COMPARTMENT WALLS AND FLOORS TO BE PLASTERED IN A TWO COAT 1:2 CEMENT/SAND MORTAR FINISH WITH A WOOD FLOAT AND HAVING COMPLETE OVERAGE OF 12mm THICKNESS.
4. MANHOLE COVER AND FRAME TYPE TO BE AS PER APPROVAL AUTHORITY'S REQUIREMENTS.
5. BRICKWORK: SEE SECTION 10.4.10 "SPECIFICATION FOR MASONRY UNITS".
6. EXTERNAL WALLS AND PORTION WALLS TO BE DESIGNED TO SUITS LOCAL SOIL CONDITIONS. REINFORCED CONCRETE MAY BE USED AS AN ALTERNATIVE.
7. TOP SLAB TO BE IN REINFORCED CONCRETE DESIGNED TO ACCOMMODATE THE LOCAL CONDITIONS.

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TITLE

TYPICAL EXAMPLE OF OIL/FUEL SEPARATOR SYSTEM

STANDARDS AND GUIDELINES DETAILS

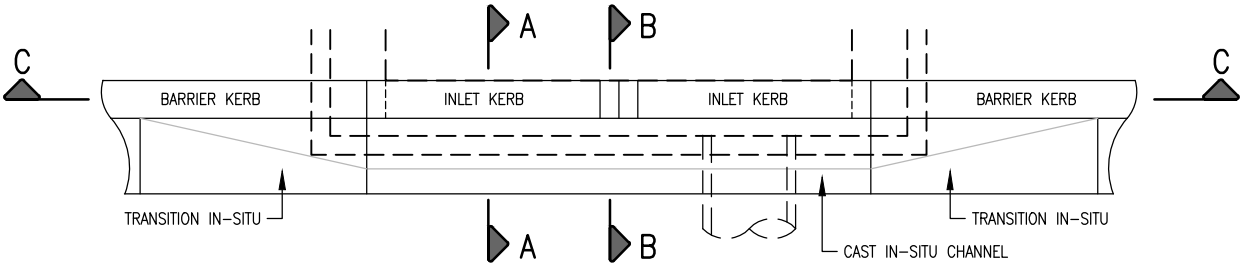
SCALE	PAPER
1:50	A4
DRAWING No.	REV
SW8	A

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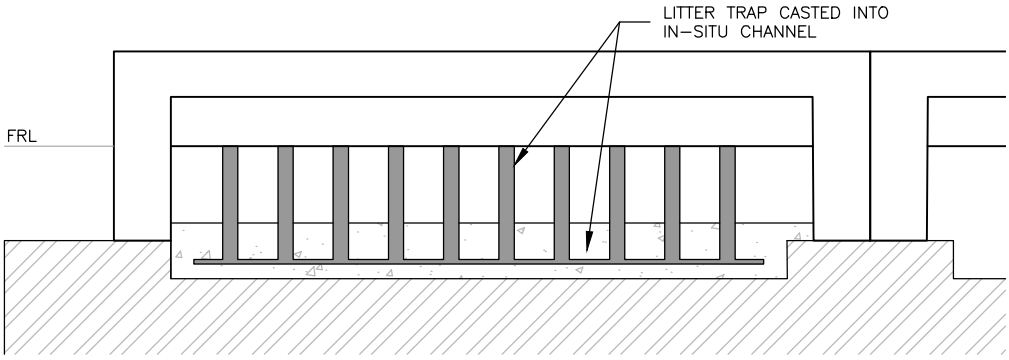
LIMITING GRADES

INTERNAL DIAMETER	STORMWATER PIPES (CONCRETE) Velocity: 0.91m/sec				FOUL SEWER PIPES (UPVC) Velocity: 0,71m/sec		
	GRADE	GRADE (%)	CAPACITY IN l/s PIPE FLOWING FULL		GRADE	% GRADE	CAPACITY IN l/S PIPE FLOWING FULL
150	-	-	-		1:178	0,561	12,90
225	-	-	-		1:305	0,327	29,10
300	1:270	0,370	66,7		1:445	0,224	51,85
375	1:363	0,275	104,2		1:600	0,166	81,20
450	1:460	0.217	150,5		1:760	0,131	117,00
525	1:570	0,147	204,5		1:940	0,106	159,40
600	1:680	0,126	266,9		1:1084	0,092	208,00
675	1:790	0,109	338,9		1:1284	0,077	262,10
750	1:910	0,95	417,0		1:1500	0,066	325,10
825	1:1050	0,95	518,0		1:1775	0,056	391,10
900	1:1140	0,87	602,0		1:1925	0,051	467,00
975	1:1300	0,076	705,0		1:2150	0,046	547,00
1050	1:1470	0,068	818,5		1:2350	0,042	637,00
1125	1:1530	0,065	941,0		1:2600	0,038	728,10
1200	1:1700	0,058	1073,0		1:2800	0,035	830,00
1275	1:1850	0,054	1207,0		1:3050	0,032	938,90
1350	1:2000	0,050	1350,0		1:3300	0,030	1051,00
1425	1:2150	0,046	1510,0		1:3550	0,028	1171,00
1500	1:2300	0,043	1672,0		-	-	-
1575	1:2450	0,040	1847,0		-	-	-

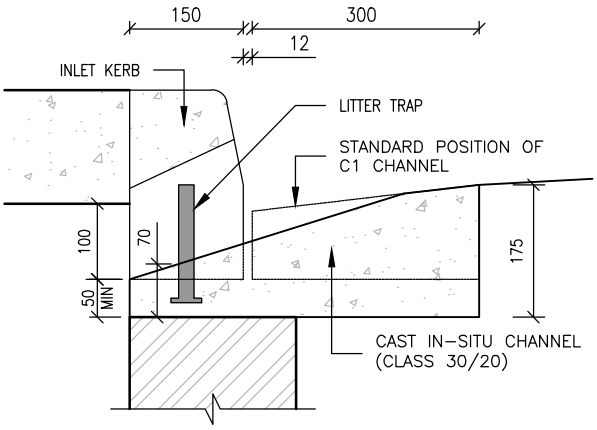
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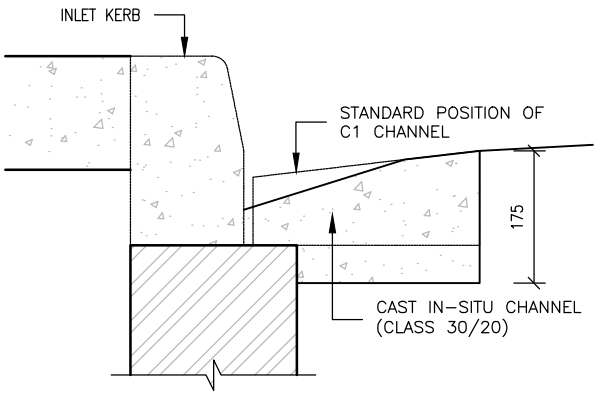
PLAN VIEW



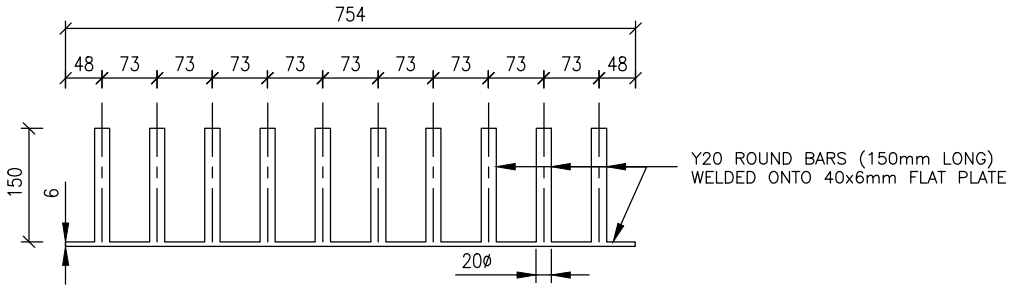
PARTIAL SECTION C-C



SECTION A-A



SECTION B-B



LITTER TRAP DETAIL

NOTES:

1. DETAILS ON THIS DRAWING REFERS TO THE LITTER TRAP ONLY. REFER TO DRAWINGS SERIES SW3 FOR THE DETAILS PERTAINING TO THE CONSTRUCTION OF CATCHPITS.
2. LITTER TRAPS TO BE PROVIDED AS REQUIRED BY THE APPROVAL AUTHORITY.
3. ALL LITTER TRAPS TO BE HOT DIPPED GALVANISED AND CAST INTO IN-SITU CAST CONCRETE CHANNEL, ALONG THE CENTER OF THE INLET KERB.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

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TITLE

LITTER TRAP
(FOR STORMWATER KERB INLET CATCHPITS)

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
SW10	B

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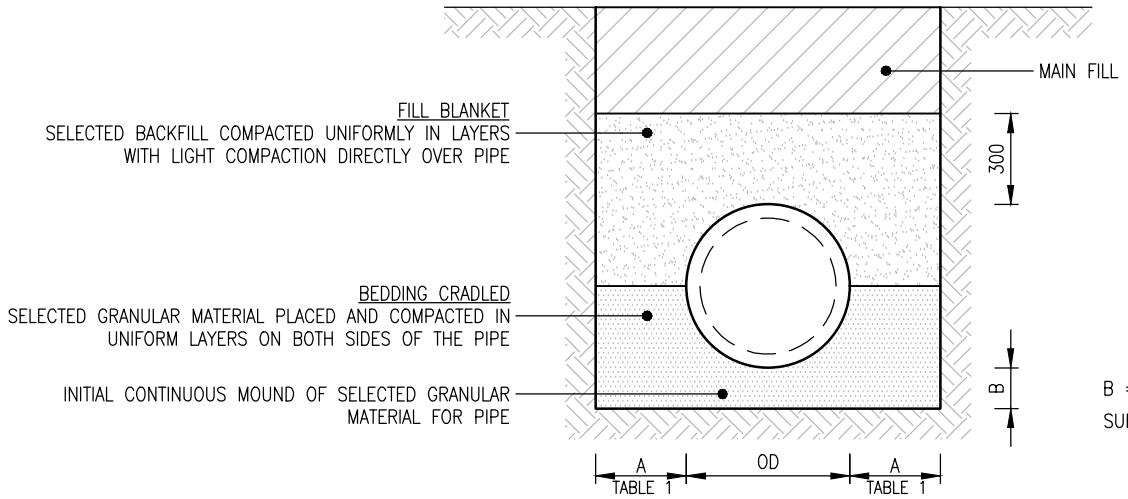


TABLE 1 SIDE ALLOWANCE FOR TRENCH EXCAVATION "A"	
PIPE OUTSIDE DIAMETER "OD" (mm)	SIDE ALLOWANCE (mm)
0 < OD ≤ 125	300
125 < OD ≤ 700	300
700 < OD ≤ 1000	400
1000 < OD ≤ 2000	500
2000 < OD	600

B = OD/4,

SUBJECT TO: 100mm < B < 200mm

BEDDING AND CONSTRUCTION DETAIL

(SOIL/NATURAL GROUND FOUNDATION)

NOTES:

1. BEDDING CRADLE:
   - 1.1. CRADLE TO SUPPORT THE BOTTOM HALF OF THE PIPE BARREL.
   - 1.2. SHALL CONSIST OF FINE GRANULAR MATERIAL (i.e. COARSE SAND OR WELL-GRADED CRUSHED STONE), OF NOMINAL SIZE NOT EXCEEDING 6.7mm AND NOT MORE THAN 10% OF WHICH SHALL PASS THROUGH A 0.15mm SIEVE.
   - 1.3. MATERIAL SHALL TO BE THOROUGHLY RAMMED AND TAMPED IN UNDER THE SIDES OF THE PIPE, TO PROVIDE A UNIFORM BEDDING.
2. BACKFILL BLANKET:
   - 2.1. THE BLANKET MATERIAL SHALL BE SAND, GRAVEL, WELL-GRADED CRUSHED STONE OR ANY OTHER APPROVED MATERIAL CONTAINING NO MORE SILT OR CLAY THAN IS NECESSARY TO PROVIDE A DENSE AND STABLE FILLING. THE MATERIAL SHALL NOT HAVE A PI EXCEEDING 6 AND SHALL BE FREE FROM VEGETATION AND LUMPS AND STONES OF DIAMETER EXCEEDING 30mm.
   - 2.2. THE FILL MATERIAL SHALL BE PLACED AT OPTIMUM MOISTURE CONTENT AND COMPACTED IN LAYERS NOT EXCEEDING 150mm. THE DENSITY SHALL BE AT LEAST THE DENSITY REQUIRED FOR THE MATERIAL IN ADJOINING LAYERS OF FILL, SUBGRADE AND SUBBASE. FOR BACKFILLING IN EXCAVATIONS MADE IN NATURAL GROUND, THE DENSITY SHALL BE AT LEAST 93% OF MDD.
   - 2.3. BACKFILLING SHALL BE CARRIED OUT SIMULTANEOUSLY AND EQUALLY ON BOTH SIDES OF THE PIPE, TO PREVENT UNEQUAL LATERAL FORCES FROM OCCURRING.
3. FOR EXCAVATIONS IN ROCK OR OTHER HARD MATERIAL, THE MATERIAL BELOW THE PIPE SHALL BE REMOVED AND REPLACED WITH A BED OF SAND (OR OTHER APPROVED GRAVEL OF SOIL) TO A DEPTH AS PRESCRIBED BY THE ENGINEER. THE MATERIAL TO BE WATERED AND COMPACTED TO PROVIDE A FIRM FOUNDATION. THEREAFTER, THE CRADLED SHALL BE PREPARED.

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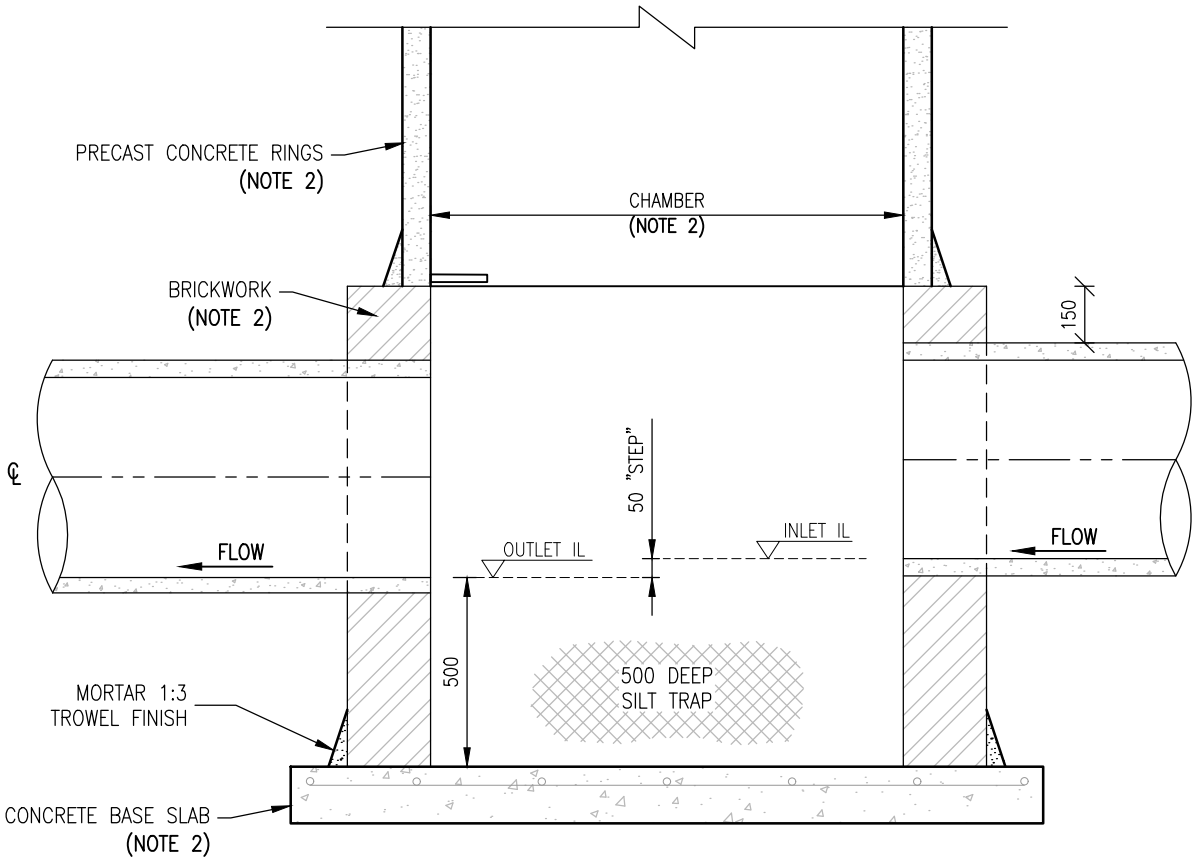
TITLE

BEDDING DETAILS FOR RIGID STORMWATER PIPES (CLASS 'B')

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:25	A4
DRAWING No.	REV
SW11	B

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TYPICAL SECTION

NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE FOLLOWING DRAWINGS:
   - SW2.2: STORMWATER MANHOLES (SHALLOW TYPE)
   - SW2.3. STORMWATER MANHOLES (DEEP TYPE)
2. DETAIL RELATING TO THE CONCRETE BASE SLAB, CHAMBER DIAMETER, PRECAST CONCRETE RINGS AND BRICKWORK SHALL BE IN ACCORDANCE WITH THE ABOVE–MENTIONED DRAWINGS.
3. THE PROVISION OF STORMWATER MANHOLES WITH SILT TRAPS SHALL BE SUBJECT TO THE APPROVAL AUTHORITY'S CONSENT.

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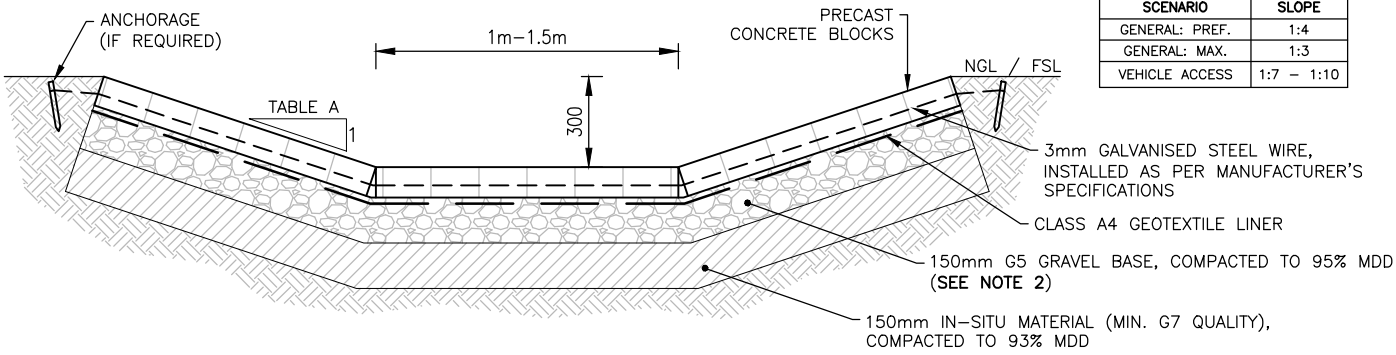
SILT TRAP FOR STORMWATER MANHOLES

STANDARDS AND GUIDELINES DETAILS

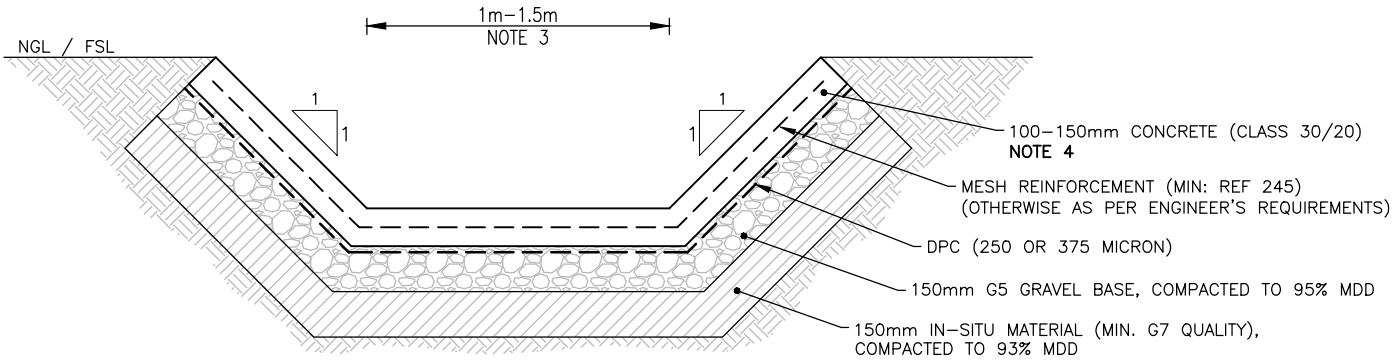
SCALE	PAPER
1:25	A4
DRAWING No.	REV
SW12	A

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TABLE A CHANNEL SIDE SLOPE	
SCENARIO	SLOPE
GENERAL: PREF.	1:4
GENERAL: MAX.	1:3
VEHICLE ACCESS	1:7 – 1:10

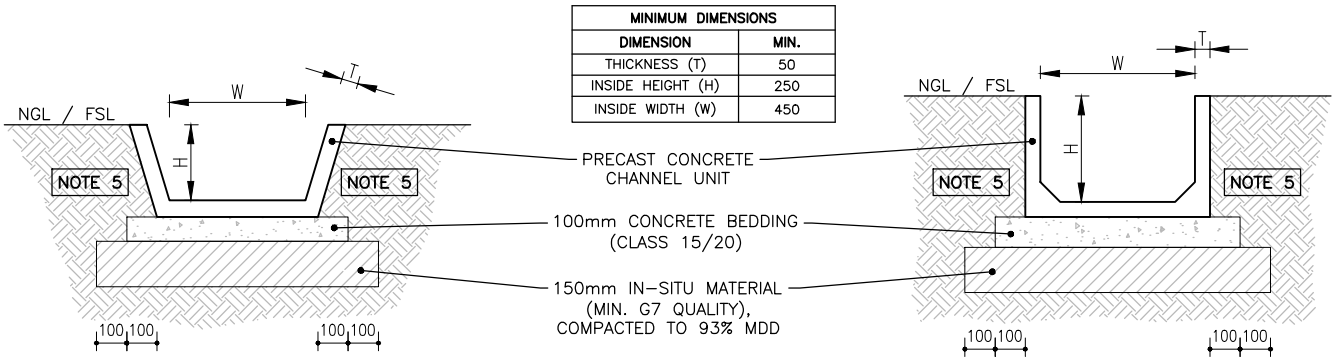


FLEXIBLE CONCRETE BLOCK STRUCTURE



IN–SITU CAST CONCRETE CHANNEL

MINIMUM DIMENSIONS	
DIMENSION	MIN.
THICKNESS (T)	50
INSIDE HEIGHT (H)	250
INSIDE WIDTH (W)	450



PRECAST TRAPEZOIDAL/RECTANGULAR CONCRETE CHANNELS

NOTES:

1. DISCLAIMER:
   - THIS DRAWING MERELY CONTAINS TYPICAL EXAMPLES AND DETAILS OF CHANNELS THAT CAN BE USED TO CONVEY OVERLAND STORMWATER RUNOFF.
   - DETAILS, SUCH AS DIMENSIONS AND SLOPES, MAY VARY BASED ON SITE SPECIFIC CONDITIONS AND REQUIREMENTS.
   - THE FINAL OVERLAND CHANNEL PROPOSAL SHALL BE APPROVED BY THE APPROVAL AUTHORITY.
2. THE G5 LAYER SHALL BE STABILISED WITH CEMENT FOR THE FOLLOWING SCENARIOS:
   - WHERE VEHICLES WILL CROSS THE OVERLAND CHANNEL.
   - WHERE THE PROTECTION OF THE CHANNEL'S LONGITUDINAL SLOPE IS OF UTMOST IMPORTANCE.
3. WHERE THE CHANNEL WIDTH EXCEEDS 1.5m, SPECIALISED DESIGN MAY BE REQUIRED FOR THE REINFORCEMENT.
4. PANEL/JOINT SPACING AND JOINT TREATMENT SHALL BE SPECIFIED BY THE DESIGNER.
5. WHERE CHANNEL CHANGES DIRECTION OR ARE SITUATED ON A BEND, LATERAL PROTECTION/SUPPORT MAY BE REQUIRED FOR THE AFFECTED UNIT. SUCH DETAILS TO BE DISCUSSED WITH THE APPROVAL AUTHORITY.
6. ALL DIMENSIONS GIVEN IN mm, UNLESS SPECIFIED OTHERWISE.
7. WHERE VEHICLE ACCESS IS REQUIRED ACROSS AN OPEN CHANNEL, DESIGNERS SHALL COMPILE AND SUBMIT A SPECIAL DESIGN THEREOF FOR APPROVAL.

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TITLE

LINED OVERLAND CHANNELS

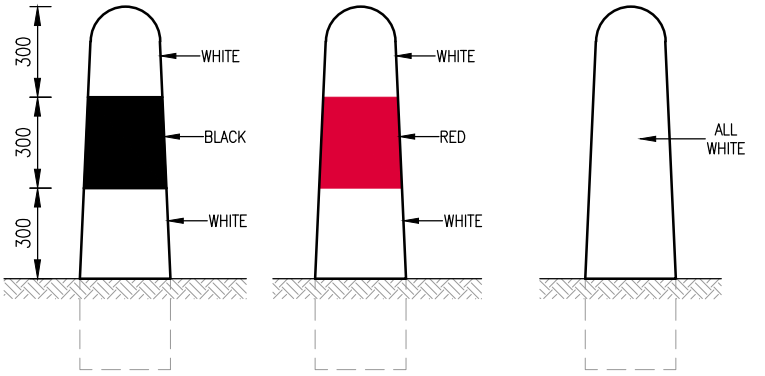
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:25	A4
DRAWING No.	REV
SW13	A

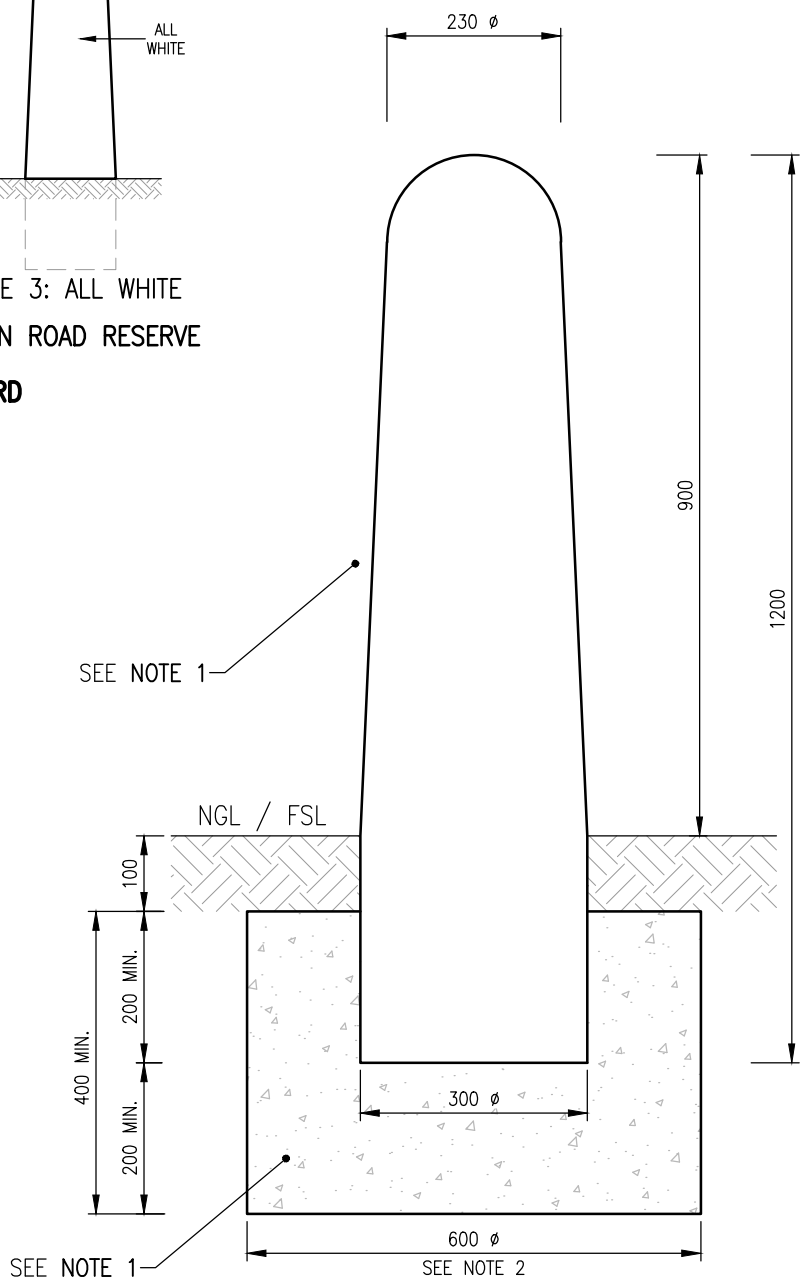
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Detail Drawings

GENERAL



DETAIL A: PAINTING OF BOLLARD
(SEE NOTE 4)



PLAN VIEW

NOTES:

1. FOOTING:
   - THE FOOTING SHALL GENERALLY BE STABILISED SOIL (4% CEMENT).
   - FOR INDUSTRIAL AREAS, THE FOOTING SHALL BE CONCRETE CLASS 20/20.
2. FOR INDUSTRIAL AREAS, THE DIAMETER OF THE FOOTING MAY BE INCREASED.
3. BOLLARD SHALL NOT BE PLANTED CLOSER THAN 500mm FROM ROAD EDGE, UNLESS, APPROVED OTHERWISE.
4. PAINTING OF BOLLARDS:
   - 4.1. WHERE THE APPROVAL AUTHORITY REQUIRES THE BOLLARD TO BE PAINTED, IT SHALL BE DONE AS PER "DETAIL A", USING RETRO-REFLECTIVE PAINT.
   - 4.2. "TYPE 1" AND "TYPE 2" SHALL BE APPLICABLE FOR BOLLARDS SITUATED INSIDE NMT FACILITIES. THE PAINT TYPE WHICH PROVIDES THE BEST CONTRAST TO THE SURROUNDING NMT FACILITY SURFACE SHALL BE USED.
   - 4.3. "TYPE 3" SHALL BE USED FOR BOLLARDS SITUATED INSIDE THE ROAD RESERVE.
5. BOLLARD SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 15MPa.

NGL: NATURAL GROUND LEVEL
FSL: FINISHED SURFACE LEVEL

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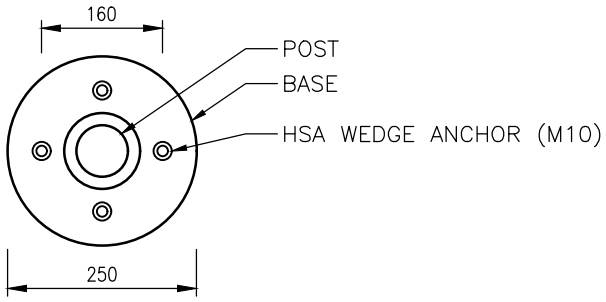
TITLE

PRECAST CONCRETE BOLLARD

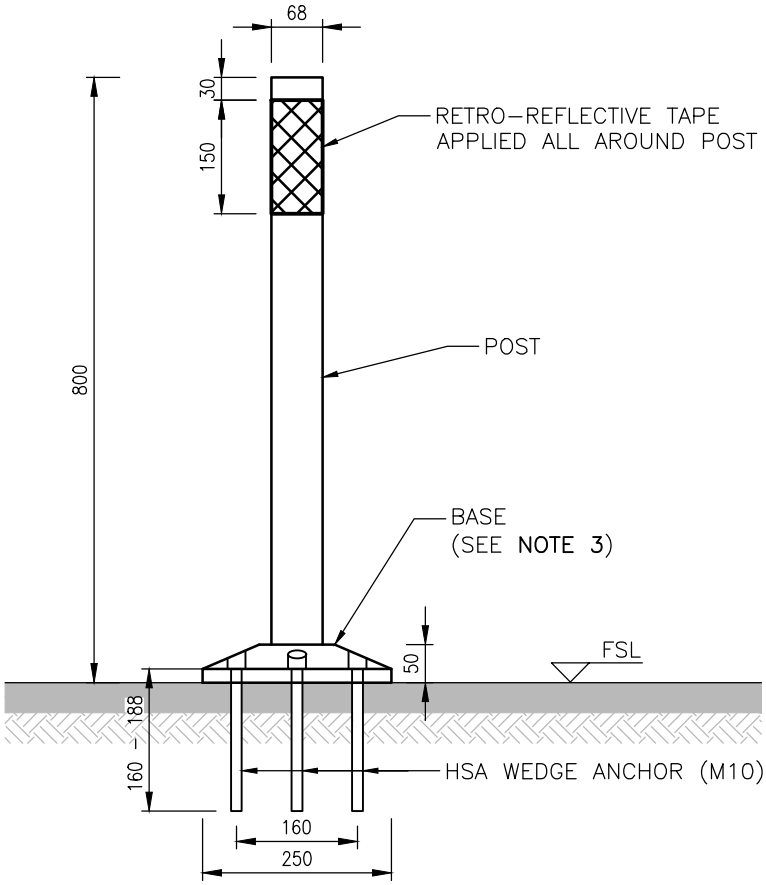
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:10	A4
DRAWING No.	REV
GE1.1	A

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TOP VIEW



SECTION

NOTES:

1. THE INDICATED DIMENSIONS OF THE FLEXIBLE BOLLARD ARE CONSIDERED TYPICAL. THE FINAL DETAILS OF THE FLEXIBLE BOLLARDS, INCLUDING THE PROVISION OF THESE BOLLARDS, SHALL BE DISCUSSED AND AGREED WITH THE APPROVAL AUTHORITY, PRIOR TO IMPLEMENTATION.
2. POST:
   - 2.1. POST SHALL CONSIST OF LOW DENSITY POLYETHYLENE (LDPE) WITH ULTRAVIOLET STABILISERS.
   - 2.2. A RETRO-REFLECTIVE TAPE/SHEETING SHALL BE APPLIED AT THE TOP OF THE POST. THE SHEETING SHALL COMPLY WITH SANS1519-1.
3. BASE:
   - 3.1. BASE SHALL CONSISTS OF HIGH-IMPACT THERMOPLASTIC STYRENIC ALLOY.
   - 3.2. BASE SHALL BE SECURED TO THE SURFACE USING 4 X WEDGE ANCHORS (M10) AND ANCHORING ADHESIVES. THE ANCHOR LENGTH SHALL BE MINIMUM 160mm.
4. INSTALLATION
   - 4.1. THE HOLES SHALL BE DRILLED AS PER ANCHOR OPENINGS IN THE BASE.
   - 4.2. CLEAR AND CLEAN THE DRILLED HOLES, INCLUDING THE SURFACE AREA WHERE BASE WILL BE INSTALLED, OF ANY DEBRIS AND/OR STANDING WATER.
   - 4.3. APPLY THE ANCHOR ADHESIVE (AS PER MANUFACTURER'S SPECIFICATIONS) INTO THE DRILLED HOLES.
   - 4.4. POSITION THE BASE AND INSTALL WEDGE ANCHORS.

NGL: NATURAL GROUND LEVEL
FSL: FINISHED SURFACE LEVEL

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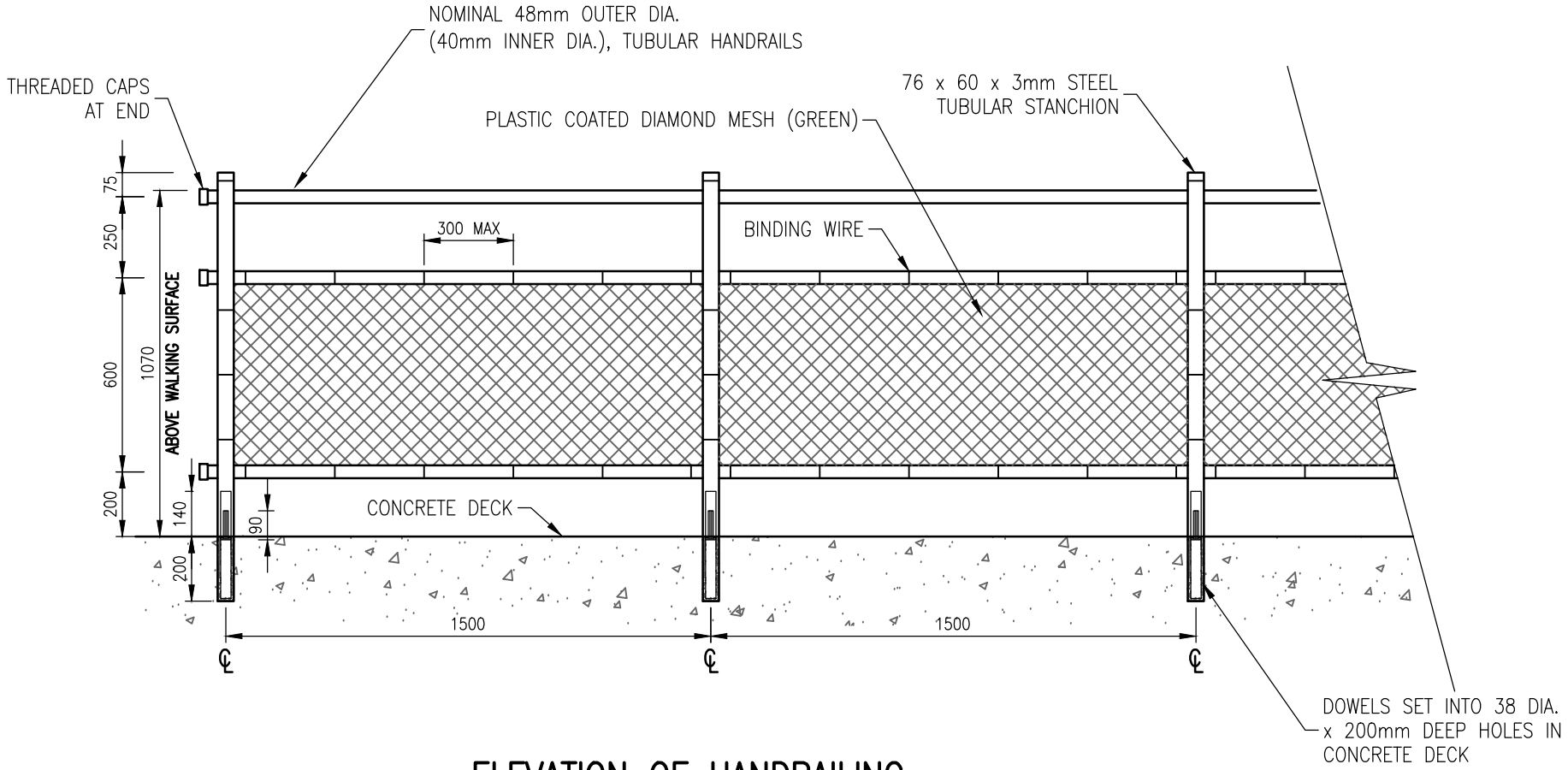
TITLE

SURFACE MOUNTED FLEXIBLE BOLLARD

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:10	A4
DRAWING No.	REV
GE1.2	A

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ELEVATION OF HANDRAILING

SCALE 1:20

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CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

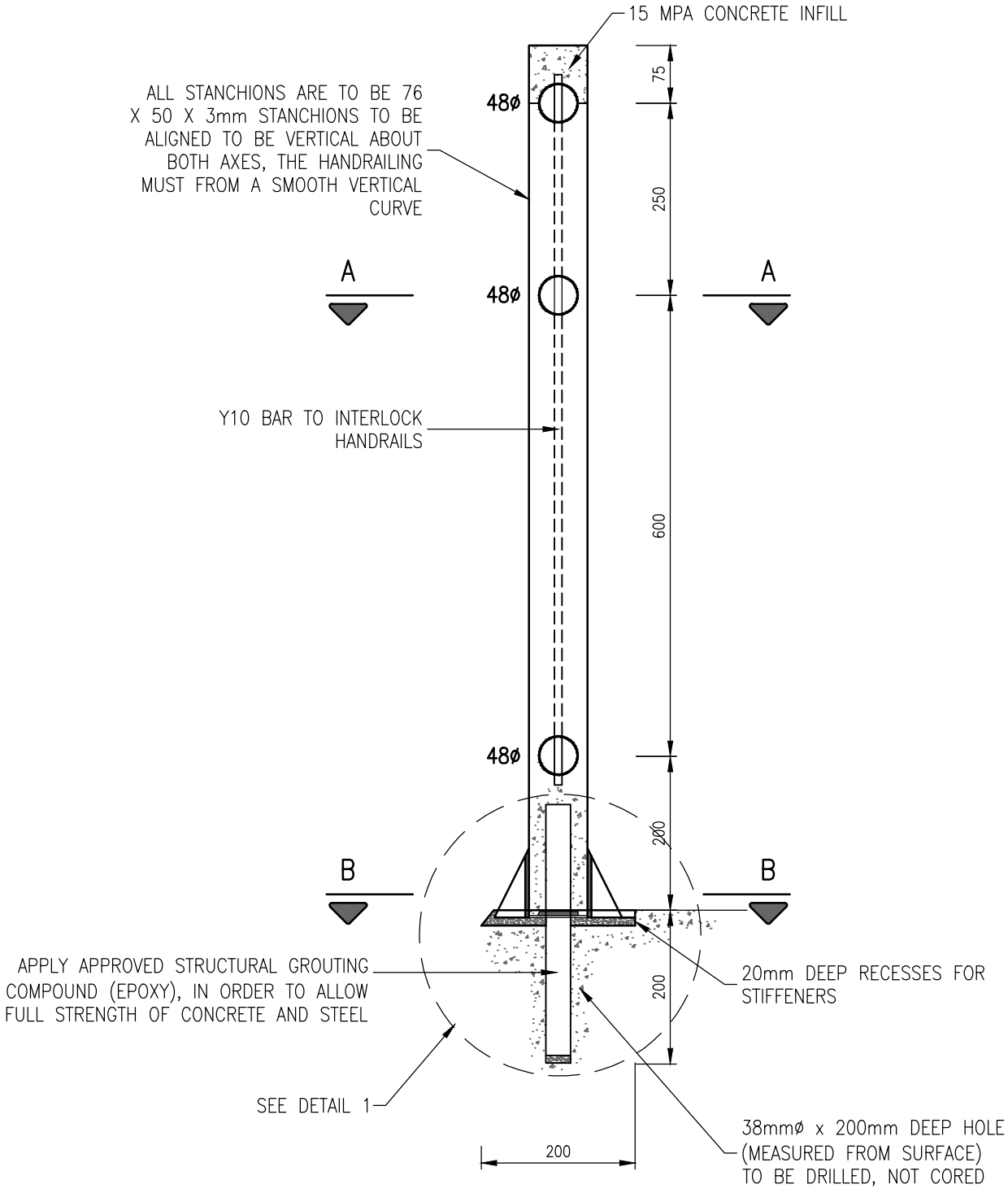
STEEL HANDRAIL:
STANCHION IN CONCRETE

STANDARDS AND GUIDELINES DETAILS

SHEET 1

SCALE	PAPER
1:20	A4
DRAWING No.	REV
GE2A	B

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STANCHION INSTALLED IN CONCRETE

SCALE 1:8

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CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

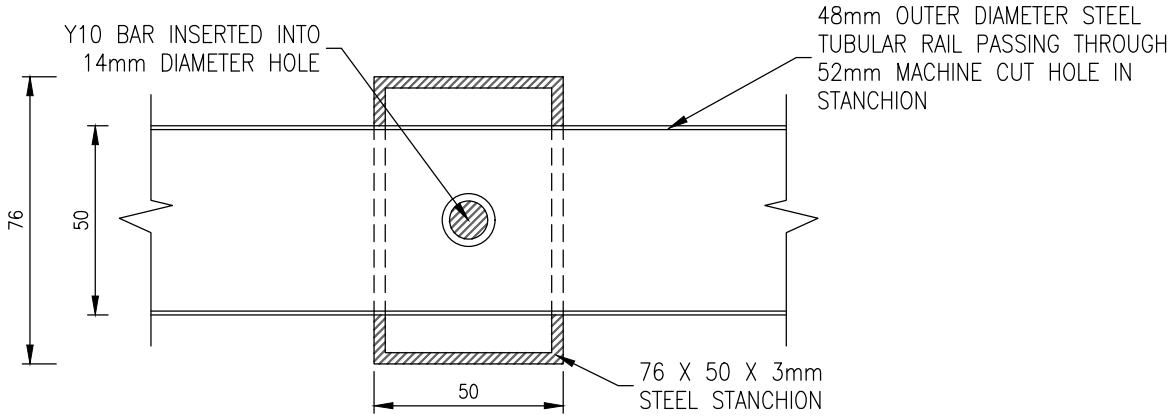
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STEEL HANDRAIL:
STANCHION IN CONCRETE

STANDARDS AND GUIDELINES DETAILS

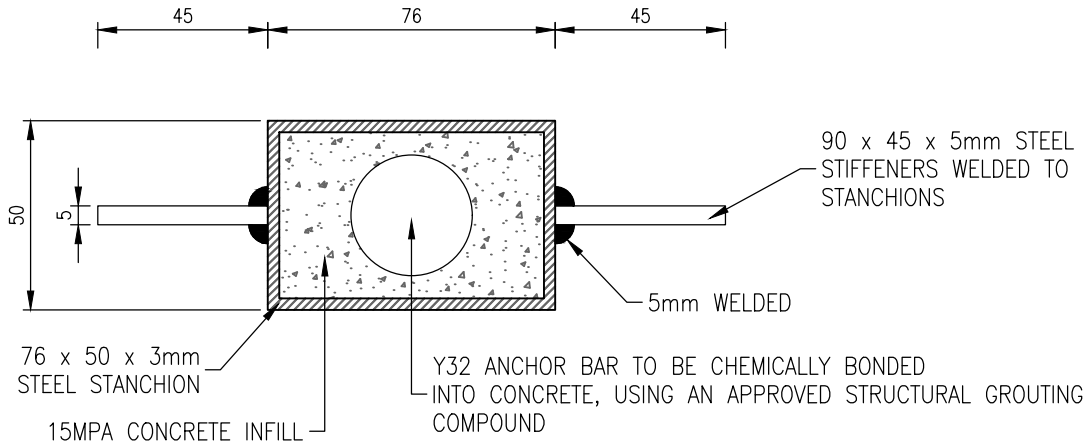
SHEET 2

SCALE	PAPER
1:8	A4
DRAWING No.	REV
GE2B	A



SECTION A–A

SCALE 1:2



SECTION B–B

SCALE 1:2

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CITY OF CAPE TOWN
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URBAN MOBILITY

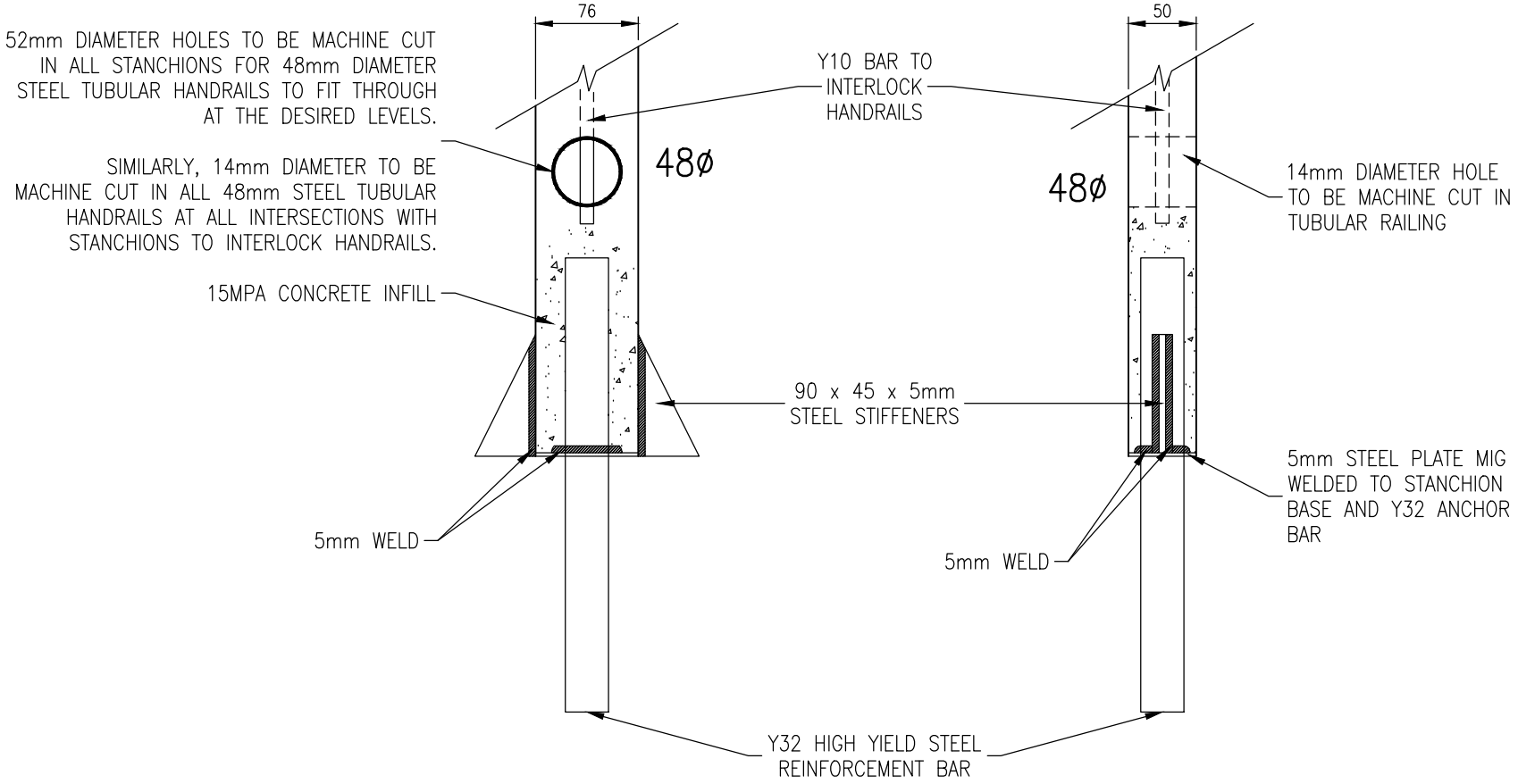
TITLE

STEEL HANDRAIL: STANCHION IN CONCRETE

STANDARDS AND GUIDELINES DETAILS

SHEET 3

SCALE	PAPER
1:2	A4
DRAWING No.	REV
GE2C	A



DETAIL 1

SCALE 1:5

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TITLE

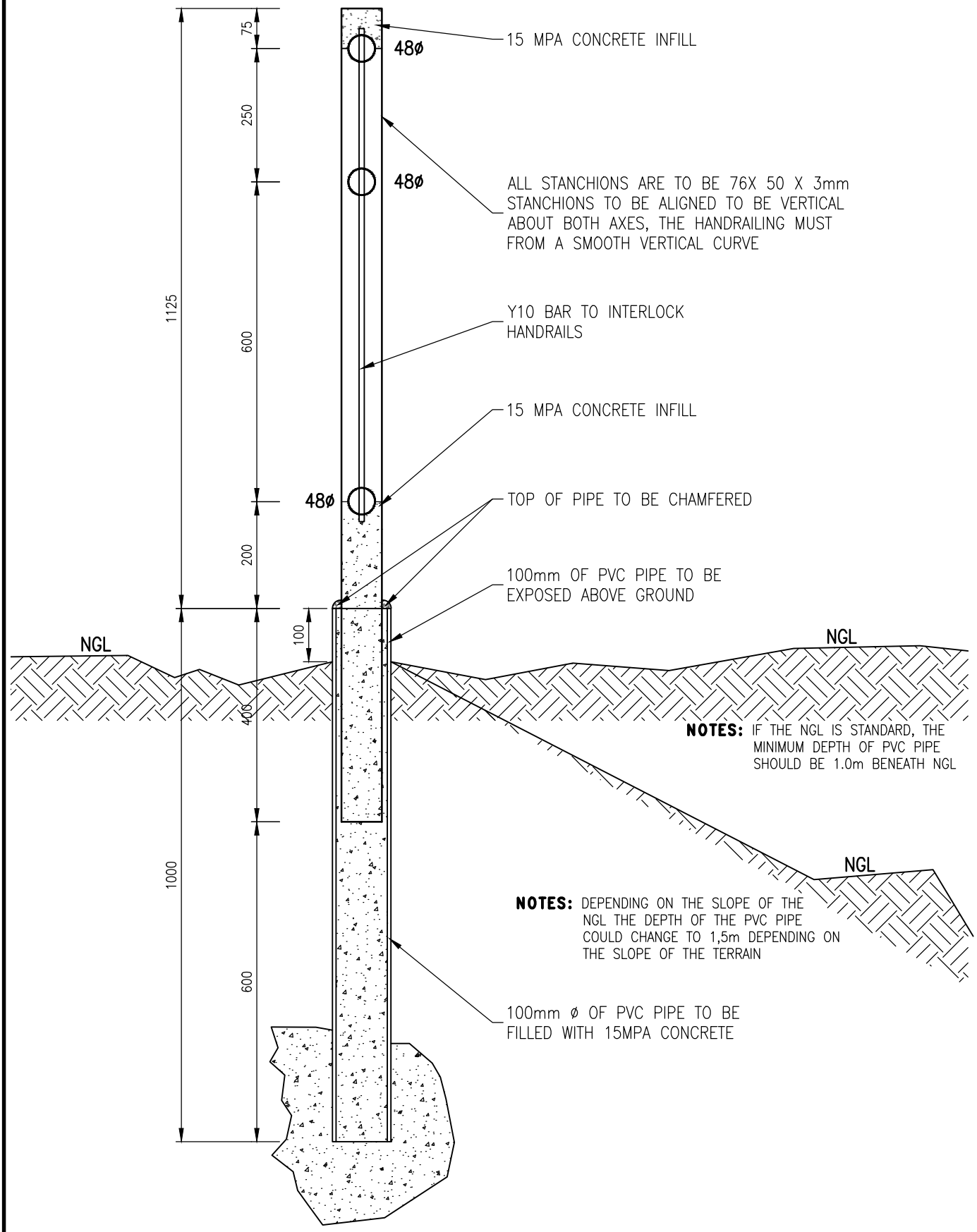
STEEL HANDRAIL: STANCHION IN CONCRETE

STANDARDS AND GUIDELINES DETAILS

SHEET 4

SCALE	PAPER
1:5	A4
DRAWING No.	REV
GE2D	A

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NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

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URBAN MOBILITY

TITLE

STEEL HANDRAIL: STANCHION IN CONCRETE

STANDARDS AND GUIDELINES DETAILS

SHEET 5

SCALE	PAPER
1:10	A4
DRAWING No.	REV
GE2E	A

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NOTES:

REMOVAL OF EXISTING PARAPETS AND DRILLING OF POCKETS

NEATLY CUT AND GRIND ALL EXISTING ALUMINIUM HANDRAILS TO 6mm BELOW THE SURFACE. THE EXISTING ALUMINIUM HANDRAILS ON THE STAIRWAYS TO BE DISPOSED OF BY THE CONTRACTOR. A DURABLE APPROVED STRUCTURAL REPAIR MORTAR TO BE APPLIED TO DAMAGED CONCRETE SURFACES.

ACCURATELY SET OUT, AND INDELIBLY MARK, THE LONGITUDINAL CENTRELINES OF THE HOLES TO BE DRILLED, AND MEASURE OUT AND MARK OFF THE HOLE CENTRE POSITIONS IN PREPARATION FOR THE DRILLING BY CONTRACTOR, BASED ON A SETTING–OUT ORIGIN (TO BE DETERMINED ON SITE).

DETERMINE THE POSITION OF THE EXISTING REINFORCEMENT BY USING A COVER METER, AND ADJUST THE SETTING–OUT OF THE HOLES ACCORDINGLY.

SUPERVISE AND DIRECT THE DRILLING TO ENSURE ACCURATE ADHERENCE TO THE GIVEN HOLE POSITIONS, ACHIEVEMENT OF THE MINIMUM DEPTHS AND THAT THE HOLES ARE PLUMB.

ONCE THE DRILLING HAS BEEN COMPLETED, CUT 20mm DEEP x 10mm WIDE x 270mm LONG TRANSVERSE SLOTS CENTERED ACROSS THE POCKETS FOR THE STABILISING PLATES ON THE HANDRAIL STANCHIONS.

THE HORIZONTAL AND VERTICAL ALIGNMENT OF THE PROPOSED HANDRAIL TO BE PLUMB IN BOTH PLANES.

GROUT THE STANCHIONS IN THE POCKETS USING AN APPROVED STRUCTURAL GROUTING COMPOUND, ENSURING THAT THE GROUT COMPLETELY FILLS THE POCKETS AND THAT ALL THE AIR HAS BEEN EXPELLED.

38mm DIAMETER POCKETS TO BE DRILLED VERTICALLY (PLUMB) INTO THE CONCRETE TO A DEPTH OF NOT LESS THAN 200mm. WHEN THE DRILL IS REMOVED. THE DEPTH MUST BE AT LEAST 200mm. THE POCKETS MUST BE CLEANED TO REMOVE ALL LOOSE DUST PRIOR TO GROUTING.

GENERAL:

1. ALL ASPECTS OF THE STRUCTURAL STEELWORK ARE TO BE IN ACCORDANCE WITH THE CURRENT EDITION OF SANS 10162: THE STRUCTURAL USE OF STEEL.

2. ALL STEEL IS TO BE GRADE 300W.

3 STANDARDS TO BE FABRICATED FROM STANDARD 76 x 50 x 3mm AND 48mm DIAMETER STEEL TUBES.

4 ALL WELDS TO BE 5mm MIG (UNLESS OTHERWISE SPECIFIED). WELD SCALE AND SPLATTER ARE TO BE REMOVED BY WIRE BRUSHING, OR GRINDING WHERE NECESSARY, PRIOR TO GALVANISING.

5 ALL HOLES TO BE MACHINE CUT.

6 ALL BURR TO BE REMOVED AND SHARP EDGES SMOOTHED OFF AFTER MACHINING.

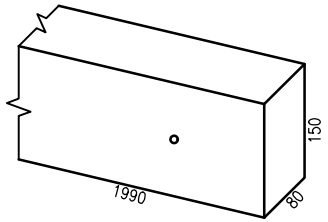
7 ALL STANDARDS, RAILINGS, COUPLINGS AND CAPS TO BE HOT–DIP GALVANISED IN ACCORDANCE WITH SANS 121/ISO 1461 TO 85 MICRON MINIMUM THICKNESS. NO GALVANISED COMPONENT IS TO BE SUBJECTED TO ANY CUTTING, BENDING, WELDING, HEATING, ABRADING OR ANY OPERATION LIKELY TO RESULT IN DEFORMATION OF THE COMPONENT OR DAMAGE TO ITS PROTECTIVE COATING.

8 NOMINAL 48mm OUTER DIAMETER TUBULAR RAILING TO BE THREADED AT EITHER END TO TAKE COUPLINGS OR CAPS AS REQUIRED. NOTE THAT THE THREADED LENGTHS MUST BE CURTAILED, IN ORDER NOT TO EXPOSE UNTREATED STEEL TO CORROSION.

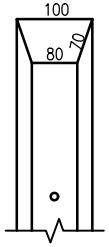
9 52mm HOLES ON EITHER SIDE OF THE TUBULAR STANCHION TO BE ALIGNED TO ALLOW FOR THE RAIL.

10 UNTREATED THREAD LENGTHS TO BE COATED WITH AN APPROVED ZINC–RICH EPOXY COATING, AS WELL AS THE INTERFACE OF THE STEEL STANCHIONS AND THE CONCRETE.

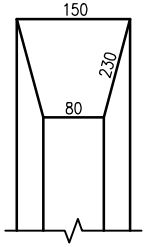
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RAIL
1:10



PALE
1:10



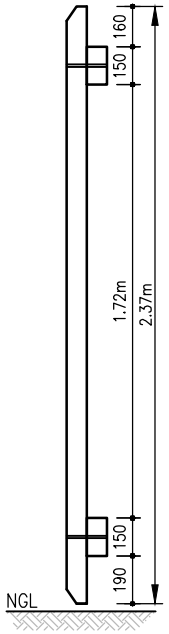
POST
1:10

TABLE 1: COMPONENT DETAILS	
COMPONENT	TYPICAL DIMENSIONS
POST	3000x230x150 (TAPERED TO 80mm)
PALE	2370x80x110 (TAPERED TO 80mm)
RAIL	1990x75x150
BOLTS	8mmø CARRIAGE BOLTS

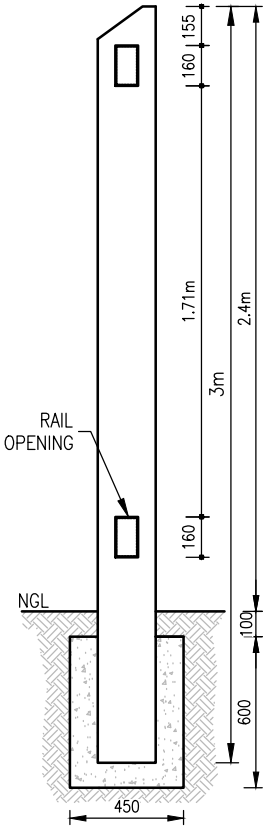
NOTES:

1. ALL CONCRETE COMPONENTS SHALL BE CLASS 40/14.
2. CONCRETE FOOTINGS SHALL BE CLASS 25/20.
3. COMPONENT DIMENSIONS AND MEASUREMENTS ARE APPROXIMATE AND MAY DIFFER, DEPENDING ON MANUFACTURER.

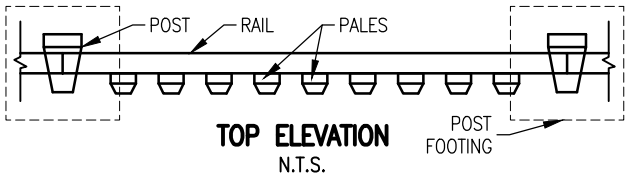
NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL



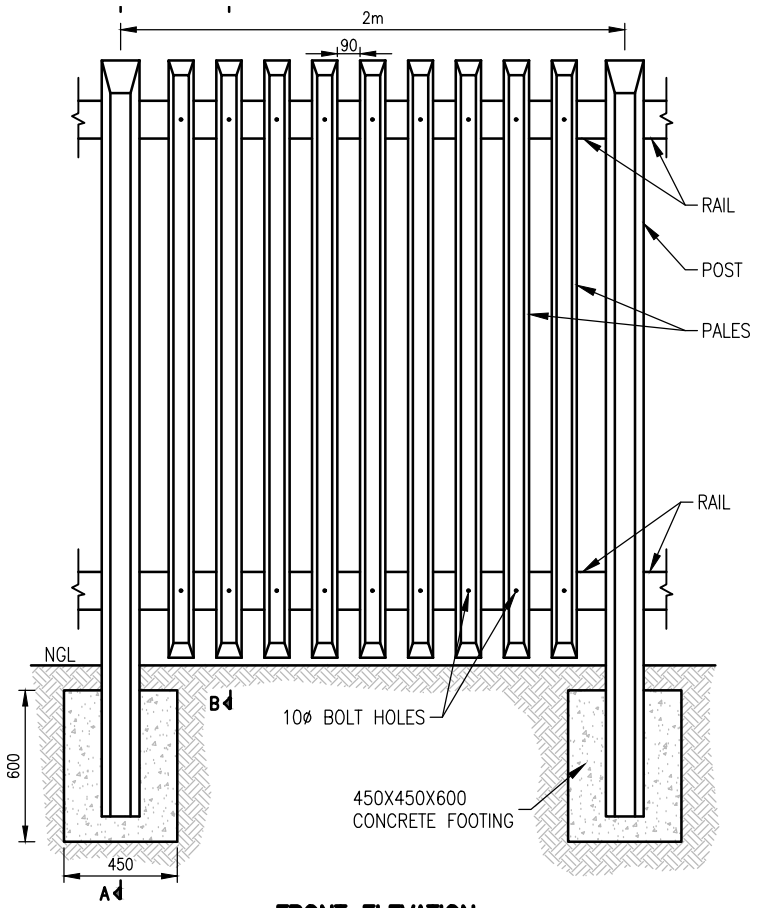
SECTION B–B:
PALE
N.T.S.



SECTION A–A:
POST
N.T.S.



TOP ELEVATION
N.T.S.



FRONT ELEVATION
N.T.S.

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

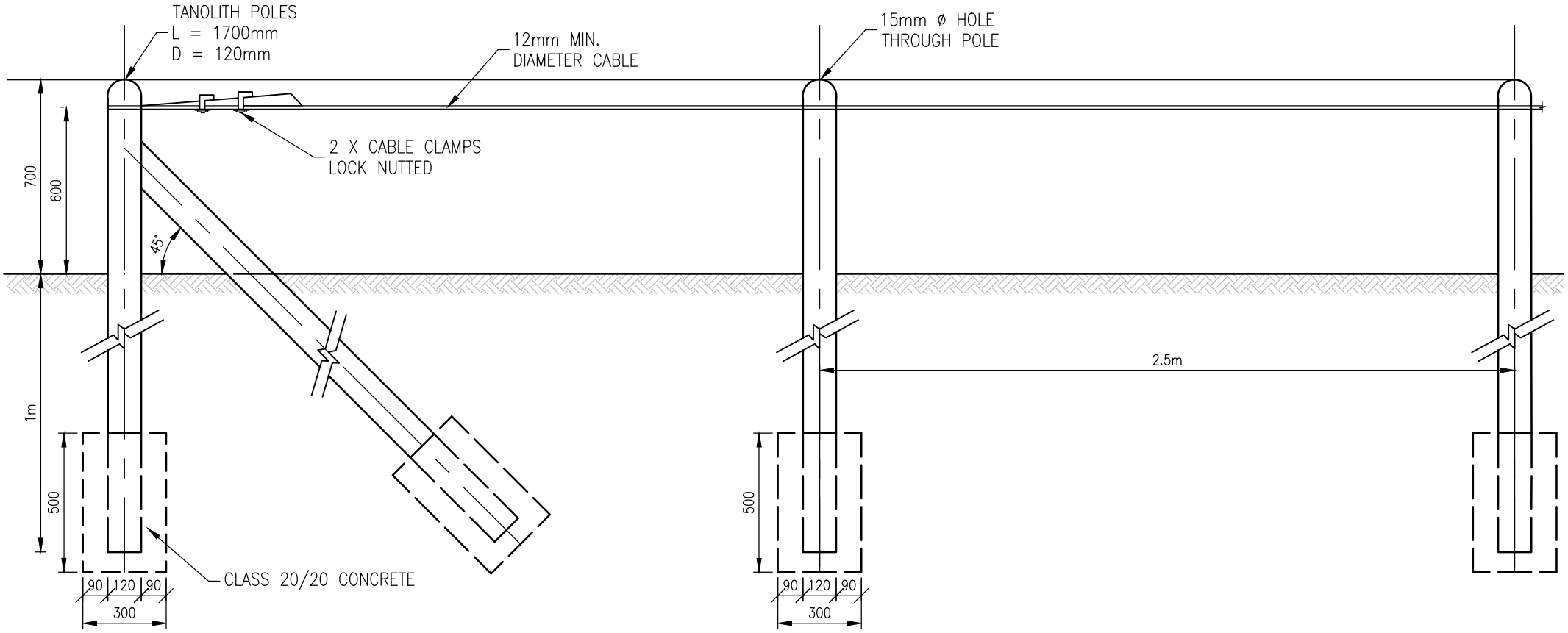
TITLE

CONCRETE PALISADE FENCING

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
GE3	B

P:\CAD\R&SD\ITI_01 Design\T_1000B Standards\T_1000RS DESIGN_Roads and Stormwater\0002 Drawings_Version4.0\04 GE\GE3 – Concrete Palisade Fencing_RevB.dwg



CABLE FENCE DETAIL (BARRIER)

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

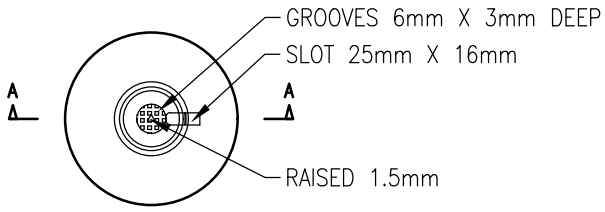
TITLE

CABLE FENCE

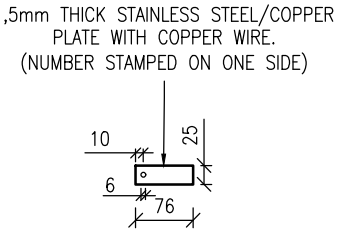
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:20	A4
DRAWING No.	REV
GE4	B

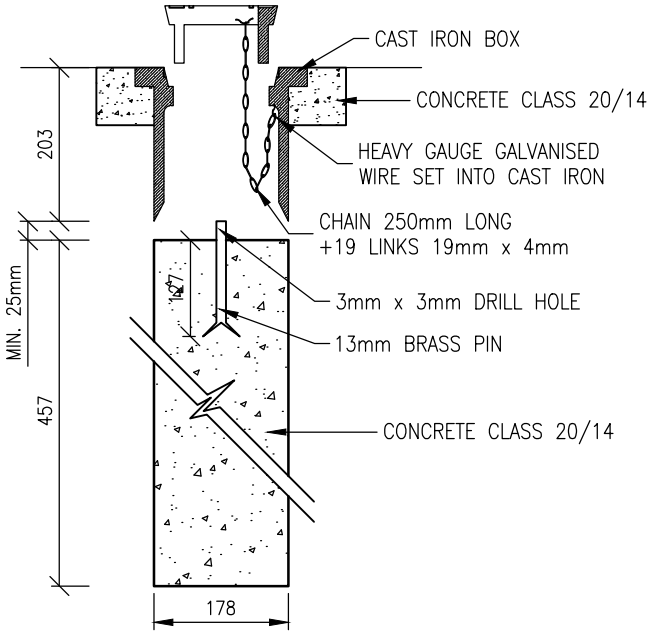
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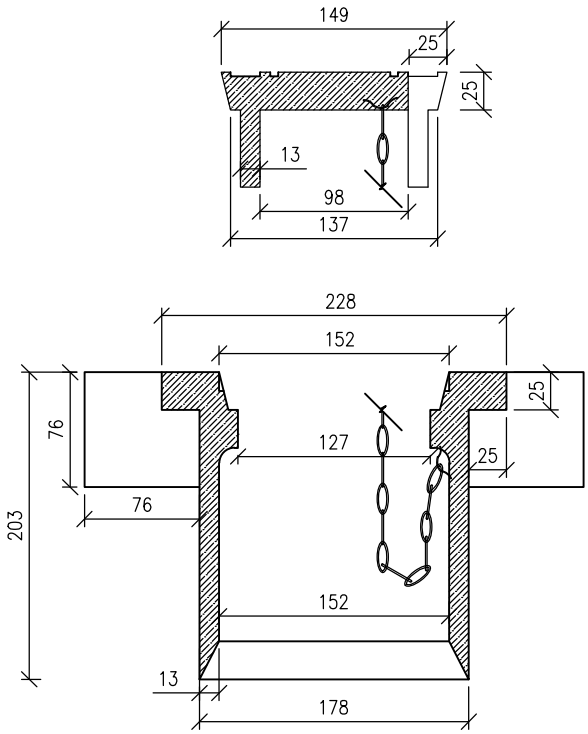
PLAN VIEW



TAG FOR NUMBER



SECTION A–A



CAST IRON COVER

SCALE 1:5

NOTES:

1. DIMENSIONS AND TOLERANCES:
   a. ALL CASTINGS, CHAINS AND CHAIN STAPLES SHALL CONFORM TO THE RELEVANT DIMENSIONAL REQUIREMENTS GIVEN ON THE PLAN.
   b. COVERS AND FRAMES SHALL BE FREE FROM TWIST, SHALL BE SO FINISHED THAT COVERS REST EVENLY ON INTENDED MUTUAL BEARING SURFACES AND SHALL NOT ROCK. WHEN FITTED TO FRAMES, COVERS SHALL FIT SUFFICIENTLY LOOSELY TO BE RETAINED IN POSITION BY WEIGHT ONLY. THE TOP SURFACES OF COVERS, INCLUDING ANTI–SLIP PROJECTION, SHALL NOT PROTRUDE ABOVE, NOR BE MORE THAN 1,5mm BELOW THE TOPS OF ASSOCIATED FRAMES.

2. MATERIAL AND FINISH:
   a. CASTINGS SHALL BE MANUFACTURED IN GOOD QUALITY GREY CAST IRON AND NOT OF IRON WHICH APPEARS WHITE ON FRACTURE. ALL CASTINGS SHALL BE SOUND, HOMOGENUOUS AND FREE FROM SAND AND BELOW HOLES, COLD SHUTS, SCAB AND OTHER DEFECTS.
   b. THE CHEMICAL ANALYSES OF GREY CAST IRON IS GIVEN IN THE FOLLOWING TABLE:

CARBON %	SILICON %	SULPHUR %	PHOSPHORUS %	MANGANESE %
3,5–4,0	1.25–2,0	0.05	0.02	0,75–1,0

   c. CHAINS AND CHAIN STAPLES SHALL BE MILD STEEL.
   d. CHAINS SHALL BE HOT DIPPED GALVANISED.

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

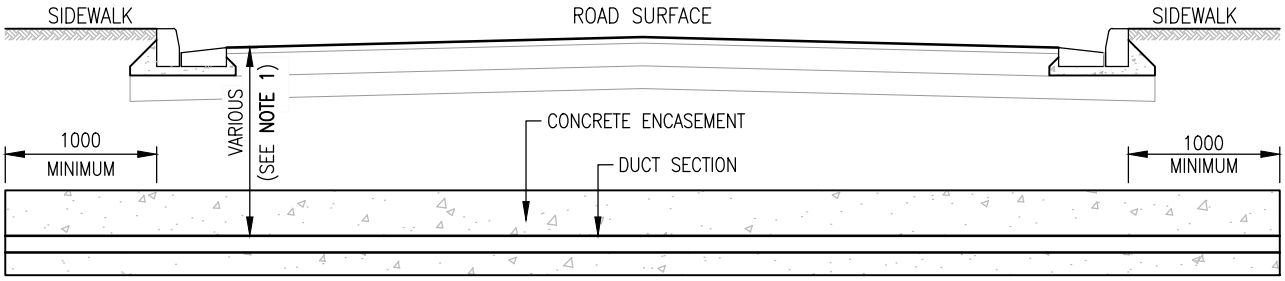
TITLE

TOWN SURVEY MARK

STANDARDS AND GUIDELINES DETAILS

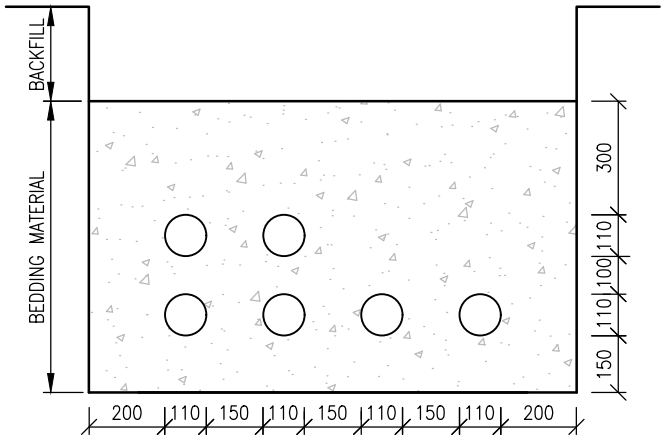
SCALE	PAPER
1:10	A4
DRAWING No.	REV
GE5	B

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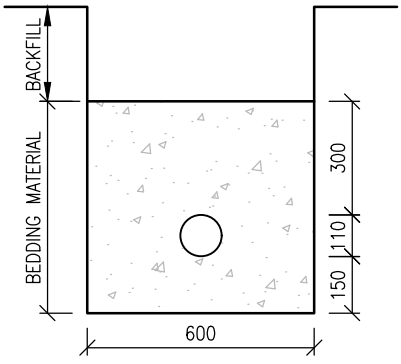
TYPICAL CROSS SECTION UNDER ROADWAY

SCALE 1:50



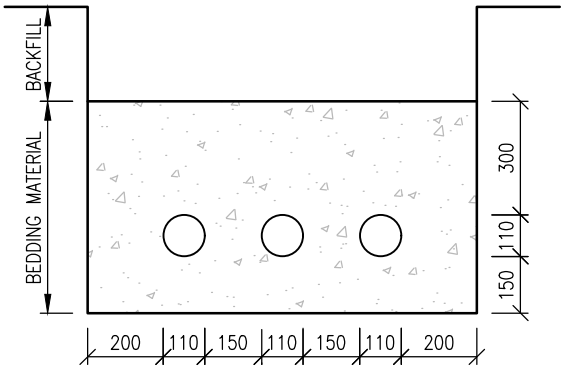
FIVE TO EIGHT DUCTS

SCALE 1:20



ONE DUCT

SCALE 1:20



TWO TO FOUR DUCTS

SCALE 1:20

NOTES:

1. MINIMUM DEPTH OF SERVICE BELOW FINISHED ROAD LEVEL AS PER SECTION 13.2.
2. ALL DUCTS SHALL HAVE A MINIMUM CLEARANCE OF 750mm BETWEEN ROAD SURFACE AND TOP OF DUCT/DUCT ENCASEMENT.
3. DUCTS SHALL BE ENCASED IN CONCRETE WITH A 28 DAY COMPRESSIVE STRENGTH OF 10MPa.
4. PIPE DUCTS TO BE HEAVY DUTY (SDR 34) PVC–U (SANS 791).
5. DUCTS SHALL EXTEND 1m PAST THE KERB ON BOTH SIDES OF THE ROAD.
6. A 2.5mm ø GALVANISED DRAW WIRE WITH A 2m FREE LENGTH AT EACH END SHALL BE LEFT IN EACH DUCT.
7. DUCTS SHALL BE SEALED AFTER INSTALLATION BY A DOUBLE LAYER OF DPC SHEETING TIED AROUND THE ENDS WITH GALVANISED BINDING WIRE TO PREVENT THE INGRESS OF OBSTRUCTIONS. ALTERNATIVELY, END CAPS TO BE PROVIDED.
8. THE POSITION OF THE INSTALLED DUCTS TO BE PERMANENTLY MARKED AS DESCRIBED IN SECTION 13.5.

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

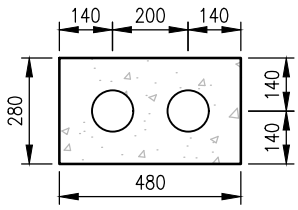
SPECIFICATIONS FOR THE INSTALLATION OF ELECTRICAL DUCTS

STANDARDS AND GUIDELINES DETAILS

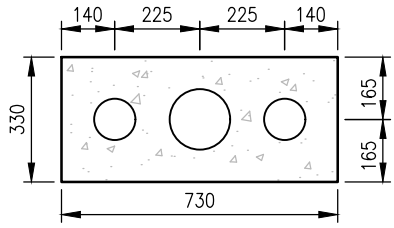
SHEET 1

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
GE6.1	B

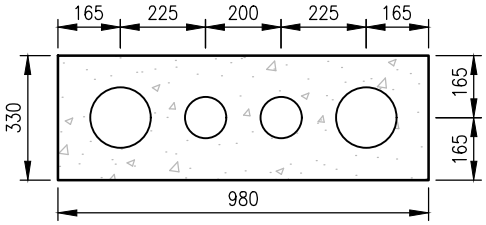
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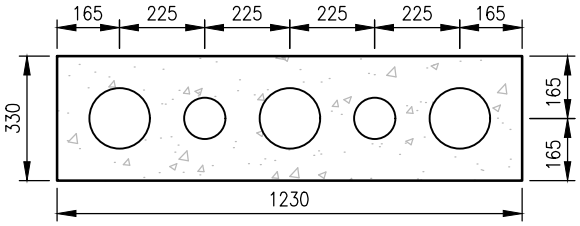
A TYPE
(2x110)



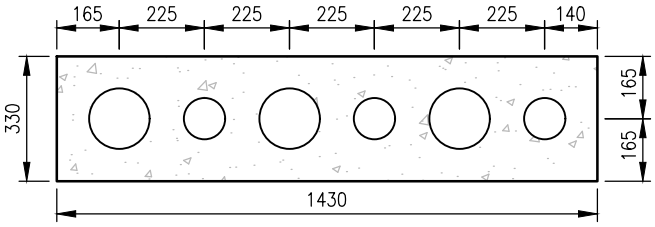
B TYPE
(2x110 ; 1x160)



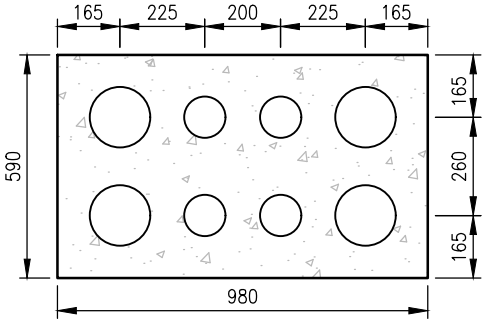
C TYPE
(2x110 ; 2x160)



D TYPE
(2x110 ; 3x160)



E TYPE
(3x110 ; 3x160)



F TYPE
(4x110 ; 4x160)

NOTES:

1. MINIMUM DEPTH OF SERVICE BELOW FINISHED ROAD LEVEL AS PER SECTION 13.2.
2. ALL DUCTS SHALL HAVE A MINIMUM CLEARANCE OF 750mm BETWEEN ROAD SURFACE AND TOP OF DUCT/DUCT ENCASEMENT.
3. DUCTS SHALL BE ENCASED IN CONCRETE WITH A 28 DAY COMPRESSIVE STRENGTH OF 10MPa.
4. PIPE DUCTS TO BE HEAVY DUTY (SDR 34) PVC–U (SANS 791).
5. DUCTS SHALL EXTEND 1m PAST THE KERB ON BOTH SIDES OF THE ROAD.
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7. DUCTS SHALL BE SEALED AFTER INSTALLATION BY A DOUBLE LAYER OF DPC SHEETING TIED AROUND THE ENDS WITH GALVANISED BINDING WIRE TO PREVENT THE INGRESS OF OBSTRUCTIONS. ALTERNATIVELY, END CAPS TO BE PROVIDED.
8. THE POSITION OF THE INSTALLED DUCTS TO BE PERMANENTLY MARKED AS DESCRIBED IN SECTION 13.5.

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

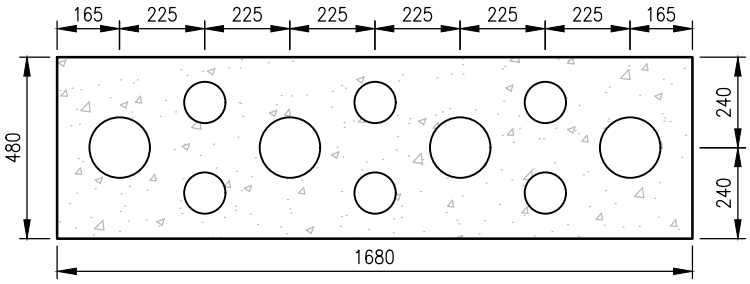
SPECIFICATIONS FOR THE INSTALLATION OF ELECTRICAL DUCTS

STANDARDS AND GUIDELINES DETAILS

SHEET 2

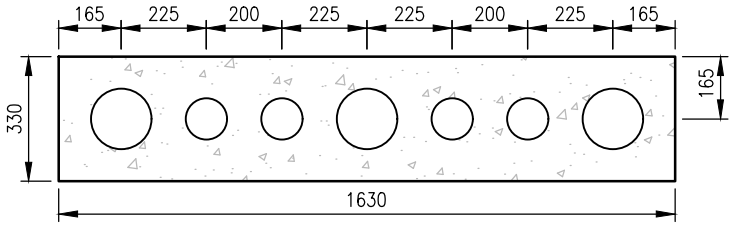
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SHOWN	A4
DRAWING No.	REV
GE6.2	B

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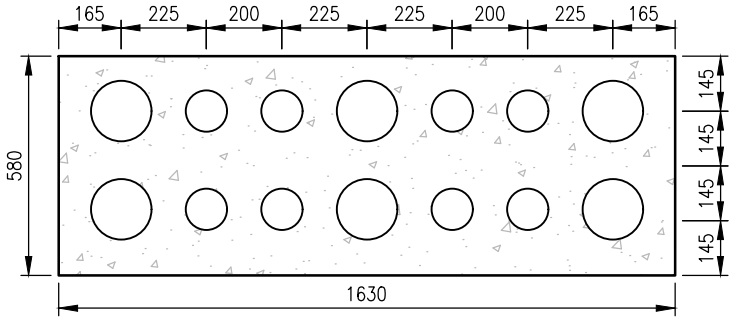
G TYPE

(6x110 ; 4x160)



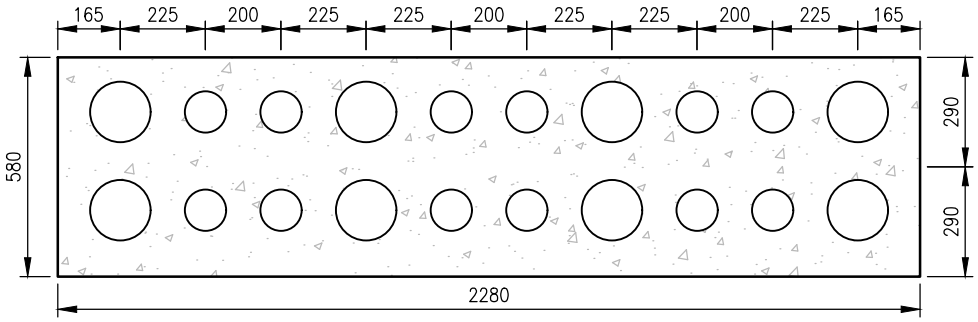
H TYPE

(4x110 ; 3x160)



J TYPE

(8x110 ; 6x160)



K TYPE

(12x110 ; 8x160)

NOTES:

1. MINIMUM DEPTH OF SERVICE BELOW FINISHED ROAD LEVEL AS PER SECTION 13.2.
2. ALL DUCTS SHALL HAVE A MINIMUM CLEARANCE OF 750mm BETWEEN ROAD SURFACE AND TOP OF DUCT/DUCT ENCASEMENT.
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CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

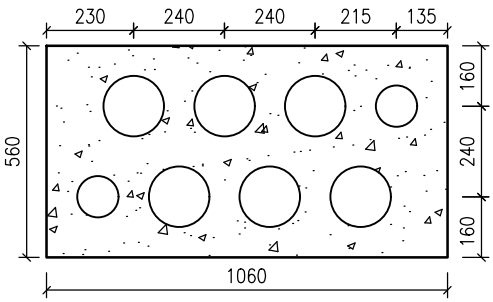
SPECIFICATIONS FOR THE INSTALLATION OF ELECTRICAL DUCTS

STANDARDS AND GUIDELINES DETAILS

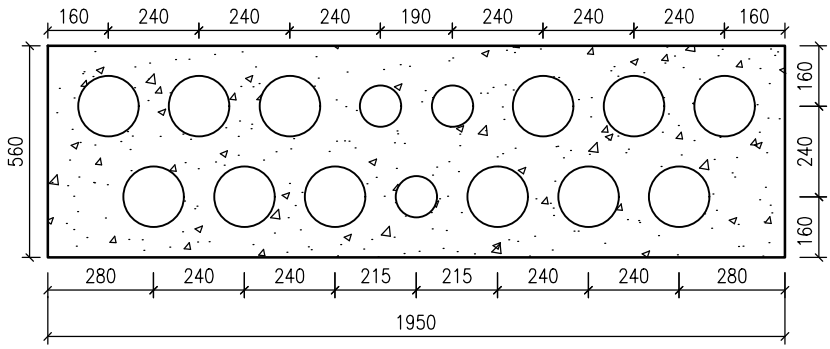
SHEET 3

SCALE	PAPER
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DRAWING No.	REV
GE6.3	B

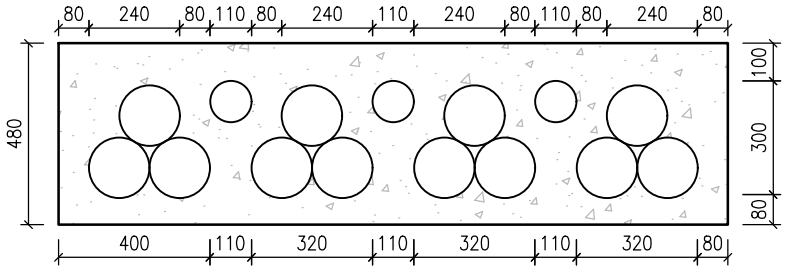
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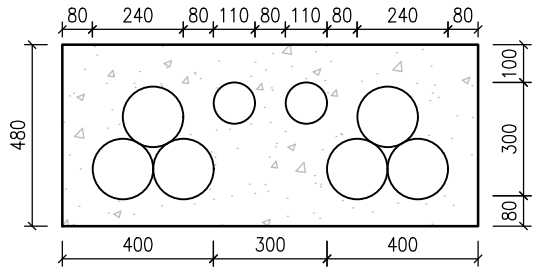
P (F) TYPE
TO ACCOMMODATE 3 x Sc. CABLES FLAT
(2x110 ; 6x160)



L (F) TYPE
TO ACCOMMODATE 6 x Sc. CABLES FLAT
(3x110 ; 12x160)



L (T) TYPE
TO ACCOMMODATE 6 x Sc. CABLES IN TREFOIL
(3x110 ; 3x160)



L (T) TYPE
TO ACCOMMODATE 3 x Sc. CABLES IN TREFOIL
(3x110 ; 3x160)

NOTES:

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CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

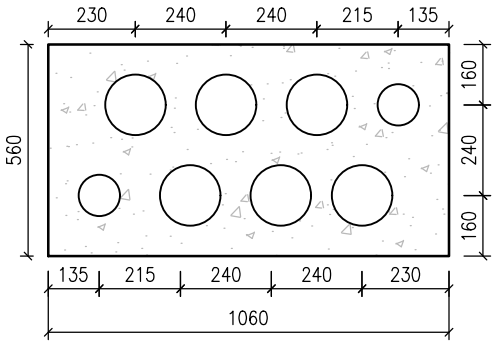
SPECIFICATIONS FOR THE INSTALLATION OF ELECTRICAL DUCTS

STANDARDS AND GUIDELINES DETAILS

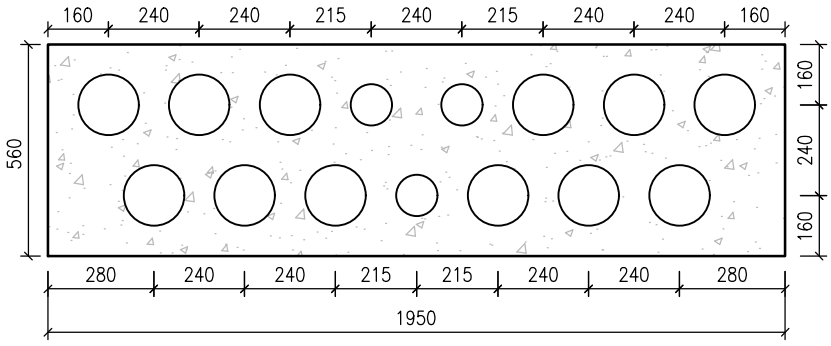
SHEET 4

SCALE	PAPER
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DRAWING No.	REV
GE6.4	B

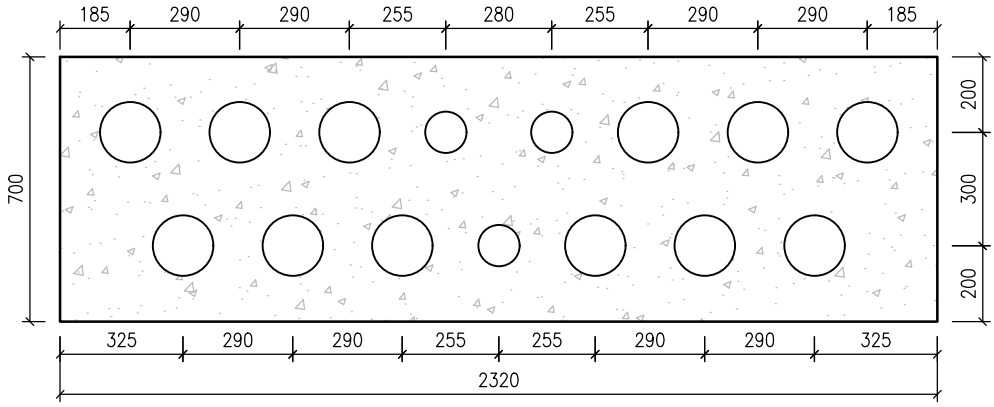
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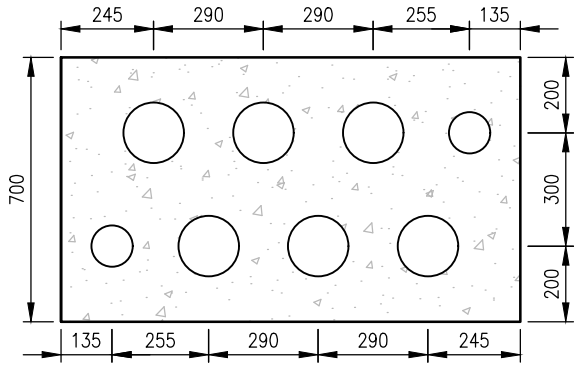
L (F160) TYPE
TO ACCOMMODATE 3 x Sc. CABLES IN FLAT
(3x110 ; 12x160)



L (F160) TYPE
TO ACCOMMODATE 6 x Sc. CABLES IN FLAT
(3x110 ; 12x160)



L F(210) TYPE
TO ACCOMMODATE 6 x Sc. CABLES FLAT
(3x110 ; 12x210)



P F(210) TYPE
TO ACCOMMODATE 6 x Sc. CABLES FLAT
(2x110 ; 6x210)

NOTES:

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2. ALL DUCTS SHALL HAVE A MINIMUM CLEARANCE OF 750mm BETWEEN ROAD SURFACE AND TOP OF DUCT/DUCT ENCASEMENT.
3. DUCTS SHALL BE ENCASED IN CONCRETE WITH A 28 DAY COMPRESSIVE STRENGTH OF 10MPa.
4. PIPE DUCTS TO BE HEAVY DUTY (SDR 34) PVC-U (SANS 791).
5. THE POSITION OF THE INSTALLED DUCTS TO BE PERMANENTLY MARKED AS DESCRIBED IN SECTION 13.5..

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

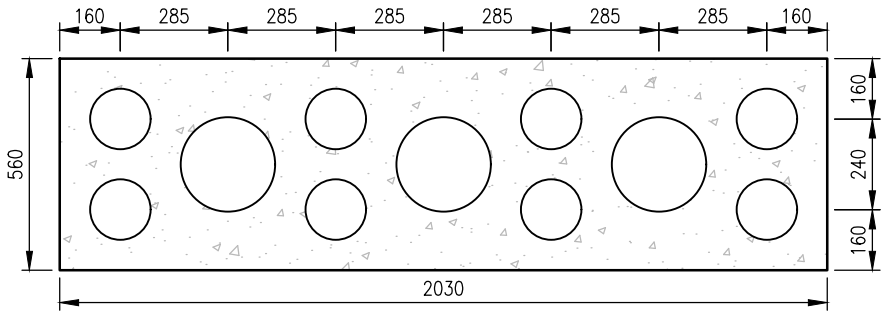
SPECIFICATIONS FOR THE INSTALLATION OF ELECTRICAL DUCTS

STANDARDS AND GUIDELINES DETAILS

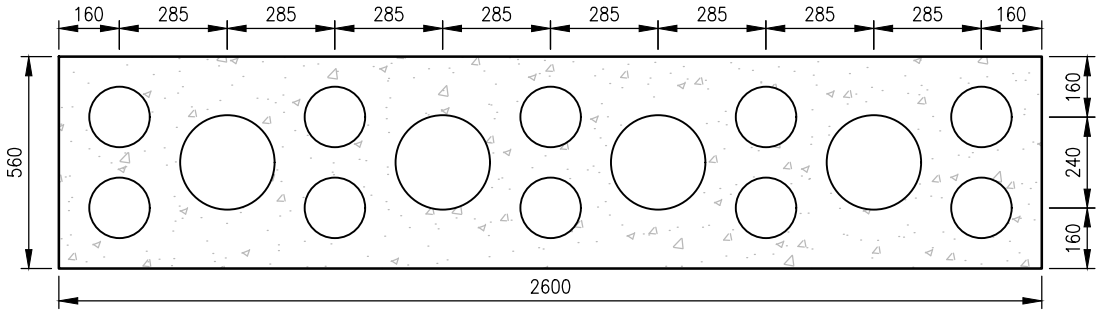
SHEET 5

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
GE6.5	B

P:\CAD\R&SD\ITL_01 Design\T_1000B Standards\T_1000RS DESIGN_Roads and Stormwater\0002 Drawings_Version4.0\04 GE\GE6.5 - Specification for Installation of Electrical Ducts_RevB.dwg



M TYPE
TO ACCOMMODATE 2 x 3 CORE CABLES
(8x160 ; 3x250)



N TYPE
TO ACCOMMODATE 2 x 3 CORE CABLES
(10x160 ; 4x250)

NOTES:

1. MINIMUM DEPTH OF SERVICE BELOW FINISHED ROAD LEVEL AS PER SECTION 13.2.
2. ALL DUCTS SHALL HAVE A MINIMUM CLEARANCE OF 750mm BETWEEN ROAD SURFACE AND TOP OF DUCT/DUCT ENCASEMENT.
3. DUCTS SHALL BE ENCASED IN CONCRETE WITH A 28 DAY COMPRESSIVE STRENGTH OF 10MPa.
4. PIPE DUCTS TO BE HEAVY DUTY (SDR 34) PVC-U (SANS 791).
5. THE POSITION OF THE INSTALLED DUCTS TO BE PERMANENTLY MARKED AS DESCRIBED IN SECTION 13.5..

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

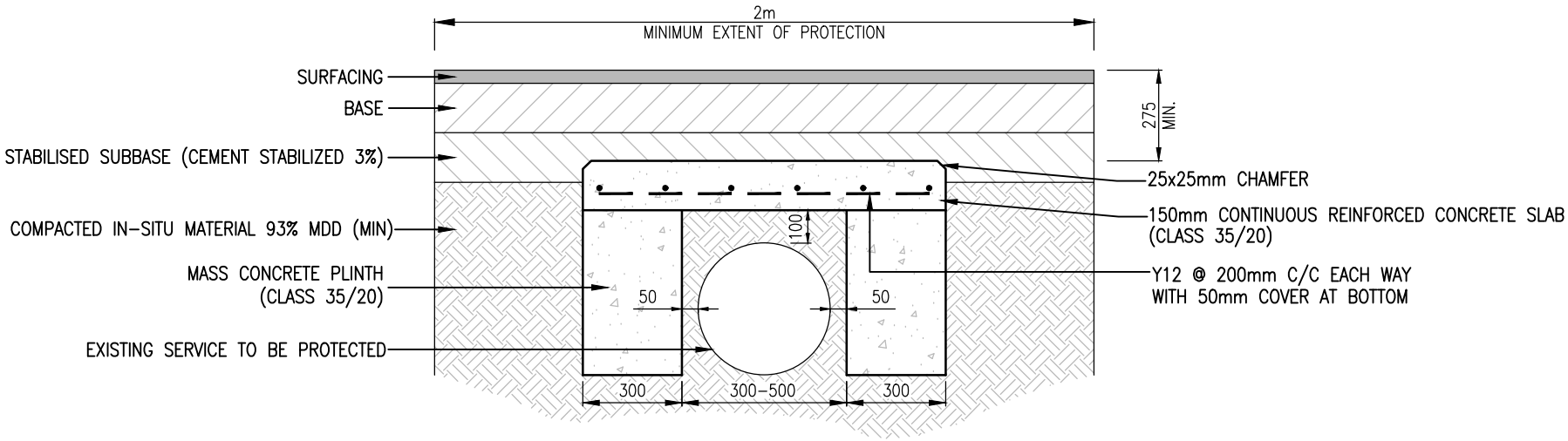
SPECIFICATIONS FOR THE INSTALLATION OF ELECTRICAL DUCTS

STANDARDS AND GUIDELINES DETAILS

SHEET 6

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
GE6.6	B

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NOTES:

1. LOW TONNAGE ROLLER TO BE USED ON BASE AND SUBBASE LAYERS, IN ORDER TO PROTECT STRUCTURE.

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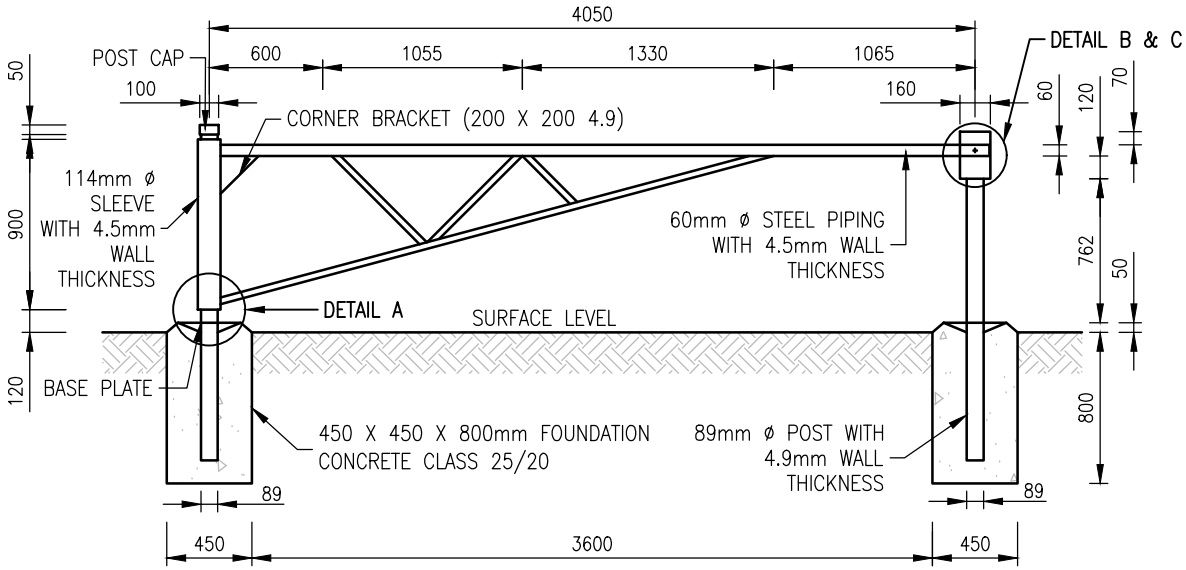
TITLE

PROTECTION OF EXISTING SERVICES IN ROADWAY

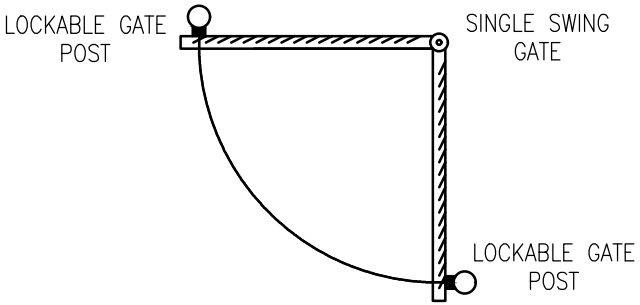
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
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DRAWING No.	REV
GE7	B

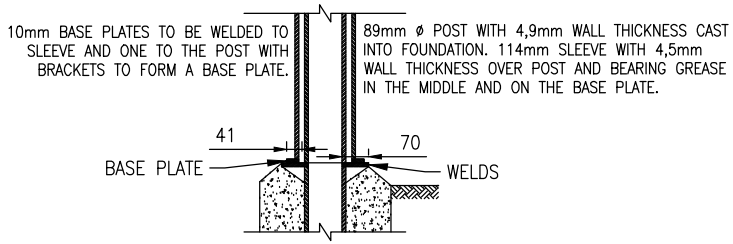
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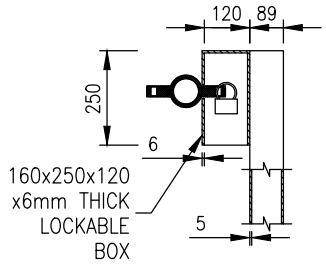
PLAN
SCALE 1:40



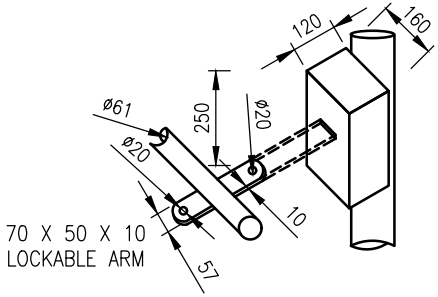
TOP VIEW
SCALE 1:30



DETAIL A
SCALE 1:20



DETAIL B
SCALE 1:20



DETAIL C
SCALE 1:20

NOTES:

1. ALL STEEL TO BE HOT-DIP GALVANISED AFTER WELDING.
2. NO WELDING ALLOWED AFTER HOT-DIP GALVANISING.

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URBAN MOBILITY

TITLE

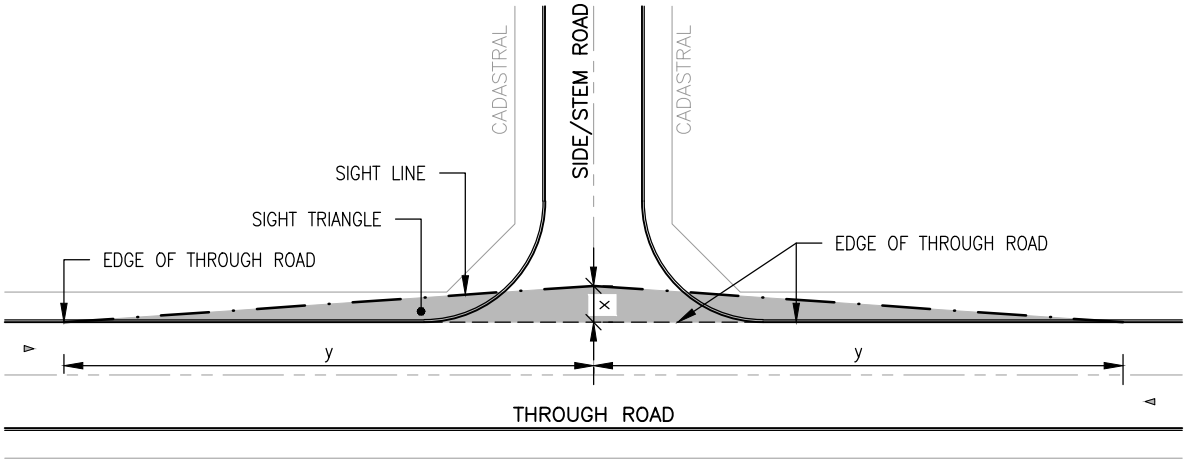
SWING GATE

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
SHOWN	A4
DRAWING No.	REV
GE8	B

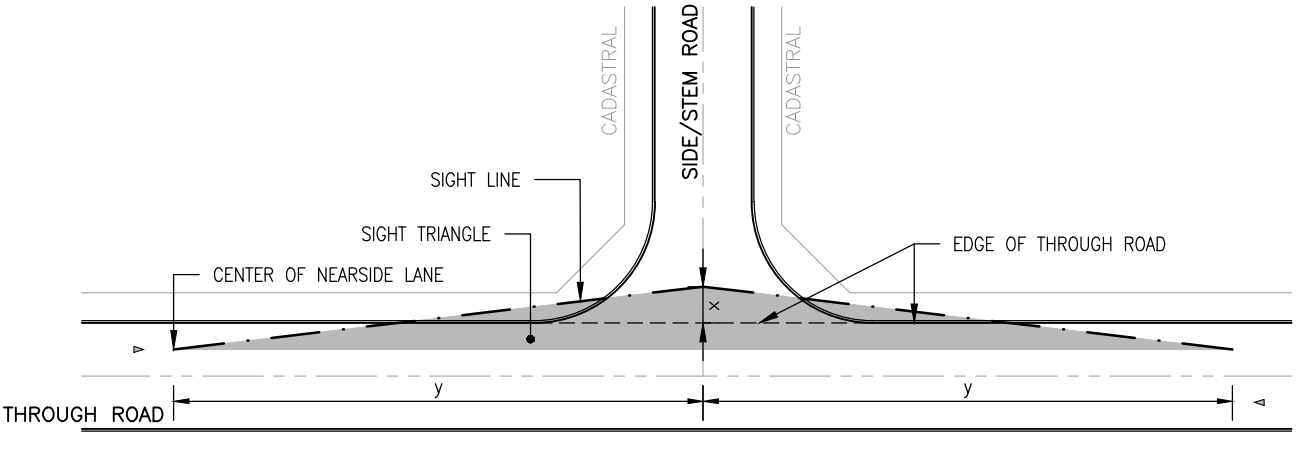
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THROUGH ROAD CLASS/TYPE	DIMENSIONS (M)	
	x	y
MAJOR RESIDENTIAL ACCESS LINK	2.4	45
RESIDENTIAL ACCESS LOOP/CUL-DE-SAC	2.4	35



SIGHT TRIANGLES FOR URBAN LOCAL RESIDENTIAL STREETS (UTG7)

THROUGH ROAD CLASS/TYPE	YIELD CONTROL		STOP CONTROL	
	x	y	x	y
REGIONAL SHOPPING CENTRES/SINGLE SITE COMMERCIAL DEVELOPMENTS	9	55	2.4	45
INDUSTRIAL TOWNSHIPS/PARKS	9	90	4.5	90
OFFICE/SCIENCE PARKS	9	55	2.4	45
TRUCK PARKS/TRANSSHIPMENT CENTRES/WAREHOUSING	9	75	4.5	55
EXHIBITION CENTRES/THEME PARKS/SPORTS CENTRES AND STADIA	9	55	2.4	45
CENTRAL AND SUBURBAN/REGIONAL BUSINESS AREAS	9	55	2.4	45



SIGHT TRIANGLES FOR INDUSTRIAL/COMMERCIAL DEVELOPMENTS (UTG10)

NOTES:

1. SIGHT TRIANGLES AND INFORMATION BASED ON THE REQUIREMENTS OF UTG7 AND UTG10.

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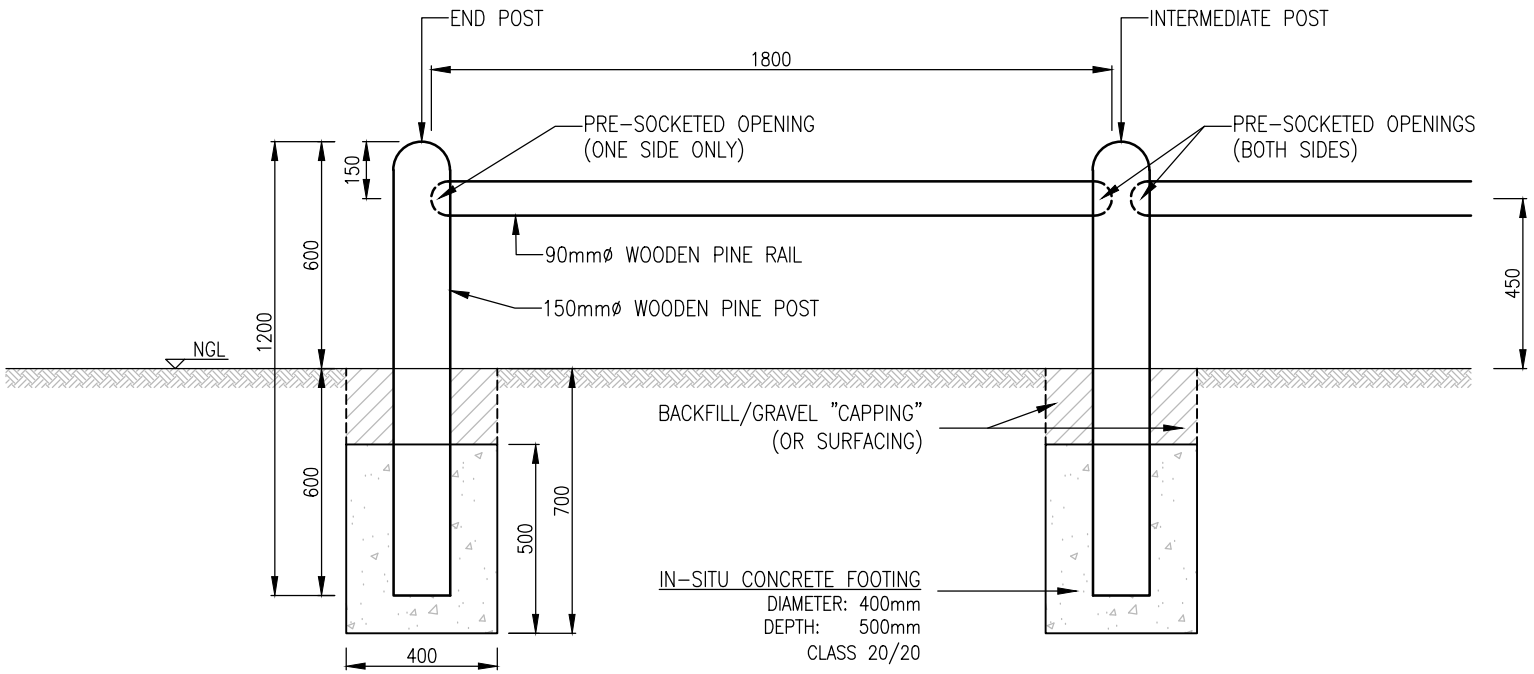
TITLE

SIGHT TRIANGLES FOR LOWER & MIDDLE ORDER ROADS

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
N.T.S.	A4
DRAWING No.	REV
GE9	A

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NOTES:

1. TIMBER POSTS:
   - 150mm DIAMETER LATHE TURNED AND TANALITH TREATED PINE, WITH A LENGTH OF AS SPECIFIED.
   - PRE-SOCKETED OPENINGS. END POST TO BE PRE-SOCKETED ON ONE SIDE ONLY.
   - PLANTED 600mm DEEP, REGARDLESS OF FENCE TYPE (i.e. SINGLE OR DOUBLE RAIL).
2. TIMBER RAIL:
   - 90mm DIAMETER LATHE TURNED AND TANALITH TREATED PINE, WITH A LENGTH OF 1.8m.

CITY OF CAPE TOWN
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CITY OF CAPE TOWN
URBAN MOBILITY

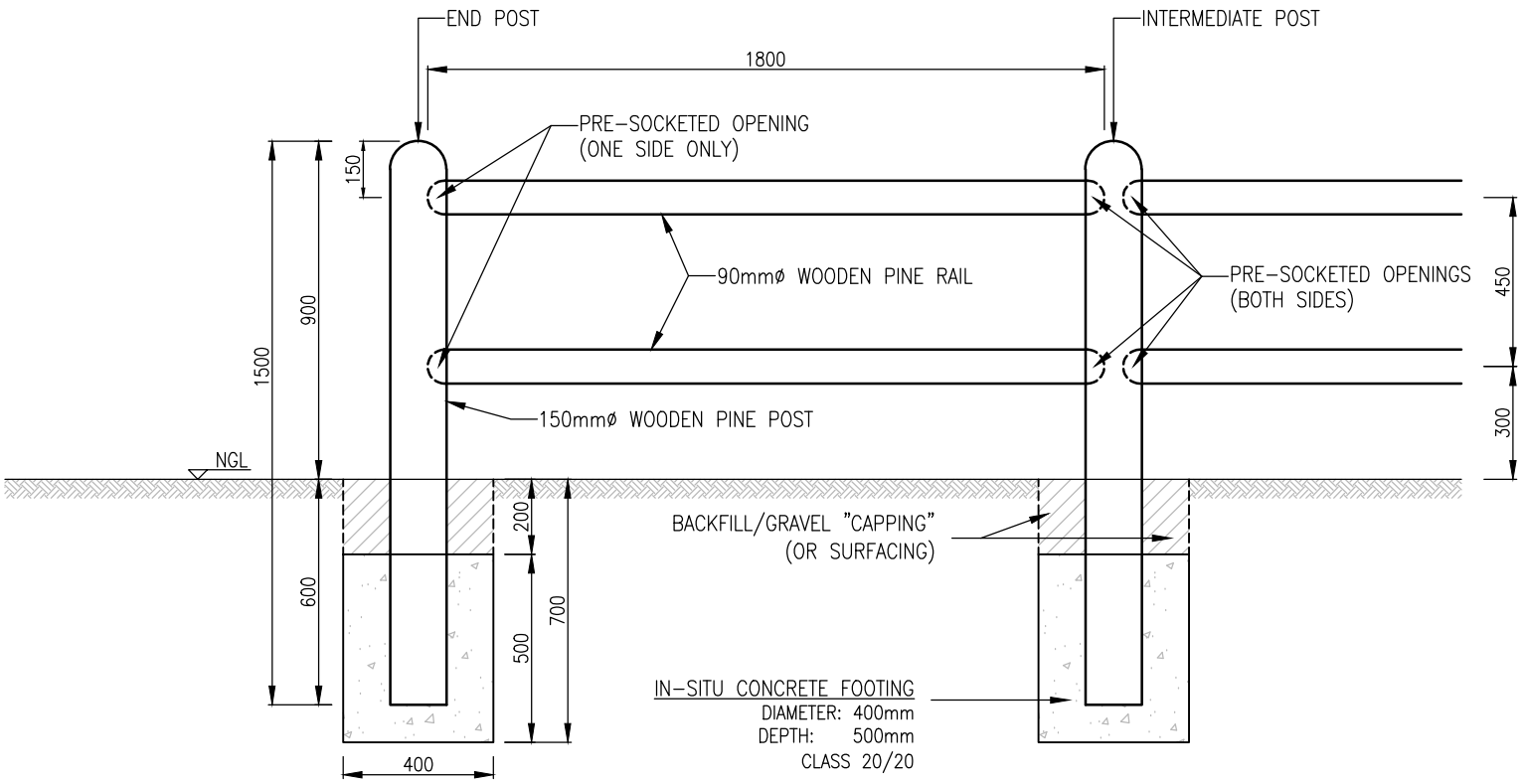
TITLE

TIMBER POST AND RAIL (RANCH) FENCING: SINGLE RAIL

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:20	A4
DRAWING No.	REV
GE10.1	B

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NOTES:

1. TIMBER POSTS:
   - 150mm DIAMETER LATHE TURNED AND TANALITH TREATED PINE, WITH A LENGTH OF AS SPECIFIED.
   - PRE–SOCKETED OPENINGS. END POST TO BE PRE–SOCKETED ON ONE SIDE ONLY.
   - PLANTED 600mm DEEP, REGARDLESS OF FENCE TYPE (i.e. SINGLE OR DOUBLE RAIL).
2. TIMBER RAIL:
   - 90mm DIAMETER LATHE TURNED AND TANALITH TREATED PINE, WITH A LENGTH OF 1.8m.

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

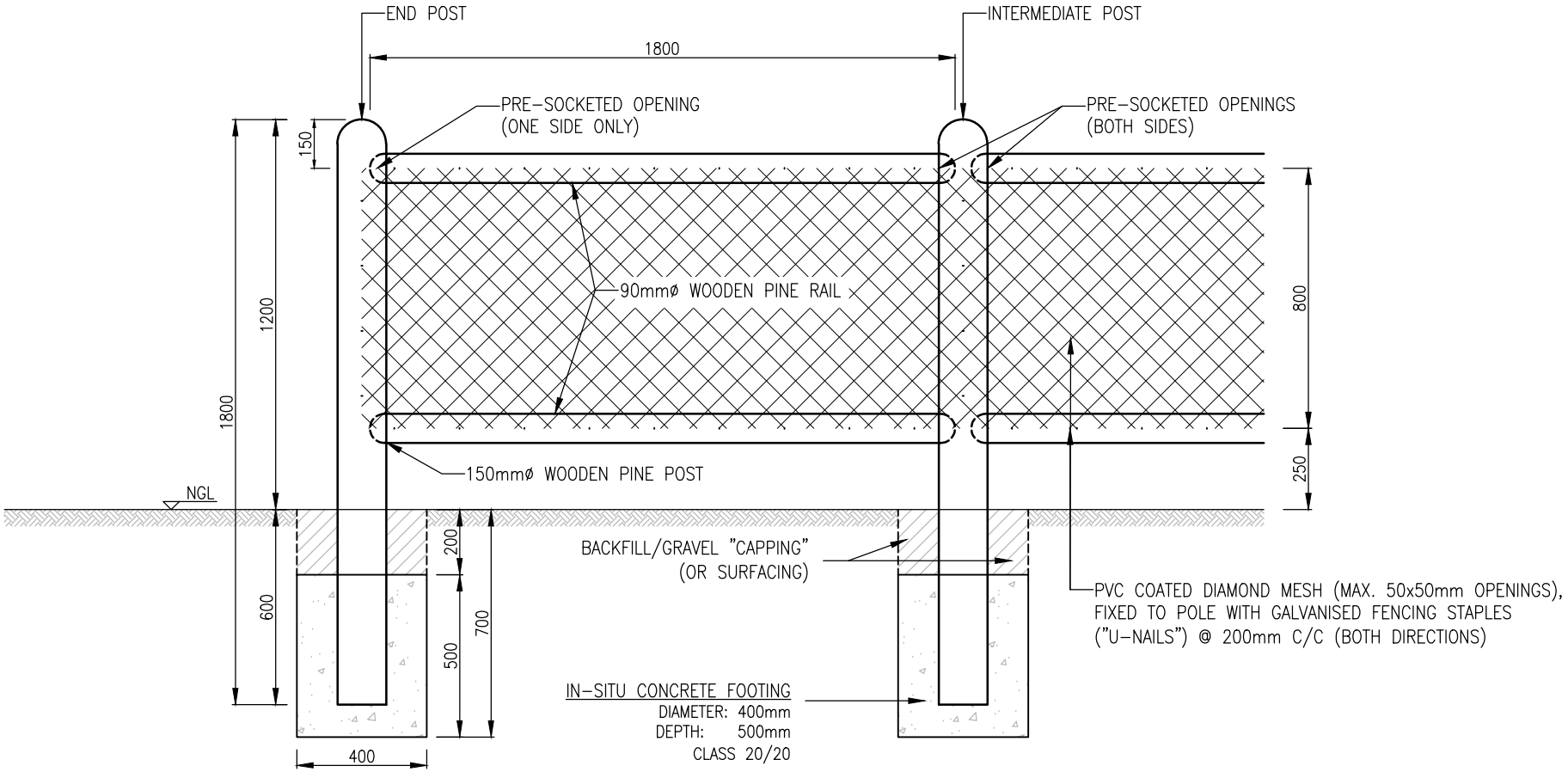
CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

TIMBER POST AND RAIL (RANCH) FENCING: DOUBLE RAIL

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:20	A4
DRAWING No.	REV
GE10.2	B



NOTES:

1. TIMBER POSTS:
   - 150mm DIAMETER LATHE TURNED AND TANALITH TREATED PINE, WITH A LENGTH OF AS SPECIFIED.
   - PRE–SOCKETED OPENINGS. END POST TO BE PRE–SOCKETED ON ONE SIDE ONLY.
   - PLANTED 600mm DEEP, REGARDLESS OF FENCE TYPE (i.e. SINGLE OR DOUBLE RAIL).
2. TIMBER RAIL:
   - 90mm DIAMETER LATHE TURNED AND TANALITH TREATED PINE, WITH A LENGTH OF 1.8m.

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

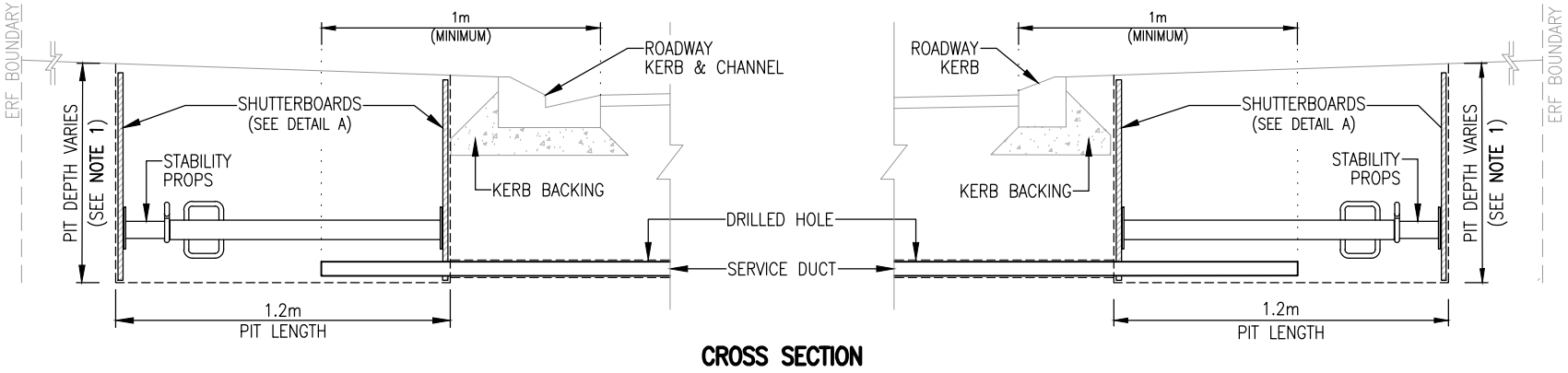
TITLE

TIMBER POST AND RAIL (RANCH) FENCING: DOUBLE RAIL WITH MESH PROTECTION

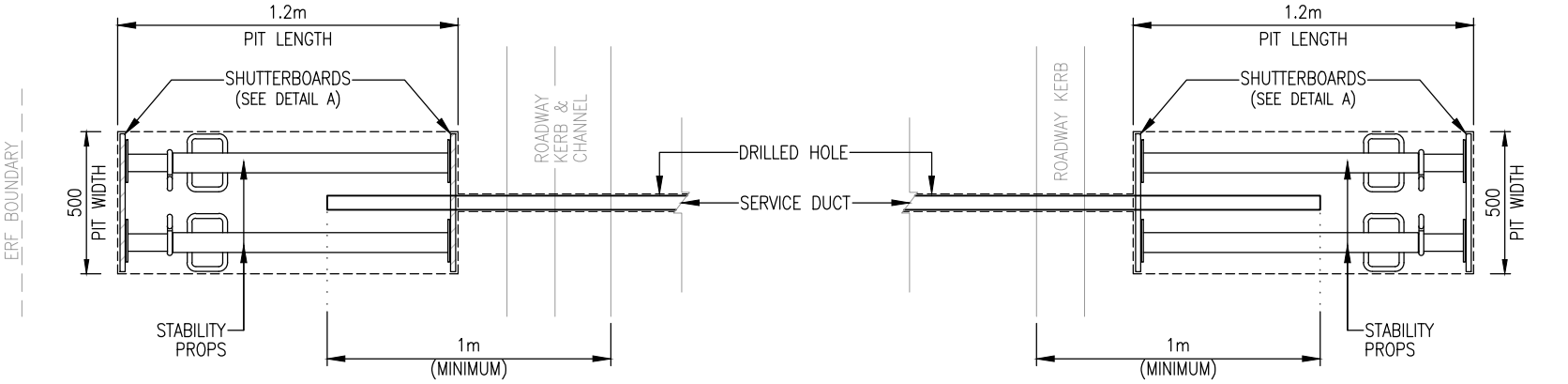
STANDARDS AND GUIDELINES DETAILS

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DRAWING No.	REV
GE10.3	B

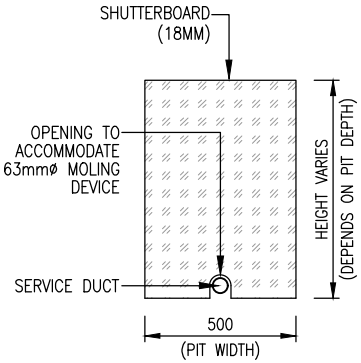
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CROSS SECTION



PLAN VIEW



DETAIL A: SHUTTERBOARD

NOTES:

1. A PIT DEPTH OF 1m IS PREFERRED, WITH A MINIMUM DEPTH OF 600mm (PROVIDED THAT THE MOLING IS UNDERNEATH THE ROAD LAYER WORKS).

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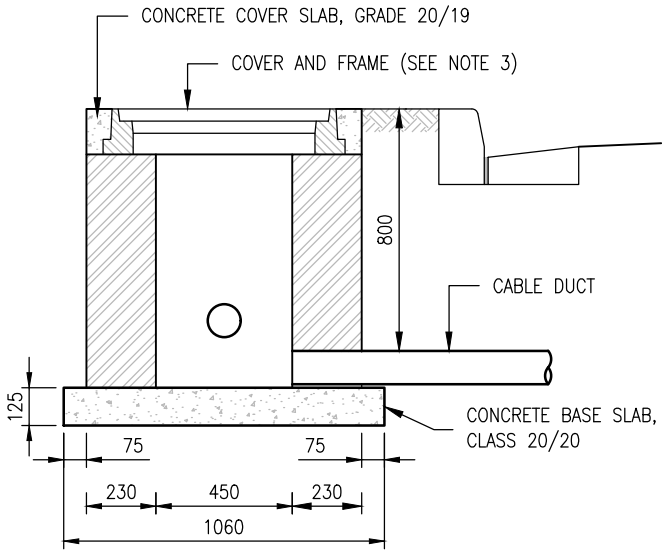
TITLE

PNEUMATIC HORIZONTAL BORING ("MOLING")

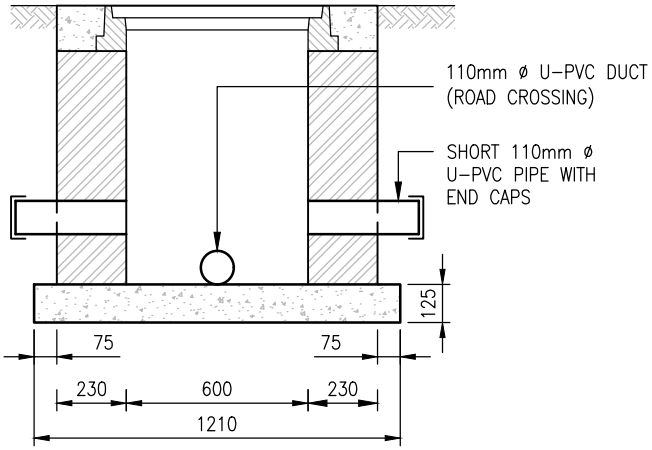
STANDARDS AND GUIDELINES DETAILS

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DRAWING No.	REV
GE11	A

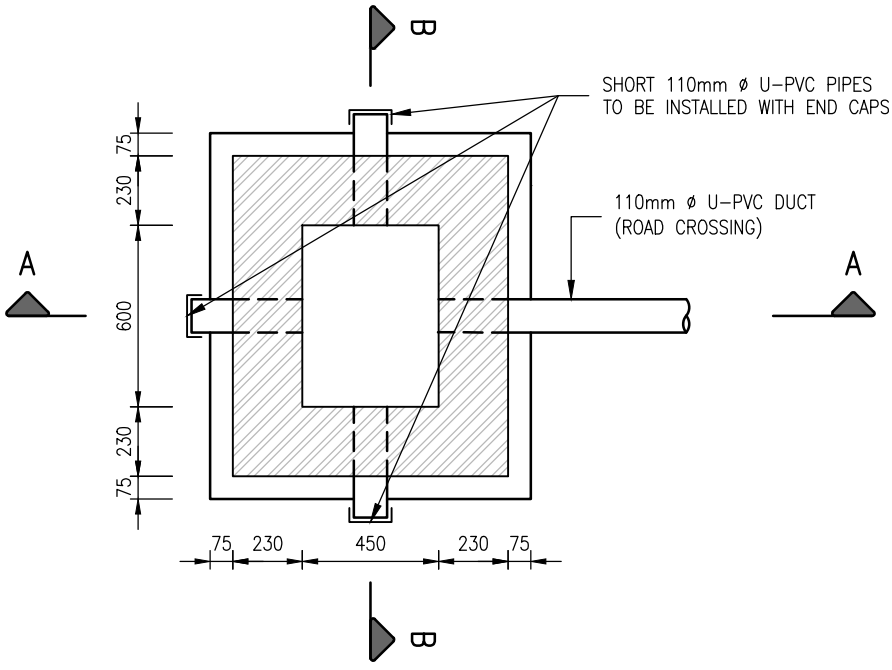
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SECTION A–A



SECTION B–B



SECTIONAL PLAN VIEW

NOTES:

1. BRICKWORK: SEE SECTION 10.4.10 "SPECIFICATIONS FOR MASONRY UNITS".
2. MANHOLES ONLY ALLOWED ON FOOTWAYS AND VERGES (NOT IN ROADWAYS).
3. MANHOLE COVER AND FRAME SHALL BE AS PER THE REQUIREMENTS OF THE CITY'S TRAFFIC SIGNALS DEPARTMENT.

NGL: NATURAL GROUND LEVEL
FRL: FINISHED ROAD LEVEL
FSL: FINISHED SURFACE LEVEL

CITY OF CAPE TOWN
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STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

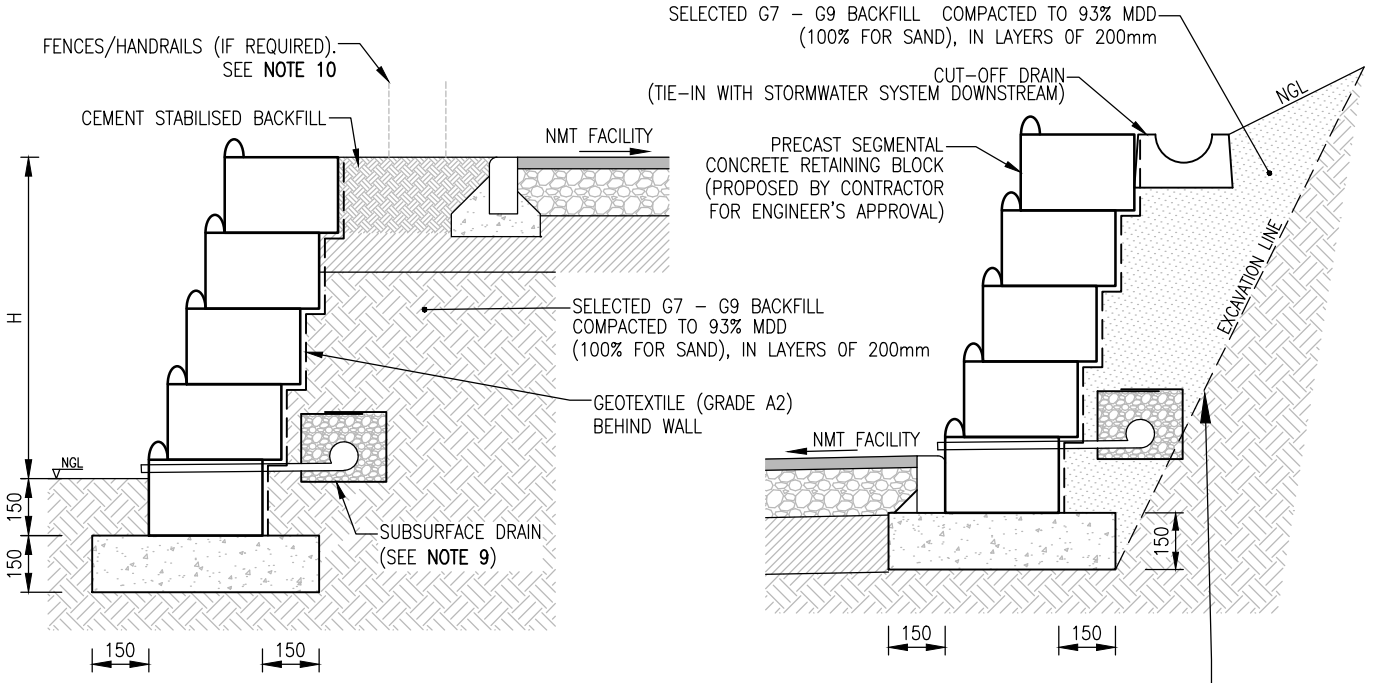
TITLE

CABLE INSPECTION MANHOLE FOR TRAFFIC SIGNAL SERVICES

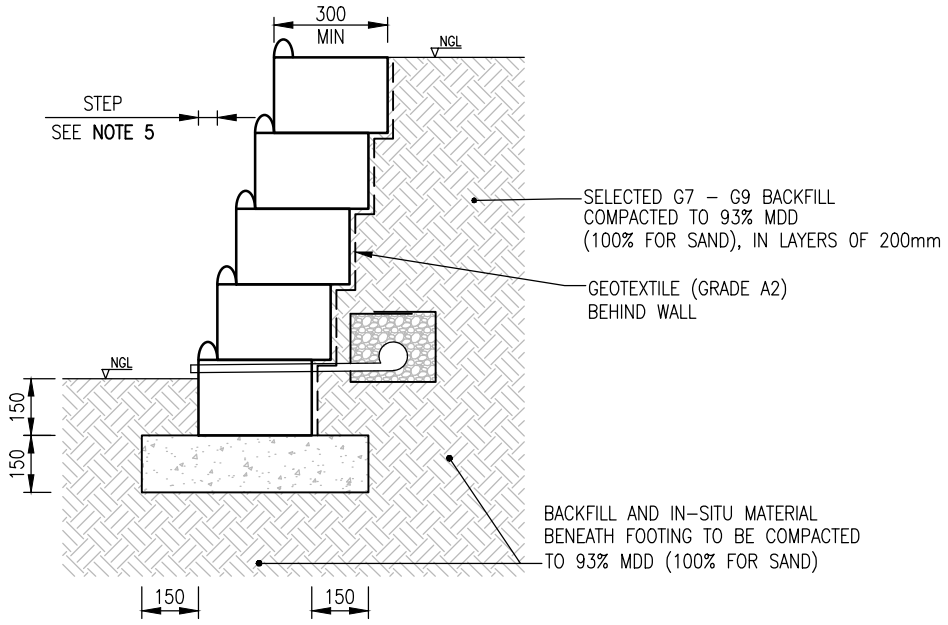
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
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DRAWING No.	REV
GE12	C

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APPLICATION ALONG NMT FACILITIES



GENERAL APPLICATION

NGL: NATURAL GROUND LEVEL
FSL: FINISHED SURFACE LEVEL

NOTES:

1. THE ABOVE DETAILS SHOULD BE CONSIDERED TYPICAL. SPECIFICATIONS MAY DIFFER, SHOULD SITE SPECIFIC CONDITIONS REQUIRE IT.
2. ALL BLOCKS TO COMPLY TO SANS 508:2020.
3. THE BLOCK WALL SHOULD PREFERABLY HAVE A CLOSED FACE CONFIGURATION AND A SEGMENTAL BUILD-IN NIB. IF NO NIB IS PRESENT, GRANULAR STONE WILL BE USED AS INFILL TO ENSURE INTERLOCK.
4. THIS DETAIL SHALL ONLY BE APPLICABLE FOR BLOCK RETAINING STRUCTURES WITH A VERTICAL HEIGHT OF UP TO 800mm WITH VERTICAL CREST AND 400mm WITH CREST SLOPE.
5. FOR WALLS HIGHER THAN THOSE IN NOTE 4, THE WALLS SHALL BE DESIGNED BY A PROFESSIONAL ENGINEER. DESIGN BY SUPPLIER SHALL NOT BE PERMITTED BEFORE TENDER.
6. BLOCKS SHALL EITHER BE FILLED WITH CONCRETE OR SUITABLE GRANULAR MATERIAL. THE APPROVAL AUTHORITY TO PROVIDE GUIDANCE IN THIS REGARD.
7. FOOTING SHALL CONSIST OF A COMPACTED BASE (1 CEMENT : 2 SAND : 3 STONE), UNLESS ADVISED OTHERWISE.
8. HORIZONTAL STEP/SETBACK SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS, BUT SHOULD NEVER BE LESS THAN 50mm.
9. SUBSURFACE DRAIN: 75ø HDPE DOUBLE WALLED SLOTTED PIPE (SLOTS AT TOP), WITH 20ø WEEPHOLES @ 2m c/c. PIPE TO BE SURROUNDED WITH 13mm CRUSHED STONE, WRAPPED INSIDE A GEOTEXTILE (GRADE A2). FOR HIGHER GROUND WATER, SEE NCMA MANUAL FOR SEGMENTAL RETAINING WALLS. FOR WALLS LOWER THAN 400mm IN HEIGHT, SUBSURFACE DRAINS MAY BE OMITTED.
10. WHERE THE VERTICAL HEIGHT/DROP EXCEEDS 500mm, FENCES AND/OR HANDRAILS SHALL BE PROVIDED BEHIND THE EDGING, IN ORDER TO ENSURE PUBLIC SAFETY.

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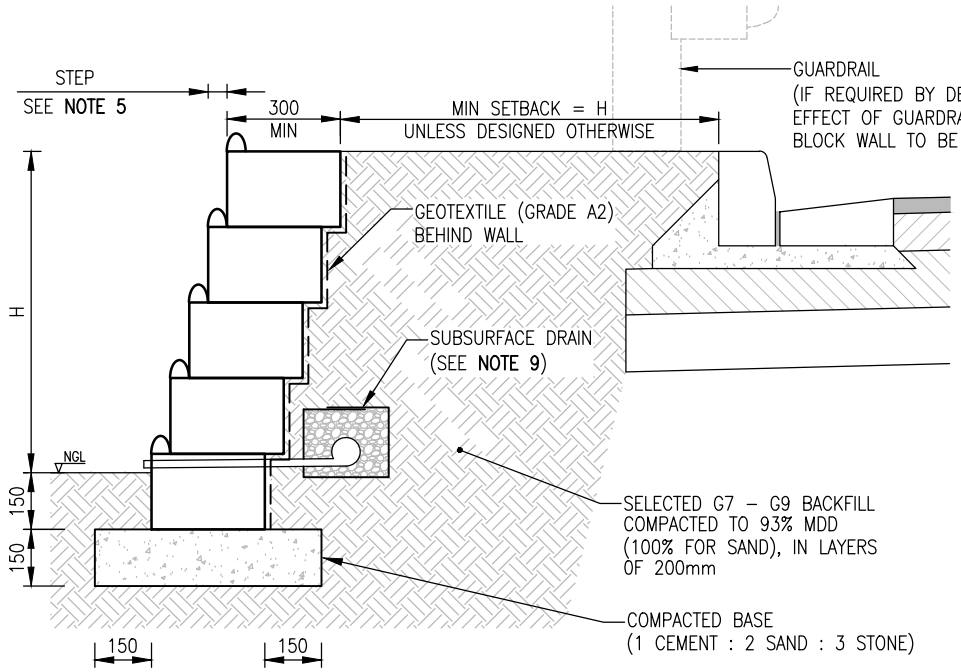
TITLE

SINGLE SEGMENTAL BLOCK RETAINING WALL ALONG NMT FACILITIES & GENERAL

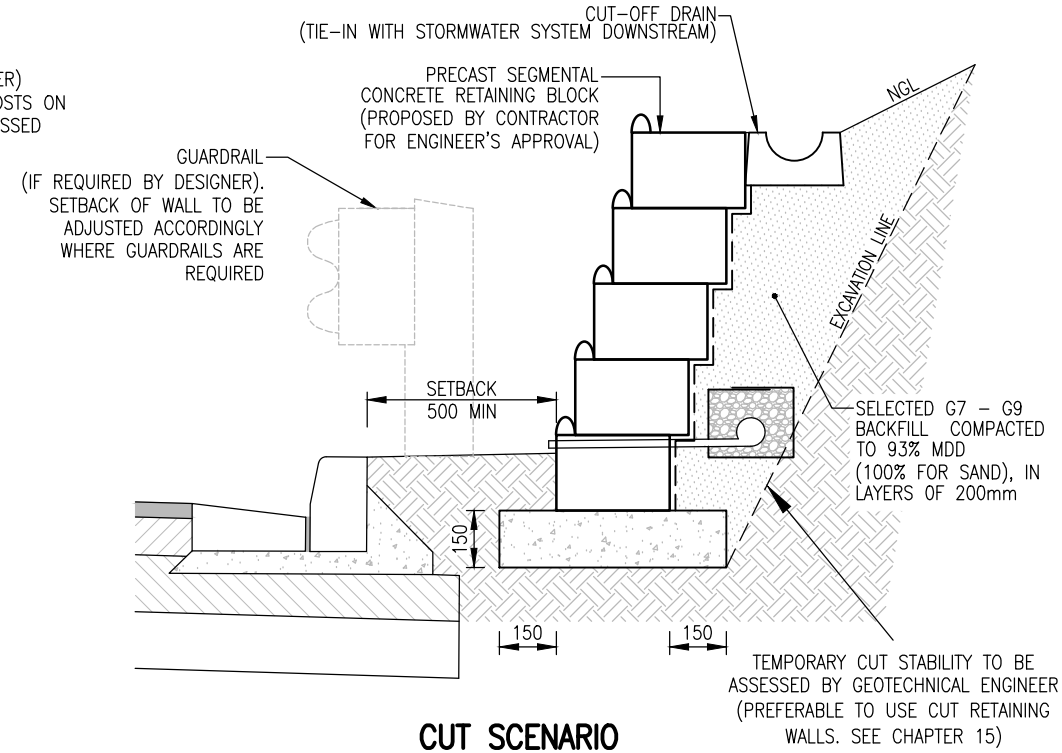
STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:10	A4
DRAWING No.	REV
GE13.1	A

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FILL SCENARIO



CUT SCENARIO
NOT PREFERRED

APPLICATION ALONG ROADWAYS
(NO NMT FACILITIES PRESENT)

NOTES:

1. THE ABOVE DETAILS SHOULD BE CONSIDERED TYPICAL. SPECIFICATIONS MAY DIFFER, SHOULD SITE SPECIFIC CONDITIONS REQUIRE IT.
2. ALL BLOCKS TO COMPLY TO SANS 508:2020.
3. THE BLOCK WALL SHOULD PREFERABLY HAVE A CLOSED FACE CONFIGURATION AND A SEGMENTAL BUILD–IN NIB. IF NO NIB IS PRESENT, GRANULAR STONE WILL BE USED AS INFILL TO ENSURE INTERLOCK.
4. THIS DETAIL SHALL ONLY BE APPLICABLE FOR BLOCK RETAINING STRUCTURES WITH A VERTICAL HEIGHT OF UP TO 800mm WITH VERTICAL CREST AND 400mm WITH CREST SLOPE.
5. FOR WALLS HIGHER THAN THOSE IN NOTE 4, THE WALLS SHALL BE DESIGNED BY A PROFESSIONAL ENGINEER. DESIGN BY SUPPLIER SHALL NOT BE PERMITTED BEFORE TENDER.
6. BLOCKS SHALL EITHER BE FILLED WITH CONCRETE OR SUITABLE GRANULAR MATERIAL. THE APPROVAL AUTHORITY TO PROVIDE GUIDANCE IN THIS REGARD.
7. FOOTING SHALL CONSIST OF A COMPACTED BASE (1 CEMENT : 2 SAND : 3 STONE), UNLESS ADVISED OTHERWISE.
8. HORIZONTAL STEP/SETBACK SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS, BUT SHOULD NEVER BE LESS THAN 50mm.
9. SUBSURFACE DRAIN: 75ø HDPE DOUBLE WALLED SLOTTED PIPE (SLOTS AT TOP), WITH 20ø WEEPHOLES @ 2m c/c. PIPE TO BE SURROUNDED WITH 13mm CRUSHED STONE, WRAPPED INSIDE A GEOTEXTILE (GRADE A2). FOR HIGHER GROUND WATER, SEE NCMA MANUAL FOR SEGMENTAL RETAINING WALLS. FOR WALLS LOWER THAN 400mm IN HEIGHT, SUBSURFACE DRAINS MAY BE OMITTED.

NGL: NATURAL GROUND LEVEL
FSL: FINISHED SURFACE LEVEL

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY OF CAPE TOWN
URBAN MOBILITY

TITLE

SINGLE SEGMENTAL BLOCK RETAINING WALL ALONG ROADWAYS

STANDARDS AND GUIDELINES DETAILS

SCALE	PAPER
1:10	A4
DRAWING No.	REV
GE13.2	A

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PART C

MAPS

List of Maps

Map Title		Description
CCT:	**RIM DISTRICTS**	Roads and Stormwater district areas and boundaries
CCT:	**Non-Motorised Transport (NMT) Network Plan Cycle Routes, City of Cape Town Metropolitan**	Illustration and status of the City's NMT cycle routes network (existing and proposed)
CCT:	**Public Right of Way, Road Network (Metropolitan Area)**	Classification of roads in the City of Cape Town metropolitan area
WCG:	**Assignment of Roads in City of Cape Town Area**	Status of proclaimed roads in the City of Cape Town metropolitan area with regards to Road Authority (ownership)
WCG:	**City of Cape Town – National, Trunk, Main, Divisional & Minor Road Network**	Status of road network in the City of Cape Town metropolitan area and surrounds

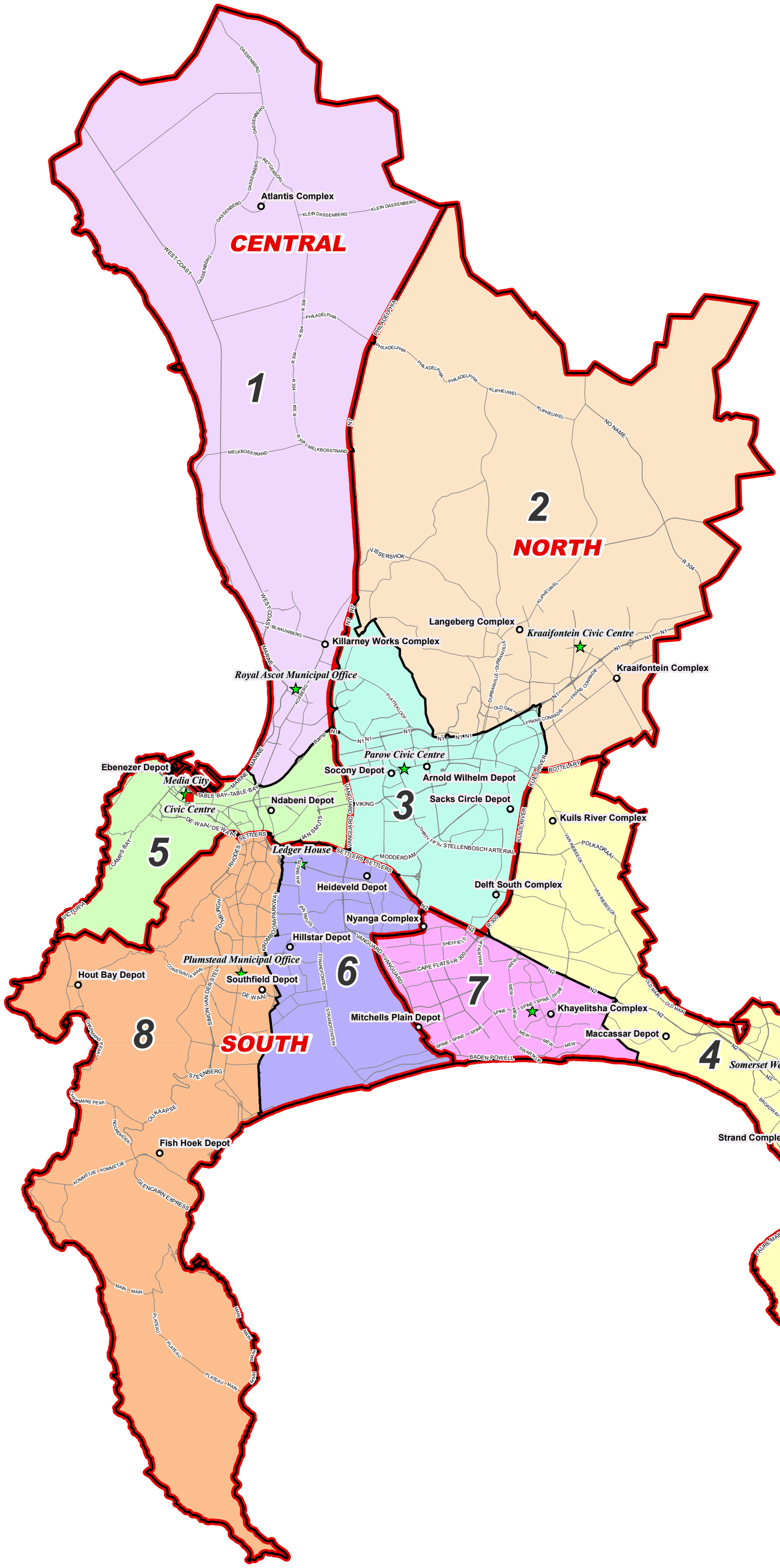
To: ***Document Structure***

Roads Infrastructure Management - District Contact Details

Management			
Director: Roads Infrastructure Management	Hilton Scholtz	021 444 7619	Hilton.Scholtz@capetown.gov.za
Manager: Operations, Assets and Performance	Moegamat Adams	021 400 1113	Moegamat.Adams@capetown.gov.za
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Area Manager: East (Districts 4 & 7)	Odwa Gabuza	021 444 4699	Odwa.Gabuza@capetown.gov.za
Area Manager: North (Districts 2 & 3)	Johan Snyman	021 400 1112	Johan.Snyman@capetown.gov.za
Area Manager: South (Districts 6 & 8)	Jade Oliver	021 400 1399	Jade.Oliver@capetown.gov.za

District Office Locations		
District 1	Blaauwberg	Royal Ascot Municipal Office, Bridal Way, Milnerton
District 2	Kraaifontein	Kraaifontein Civic Centre, Brighton Road, Kraaifontein
District 3	Bellville	Parow Civic Centre, c/o Voortrekker Road & Tallent Street, Parow
District 4	Somerset West	Somerset West Municipal Office, c/o Andries Pretorious & Victoria Streets, Somerset West
District 5	Cape Town	Media City, c/o Vasco da Gama & Heerengracht, Cape Town
District 6	Athlone	Ledger House, c/o Aden & Beverley Streets, Athlone
District 7	Khayelitsha	Stocks & Stocks Building, Ntlakhohlaza Street, Khayelitsha
District 8	Plumstead	Plumstead Municipal Office, Victoria Road, Plumstead

District Contact Details				
District 1 Blaauwberg	District Manager	Gilbert Titus	021 444 5763	GilbertGawain.Titus@capetown.gov.za
	Development Facilitation & Design	Shamiel Thomas	021 444 5770	Shamiel.Thomas@capetown.gov.za
	Infrastructure Maintenance	Robin Janse	021 444 5766	Robin.Janse@capetown.gov.za
	Wayleaves & Permits	Thelela Hilary Ncanywa Ullrich van Staden	021 444 0014 021 444 1587	Roads.Blaauwberg@capetown.gov.za
	Existing Services Information (GIS)	Simphiwe Vanqa	021 444 5771	Simphiwe.Vanqa@capetown.gov.za
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	Existing Services Information (GIS)	Sinclair Witbooi	021 400 7193	Sinclair.Witbooi@capetown.gov.za
District 3 Bellville	District Manager	Jeanine du Preez	021 444 7108	Jeanine.duPreez@capetown.gov.za
	Development Facilitation & Design	Louise du Toit	021 444 7118	Louise.duToit@capetown.gov.za
	Infrastructure Maintenance	Deon Botha	021 444 7109	Deon.Botha@capetown.gov.za
	Wayleaves & Permits	Leandra Manefeldt Necole Butler	021 444 7106 021 444 7128	Leandra.Manefeldt@capetown.gov.za Necole.Butler@capetown.gov.za
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District 4 Somerset West	District Manager	Heuppschenne Lekay	021 444 3252	Heuppschenne.Lekay@capetown.gov.za
	Development Facilitation & Design	Roauwhen Thomas	021 444 4695	Roauwhen.Thomas@capetown.gov.za
	Infrastructure Maintenance	Leon de Goede	021 444 4686	Leon.DeGoede@capetown.gov.za
	Wayleaves & Permits	Cordelia Mgabadeli	021 417 2015	Roads.SomersetWest@capetown.gov.za
	Existing Services Information (GIS)	Cordelia Mgabadeli Transport GIS	021 417 201 021 400 3485	Cordelia.Mgabadeli@capetown.gov.za TransportGIS.Support@capetown.gov.za
District 5 Cape Town	District Manager	Brendon Abrahams	021 400 6426	BrendonMarlon.Abrahams@capetown.gov.za
	Development Facilitation & Design	Henno van Graan	021 400 6431	HendrikC.VanGraan@capetown.gov.za
	Infrastructure Maintenance	William Douries	021 400 6425	William.Douries@capetown.gov.za
	Wayleaves & Permits	Xolisa Ngwcenga	021 400 2256	Roads.CapeTown@capetown.gov.za
	Existing Services Information (GIS)	Andile Zigoxo	021 400 2948	Andile.Zigoxo@capetown.gov.za
District 6 Athlone	District Manager	Grant Rigby	021 684 4389	Grant.Rigby@capetown.gov.za
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	Infrastructure Maintenance	Thandeka Dukhwe	021 400 6428	Thandeka.Dukhwe@capetown.gov.za
	Wayleaves & Permits	Lana Roodt Zoleka Mapundu	021 400 3183 021 684 4358	Roads.Athlone@capetown.gov.za
	Existing Services Information (GIS)	Zahir Parker	021 400 1916	ZahirAllie.Parker@capetown.gov.za
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	Development Facilitation & Design	Gregg Faulmann	021 360 1178	Gregg.Faulmann@capetown.gov.za
	Infrastructure Maintenance	Rushdi Brown	021 360 1129	Rushdi.Brown@capetown.gov.za
	Wayleaves & Permits	Noludwe Tchongwang	021 360 1104	Roads.Khayelitsha@capetown.gov.za
	Existing Services Information (GIS)	Sikhulule Noliroto	021 400 1351	Sikhulule.Noliroto@capetown.gov.za
District 8 Plumstead	District Manager	-	-	-
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	Infrastructure Maintenance	Enrico Bell	021 400 5382	Enrico.Bell@capetown.gov.za
	Wayleaves & Permits	Riyahna Esau Zethu Sinxeke	021 444 3255 021 400 3257	Roads.Plumstead@capetown.gov.za
	Existing Services Information (GIS)	Tohira West Roland Lewin	021 400 1413 021 400 7600	Tohira.West@capetown.gov.za Roland.Lewin@capetown.gov.za



CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

DIRECTORATE : Urban Mobility
DEPARTMENT : Roads Infrastructure Management

Title

RIM Districts

Version: 5.3
Publish Date: 02 Sep 2024

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Daneel.DuToit@capetown.gov.za

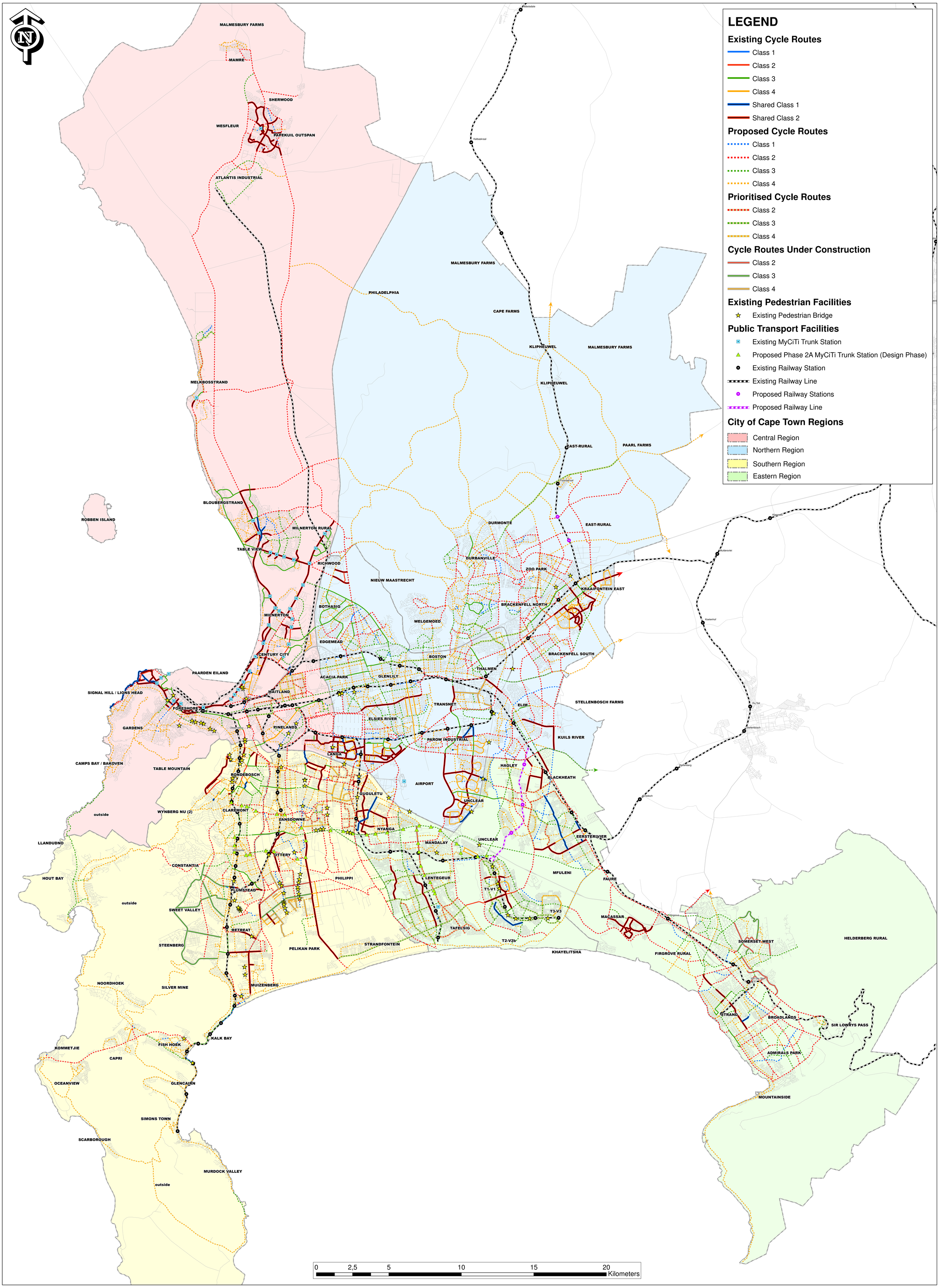
Spheroid
WGS84
Projection
Transverse Mercator
Datum
Hartebeesthoek 1994
Central Meridian
21 Degrees

N W E S

1:200 000 @ A2

Disclaimer

The City of Cape Town makes no warranties as to the correctness of the information provided. The information is considered correct at the time of publication and is subject to change thereafter. Persons relying on this information do so entirely at their own risk.



LEGEND

Existing Cycle Routes
- Class 1
- Class 2
- Class 3
- Class 4
- Shared Class 1
- Shared Class 2

Proposed Cycle Routes
- Class 1
- Class 2
- Class 3
- Class 4

Prioritised Cycle Routes
- Class 2
- Class 3
- Class 4

Cycle Routes Under Construction
- Class 2
- Class 3
- Class 4

Existing Pedestrian Facilities
- Existing Pedestrian Bridge

Public Transport Facilities
- Existing MyCiTi Trunk Station
- Proposed Phase 2A MyCiTi Trunk Station (Design Phase)
- Existing Railway Station
- Existing Railway Line
- Proposed Railway Stations
- Proposed Railway Line

City of Cape Town Regions
- Central Region
- Northern Region
- Southern Region
- Eastern Region

TDA CAPE TOWN
The City of Cape Town's Transport and Urban Development Authority

Project:
REVIEW AND UPDATE OF THE CITYWIDE NON-MOTORISED TRANSPORT NETWORK PLAN FOR THE CITY OF CAPE TOWN

Description:
NON-MOTORISED TRANSPORT (NMT) NETWORK PLAN CYCLE ROUTES

CITY OF CAPE TOWN METROPOLITAN

Scale:
1: 80 000 @ A0

Date:
JULY 2017

Figure No.:
-

Legend

- Class 1: Principal Arterial
- Class 2: Major Arterial
- Class 3: Minor Arterial
- Class 4: Collector
- Class 5: Local Street
- Class 1: Proposed Principal Arterial
- Class 2: Proposed Major Arterial
- Class 3: Proposed Minor Arterial
- Class 4: Proposed Collector

Future Interchanges

- Access (No. of ramps)
- Systems (No. of ramps)
- Road over Road
- Road Closure
- Existing Railway Stations
- Proposed Rail Stations
- Railway Line
- Proposed Railway Line
- IRT Route
- Proposed IRT

Regional Boundaries

- Mitchells Plain/Khayelitsha
- Southern (Excluding False Bay Area)
- Tygerberg
- West Coast
- City Boundary

SEE INSERT

CBD INSERT

0 5 10 20 Kilometers

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

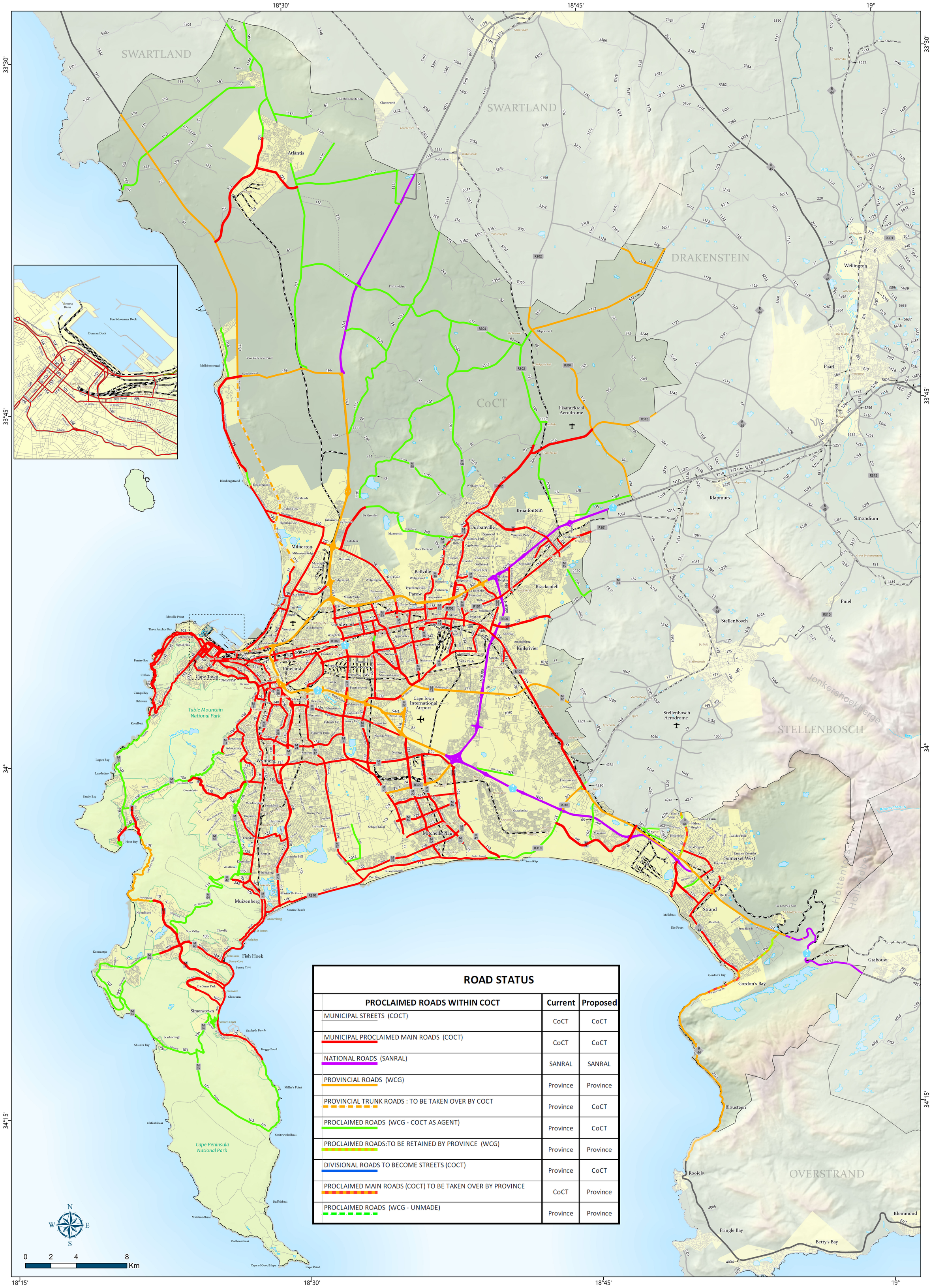
PUBLIC RIGHT OF WAY

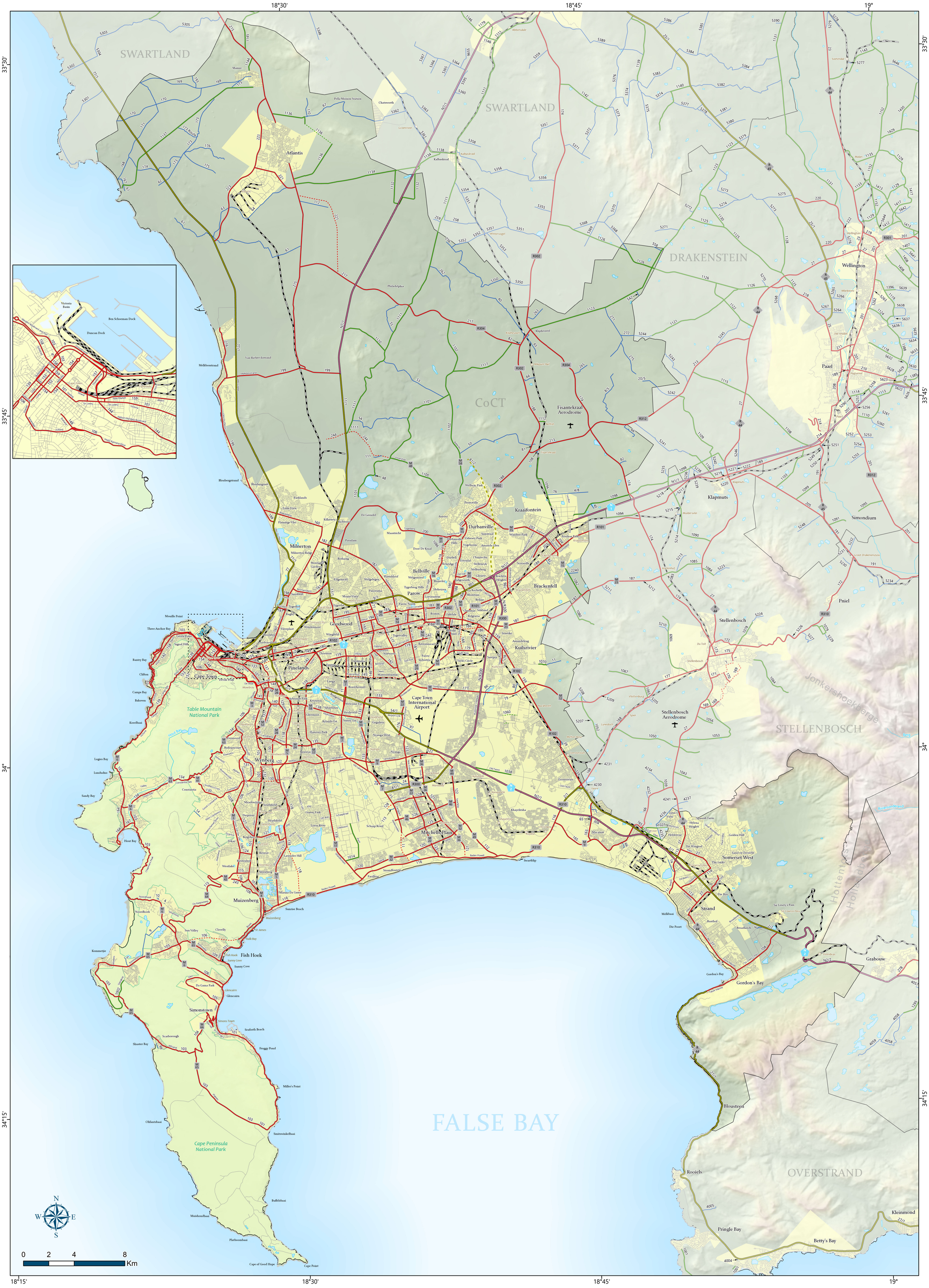
ROAD NETWORK
METROPOLITAN AREA

2023

Disclaimer: The City of Cape Town makes no warranties as to the correctness of the information supplied. Persons relying on this information do so entirely at their own risk. The City of Caper Town will not be liable for any claims whatsoever, whether for damages or otherwise, which may arise as a result of inaccurancies in the information supplied.

N


18°30'
18°45'
19°
33°30'
33°45'
34°
34°15'
SWARTLAND
CoCT
DRAKENSTEIN
STELLENBOSCH
OVERSTRAND
Atlantis
Mamre
Pella Mission Station
Chatsworth
Groenrivier
Abbotsdale
Kalbaskraal
Philadelphia
Van Riebeeckstrand
Melkbosstrand
Bloubergstrand
Milnerton
Table View
Parklands
Killarney
Flamingo Vlei
Richwood
De Grendel
Potsdam
Bothasig
Montague Gardens
Edgemead
Milnerton Ridge
Tygerhof
Rugby
Yzerplaat
Windermere
Brooklyn
Greenland
Wingfield
Woodbridge Island
Mouille Point
Three Anchor Bay
Green Point
Signal Hill
Bantry Bay
Clifton
Camps Bay
Bakoven
Koeelbaai
Cape Town
Devil's Peak
Table Mountain National Park
Mouth Bay
Logies Bay
Lunduduno
Sandy Bay
Hout Bay
Constantia
Constantia Nek
Wynberg
Bishopscourt
Kenwood
Meadowridge
Southfield
Heathfield
Retreat
Lakeside
Steenberg
Westlake
Kirstenhof
Tokai
Bergvliet
Diepriver
Pinelands
Thornton
Langa
Bonteheuwel
Rylands Est
Gleemoor
Hanover Park
Silvertown
Welcome Est
Surrey Est
Lingulethu
Nyanga West
Nyanga
Manenberg
Phillipi
Mitchells Plain
Lotus River
Grassy Park
Schaapkraal
Schaap Kraal
Khayelitsha
Welbway Park
Protea Village
Aurora
Tygerberg
Maastricht
Durbanville
Sonstraal
Valmary Park
Windsor Park
Durbanville Hills
Vygeboom
Amanda Glen
Door De Kraal
Durbell
Chantecler
Eversdal
Scottsville
Kenridge
Stellenryk
Stellenberg
Bellville
Welgemoed
Glenvee
Bracken Heights
Blomtuin
Blomvlei
Tygerberg Hills
Hoheizen
Panorama
Sanddrift
Monte Vista
Loevenstein
Parow
Parow North
Ridgeworth
La Rochelle
Bellair
Oakdale
Boston
Chrismar
Stikland
Belgravia
Brackenfell
Kraaifontein
Wellington
Soetendal
Malan
Berg
Paarl
Hugenot
Dal Josafat
Wellington Industria
Mbekweni
Simondium
Klapmuts
Muldersvlei
Koelenhof
Groot Drakenstein
Cidlie
Pniel
Stellenbosch
Du Toit
Jonkershoekberge
Kuilsrivier
Amandelrug
Soneike
Ravensmead
Parow Industria
Sacks Circle
Eersterivier
Fisantekraal Aerodrome
Stellenbosch Aerodrome
Cape Town International Airport
Klipheuwel
Melkbosstrand
Mosquito Rail
Melkbosstrand
Somerset West
Spanish Farm
Helena Heights
Macassar
Golden Hill
Die Wingerd
Helderzee
Land en Zeezicht
The Lanks
Strand
Rusthof
Broadlands
Die Poort
Gordon's Bay
Grabouw
Blousteen
Rooiels
Pringle Bay
Betty's Bay
Kleinmond
Muizenberg
Sunrise Beach
Marina Da Gama
Sun Valley
Clovelly
Fish Hoek
Sunny Cove
Kommetjie
Noordhoek
Da Gama Park
Glencairn
Simonstown
Seaforth Beach
Froggy Pond
Scarborough
Shuster Bay
Miller's Point
Olifantsbaai
Smitswinkelbaai
Cape Peninsula National Park
Buffelsbaai
Muishondbaai
Platboombaai
Cape of Good Hope
Cape Point
Victoria Basin
Ben Schoeman Dock
Duncan Dock
Woodstock
Salt River
Sir Lowry
Paarden Eiland
Maitland
Milnerton
Table View
Bloubergstrand
Melkbosstrand
Van Riebeeckstrand
Mamre
Atlantis
Chatsworth
Pella Mission Station
Abbotsdale
Kalbaskraal
Philadelphia
Groenrivier
Wellington
Soetendal
Malan
Berg
Paarl
Hugenot
Dal Josafat
Wellington Industria
Mbekweni
Simondium
Klapmuts
Muldersvlei
Koelenhof
Groot Drakenstein
Cidlie
Pniel
Stellenbosch
Du Toit
Jonkershoekberge
Kuilsrivier
Amandelrug
Soneike
Ravensmead
Parow Industria
Sacks Circle
Eersterivier
Fisantekraal Aerodrome
Stellenbosch Aerodrome
Cape Town International Airport
Klipheuwel
Mosquito Rail



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Spheroid: WGS84
Datum: Hartebeesthoek 1994
Projection: Transverse Mercator
Central Meridian: 21 Degrees

PART D

ANNEXURES

List of Annexures

Annexure A : Asset Register

Annexure B : Design Checklist

Annexure C : As-Built Checklist

Annexures can be accessed/downloaded using the following link:
https://resource.capetown.gov.za/cityassets/Media%20Centre%20Assets/SGRSW_Annexures.zip

Notes:

1) All Annexures are provided in Microsoft Excel format.
2) Completed Annexures shall be submitted in Microsoft Excel format.

To: ***Document Structure***