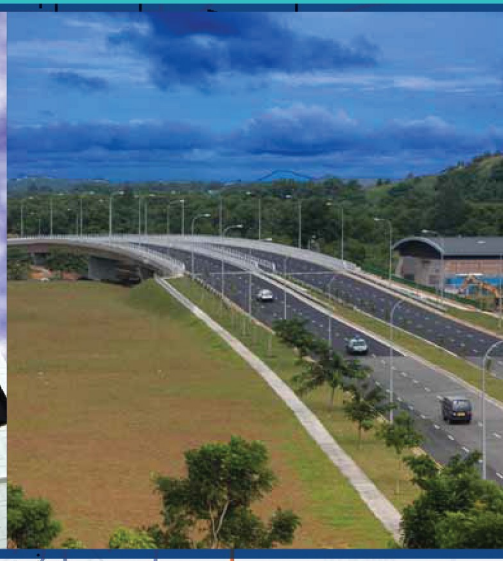
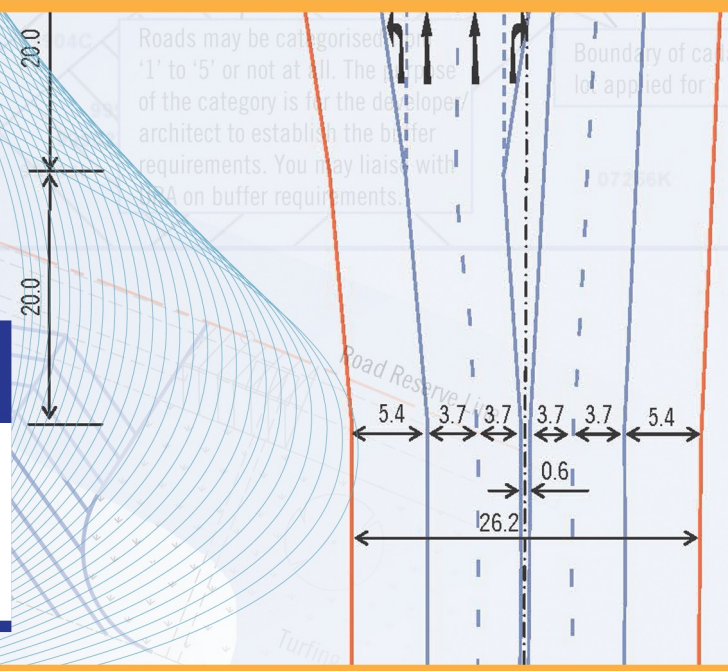
Version 1.2

Code of Practice

Street Work Proposals Relating to Development Works





Development and
Building Control Division

Land Transport Authority
We Keep Your World Moving

Introduction

The Code of Practice on Street Work Proposal Relating to Development Works replaces the "Street Work Proposals Relating to Development Works" guidebook that has been in circulation since 2007. Many significant changes have since occurred in the environment in which the Land Transport Authority constructs and maintains its infrastructure and the specifications have been revised to fit this environment.

The guidebook has been renamed as Code of Practice to underscore the importance of this publication to street work proposals that are done in tandem with development proposals. Many useful features have been introduced in this code to facilitate easy reading and quick retrieval of information. Throughout the code, colored spots are used to flag relevant codes and standards. Hyperlinks to these codes and standards are provided where available. The entire set of diagrams have been enhanced to ensure legibility and important sections of the diagrams have been highlighted to bring the reader's attention to the features that are relevant to the topic. Please refer to the User Guide on page 2 for more on this.

This code introduces the technical requirements, standards and specifications of the Land Transport Authority to aid the design of development layout with regards to proposed street works, as well as the engineering design and construction of proposed street works. Although it touches more on the civil engineering design and construction of street and street related works, this publication also highlights some of the essential submission procedures and technical requirements in relation to the design and installation of Mechanical and Electrical items for street and street related works.

The Code of Practice has been updated to include the new requirement of a Walking and Cycling Plan (WCP). As part of Walk Cycle Ride SG's vision, the Land Transport Authority and Urban Redevelopment Authority have jointly launched the new Walking and Cycling Plan to ensure that our built environment is designed to address the needs of pedestrians and cyclists. The relevant requirements and procedures on submission can be found in Chapter 9: Traffic Impact Assessment.

May 2016 Edition

No	Chapter	List of changes in COP
1	Chapter 9	Inclusion of Walking and Cycling Plan under Traffic Impact Assessment.

Users Guide

Contents

List of the topics within each chapter that displays where each topic can be located. e.g.

Numbering System

The page number is located on the top of the 'cross-hair' and in bold type. The chapter number is located on the bottom of the 'cross-hair' and in light type. i.e.

Facing Pages

Page 10
Chapter 1

Page 11
Chapter 1

Glossary

Can be found at the start of most sections to explain some commonly used technical terms

Spot References

Throughout this code colored spots are used to flag relevant codes and standards. Hyperlinks to these codes and standards are provided where available.

ADC — Architectural Design Criteria

SDRE — Standard Detail of Road Elements

Figures

The readers attention is drawn to the features that are relevant to the topic by showing them in colour. The rest of the background information is grayed out.

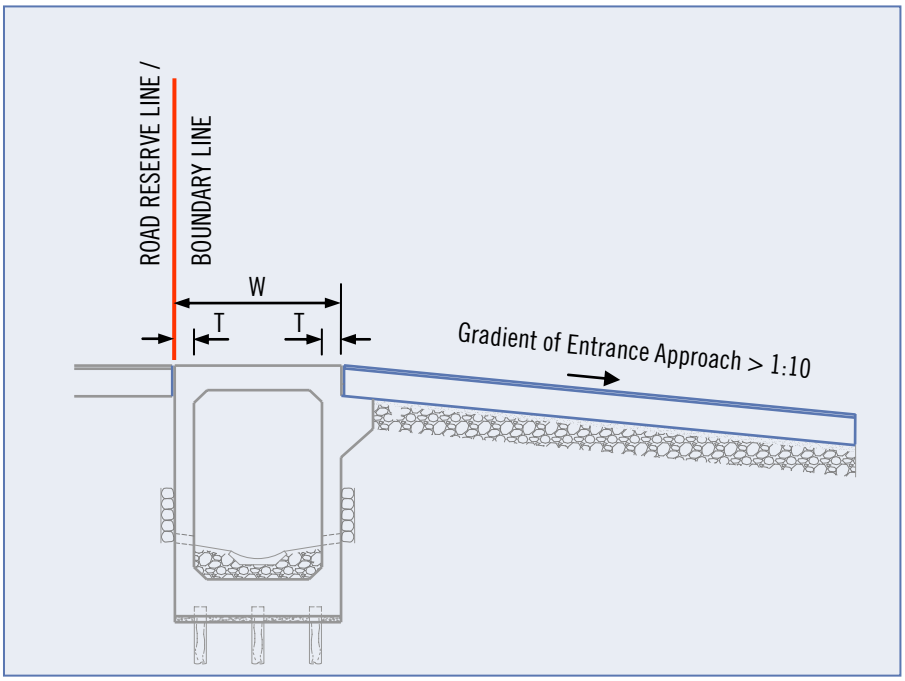


Figure 7.11 **Typical Section of Entrance Culvert**

Downloads

Documents that can be downloaded are identified easily by this icon.

References

SWA

Street Works Act
An Act relating to the construction, improvement, repair, maintenance and management of streets and back-lanes and other matters connected therewith, and the prevention of obstruction of five footways and private footways.

ADC

Architectural Standards
These standards set out the architectural design and the materials and workmanship specifications.

CDC

Civil Design Criteria
Contains the requirements for the design and detailing of all Civil Engineering Works for the construction of the roads and rail system.

MWS

Materials and Workmanship Specifications
Sets out the basic standard for the quality of materials and workmanship required by the Land Transport Authority.

SDRE

Standard Details of Road Elements
These standards set out guidelines for common road elements such as drains, kerbs and pavement as a reference for road construction.

WPS

Code Of Practice for Works on Public Streets
This Code of Practice sets out the procedures and requirements for carrying out works on public streets.

TCWZ

Code of Practice for Traffic Control at Work Zone
This Code of Practice sets out the guidelines and procedures for traffic control at work zones.

RSSZ

Guide to Carrying Out Engineering Works within Road Structure Safety Zone and Engineering Activity on Land adjoining Public Streets
This guide sets out the procedures and requirements for carrying out engineering works within road structure safety zone and engineering activity on land adjoining public streets.

SPS

Guidelines for Placing Skips on Public Streets
These guidelines provide the necessary requirements for the proper placement of skips along public roads to ensure safety and minimise obstructions and inconvenience to road users.

CP10

SS CP 10
Code of Practice for Installation and Servicing Electrical Fire Alarm Systems

OIC Search
This search allows you to find out the Officer-in-Charge of a certain road or Mukim/Township in Development & Building Control Division by keying in the road name or Mukim/Township no.

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Contents

This chapter sets out the key considerations of the LTA at the Development Control Stage and the extent of information required to be shown in the proposal plans to obtain clearance.

Chapter 1

Submission Of Development Proposal Plan For Development Control (DC) Clearance

Glossary

Access Point

Generally refers to the vehicular entrance to a development

Lodgement

A process of self-declaration by a Professional Engineer (PE) who prepares the Street Plans in accordance with the Street Works Act and its Regulations, and declares compliance with the Street Works Act and its Regulations when he lodges the Street Plan with LTA.

New Street

includes:

- The continuation of an existing street;
- The widening or alteration of any existing street and
- The adapting of a street, made for foot traffic only, for carriage traffic.

Glossary

Public Street	Any street over which the public has a right of way and which has become vested in the Government under the Street Works Act or any other repealed Acts.
Qualified Person (QP)	Means a person who is registered either as: • An architect registered under the Architect Act or • A professional engineer registered under the Professional Engineers Act.
Road Structure Safety Zone	Part of the land or area which is 20m from the outer edge of any part of a road structure .
Road Structure	Includes any bridge, underpass, road tunnel, earth retaining wall & ancillary buildings such as substations and pump house serving road tunnels, control centres for road tunnel operations.
Road Reserve / Widening Plot	Part of the development that is required for future road widening or to make up that standard features of a road.
Street Furniture	Street features such as streetlights, kerb, roadside drain, etc placed along the street.

Chapter 1

Submission Of Development Proposal Plan For Development Control (DC) Clearance

1.1 Introduction

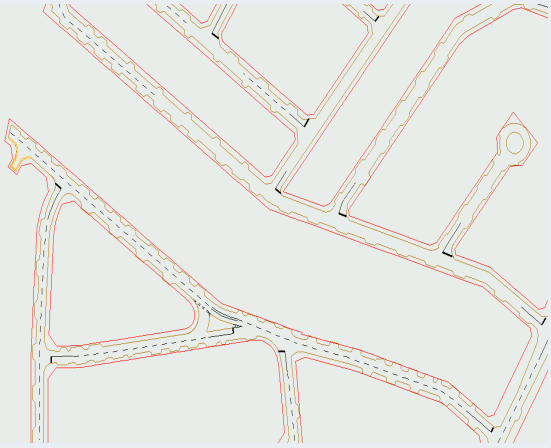
There are 3 major stages where approval is required from LTA for any proposed development, namely Development Control (DC), Building Plan (BP) or Street Plan and Certificate of Statutory Completion (CSC). The Development Control stage is the stage where LTA will evaluate if the proposal can meet the requirements of traffic operations and safety. This is the stage which has a significant impact on the overall layout design of the development.

The Qualified Person (QP) has to obtain LTA's clearance at Development Control (DC) stage when development proposals involve the following but not limited to:

- Construction of new street as defined in the Street Works Act.
- Alteration of an existing street including relocation/widening of existing access point(s) to the development.
- Alteration of an existing street including street furniture and traffic marking/traffic signs within the road reserve.
- Construction of new access point(s) to the development.
- Construction of road within the road widening plot set aside from the development.
- Development proposal that is affected by the line of road or tunnel reserve.
- Development that is located above, below and near to road structures.

1.2 Key Evaluation Areas at Development Control Stage

The following key areas are evaluated in this stage:

Key Considerations	
Suitability of access points Access points shall be suitably located to ensure smooth flow of traffic on roads. Access points are to be located along local access roads and at a safe distance from road junctions, road bends, pedestrian crossings, bus-stops, existing access points etc. Access points shall be located along the lowest hierarchy of roads if there is more than one road category fronting the development site.	
Adequacy of new road proposed The new road proposed shall serve the various plots of developments adequately with each plot directly accessible from a public street. The proposed road reserve widths shall be determined based on the type and intensity of development.	
Extent of frontage improvement The extent of frontage improvement including upgrading of open drains to covered drains for safety of pedestrians and to serve as footpaths is determined at this stage for the details to be worked out by the Professional Engineer.	

Key Considerations	
Improvement needed to existing traffic scheme Any improvement to the existing traffic scheme including introduction of yellow boxes, relocation of arrow markings, relocation of hump etc are determined at this stage.	
Requirement for a Traffic Impact Assessment (TIA) TIA studies are required for developments exceeding certain threshold development intensity. The purpose of a TIA is to identify the traffic impact of a development on the surrounding transport network and the necessary measures to mitigate these impacts. If the development is located in an area with already high traffic volume, LTA will advise the applicant on whether a TIA is required.	
Adequacy of commuter facilities Some types of developments may require commuter facilities to adequately serve those who patronise these developments. These include pedestrian overhead bridges, bus stops or bus-bays, taxi stands, etc.	
Relocation of any street lights and related facilities Existing street lights and/or its related facilities such as overground (OG) boxes may be required to be relocated to give way for proposed access points.	

1.3 Follow-up Submission After Obtaining DC Clearance

Once the DC clearance for the proposed development layout is obtained, the QP (Civil) shall submit the Street Plan to obtain BP clearance. The Street Plan shall be prepared based on the approved DC layout plan and prevailing specifications, standards, guidelines and codes of practice.

The QP (Civil) shall lodge the street plans with LTA if the proposal falls within the lodgement criteria. This is further explained in Chapter 2.

1.4 Additional Information

QP would also evaluate if a proposed development would affect an existing road or road structure during the course of construction and implement suitable measures to ensure the safety of the public. Additional information is required to be submitted if a development:

- is above, below or near to road structures (refer to Chapter 3);
- involves works that are adjacent to or within an existing public street (refer to Chapter 3); and / or
- is affected by the road tunnel protection reserve (refer to Chapter 11)

1.5 Requirements For Works on Public Streets

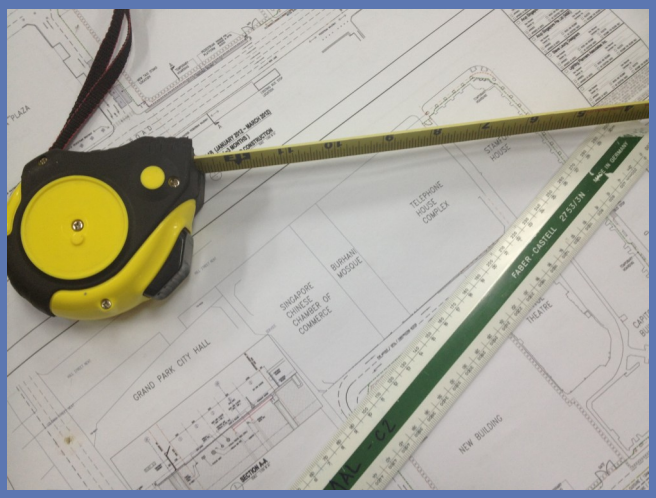
External Works

QP shall ensure that an application for a permit to carry out works on public streets is submitted via the LTA.PROMPT website: https://prompt.lta.gov.sg before carrying out any external works. A copy of the BP/DC clearance should be attached together with the application. QP shall ensure that no works on the public streets is allowed until a permit has been issued.

Utility Services Connections

QP shall ensure that the necessary utility services connections to the development are properly co-ordinated to minimise lane occupation and unecessary disruptions to the road users such as staging the works of different utility services sequentially in conjunction with the development works so that only one party is working on the public street at any one time,etc.QP shall also ensure the permanent reinstatement is carried out at one go after all parties have completed their works to minimise repeated diggings and abortive works.

This chapter sets out the key considerations of the LTA at the Street Plan Stage and the extent of information required to be shown in the proposal plans to obtain clearance.



Chapter 2

Submission of Street Plans

Glossary

Commuter Facilities	All forms of road related facilities (includes covered or open linkways, pedestrian overhead bridges, underpass and footway) connected to various transport nodes to cater to the needs of pedestrians and commuters.
Street Works	Means works of levelling, paving, metalling, flagging, kerbing, channelling, draining, lighting, laying of cables and mains and other utility services and otherwise the making good of a street or part of the street.
Road Related Facility	Includes any traffic sign, directional sign, street name sign, traffic light, bus shelter, railing and any other road related structure and facility within the street maintained by the Authority.
Street Plan	Refers to the plan relating to the construction of a new street as referred to in Section 18 of the SWA.
Traffic Layout Plan	A plan showing existing and proposed traffic markings, traffic signs and arrow/lane markings, etc.

Submission Of Street Plans

2.1 Introduction

The QP (Civil) is required to submit only the Street Plans to LTA at the Building Plan (BP) approval stage. Submission of Building Layout Plans is not required.

2.1.1 References

In preparing Street Plans, the QP (Civil) shall make reference to the relevant chapters in the following publications and comply with the requirements stated therein:

SWA
- Street Works Act (Chapter 320A) & Street Works (Private Street Works) Regulations

CDC
- Civil Design Criteria for Road & Rail Transit Systems

ADC
- Architectural Design Criteria for Road & Rail Transit Systems

SDRE
- LTA Standard Details of Road Elements

MWS
- Materials & Workmanship Specification for Civil & Structural Works
- Materials & Workmanship Specification for Architectural Works

QPs are advised to refer to the LTA website for the most updated version of the publications.

2.1.2 Submission Requirements

Submission of Street Plan for approval by the QP (Civil) shall include the following:

- Detailed plan showing the proposed street works, including details of entrance access, positions of public street lights, sign posts and any other street related facilities
- Traffic scheme plan, where applicable
- Topographical survey plan (if not submitted by the QP earlier)
- Design calculations of the proposed structures, if structural design differs from LTA's Standard Details of Road Elements.
- General Requirements to comply with during Street Plan submission (see Appendix 2A)
- Application Form under Section 20(1) (Please see Appendix 2B)

2.1.3 Submission of Mechanical and Electrical (M & E) Details in Relation to Proposed Street Works

Where applicable, details of mechanical and electrical design/installation in relation to the proposed street works, such as installation of public street lights, beacon lights, installation of escalators to pedestrian overhead bridge and underpass etc. shall be submitted to LTA for clearance before the commencement of the M & E installation works.

Unless otherwise stated in LTA's written direction to the Street Plan submission, all M&E details can be submitted separately from the Street Plans submission.

The developer and QP(s) shall be informed that if the proposed M&E details are not acceptable to LTA and require amendment that may affect the overall street proposal layout, the Street Plans that may have been approved separately shall be re-submitted for regularisation/re-endorsement.

2.1.4 Submission of Public Street Lighting Proposal (For New Streets)

A QP (Electrical) shall follow-up to submit the following with regards to the provision of street lighting:

- Checklist for street lighting design submission (Appendix 2C)
- location plan showing the proposed development.
- a copy of approved street layout plan
- Development Plan showing:
    - i) position of proposed poles
    - ii) underground cable routing
    - iii) lighting control boxes location
    - iv) lighting simulation
    - v) electrical single line diagram
    - vi) design electrical load calculation
    - vii) pole concrete foundation design & calculation with QP (Civil) endorsement
    - viii) manufacturer's information / catalogue on the lamp, lantern, gears, cables, cut-out unit, control box, its accessories and concrete base, HD UPVC pipe, cable warning slab, fuse, earthing accessories including country of origin.

- The following Photometric Data relevant to each luminaire type shall also be provided:

i) Isolux Diagram

ii) Utilization Factor Curves

iii) Polar Curves

iv) Downward Light Output Ratio

v) Downward and Upward Flux Fractions

CDC

All design pertaining to provision of public street lighting shall comply with the specifications/requirements stipulated in Chapter 21 of LTA's publication - Civil Design Criteria for Road & Rail Transit System

The QP (Electrical) shall also -

- comply with all written law, bylaws, rules, regulations and Code of Practices of any government ministries, statutory boards or other public authorities which are applicable or relevant to the execution of the services;

- conduct site visits to investigate and propose feasible design to suit the actual site condition for installation of new poles, or relocation of poles, etc.;

- arrange for a licensed cable detection worker to carry out detection of underground services.

2.1.5 Mechanical & Electrical (M&E) Details for Commuter Facilities

Similar to section 2.1.3, details of the M & E design and installation for commuter facilities such as pedestrian underpass and bus shelters are to be submitted for clearance by a QP (M & E).

The M & E design and installation shall comply with the specifications given in the Architectural Design Criteria for Road & Rail Transit Systems.

2.2 Lodgement of Street Plans

Under the lodgement scheme, a QP(Civil) will prepare the street plans in accordance with the Street Works Act and its Regulations, and declare compliance with the Act and the Regulations when he lodges the street plans with LTA. LTA will acknowledge receipt of the lodgement by issuing an acknowledgement letter.

Below is a list of developments that can be lodged, if the site is not affected by Road Reserve lines:

- Residential (all types)
- Industrial
- Educational institutions
- Places of worship
- Health and medical care establishment
- Sports and recreation centre
- Civic and community institutions
- Building designated for conservation under the Planning Act

The lodgement scheme will not be applicable for street plans that involve the following types of works:

- construction of a new street
- continuation of an existing street
- adaptation of a street, made for foot traffic only, for carriage traffic
- modification of any existing traffic scheme
- introduction or modification of any road related facilities, such as bus stop and pedestrian overhead bridge
- introduction or relocation of any covered linkway
- commercial developments

2.2.1 Making an Application

Under the lodgement scheme, the QP has to ensure and make a self-declaration that the street plans submitted are in compliance with the Street Works Act and its Regulations.

The QP shall lodge the street plans via CORENET after the Development Control (DC) clearance has been obtained from LTA. Details of the street plans shall follow the approved DC layout plan.

QP will receive an auto-acknowledgement through CORENET .

The QP shall apply for Certificate of Statutory Completion (CSC) clearance upon completion of the street works.

2.2.2 Documents to Submit

- Completed Application Form "LTA-DBC_Roads.xfd"
- A copy of the Written Permission together with the approved plan
- Set of street plans
- A copy of LTA's DC Clearance letter

2.2.3 Audit Checks on Street Plans Lodged to LTA

LTA would carry-out audit checks on the Street Plans that have been lodged. If details of the Street Works do not comply with LTA's requirements, LTA would issue a written direction to the QP (Civil) to amend the proposal. If however, any deviation is discovered during CSC inspection, the QP will have to demolish the completed works and reconstruct the Street Works according to LTA's requirements.

QPs can refer to the Quick Guide prepared to assist them in lodgement of Street Plans (Appendix 2D)

2.3 Existing Lamp Post and Overground (OG) Box Affected by Proposed Road Works

For street plan submissions involving relocation of existing street lampposts and/or OG boxes , the QP(Civil) shall forward the proposal with a cut out plan of the affected streetlights, lighting control boxes and proposed positions with the inventory ID (lamppost no.) and road name attention to:

Engineer-In-Charge,
Lighting & Facilities Dept,
Road Infrastructure Management Division,
Block 3, Level 2,
No. 1 Hampshire Road.
Singapore 219428

This chapter provides guidelines to the QP (Civil) on the submission requirements for development works in close proximity to existing road structures and public streets.

Chapter 3

Development Proposals Above / Below Road Structures and Adjacent to / Within Public Streets

Glossary

	Utilities	Includes water pipes, gas pipes, sewer pipes, drainage facilities, electricity cables, telecommunication cables and any other pipes, cables and their related apparatuses.
RSSZ	Engineering Activities/Works	Please refer to the definition in Guide to Carrying Out Engineering Works within Road Structure Safety Zone and Engineering Activity on Land adjoining Public Streets

Chapter 3

Development Proposals Above / Below Road Structures and Adjacent to / Within Public Streets

3.1 Introduction

Development proposals above or below road structures and those adjacent to or within existing public streets are of special concern to LTA as they may affect the structural integrity of the nearby road structures or public streets.

The developer shall engage a qualified person for supervision of structural works, QP (Civil), to obtain the Authority's clearance at Development Control (DC) stage. This chapter provides guidelines to the QP (Civil) to obtain DC clearance for development proposals under this scenario.

3.2 Development Proposals Above / Below or Near Road Structures

The QP (Civil) shall identify and verify the presence of all road structures affected by the development proposal and indicate them in his DC application. The following figures illustrate the Road Structure Safety Zone for above-ground and underground structures.

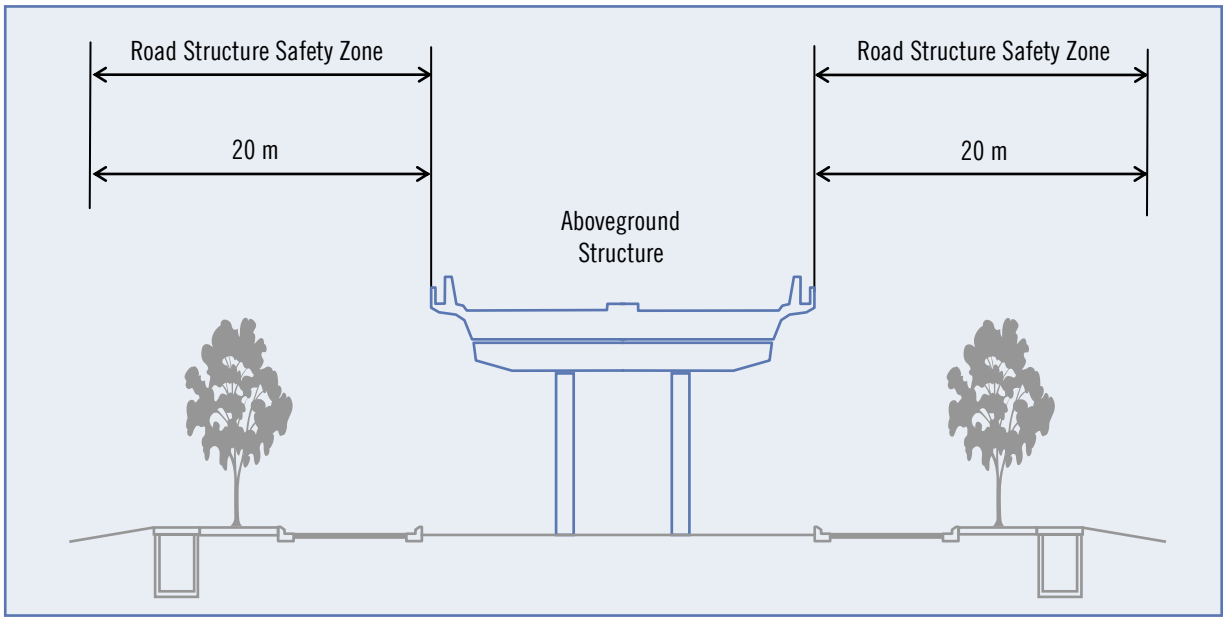


Figure 3.1 **Road Structure Safety Zone for Structures Above Ground Structures**

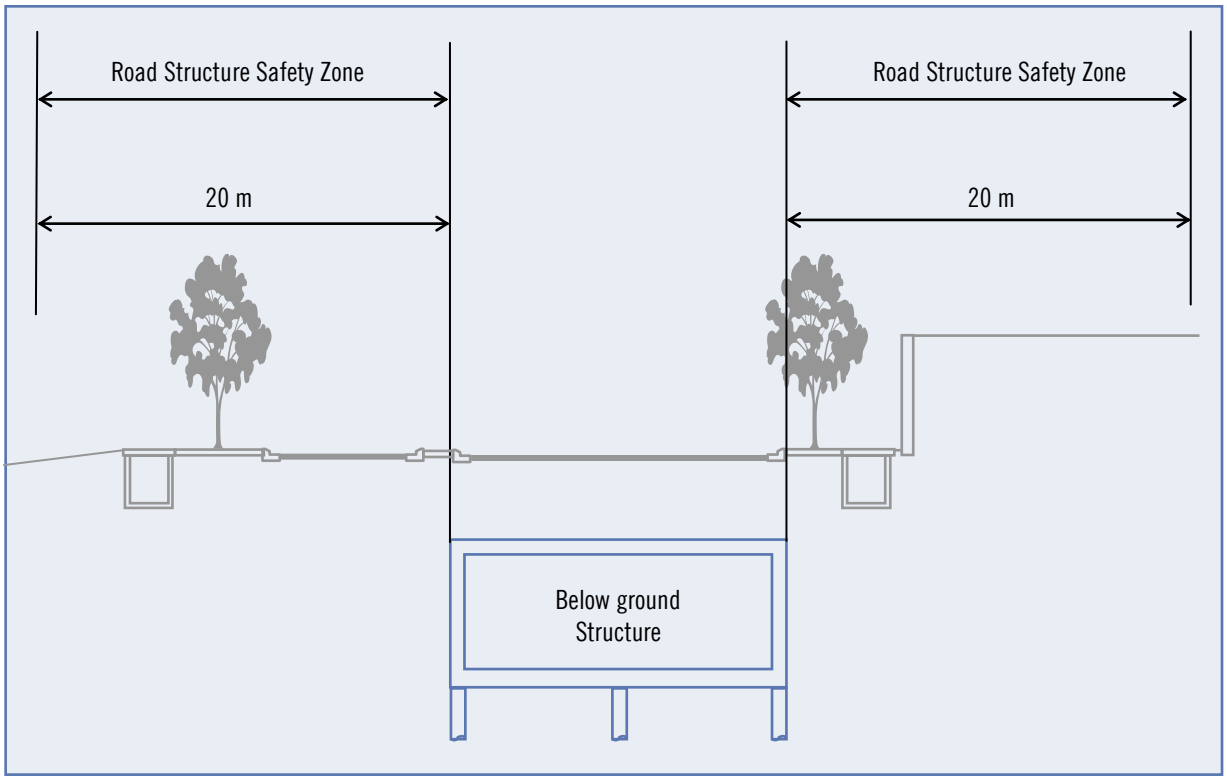


Figure 3.2 **Road Structure Safety Zone for Structures Below Ground Structures**

3.2.1 Documents for Submission at DC Stage

To facilitate the approval process, the QP (Civil) shall submit the proposed development plans for DC clearance.

Generally, the plans shall comply with clauses 3.2.2, 3.2.3 and 3.2.4 where applicable in relation to the road structure; existing ground levels; and below ground structure outline (if any).

The Authority reserves the right to impose any additional requirement deemed necessary to safeguard the road structures.

3.2.2 Development/Building Works Above Road Structures

3.2.2.1 General Conditions

All proposed building (or development) works shall not affect the structural integrity of any road structures. They shall not in anyway interfere with the Authority's routine inspection and maintenance work on road structures.

Utilities should not be affixed on any parts of the road structures. All parts of the road structure shall be kept accessible at all times.

3.2.3 Development/Building Works Under Road Structures

(Read in conjunction with Figure 3.3 and 3.4)

3.2.3.1 General Conditions

- The design, occupancy and use of any development under bridges shall be such that neither the use, safety, appearance, nor the enjoyment of the road and bridge is adversely affected;
- Any temporary or permanent change in alignment or profile of the existing roads and bridges shall not be allowed;
- No structure of any kind shall be allowed to be built around or enclose any bridge columns/piers/abutments. Structure shall be at least 5m away from any bridge columns/piers/abutments. All parts of the bridge shall be kept accessible at all times;
- Utilities should not be affixed on any parts of the road structures. All parts of the road structure shall be kept accessible at all times;
- The ingress to and egress from the development shall not interfere with the major flow of the road traffic. This ingress shall be located away from traffic junctions, bus stops and pedestrian crossings;
- Pedestrian access to the development shall be provided with proper footpath and lighting; and
- The development shall be designed to allow the Authority to carry out maintenance and inspection of bridge bearings at all times. A vertical clearance of not less than 2.5m from the lowest point of the beam soffit/ girders/slabs/bridge viaducts to the roof of development shall be provided.
- All categories of development shall be of low risk. The development shall have no basement. The roof of the proposed development shall be designed to carry a minimum live load of 5kN/m^2. The Authority shall reserve the right to order temporary closure of the business operation for the routine inspection and maintenance of the road structures.

3.2.3.2 Fire Safety Requirements

CP10

- Automatic fire alarm system in compliance with SS CP10 shall be provided. The fire alarm system shall be connected to the fire station via an approved alarm monitoring station in accordance with SS CP10; and
- Roof and external walls of the development including window openings/ventilation openings located within 6m from exterior of viaduct structure shall have 2 hours fire resistance rating as shown in Figure 3.3. If sprinklers are provided, the fire resistance rating can be reduced to 1 hour.

3.2.3.3 Aesthetic Treatment

- The development shall blend well into the surroundings and pre-consultation with the Authority and other relevant authorities on the aesthetic treatment is required; and
- Commercial or non-commercial signage or signboard shall not be placed on or installed on any parts of the bridge. However, independent signage or signboard may be installed on the ground with approval from the Authority and other relevant authorities.

3.2.3.4 Parking Space

- Flame detectors compliance with SS CP10 shall be provided for open parking spaces. The fire alarm system shall be connected to the fire station via an approved alarm monitoring station in accordance with SS CP10;
- Hose reel shall be located such that all parking spaces are accessible; and
- Car park shall only be used for passenger cars and motorcycles. If parking spaces are opened for light good vehicles or lorries, 2 hours fire rated enclosed structure in compliance with section 9.2 shall be provided.

3.2.3.5 Maintenance

- The developer/owner of the development shall be fully responsible for the proper maintenance of the building/ facility occupying the space so as to assure no interference with the functions and operations of the bridge.

3.2.4 Design for Structures Near Road Structures

Building near bridges and viaducts shall be at least 6m clear or the separation distance calculated for unprotected opening in accordance with the Code of Practice for Fire Precaution in Building, whichever is greater, from the outermost edge of the road structure.

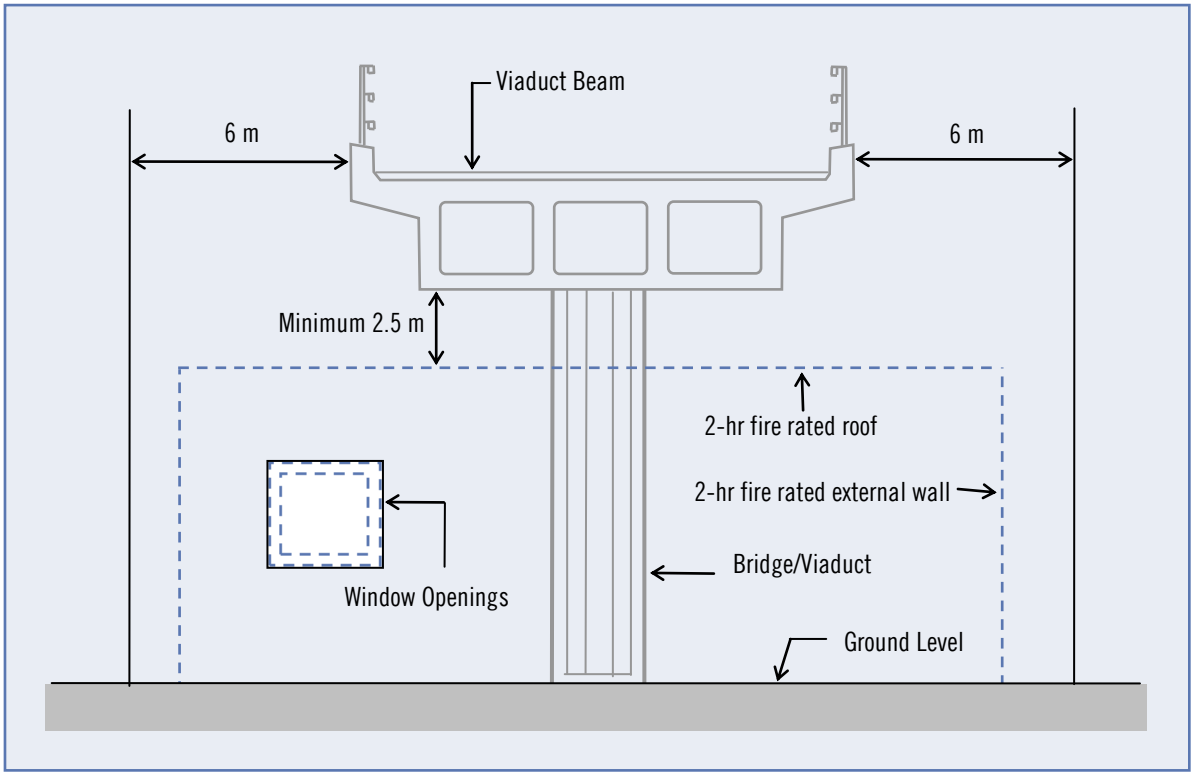


Figure 3.3 **Clearance of Building Roof below Bridge/Viaduct (Cross Section)**

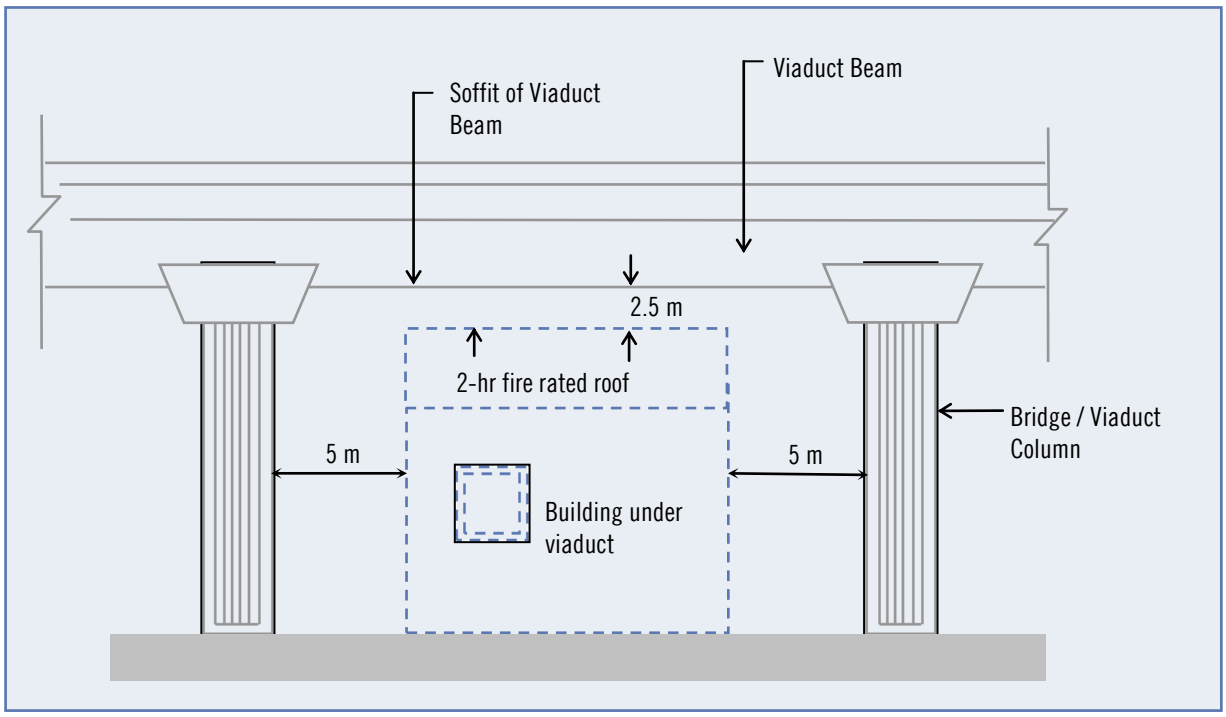


Figure 3.4 **Clearance of Building Roof Below Bridge/Viaduct (Longitudinal Section)**

3.3 Development Proposals Adjacent to / Within Public Streets

This may include excavation works adjacent to the road reserve of an existing public street or installation of ground stabilization measures (e.g ground anchors) within an existing public street. When such works are not appropriately designed and supervised, it may pose a hazard to the surroundings, such as slope failure, subsidence or collapse of adjacent road etc.

Other than carrying road traffic, roads in Singapore also house many utility services. Any collapse of a road due to adjacent excavation work will disrupt traffic movement and utility services which poses a great inconvenience to the general public.

It is therefore very important for the QP (Civil) to ensure that any such works are appropriately designed, supervised and executed at all times. If the proposed development works (including Earth Retaining and Stabilizing System) encroaches into the Road Reserve, they shall be stated and shown clearly on plans.

3.4 Granting of DC Clearance

The Authority will grant DC clearance for the development proposal if the Authority is satisfied that:

- QP (Civil) has complied with the requirements of sub-sections 3.2 to 3.3 and that all submissions are in order; and
- QP (Civil) has declared and confirmed that the Engineering Works and Engineering Activities are to be carried out without affecting the structural integrity and safe operation of the road structures and the public street and the requirements in the "Guide To Carrying Out Engineering Works within Road Structure Safety Zone and Engineering Activity on Land Adjoining Public Streets" will be complied with during the submission for approval to commence Engineering Works and notification of Engineering Activities.

3.5 Follow Up Submission After Obtaining DC Clearance

The QP (Civil) shall note that the DC clearance given by the Authority at this stage does not automatically allow the developer and his appointed builder/contractor to carry out the Engineering Works.

A separate application shall be made to the Authority:

(i) for Approval to commence Engineering Works within RSSZ.
(ii) for Notification to carry out Engineering Activities on land adjoining public streets

Please refer to "Guide To Carrying Out Engineering Works within Road Structure Safety Zone and Engineering Activity on Land Adjoining Public Streets".

The overview of the process of submission for proposals within Road Structure Safety Zone & Adjacent To Public Street is given in Fig 3.6.

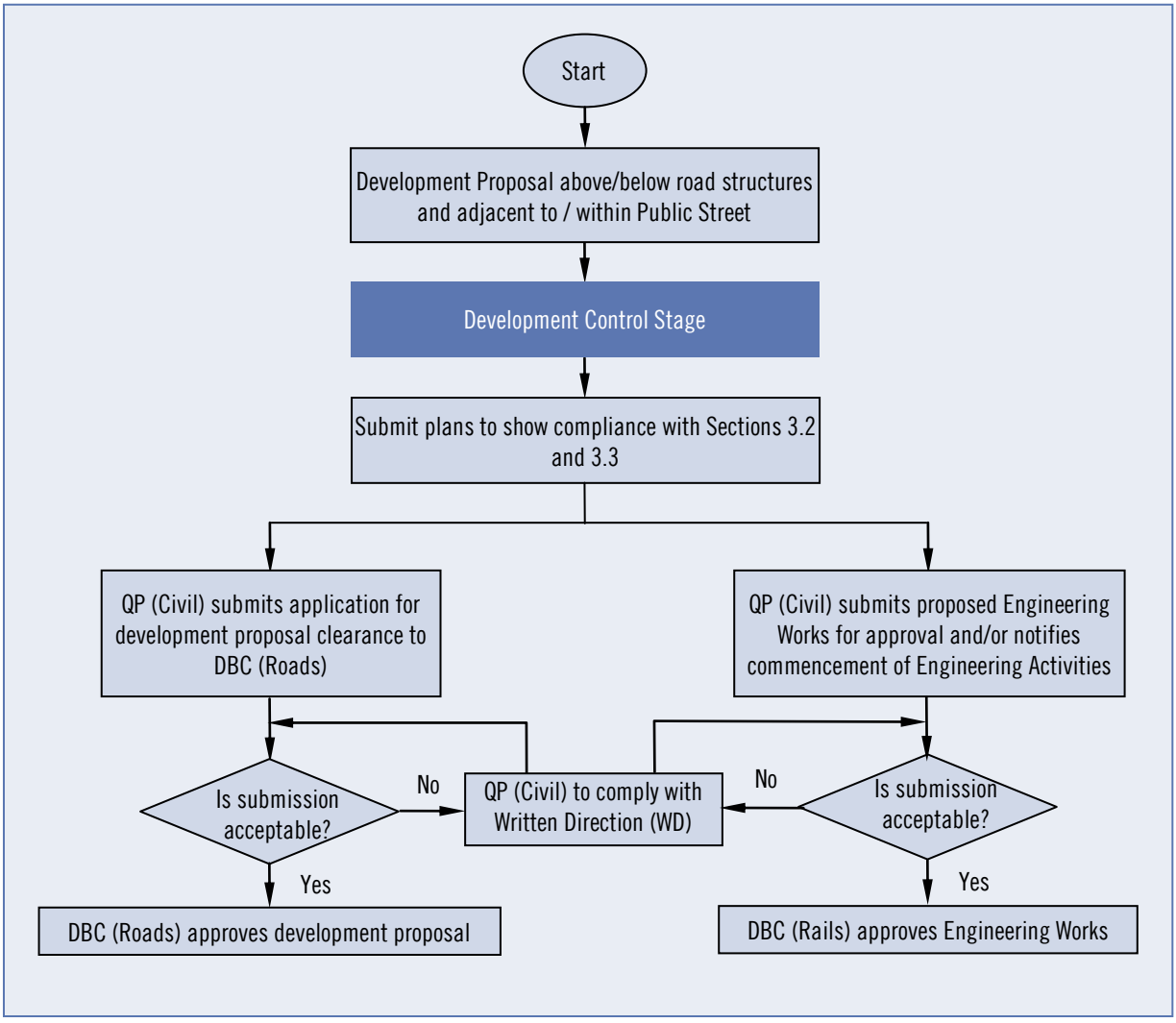


Figure 3.5 **Overview of Process For Development Proposals above / below Road Structures And Adjacent to / Within Public Street**

This chapter outlines the process of inspection & handing over of completed street works to obtain CSC clearance and / or final taking over clearance.

Chapter 4

Inspection For CSC Clearance And Handing Over Of Completed Street Works

Glossary

Defects Liability Period	In relation to any works which have been carried out on a public street, means the defects liability period as specified in the Code of Practice in respect of that type of works.
Latent Defects	The condition of a road surface is a function of the severity and extent of a range of defects including road settlement, cracks, potholes, etc.

Chapter 4

Inspection For CSC Clearance And Handing Over of Completed Street Works

4.1 Introduction

When the street works of any development proposal is completed, the QP shall request for a CSC inspection before the completed street works can be handed over to LTA. Generally, this process is associated with the issuance of Certificate of Statutory Completion (CSC) by the Building and Construction Authority, in which the CSC is granted when the relevant technical departments have cleared and accepted the completion of works approved by them earlier. In this regard, LTA continues to use the caption of CSC clearance in its clearance letter to the QP on the acceptance of completed street works.

4.2 Site Inspection of Completed Street Works

Upon request by the QP, LTA officers will inspect the completed works to check if the works were carried out in accordance with approved plans and whether they meet the material and workmanship specifications of LTA. If the completed works includes a new street, underpass or pedestrian overhead bridge (POB), a joint site inspection with the project QP will be arranged.

CSC clearance will be issued to the QP when:

- the street works are carried out according to the approved plans and have met the material and workmanship specifications of LTA, and
- relevant documents as stipulated in section 4.5 are duly submitted and accepted by the LTA.

4.3 Maintenance Period (MEP) (For New Street, Underpass And Pedestrian Overhead Bridge)

In civil engineering construction works, latent defects of the constructed works do not normally surface immediately upon completion of the works. It is common in engineering contract to impose defect liability period for such latent defects to safeguard the interest of the developer and whoever is maintaining the works in due course.

Likewise in the construction of new streets, underpass and POB, a one year maintenance period (MEP) commencing from the date of CSC Clearance will be imposed on a development that includes construction of new street(s), where the new street(s) is to be handed over to LTA for management and maintenance. During the 1-year MEP, the developer shall be responsible for the maintenance of the new street and all the related street furniture.

The imposition of MEP is applicable only to developments that includes construction of new street, underpass and POB. Whereas development that comprises only the construction/alteration of accesses, and frontage/localised street improvement works are not subjected to MEP.

Street works that do not include construction of new street, i.e. works related to construction/alteration of accesses, frontage/localised street improvement are considered to be taken over for maintenance by the LTA once CSC clearance is issued.

4.4 Commencement of Maintenance Period (MEP)

The MEP commences when LTA notifies the QP of the CSC clearance of completed street works. For better management of the completed street during MEP, the initial inspection of street works for commencement of MEP should be arranged in such a manner that the start of the MEP can coincide with the defects liability period (DLP) of the main building works.

Towards the end of the MEP, the QP shall write to LTA for a final joint site-inspection. If the inspection reveals no major latent defects to be rectified and that the required documents stipulated in section 4.5 below are duly submitted, LTA will arrange to declare the new street as a public street and will take over the street for management and maintenance.

4.5 Documents to be Submitted Before The Issue of CSC Clearance And The Handing Over of The Completed Street Works

Before the LTA/QP joint site inspection is held, the following relevant documents are to be submitted to LTA for the handing over of the completed street works.

4.5.1 For Developments That Include Only The Widening And Alteration of Existing Street Fronting The Development Site And/or Widening/Relocation of Accesses to The Development (Without New Street)

- E-Form for CSC application (Appendix 4A)
- As-built drawings prepared by a Registered Surveyor in digital format (dgn, dwg or dxf). The drawings shall be in true co-ordinates
- Approved subdivision plan with written permission from the URA and Certified Plan (CP) if road reserve plot (s) is required to be vested to the State after the CSC Clearance is issued.

4.5.2 For Developments That Include Construction of New Streets

- E-Form for CSC application
- As-built drawings prepared by a Registered Surveyor in digital format (dgn, dwg or dxf). The drawings shall be in true co-ordinates
- Approved land subdivision plan with Written Permission and Certified Plan (CP) for the new road to be vested to the State upon handing over
- Confirmation letter from Street and Building Names Board (SBNB) on the approved street names of the constructed new street
- Road testing results

4.5.3 Documents to be Submitted For Proposed Street Work With New Street, Underpass And POB Before The Taking Over

- Road Data Form. (Appendix 4B)
- Asset Master Input Form.
- 12 copies of declaration plan.
- Taking over letters from the PUB (Drainage), NParks and Environmental Health Agency (NEA).

4.5.4 Submission of Documents For Handing Over of Public Street Lighting in Hardcopy

- 1 set of as-built installation of the street lampposts and control boxes with labeling and underground cable routing endorsed by QP.
- 1 set of Electrical Single Line diagram with QP endorsement.
- 1 set of Statement of Turn On and Test Report from SP Services for the new control box.
- 1 set of Letter of Supervision on the electrical installation endorsed by Licensed Electrical Worker (LEW).
- 1 set of Letter of Supervision on the lampposts installation endorsed by PE (Structural).
- 1 set of underground cable insulation resistance test report endorsed by LEW.

Notes:

Submission of documents under sections 4.5.3 and 4.5.4 can be made anytime during the one year Maintenance Period

This chapter outlines the considerations for the design, location and arrangement of vehicular access to developments.

Chapter 5

Access Arrangements

Glossary

Major Arterial Roads	A major road carries large volumes of traffic between 2 major points of interest eg. two towns etc, having a road reserve width of 31.8m or more.
Sight Distance	The distance from which an object at eye level remains visible to an observer.
Tactile Tiles	Tiles which are placed to warn the visually handicapped of a hazard or to guide them to a destination.

Chapter 5

Access Arrangements

5.1 Introduction

LTA regulates the design, position and arrangement of access points of entrance / exit to or from driveways. This is necessary because an access point interferes with the free flow of traffic along the road to which it connects. One of the design considerations is to ensure that ample sight distance is provided for vehicles to maneuver safely in and out of the access. Consideration shall also be given to the environmental impact the access would have on surrounding residential houses or public amenities in the vicinity.

LTA also regulates the number of access points to any development. Unless there are good technical reasons, each development shall be served by only one access point.

5.2 Location of Vehicular Access Point

Generally, vehicular access points are to be located outside the storage lane if there is one on site or at a minimum distance of 50m distance from road junctions, bends and commuter facilities e.g. bus stops, etc depending on the linearity of the road fronting the development. Any proposed access shall be located 30m away from existing bus stops and other existing access points where site conditions permit. In determining the location of an access point, consideration shall also be given to the following.

- Direct access from expressways, slip roads, acceleration or deceleration lanes, bus or taxi bays and major arterials roads are not allowed.
- For commercial and shophouse developments, where a rear service road is available or safeguarded, access shall be taken from the rear service road.
- Where a development is accessible from two public streets, it shall be designed to take access from the road which is classified as a lower category in the Road Line Plan (RLP).
- Access points shall be suitably located to ensure smooth flow of traffic on roads. Access points are to be located at a safe distance from road junctions, road bends, pedestrian crossing, bus-stops, existing opposite access points etc.

5.3 Service Accesses

Services access to electric sub-station and bin centre shall all be taken from within the site. Separate access directly from the public street is not allowed.

5.4 Access Arrangements For Landed Residential Developments

Access for residential developments should be adequately spaced apart and shall not be directly opposite one another. Access locations are required to be at least 6m apart, for the consideration of tree planting and roadside parking requirements (if any). Otherwise, the accesses shall be paired. Figures 5.1 illustrates this.

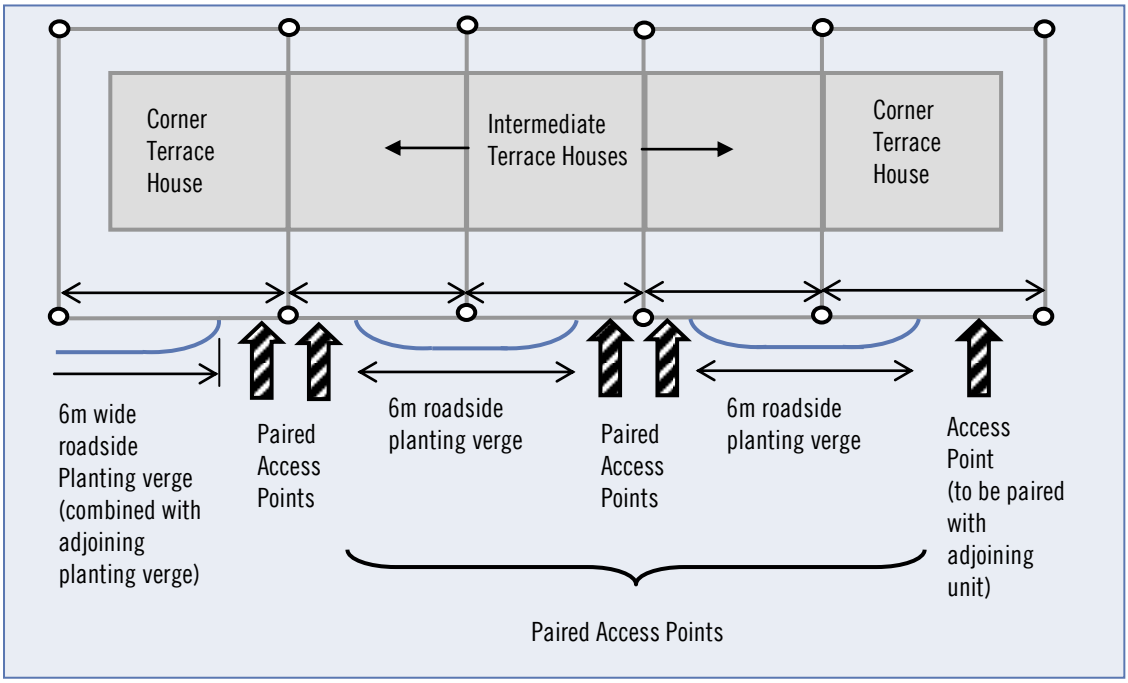


Figure 5.1 **Correct Access Arrangement For Landed Houses**

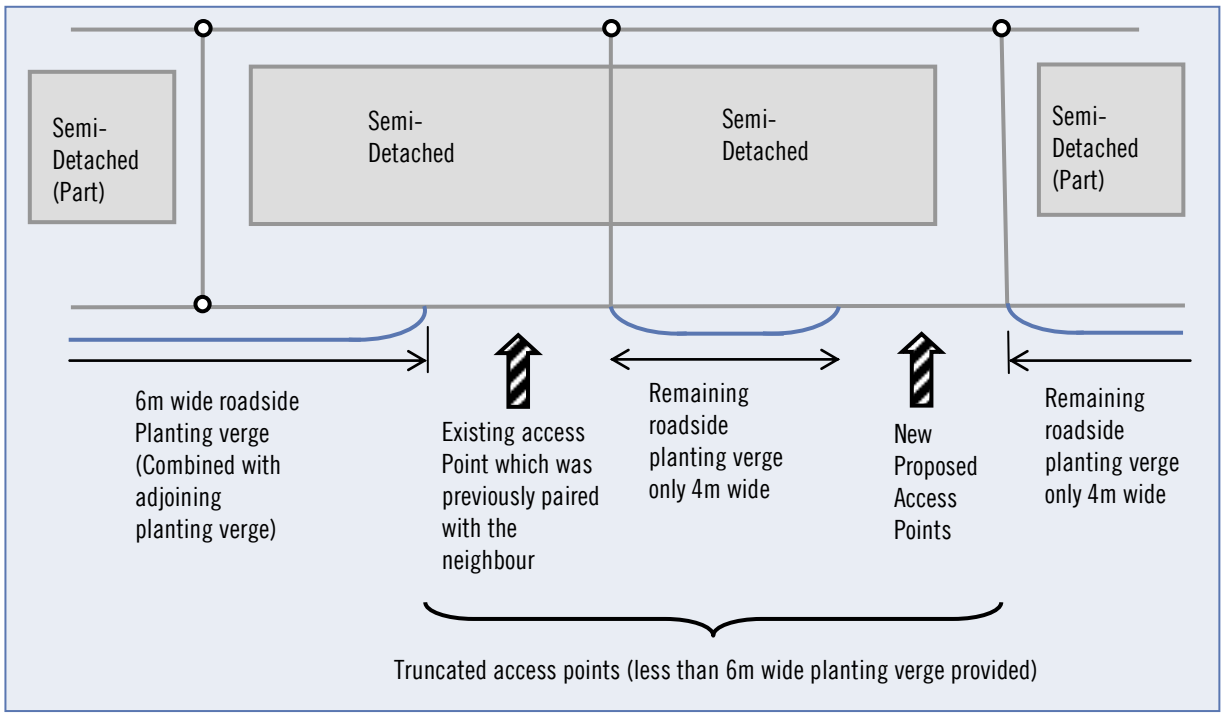


Figure 5.2 **In-correct Access Arrangement for Landed Houses**

5.5 Design of entrance access

The photograph below illustrates the basic components of an entrance driveway. The turning kerb is aligned with the gate post and drop-inlet chambers are provided on both sides at the tangent point of the turning kerb radii. Tactile tiles are provided 300mm from the driveway.

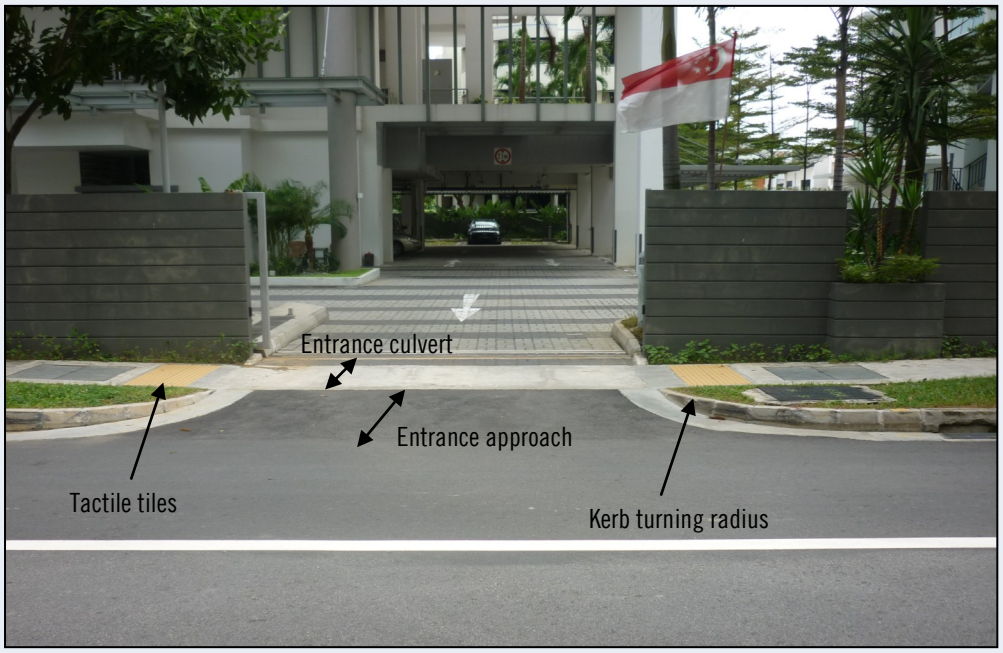


Figure 5.3 **Photograph illustrating The Basic Components of an Entrance Driveway**

The access shall be designed as follows:

- A separate lane for visitors shall be considered to allow residents to enter the development quickly (Please see Figure 5.4).
- For residential developments exceeding 600 units, an additional access from another road fronting the proposed development can be considered. (Please see Figure 5.5). For developments located in an area with already high traffic volume, LTA will advise for the need for an additional access from another road fronting the proposed development for developments having less than 600 units.
- The position of drop-barriers / guard posts within the development boundary would also have an impact on the public street. A bottleneck at the entrance of a development may result in a spill over of vehicles queuing on the main road and could result in collision from the rear. Therefore sufficient storage length shall be provided within the development site's before entrance gate / guard house / drop barrier to offset any possible traffic congestion onto the main road. (For residential developments, provision of a holding bay for a minimum of 2 vehicles within the development shall be considered. (Please see Figure 5.6 and 5.7))
- Entrance shall be maintained as a Left-In, Left-Out (LILO) arrangement if it is along major arterial road.
- The gradient of the entrance driveway shall not be steeper than 1:10.
- The top of the culvert shall be flat and is allowed to follow the longitudinal profile of roads that are sloping. Amendments to the level of culvert for paired access is not allowed as it may lead to water stagnation issues.

- Any hard structures such as concrete boundary wall / fencing shall be recessed in adequately to allow sufficient line of sight between vehicles exiting the development & pedestrians using the footpath. Alternatively, the boundary wall / fencing shall be constructed with non-porous material.

- Any footpath meeting the access shall be flushed in level and the gradient of the resulting footpath section shall not be steeper than 1:12.

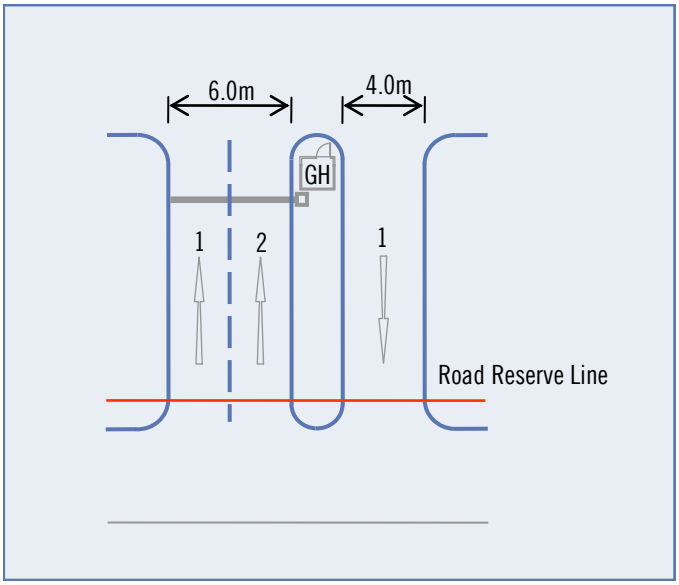


Figure 5.4 **Access Arrangement for Residential Developments Showing Separate Lane For Visitor Entry**

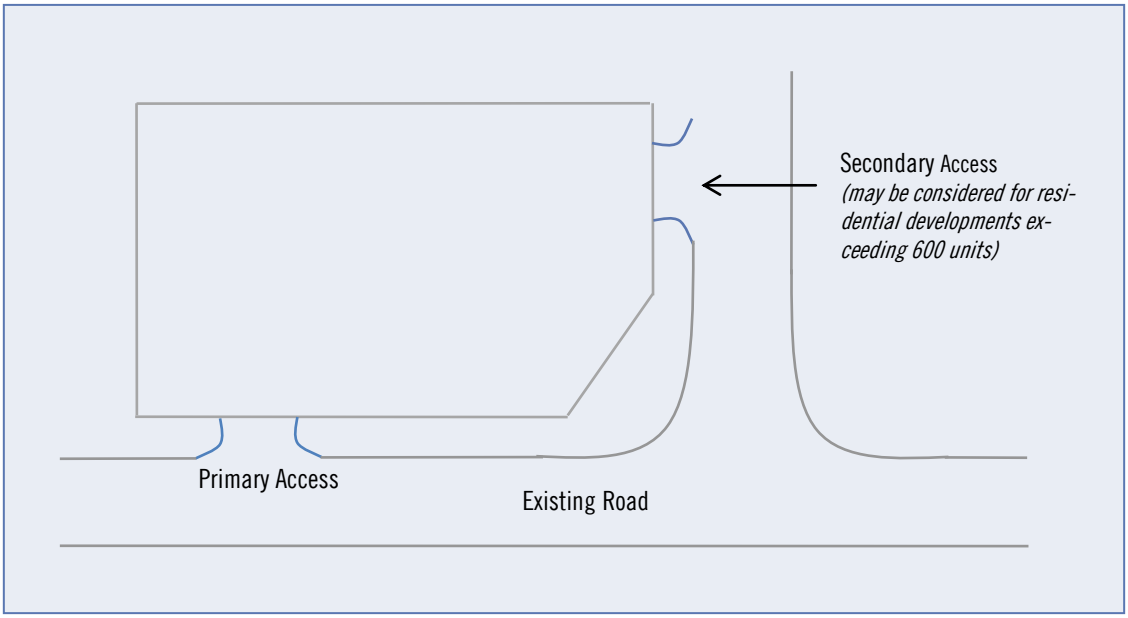


Figure 5.5 **Access Arrangement for Residential Developments Exceeding 600 Units - additional ingress/egress could be considered from another road fronting the development site**

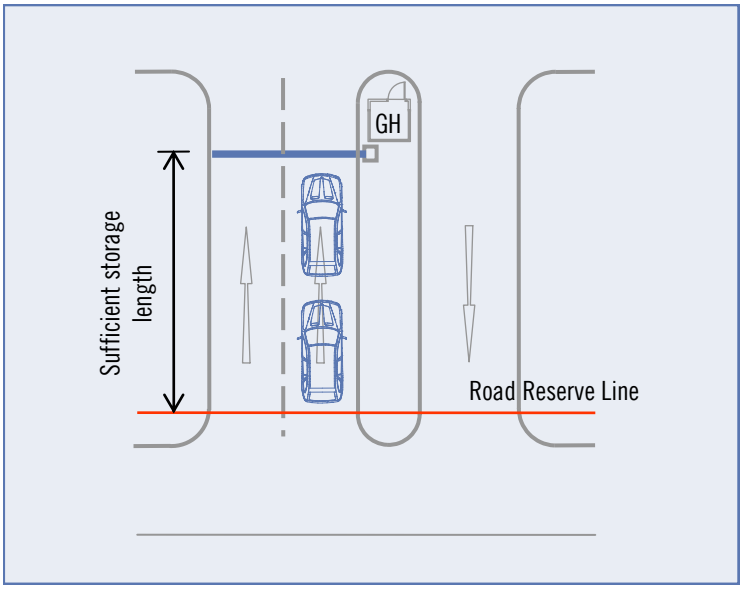


Figure 5.6 **Storage Length Provided Within The Development Site**

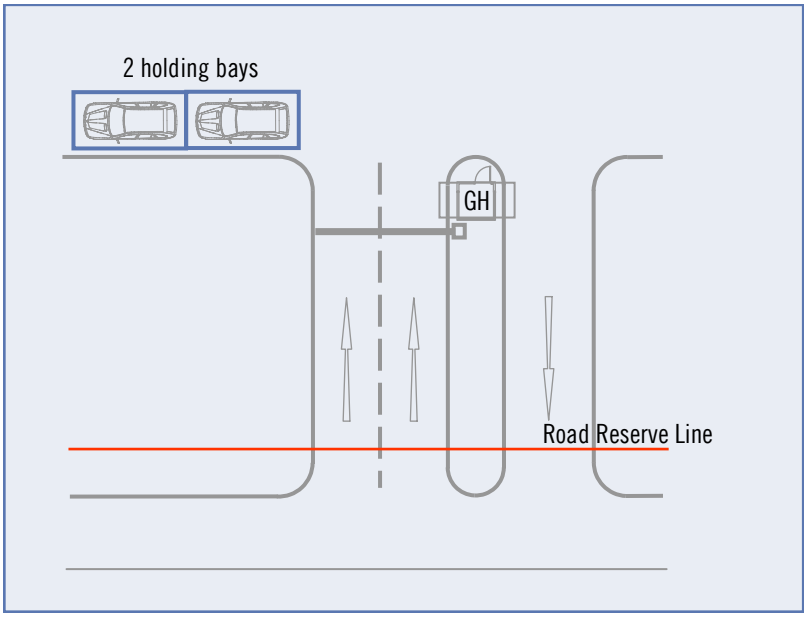


Figure 5.7 **Holding Bays Provided Within The Development Site**

- Tactile tiles shall be provided where the footpath meet the driveway for all developments except landed houses.
- The driveway should, as much as possible, be connected perpendicular with the road to offer better visibility for turning in/out to/from the development. It shall also be in line with the proposed gate post.
- Meter compartment shall not be located at the common party wall when the accesses are paired to reduce the possibility of impact by vehicles.
- Existing access arrangement for terrace and semi-detached landed housing with paired access shall not be separated as part of redevelopment, if the access arrangement does not comply with scenarios in section 5.4 above.

5.6 Width And Turning Radius of Vehicle Accesses

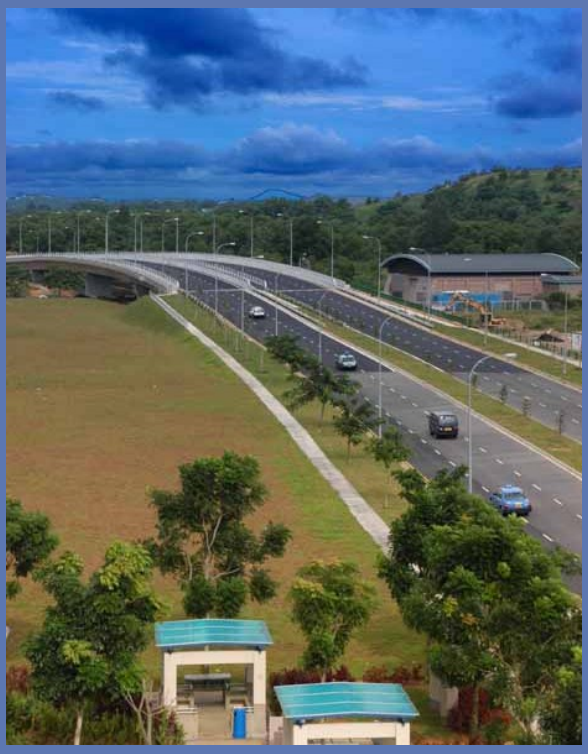
The recommended width and turning kerb radius of an entrance / exit driveway is given in Table 5.1.

Type of Developments	Recommended Clear Width of Access	Recommended Turning Kerb Radius
Terrace Houses	For Frontage Width <8.0m 3.0m to 4.5m (max.) For Frontage Width ≥8.0m 3.0m to 5.5m (max.) Where accesses are separated, a 6.0 m long strip of planting strip / service verge shall be provided between accesses for tree planting and kerbside parking (if any)	1.5m to 3.0m
Semi-Detached Houses		
Detached Houses		
Commercial	6.0m to10.0m max (two - way operation)	Car 3.0m to 5.0m Lorry 5.0m to 6.0m
Condominium / Flats/ Public Housing	11.0m-13.0m (separated by 3.0m island for ingress and egress) 11.0m (4.0m lane + 3.0m island + 4.0m lane) 13.0m (3.0m lane + 3.0m lane + 3.0m divider + 4.0m lane) Please refer to illustration in Figures 5.4 to 5.6 for the various access arrangements which are acceptable.	3.0m to 5.0m

Type of Developments	Recommended Clear Width of Access	Recommended Turning Kerb Radius
Public Building, Community Centres,	6.0m to 8.0m (4.0m single direction)	3.0m to 5.0m
School (Primary, Secondary and Junior College), Petrol Station		6.0m to 8.0m
Single Access (ingress or egress only)	6.0m (max)	
Combined ingress and egress	10.0m to 12.0m (max)	
Factories:		6.0m to 8.0m
- Terrace	6.0m	
- Single Type	8.0m to 10.0m	
- Multi-User (Warehouse)	10.0m to 12.0m	
All Other Uses:		3.0m to 5.0m
- Sub-Stations	4.0m	
- Fire Engine Access	4.0m	

Table 5.1 **Recommended Width and Turning Kerb Radius**

This chapter provides guidelines on new street proposals required in conjunction with new developments.



Chapter 6

New Street Proposals

Glossary

Land Subdivision	The dividing of a single parcel land into two or more parcels each to be given a separate title.
Street Works Deposit	An amount to be deposited for the execution of street works. The deposit can be in the form of a banker's guarantee (BG).

Chapter 6

New Street Proposals

6.1 Introduction

Section 18 of the Street Works Act (Chapter 320) stipulates that Street Plans shall be submitted for approval before a road can be constructed to serve a development. This is, however, not applicable for internal driveways where land sub-division is not required e.g. for condominiums, cluster housing or flat developments (Please see Figure 6.1).

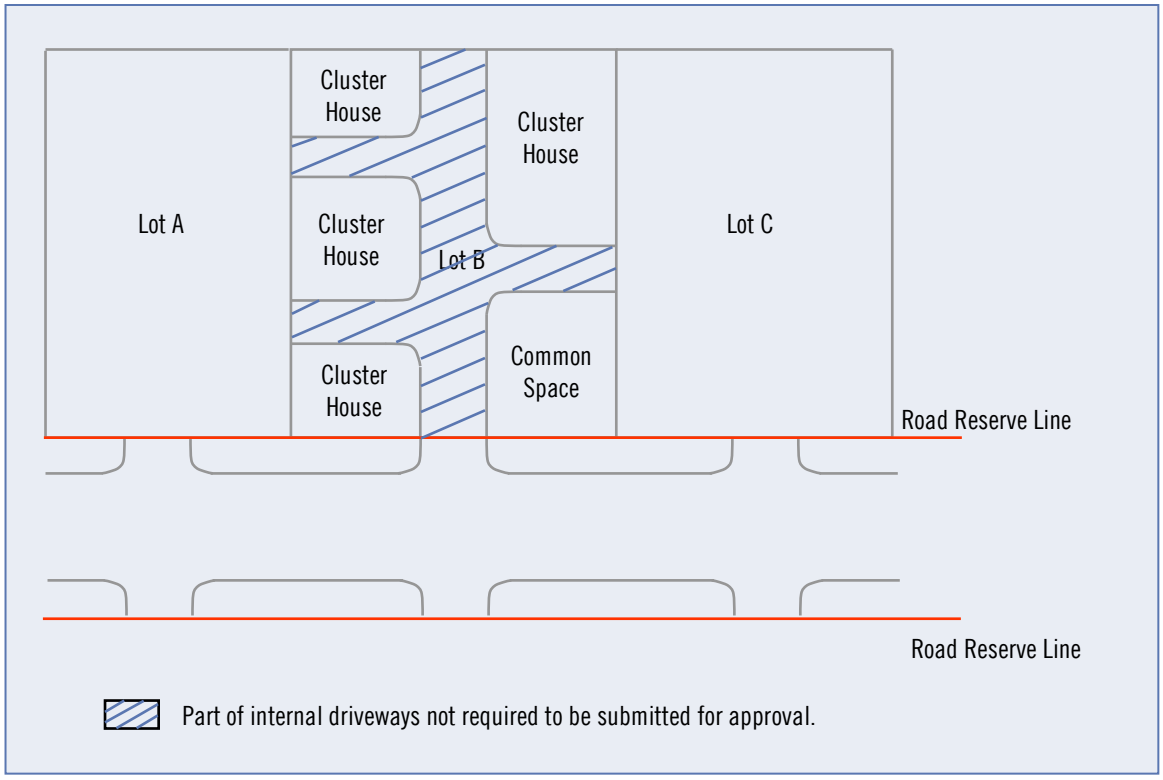


Figure 6.1 **Showing internal Driveways For Cluster Housing (Submission Under New Street Proposal is Not Applicable.**

The design of new streets shall make reference with the LTA's publications stated in section 2.2. The submission requirements for new street proposals are also indicated in section 2.3.

6.2 Adequate Provision of Roads

The width of a road depends on the type and scale of a development. In general:

- Where the development plot entails land sub-division, access to each sub-divided plot must be available either from an existing public road of acceptable function (Figure 6.2) or a road network created within the development (Figure 6.3)
- The width of the road reserve shall vary with the type and intensity of the development

- The new road shall be .safeguarded as road reserve and constructed in accordance with Section 18 of the SWA and handed over to LTA after expiry of the MEP.

The developer shall also carry out the necessary improvement works at the connection of the new street to an existing public street.

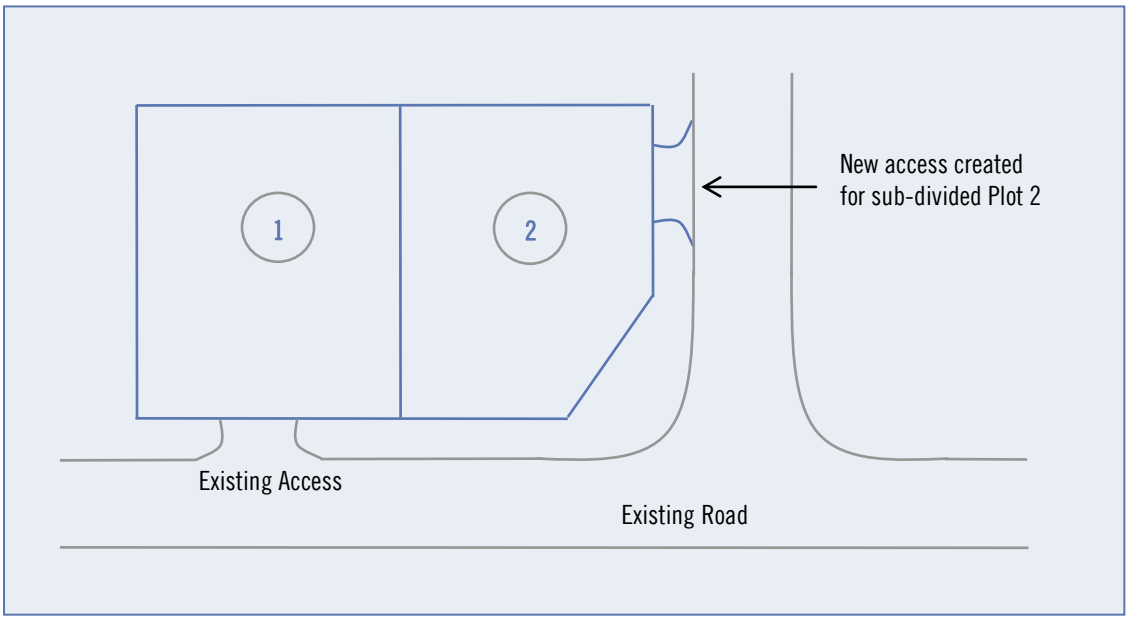


Figure 6.2 **Showing Access to Sub-divided Plot Taken From Existing Road Network.**

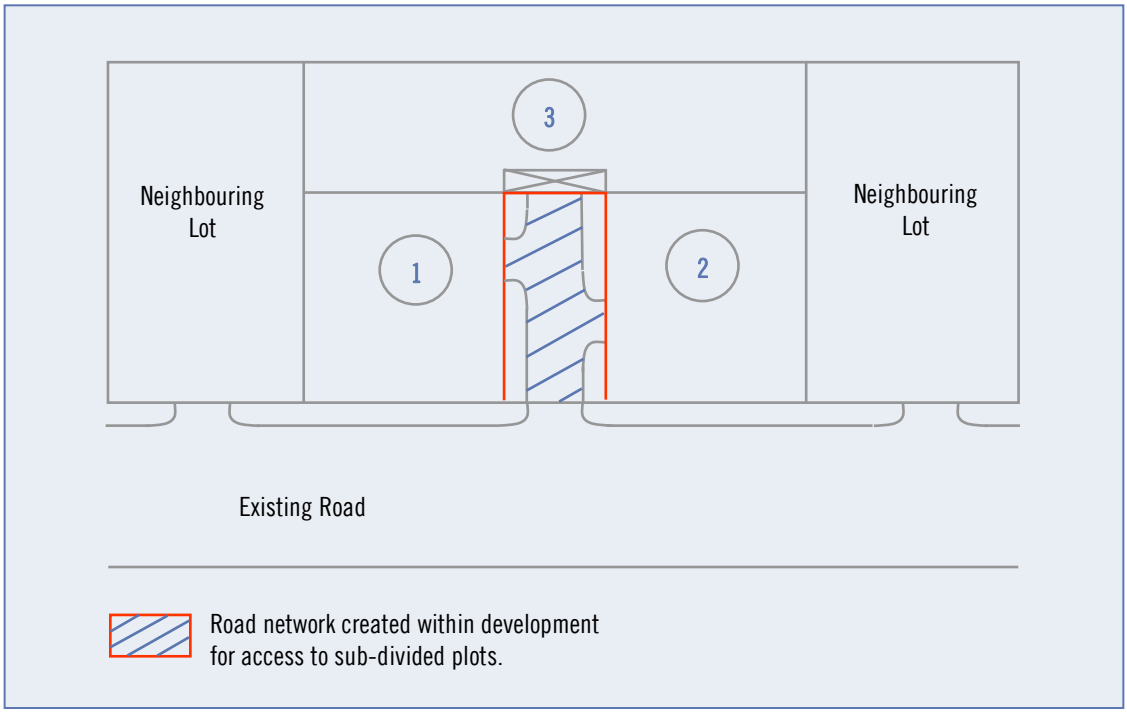


Figure 6.3 **Showing a Road Network Created Within the Development to Provide Access to Sub-Divided Lots**

6.3 Planning Permission

The developer shall obtain the necessary permission under the provisions of the Planning Act if he has the intention to hand-over the completed road to LTA for maintenance. Statutory boards and other government agencies would be required to obtain approval of the Master Planning Committee (MPC) set-up by URA.

The developer's appointed surveyor shall then obtain the Certified Plan approved by Survey Services Department, Singapore Land Authority. The Certified Plan shall be submitted anytime during maintenance period (MEP) before the road is handed over to LTA.

6.4 Utility Services

The developer is advised to liaise with all services providers who wish to lay their services within the new road. This will minimise the inconvenience of having utilities over-crossing the drain. In addition, LTA imposes a no-opening period for 1 year from the time the new street is handed-over to LTA for maintenance.

6.5 Street Works Deposit

For proposals involving construction of a new street, the developer is required to place a street works deposit to LTA before BP Clearance can be issued. LTA is empowered to take over street works which are not commenced or executed satisfactorily and complete the street. All costs incurred will be recovered from the street works deposit. The deposit may be in the form of a banker's guarantee (BG-Appendix 6A). LTA shall advise the developer on the amount to be deposited based on the street plans submitted and the prevailing fixed schedule of rates by LTA.

Once the street plans are approved by LTA, an Order (see sample in Appendix 6B) will be served on the developer to furnish the deposit. The deposit shall be furnished within 21 days from the date of service of the Order.

If the developer fails to furnish the deposit on expiry of the 21 days grace period of the Order, a first reminder will be served. This first reminder will give a further grace period of 14 days. On expiry of the first reminder, a second reminder that gives an additional 14 days notice will be served on the developer. This means that the original 21 days grace period is extended for another 28 days, giving a total grace period of 49 days for the developer to furnish the deposit.

On expiry of the second notice served, the approved street plans will be stamped "Cancelled" and will be returned to the owner if the deposit is still not furnished.

Street works deposit is also applicable for proposed overhead bridges and underpasses across public street constructed by private developer.

6.6 Reduction of Street Works Deposit

Once CSC clearance from LTA is obtained for the new street, LTA need to retain only a portion of the amount that was deposited to cover works during the maintenance period (MEP). The developer shall prepare another BG (Appendix 6C) based on the amount to be retained during the MEP before LTA returns the BG for the original amount deposited.

If the original amount of the street works deposit exceeds S$1 million, LTA shall retain 5% of the original sum or S$100,000, whichever is greater.

If the original amount of the street works deposit is less than S$1 million, LTA shall retain 10% of the original sum or S$20,000 whichever is greater.

When the road is declared a public street and LTA takes over its maintenance, the reduced street works deposit will be returned.

6.7 Maintenance of New Street

A developer may choose to maintain a street while giving the public free access. In this instance, the developer shall maintain the street in a manner acceptable to LTA and not compromise the safety of the general public. The Street Works Act authorises the LTA to execute an order on the developer to rectify any defect on the private street so as not to jeopardise safety of the public. Alternatively, LTA may carry out the repair works and recover the costs from the owner.

LTA reserves the right to evaluate whether or not to take over a road and its related facilities for maintenance. In general, a road that is serving one development only shall not be maintained by the LTA.

6.8 Service Roads

Service Roads are safeguarded to cater for access to localized parking facilities of shophouses and commercial buildings mainly in areas in city centre, Little India, Jalan Besar and Geylang, etc where vehicular access from the main road is not recommended.

Currently, there are two standard cross sections of service road being used by LTA. The width of the standard service road reserves are 9.14m and 7.6m.

Typical cross section of the 7.6m and 9.14m wide service road are shown in Chapter 8 - Appendix 8E.

If the safeguarded service road has not been widened and is unable to cater for any vehicular traffic, they shall be widened and reconstructed in conjunction with the development to serve the new development. Details on the making up and widening of the backlane to road standard shall be submitted during Street Plan stage.

To ensure the owner/developer is aware of the conditions of the existing backlane/service road and whether it can serve the proposed development, the Qualified Person (QP) shall demonstrate the possible access to the development site using the service road by taking measurement of the width of the existing backlane/service road. The QP shall ensure that the service road is wide enough and structurally sound to cater for the development usage.

General requirements of service road:

- The levels of the service road shall be level with the adjacent public street/service road levels to ensure its functionality
- Levels of the proposed and existing service road shall be indicated on plan
- 650mm slab over roadside drain shall be provided on both sides of the service road
- The service road cross-fall shall camber to both sides with gradient 1:30. Cross sectional details to be provided in the submission
- The service road shall be made up of 225mm thick grade 40 concrete, 1 layer of WSFR B8, 1 layer of water proofing membrane, 200mm thick graded granite aggregates and expansion joints at 6m c/c
- Provision of lamp poles is applicable

This chapter deals at depth the presentation standards for street plan submission and relevant documents to be submitted.

Chapter 7

Street Plan Presentation Standards And Requirement

Glossary

Carriageway	Portion of the road formation, including lanes, auxiliary lanes and shoulders that is set aside for the use of vehicles, either moving or stationary.
Permanent Government Benchmark	A major reference mark by surveyors to assist them in re-pegging land parcels and extending new surveys.
Temporary Benchmark	A fixed point with a know elevation used for level control during construction works and surveys.

Chapter 7

Street Plan Presentation Standards And Requirements

7.1 Types of Plans And Documents For New Street Proposals

7.1.1 Types of Plans to be Submitted

The following types of plans in a set of standard A1-sized drawings shall be prepared and submitted:

- Location plans / key plans shall be drawn to a scale of either 1 : 20,000, 1: 10,000 or 1: 5,000
- Site plans, Traffic Plans and Topographical Survey Plans shall be drawn to a scale of either 1: 100, 1: 500 or 1: 1,000
- Cross Sectional Plans and detailed plans shall be drawn to a scale of either 1:20, 1:10, 1:5 or 1:1
- Longitudinal Sectional Plans shall be drawn to a scale of 1:500 or 1:1000 horizontal and 1:50 or 1:100 vertical

7.1.2 Forms And Documents Required

Form and documents accompanying the street plan submission shall include:

- See Appendix 2-A which is to be used when the PE submits the proposed street plans for the development project, to LTA for approval
- A copy of Acknowledgement of Notification of Project Reference Number from Building and Construction Authority where applicable

- Application form duly completed by the owner/developer (Appendix 2-B) and
- A set of structural calculations for proposed road related structural elements. The calculations and plans are required to be checked and certified by PE or Accredited Checker.

7.2 Site Plan

7.2.1 Site Plan Details

A Site Plan shall consist of the following standard typical details:

- A Key Plan showing the location of the proposed road, which shall :
    - be placed at the top left-hand corner of the site plan
    - include the surrounding roads names in the vicinity
    - be drawn to scale (Scale of 1:20,000, 1:10,000 or 1:5,000)

- The Road Reserve Line and cadastral boundary;
- The alignment, width and layout of the proposed new road reserve, which are to be in accordance with that shown on the approved layout plan at planning/DC approval stage;
- Scale of the drawing (1:100, 1:500 and 1:1000, wherever appropriate);
- All proposed road related features (all existing features and proposed features shall be clearly differentiated);
- The proposed position of footpath, turf, tree planting areas, drop inlet chamber with scupper pipe, pedestrian grating, drains, culverts, drain summit (if any) and sump shall be indicated clearly.
- The gradients and directions of crossfalls (normal/superelevated) according to the following standard:

Types of Crossfall	Standard
Normal crossfall	1:30 sloping from the centre of the carriageway towards the edge of the carriageway.
Superelevated crossfall at the bend	1:30 sloping in one direction towards the inner edge (i.e. smaller arc length) of the carriageway at the bend.

Table 7.1 – **Types of Crossfall**

- Layout of proposed entrance design/arrangement to respective development sites, which shall consist of:
    - The Road Reserve Line/ boundary line
    - The actual proposed gradients of the entrance driveways to the development site, within road reserve
    - The proposed entrance widths
    - The dimension of carriageway & sidetable etc.

A typical detail of proposed entrance presentation is in Figure 7.1.

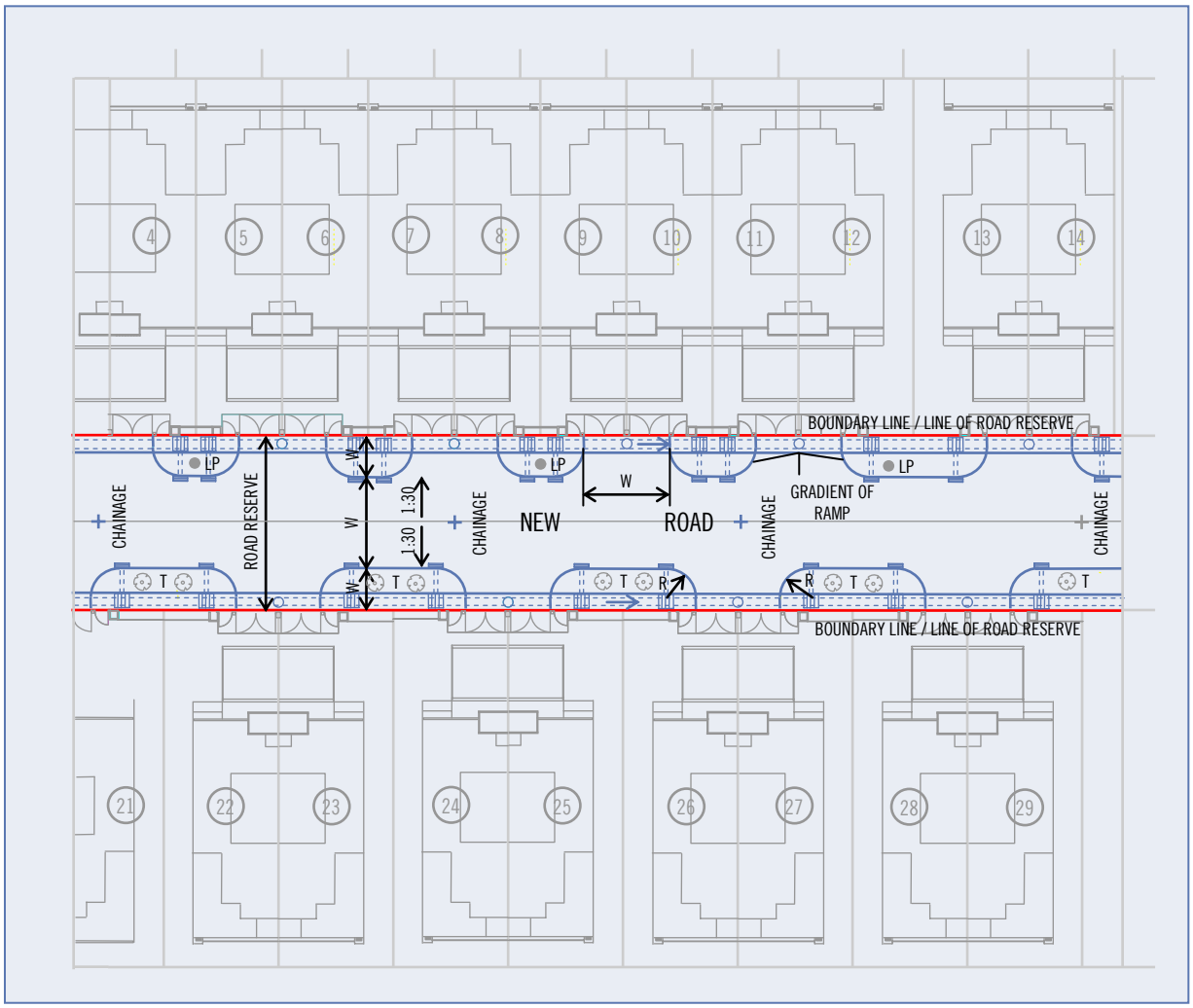


Figure 7.1 **Typical Detail of Proposed Entrance**

- One nearest permanent government benchmark is to be indicated in the Notes and two temporary benchmarks to be shown on the plans;

- Mode of drainage of the new street, in particular -

    - the positions, levels and dimensions of drains
    - the positions of the summits (if any) and the directions of flow with the same information given in respect of existing drains (if any) into which the new drains are to discharge
    - all existing rivers, streams and drains, showing lines, levels and cross-sections
    - the positions, levels and dimensions of culverts (if any) in the new drains at the intersections or entrances of the proposed streets, with the same information given in respect of culverts across existing and new streets.

- Chainage points to be indicated -

    - along the centre line of the road
    - at 30m intervals for proposed roads more than 100m
    - at 15m intervals for proposed roads shorter than 100m
    - at start and end points of transition length of horizontal curve

(Note - proposed levels are to be indicated at these chainages)

The reference marks (e.g. A, B, C, D) shall be indicated along the sides which the longitudinal sections have been taken.

7.2.2 Details at Road Bend

Local widening of the carriageway around the road bend is usually required to mitigate the effects of centrifugal force subjected on vehicles. The following shall be noted when preparing site plan that includes a road bend:

- The widths of the widened carriageway shall be indicated on plan
- To indicate the width of the carriageway for each lane
- The additional carriageway width could be taken from the sidetable width
- To show transition length and position where the road bend starts and ends
- To indicate the superelevated crossfall sloping down 1:30 towards the inner edge (i.e. smaller arc length) of the carriageway
- To indicate the horizontal curve radius measured to the centre line of road.

A typical layout at road bend is shown in Figure 7.2

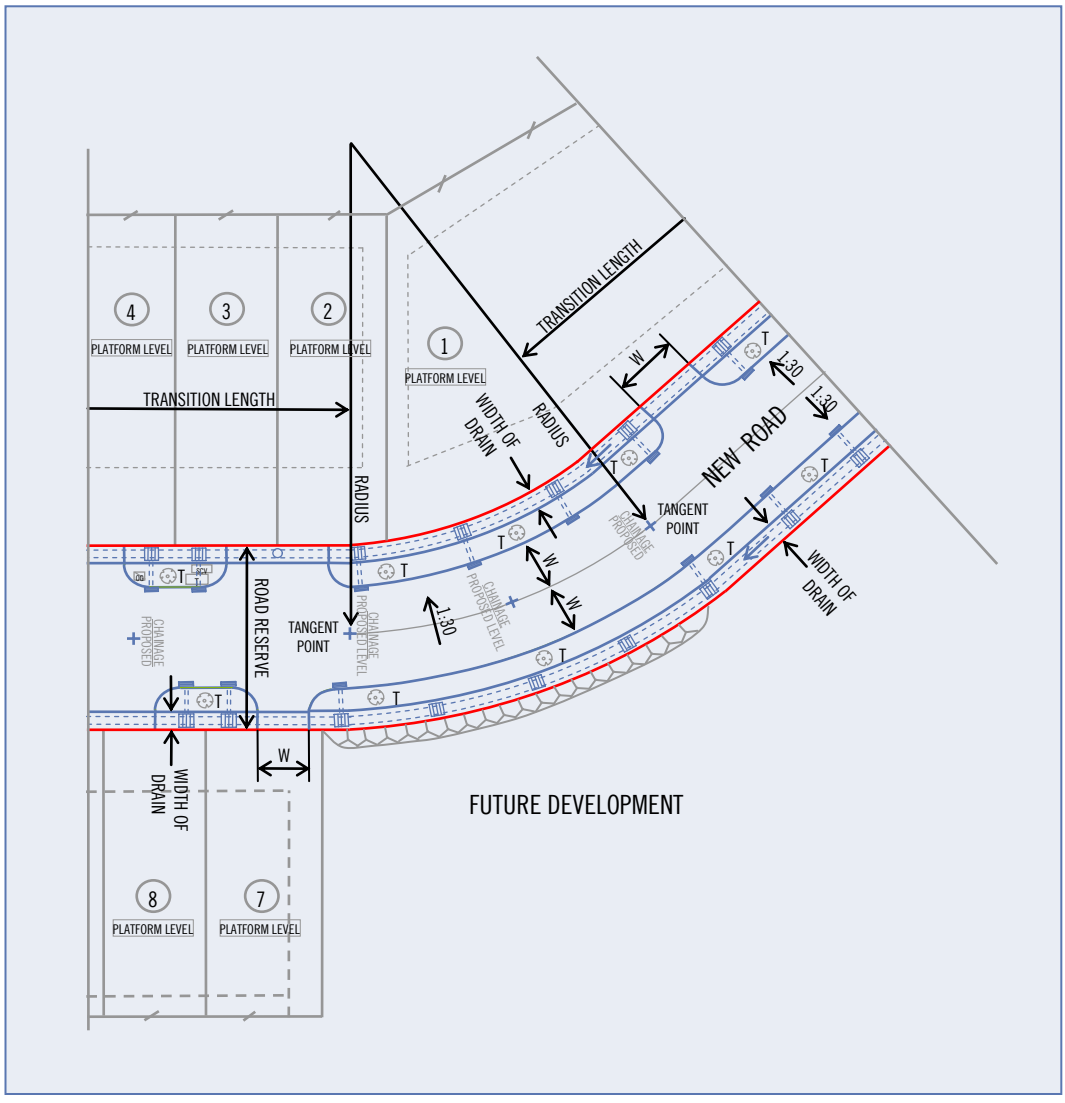


Figure 7.2 **Typical Layout of Road Bend**

7.2.3 Road Connection / Junction

The site plan shall also show the road connection, where the proposed road meets the existing road with the following standards

- There shall be a difference in the colour representation between the existing road (black) and the proposed road (red);
- The angle at which the new street connects with the existing road should be near to 90 degrees for safety and operational viewpoints, but no less than 60 degrees;
- Some existing spot levels of the existing road shall be shown in the site plan, in order to match the proposed road levels with the existing road levels;
- The splay corners and the proposed turning kerb radius at the road connection are also to be indicated on plan; (Refer to Section 8.3.4 for details)
- Sufficient design radius and splay corners are to be provided to allow ample sight distance for vehicles to manoeuvre safely into and out of the main road;
- Proposed footpath ramps for pedestrians shall be indicated at the road junctions to cater for the continuous pedestrian flow.

A typical details presenting junction connection is shown in Figure 7.3.

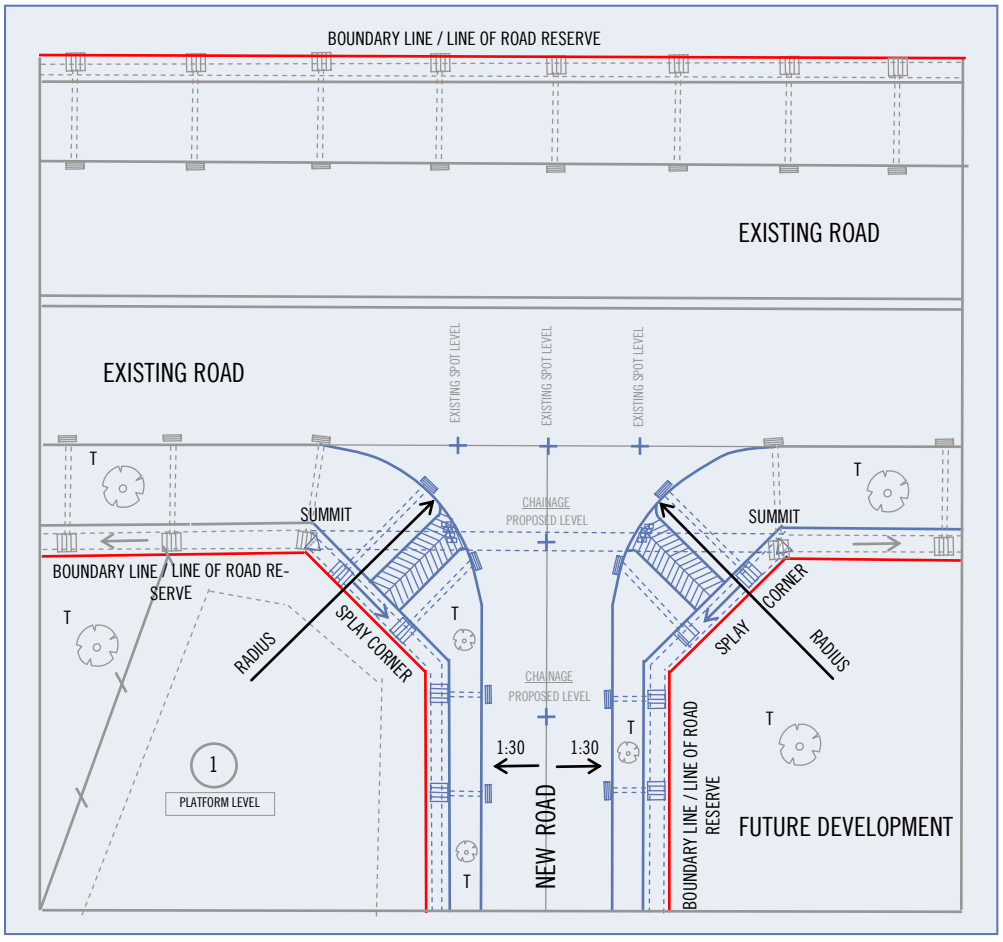


Figure 7.3 **Typical Details of Junction**

7.2.4 Other Proposed Road Facilities

Where applicable, the site plan shall also show other proposed road facilities like bus stop (with / without bay), taxi stand, pedestrian overhead bridges etc.

7.2.5 Right Hand Column on The Site Plan

The right-hand-side column (about 9cm) of the site plan shall show the following:

- Project title
- Job title
- Drawing numbers
- Names of Architects (QP), PE & Owner.
- The Approved layout plan number & the BP number are to be indicated at the top of the column etc.

7.2.6 Bottom Row on The Site Plan

The row at the bottom of the site plan (about 6cm) is for the Notes, the Legends & the Reference to Standard Details of Road Elements.

a) Notes consist of common sections to be shown in the site plan. A sample is shown below:

Notes
1) Slope embankment to be 2 horizontal to 1 vertical (2H: 1V) unless otherwise stated with approved close turfing on 125 layer of top soil.
2) All dimensions shown are in mm unless otherwise stated.
3) To provide 1 government bench mark and 2 temp bench marks.
4) The gradient of all entrance approaches shall not be steeper than 1:10.
5) No manhole shall be placed within the carriageway, entrance approach, entrance culvert, and footpath.

Table 7.2 **Notes**

b) The Legend columns include colour representations and abbreviations in the site plan. A sample legend is shown below;

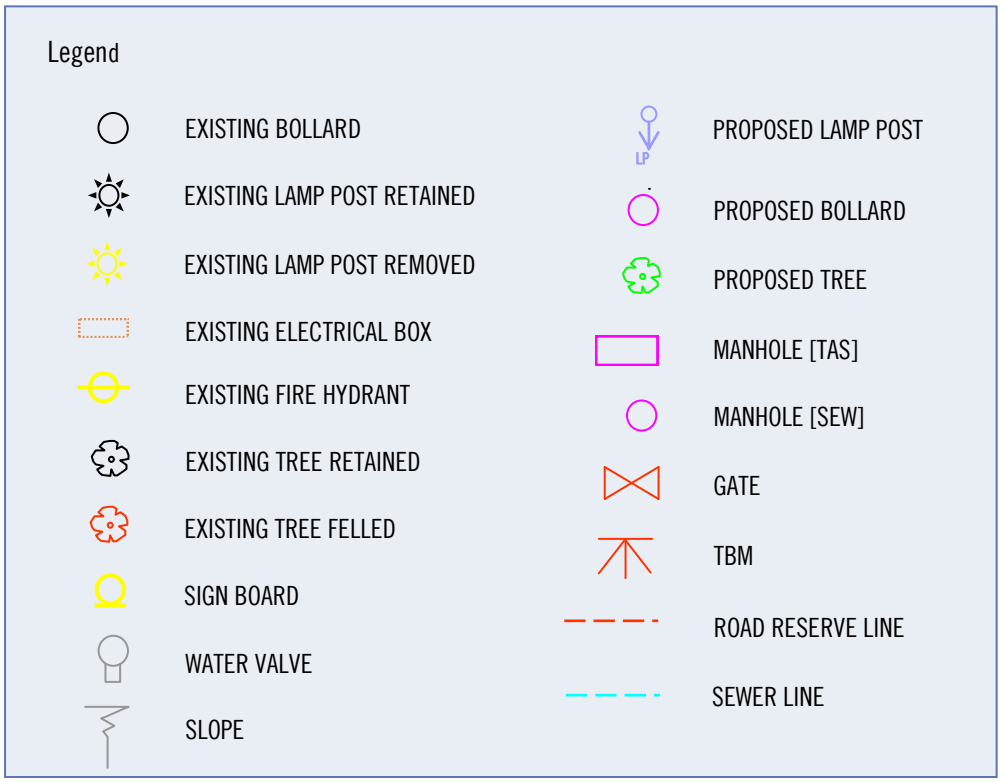


Figure 7.4 **Legend Sample**

c) The Reference to Standard Details of Road Elements is also included in the row provided to show the proposed road related features within road reserve.

Reference to Standard Details of Road Elements		
Note	Description	Drawing no.
1	Pedestrian grating (with chequer plate)	LTA/RD/SD99/GRA/2
2	Type K2 PC. C kerb	LTA/RD/SD99/KER/1A
3	Footpath ramp (side road)	LTA/RD/SD99/KER/9A
4	Footpath ramp (driveway)	LTA/RD/SD99/KER/10A
5	Cast in situ box culvert	LTA/RD/SD99/DRA/2
6	Aluminium rung	LTA/RD/SD99/DRA/4A
7	Precast U-drain and slabbed over U-drain	LTA/RD/SD99/DRA/4A&5A
8	PC. C. Drop-inlet chamber	LTA/RD/SD99/DRA/7E
9	Flexible pavement (Type III) for local access	LTA/RD/SD99/PAV/4A
10	Soil aeration	LTA/RD/SD99/PNR/2A&3

Table 7.3 **Examples of Reference to Standard Details of Road Elements**

d) North Point

The North Point shall also be indicated on the right hand side in the bottom column.

7.3 Longitudinal Section Plan

7.3.1 Reference Markings

The longitudinal section plan consists of a plan showing the longitudinal sections through the centre line and through each side of the carriageway. This plan illustrates the vertical alignment of the proposed road. It has two presentations of longitudinal sections, one for each side of the carriageway (see sample titles below).

- LONGITUDINAL SECTION ALONG NORTHERN EDGE OF ROAD A-B
- LONGITUDINAL SECTION ALONG SOUTHERN EDGE OF ROAD C-D

All reference marks (e.g. A, B, C & D) shall tally with the reference marks as shown on the site plan. This is to differentiate which side of the carriageway the proposed levels are computed.

7.3.2 Levels to be Shown on Plan Shall Include

- the datum level
- the proposed level along centre of carriageway
- the proposed level along edge of carriageway
- the proposed top level of drain/culvert
- the invert level of drain/culvert
- chainage points along centre of carriageway

7.3.3 Legend

Every proposed levels shall be represented by different types of lines and colour

Items	Different Types of Lines And Colour
Datum Level 115.00	
Proposed level along centre line of carriageway	(Bold Thick Black Line)
Proposed level along edge of carriageway	(Dashed Red Line)
Proposed top level of drain/culvert	(Normal Red Line)
Proposed invert level of drain/culvert	(Normal Black Line)
Existing ground level along centre of carriageway	(Normal Black Line)
Chainage in metres along centre of carriageway	

Table 7.4 **Legend**

The vertical & horizontal scales of the longitudinal sections are to be indicated clearly based on the Street Works Regulations (Scale of 1:500 or 1:1000 horizontal and 1:50 or 1:100 vertical).

7.3.4 Chainage

On the longitudinal section plan, chainages should be indicated at the steeper gradients of the entrance approaches, vertical curves horizontal curves and at reference marks (Please refer to section 7.2.1).

7.3.5 Other Details

Other details required to be shown on longitudinal section plan

- Longitudinal gradient along the new street
- Vertical curve wherever changes of gradients occur (if any) & its length at each side based on the point of vertical intersection (PVI)
- Horizontal curve (if any) with its transition length at both sides and radius
- Clear indications of the proposed entrance culverts to respective plots
- Position of the cross culverts (if any) crossing roads (underneath the proposed road levels)
- Proposed levels and existing level at the road connection with the existing street
- Proposed gradient at top of slab over drain
- Indication of the invert levels of drains and the its gradient
- Boundary lines etc

Please note that the above items are to be indicated at the top of proposed profile of road as shown in Figure 7.5 below.

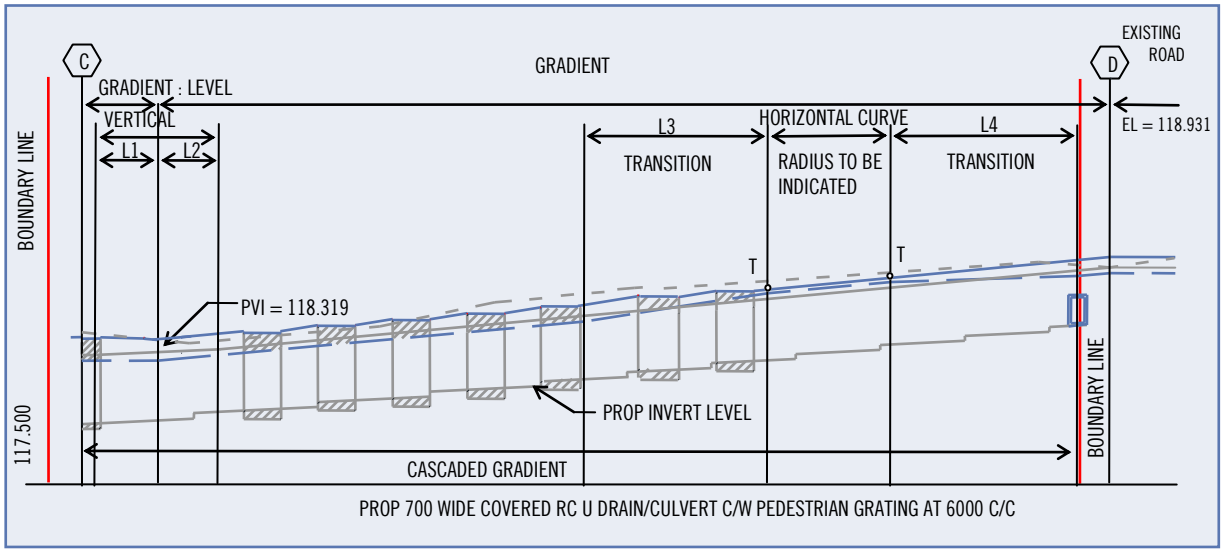


Figure 7.5 **Longitudinal Section of a New Street**

7.3.6 Horizontal Curve in Longitudinal Section

Horizontal curve shall be provided when there is a change in direction of road. Transition lengths at both sides of horizontal curve and radius are to be shown on plan (see typical presentation shown in Figure 7.6 below).

Details showing horizontal curve on longitudinal section plan shall include:

- Sufficient design radius shall be indicated;
- Along the inner edge of road bend (i.e. the shorter arc length), there shall be no change in the crossfall;
- Along the outer edge of road bend (i.e. the longer arc length), there shall be changes in the crossfall in the following circumstances -
    - Where the transition starts, the proposed edge level of carriageway is increased proportionately till the tangent point (TP). There would be a point where proposed levels of road edge and centre of road are the same;
    - At the end of the transition, the proposed level of road edge is greater than the proposed level of road centre. (This is the start of the widened carriageway where the crossfall is 1:30 sloping in one direction towards to the smaller arc length of the curve).
    - There would be another transition length for the super-elevated road to match again with the normal cross-fall road.

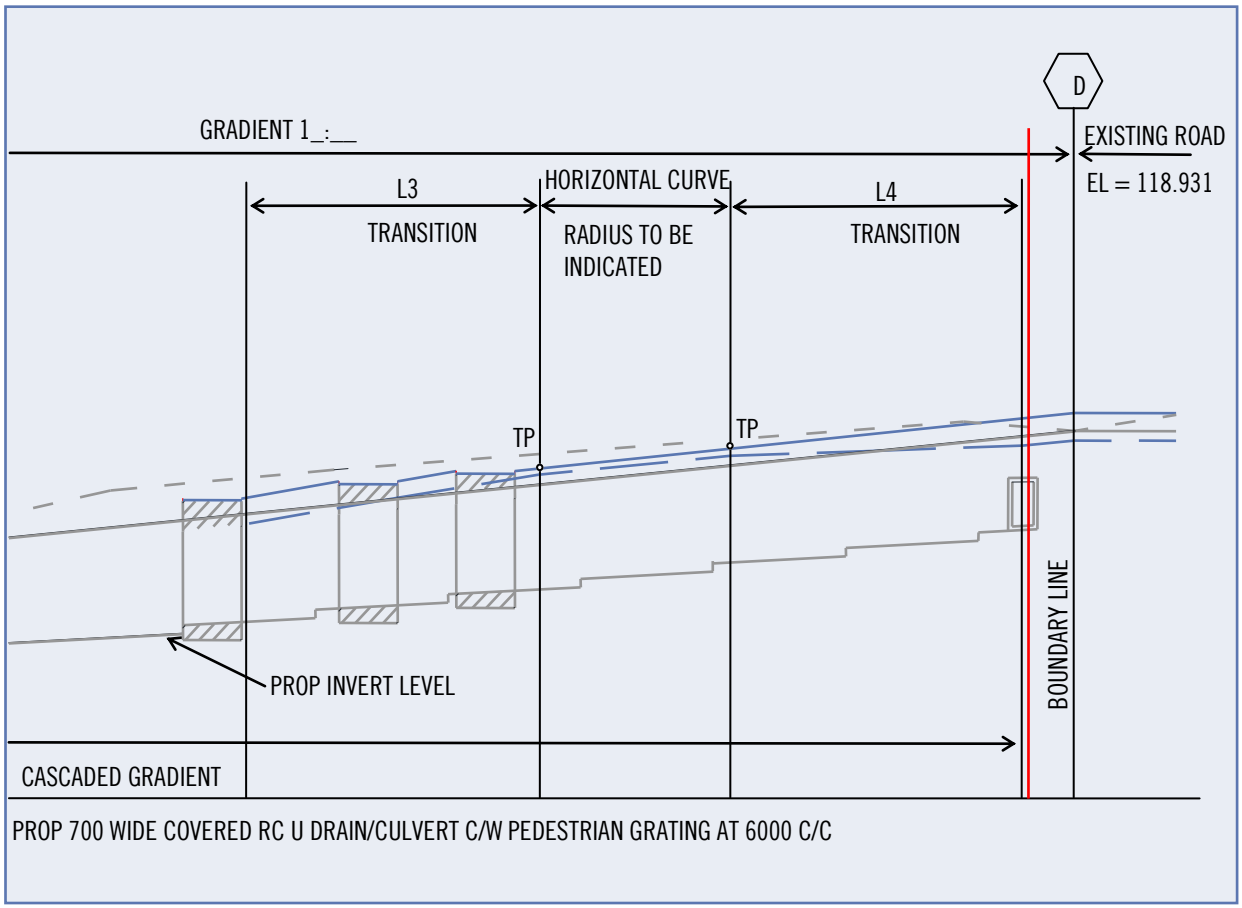


Figure 7.6 **Longitudinal Section of Horizontal Curve**

7.3.7 Vertical Curve in Longitudinal Section

Vertical curve shall be provided when there is a change in gradient of road; it can be either a vertical hog or sag. A vertical curve details shall show the following:

- length of vertical curve
- point of vertical intersection (PVI)
- tangent points (TP)

A typical detail of vertical curve is shown in Figure 7.7 below.

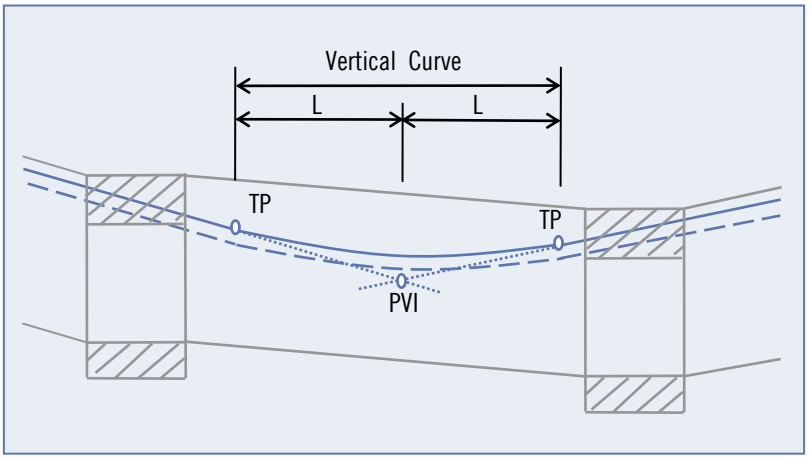


Figure 7.7 **Vertical Curve in Longitudinal Section**

7.3.8 Longitudinal Gradient

For the longitudinal gradient of road, the minimum longitudinal gradient is recommended to be of 0.4% or 1:250. This is to allow proper drainage of the road carriageway. The maximum road gradient shall not be steeper than 1:10. If the proposed carriageway is 1:10, it should be constructed with rigid pavement.

When a road with gradient steeper than 1:30 approaches a junction, a minimum length of 10m with a gradient of not greater than 1:50 shall be provided before meeting the junction (see Figure 7.7 below). Otherwise a flat road of 10m shall be provided.

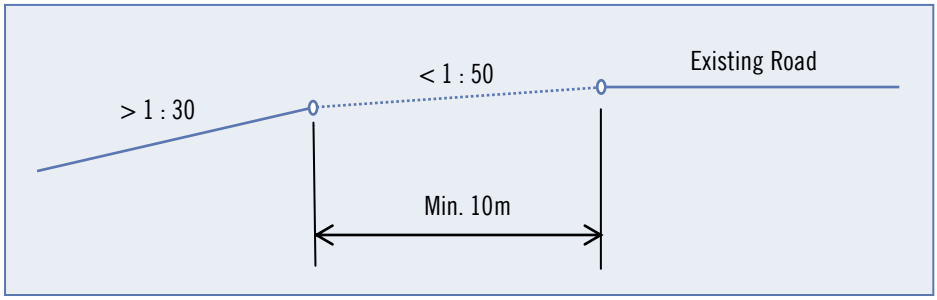


Figure 7.8 **Longitudinal Gradient**

Notes

A minimum length of 40m rigid pavement should be provided for all roads at the junction of a public residential development (such as HDB roads) and a length of 50m rigid pavement for all roads at the junction of an industrial estate.

The rigid pavement starts at the stop line of the approach roads at junctions.

7.4.1 Cross Sectional Plans

The Cross Sectional plans, in A1 size drawing shall show the positions, dimensions and details of the construction of carriageway, kerbs, footpath, sidetables, scupper drains and roadside drains etc. within road reserves or the boundaries of the new street.

The Cross Sectional plans shall have a separate right-hand-side column and a bottom row for neater and systematic presentation.

a) The 9cm wide right-hand-side column is used to indicate the following:

- Project title
- Drawing title & numbers
- Developer's endorsement
- Professional Engineer's endorsement etc.

b) The 6-cm wide row at the bottom is for the following:

Notes

The Notes comprises of general notes & requirements relevant to the displayed cross-sectional details. A sample is

Notes
1. The design of structure not in accordance to LTA's Standards require PE's endorsement and detailed calculations based on the site conditions.
2. Pedestrian aluminium alloy safety railing are to be painted grass green in colour paint code is RAL Standard: RAL 5002 grass green.
3. Surface of interval walls /soffits of the box culvert are to be treated with a coat of anti-carbonate such as Alkyl Silane or Silane Silaxane penetrating sealor 10 to protect against chloride ingress.
4. The following concrete grades shall be used unless otherwise stated in the LTA's Standard drawings: Reinforced concrete – grade 40 Mass concrete – grade 20 Lean concrete – grade 15
5. The last layer of 500mm of sub-grade material shall have a minimum soaked CBR of 5% and shall be compacted to minimum of 95% of maximum dry density. The minimum compaction for sub-base material shall be 95% and for base course material shall be 98% of the maximum dry density using the modified AASHTO compaction test or test 13 of BS 1377.

Table 7.5 **Notes**

Reference Notes to Standard Details of Road Elements.

The table lists down the LTA's standard detailed drawings relevant to the proposed road related features within road reserve shown on the cross-sectional plan. For example, when one indicates the flexible pavement type 3, pedestrian gratings with chequer plates standard drawing numbers in the Reference table, one need not show the structural details in the drawing.

Reference to Standard Details of Road Elements		
Note	Description	Drawing no.
1	Pedestrian grating (with chequer plate)	LTA/RD/SD99/GRA/2
2	Type K2 PC. C kerb	LTA/RD/SD99/KER/1A
3	Footpath ramp (side road)	LTA/RD/SD99/KER/9A
4	Footpath ramp (driveway)	LTA/RD/SD99/KER/10A
5	Cast in situ box culvert	LTA/RD/SD99/DRA/2
6	Aluminium rung	LTA/RD/SD99/DRA/4A
7	Precast U-drain and slabbed over U-drain	LTA/RD/SD99/DRA/4A&5A
8	PC. C. Drop-inlet chamber	LTA/RD/SD99/DRA/7E
9	Flexible pavement (Type III) for local access	LTA/RD/SD99/PAV/4A
10	Soil aeration	LTA/RD/SD99/PNR/2A&3

Table 7.6 **Example of Reference to Standard Details of Road Elements**

7.4.2 Typical Cross Sections to be Shown

The following types of typical cross sections of proposed roads shall be shown on plan:

- Typical Road Section with Normal Crossfall (Section A)
- Typical Superelevated Road Section (Section B)
- Typical Entrance Culvert Section (Section C), where applicable
- Typical Cul-de-sac Section (Section D), where applicable
- Typical RC Sump Section (Section E)

In each of these typical cross sections, the following information shall be shown:

- drawing title
- scale
- reference section number.
- details of the standard road elements can be annotated by pointers like "See Note….."
- line of Road Reserve Line
- a uniform dimensioning and detailing system

7.4.3 Examples of The Various Typical Cross Sections

a) Cross section with normal crossfall

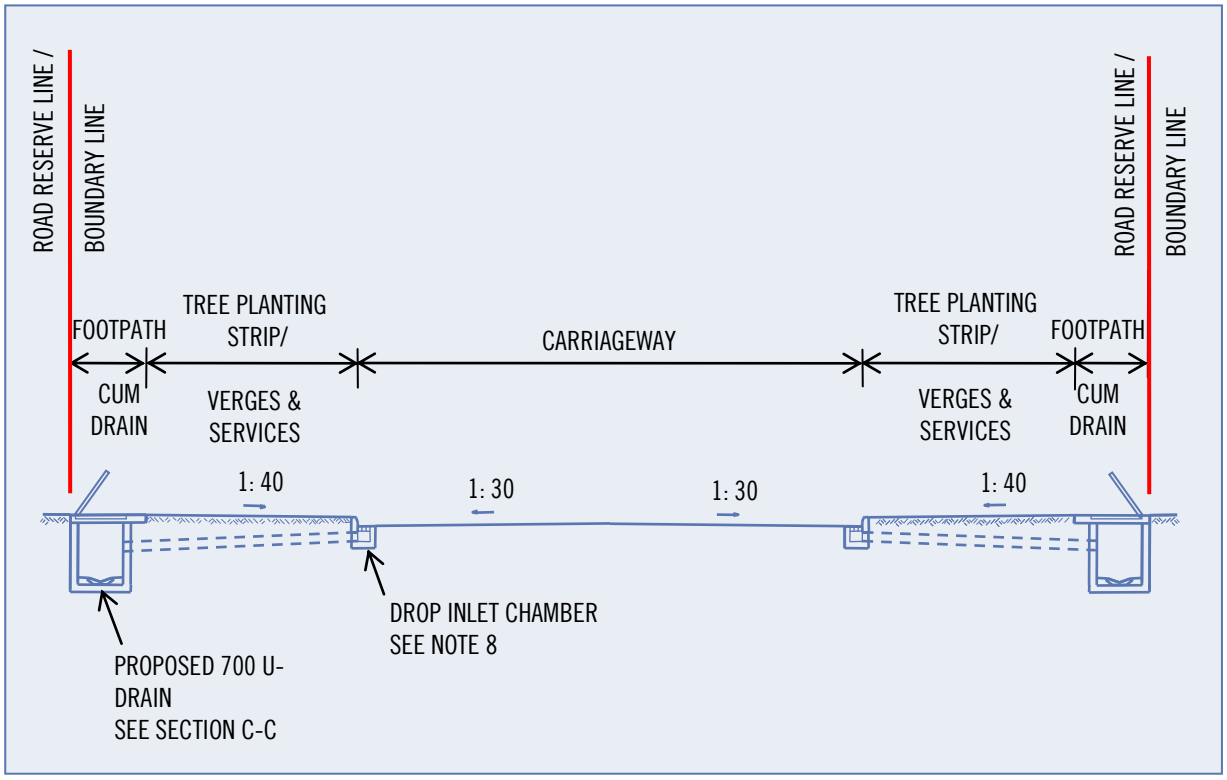


Figure 7.9 **Cross Section With Normal Crossfall**

- The gradients shall be indicated clearly on the drawings
- The widths of the road sidetable and the road carriageway shall indicated clearly
- Details of the standard road elements such as the drop inlet chambers shall be annotated by pointers as “See Note 8”
- The Road Reserve Lines and boundary lines shall also be indicated clearly on the cross-section.
- The enlarged details of a section could be indicated as ‘see other sections’. In the above example, it is indicated as ‘see section C-C for details of the proposed 700 U drain’
- Openings are required along the scupper pipe if length of scupper pipe exceeds 5m

b) Typical cross section for super elevated road

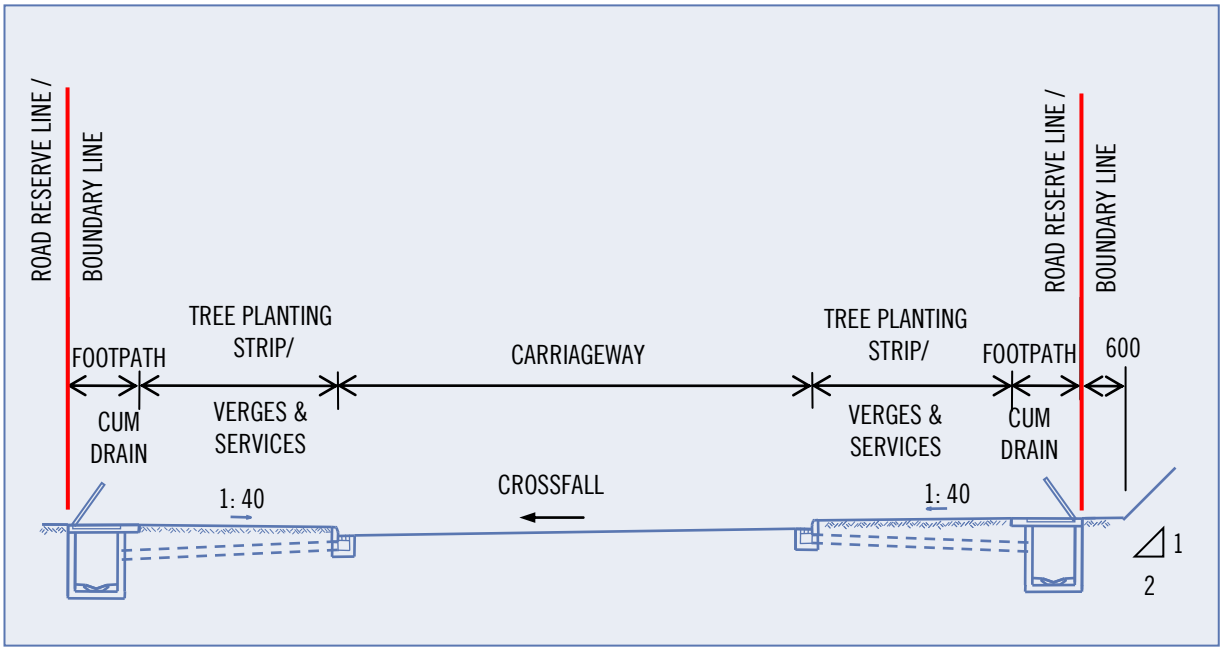


Figure 7.10 **Cross Section For Super Elevated Road**

The section shows a typical superelevated road cross-section at a road bend. Some of the differences from the typical normal crossfall road are as follows:

- Crossfall is sloping towards the inner curve of the horizontal curve (i.e. the smaller arc length of the road bend). The crossfall for super-elevation depends on the road design speed and the radius of the horizontal curve. Please refer to Civil Design Criteria for details.

- Widths of the carriageway & sidetable are adjusted to allow a wider carriageway width at the road bend. For the above case, the carriageway width is widened by 300mm for each direction and the planting verge width is reduced accordingly.

Note
For some cases, the width of the road reserve would be increased meaning taking in more land from the adjacent sites for the road widening, therefore retaining the standard sidetable width.

Slope beside proposed covered drains (See Figure 7.10)

- Where the height of cut & fill are 2 metres or more, the slope shall not be steeper than a ratio of 2 horizontal to 1 vertical. Slopes steeper than the above may require soil investigations and analysis by PE before deeming it to be acceptable.

- The 600mm level berm indicated in Figure 7.10 serves as a buffer for any soil erosion from the slope getting directly onto the footpath, which may inconvenience pedestrians.

- Alternatively, the PE may provide retaining wall system outside the road reserve, with permission of the land owner. LTA shall only maintain the retaining wall that is supporting the road.

c) Typical section of entrance culvert

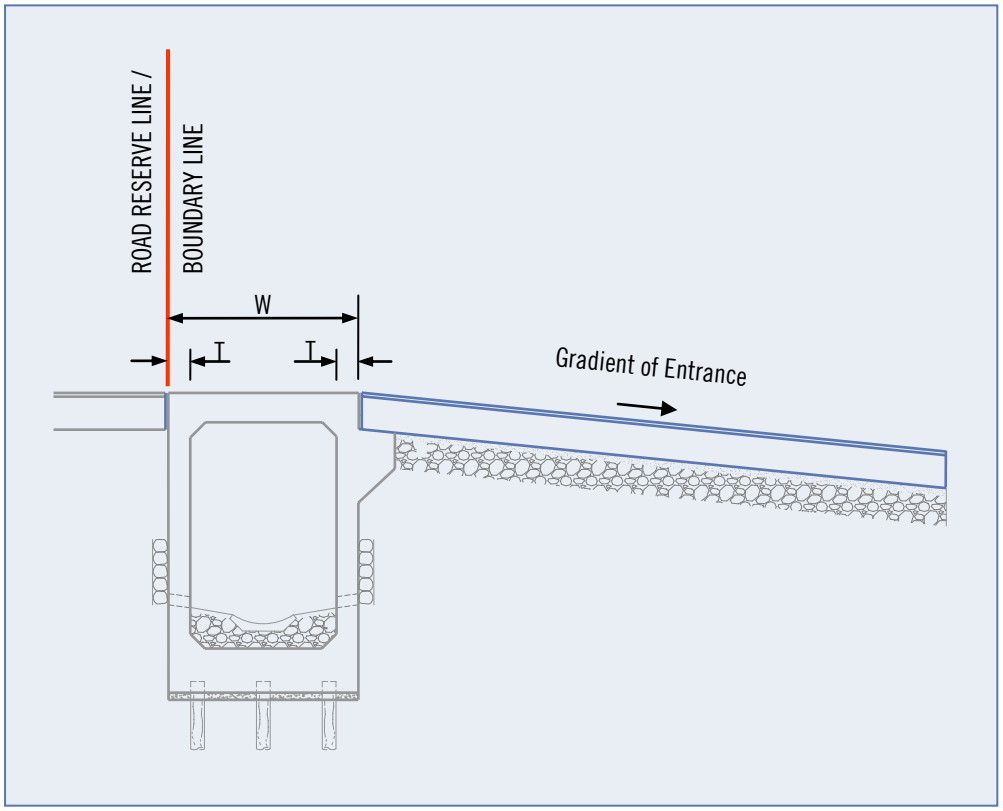


Figure 7.11 **Typical Section of Entrance Culvert**

The PE could exercise flexibility in the design of proposed road related features within road reserves. The PE shall ensure the structural integrity of all such features with detailed drawings and calculations based on the site conditions. The Standard Details of Road Elements could be used by the PE for the proposed submission or as a guide in PE's design of the proposed road features.

- For this section, the PE shall design the structural details of the reinforced concrete culvert. The widths, dimensions and gradient of entrance approach shall be indicated.

- The corbel details could also follow the standards shown in the Standard Details of Road Elements.

d) Typical section of cul-de-sac

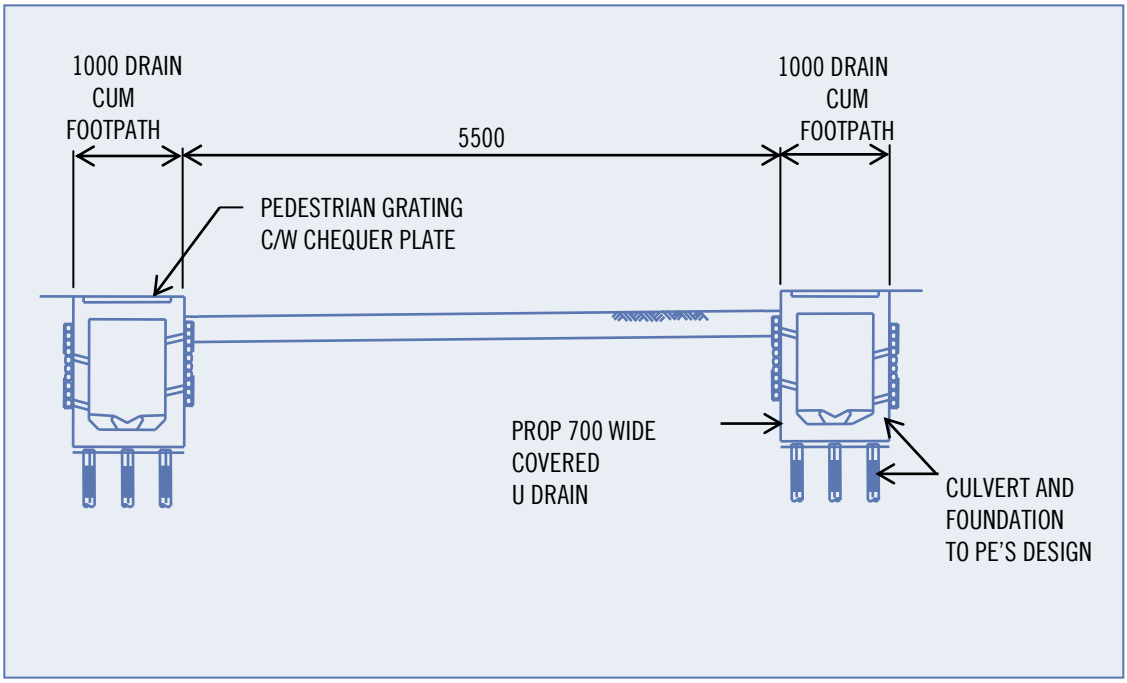


Figure 7.12 **Typical Section of Cul-de-sac**

Whenever a cul-de-sac is proposed in a site plan, a cross-section detail should indicate the widths of footpaths and carriageway. The above section shows a typical example of a cul-de-sac section.

e) Typical section of RC sump

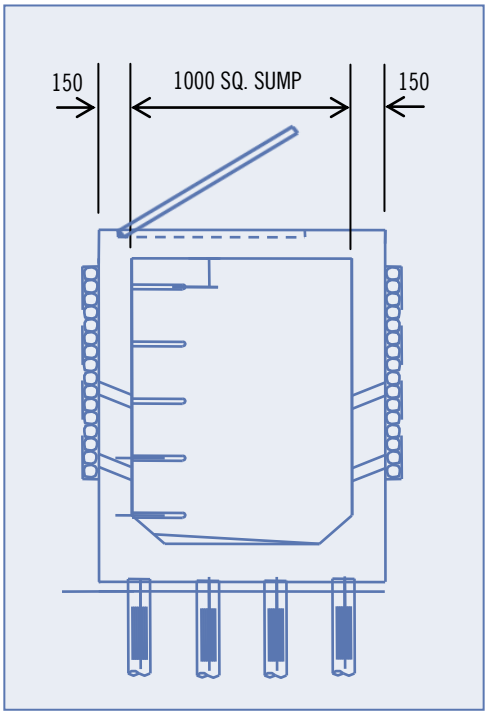


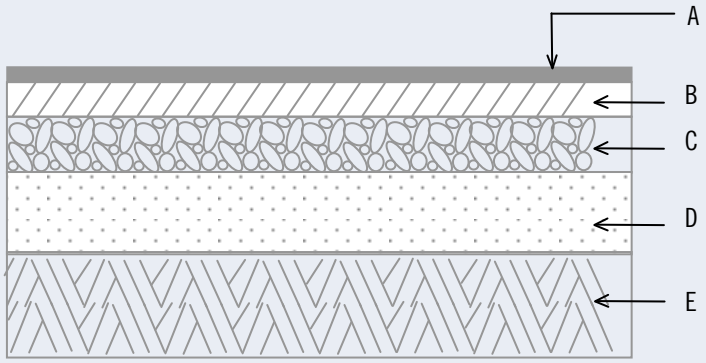
Figure 7.13 **Typical Section of RC Sump**

- The PE shall also design and show the structural details of the proposed reinforced concrete sump within road reserve.
- The standard aluminium rungs shall also be shown.
- It would be advisable to use geocomposite sub-soil drain to be riveted at 1.2m c/c throughout length of wall (with reference to the LTA Standard Details for Road Elements) rather than to use the hardcore packing throughout the wall length. This is to facilitate the construction works on site.

7.5 Types of Road Pavements

The more common types of road pavements are described below. Please refer to the Standard Details of Road Elements and the Materials & Workmanship Specifications for more information.

- Flexible pavement (Type I) for expressways, semi-expressways, arterial roads or industrial roads



A - 50mm thick bituminous wearing course (mix classification SMA) shall be of 60/ 70 penetration with minimum 4.5% and maximum 5.5% soluble bitumen content (to LTA's standard) and shall be laid with a mechanically spreader. Laying a wearing course is to be included in **Final Premix Surfacing Contract** only.

B - 120mm thick bitumen binder course (mix classification B1) shall be of 60/ 70 penetration with minimum 4.5% and maximum 5.0% soluble bitumen content (to LTA's standard) and shall be laid with a mechanically spreader.

C - 250mm thick base course shall be of graded granite aggregate and shall be laid in 2 layers, each at 125mm thk. The base course material shall be compacted to minimum 98% of the maximum dry density using the modified AASHO Compaction Test or Test 13 of BS 1377.

D - 300mm consolidated thickness of sub-base shall be quarry waste or equivalent shall be compacted to minimum of 95% of the maximum dry density maximum obtained using the modified AASHO Compaction Test or Test 13 of BS 1377 and shall have a minimum soaked CBR of 30%.

E - The last layer of 500mm thick sub-base material of sub-base shall have a minimum soaked CBR of 5% and shall be compacted to minimum of 95% of maximum dry density modified AASHO Compaction Test.

Figure 7.14 **Flexible pavement (Type I) for Expressways, Semi-expressways, Arterial Roads or Industrial Roads**

- Flexible pavement (Type II) for primary access roads

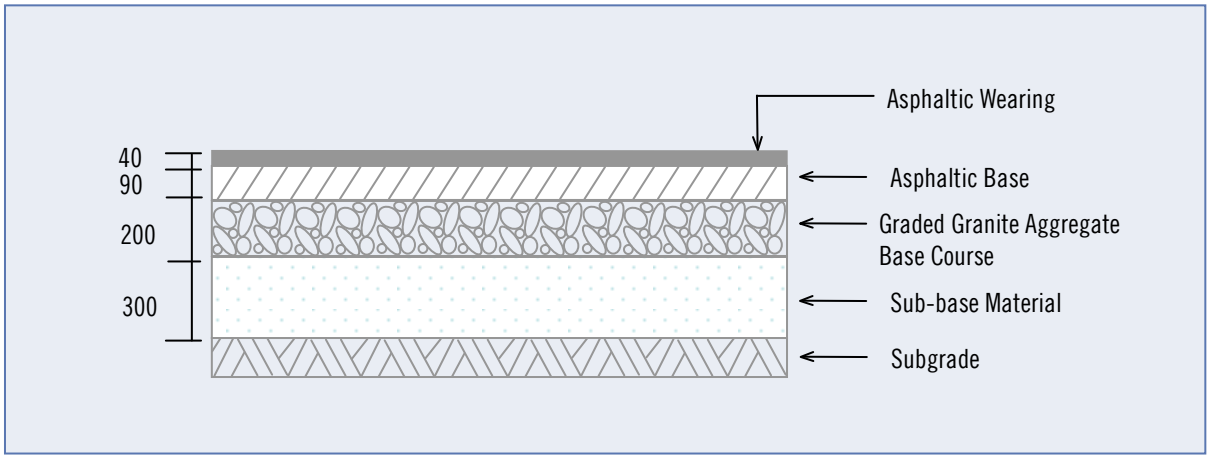


Figure 7.15 **Flexible Pavement (Type II) For Primary Access Roads**

- Flexible pavement (Type III) for local access roads

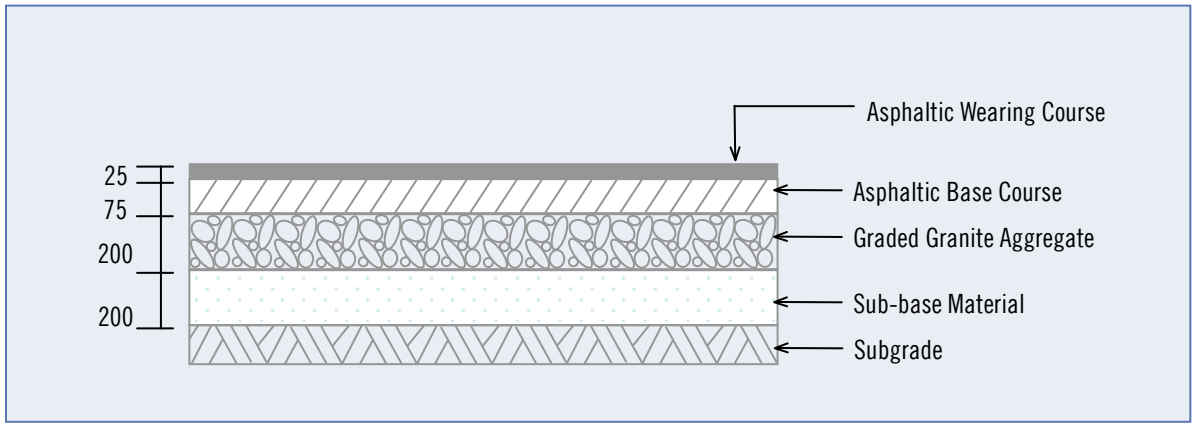
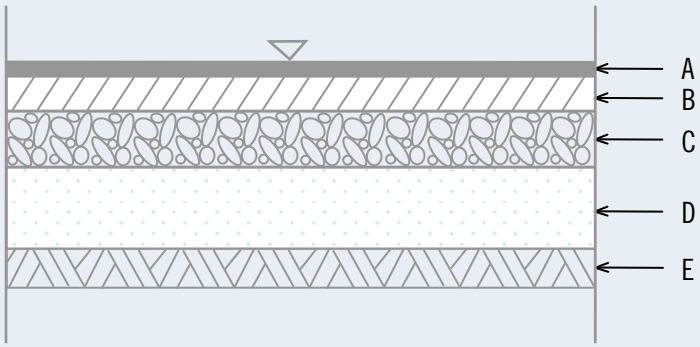


Figure 7.16 **Flexible Pavement (Type III) For Local Access Roads**

- Reclaimed land



A - 75mm thick wearing course using stone mastic asphalt (SMA) with polymer modified of performance grading not less than PG-76.

B - 120mm thick base course (B1) with the addition of a bitumen additive at the rate of 8% by weight of the total bitumen content. The bitumen additive shall be high in asphaltenes (not less than 70%) and nitrogen compounds (not less than 3%). One such additive available in the market carries the trade name of "Gilsonite".

C - 400mm thick base course shall be of graded granite aggregate and shall be laid in 3 layers: 2 layers at 130mm thick and 1 layer at 140mm thick. The base course material shall be compacted to minimum 98% of the maximum dry density using the modified AASHO compaction test or Test 13 of BS 1377.

D - 400mm consolidated thickness of sub-base shall be quarry waste or equivalent shall be compacted to minimum of 95% of the maximum dry density maximum obtained using the modified AASHO Compaction Test or Test 13 of BS 1377 and shall have a minimum soaked CBR of 30%.

E - The last layer of 500mm thick sub-base material of sub-base shall have a minimum soaked CBR of 5% and shall be compacted to minimum of 95% of maximum dry density modified AASHO Compaction Test.

Figure 7.17 **Reclaimed Land**

7.6 Details of Frontage Improvement to Development

The figures below explains the points to take note when preparing plans for frontage improvement along proposed developments.

- Development Frontage (With Road Widening Plot)

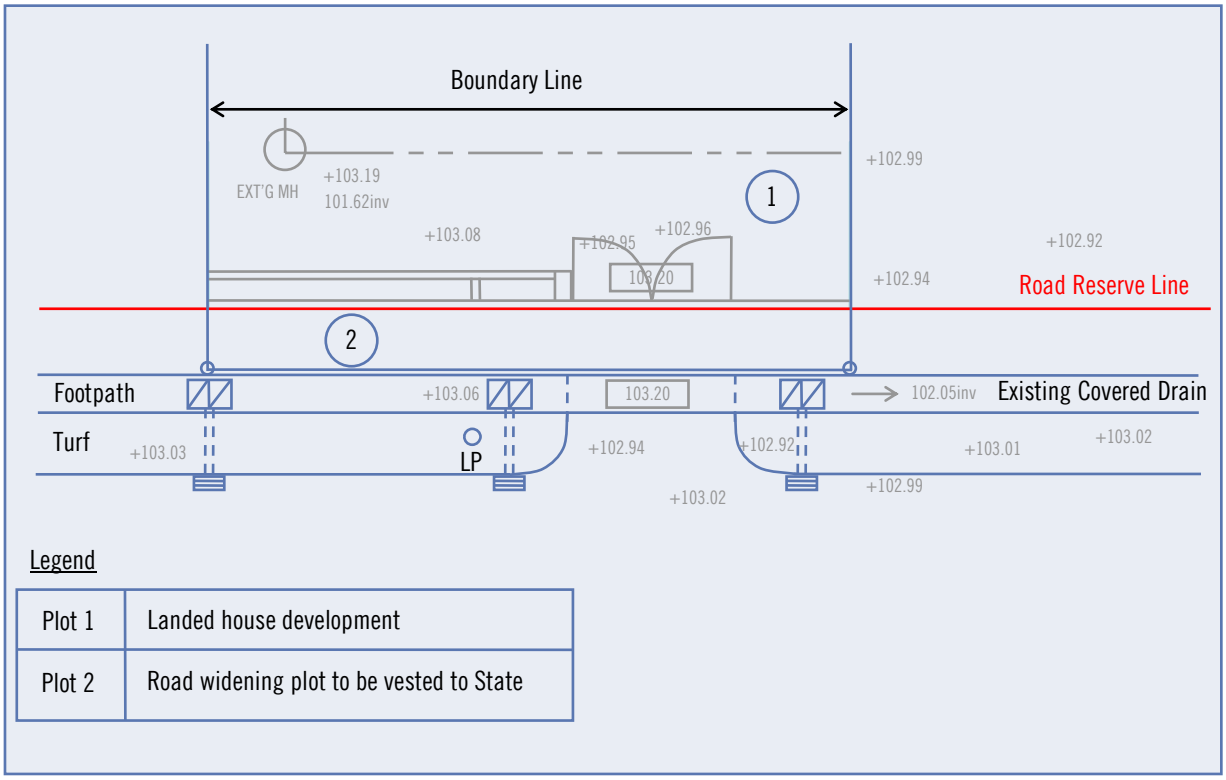


Figure 7.18 **Details of Frontage Improvement to Development**

- Show boundary line
- Show Road Reserve Line
- Show road widening plot
- Show legend for road widening plot
- Show footpath and kerbline
- Show existing turf area
- Show existing open/covered drains
- Show existing drop inlet chambers
- Indicate existing road levels, proposed culvert & internal platform levels
- Show existing lamp posts, OG box, traffic signs, manholes
- Show existing traffic markings, road hump, zebra crossing

- Development Frontage (With Road Widening Plot)

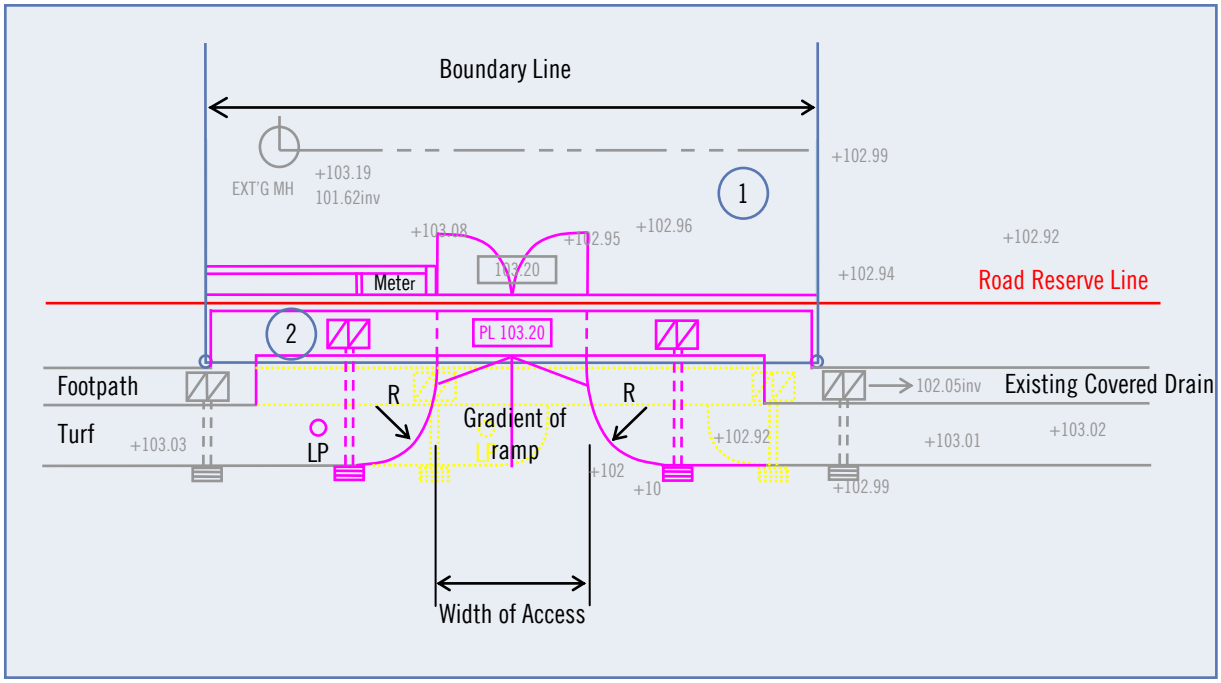


Figure 7. 19 **Details of Frontage Improvement to Development**

- Show road features to be deleted in dotted yellow lines
- Show proposed road features in magenta
- Proposed covered drain to set back and abut road reserve line
- Indicate width of proposed access
- Indicate proposed turning kerb radius
- Show gradient of proposed entrance approach
- Proposed top level of culvert to be higher than road level
- Show location of meter compartment
- Show proposed location of lamp post affected by proposal
- Show proposed drop inlet chamber at tangent points of turning radius
- Show position of side gate, if any

- Development Frontage (Without Road Widening Plot)

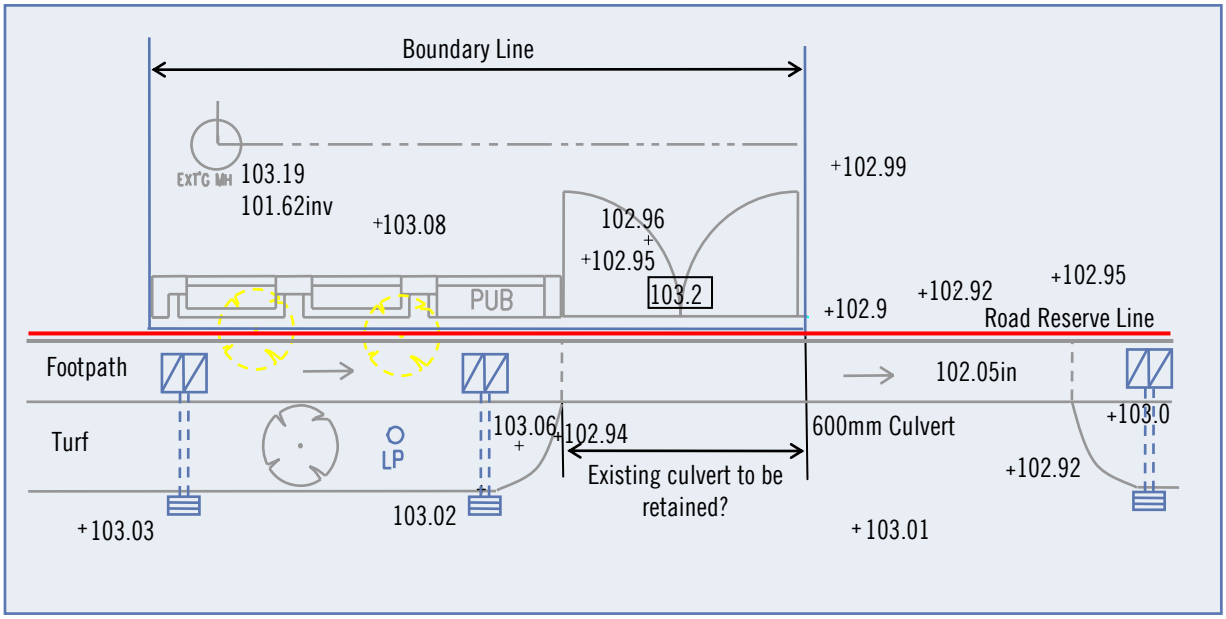


Figure 7.20 **Development Frontage (without Road Widening Plot)**

- Show boundary line
- Show Road Reserve Line
- Show existing kerbline
- Show existing turf area
- Show existing footpath of adjacent building
- Show existing open/covered drain
- Show existing drop inlet chambers
- Indicate existing road levels, proposed culvert & internal platform levels
- Show existing lamp posts, OG box, traffic signs, manhole & meter compartment
- Show existing traffic markings, road hump, zebra crossing
- Annotate on plan whether the existing culvert is to be retained or is there any proposed works within the road reserve

- Development Frontage (Without Road Widening Plot)

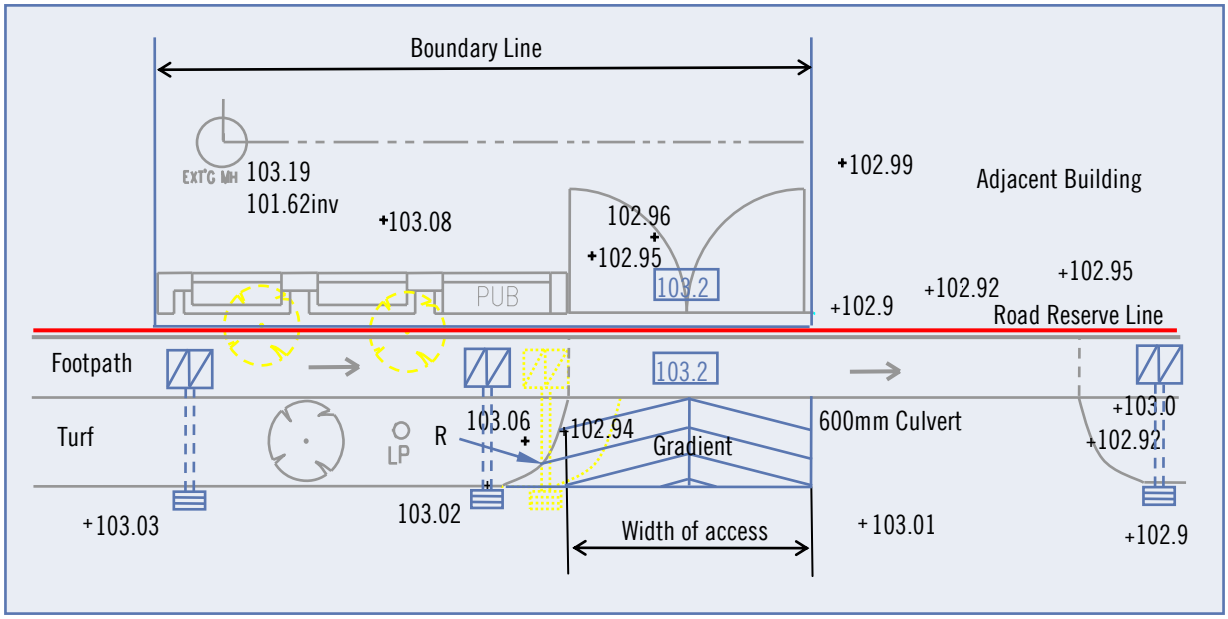


Figure 7.21 **Development Frontage (without Road Widening Plot)**

- Show road features to be deleted in dotted yellow lines
- Show proposed road features in magenta
- Indicate width of proposed access
- Indicate proposed turning kerb radius
- Indicate the gradient of entrance approach
- Proposed top level of culvert to be higher than existing road level. Otherwise, cut off drain to be provided

7.7 Examples of Various Plans to be Submitted

- Site Plan

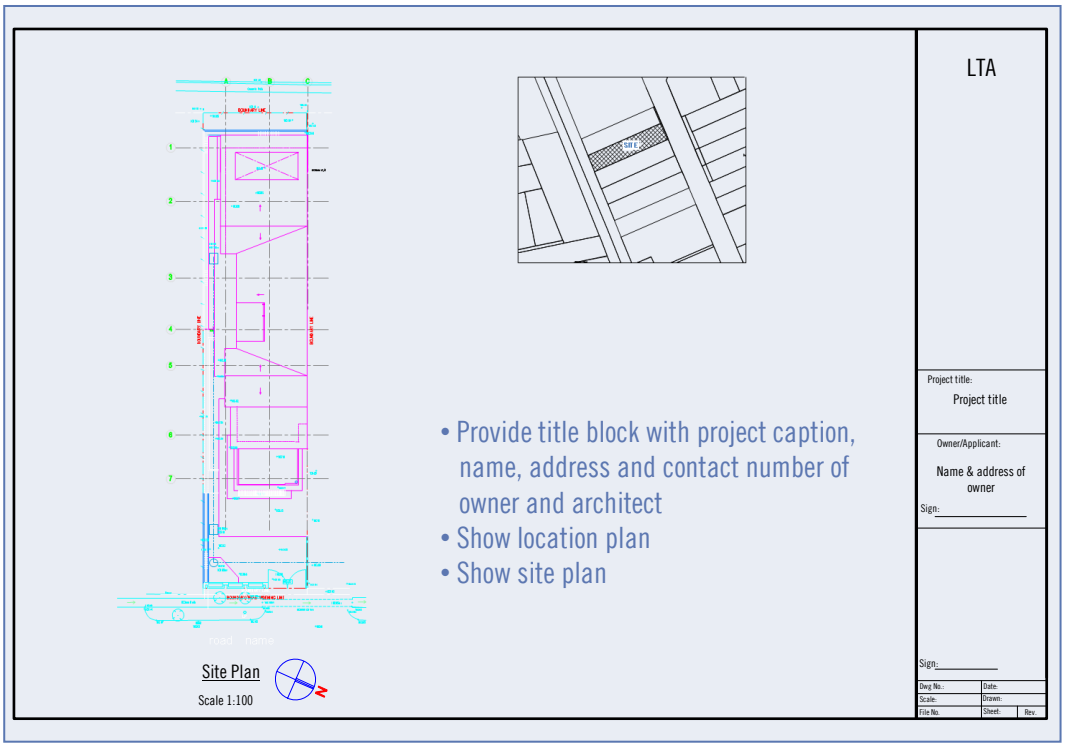


Figure 7.22 **Site Plan**

- First Storey Plan

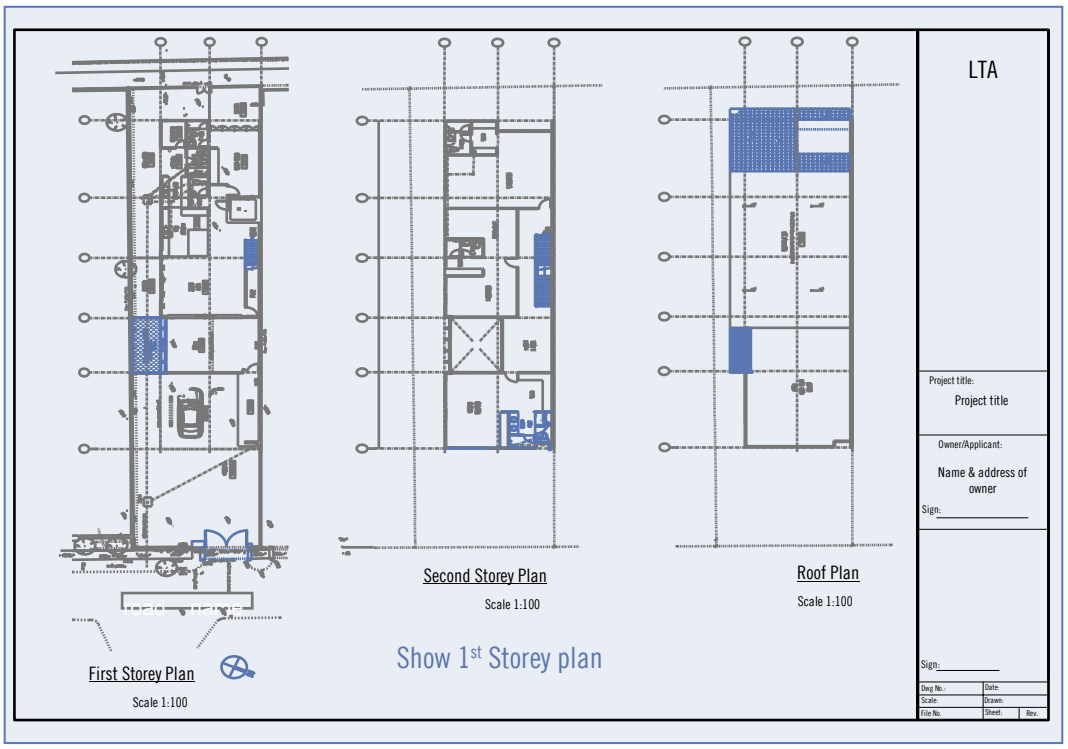


Figure 7.23 **First Storey Plan**

- Cross-section and Elevation Plans

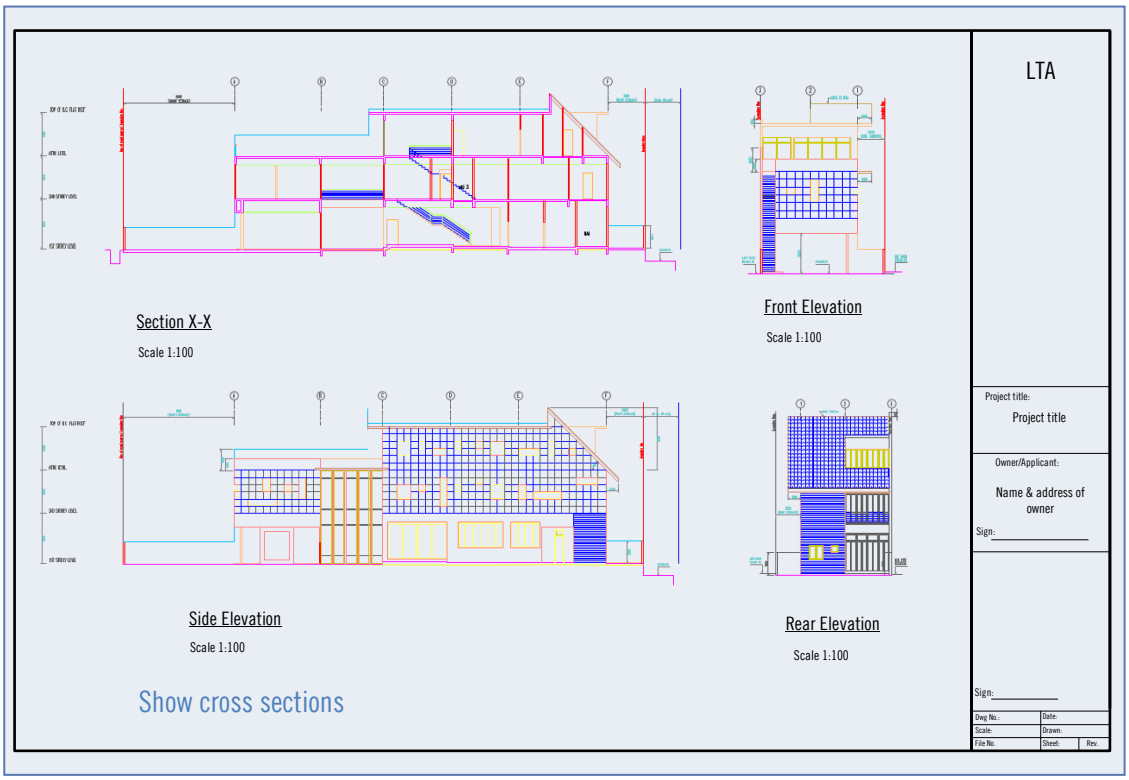


Figure 7.24 **Cross-section and Elevation Plans**

- Topographical Survey Plan

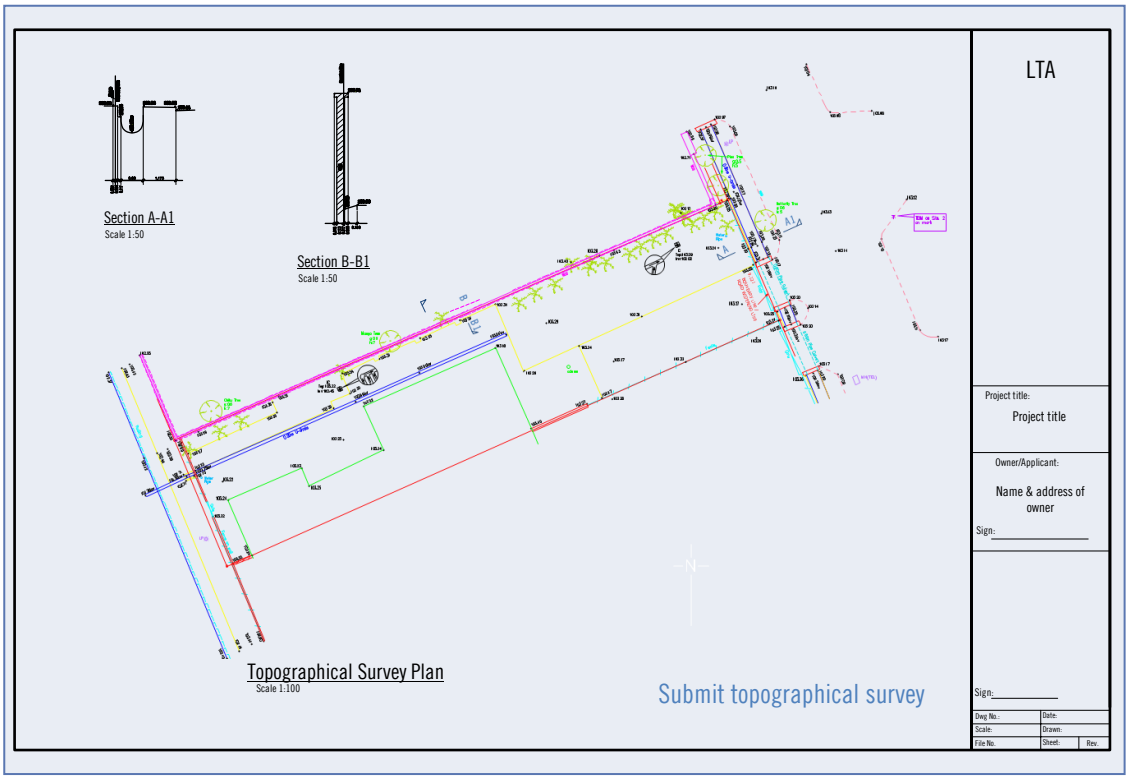
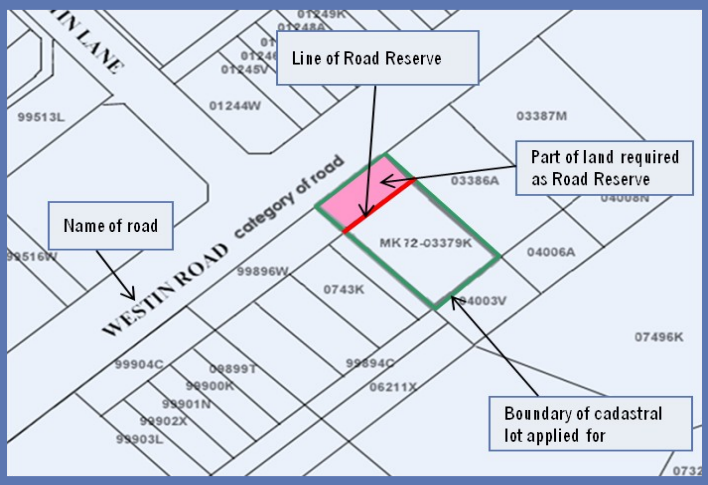


Figure 7.25 **Topographical Survey Plan**

This chapter outlines the process of safeguarding of road reserve lines and the various standards adopted for road geometry (cross-section, junction layout, cul-de-sac layout etc).



Chapter 8

Safeguarding of Road Reserve Lines

Glossary

Encumbrance	Generally refers to private structures that encroaches into the road reserve.
Vest in the Sate	To convert the status of the land lot from Private to State Land.

Chapter 8

Safeguarding of Road Reserve Lines

8.1 Introduction

Road reserve lines are safeguarded for -

- road widening
- proposed roads, e.g. expressways and arterial roads
- road interchanges and traffic junctions
- bus-bays and other road facilities; and
- access to plots of land

8.2 Information on Road Reserve Lines

Information on road reserves lines is available to the public via the Road Line Plan (RLP). The extent of road reserve lines affecting a particular land lot is shown in the RLP. The RLP may be purchased from the convenience of home or office via the Internet.

You may visit LTA's website at http://www.lta.gov.sg or Integrated Land Information Service (INLIS) website at http://www.inlis.gov.sg to make a purchase.

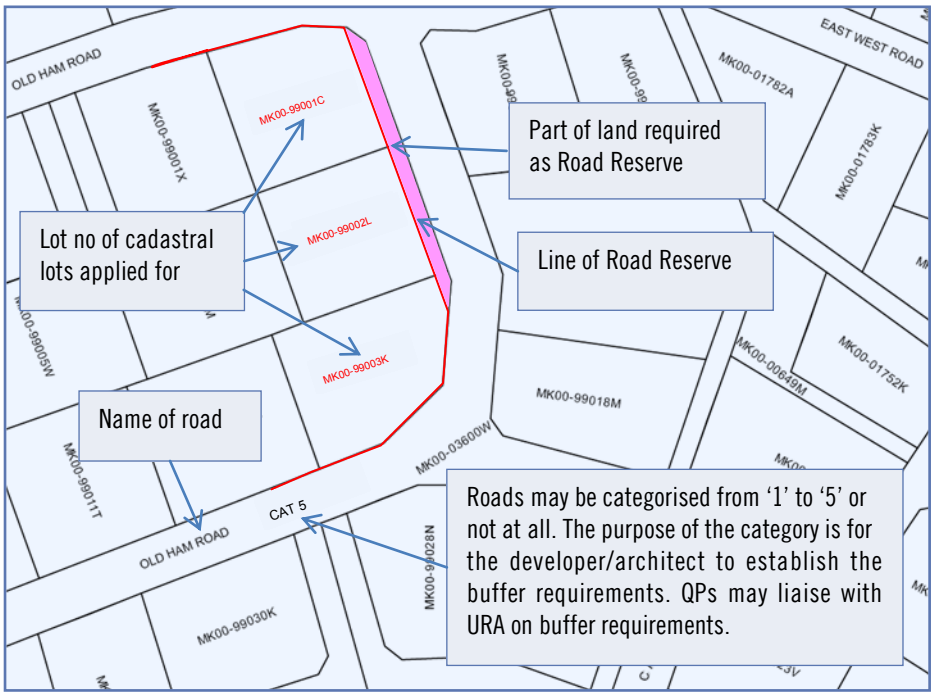


Figure 8.1 **Sample of a Road Line Plan**

8.3 Criteria for Safeguarding Road Reserve Lines

Generally, the future demand for road space depends on the generated traffic volume, which in turn depends on the scale, intensity and type of land use. In terms of width of road reserve, the safeguarding criteria are generally as given in the following sections.

8.3.1 Safeguarding of Private Residential Estate Roads and Service Roads

The road reserve width of roads within private residential estates is generally 15.4m as shown in table 8.1 below. The standard cross-section details for existing roads that have been constructed based on a 12.2 m or 14.2 m road reserve can be found in Appendix 8D. This is made available for reference only and all new local access roads in private estates shall follow the 15.4m road reserve. The road reserve width of service road shall be either 7.6m or 10m depending on its location.

Function	Development Type	Width of Road Reserve
Local Access	Detached / Semi-Detached / Terrace	15.4m
Service Roads	(i) All Types (ii) Within central area	7.6m 10m

Table 8.1 **Road Reserve Width For Residential Estate Roads And Service**

8.3.2 Safeguarding of Expressways, Road Interchanges and Junctions

Notional alignments of expressways and locations of road interchanges are formulated in land use and transportation studies. An expressway reserve is either 45.5m wide for a dual three-lane carriageway or 52.9m wide for a dual four-lane expressway. At expressway interchanges and junctions, the required road reserve varies and is dependant on the design layout.

8.3.3 Safeguarding of Road Related Facilities

Where facilities such as bus-bay, pedestrian overhead bridge and underpass are to be catered for, the road reserve lines would be extended to safeguard the additional land area required.

8.3.4 Safeguarding of Splay Corners

A splay corner is required at the intersections of roads so that motorists' view of the oncoming traffic will not be obscured. Provision of a splay corner shall be as follows:

Type of Roads	Dimension of Splay Required
Roads in industrial area	9m x 9m
Roads in residential area	3m x 3m
Roads in residential area (meeting major roads)	6m x 6m
Service roads and backlanes	3m x 3m

Table 8.2 **Dimension of Splay Corner For Various Road Types**

8.4 Setback of Development Boundary

Where a development proposal is affected by Road Reserve Line, the developer is required to setback his development boundary. The developer is also required to reconstruct the culvert and roadside drains to abut the Road Reserve Line. This would minimise disruption to his property when the relevant authorities carry-out any upgrading works in the future.

For proposals involving additions and alterations works only, the developer will not be required to setback his boundary. However, no new structures shall be allowed within the road reserve.

In addition, the developer is required to vest the affected portion of land to the State without the State or the LTA making any payment or giving any consideration whatsoever for the same with vacant possession and free from encumbrances prior to the issue of the Certificate of Statutory Completion (CSC). For the purpose of vesting the affected portion of land, the developer is required to submit a copy of the approved Subdivision Plan under Section 14(4) of the Planning Act and a copy of the Certified Plan before handing over the completed streets or frontage improvements.

8.5 Cross-Section of Road Reserves

A road reserve consists of a carriageway, tree-planting strip, verge for services, roadside-drain cum footpath and a centre median. A list of cross-sections for the various types of road reserves are shown in Appendix 8A to 8E.

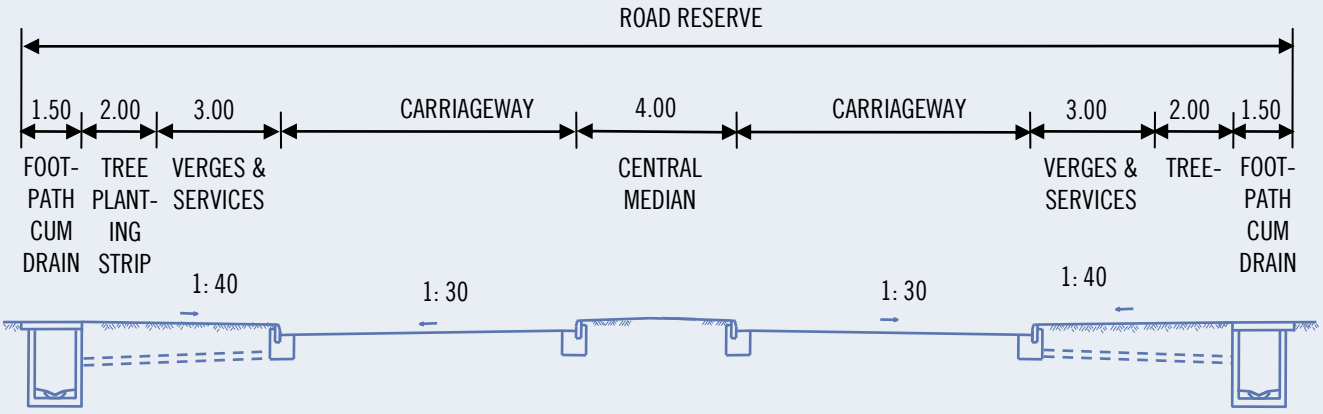
8.6 Cul-de-sacs

At the end of a no-through road (dead-end), a cul-de-sac may be provided to facilitate turning for long vehicles. Generally, a cul-de-sac has to be provided for all industrial roads. The various types of cul-de-sacs are shown in Appendix 8F & 8G

8.7 Junction Layout

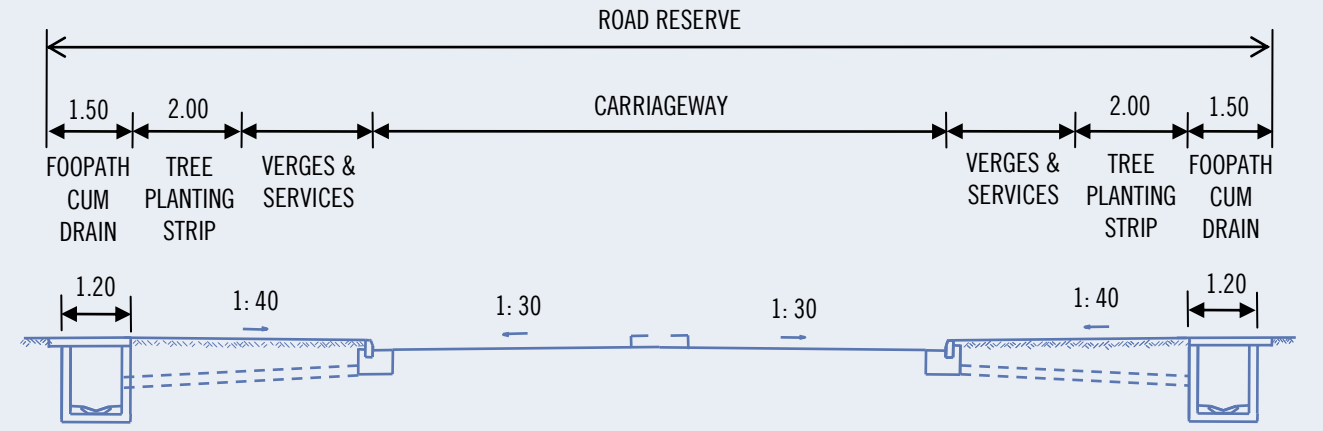
A typical arrangement of the various types of junction layout are shown in Appendix 8H to 8L

Appendix 8A - Major Roads



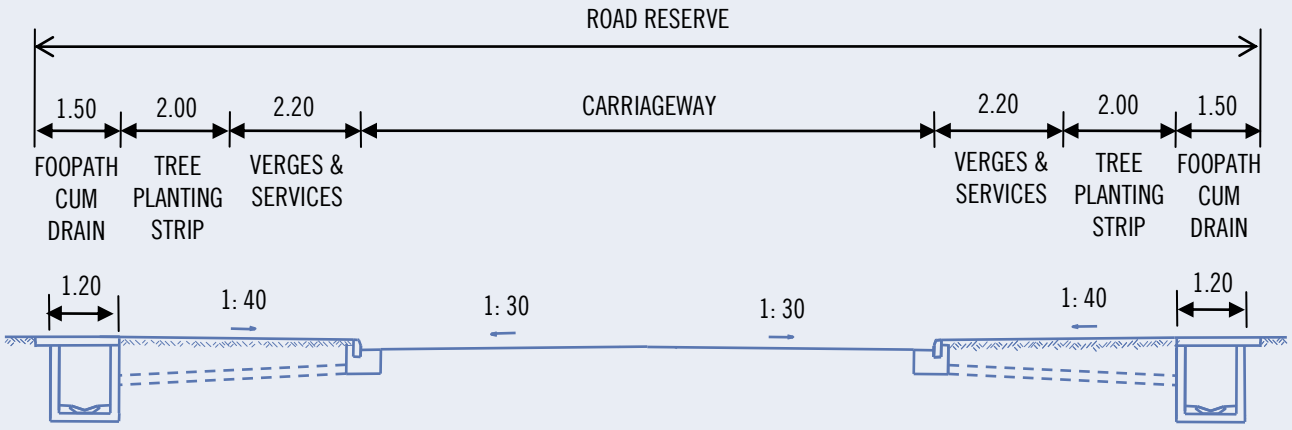
Number of Lanes	Central Divider (m)	Carriage-way (m)	Verge & Services (m)	Tree Planting (m)	Footpath Cum Drain (m)	Road Reserve (m)
8	4.00	2 x 14.20	2 x 3.00	2 x 2.00	2 x 1.50	45.40
6	4.00	2 x 10.80	2 x 3.00	2 x 2.00	2 x 1.50	38.60
4	4.00	2 x 7.40	2 x 3.00	2 x 2.00	2 x 1.50	31.80

Figure 8.1 **Dual - Carriageway Roads**



Number of Lanes	Carriageway (m)	Verge & Services (m)	Tree Planting (m)	Central Divider (m)	Footpath Cum Drain (m)	Drain (m)	Road Reserve (m)
4	2 x (3.7 + 3.7)	2 x 1.90	2 x 2.00	0.60	2 x 1.50	2 x 1.20	26.20
2	10.00	2 x 2.20	2 x 2.00	-	2 x 1.50	2 x 1.20	21.40

Figure 8.2 **Divided / Un-divided Two-Way Roads**



Number of Lanes	Carriageway (m)	Verge & Services (m)	Tree Planting (m)	Footpath Cum Drain (m)	Drain (m)	Road Reserve (m)
2	7.40	2 x 2.20	2 x 2.00	2 x 1.50	2 x 1.20	18.80
3	11.10	2 x 2.20	2 x 2.00	2 x 1.50	2 x 1.20	22.50
4	14.80	2 x 2.20	2 x 2.00	2 x 1.50	2 x 1.20	26.20
5	18.50	2 x 2.20	2 x 2.00	2 x 1.50	2 x 1.20	29.90

Figure 8.3 **One-way Traffic Roads**

Appendix 8B - Roads in Industrial Area

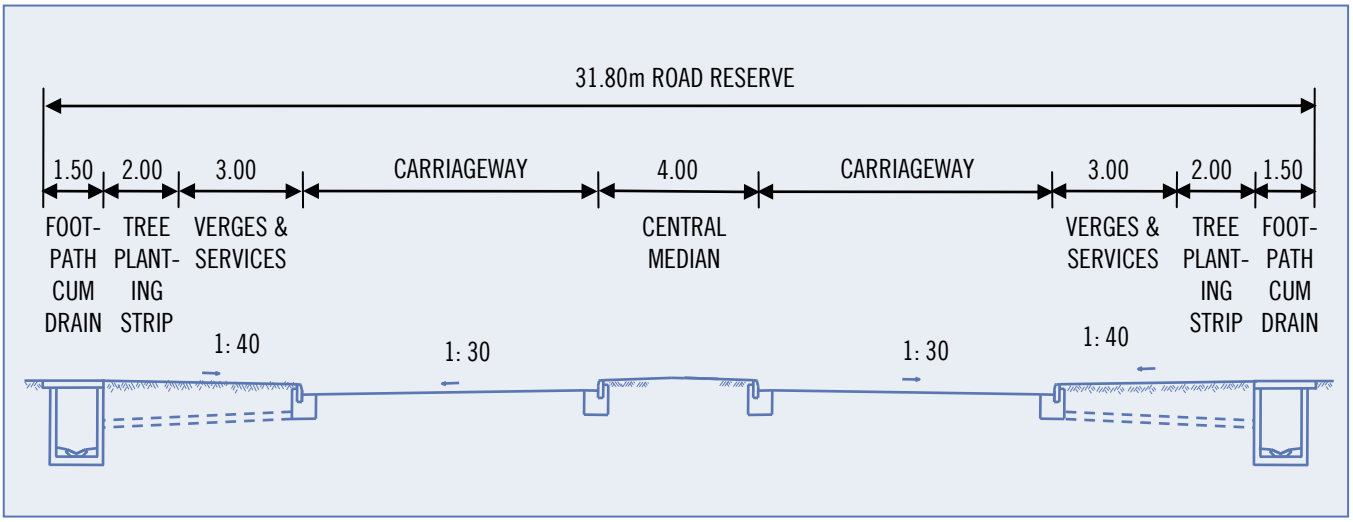


Figure 8.4 **Dual-Carriage Way Roads**

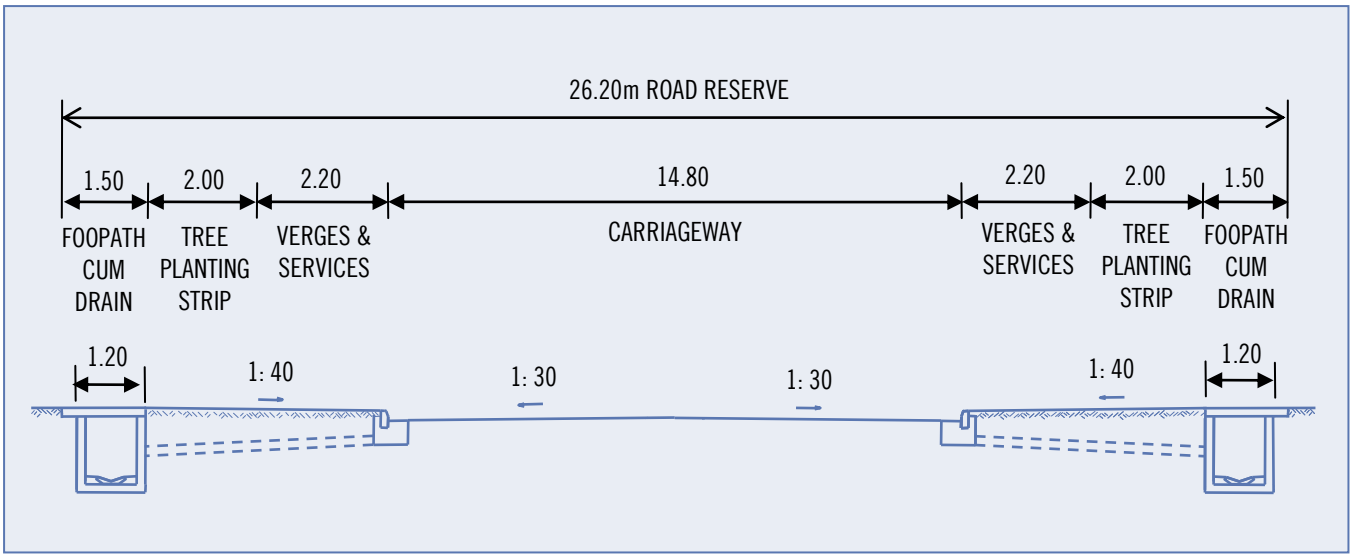


Figure 8.5 **Undivided Two-Way Roads (4 Lanes)**

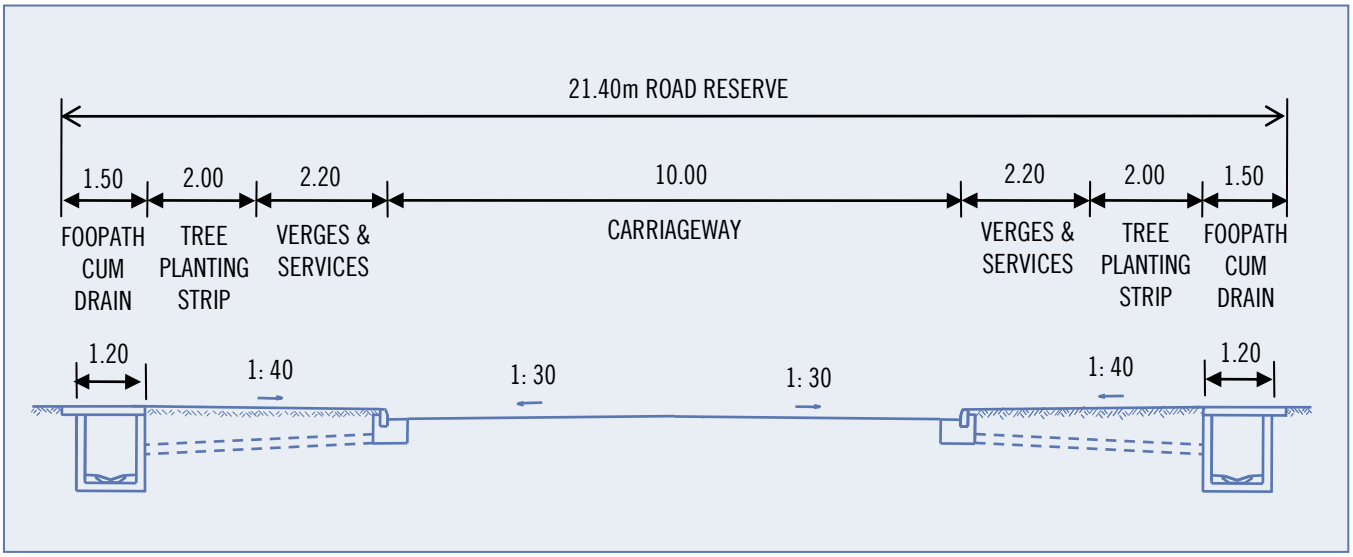
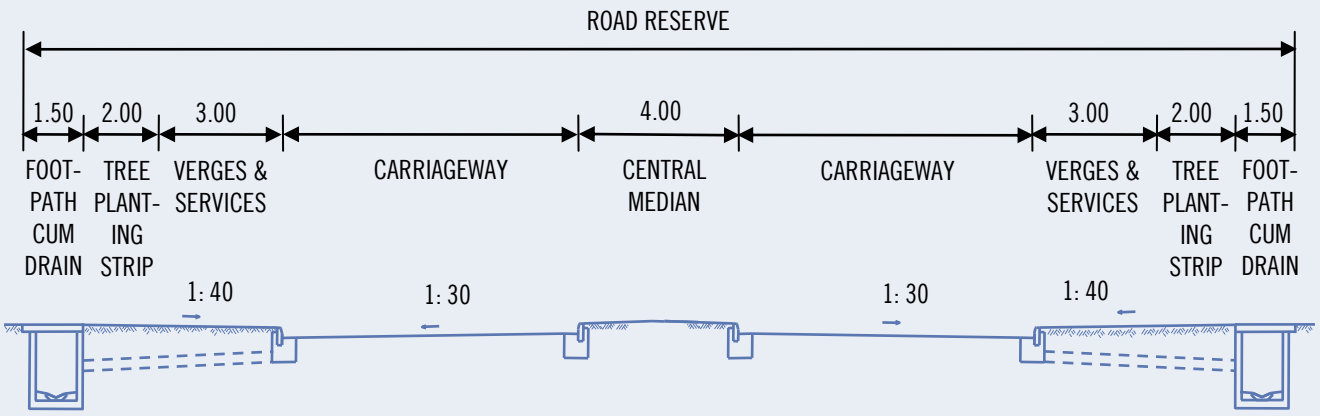


Figure 8.6 **Undivided Two-Way Roads (2 Lanes)**

Appendix 8C - Roads in Residential Area for Public Housing

Major Arterial Roads



Number of Lanes	Central Divider (m)	Carriage-way (m)	Verge & Services (m)	Tree Planting (m)	Footpath Cum Drain (m)	Road Reserve (m)
4	4.00	2 x 7.40	2 x 3.00	2 x 2.00	2 x 1.50	31.80
6	4.00	2 x 10.80	2 x 3.00	2 x 2.00	2 x 1.50	38.60

Figure 8.7 **Dual-Carriage Way Roads**

Primary Access Road

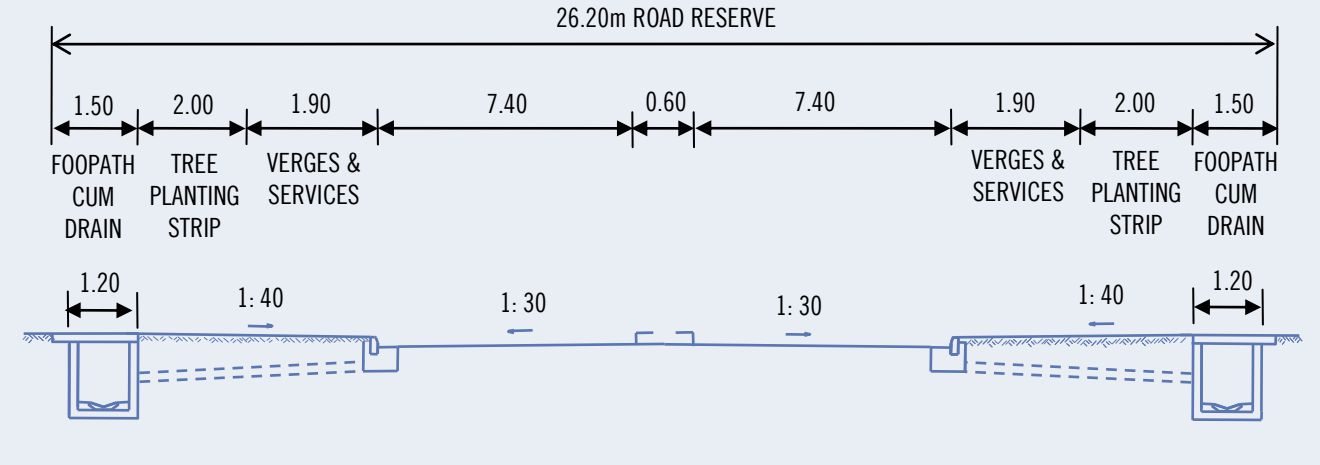


Figure 8.8 **Divided Two-Way Roads (4 Lanes)**

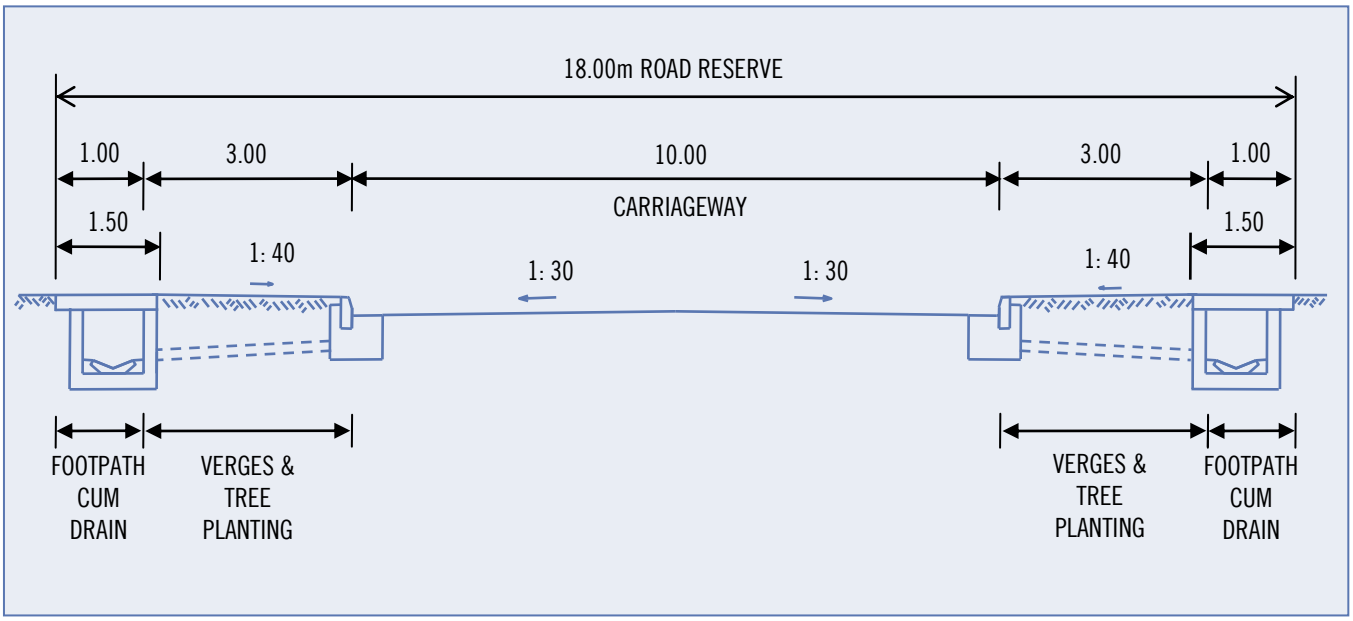


Figure 8.9 **Undivided Two-Way Roads**

Appendix 8D - Roads in Residential Area for Private Housing

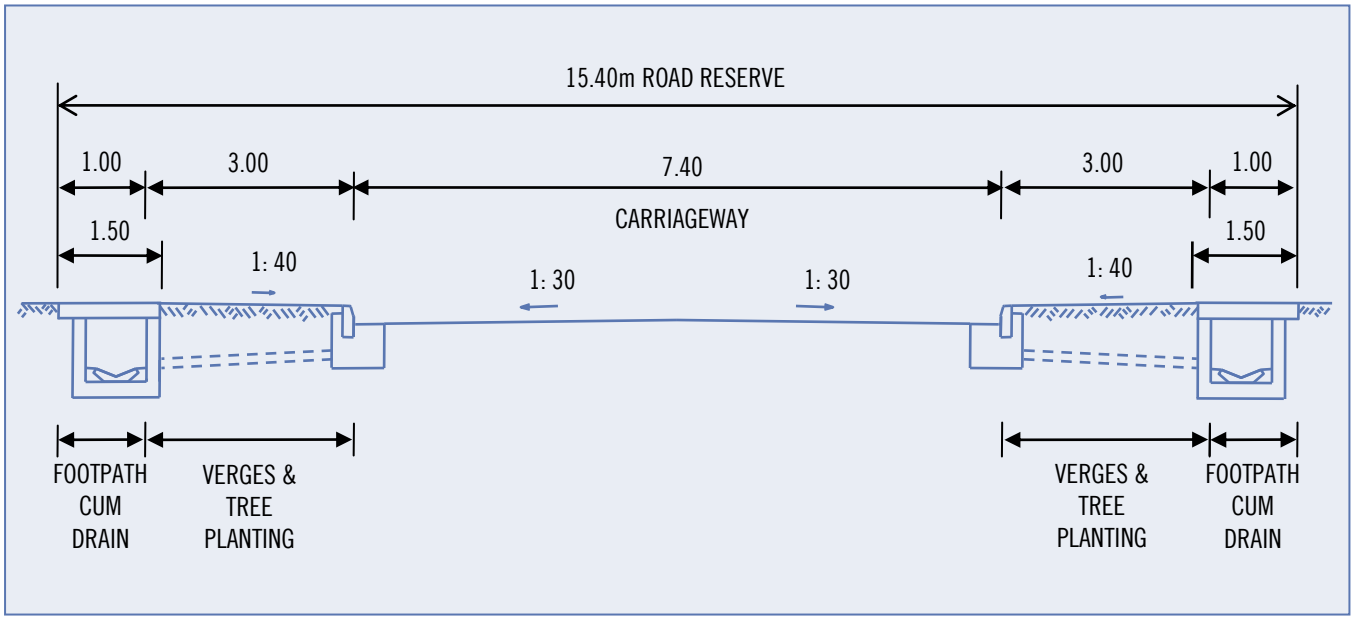


Figure 8.10 **Undivided Two-Way Roads**

The cross-sections of existing roads in residential area for private housing that have been constructed based on 14.2m or 12.2m road reserve is given below. This is made available for reference only and all new local access roads in private estates shall follow the 15.4m road reserve.

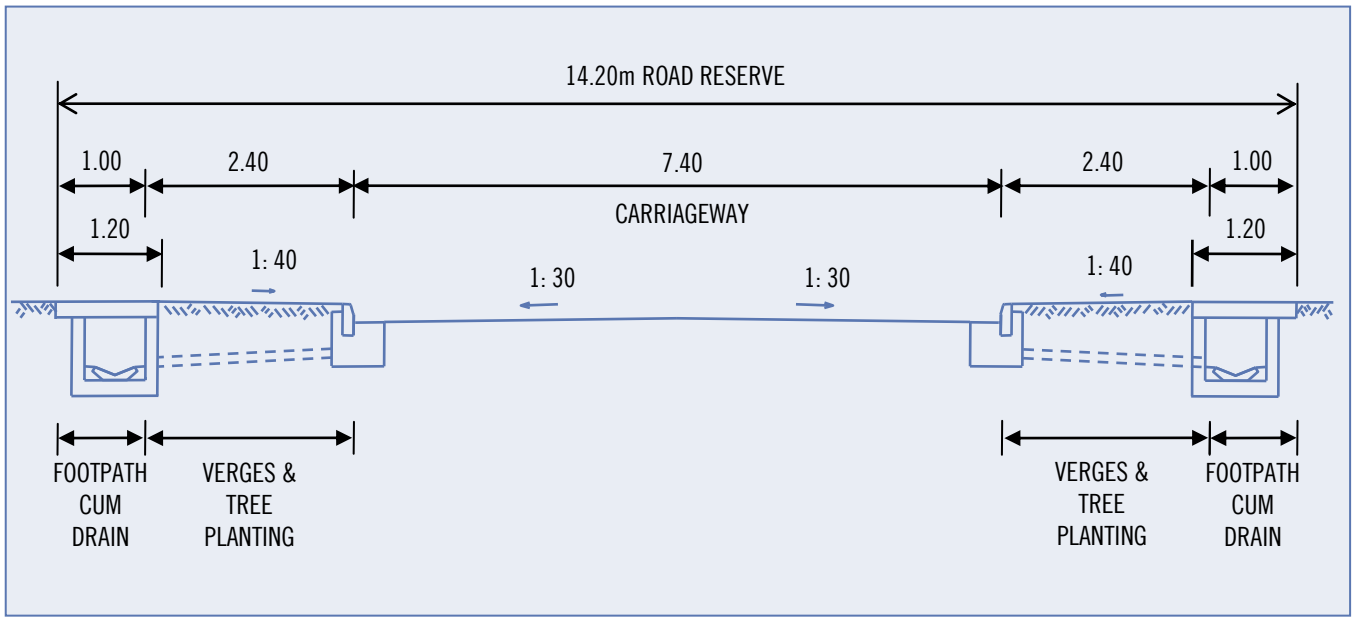


Figure 8.11 **14.2m Road Reserve**

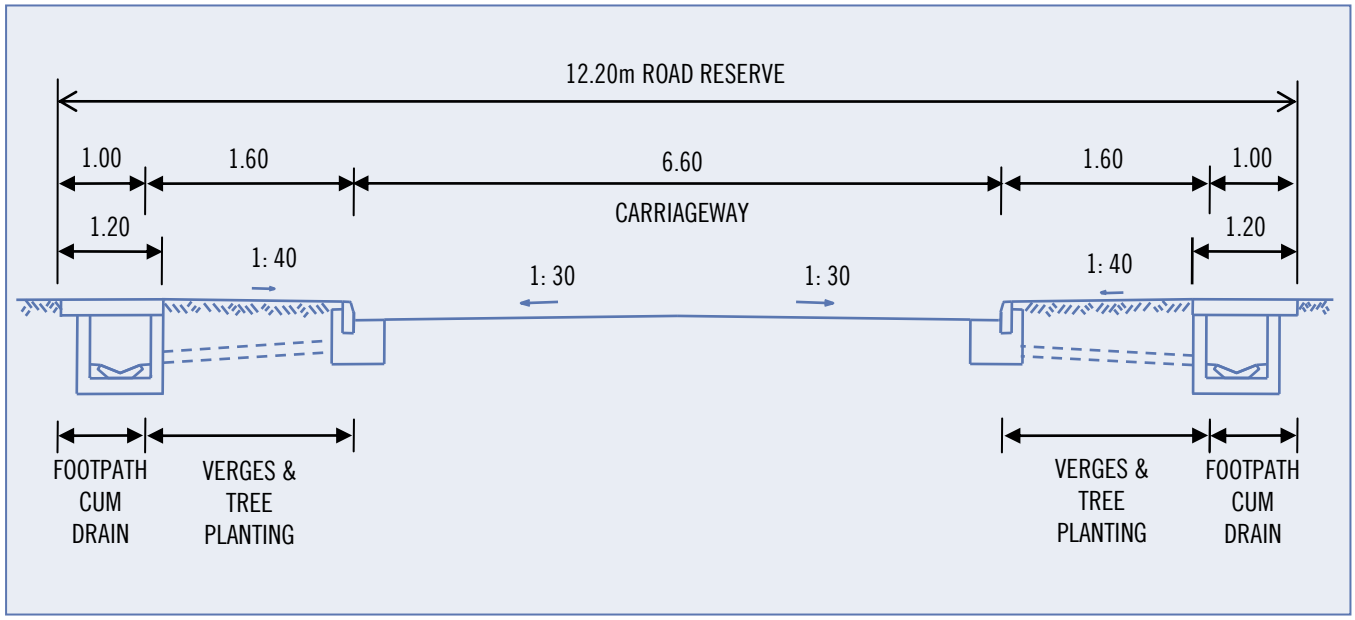


Figure 8.12 **12.2m Road Reserve**

Appendix 8E - Service Roads

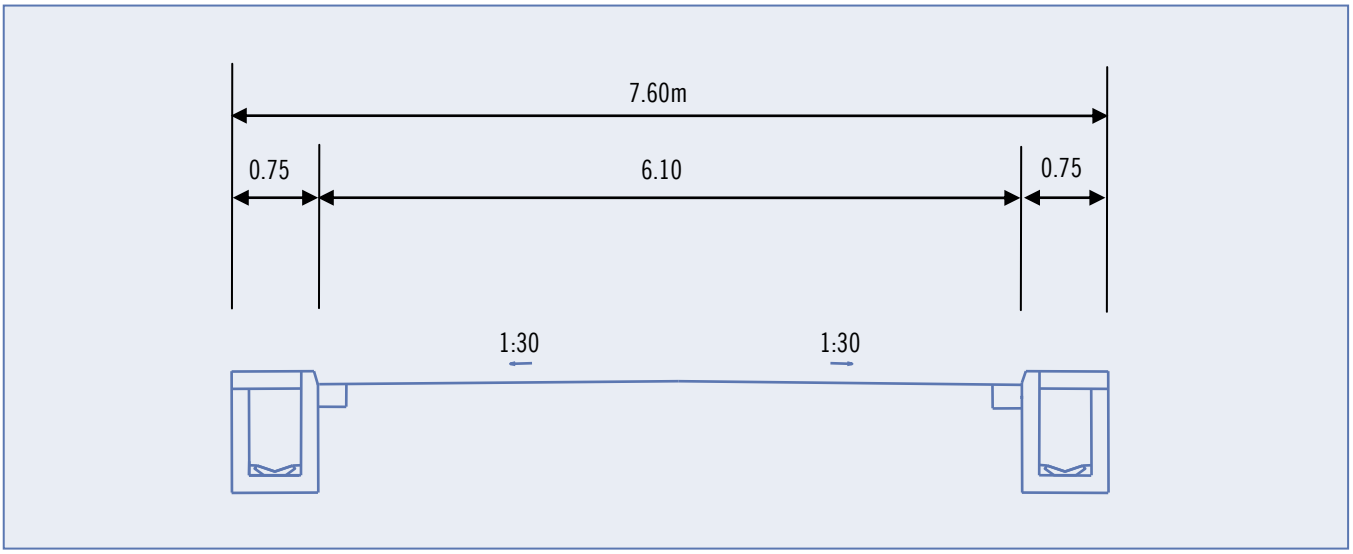


Figure 8.13 **Front / Rear Service Road**

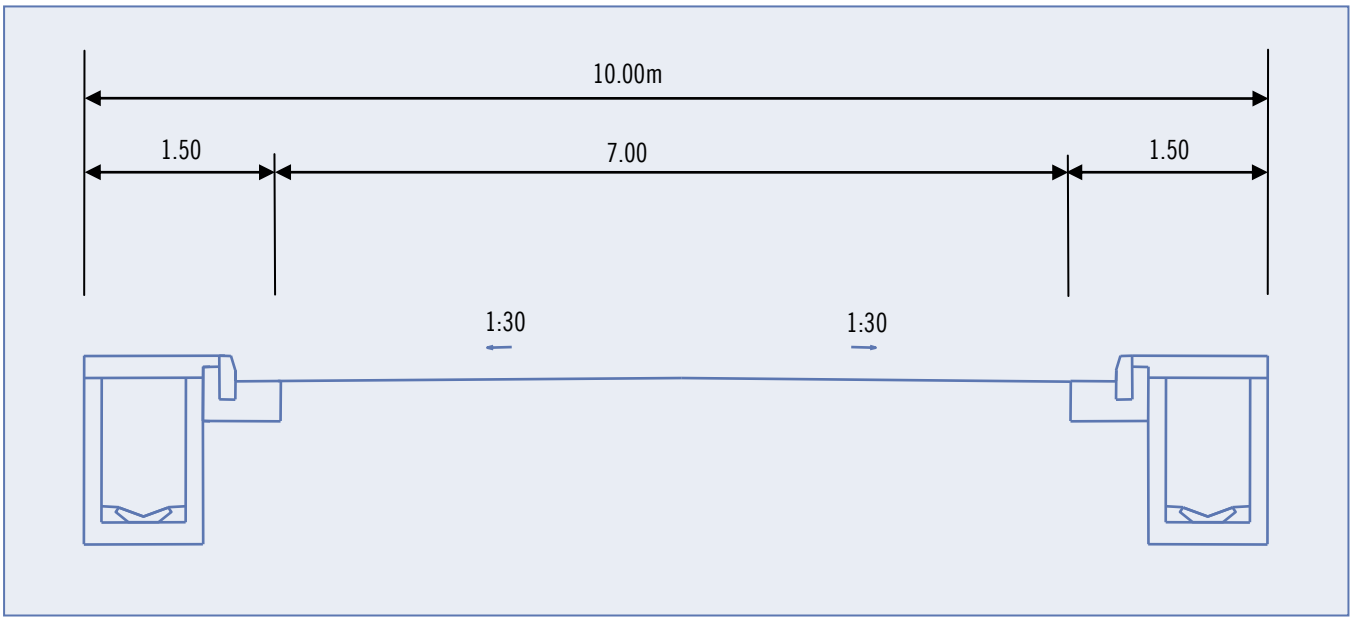


Figure 8.14 **Service Road in Central Area**

Appendix 8F- Cul-de-sac for Industrial Roads

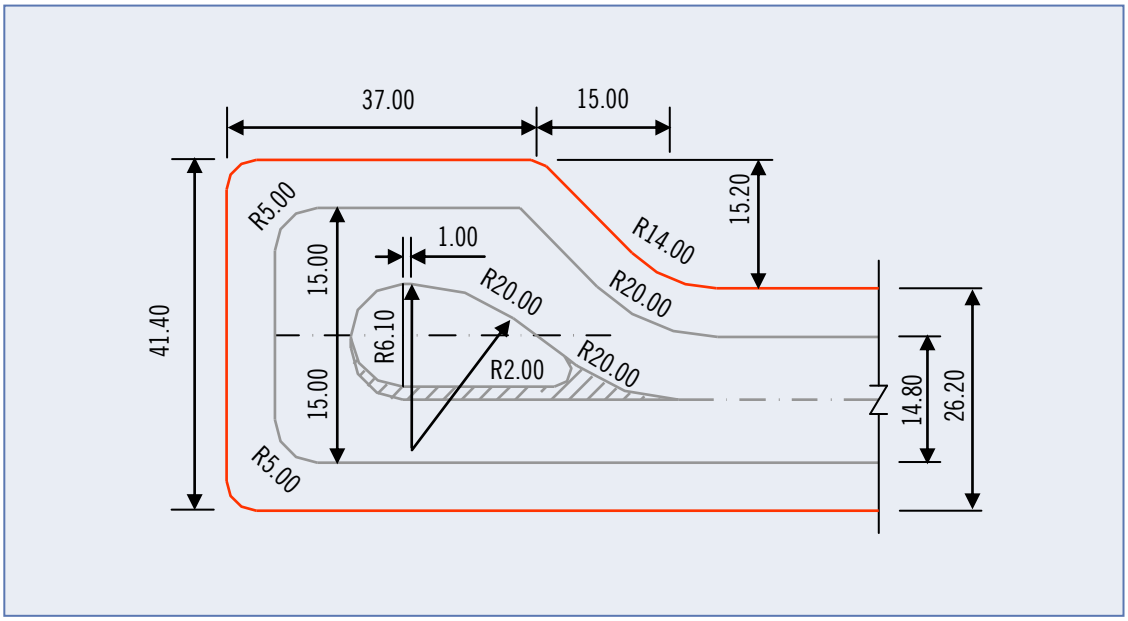


Figure 8.15 **Cul-de-sac for 26.2m wide Road**

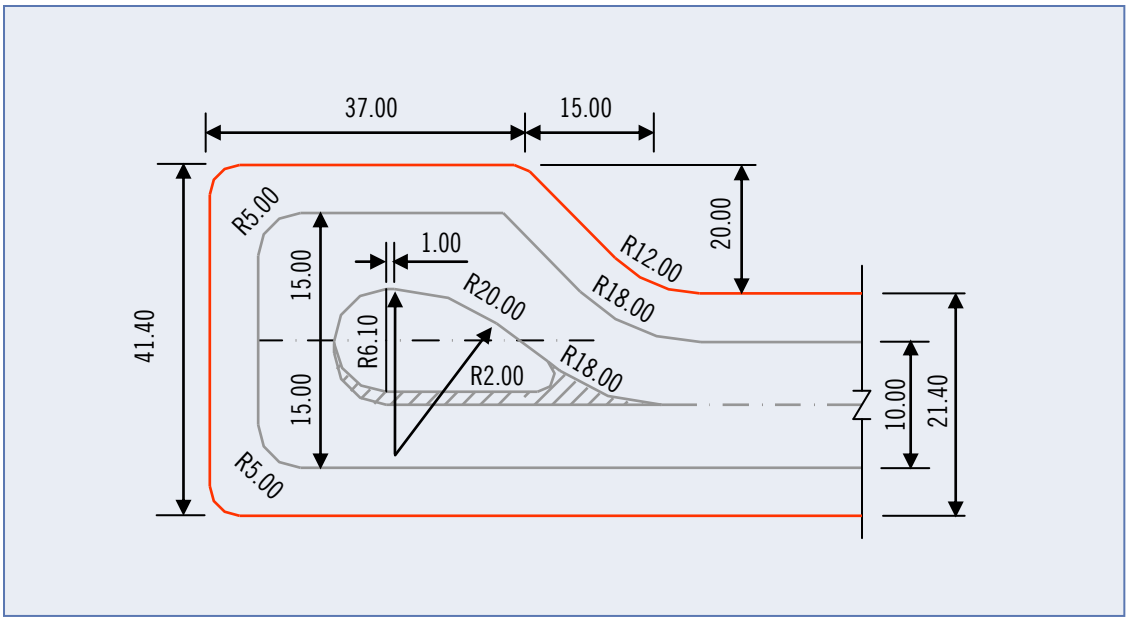
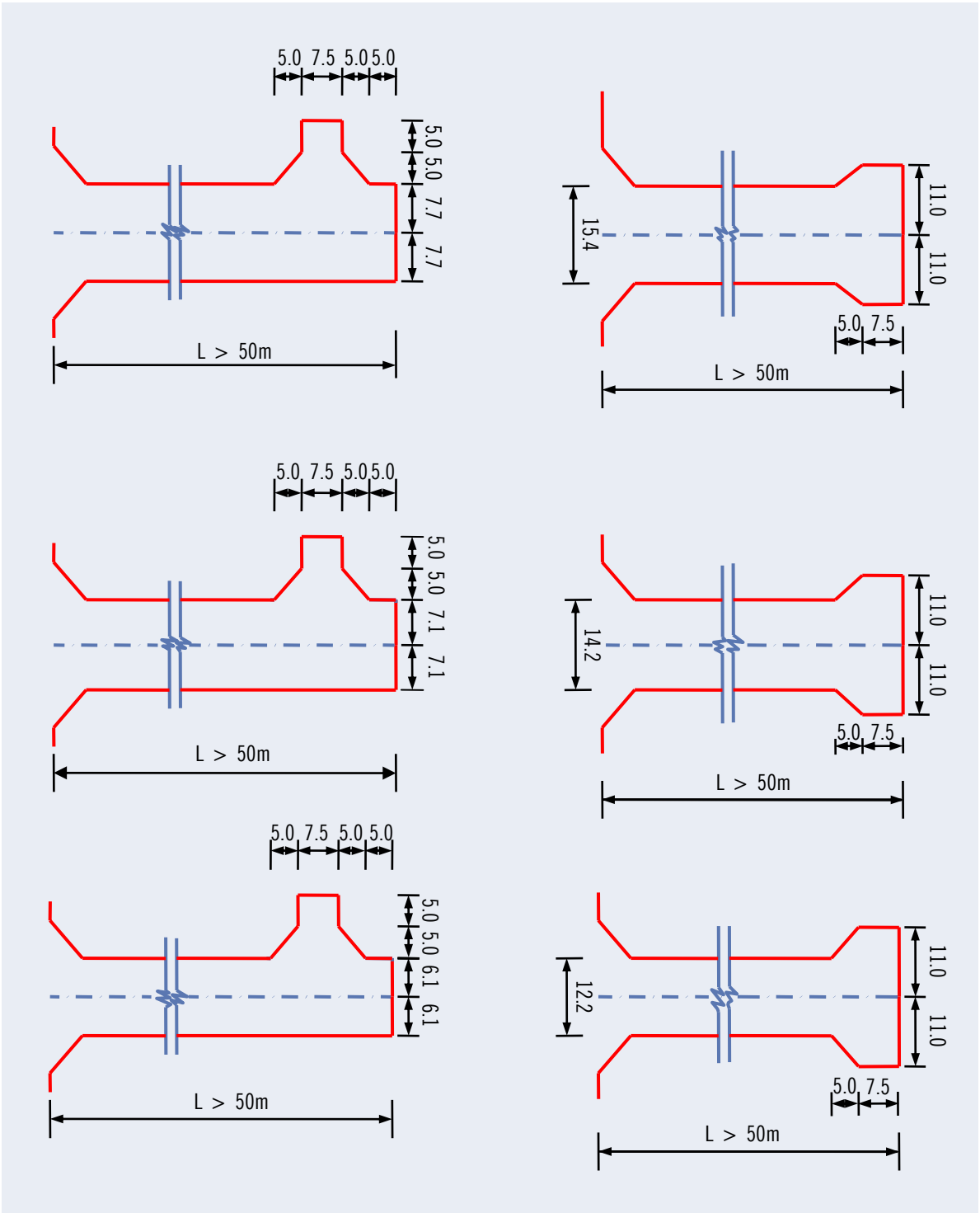


Figure 8.16 **Cul-de-sac for 21.4m wide Road**

Appendix 8G - Cul-de-sac for Various Type of Roads



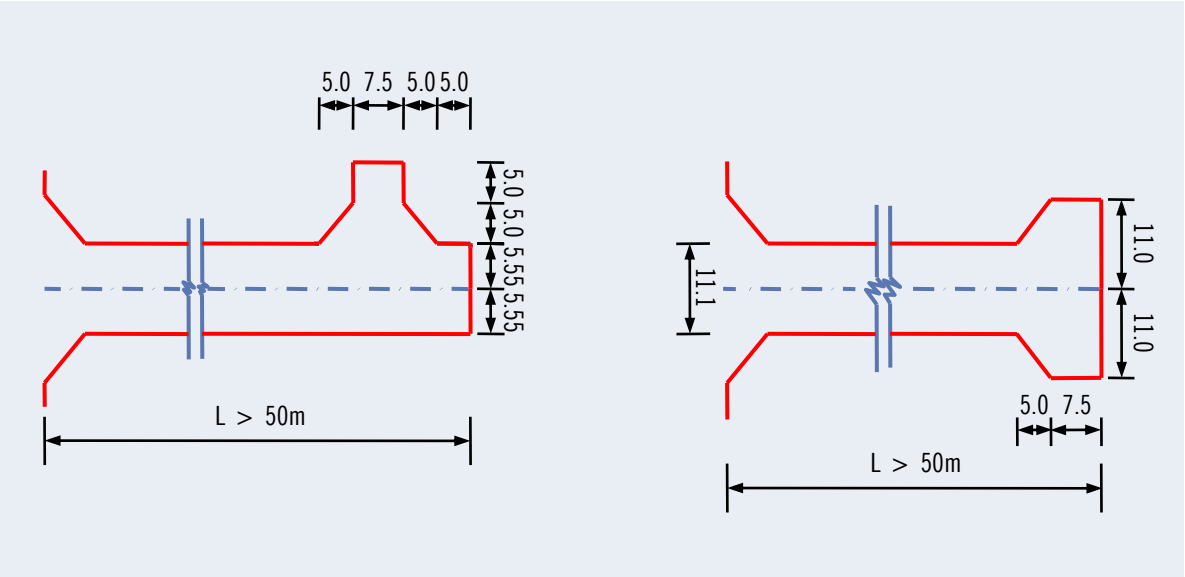


Figure 8.17 **Cul-de-sac for Various Type of Roads**

Appendix 8H - 18.0m Road Reserve at Junction

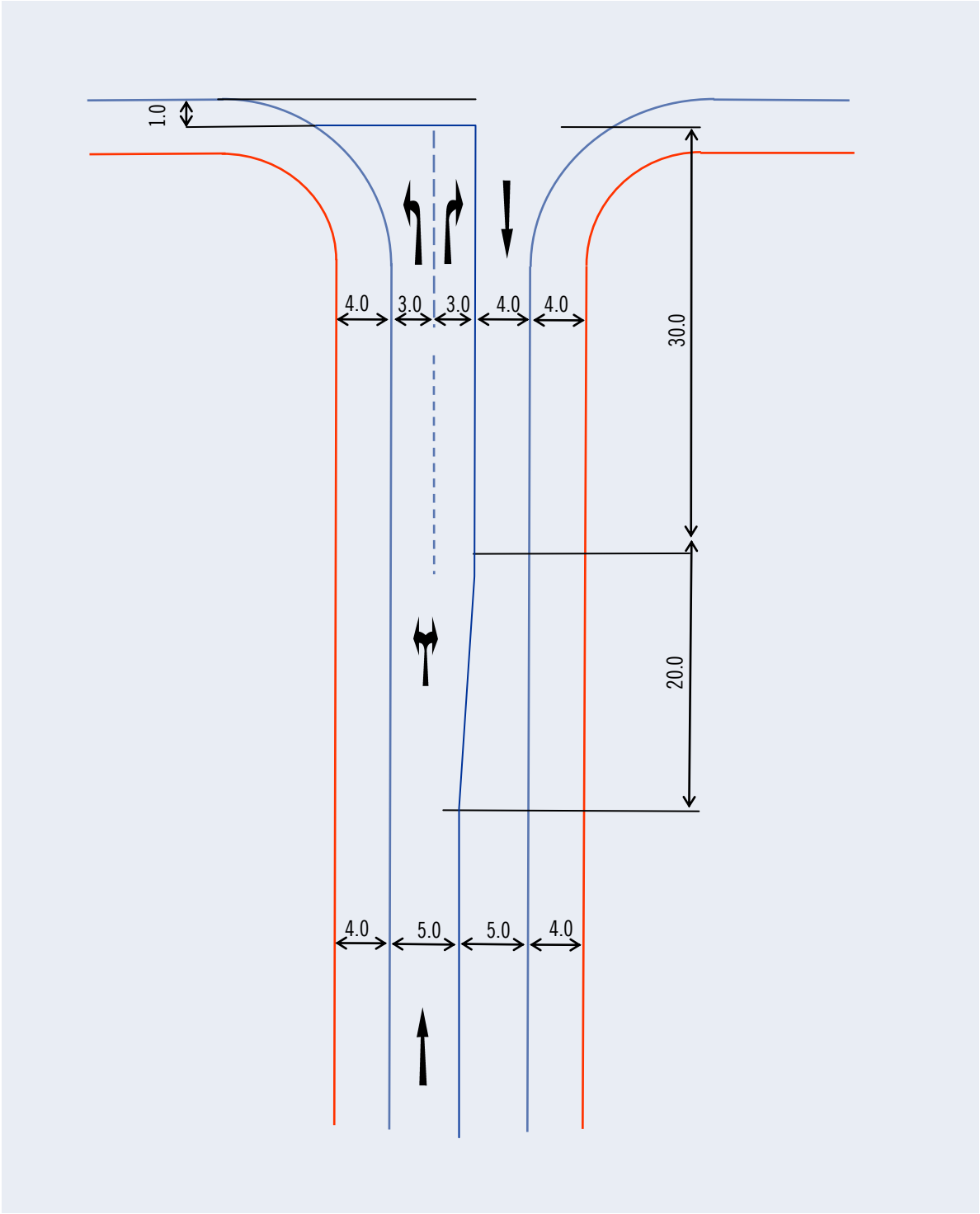


Figure 8.18 **18.0m Road Reserve at Junction**

Appendix 8I—26.2m Road Reserve at Cross Junction (With Slip Roads)

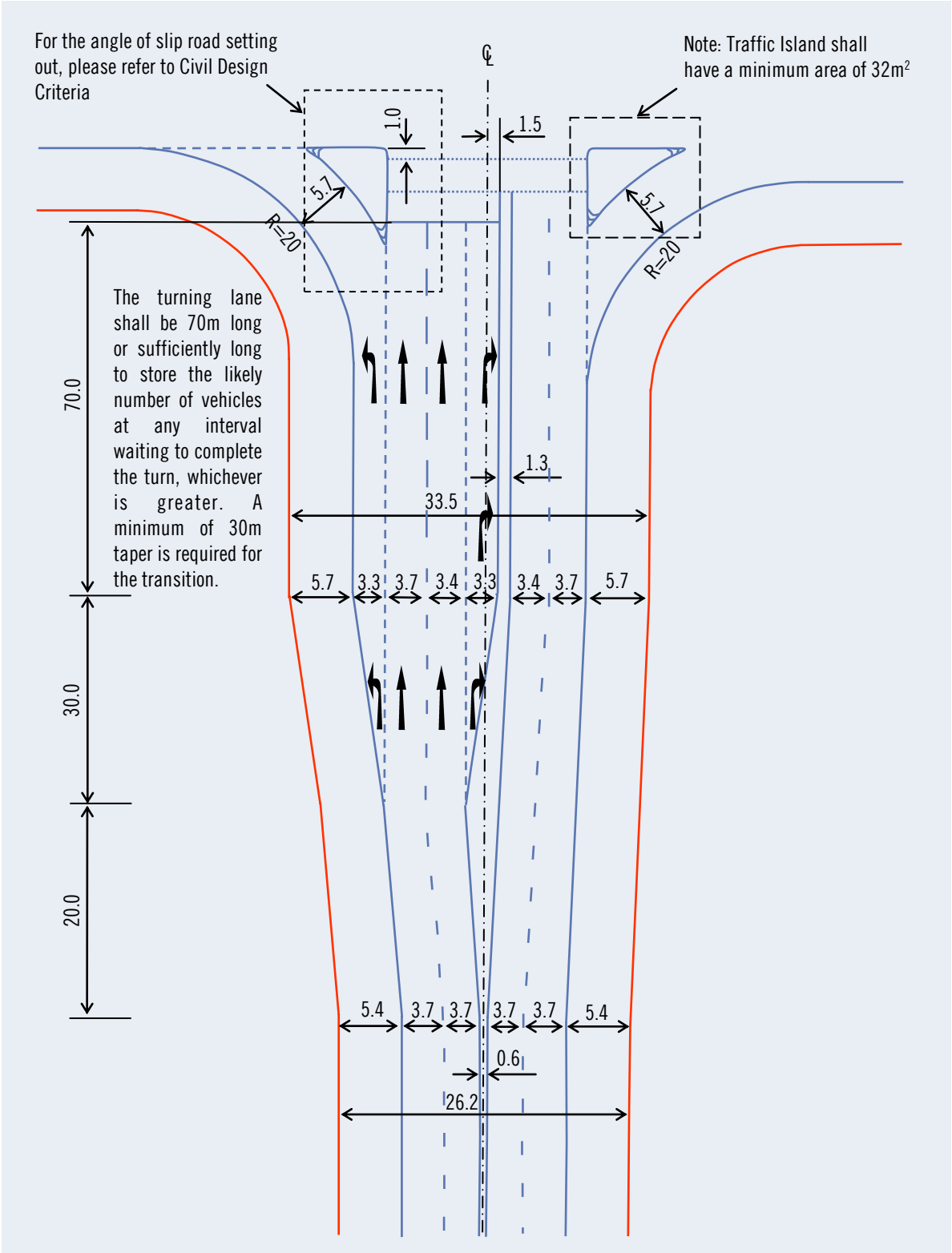


Fig 8.19 **26.2m Road Reserve At Cross Junction (With Slip Roads)**

Appendix 8J -26.2m Road Reserve at Cross Junction (Without Slip Roads)

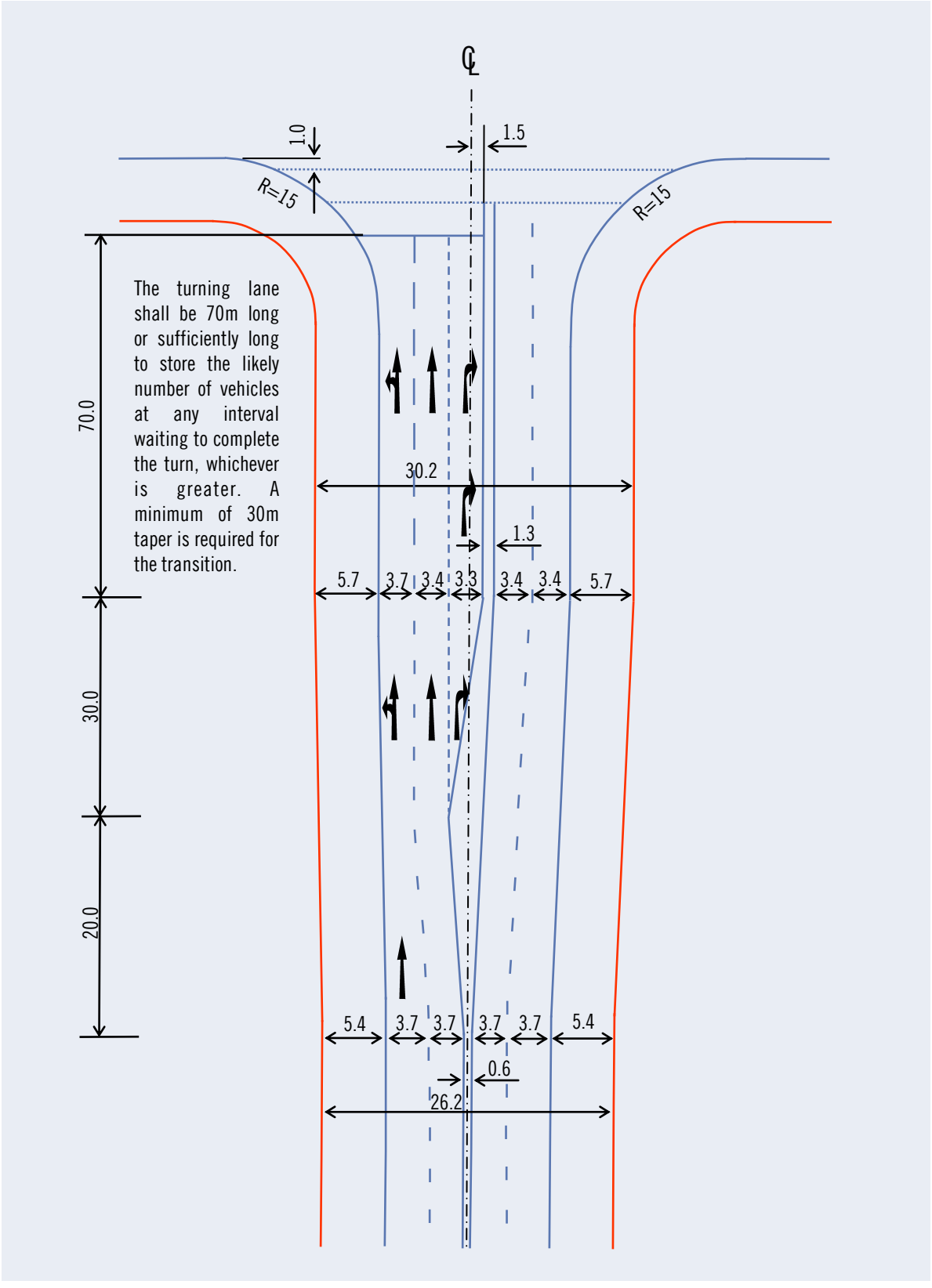


Fig 8.20 **26.2m Road Reserve At Cross Junction (Without Slip Roads)**

Appendix 8K –31.8m Road Reserve at Cross Junction (With Slip Roads)

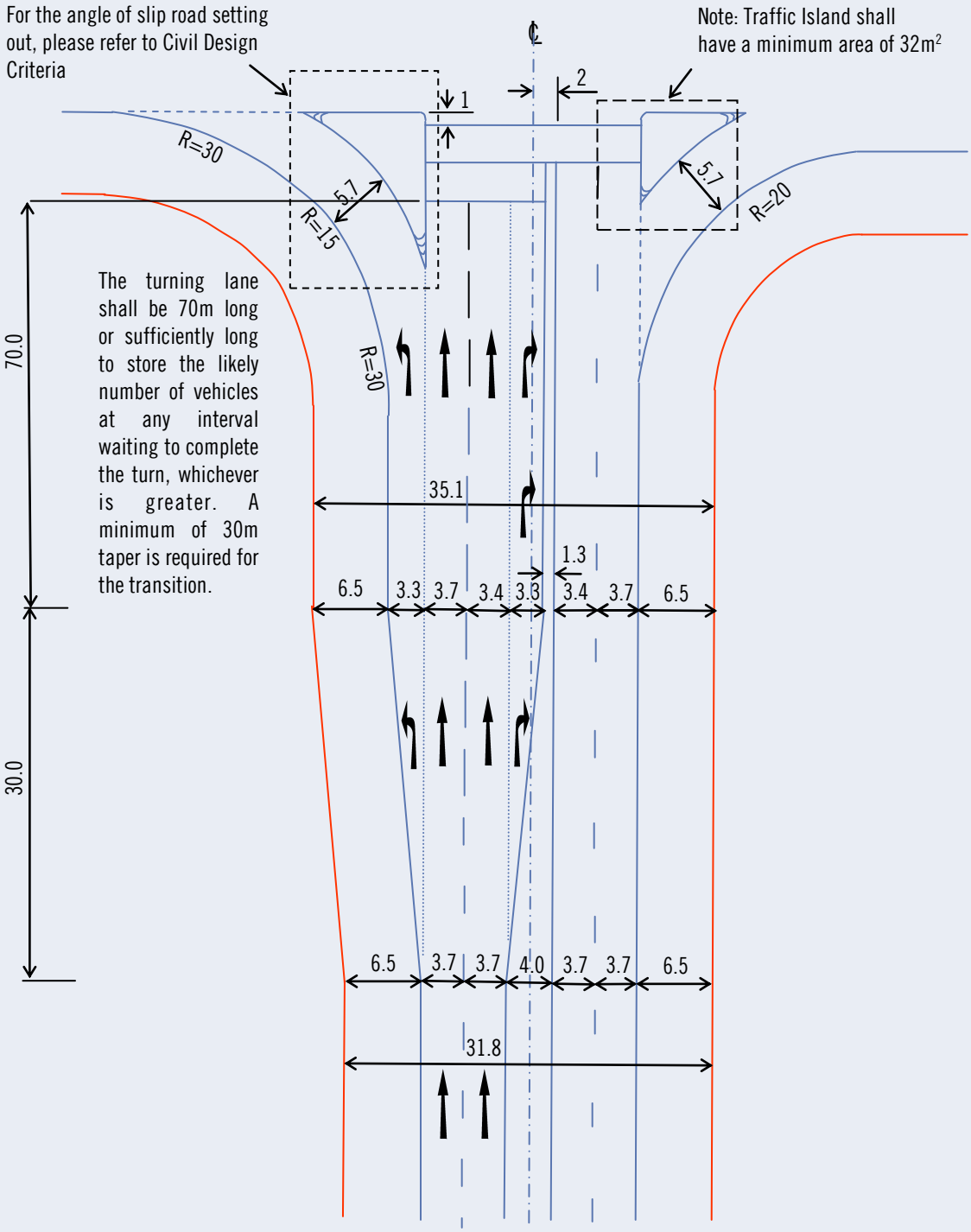


Fig 8.21 **31.8m Road Reserve At Cross Junction (With Slip Roads)**

Appendix 8L -38.6m Road Reserve at Cross Junction (With Slip Roads)

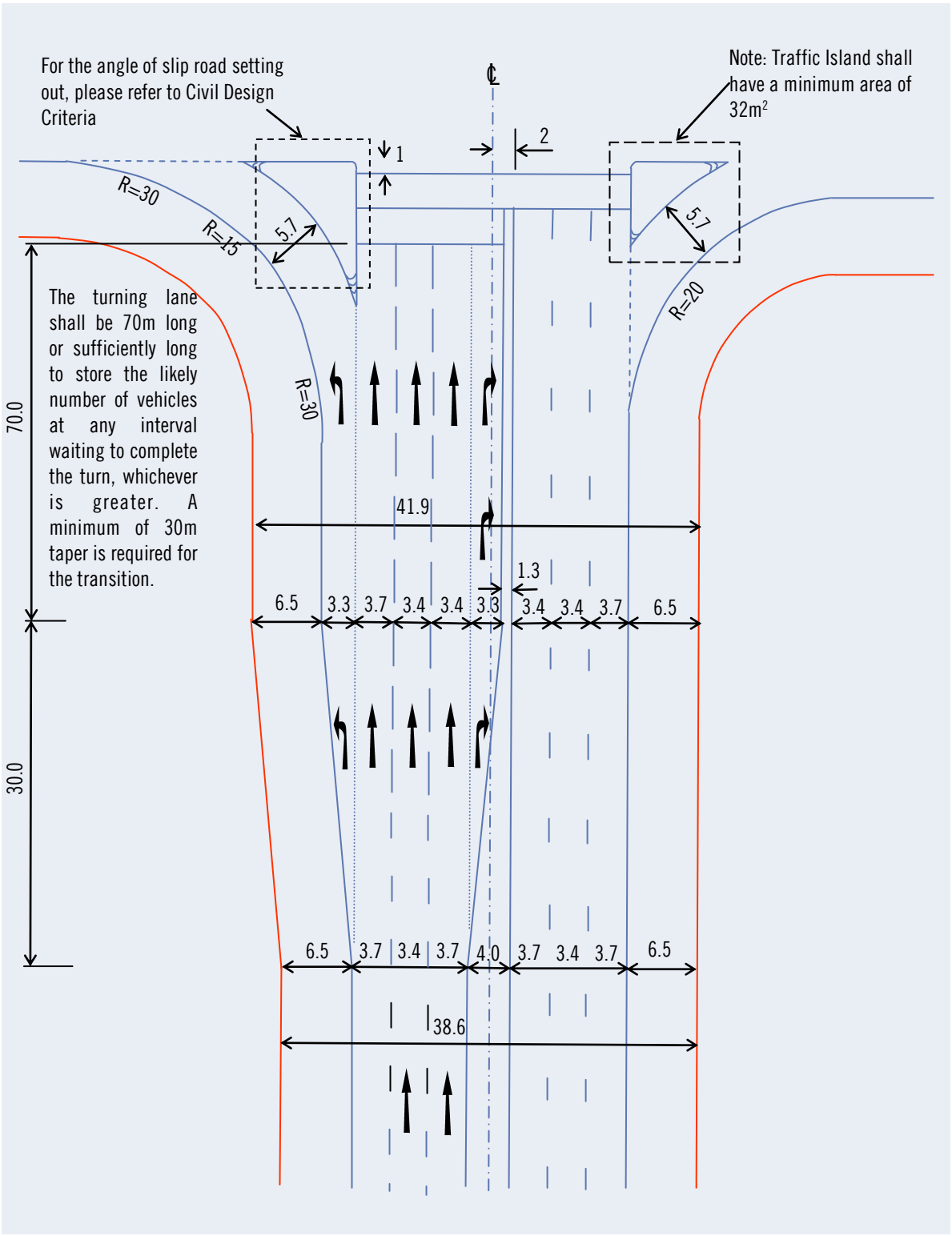


Fig 8.22 **38.6m Road Reserve At Cross Junction (With Slip Roads)**

This chapter provides a guide to developers and transport professionals on the requirements of a Traffic Impact Assessment (TIA).

Chapter 9

Traffic Impact Assessment (TIA)

Glossary

Delay	the amount of time it takes to traverse a given road facility minus the amount of time it would take to traverse that road facility at the posted speed limit if there were no interference.
Level of service (LOS)	a qualitative measure describing the operational conditions within a traffic stream. The LOS standards adopted internationally use the letters A through F, with A being the best and F being the worst.
Degree of saturation	(DOS, also referred to as volume-to-capacity ratio, or *v/c*): a measure of the amount of traffic on a given road facility in relation to the amount of traffic the road facility was designed to handle.
Highway Capacity Manual (HCM)	a publication of the Transportation Research Board (TRB) in the United States. It contains concepts, guidelines, and computational procedures for computing the capacity and quality of service of various road facilities. Since its first version published in 1965, HCM has been updated regularly over the years and being applied internationally.

Glossary

Passenger Car Equivalent (PCE) a metric used to assess traffic-flow rate. A PCE is essentially the impact that a mode of transport has on traffic variables (such as headway, speed, density) compared to a single passenger car.

Back of queue: the distance between the stop line of a signalized intersection and the farthest reach of an upstream queue. The vehicles previously stopped at the front of the queue are counted even if they begin moving.

Peak flow factor the ratio of the average demand flow rate in the total flow period to the demand flow rate in the peak flow period.

Saturation flow rate the maximum volume of vehicles from a lane group that would pass through in one hour under the prevailing traffic and roadway conditions if the lane group was given a continuous green signal for that hour. This assumes that there is a continuous queue of vehicles with minimal headways.

Chapter 9

Traffic Impact Assessment (TIA)

9.1 Introduction

This chapter provides a guide to assist developers (and transport professionals who are so engaged) required to submit a Traffic Impact Assessment (TIA) report in accordance with LTA's stipulated requirements as described in section 9.2 below.

The purpose of a TIA is to identify the transportation impacts of a new development / redevelopment on the surrounding transport network and recommend necessary measures to mitigate the negative impacts. The scale of the impacts is dependent on the type, size and location of the development and may vary from localised impacts such as at its access point(s) and nearby road intersections for the smaller developments to regional impacts for the larger ones.

The provision of an adequate transportation network near a proposed development benefits those accessing the development as well as the community at large. Design oversights with regard to site access and circulation can lead to operational challenges if left undetected. Traffic impact studies help in the early identification of such potential problems and can thus help avoid expensive remedial actions if the challenges are addressed upfront in tandem with the implementation of the development. In addition, a TIA assists LTA to better plan and design the transportation system by enabling it to anticipate incremental traffic impacts of each new development on the overall road network.

It is also important to ensure that due consideration is given to the needs of pedestrians and cyclists in the upfront design of the development and that the vehicular traffic does not come into conflict with pedestrians and cyclists.

The purpose of this document is therefore to:

- Assist developers (and transport professionals who are so engaged) by outlining the requirements and the level of detail required for the study; and
- Provide greater clarity, maintain uniformity and consistency in the preparation and evaluation of traffic impact studies to expedite the approval of development applications.

9.2 When is a Traffic Impact Study Needed?

In general, a TIA is required to be submitted if the type and size of the proposed development meets one or more of the criteria stipulated in Annex A. The size of the development reflects the level at which the development is likely to generate sufficient additional traffic that is likely to impact on the surrounding road network.

Because of the difference in the type, size and location of a development(s), it is not practical to describe a single scope of work that can be applicable for all proposals. The document is therefore intended to serve as a guide for developers and consultants who are strongly encouraged to discuss and review their scope of work with the LTA before proceeding with their studies.

9.3 Who Prepares a TIA?

The transportation impacts of the development shall be evaluated by a professional transportation firm appointed by the developer. The consultant should ensure (a) accuracy and validity of all information and assumptions to be used in the study and (b) discuss the project scope with LTA in advance of preparing the study.

9.4 Pre-Scoping Meeting

To assist in determining the extent of the TIA, developers, architects and traffic consultants are required to hold discussions with the LTA on their study scope, and any specific requirements that may apply to the development prior to commencing the study. Such a discussion ensures understanding of relevant issues. Prior to the Scoping Meeting, Developers are encouraged to provide LTA the development transport related information in order to facilitate the discussion at scoping meeting. In addition, developers and/or consultants are also encouraged to conduct a survey of the existing site condition and provide LTA with questions/clarifications before the meeting.

9.5 Scoping Meeting

The issues discussed at the Scoping Meeting may include but not limited to:

- Study purpose and objectives,
- Proposed methodology and assumptions,
- Existing data intended to be used,
- Size of the study area and traffic intersections to be studied,
- Assessment years,
- Forecast background traffic volumes or growth rate to be adopted,
- Type of surveys to be undertaken e.g. intersection, travel time, origin-destination etc,
- Relevant peak hour(s) and site(s) for the conduct of traffic surveys,
- Derivation of trip generation rates,
- Whether traffic microscopic simulation/network assessment is required, and if required, what is the assessment area(s) and assessment scenario(s) required,
- Proposed modelling tool(s) and parameters to be used,

- LTA road and/or junction improvement plans for the study area to be taken into consideration as a base in the analysis for corresponding assessment year(s),
- Intended location of development's vehicular, pedestrian and cyclist access point(s), supporting cycling facilities, parking provision and circulation,
- Whether public transport/pedestrian/cyclist analyses and/or development traffic operation plans are required and to what extent,
- Whether there is a planned cycling path abutting the development,
- Whether there is a need for an Inception Report and/or Interim Report,
- Other requirements if any, that may apply to the proposed development.

A senior level representative of the developer and consultant shall attend the Scoping Meeting. This is to facilitate clear understanding of the extent of the TIA to be done. Developers and/or consultants are advised to submit to LTA the minutes of the Scoping Meeting based on the agreed timeline discussed at the Scoping Meeting.

After the scoping meeting, the consultant shall follow up with LTA to finalise the parameters used for the Traffic Impact Assessment prior to preparation and submission of the TIA Report. The parameters include:

- Proposed trip generations
- Proposed traffic flow forecasts
- Vehicular traffic survey counts
- Pedestrian and cyclist survey counts
- Coding of base traffic layouts

9.6 Requirements of TIA Report

- The following section outlines the information and assumptions that may be used to assist in the preparation of TIA reports. The information should be used in conjunction with Annex B and Figure 9.3, which illustrates the structure and contents of a standard TIA report.

9.6.1 Executive Summary

- The report shall include a technical summary that is concise and clear on the study purpose, major findings, conclusions and recommendations.
- Improvements recommended in the TIA are to be illustrated using appropriate plan(s) with sufficient detail to substantiate their feasibility.
- Examples of summary tables with illustrated plan(s) that may be used in TIA reports are provided in Annex C.

9.6.2 Study Purpose and Objectives

The objectives and purpose of the study are to be clearly stated. In addition, key issues, methodology, study schedule and scope of work shall also be included. Where appropriate, LTA may require the submission of an Inception Report. The Inception Report may include but not be limited to the following

- Study objectives and scope of work,
- Description of the proposed development, size, location of vehicular, pedestrian and cyclist access point(s), parking provision and intended circulation, for vehicles, pedestrians and cyclists,
- Study area, roads and intersections,
- Existing landuse/transport network nearby,
- Assessment years,
- Study methodology and assumptions,
- Survey plan,
- Historical data / overseas data intended for use.

The consultant is required to obtain LTA's endorsement of the inception report prior to commencing the study.

9.6.3 Description of Site and Study Area

- Description of the proposed development including quantum, use and timeframe.

- The size of the study area will depend on the type, size and traffic condition in the vicinity of the development. Generally, small developments that do not generate high volume of traffic are likely to have localised impacts so the area to be studied may include own vehicular, pedestrian and cyclist access point(s) and the nearby major intersections. In contrast, larger developments with higher volume of additional traffic may impact the road network for a considerable distance from the site so a wider study area that may include already critical intersections would be needed.

  As a guide, the study area may be based on the extent of the impact of the development's traffic using preliminary estimation of traffic generation and assignment of development's traffic onto the road network up to major road/expressway or a point where development's traffic contribution becomes less than 100pcu either to or from the site in the peak hour or alternatively experiences 10% or more increase in traffic on any approach leg to a junction due to the development's traffic. This is provided as a guide and consultants are advised to confirm the extent of the study area with LTA prior to commencing the study.

- Analysis of contextual site issues e.g. size, current use, vehicular, pedestrian and cyclist access point(s) etc.

- Description of the road geometry, pedestrian routes, cycling paths, bus stops and MRT/LRT stations near the development.

- Appreciation of surrounding landuse and environs.

- A map with the location of the proposed development in relation to its surrounding road network and the overall study area is to be included.

9.6.4 Existing Traffic Conditions in the Area of Development

- An assessment of all roads and junctions likely to be affected by traffic from the development during the peak hours is to be undertaken. The junctions and peak hours to be assessed should be determined in consultation with LTA during the Scoping Meeting. Identifications of existing traffic problems are to be supported by site survey and photos.

- In circumstances where the development's peak traffic generation occurs outside of regular commuting peak hours, then periods to be surveyed should include both the adjacent road network peaks as well as the development's peak period(s) which may occur in the off-peak or during the weekend. This is to ensure that the access points are able to accommodate the peak traffic generated by the development during its busiest period (s).

- Generally, for commercial, industrial and residential developments, surveys are conducted in the morning and evening weekday peak periods. Retail developments may require surveys during the weekend as well as weekday. Traffic surveys are commonly carried out in 15 minute intervals and classified by vehicle type to determine the profile of traffic changes within the peak hour. Traffic surveys should be undertaken on a typical weekday excluding Mondays and Fridays unless specified or weekend (where applicable) and not be affected by inclement weather or a public or school holiday period. The results of the surveys should be summarised with the peak hours identified and graphically illustrated (in pcu/hr) within the main body of the report. Consultants shall agree with the LTA on the intended survey location(s), period(s) and date(s), at least 3 working days prior to the survey. Consultant is to seek LTA's agreement on any change to the plan at least 1 working day prior to the survey date, unless the change is due to unexpected incidents such as inclement weather or the occurrence of a traffic accident at the survey site(s). During the intended survey period(s), LTA officers may selectively undertake survey observations.

- The LTA may request for raw traffic survey data conducted by consultants. Consultants are to ensure that the survey data are appropriately formatted and the raw data are to be kept for at least six months for LTA's possible audit purpose.

9.6.5 Pedestrians & Cyclists

Due consideration shall be given for pedestrians' and cyclists' safety and needs in the design stage of all new developments or redevelopments. The TIA needs to identify the major desired pedestrian lines and cycling route to/ from the development to MRT, bus stops or existing pedestrian/cycling network, based on shortest and most convenient travel distance. A plan of the site showing the location of desired pedestrian lines and direct cycling routes shall be provided in the report. The location of crossing facilities i.e. at grade crossing and grade separated crossing shall match pedestrian movement needs with minimal diversion from the most convenient line. Justifications would be required on why a proposed pedestrian or cyclist facility cannot be provided along the desired line.

The provision of bicycle parking facilities shall be provided in accordance with LTA's guidelines in Annex D. Consultants are to review and propose the provision of cycling paths linking from the proposed development to the existing/planned cycling tracks and MRT/LRT stations nearby.

The TIA shall also address pedestrian and cyclist safety in terms of visibility and sight distances at intersection, entry/ exit points to the development and road crossings.

9.6.6 Walking & Cycling Plan

The Walking and Cycling Plan (WCP) is an in-depth study of the pedestrian and cyclist accesses and routes. The WCP will require the developer to consider the pedestrian and cycling connectivity in the upfront design of the development. Direct and seamless connection to major transport nodes and related facilities shall be provided for whenever possible.

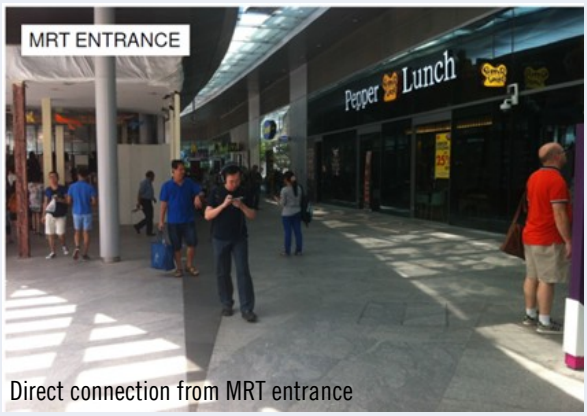
A WCP is required to be submitted for Commercial and Retail Developments, Business Parks, and Schools that meet the TIA criteria stipulated in Annex A. These are developments that are expected to generate high volume of pedestrians and cyclists. Developments that do not fall under the criteria to submit WCP shall provide a pedestrian and cyclist assessment as described in Section 9.6.5.

9.6.6.1 Who Prepares a WCP?

The WCP shall be prepared by the Traffic Consultant and the Qualified Personnel (Architect) appointed by the developer. The design of the development and its connection to the surrounding directly affects the user experience of pedestrians and cyclists. Therefore, it is important for the Architect engaged for the development project to work closely with the Traffic Consultant in the preparation of WCP. The Qualified Personnel (Architect) shall design for safe access and routing of pedestrian and cyclists to/fro the development and the surrounding major transportation nodes , as well as within and between developments. To assist the consultants in the preparation of WCP, the content to be included in WCP is summarized in Annex E. A preliminary WCP shall be submitted at pre-scoping stage to facilitate the discussion at scoping meeting (See Annex F for the submission procedure of WCP).

9.6.6.2 General Design Considerations

- Pedestrian and cyclist routes shall be ideally located along the natural desired lines i.e. the most direct path where possible. There shall also be seamless connections between developments to transport nodes such as MRT station, bus stop and existing pedestrian/cycling network as shown in Figure 9.1. Segregated paths for pedestrians and cyclists is preferred. Where there are site constraints, shared path for pedestrians and cyclists can be considered.



Direct connection from MRT entrance


Seamless connection to bus stops and MRT entrances

Figure 9.1 **Examples of good practices**

- Vehicular access(es) of the developments shall be located away from major pedestrian and cyclist routes, where the site permits. Where pedestrian and cyclist routes intersect with vehicular access points, appropriate measures are to be adopted to safeguard pedestrian and cyclist safety. Any hard structures such as concrete boundary wall / fencing is to be recessed in adequately to allow sufficient line of sight between vehicles exiting the development & pedestrians / cyclists using the footpath / cycling path. Alternatively, the boundary wall / fencing is to be constructed with porous material.

- Where existing footpaths / linkways / cycling paths are to be removed upon hoarding of the development site, there should be provision of interim linkages during the construction phase of the development.

9.6.6.3 Design for Pedestrians

An assessment of pedestrian movement associated with the development shall be shown in the WCP. In addition to the general considerations in Section 9.6.6.2 , other areas of consideration include:

- Provision of sheltered pedestrian routes to adjacent developments; surrounding pedestrian network and major transport nodes eg. MRT and bus stops where adequate;

- Assessment of pedestrian numbers, capacity and performance of nearby pedestrian facilities including walkways, stairways and crossings to substantiate the adequacy of the design to accommodate the expected pedestrian demand;

- Pedestrian safety e.g. adequacy of sight distances at crossing facilities, conflict at driveways, cycling paths, provision of slow points etc. Details of treatments at intersections, entry/exit points to the development and road crossings shall be presented in a write-up with relevant drawing(s) and justifications in the report; and

- There shall be provision of wayfinding signage directing pedestrians to the public transport nodes and adjoining buildings within the development as shown in Figure 9.2. The signage shall be well-positioned within the development and integrated with the overall development design. It is also recommended to display the barrier-free and sheltered routes within and outside the development.

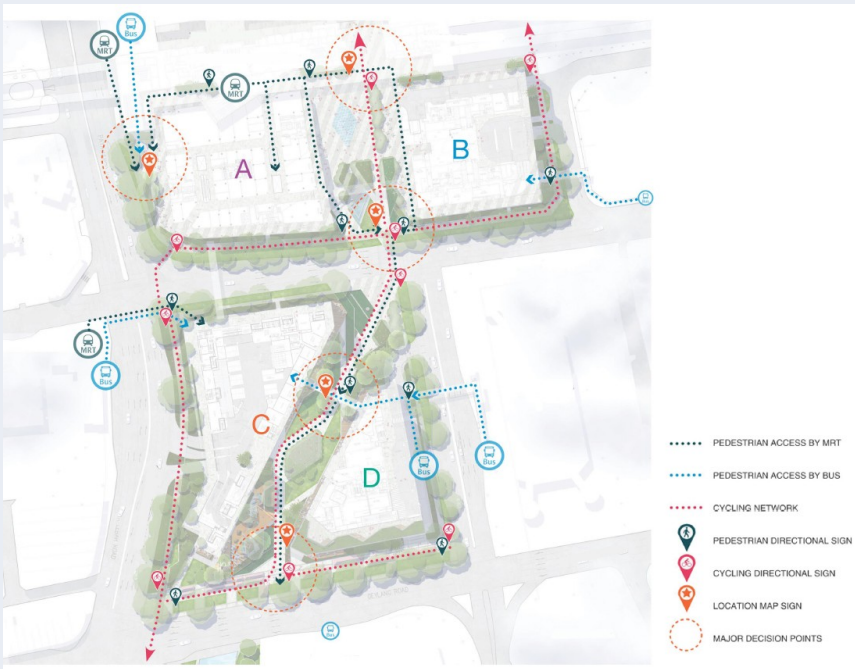


Figure 9.2 **Example of a Wayfinding Signage Map**

9.6.6.4 Design For Cyclists

An assessment of cyclists movement associated with the development shall be shown in the WCP. In addition to the general considerations in Section 9.6.6.2 , other areas of consideration include:

- Where there is a planned cycling path abutting the development frontage(s) and the side table space is sufficient, the developer is required to make good the side table with a 2m wide dedicated cycling path, lane markings and lightings within the road reserve to extend/complete the existing cycling network. If the surrounding cycling path network is not ready upon completion of the development , the developer shall provide a widen footpath with embedded conduits for future cycling path lightings. LTA will complete the cycling path finishing and the network in the future.

- Where there is a planned cycling path abutting the development frontage(s) and the side table space is insufficient for a 2m wide dedicated cycling path, the existing footpath within the road reserve can be converted into a 2.5m shared path with NParks' acceptance of a narrower verge; or the existing footpath can be widen and converted into a 2m dedicated cycling path with NParks' acceptance of a narrower verge, provided there is a covered walkway provision along the development frontage on the same level as the converted cycling path.

- Provision of bicycle parking spaces within the development shall be based on the bicycle parking guidelines in Annex D;

- Assessment of cyclist numbers, capacity and performance of associated cycling facilities such as shower facilities, lockers, bike sharing facilities to accommodate the expected cyclists demand;

- Cyclist safety e.g. adequacy of sight distances at crossing facilities, conflict at driveways, pedestrian paths, provision of slow points etc. Details of treatments at intersections, entry/exit points to the development and road crossings are to be presented in a write-up with relevant drawing(s) and justifications included in the report; and

- In addition to the wayfinding signage provided for pedestrians, there shall also be signage directing cyclists to the facilities such as bicycle parking, shower facilities, lockers etc within the development, especially when the facilities are provided at multi-locations.

9.6.7Assessment Years

The assessment years generally include the opening year when the development is expected to be fully operational and the design year which is typically five years thereafter. LTA may propose a different design year from the typical definition according to respective study needs. For developments that are expected to be open in phases, a separate assessment representing the expected completion date of each major phase may be required. Consultants are to seek LTA's advice on the assessment years to adopt for case specific development proposals.

Type	Assessment Year
Single phase developments	- Anticipated opening year assuming full occupation
Multiple-phases developments	- Anticipated major phases of completion of the development including the first and the last phases

Table 9.1- **Assessment Years for New developments**

9.6.8 Background Traffic Forecast

In general, the background traffic volume can be estimated using the growth factor method for forecasts of up to five years from the current year. Typical growth factors between 0.5% and 1.5% per annum may be considered appropriate. Notwithstanding this, the location and proximity of the development to other major new developments and/or new roads is likely to influence the extent of background traffic. Thus, other growth rates may be more applicable in some circumstances. Consultants are required to consult with LTA to confirm on appropriate growth rate(s) to be adopted for the estimation of background traffic.

Where applicable (e.g. longer future year forecasts, or, areas to have significant changes in landuse and/or infrastructure), LTA may advise on the methodology to estimate the future background traffic.

9.6.9 Development Trip Generation

Trip generation rates are to be based on survey(s) of similar development(s) agreeable to LTA. Such survey(s) data shall have a maximum validity of not more than two years prior to the date of the TIA study. The survey information including site(s), location(s), date(s) and time period(s) is to be included in the TIA report to substantiate similarities.

For developments where a comparable site may not exist, trip generation may be estimated from first principles e.g. employer numbers, number of visitors etc. based on the methodology agreeable to LTA.

For mixed developments such as retail/office or retail/residential where there may be interaction between various land uses, a portion of the trips will be generated from within the development. The total traffic generation of the development is likely to be lower than the sum of individual uses if the rates were derived from stand-alone developments. A reduction in the development's trip generation rate may be warranted when estimating additional traffic on external roads.

The choice of site(s) and the time of survey(s) to obtain trip generation survey rates, or the intent to use historical trip/traffic generation survey data, shall be discussed at the Scoping Meeting and agreed by LTA prior to commencing the study.

9.6.10 Development Trip Distribution

A description of the methodology used to distribute traffic is to be provided for LTA's review. For most developments, the distribution of development traffic may be based on the survey of an existing nearby development that is similar to the proposed development. Where such development is unavailable, current travel patterns on nearby links and intersections may be used to distribute traffic to/from the development onto the road network. For larger developments or those likely to attract traffic from further afield, traffic distribution may be based on the area of influence of the development e.g. retail centre catchment area or from an origin and destination study to assign the development's traffic to the appropriate routes.

Diagrams are to be included with clear indications of directional and turning distributions (in percentage) of the proposed development trips onto the road network.

For mixed developments, different trip distribution for different components of the development may need to be adopted to account for different travel behavior of users.

9.6.11 Modal Split of Development

Developments located away from major public transport nodes are likely to have higher vehicular generation compared to those nearer to public transport facilities. The trip generation rates shall therefore account for the differences in level of public transport accessibility to ensure relevance. Adjustments to the trip rates will be required where level of public transport accessibility is significantly different. Modal split of a similar development in a similarly located site with similar level of public transport service will provide useful information and should be used wherever possible.

The TIA shall address alternative modes of travel and the provisions to cater for pedestrians and cyclists' needs (refer to Section 9.5.5).

9.6.12 Development Traffic Assignment and Traffic Forecast Results

- The assignment of traffic from the development shall be based on shortest travel time/cost in the peak periods (where appropriate, LTA may request the inclusion of weekend peak period) and shortest travel distance/cost in the off-peak periods. For larger developments, traffic assignment accounting for travel condition on available routes needs to be considered. The appropriate methodology is first to be accepted by LTA.

- On routes with ERP, the applicable rate is to be converted to generalised time and added to the travel time for that route. LTA will provide the appropriate values of time for private and public vehicles.

- LTA may require the consultant to substantiate the routes chosen for the assignment using field travel time and/or origin-destination surveys.

- A diagram with the routes and the assigned volumes (in pcu/hr) is to be included in the report.

- The methodology, assumptions and data adopted at each step of traffic forecasting shall be clearly reported. Where appropriate, LTA may require the submission of an Interim Report. The Interim Report may include but not be limited to the following:

    - Traffic survey(s) conducted and results,
    - Assessment of the existing traffic conditions,
    - Background traffic forecasts for the assessment years,
    - Development trip / traffic generation,
    - Trip distribution (including diagrams as specified in Section 8.2),
    - Modal split as applicable,
    - Traffic assignment (including diagrams as specified in Section 10.4).

- The consultant is required to obtain LTA's endorsement of the Interim Report before further processing of the study.

9.6.13 Assessment of Development Traffic Impact

The performance of the affected junctions shall be assessed using a commercially available intersection modelling program. LTA uses the latest version of the aaSIDRA software. Consultants are advised to adopt the "Delay & v/c (HCM 2010)" method to determine the level of service (LOS) for aaSIDRA intersection analysis. The performance standards are shown in Table 9.3. In general, LTA will not accept intersection assessment outcomes produced by an outdated version of the software, given that a newer version(s) has been available to users for more than two years. The use of other types of software for analysis is acceptable provided that it can produce results comparable to aaSIDRA. Consultants are advised to seek LTA's approval on the suitable software to be used at the Scoping Meeting.

LOS For *v/c* ≤ 1.0	Average Delay Per Vehicle In Seconds (d)		LOS For *v/c* > 1.0
	Signalised Junctions	Give Way / Stop Sign Junctions & Roundabouts	All intersection types
A	d ≤ 10	d ≤ 10	F
B	10 < d ≤ 20	10 < d ≤ 15	
C	20 < d ≤ 35	15 < d ≤ 25	
D	35 < d ≤ 55	25 < d ≤ 35	
E	55 < d ≤ 80	35 < d ≤ 50	
F	80 < d	50 < d	

Table 9.2 - **LOS Definition for Intersections**

For areas where queues from closely spaced junctions are likely to interact and significantly affect traffic, suitable modelling software is strongly encouraged to be used for assessing traffic performance at the network level. This could include conducting microscopic traffic simulation for the study area or parts of the study area where queue blocking effects become a concern. For larger developments, LTA may impose consultants to undertake such an evaluation. At the Scoping Meeting, consultants shall propose and seek LTA's approval on the suitable software to be used as well as the extent of the study area to be included in the microscopic traffic simulation model.

In some situations, LTA may request consultants to assess the impact of the development traffic on the affected roads. The performance standards to determine the LOS of arterial roads and expressways are shown in Table 9.4. The travel speed for arterial roads should include the running times plus delays at the intersections along the route. Where applicable, LTA will require weaving, on-ramp, and/or link capacity analyses using the latest Highway Capacity Manual (HCM) methodology to be included in the study.

LOS	Expressway – Weighted Density (pcu/km/lane)	Arterial Road – Travel Speed As A Percentage Of Link Base Free-flow Speed (%)	
		for critical v/c^* ≤ 1.0	for critical v/c^* > 1.0
A	< 7	> 85	F
B	7 – 11	67 – 85	
C	11 – 16	50 – 67	
D	16 – 22	40 – 50	
E	22 – 28	30 – 40	
F	> 28	≤ 30	

Note: * The critical v/c ratio is based on consideration of the through movement v/c ratio at each boundary intersection in the subject direction of travel. The critical v/c ratio is the largest ratio of those considered.
Source: Highway Capacity Manual 2010, Transport Research Board

Table 9.3 - LOS Definitions for Links

The LTA road and/or junction improvement plans (if any) for the study area shall be taken into consideration as a base in the analysis for corresponding year(s) assessment. The TIA report shall include intersection and road analyses for each year of assessment, with separate analysis for the scenarios of with and without the development traffic. Changes in the average delay for all vehicles at each of the affected intersections as well as the average travel speed along each of the affected roads (where applicable) due to traffic associated with the proposed development shall be analysed and clearly stated in the report.

Where possible, it is aimed to provide for a desired LOS "D" or better in the peak periods for intersections and roads affected by the development traffic. Consultants shall recommend junction/road improvement measures and include them in the TIA report, to mitigate traffic impact to achieve the desired LOS. Traditional at-grade widening of roads/junctions within the safeguard road reserve lines are to be considered prior to considering/proposing other infrastructure improvements. In areas where the desired LOS are not achievable with traditional road/junction widening within the safeguarded road reserve lines, LTA may request the consultant to conduct further scenario tests and/or sensitivity analysis as appropriate. Consultants should also consider and report on practical transport solutions to support the proposed development, to ensure that its traffic impacts are kept to a minimum.

The TIA report shall include tables to clearly explain the summarised assessment of results, including traffic volume, delay, LOS, degree of saturation (DOS), 95% back of queue, stop rate and travel speed as appropriate, of individual transport facilities pertaining to each assessment year. The summary tables shall include separate results for the scenarios with and without the development traffic. If road/intersection improvements and/or additional scenario tests or sensitivity analyses are required, the report shall also incorporate tables with a separate summary of the assessment results. Relevant proposals/assumptions for each scenario are to be clearly listed in the tables.

LTA generally requires the submission of softcopies of all data files for verification of results.

9.6.14 Junction Analysis Parameters

a) The values listed below are provided as a guide for the evaluation of isolated signalised junctions.

i. Cycle time: Existing cycle time in peak period for existing junctions, or an optimised cycle time within the range of 90-150 seconds to determine a new or future traffic signal along arterial roads,

ii. Peak flow factor: 0.95 in general. Lower values are to be used for areas with significant demand peaks e.g. areas for schools, cinema, stadium,

iii. Basic lane saturation flow rate: 2,000pcu/hr/lane (or 1,950tcu/hr/lane) for arterial roads. Lower values are to be used for residential streets and environment with high roadside friction e.g. CBD,

iv. Queue definition: 95% back of queue. When necessary LTA may request consultants to assess the queue length based on other specified definitions,

v. Passenger Car Unit (PCU) factors: as shown in Table 9.5.

Vehicle Type	Passenger Car Unit Equivalent (pcu/veh)
Passenger cars & vans	1.0
Single unit trucks: - LGV - HGV	 1.3 2.25-2.75
Buses -Small -Large - Articulated	 1.6 2.5 2.9
Motorcycles	0.7

Table 9.4 – **Passenger Car Equivalent Unit Factors**

LGV: Light good vehicles with laden weights up to 3 tonnes
HGV: Heavy goods vehicle with laden weights more than 3 tonnes or with 3 or more axles
HGV: Lower pcu value appropriate for arterial roads higher value for expressways
Bus: Small bus includes up to 30 seats. Large bus more than 30 seats

Subject to consultants' justification and LTA's approval, other values for the above parameters can be adopted if they are considered more appropriate to the circumstances. For other parameters which are not defined above, consultants shall justify the parameter values adopted if they are different from their defaults provided in the intersection analysis software. For simulating existing traffic situation, the outputs of mean back of queue shall be comparable to the observed average queues or the difference between the two shall be justifiable.

9.6.15 Public Transport

For larger developments, consultants are to estimate the proposed development's public transport demand and evaluate the accessibility and adequacy in the provision of the public transport system in the study area with the additional development demand. Consultants are encouraged to investigate the need for the development to provide private bus service.

Where applicable, LTA may request consultants to review and if necessary to propose suitable/optimal locations for new/relocated public transport facilities such as bus stops and taxi stands within the study area, especially those near to/within the proposed development site.

Consultants shall review the development internal layout design and location of development accesses to avoid creating traffic conflicts. Consultants are to review and if necessary to propose improvement solutions to minimise traffic conflict between the different modes of transport including public buses, taxis, goods vehicles, private vehicles, pedestrians and cyclists, along the roads surrounding the development boundary and within the development site.

9.6.16 Parking and Pick-up/Drop-off Provision

The consultant shall document the analysis for parking provisions to ensure that parking requirements for the development have been adequately catered for. The number of parking spaces and access arrangement of new developments shall comply with the requirements stipulated in "Code of Practice for Vehicle Parking Provision in Developments" and Chapter 5 of this document.

The consultant shall also consider the potential traffic impacts and externalities that may arise as a result of car parking operations, and provide appropriate mitigation measures as necessary. If any proposal is unable to meet the access provision and arrangement requirements or LTA considers that the development access point warrants detailed evaluation, the consultant shall demonstrate the viability of the proposed arrangement.

Consultants shall assess whether there is a need to provide pick-up/drop-off bays and to estimate the number of bays required and to propose suitable location(s). If the development design is carried out as the TIA is in progress, the consultant is to comment on the layout, identify potential traffic problems associated with the proposed pick-up/drop-off bays and recommend necessary improvements to the plan

9.6.17 Site Access and Traffic Circulation

Provision of good site access and circulation for all users whether for motorists, public transport commuters or pedestrians help towards the success of a development. The ease with which users move to/from the development and nearby areas, roads and public transport facilities is important to the long-term success of the development.

The proposals (access, lay-by, pick-up/drop-off point, pedestrian facility etc) shall take into consideration the following requirements:

- Safety – The location and configuration of the access, lay-by, pick-up/drop-off point, pedestrian facilities etc shall not pose a danger to motorists and pedestrians. Generally, the proposal to locate the development access at major arterial roads will not be supported when there are alternative feasible option(s) available.

- Capacity of road – This shall be considered when designing the configuration of the access. For example, a Left-In-Left-Out (LILO) arrangement for an access connecting to a road with heavy traffic volumes may be more appropriate.

- Queuing Length – Sufficient queue space within the development shall be provided at the proposed access, lay-by or pick-up/drop-off point(s) to prevent queues encroaching onto main road carriageways which can obstruct traffic. The TIA shall include an assessment of entry barrier capacity and queue length to demonstrate that the distance between the development boundary line and the car-park barrier is sufficient to accommodate the expected queue length.

- Traffic Conflicts – Proposals shall not create conflicts of traffic. Access points shall not be located opposite to each other, near bus stops or traffic junctions.

- Obstruction to traffic – Vehicles manoeuvring into the access(es) shall not obstruct traffic along the road carriageway. All vehicles shall enter and exit the site in a forward direction. Reversing of vehicles is not allowed onto a public road.

- Pedestrian/commuter facilities – Should a pedestrian crossing facility be proposed, analysis of its impact on traffic flow is to be done. Depending on pedestrian/traffic volumes, other facilities such as an overhead bridge or underpass are to be considered if more appropriate.

Generally, proposals to signal the junction of the access of the development on arterial roads will not be favoured unless it can be justified. If a new traffic signal is proposed, the impact of the traffic signal on the traffic flow along affected roads is to be evaluated as described in Sections 9.5.12 and 9.5.13 of this document. This is to demonstrate that the proposed traffic signal will not significantly affect the traffic flow or reduce the travel speeds along the roads.

Access, road carriageway and junction improvements shall be in accordance with appropriate LTA design standards and specifications and take into consideration site constraints.

9.6.18 Development Traffic Operation Plan

For developments expected to have significant surge in traffic (e.g., shopping mall opening stage, school morning arrival peaks, development major events, etc), consultants may be required to:

- Establish the traffic surge profile;

- Estimate the traffic volume during the peak hours of the surge periods;

- Assess the impacts of traffic within the proposed development as well as on surrounding public roads during the peaks;

- Develop conceptual traffic operation plans to mitigate the negative impacts. The plans shall cover transport facilities which can potentially create significant traffic problems due to overwhelming traffic demand such as car-park accesses, lay-bys, pick-up/drop-off points, pedestrian crossings, immediate junctions with traffic approaching the proposed development, pedestrian holding areas, etc.

- Recommend whether it is necessary to engage Auxiliary Police Officers (APO) to implement the proposed traffic operation plans.

A diagram indicating the proposed traffic control measures at relevant locations is to be included in the report.

9.6.19. Traffic Management during Construction

For very large developments, an assessment of the impact of traffic during the construction period may be required as a separate assessment/ submission (not part of the TIA study). LTA will advise whether such a study/evaluation is required to be submitted.

9.6.20 General Comments

The report shall be set out logically with clear conclusions and recommendations. All assumptions and sources of information shall be clearly documented.

Ambiguities and validity/lack of information shall be resolved with LTA as soon as possible. Inadequate reports will be returned to the consultant for completion or modification as required.

This Guideline sets the general technical requirements for the preparation and submission of TIA reports. Some requirements stated in this document may not be imposed for a particular TIA when they are not the most suitable. Consultant is to follow the LTA officers' instructions during the course of TIA preparation.

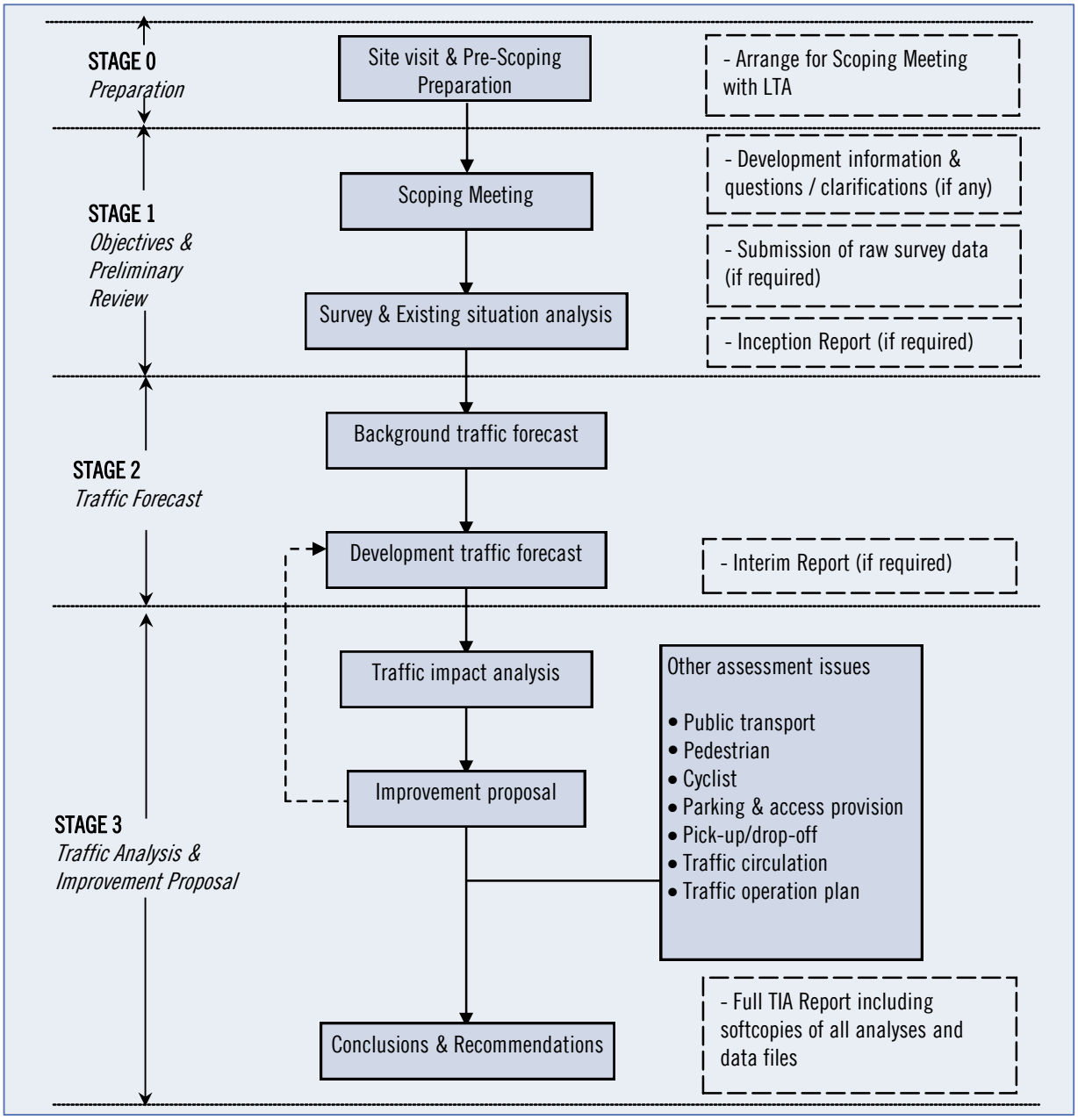


Figure 9.3 **Typical TIA Process and Submissions (For Developments)**

Annex A - Conditions When a Traffic Impact Assessment (TIA) and Walking Cycling Plan (WCP) are Required

A TIA is required to be prepared at the Development Control stage if one or more of the following conditions apply to the development. For Retail, Commercial, Science Park/High Tech Park, and schools meeting the TIA conditions, WCP is required to be submitted. However, if other specific developments are expected to generate high pedestrian and cyclist volume, LTA will advise the applicant on whether a WCP is required.

A-1 Developments exceeding the scales specified in the following table:

Type of Development	Scale of Development
1. Residential 1.1. Landed properties / Condominium Executive HDB housing	1.1. >= 600 dwelling units
2. Retail* Shopping centre	>= 10,000m² GFA
3. Commercial* Office development	>= 20,000m² GFA
4. Industrial 4.1. General industry 4.2. Warehousing / Distribution 4.3. Science park / High tech park*	4.1. >= 50,000m² GFA 4.2. >= 40,000m² GFA 4.3. >= 40,000m² GFA
5. Educational* 5.1 Primary school 5.2 Secondary school 5.3 International school 5.4 Junior college 5.5 University, polytechnic, ITE campus	5.1. >= 1,500 students (single-session) or >= 2,000 students (double-session) 5.2. >= 2,000 students 5.3. >= 2,000 students 5.4. >= 2,000 students 5.5. TIA required
6. Medical Hospital	>= 200 car parking spaces
7. Hotel Business & tourist	>= 600 rooms
8. Recreational Exhibition centre & major tourist attraction	>= 200 car parking spaces

Note:
Generally, for mixed-use residential/retail developments, a TIA is required if the total trip generation of the development exceeds 200pcu/hr either inbound or outbound. However, if the development is located in an area with already high traffic volume, LTA will advise the applicant on whether a TIA is required.
* Walking and Cycling Plan (WCP) is required.

Table 9.5 – **Conditions When a Traffic Impact Assessment (TIA) is Required**

A-2 For types of developments not listed in table above and for temporary developments with leases of over 5 years or more that may have significant impact to traffic within the surrounding area or be located within a densely developed area, LTA may require the submission of a TIA.

A-3 A TIA is applicable for any development seeking direct access either via a dedicated driveway or a new service/access road onto a Category 2 (major arterial) or above type road.

Annex B - Key Issues to be addressed in a TIA Report

A comprehensive TIA report shall cover the following issues. The sequence and headings may not be necessarily the same as those suggested here.

Heading	Description Of What To Include
Executive Summary	A technical summary that is concise and clear on the study purpose, major findings, conclusions and recommendations
1.0 Introduction	
1.1 Background	Description of the development proposal, previous submissions if relevant and the study schedule
1.2 Study Objectives and Key Issues	A statement of the key objective(s), with a summary of key issues to be covered
1.3 Outline of Report	A report structure, with short description of the main purpose of each section
2.0 Existing Transport Network & Traffic Situation	
2.1 Site Location	Current landuse characteristic, site location & boundary, and planned developments/redevelopments in the vicinity
2.2 Study Area	A map with description identifying the study area including study of inter-sections and roads agreed with the LTA at the TIA inception stage
2.3 Existing Transport Network	Description of the existing road geometry, on-street parking, MRT/LRT station(s), bus stop(s), taxi stand(s), pedestrian route(s) and cycling
2.4 Survey & Existing Traffic Flow	Traffic (count) survey required, including the survey method, location(s), date(s), period(s) and summary of the existing traffic flows
2.5 Observation of Existing Traffic Conditions	Description of existing traffic condition for each assessment period re-quired. Existing traffic concerns shall be highlighted, supported by site
2.6 Assessment of Existing Traffic Conditions	Assessment of the traffic situation at existing intersections, including delays, LOS, DOS, queue length, stop rate, etc. If required, evaluation of the traffic situation at existing road(s), including the average travel
3.0 Proposed Development	
3.1 The Development	Nature & size e.g. projected number of residential units / GFA of each component / number of students, hours & days of operation, staging of
3.2 Access Location	Access locations, sight distance of access points, desirable minimum sight distances
3.3 Pedestrians & Cyclists If a Walking & Cycling Plan (WCP) is required, the plans and associated write up shall be submitted as a separate sub-report of the TIA.	Review of pedestrian and cyclists accesses & routes to key transport nodes and surrounding areas, location of bicycle facilities, and conflict treatment at access points.
3.4 Development Traffic Generation	Estimated peak hour traffic generation, based on surveys of similar sites, historical data or method agreed with LTA during the TIA inception stage

Heading	Description Of What To Include
4.0 Future Transport Network & Traffic Forecast	
4.1 Future Transport Network	Description of relevant transport improvement plans for the corresponding years as agreed by LTA (a statement shall be included if LTA confirms that there is no future improvement plan to the existing transport network)
4.2 Future Background Traffic	Forecast of background traffic volumes corresponding to each future assessment year, based on a method agreed with LTA during the TIA inception stage
4.3 Development Traffic Distribution & Assignment	Assignment of development traffic to the road system based on the method agreed by LTA
4.4 Future Traffic Flows	Separate diagrams to illustrate the forecast background traffic flows (without development traffic) and the total traffic flows (with development traffic)
5.0 Impact Of Proposed Development	
5.1 Future Traffic Conditions without the Proposed Development	Assessment of the future traffic situations, including affected intersections and roads, based on the forecast background traffic flows
5.2 Future Traffic Conditions with the Proposed Development	Assessment of the future traffic situations, including affected intersections and roads, based on the forecast total traffic flows
5.3 Development Traffic Impact	Analysis on the impact of the additional traffic associated with the proposed development, with a comparison of the traffic situations with and without the proposed development
6.0 Other Assessment Issues	
6.1 Public Transport	<If Required> Estimation of the proposed development's public transport demand, accessibility and adequacy of provision, the need to provide private bus service, optimised traffic layout to minimise traffic conflicts between different modes of transport, etc
6.2 Parking Provision	Proposed parking provision and required parking provision by standard
6.3 Loading & Unloading Facilities	<As applicable> Provision and operation of service vehicle area
6.4 Pick-up / Drop-off Facilities	<As applicable> Suitable location for pick-up/drop-off activities and number of bays required
6.5 Access & Traffic Circulation	Traffic circulation pattern & internal road layout, type of traffic control at development entrances and projected queue lengths at entrances, and if necessary proposal to improve the traffic layout
6.6 Traffic Operation Plan	<If Required> Estimation of traffic surge demand and conceptual proposal of traffic operation plans to mitigate the traffic surge impact
6.7 Traffic Management during Construction	<If Required> Assessment of traffic impact during the development construction period
7.0 Recommendations And Conclusion	
7.1 Findings	Summary of the key study issues & findings
7.2 Recommendations	Summary of improvement recommendations
7.3 Conclusion	Overall conclusion of the TIA

Table 9.6 – **Key Issues to be Addressed in a TIA Report**

Annex C - Contents to be included in the Executive Summary of a TIA Report

The Executive Summary of a TIA report shall include the following contents, in summarised tables or in other formats which are easy for reference.

Information Type	Details Required
Developer / Agency	Name(s) of the developer / agency and the representative of the developer / agency as applicable.
TIA consultant	Name(s) of the TIA consultant firm and the TIA project manager
QP (Architect)	Name(s) of the Architectural consultant firm and QP(Archi)
Schedule	Include Scoping Meeting date, submission dates of all notes and reports submitted during the course of the TIA study.

Table 9.7 – **Summary of TIA Report Information**

Information Type	Details Required
Type and Scale of Development (1)	For mixed developments, include different component type and scale by land use type.
Assessment years	List the assessment years agreed with LTA. For multi-phase developments, describe the development quantum to be operational corresponding to each assessment year.
Assessment periods	Describe the day (i.e., weekday, Saturday or Sunday) and time period (e.g., 7am–9am) of each assessment period as agreed with LTA.
Traffic / transport surveys	Include information of the survey type (e.g., OD survey), site, methodology (e.g., licence plate matching), date and time period of when the data had been collected of the survey data used.
Resource of vehicular trip rate(s) used	Describe where the trip rate(s) are taken from and how they are applicable to the proposed development.
Trip generation	Include directional vehicular trips (in pcu/h) by assessment period and assessment year (for multi-phase development).
Intended vehicular access points	Indicate the location (name of street) of each vehicular access point (including carpark entrance and/or exit, pick-up /drop-off and loading/unloading as per applicable).
Intended parking provision	List the proposed numbers of parking lots by vehicle type/purpose (i.e., car, motorcycle, loading/unloading, etc).
Background traffic Prediction	Describe the methodology used to forecast the future background traffic and provide the growth rate(s) adopted if applicable.
Other issues	Include findings of other transport related issues such as public transport, pedestrians, cyclists, traffic operation plans, etc. and any other issues / factors that may significantly affect the traffic forecast, as applicable.

Note: (1) Please refer to Table A-1 for the definition of Type and Scale of Development.

Table 9.8 – **Summary of Development and Traffic Forecast Information**

Assessment Year And Location	Assessment Conclusion & Highlights Of Traffic Issues		
	Without Development	**With Development**	**Impact On Average Delay**
▪Year 2015	*(Refer to Table 4.4 in Page 51)*	*(Refer to Table 4.5 in Page 52)*	
▪Junction 1 (Road A / Road B)	▪AM: ▪Average delay: 41 sec ▪DOS: 0.73 ▪LOS: D ▪95% Back of queue: 262m ▪Stop rate: 0.70 ▪PM: ▪Average delay: 39 sec ▪DOS: 0.71 ▪LOS: D ▪95% Back of queue: 198m ▪Stop rate: 0.67 ▪Highlight of traffic issues: ▪Nil.	▪AM: ▪Average delay: 50 sec ▪DOS: 0.80 ▪LOS: D ▪95% Back of queue: 348m ▪Stop rate: 0.78 ▪PM: ▪Average delay: 45 sec ▪DOS: 0.76 ▪LOS: D ▪95% Back of queue: 319m ▪Stop rate: 0.76 ▪Highlight of traffic issues: ▪Nil.	▪AM: ▪↑ 22% ▪PM: ▪↑ 15%
▪Junction 2 (Road B / Road C)	▪AM: ▪Average delay: 69 sec ▪DOS: 0.91 ▪LOS: E ▪95% Back of queue: 402m ▪Stop rate: 0.78 ▪PM: ▪Average delay: 51 sec ▪DOS: 0.82 ▪LOS: D ▪95% Back of queue: 269m ▪Stop rate: 0.56 ▪Highlight of traffic issues: ▪Nil.	▪AM: ▪Average delay: 97 sec ▪DOS: 1.74 ▪LOS: F ▪95% Back of queue: 552m ▪Stop rate: 0.92 ▪PM: ▪Average delay: 82 sec ▪DOS: 1.30 ▪LOS: F ▪95% Back of queue: 457m ▪Stop rate: 0.88 ▪Highlight of traffic issues: ▪Right-turn from North Approach is over capacity, at both AM & PM peaks.	▪AM: ▪↑ 41% ▪PM: ▪↑ 61%
Year 2020	(Refer to Table 4.6 in Page 53)	(Refer to Table 4.7 in Page 55)	
Junction 1	…	…	…
Junction 2	…	…	…
…	…	…	…

Table 9.9–**Summary of Traffic Impact Assessment Results**

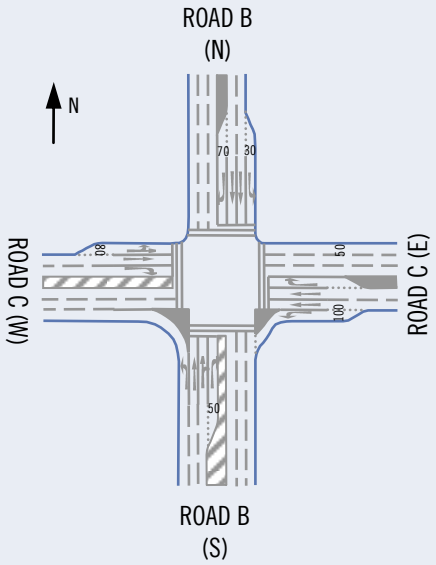
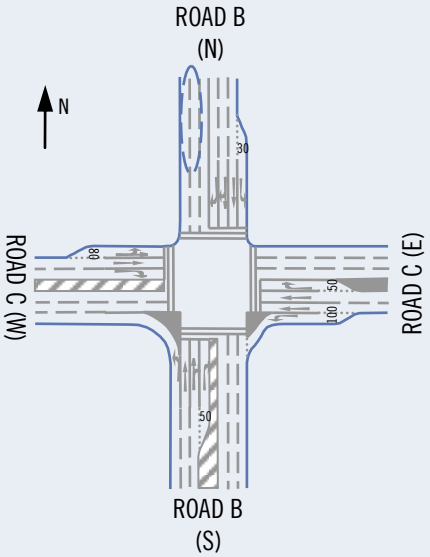
Assessment Year And Location	Improvement Proposal & Results	
*Year 2015	(Refer to Table 4.8 in Page 56)	(Refer to Table 4.9 in Page 58)
•Junction 1	*No improvement required.*	
•Junction 2 (Road B / Road C)	*Proposed mitigation measures: •Convert the right-turn short lane at the North approach from 70m to a full lane; •Convert a through lane to a shared lane with right-turn at the North approach;	
	Layout without proposed improvements  	Layout with proposed improvements 
	Assessment results with the proposed improvements:	
	AM: Average delay: 75 sec DOS: 0.93 LOS: E 95% Back of queue: 385m	PM: Average delay: 63 sec DOS: 0.85 LOS: E 95% Back of queue: 330m Stop rate: 0.75
	Conclusion: Satisfactory performance achieved	
Year 2020	(Refer to Table 4.10 in Page 60)	(Refer to Table 4.11 in Page 61)
Junction 1	•.....	•.....
Junction 2	•.....	•.....
.....	•.....	•.....

Table 9.10 – **Summary of Recommendation**

Annex D - Guide for Bicycle Parking and Related Facilities

In designing bicycle parking spaces, it is prudent for the designer to ensure the facilities are user-friendly and attractive to use. This guide serves to include good practices for designing of bicycle parking and related facilities with an objective to meet cyclists' needs, therefore encouraging proper use of the facilities.

A. Creating safe bicycle parking spaces

Designers shall take into consideration of the vehicle and pedestrian movements when determining the location for the bicycle parking spaces. The bicycle routes and parking spaces within the development shall be away from the major vehicle and pedestrian movements.

Designers, as far as possible, shall avoid using vehicular ingress and egress for cyclists access to bicycle parking spaces. Markings and warning signage that indicate cyclists' presence shall be provided when there is inevitable conflict between vehicular and cyclist movements

B. Providing bicycle parking spaces within the development

Shortage of bicycle parking spaces will lead to indiscriminate bicycle parking in the development vicinity. This may lead to an unpleasant streetscapes and blockage of the pedestrian route. Developers are encouraged to provide bicycle parking spaces according to the following table 9.11:

Development Type	Proposed provision
Residential	1 lot per 6 dwelling units
Office, Retail, Hotel, Medical, Industrial, Mixed -use Commercial and Office, Place of Worship, Civic and Cultural Institution	For GFA of at least 1,000 m^2 and up to 3,000m^2 · 10 bicycle lots For GFA above 3,000 m^2 · First 15,000m^2 of GFA: 1 bicycle lot per 300 m^2 · Subsequent GFA: 1 bicycle lot per 1,000 m^2
Community institution, Sports & Recreation Facilities	For GFA of at least 1,000 m^2 and up to 3,000 m^2 · 20 bicycle lots For GFA above 3,000 m^2 · First 15,000 m^2 of GFA: 1 bicycle lot per 150 m^2 · Subsequent GFA: 1 bicycle lot per 500 m^2

Table 9.11 – **Bicycle Parking Provision**

C. Creating convenient bicycle parking spaces

Bicycle spaces shall ideally be located at visible and convenient spots, taking into consideration of the alignment of the cycling paths in the vicinity. If there are limitations that prevents all the bicycle lots to be consolidated in one location, it is acceptable to propose more than one bicycle parking location. However, the bicycle lots shall not be scattered throughout the development in an ad-hoc manner. The lots shall be well organised. Each bicycle parking area shall accommodate at least 10 bicycle parking lots.

The designer shall also consider whether the bicycle parking spaces are intended for short or long-term parking. Workers, tenants or occupants of a building who are likely to park long-term would require secured and sheltered parking. Visitors and customers who usually park for a shorter period and would require convenient parking location.

I. Short-term bicycle parking space:

Short-term bicycle parking spaces cater mainly for visitors who park for three hours or less. This space shall be easily accessible by public at all times and located on the ground floor & building entrances of the development. The design of the space shall not cause inconvenience to the movements of pedestrians and/or vehicles .

II. Long-term bicycle parking space:

Long-term bicycle parking spaces cater mainly for employees working in the development. It is recommended for this parking space to be fully protected against the weather and designed for protection against vandalism and theft. Long-term bicycle parking space(s) can be located on any level of the development.

The routes to bicycle lots located other than ground level shall be carefully considered in the overall design of the development. The gradient of any ramp at the cyclist access or along the bicycle route shall not be steeper than 1:25. Routes to bicycle parking spaces shall be separated from vehicular ramps. Instead, cyclists shall be allowed to use passenger lifts. The lift shall be able to accommodate a horizontally standing bicycle. The recommended dimensions for the lift that can accommodate three bicycles with three to four standing persons are shown in Figure 9.4.

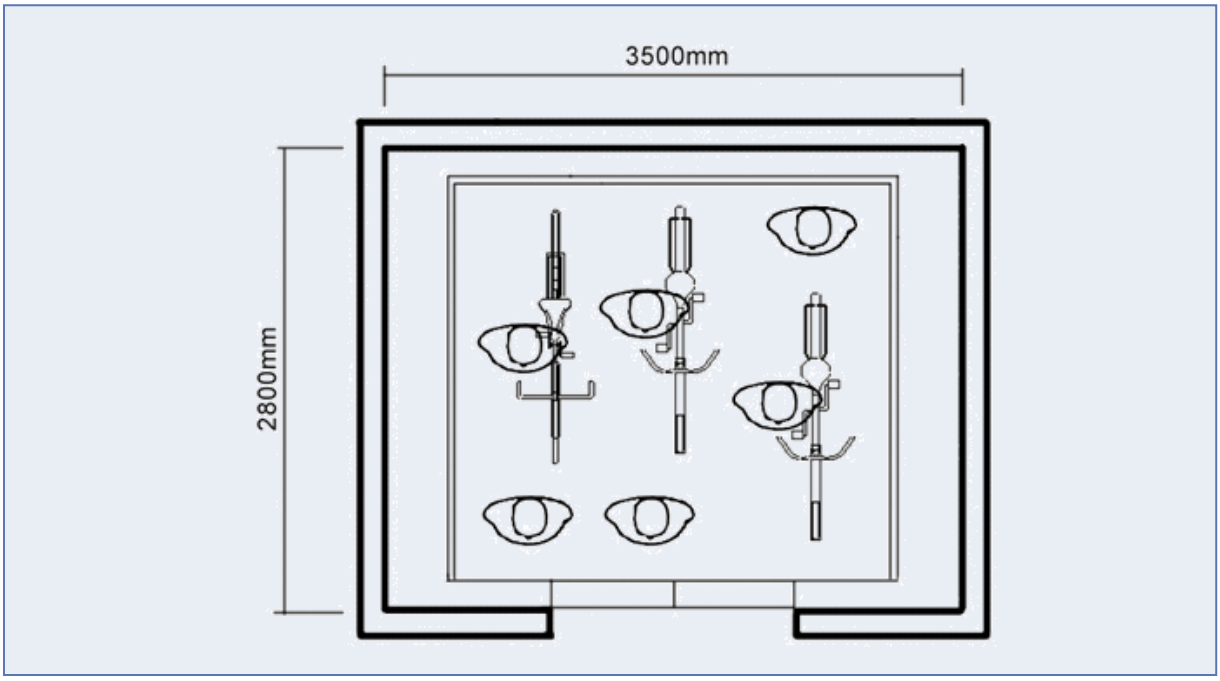


Figure 9.4 **Plan view of the recommended lift size to accommodate 3 bicycles and 3-4 standing persons**

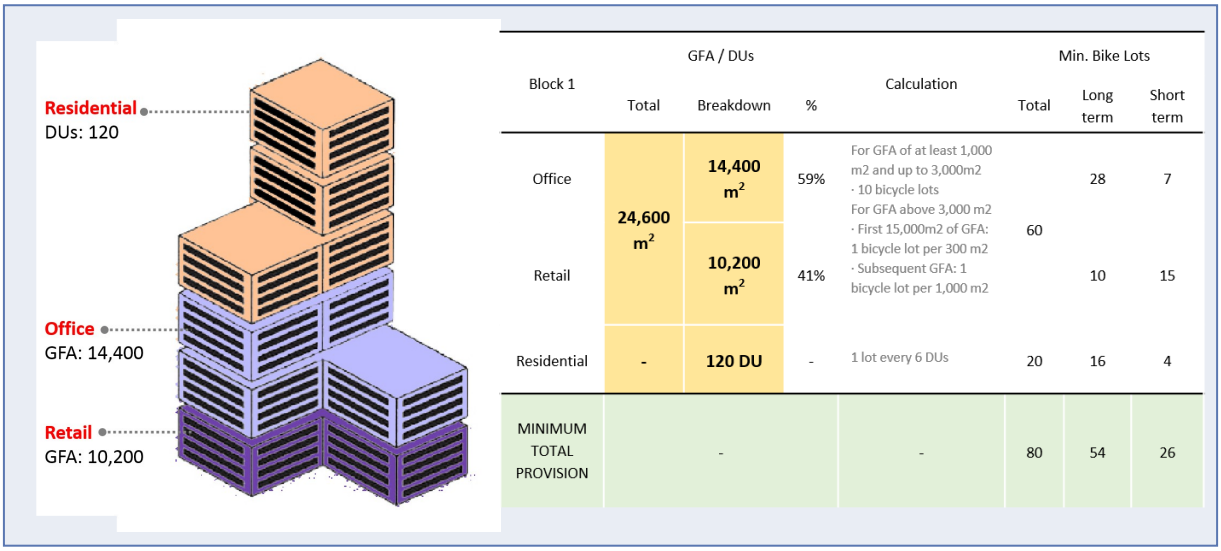
III. Proportion of Short-term and Long-term bicycle parking spaces

The proportion of short-term bicycle parking spaces and long-term bike parking spaces is recommended as follows:

Type of users	Type of bicycle parking spaces	
	Long term bicycle parking	Short term bicycle parking
Residential, Hotel, Office, Industrial	80%	20%
Retail, Health institution, Civic & community institution, place of worship, sports & recreation facilities	40%	60%

Table 9.12 –**Type of Bicycle Parking Spaces**

A sample computation of bicycle parking provision in a mixed-use development is shown in Figure 9.5. For a multi-blocks development, sufficient bicycle parking spaces shall be provided at the individual blocks to serve the respective users in the development where possible. It is recommended that the bicycle parking provision per block be proportional to its respective blocks GFA.



Block 1	GFA / DUs			Calculation	Min. Bike Lots		
	Total	Breakdown	%		Total	Long term	Short term
Office	24,600 m^2	14,400 m^2	59%	For GFA of at least 1,000 m2 and up to 3,000m2 · 10 bicycle lots For GFA above 3,000 m2 · First 15,000m2 of GFA: 1 bicycle lot per 300 m2 · Subsequent GFA: 1 bicycle lot per 1,000 m2	60	28	7
Retail		10,200 m^2	41%			10	15
Residential	-	120 DU	-	1 lot every 6 DUs	20	16	4
MINIMUM TOTAL PROVISION	-			-	80	54	26

Figure 9.5 **Sample Computation for Mixed-use Development**

D. Dimensions for Bicycle Parking Space and Racks

A Bicycle Parking Space refers to the space for parking of one bicycle. A bicycle parking rack shall be provided for each bicycle parking space and anchored to the ground so as to allow cyclists to lock their bicycles with ease. The rack should support the bicycle upright by its frame.

Designers shall design for adequate clearance for users to lock/unlock their bicycles onto/from the racks and to push the bicycle in and out of the racks. The following are suggested designs and dimensions that designers can adopt for bicycle parking racks. It is recommended to provide the minimum aisle width for circulation.

I. Single-tier bicycle parking space

Space Width: 600mm
Space Length: 1800mm
Aisle Width: 1500mm (min)

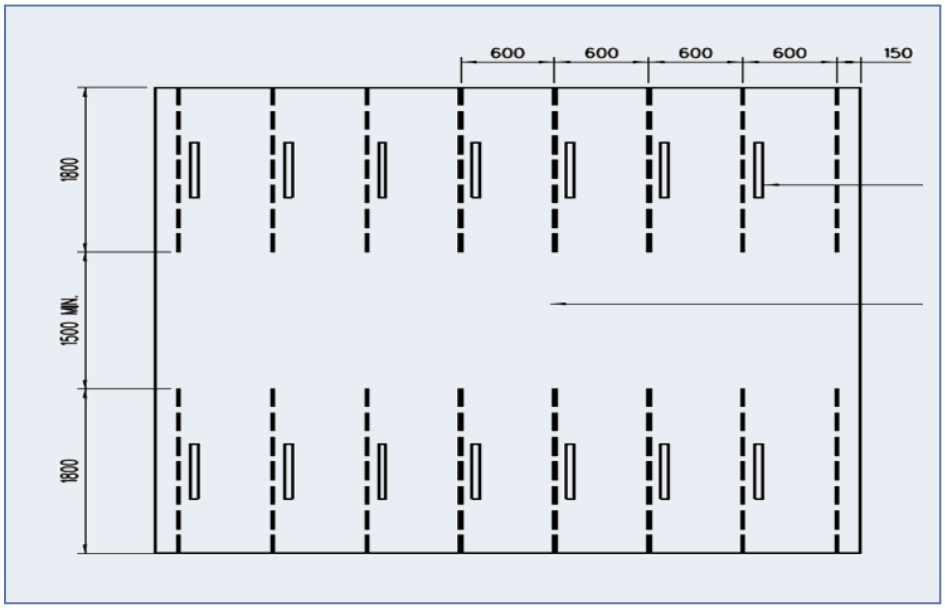


Figure 9.6 **Plan View of Parking Space With Single-Tier Bicycle Parking**

II. Bicycle Rack Dimension for Single-tier bicycle parking

Width: 600mm
Length: 900mm
Diameter: 50mm

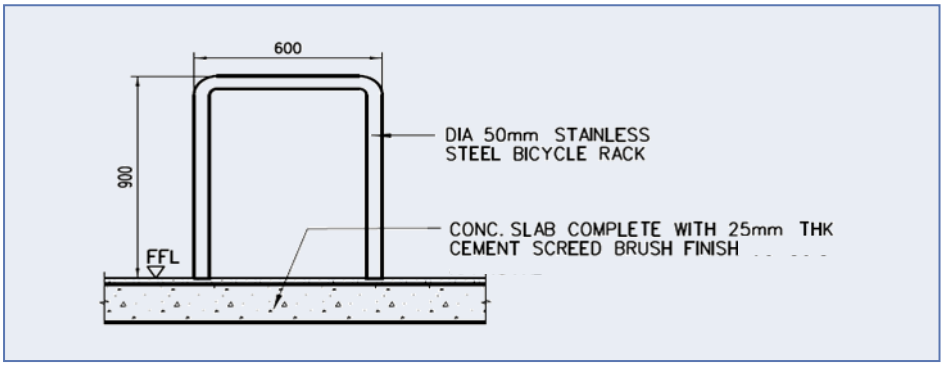


Figure 9.7 **Recommended Dimensions of Single Tier Bicycle Racks**

III. Double Tier Bicycle Parking space

Space Width:	650mm
Space Length:	2000mm
Aisle Width:	2500mm (min)

Designers are encouraged to propose other innovative and high-density bicycle racks designs which are able to accommodate a higher number of bicycle racks within a given area .

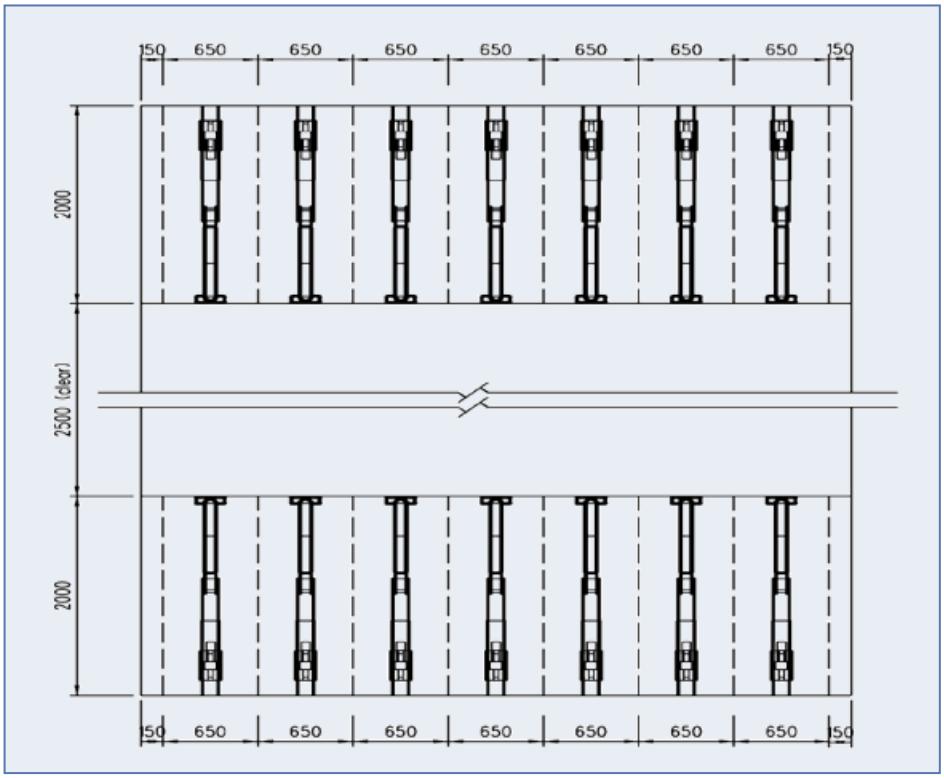


Figure 9.8 **Plan view of Bicycle Parking Spaces with Double Tier Bicycle Racks**

IV. Bicycle Rack dimension for Double Tier Bicycle Parking

Width:	100mm
Length:	1864mm
Height:	1550mm
Headroom	2600mm clear

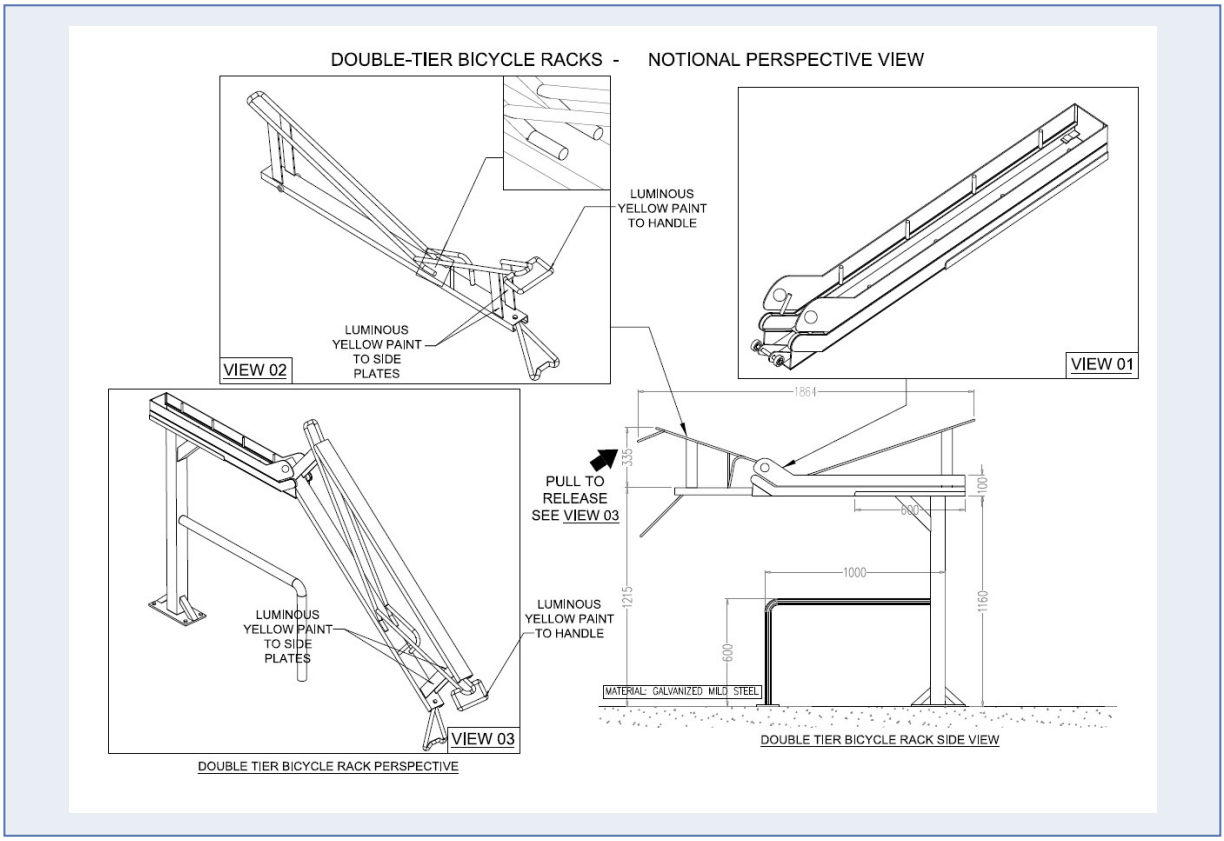


Figure 9.9 **Recommended Dimensions of Double Tier Bicycle Racks**

E. Complementary end-of-trip facilities:

Complementary end of trip facilities provide a convenient and comfortable cycling experience for visitors. therefore improve the viability of cycling as a mode of transport. Designers are encouraged to provide such supporting facilities in close proximity to the bicycle parking spaces, especially for long-term bicycle parking. For large development with several building blocks, each block shall ideally have its own supporting facilities to serve the users of the block. Developers/owners/building management committee may consider providing following facilities within their development. :

- Sheltered bicycle parking spaces
- Shower facilities
- Changing Room
- Security such as CCTV
- Lockers
- Air pump

Provision of innovative and artistic signage and/or floor markings with clear information is encouraged to guide cyclists to the bicycle parking spaces and nearby end-of-trip facilities.

Recommended provision of the facilities is shown in Table 9.13:

Uses	Shower	Locker	Other facilities
Residential, Hotel, Sports & Recreation facilities	Not Necessary	Not Necessary	Not Necessary
Retail, Health institution, Office, Industry, Civic & Community institution, Place of worship,	1 shower stall per 10 bicycle lots	1 locker per bicycle lot	≤5 m^2 per 10 bicycle lots (e.g. bicycle repair station, changing room, toilet, fresh towel station)

Table 9.10 – **Provision of End-Of-Trip Facilities**

The developer/owner/ building management committee shall be responsible for the operation and maintenance of the bicycle parking lots and other related facilities at all times.

Annex E- Contents to be included in the Walking & Cycling Plan (WCP)

Types of information/ plans to be submitted	Description of contents to include	Remarks
WCP write up	Assessment with justifications (if any)	To be submitted as a separate sub report of TIA.
Location Plan (See Figure 9.10 for an example of a Location Plan)	Please indicate the following: **Accesses** 1. Proposed pedestrian access(es); 2. Proposed cyclists access(es); 3. Proposed vehicular access(es); **Routes/circulation** 4. Existing pedestrian routes across/ to /from development site and the MRT station(s), bus stop(s), taxis stand(s) & adjacent buildings; 5. Existing cycling path abutting the development ; 6. Proposed interim linkages during construction phase of the development where existing footpaths / linkways / cycling paths are affected upon hoarding of the development. **Facilities** 7. Existing adjacent pedestrian crossing(s) eg. signalised PC, zebra crossing, overhead bridge, underpass ,underground linkage; 8. Existing covered walkway / linkway within and abutting development.	A Location Plan is required to show the development in relation to the surrounding context. The plan is to include the locations of the MRT entrances, bus stops and taxi-stands, adjacent developments existing/ planning cycling path network and pedestrian paths. Please use different colours to differentiate between pedestrian facilities/ routes, cyclist facilities/routes and vehicular routes. For existing routes, please use solid lines. For proposed routes, please use dotted lines.

Types of information/ plans to be submitted	Description of contents to include	Remarks
First Storey Plan (& other storey plan(s) with pedestrian & cyclist facilities) and relevant section drawings of sidetable abutting the development (See Figure 9.11 for an example of a First Story Plan)	Please indicate the following: **Accesses** 1. Proposed pedestrian access(es); 2. Proposed cyclist access(es); 3. Proposed vehicular access(es); **Routes/Circulation** 4. Barrier free accessibility (BFA) route(s) and non BFA route(s) within development and how it connects to the adjacent public pedestrian footpath; 5. Pedestrian circulation route(s) including through -block link within development and how it connects to the adjacent public pedestrian walkway, nearest bus stop, MRT station and taxi stand; 6. Cyclist circulation route(s) within development and how it connects to the adjacent cycling path network and the proposed bicycle parking area(s); 7. Vehicular circulation route(s) within development and how it connects to the adjacent vehicular roads. 8. Pedestrian conflict area(s) with cyclist or vehicular traffic (Details of treatment to be presented in a write-up with relevant drawing (s)); 9. Cyclist conflict area(s) with vehicular traffic (Details of treatment to be presented in a write-up with relevant drawing(s)); **Facilities** 10. Location(s) of proposed/existing taxi stand, pick -up point, drop-off point ; 11. Proposed/ existing covered walkway and linkway within and abutting development; 12. Proposed number of bicycle racks at the proposed location(s), and also the proposed type of bicycle racks (e.g. single, double tier) 13. Location(s) of other supporting infrastructure e.g. showers, lockers; 14. Location(s) and details of proposed wayfinding signage to major transport nodes, nearby amenities and pedestrian/cyclist facilities within development.	A First Storey Site Plan is required to show the location of the existing and/or planned footpaths/ cycling paths, bicycle parking, access routes to bicycle parking area, supporting facilities such as showers, lockers and changing rooms. Other storey floor plans shall be included if key pedestrian/cyclist facilities are also on that storey. Please show adjacent road name (s) surrounding the development. Please use different colours to differentiate between pedestrian facilities/ routes, cyclist facilities/ routes and vehicular routes. For existing routes, please use solid lines. For proposed routes, please use dotted lines.

Table 9.14 – **Content to be Included in WCP Submission**

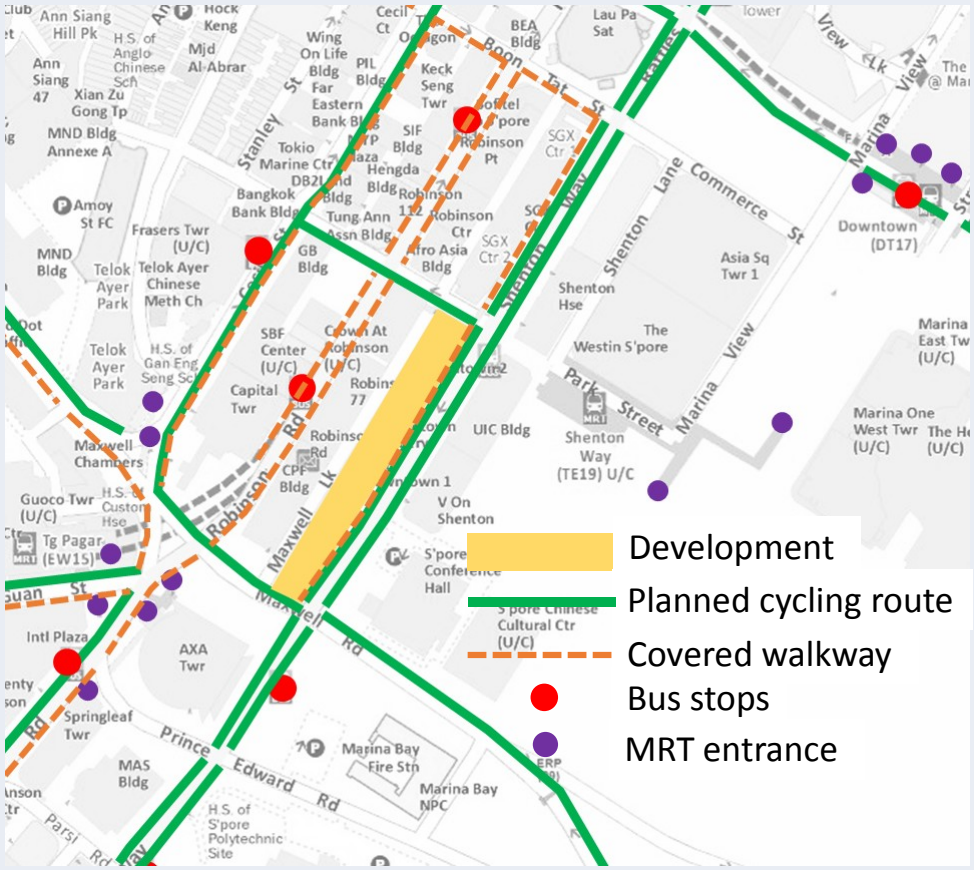


Figure 9.10 **Example of a Location Plan**

Figure 9.11 **Example of a First Storey Plan**

Annex F - Submission Procedure of Walking & Cycling Plan (WCP)

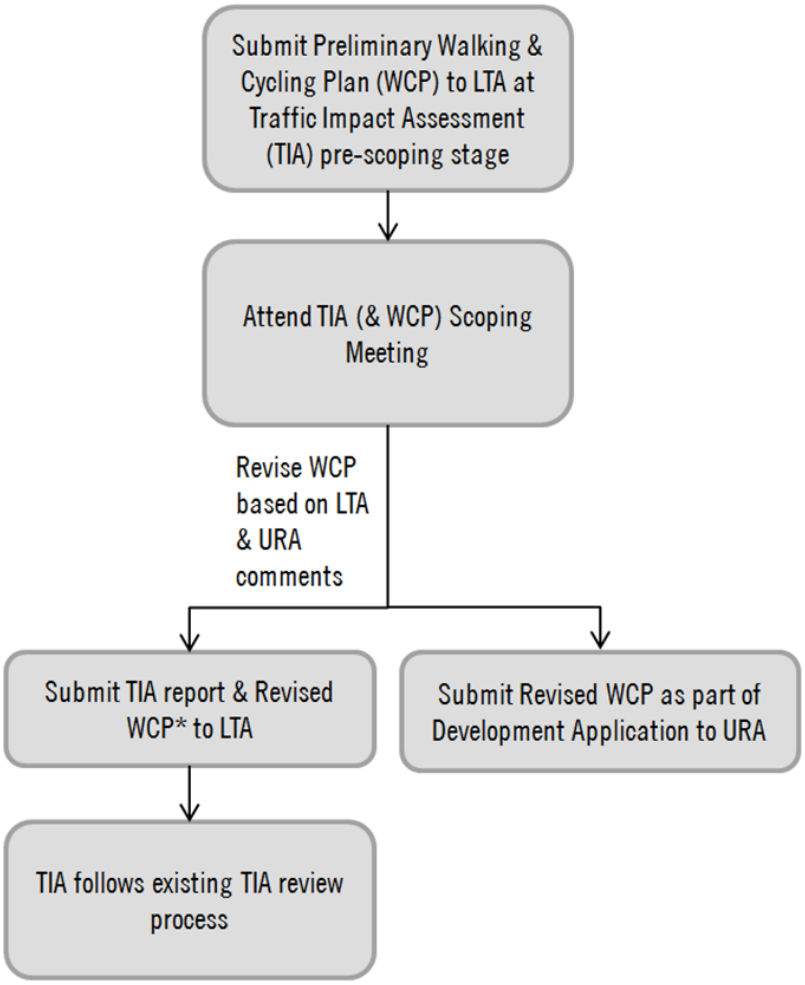
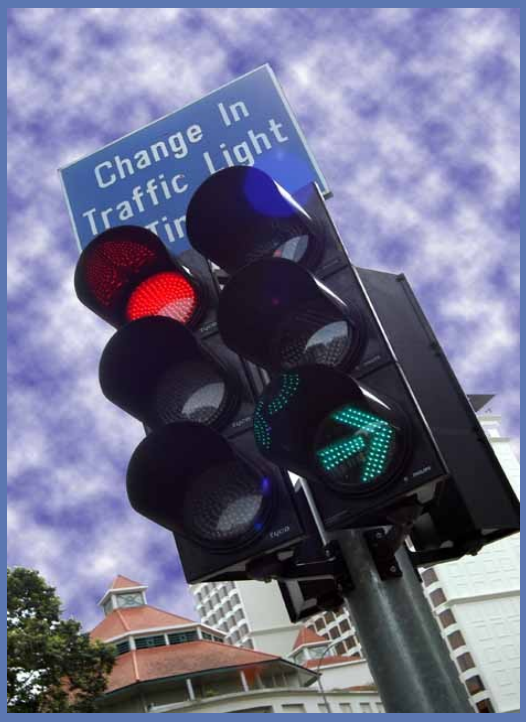


Figure 9.12 **Submission Flow Chart for WCP**

This chapter presents guidelines for the Professional Engineer to prepare quality traffic layout plans.



Chapter 10

Plan Presentation for Traffic Layout Plan

Glossary

Gazetting Table	Table that shows the list of proposed traffic markings and signs.
Enhanced School Zone	Measures introduced on the roads close to existing primary schools to enhance road safety

Chapter 10

Plan Presentation for Traffic Layout Plan

10.1 Introduction

Traffic layout plan is required to be submitted to LTA for approval when there are proposed changes to the current traffic schemes on site or for submission of new street plans connecting to an existing road. This chapter guides consultants to prepare quality traffic layout plans for submission to LTA.

10.2 Reference

Generally, the Professional Engineer would prepare the traffic layout plans based on the following guides listed below.

SWA

- Street Works (Private Streets) Regulations

SDRE

- Standard Details of Road Elements

10.3 Traffic Layout Plan Presentation

The traffic layout plan shall show the traffic schemes proposed for the new street and the adjoining streets. It is not necessary to show other details not related with the aspects of traffic schemes (i.e. chainages, levels, manholes and other irrelevant details are not require to be shown on a traffic layout plan).

The plan shall be titled as "Traffic Layout Plan" and not as Site Plan, Layout Plan or 1st Storey Plan.

a) The Gazetting Table

The gazetting table below shows the list of proposed traffic schemes to be provided in the new streets.

(i) All proposed signs/lines/markings, etc to be drawn or placed shall be indicated in the gazetting table according to the road name or proposed road.

(ii) Traffic scheme details for signs/lines/ markings can be found in LTA Standard Details of Road Elements.

S/No	Location	Signs To Be Drawn Or Placed	Signs To Be Deleted	LTA File Ref No
1	Proposed Road 1	Arrow markings		
		'Bend' sign		
		'Stop' sign		
		'Slow' sign		
		Single centre white lines		
		Double centre white lines		
		Double yellow lines		
		'Hump ahead' markings		
		'Slow' & 'hump ahead' sign		
2	Proposed Road 2	'Turn left' sign	Double yellow lines	
		Arrow markings		

Table 10.1 - Gazetting Table

(iii) All existing signs/lines/markings, etc to be deleted or removed shall be indicated in the gazetting table according to the road name or proposed road.

(iv) All existing signs/lines/markings, etc to remain shall be highlighted in black in the traffic layout plan.

In some cases, the proposed traffic schemes need to be presented in more than one traffic layout plan. Please note that one table must be drawn for each drawing and all the proposed traffic schemes indicated on the drawing plan must be indicated in that table.

(b) Colour Code

The colour for all proposed, existing and removal of road signs/markings/lines should be in red, black and yellow respectively.

(c) The North Point

It should be indicated at the bottom right corner in the Traffic layout plan.

10.4 Details of Road Reserve / Key Plan / Scale

(i) The Road Reserve Lines shall be indicated in red in the traffic layout plan.

(ii) A Key Plan can be indicated on the top left/right hand corner to give a better overview of the location of the proposed road. The key plan shall also indicate development accesses and the names of the surrounding roads in the vicinity.

(iii) The traffic layout plan and key plan are required to be drawn to scale. (Traffic Layout Plan can be in scale of 1:100, 1:500 or 1:1000 whereas the Key Plan can be in scale of 1:20 000, 1:10 000 or 1:5 000).

10.5 Street Lights

The notional position of street lightings shall be indicated in the traffic layout plan.

10.6 Traffic Lights

Generally traffic lights on public roads are managed by LTA.

(i) For new traffic lights (if warranted for developer to proceed) on public roads/roads that will be handed over to LTA for management in future, the proposed traffic signals will need to be carried out by LTA. This is to ensure that all traffic light installation works satisfy our specification/requirements.

(ii) The traffic layout plans should also include traffic light poles signals layout, traffic controller/meter and traffic light phasing diagrams.

Note:

a. After the traffic layout plan is approved by LTA, the Qualified Person (QP) shall liaise with LTA (ITSC) on the payment, installation and the commissioning traffic lights.

b. The Qualified Person (QP) shall apply/monitor/make direct payments to SingTel and Singapore PowerGrid (SP) Services Ltd for connection of electricity supply and telecom line for installation of new traffic lights. The Qualified Person (QP) shall co-ordinate with PowerGrid, SingTel and any other contractors for the necessary works on the above. They should ensure the services cables connection (electricity supply & telecom line) are ready in time for commissioning of new traffic lights. Generally, this process requires about 3-4 months.

c. The Qualified Person (QP) shall provide and make available all necessary GI conduit pipes(100mm diameter) and crossings for traffic light contractors to lay the necessary cables for new traffic light installation. GI pipes shall be provided on the carriageway, side table and footpath, leading to traffic light poles, detector pits and controller boxes for new traffic lights installation. Durable red plastic cable slabs shall be placed 200mm above the GI pipes for all trenches dug regardless of the depth to mark their positions. The plastic cable slabs shall be 300mm x 1000mm and marked with the wordings "Traffic Light Cable – 1800 Call LTA – 1800 2255 582.

d. LTA (ITSC) will thereafter give the final cost estimates for traffic lights installation, which also include Auxiliary Police Officer (APO) CISCO guards on the actual day of commissioning. All payments have to reach LTA (ITSC) The Qualified Person (QP) shall issue cheque payment payable to Land Transport Authority with LTA approved plan at least 4 months prior to the implementation of traffic signals, phasing and commissioning. The cheque payment with approved plan shall forward to following address:

Land Transport Authority
ITS Centre, 181 River Valley Road
Traffic Light Maintenance, Level 4
Singapore 179034

e. The Qualified Person (QP) shall forward a copy of the official receipt from M/s SP Services Ltd and SingTel to LTA (ITSC) for information and necessary action.

f. LTA's traffic lights term contractor only carry out physical traffic light installation works. The scope of works does not include all other civil works, installation of traffic signs, lane markings, etc necessary for the proper operation of the new traffic lights.

10.7 Typical Traffic Layout Plan Related to Development With Street works

(i) Stop Line and Sign

The proposed stop line shall be provided at 1m away from the tangent of the kerb line (i.e. edge of the main road). The stop sign shall be provided before the stop line. Refer to figure 10.2

In some circumstances, where the sidetable is not wide (Category 5 road with less than 3m sidetable), the stop line at the entrance point can be placed within the private boundary.

It is emphasised that the boundary walls (if any), to be designed such that pedestrians crossing the entrance are able to see motorists exiting from the private development.

(ii) Arrow markings

a. The left-turn arrow marking on the main road should be painted about 10m from tangent point before side road/ service road/access point.

b. To provide at least one set of arrow markings before a junction for residential estate roads.

c. To provide 2 sets of arrow markings for mid block signalised pedestrian crossing.

d. It is not necessary to indicate left/right turn arrow marking on the main road to lead motorists to the access to developments.

(iii) Removal of existing lines / markings (e.g. double yellow lines etc)

a. The deletion of the markings and lines shall be shown in yellow. Refer to Figure 10.2

b. The provision of double yellow lines at the proposed entrance shall be provided up to the edge of entrance culvert.

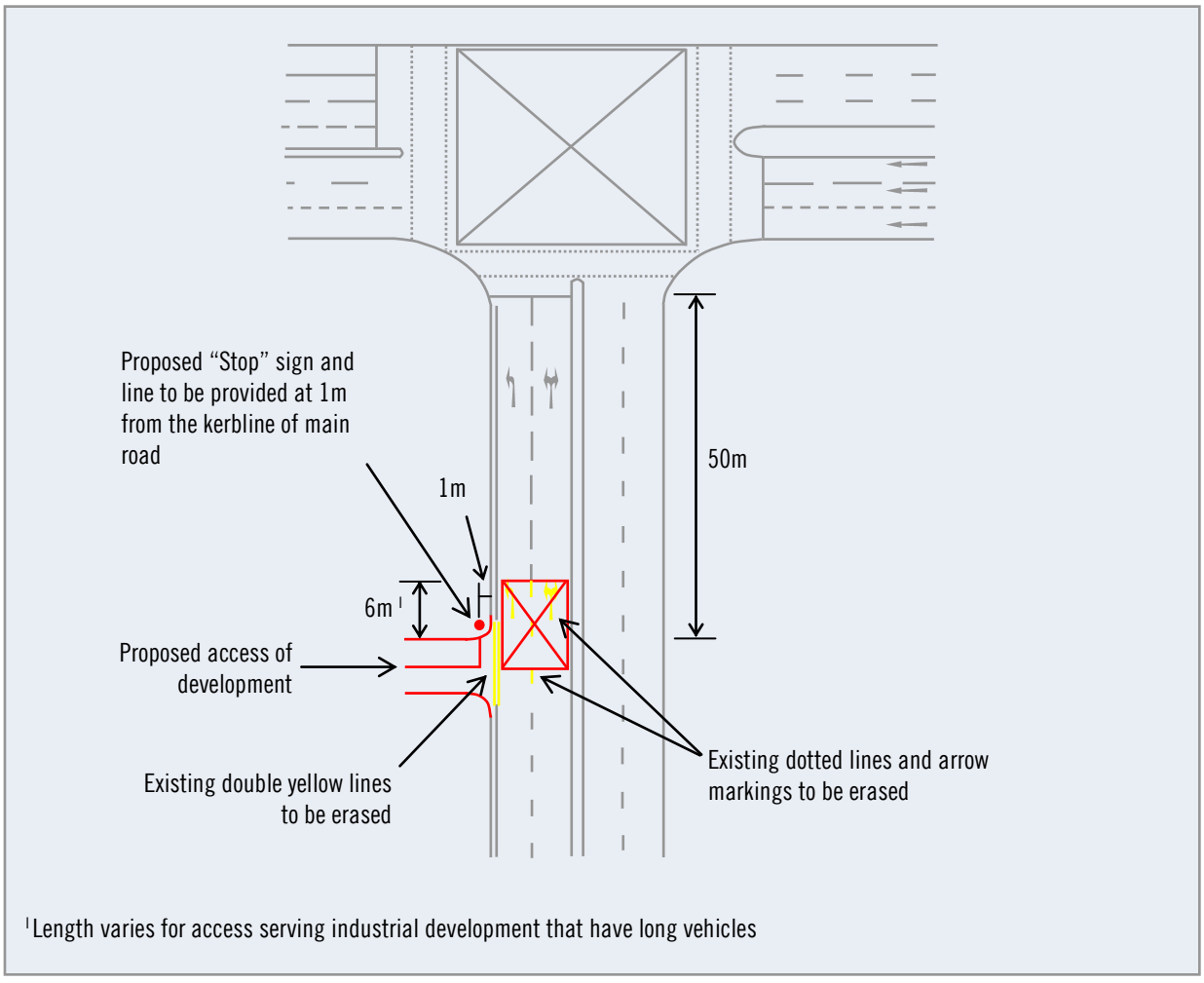


Figure 10.1 **Proposed Development Access Meeting a Road near a Junction**

(iv) Proposed lines, markings, signs and other road features (e.g. yellow box, bollards etc)

a. The proposed lines/markings/signs are to be shown on plan in red colour. Refer to figure 10.2

b. The new schemes are to be indicated in the gazetting table.

(v) Speed calming measures (e.g. humps, bus friendly hump, etc)

a. The proposed road hump is usually provided at the residential roads to deter speeding.

b. If the proposed entrance is affected by an existing road hump, relocation of the existing road hump and markings to an appropriate location are necessary. The existing hump shall not be allowed to front an access. Refer to figure 7.2.

c. Prior to the relocation of the existing road hump, the consultant is required to inform the grassroots organization(s), Citizen Consultative Committee (CCC) of the estate and the immediate residents affected on the new location of the road hump after their traffic study

d. Normal road humps, or round top humps, have been found to be unsuitable for buses as they can cause discomfort or even injuries to standing passengers. For such instances, the bus friendly hump is provided.

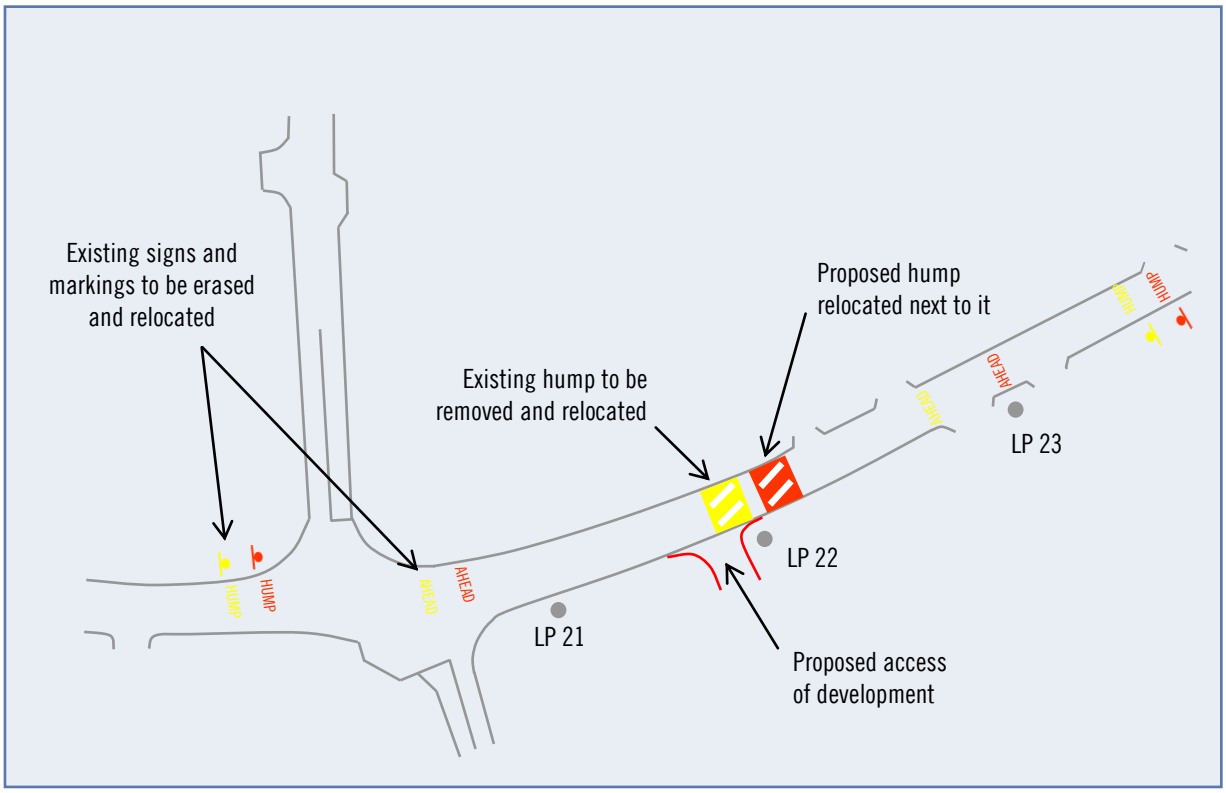


Figure 10.2 **Proposed Development Access Affected by the Presence of an Existing Hump**

(vi) Pedestrian crossing

If the existing pedestrian crossing is affected by the proposed road or new access location, the new crossing and its related lines, markings, signs and traffic lights shall be relocated accordingly.

The cost of the installation of the new traffic signals etc shall be borne by the developer.

Examples of pedestrian crossing facility shown in traffic plan are push button crossing, zebra crossing, pedestrian overhead bridge, pedestrian underpass etc.

(vii) Shared arrow markings (left-turn and straight arrow) before access to development

Shared arrow markings can be placed prior to:

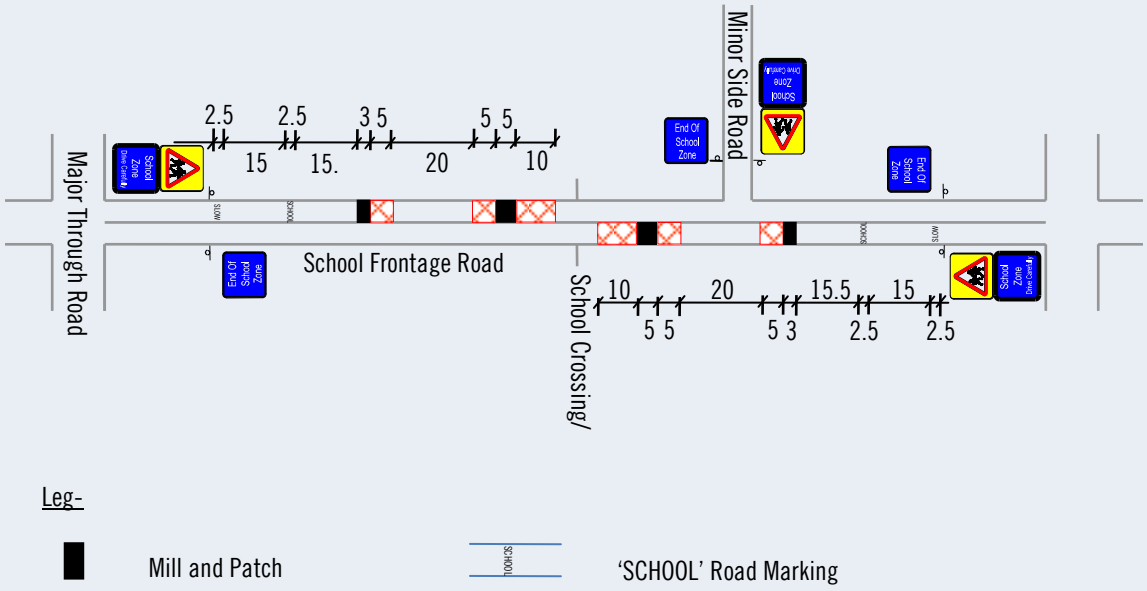
- a HDB access;
- a condo access with development exceeding 600 units; and
- a dual 2-lane road or 2-lane 2-direction road (10m wide)

These markings serve as a information on the access ahead and alerts motorist to drive at an appropriate speed when approaching these accesses.

(viii) Enhanced School Zone (ESZ) schemes

Road safety for primary school students is a paramount concern for all of us. To improve road safety for primary school children and to increase the visibility of the presence of primary schools, the enhanced school zone (ESZ) schemes was introduced. (Refer to diagrams in next pages.

The key feature of the ESZ scheme is the coloured road pavement, with an aim to alert motorists that they are in the



Details of the red pavement

- Suitable for location with high interaction of pedestrian (especially children) movement with traffic flow
- Red pavement to place at primary school entrance or at pedestrian crossing dedicated for school children
- Length of red pavement: Continuous 20m from the school entrance or stop line, followed by a 8m of treatment after allowing for a 20m gap
- No other road markings are to be painted on the red pavement except lane markings
- Minimum length of school zone should not be less than 200m for speed limit ≤50km/hr, and 400m for speed limit between 60km/hr to 70km/hr
- Maximum length shall not exceed 500m where possible

Fig 10.3 **Enhanced School Zone Scheme**

(ix) Typical Cross and T-junctions

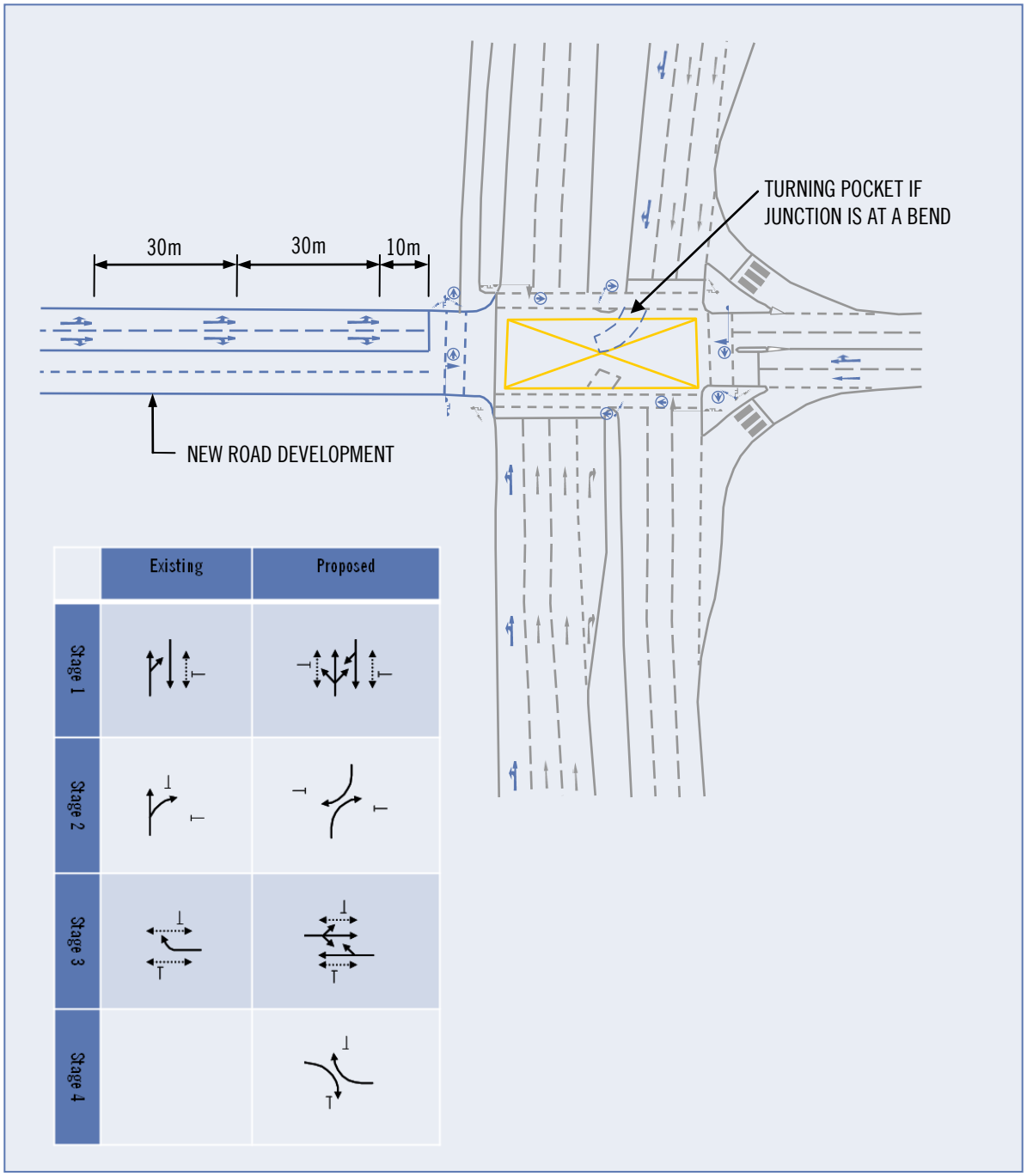


Figure 10.4 **Traffic Scheme at Typical Cross and T-junctions**

(x) Taxi stand

The following documents are required for gazetting purpose:

- Cover letter or acknowledgement from the development indicating their intension to gazette the taxi stand.
- Completed ADC checklist for taxi stand endorsed by the development (if there is any requirement that cannot be met, developer must provide supporting reasons).
- Floor plan/layout of taxi stand and surrounding traffic scheme.
- Photographs of the completed taxi stand.

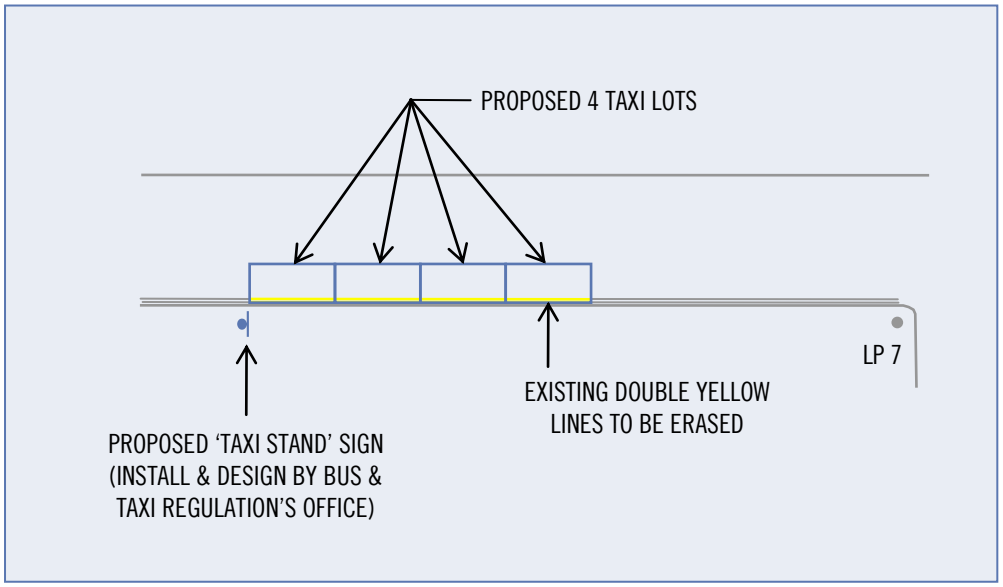


Figure 10.5 **Taxi Lots Without Bay**

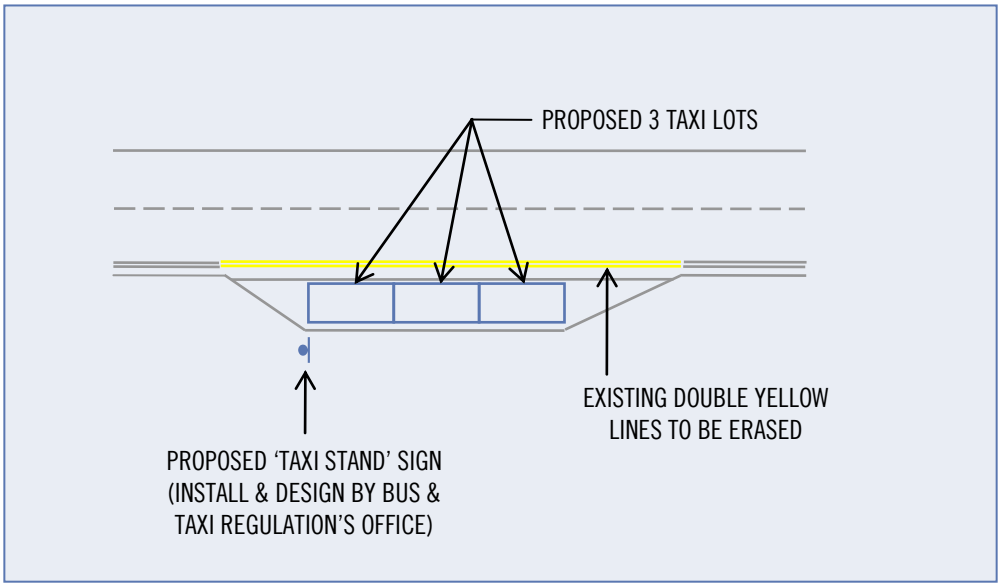


Figure 10.6 **Taxi Lots With Bay**

Sample Traffic Plans

Samples of quality traffic plans are given below:

Plans	Description
Sample Plan 1	Proposed 26.2m road at a T-junction
Sample Plan 2	Proposed 21.4m road with bus-bay construction
Sample Plan 3	Proposed 18.0m road at a T-junction
Sample Plan 4	Proposed 21.4m road at a T-junction
Sample Plan 5	Proposed 21.4m road at a T-junction

Checklist to Assist in Preparing a Traffic Plan

The following two parts of checklist are designed to assist PE in ensuring that all relevant information for a complete Traffic Layout Plan has been captured in the submission. These checklist shall accompany the Traffic Layout Plan.

Traffic Layout Plan Submission Checklist

Project Title: _____

Revision No.: _____

Notes to QP:

1. The Professional Engineer (PE) shall check that the items listed below have been complied and shall indicate it in the box provided. The QP shall state the reasons for not complying with items that are marked " Not Complied"
2. For the subsequent submissions, please attach the "checked copy" Traffic Plan.
3. Please note that the comments for the traffic plan submission shall not be deemed exhaustive and final. Further comments may be applicable depending on the review of the re-submitted plans .
4. Please note that our reply is limited to specific technical considerations under LTA's purview only and it is based on data available at the time of enquiry. The reply is given without prejudice to any changes which may take place subsequently.
5. For details on specific items/features in the checklist, please refer to relevant chapters of this the Code or the Standard Details of Road Elements.

Tick the appropriate box for all items

S/N	Item	Requirements	Complied	Not Complied	Remarks
1	Title	To indicate "Traffic Plan" and not "Site Plan" or "Traffic Scheme Plan".	☐	☐	
2	Project title	To provide description of project in traffic plan.	☐	☐	
3	Key Plan	• To indicate "Key Plan" and not "Location Plan" • To include "Key Plan" in the Traffic Plan and place it on the top left hand corner. • The scale can be 1:20,000 or 1:10,000 or 1:5,000 • To indicate access points in the "Key Plan"	☐	☐	
4	North Arrow Indicator	To include North Arrow indicator.	☐	☐	
5	Legend	To include legend in plan.	☐	☐	
6	Scale and size for traffic plan	1:100 / 1:500 / 1:1000, A3 / A1 size.	☐	☐	
7	Gazetting Table	To include a gazetting table.	☐	☐	
8	PE Endorsement	To include PE Endorsement.	☐	☐	
9	Colour code	The colour for all proposed, existing and removal of road signs / markings / lines should be in red, black and yellow respectively.	☐	☐	

S/N	Item	Description	Complied	Not Complied	Remarks
10	Existing & Proposed road	To include all existing or proposed road markings or signs in the Traffic Plan.	☐	☐	
11	Turning Radius	Indicate turning radius of accesses, junctions, etc. in traffic plan.	☐	☐	
12	Road names	All road names to be indicated, including new roads.	☐	☐	
13	Neighbouring Roads	To include neighbouring roads / streets connecting to the development so as to give an overview of the surrounding environment.	☐	☐	
14	Footpath	To indicate footpath in traffic plan.	☐	☐	
15	Street Lights	Notional position of street lights shall be indicated.	☐	☐	
16	Access	Indicate vehicular access, pedestrian access and service access (bin centre, loading/unloading, etc.) clearly in the traffic plan. Where applicable, include visitor lane for building development. This will minimise delay to residents from entering the development.	☐	☐	
17	Railings	To indicate existing / proposed railings in the traffic plan.	☐	☐	
18	Stop line / sign	To indicate “stop” line (1m from kerbline) and /or sign and drop barriers (if any) at the access point.	☐	☐	
19	Barriers	To set back drop barriers of at least two cars’ length from the public road.	☐	☐	
20	Lane Widths	To indicate lane widths in traffic plan.	☐	☐	
21	Arrow marking	Please refer to the Section 10.7 for details on provision of arrow markings on public road leading to development access.	☐	☐	
22	Signs	All signs to be installed in a conspicuous manner (not obstructed by structures, trees, shrubs, etc.) and to be indicated clearly in the plan	☐	☐	

Table 10.2 **Checklist to Assist in Preparing a Traffic Layout**

This chapter advise the Qualified Person on the technical requirements of designing building foundations in the vicinity of the future Singapore Underground Road System (SURS)

Chapter 11

Engineering Works Within Singapore Underground Road System (SURS) Tunnel Protection Reserve

Glossary

Cut-and-cover	A method for digging a tunnel laying pipe ect, by cutting a trench, constructing the tunnel or laying the pipe in it, and covering with the excavated material
Diaphragm Wall	Deep trenches excavated in the soil into which reinforced concrete is placed

Chapter 11

Engineering Works Within Singapore Underground Road System (SURS) Tunnel Protection Reserve

11.1 Introduction

The Singapore Underground Road System (SURS) forms part of LTA's long term road network for the island. Being underground, the foundation of developments within the SURS road reserve and the second reserve (see Figures 11.1 & 11.2) pose a major challenge when LTA intends to realise the SURS. Hence, the design of foundations for new erections shall comply with the tunnel construction-type stated in either Sections 11.2, 11.3, 11.4 or 11.5.

LTA would advise the QP on the tunnel construction-type, upon receiving a DC consultation of development proposal that is affected by the SURS reserve. The QP(Civil) would be required to submit details of the foundation design of the proposed development and structural calculations for LTA to review.

11.2 Cut-and-Cover Tunnels with Diaphragm Walls

Proposed structures supported on spread footings (including rafts) shall not impose either vertical or horizontal pressure greater than 20 kPa on the tunnel structure. The proposed structures shall be designed to be capable of sustaining a vertical / horizontal displacement of 150mm and a differential settlement of 1 in 200.

Proposed structures supported on pile foundation shall be designed so that they are debonded up to the invert level of the SURS structure and develop all of their load either in shear or end bearing from soil located below the invert of level of the SURS structure. The proposed structures shall be designed to be capable of sustaining a vertical / horizontal displacement of 150mm and a differential settlement of 1 in 200. The cross-section of the tunnel type is shown in Figure 11.1.

11.3 Cut-and-Cover Tunnels with Sheetpile Walls

Proposed structures supported on spread footings (including rafts) shall not impose either vertical or horizontal pressure greater than 20 kPa on the tunnel structure. The proposed structures shall be designed to be capable of sustaining a vertical / horizontal displacement of 150mm and a differential settlement of 1 in 200.

Proposed structures supported on pile foundation shall be designed so that they are debonded up to the invert level of the SURS structure and develop all of their load either in shear or end bearing from soil located below the invert of level of the SURS structure. The proposed structures shall be designed to be capable of sustaining a vertical / horizontal displacement of 150mm and a differential settlement of 1 in 200. The cross-section of the tunnel type is shown in Figure 11.1.

11.4 Transition Structures

Proposed structures supported on spread footings (including rafts) shall not impose either vertical or horizontal pressure greater than 20 kPa on the tunnel structure. The proposed structures shall be designed to be capable of sustaining a vertical / horizontal displacement of 100mm and a differential settlement of 1 in 250.

Proposed structures supported on pile foundation shall be designed so that they are debonded up to the invert level of the SURS structure and develop all of their load either in shear or end bearing from soil located below the invert level of the SURS structure. The proposed structures shall be designed to be capable of sustaining a vertical / horizontal displacement of 100mm and a differential settlement of 1 in 250.

11.5 Bored Tunnel

No piled foundation shall be permitted within the tunnel first reserve.

For structures supported on pile foundation within the second reserve, the piles shall be designed such that they are debonded within the zone of influence and develop all of their load capacity below the line of the zone of influence. The toe of the piles shall be at a minimum of 2m below the tunnel base and no pile shall be permitted within 3m from the first reserve line. The cross-section of the tunnel type is shown in Figure 11.2.

All structures shall be designed to accommodate ground movements caused by SURS construction amounting to 2% relative volume loss from bored tunnelling such that damage to the structure is no more than very slight in accordance with Table 11.1.

The design of the structure proposal shall take into consideration the effect of noise and vibration that may be induced by the construction and operation of the tunnel.

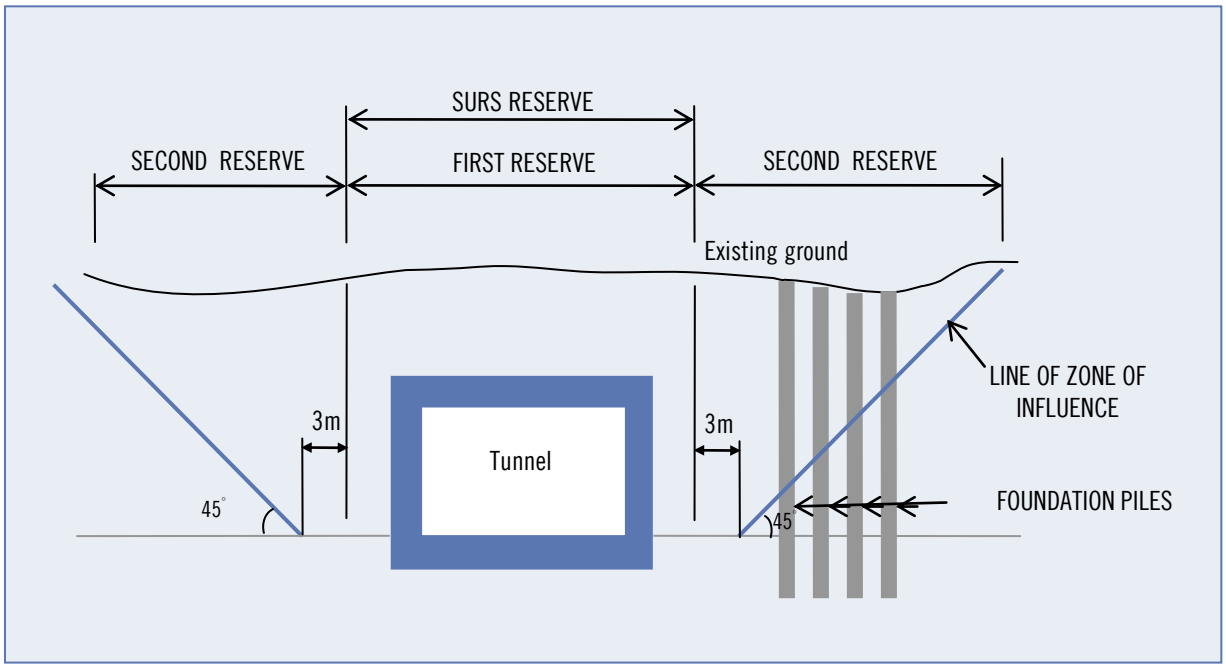


Figure 11.1 **Zone Of Influence Line For Cut & Cover Method Of Construction For SURS**

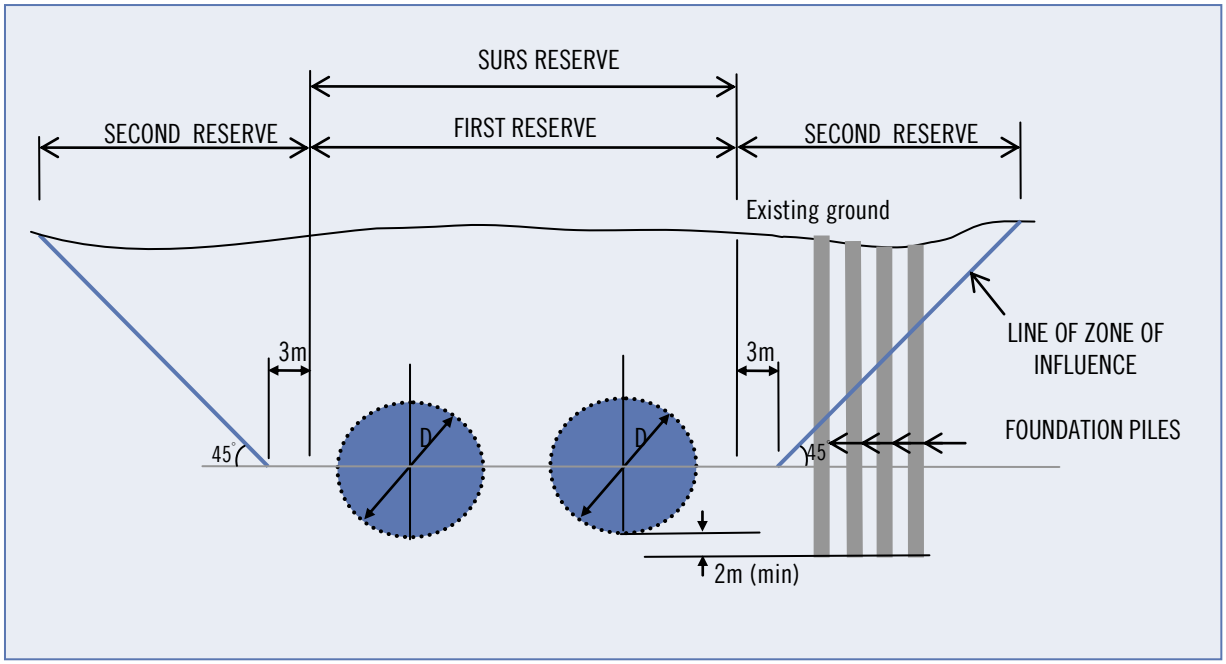


Figure 11.2 **Zone Of Influence Line For Bored Tunnel Method Of Construction For SURS**

Classification Of Visible Damage To Walls With Particular Reference To Ease The Repair Of Plaster And Brickwork Or Masonry		
Category Of Damage	Degree of Severity	Description of typical damage (Ease of repair is underlined) Note: Crack width is only one factor in assessing category of damage and should not be used on its own as a direct measure of it.
0	Negligible	Hairline cracks less than about 0.1mm.
1	Very Slight	Fine cracks which are easily treated during normal decoration. Damage generally restricted to internal wall finishes. Close inspection may reveal some cracks in external brickwork or masonry. Typical crack widths up to 1mm.
2	Slight	Cracks easily filled. Re-decoration probably required. Recurrent cracks can be masked by suitable linings. Cracks may be visible externally and some repainting may be required to ensure weather tightness. Doors and windows may stick slightly. Typical crack widths up to 5mm.
3	Moderate	The cracks require some opening up and can be patched by a mason. Repainting of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weather tightness often impaired. Typical crack widths are 5mm to 15mm or several greater than 3mm.
4	Severe	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Windows and doorframes distorted, floor sloping noticeably*. Walls leaning* or building noticeably, some loss of bearing in beams. Service pipes disrupted. Typical crack widths are 15mm to 25mm but also depend on the number of cracks.
5	Very Severe	This requires a major repair job involving partial or complete rebuilding. Beams lose bearing, walls lean badly and require shoring. Windows broken with distortion. Danger of instability. Typical crack widths are greater than 25mm but depend on the number of cracks.

* Note: Local deviation of slope, from horizontal or vertical, of more than 1/100 will normally be clearly visible. Overall deviations in excess of 1/150 are undesirable.

Based on Burland et al, 1977 (13)

Table 11.1 **Classification of visible damage to walls with particular reference to ease the repair of plaster and brick work or masonry**

This chapter sets out the procedure for expunction of public streets that are affected by private or statutory board development proposals.

Chapter 12

Expunction of Public Streets

Glossary

Amalgamate	To combine several child lots to form a parent lot.
Alienate	The transfer of property or a right into the ownership of another

Chapter 12

Expunction of Public Streets

12.1 Introduction

This chapter establishes the procedures for the expunction of a Public Street. This applies to development proposals involving a complete removal or part of an existing Public Street from the road network, by a private developer or a government agency.

12.2 Reference

SWA Street Works Act (Chapter 320A)

12.3 Expunction of Existing Public Street

Expunction of a public street refers to the partial or complete removal of any Public Street from the existing road network. The land containing the road after expunction will be returned to State for other landuse development. It is different from the temporary closure of public road to facilitate construction activities or to be used for special events. However, road expunction is also not required if the affected road is to be realigned, as part of a redevelopment.

Section 5 of the Street Works Act stipulates that any expunction of a public street shall be approved by the Minister for Transport. The Public Street cannot be altered in any way before Minister's approval is obtained. If the existing traffic circulation is affected by the proposal, the developer must provide an alternative route prior to the physical closure of the affected street and undertake any other modification works necessary to support the road expunction.

The process involved in the expunction of Public Street is outlined in the Figure 12.2.

12.4 Application by Private Developer or Government Agency

Any proposals to amalgamate a piece of State Land, which contains a public street, to form part of a private development shall be made to the Singapore Land Authority (SLA). Under the SLA's land alienation process, the SLA would in turn consult various government agencies having a stake in the State Land. Eventually, when the applicant accepts SLA's offer to alienate the State Land containing the Public Street, he would have to work closely with LTA to follow through to obtain approval to expunge the Public Street.

The developer proposing the expunction shall conduct site investigations to ascertain that the road to be expunged exists physically on site. The applicant shall furnish a letter indicating the reasons for the expunction of the road and propose any alternative access arrangement if the existing traffic circulation is affected by the proposal. The applicant shall also identify any possible affected parties / stake-holders and seek consent from the affected parties / stake-holders for the expunction.

Once the applicant obtain SLA's in-principle approval, the private developer is advised to obtain clearances from the various authorities as shown in the "List of Authorities to Clear for Expunction of Public Streets" in Section 12.5. LTA will assist to obtain the comments from the MP for the Constituency and the Chairman of Citizen Consultative Committee for Constituency (CCC).

For projects by government agencies (i.e. JTC, HDB, URA, MOE, etc), they will seek the comments directly from the MP for the Constituency and the Chairman of Citizen Consultative Committee for Constituency (CCC) with their Master Plan approval.

The following are the documents that are required to support the proposed expunction of a Public Street:

- Clearances from the various authorities as shown in Section 12.5 "List of Authorities to Seek Clearance for Expunction of Public Street"
- Written Permission / Master Planning Committee approval on the use of the State Land occupied by the expunged road proposed to be, or Landuse Plan/rezoning of landuse;
- In-principle approval from the Singapore Land Authority on the alienation of land;
- A plan (A4 size) showing the extent of the existing road to be expunged.
- Applicant's / QP's confirmation that all residents / tenants affected by the proposed expunction have vacated.

12.5 Approval

When Minister's approval for the expunction of the public street is obtained, the applicant will be required to carry out the following:

To erect temporary information signs along the road to be expunged informing motorists of the impending closure at least 4 weeks before the physical closure of the road. (Please refer to figure 12.1) The temporary information signs and revised traffic scheme of the connecting roads shall be submitted to LTA (DBC) for approval.

Upon closure of the road, existing street name plates, road signs etc, which are made redundant have to be removed. Affected existing traffic signs are to be amended as necessary. Applicant shall also carry out the modification to all road facilities (e.g. street lighting, pavement, kerb, traffic light, vehicular impact guardrail, bus shelter etc.) affected by the expunction.

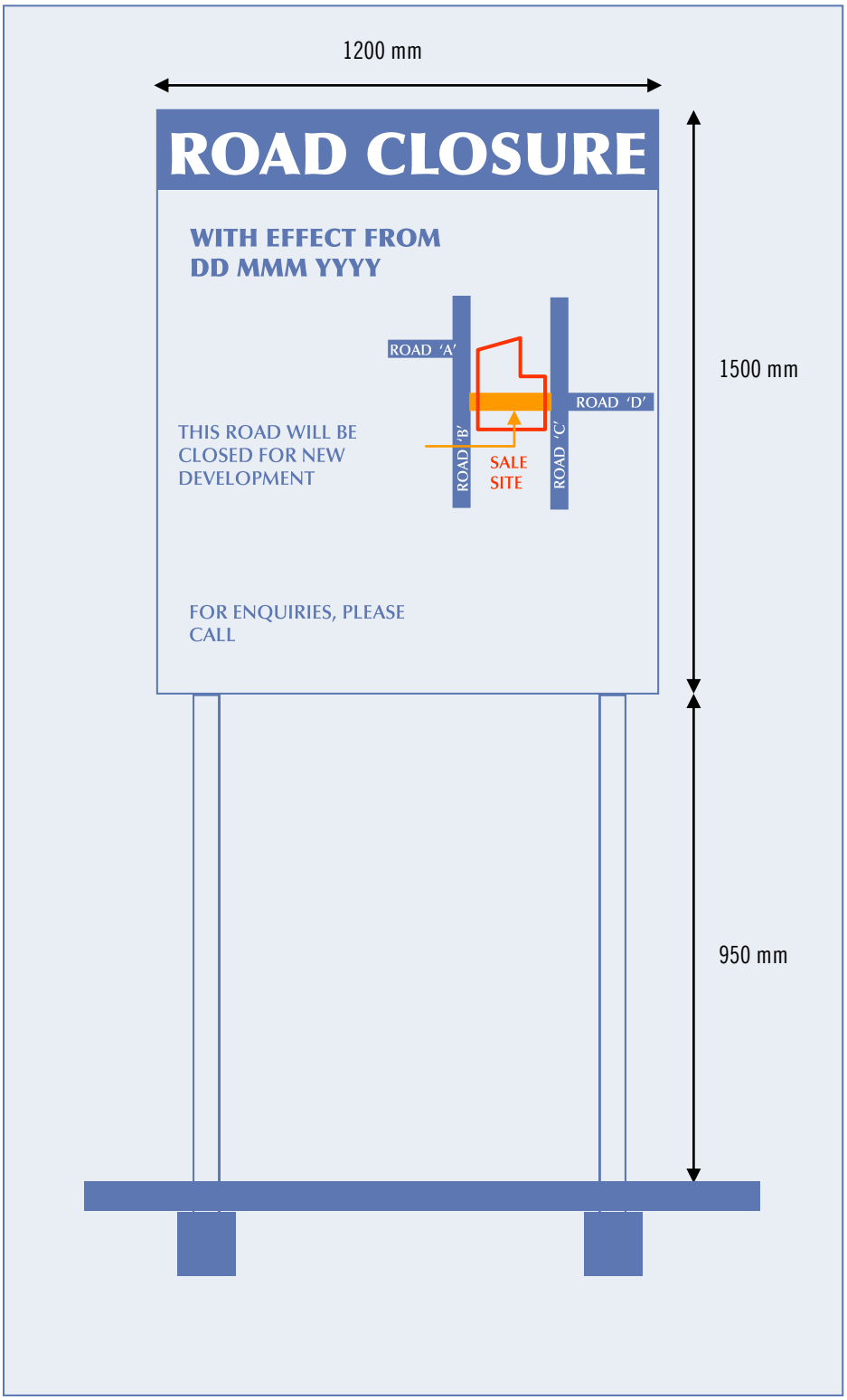


Figure 12.1 - **Sample of Information Signs to be Erected**

12.6 List of Authorities to Seek Clearance for Expunction of Public Street

Please click here for the list of authorities to seek clearance for expunction of public street.

Flowchart of Expunction Process

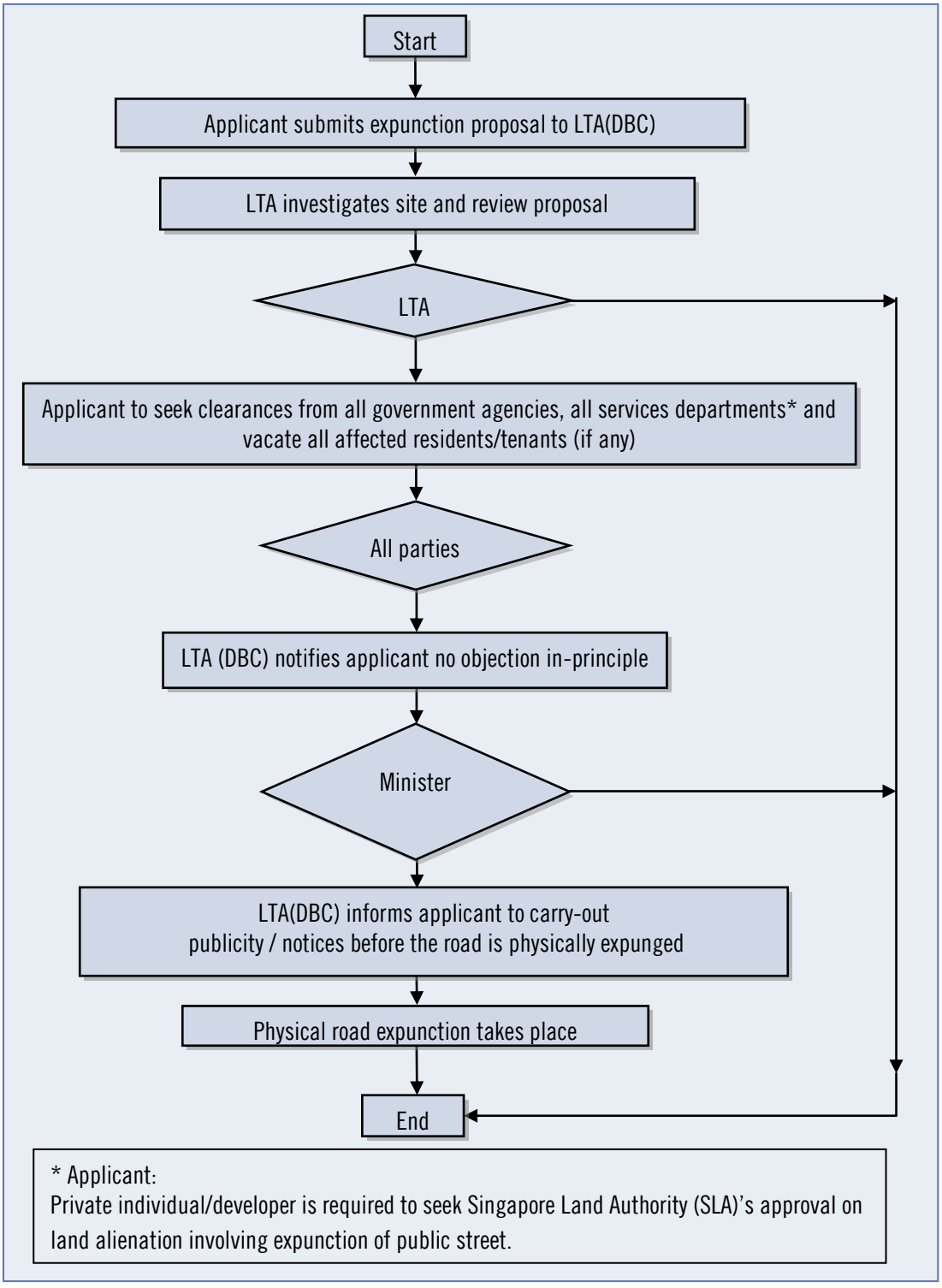


Figure 14.1 **Expunction Process of Public Street**

This chapter explains the requirements to be complied for temporary crossings to serve as construction access to development site.

Chapter 13

Application for Temporary Crossings

Glossary

Soffit	The underside of a structural component.
Surcharge Load	Additional loads by other elements.

Chapter 13

Application for Temporary Crossings

13.1 Introduction

If an applicant wishes to gain access to his development site during the course of construction other than the approved access, he must apply for a temporary crossing from LTA. Consideration for the location of the temporary access is same as that for a permanent access.

Once the location of the temporary access is approved, the applicant shall proceed to apply for a Road Opening Application at LTA.PROMPT website: http://prompt.lta.gov.sg

The temporary crossing shall be demolished on completion of the foundation / building works and all damages made good to the satisfaction of LTA.

13.2 Specifications

The temporary crossing shall not rest directly on top of the drain and shall be independently supported at least 300mm away from the wall of the drain. The soffit shall be elevated at least 150mm clear of the cope of the drains.

Provide measures to protect the drain from any surcharge load exerted by the temporary crossing.

Proper and adequate warning signs etc are to be erected to warn motorists of any danger arising out of the temporary crossing.

Provide ramps between existing footpath / covered drain and temporary crossing so as to allow continuity of pedestrian movement. This is to be clearly shown on the site and cross-section plans.

13.3 Plans to be Submitted

- 3 copies of plans
- Submit proper drawings of site plan of 1:500 scale, detailed plan and cross-section in 1:20 scale, of the temporary crossing. All drawings to be incorporated onto A1 size plans.
- Indicate kerb turning radii and width of temporary access
- The following undertaking statement by the owner/developer is to be endorsed on the plans:

"I/We the owner / developer shall be fully responsible for any damage or subsidence, as determined by LTA, to public property such as road carriageway, drain, footpath, kerb and other street furniture caused by or arising out of the usage of temporary crossing and shall take immediate action to rectify / reinstate the road and its appurtenances to the satisfaction of the LTA".

13.4 Site Maintenance

The developer, QP and contractor are jointly responsible for the cleanliness of the site. All parties concerned shall ensure that no building materials, equipments or debris are stacked along the footway, the planting verge or the drain so as to cause obstruction to pedestrians and the free flow of the drain. There shall be no loading / unloading of building materials as well as no parking / waiting of construction vehicles along the road.

The developer, QP and contractor are liable for prosecution as stipulated in the Street Works Acts (Obstruction of public streets, five-footways and private footways) if the construction materials pose an obstruction on the public street.

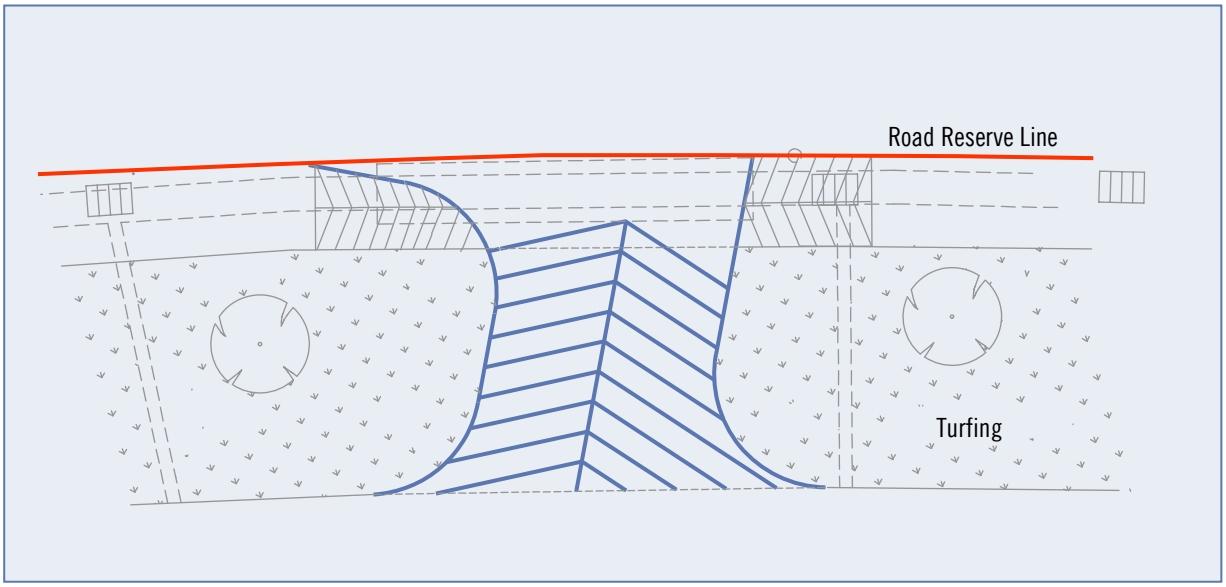


Figure 13.1 **Plan of Temporary Access**

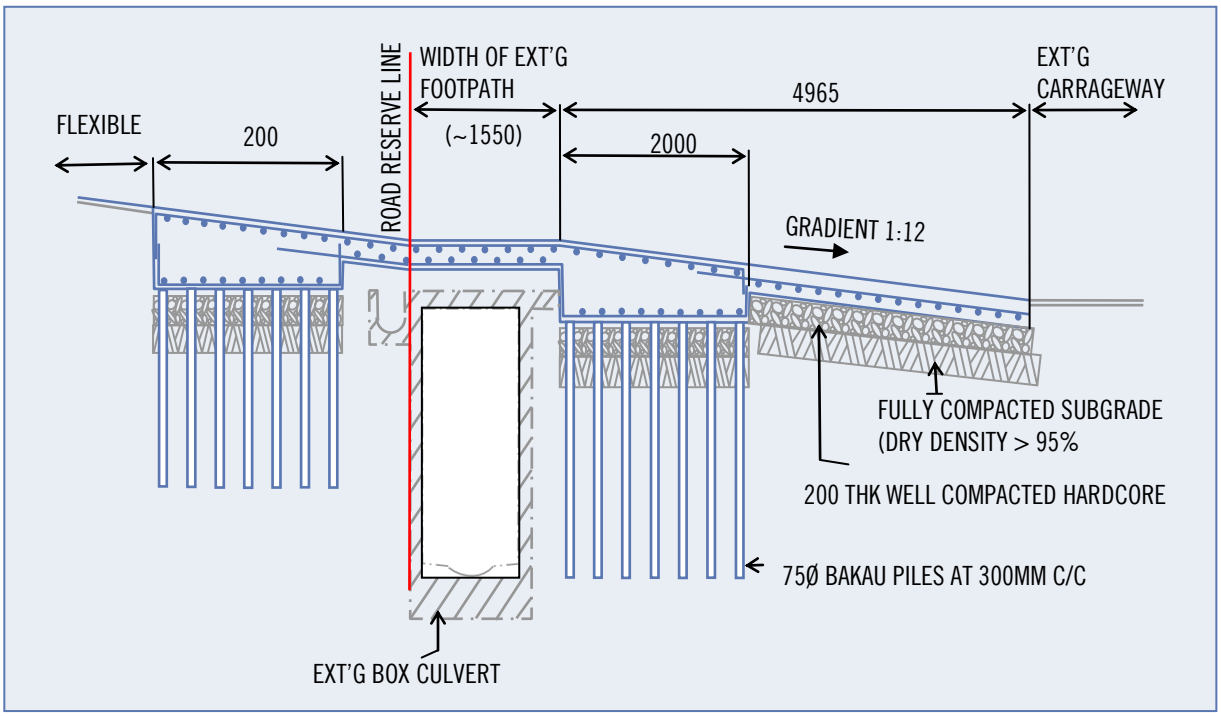


Figure 13.2 **Plan Showing Cross Section of Temporary Access**

This chapter deals with guidelines of road testing before the constructed roads are handed over to LTA.

Chapter 14

Road Testing

Glossary

Premix	A material made by mixing aggregate (preferably dried) with fluxed and/or cutback bitumen by hand or in a mixing plant.
Rigid Pavement	A road pavement structure is typically composed of concrete only.
Precast Kerb	A concrete structure typically located at the edge of a road designed to act as a barrier to prevent vehicles from leaving the road carriageway.

Chapter 14

Road Testing

14.1 Introduction

When a new street is constructed or an existing carriageway is widened, road tests shall be carried out to determine the quality of the materials used. In the case of failure and rejection, the failed sections shall be re-laid and re-tested. Chapter 10 of LTA's Materials and Workmanship Specifications contain an elaborate write-up on this subject.

The QP is required to submit a coloured site plan showing the street(s) under testing for road materials and the locations where samples are extracted.

14.2 Location of Samples

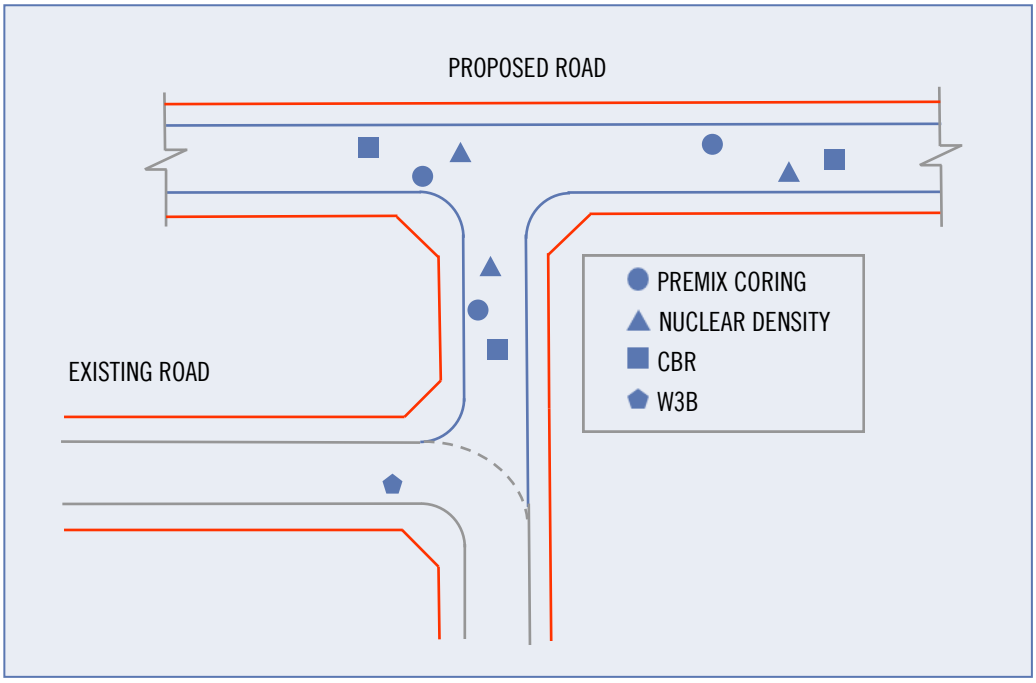


Figure 14.1 **Showing locations of samples taken**

14.3 Size of Sample

For premix - cut samples shall be obtained from the pavement at every 50m, on each carriageway.
For rigid pavement - cut samples shall be obtained at every 50m3 on each carriageway.
For precast kerbs, three (3) test kerbs shall be taken, at random, for every one thousand (1000) units.

A minimum of 3 samples shall be taken for testing where the street is less than 50m in length.

Notes

Core samples for premix shall be 150mm in diameter while sample for concrete shall be 100mm in diameter.

14.4 Certification by Accredited Laboratory

14.4.1 The QP shall engage the services of a laboratory accredited by the Singapore Accreditation Council-Singapore Laboratory Accreditation Scheme (SAC-SINGLAS) for plant, material, labour and transport necessary for the cutting of samples and to carry-out tests of the cut samples. The QP shall be responsible for the supervision of the cutting of samples and the reinstatement of the road after extraction.

14.4.2 The QP shall furnish the following information:

- Name of the accredited laboratory;
- Name of supplier of premix;
- Date of laying premix on site;
- Type of premix laid on site and its thickness;
- Date and time of sample cutting.

14.4.3 The following tests are to be carried out on the extracted samples:

- The water absorption test for precast kerbs;
- The compressive strength test for concrete;
- The aggregate gradation and bitumen content of the premix.

14.4.14 Upon completion of the tests, the QP is to submit the following:

- A record on the thickness of the wearing course, asphaltic base course and graded granite aggregate base course measured from the samples extracted.
- The original test results to be endorsed by the Professional Engineer of the accredited laboratory.
- Photographs of samples at each location during extraction.

14.5 Photographs

Figure 14.2 **Coring of Rigid Pavement**

Figure 14.3 **Coring of Premix**