

Code of Practice for works on public streets



March 2022 Edition

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CONTENTS

Preface	7
PART 1 : INTRODUCTION	
<i>Section 1 General</i>	8
1.1 Scope	
1.2 Useful References	
1.3 Consultation	
1.4 Application	
1.5 Definitions	
<i>Section 2 Structure of Code</i>	12
2.1 Code Structure	
2.2 Submission Procedure and Requirements	
2.3 Technical Requirements	
2.4 Demerit Points System	
PART II : SUBMISSION PROCEDURE AND REQUIREMENTS	
<i>Section 3 Works Proposal on Public Streets</i>	13
3.1 General	
<i>Section 4 Application for Approval to Commence Works on Public Streets</i>	14
4.1 General	
4.2 Works Permit	
4.3 Documents Required	
4.4 Duties of Applicant	
4.5 Emergency Works	
4.6 Co-ordination with Other Government Agencies and Parties of Interest	
4.7 Availability of Applicant	
4.8 Duties of Site Supervisor	
4.9 Duties of Contractor	
4.10 Defects Liability Period	

Section 5	<i>Engineering Works Proposal on Public Streets</i>	20
5.1	General	
5.2	Application for Engineering Works Proposal	
5.3	Plan for Engineering Works	
5.4	Engineering Evaluation Report	
5.5	Instrumentation Proposal	
5.6	Method Statement of Work	
5.7	Contingency Plan & Emergency Procedure	
5.8	Preparation of Contingency Plan & Emergency Procedure	
5.9	Pre-condition Survey Report	
5.10	Construction Schedule	
5.11	Traffic Control Plan	
5.12	Full-time supervision	
5.13	Commencement of Work	
5.14	Departure or Deviation from Approved Plan	

PART III : TECHNICAL REQUIREMENTS

Section 6	<i>Utility Works</i>	28
6.1	General	
6.2	Restricted Area	
6.3	Trial Holes	
6.4	Position of Utilities	
6.5	Location of Manholes, Valves, Hydrants and Over-ground Boxes	
6.6	Protection to Road Carriageways/ Adjoining Structures/ Road-related Facilities	
6.7	Temporary Earth Retaining Structure for Excavation Works	
6.8	Temporary Traffic Control	
6.9	Extent of Lane Occupation	
6.10	Working Hours	
6.11	Contingency Plans	
6.12	Temporary Steel Decking System	
6.13	Railway Protection Zone	
6.14	Housekeeping	

Section 7	<i>Engineering Works</i>	39
7.1	General	
7.2	Temporary Earth Retaining Systems	
7.3	Monitoring Road and Road Structures	
7.4	Intervention Values for Movements of Road Carriageway	
7.5	Protection of Road and Road Structures	
7.6	Completion of Works	
7.7	Others	
Section 8	<i>General Reinstatement of Public Streets</i>	44
8.1	General	
8.2	Conditions for Reinstatement to Carriageway	
8.3	Conditions for Reinstatement to Footpaths	
8.4	Rigid Pavement	
8.5	Road Markings	
8.6	Works Affecting Traffic Management Devices	
8.7	Special Reinstatement Materials	
Section 9	<i>Material Specifications & Quality Control</i>	52
9.1	General	
9.2	Backfill Materials	
9.3	Portland Cement Concrete	
9.4	Asphalt Concrete	
9.5	Recycled Concrete Aggregate	
9.6	Recycled Concrete Aggregate Dust	
9.7	Special Materials	
9.8	Thermoplastic Road Markings	
9.9	Quality Control	
9.10	Depth and Thickness Test	
9.11	Compaction Test	
9.12	Reflectivity Test	
9.13	Compressive Strength Test	
9.14	Absorption Test	
9.15	Extraction Test	
9.16	Sieve Analysis Test	
9.17	Skid Resistance Value	
9.18	Asphalt Concrete Core Test	
9.19	Recycled Concrete Aggregate Core Test	
9.20	Recycled Concrete Aggregate Dust Test	
9.21	Non-Destructive Tests	

Section 10 Administration of Demerit Points System

- 10.1 Objective
- 10.2 Demerit Points System for Contractors
- 10.3 Procedure for Appeal

APPENDICES

- Appendix A - Structure of Code
- Appendix B - Submission process for permit to carry out works affecting public streets
- Appendix C - Sample format for Banker's Guarantee furnished by Applicant
- Appendix D - Sample format for Banker's Guarantee furnished by contractor
- Appendix E - Checklist for Temporary Earth-Retaining Structures
- Appendix F - Contractor Category (Workheads/License Types) and Associated Work Type

Preface

The Code of Practice for Works on Public Streets was prepared by the Road-Opening Section, and acted upon by the Deputy Director, Road Works Regulation & Licensing Division. It comes into effect in March 2008 and supersedes the Code of Practice for Road-Opening Works.

This Code aims to ensure that all works are carried out safely with minimal inconvenience to road-users. It shall apply to all works as defined in the Street Works (Works on Public Streets) Regulation within the public streets: laying and maintaining of utility apparatus, lane closure on carriageway and engineering works.

The Code sets out the procedures and requirements for obtaining approval for permit to carry out work on public streets. It also sets out the technical requirements for the various types of utility services, engineering works and related reinstatement works. General amendments and revision to the procedures, requirements and standards may be made from time to time as the Authority deems fit.

Compliance with this Code of Practice does not by itself confer immunity from Legal obligations.

This Code of Practice for Works on Public Streets is issued by the Land Transport Authority under Regulation 12 of the Street Works (Works on Public Streets) Regulations.

LAND TRANSPORT AUTHORITY

PART I – INTRODUCTION

SECTION 1 GENERAL

1.1 SCOPE

1.1.1 This Code is issued under Regulation 12 of the Street Works (Works on Public Streets) Regulations. It sets out the procedure to obtain permission to carry out works affecting public streets. It also stipulates the technical requirements, sets standards of materials and workmanship when carrying out utility services laying work, engineering works and any other works that affect the integrity of any public infrastructure. In the absence of any other technical/engineering requirements, the latest edition of the Authority’s Material and Workmanship Specifications shall prevail.

1.1.3 Nothing in this Code shall derogate or prejudice the Authority’s powers, rights and remedies under the Street Works Act and the Street Works (Works on Public Streets) Regulations, as amended from time to time.

1.2 USEFUL REFERENCES

1.2.1 Street Works Act

1.2.2 Street Works (Works on Public Streets) Regulations

1.2.3 Code of Practice for Traffic Control at Work Zone

1.2.3.1 This Code provides a useful guide on the posting and arrangement of temporary signs. It also contains illustrations on typical signing arrangement.

1.2.4 LTA’s Standard Details of Road Elements

1.3 CONSULTATION

1.3.1 The applicant is advised to consult the Authority on any requirements relating to works on public streets before making any formal application for approval.

Consultation

1.3.2 Any preliminary consultation with the Authority or submission of plans shall not be taken as approval or disapproval of the proposed works or be construed as having the agreement of the Authority.

1.3.3 Unless otherwise stated, all conditions and comments as stipulated during the consultation process shall form part of the conditions for permit to carry out works affecting public streets.

1.3.4 The applicant shall re-submit the proposal for the comments of the Authority if the proposed works do not commence within 2 years from the date of comments given for the previous consultation.

1.4 APPLICATION

1.4.1 All applications are to be submitted electronically through the “Permit for Road Occupation Management Portal (LTA.PROMPT)” at the following URL - <https://prompt.lta.gov.sg> .

Application

1.5 DEFINITIONS

For the purpose of this Code, the following definitions shall apply :

“applicant” means any person who makes or has made an application under Regulation 5 of the Regulations and includes a person whose application has been granted by the Authority;

Applicant

“ASTM” means the American Society for Testing and Materials;

“Authority” means the Land Transport Authority of Singapore established under the Land Transport Authority of Singapore Act;

Authority

“BCA” means the Building and Construction Authority of Singapore;

“BS” means the current British Standards;

“Code of Practice” means the Code of Practice issued by the Authority under Regulation 12 of the Regulations and includes any amendment, which may be made to the Code of Practice from time to time;

“contractor” means a contractor who is registered with LTA under the LTA.PROMPT ;

“DIN” means the Deustches Institut fur Normung Standard

“emergency works” means works which must be carried out immediately in order to put end to or prevent the occurrence of any circumstances (whether existing or imminent or which the person requiring the works to be carried out believes on reasonable grounds to be existing or imminent) which are likely to cause serious danger to any person or property;

“LTA.PROMPT” means the Permit for Road Occupation Management Portal;

“major roads” means all roads other than minor roads;

“minor roads” means local access roads of carriageway width 7.4m or less;

“MPC” means the Master Plan Committee;

“no-opening period” means period during which no excavations are allowed on the road concerned. The no-opening period is determined as follows:

Type of Roads	Length of no-opening period
Newly resurfaced road	One (1) year from completion date of resurfacing work
Newly constructed or upgraded road	Two (2) years from the completion date of the project

“professional engineer” means a person who is registered as a civil or structural engineer under the Professional Engineers’ Act and who possesses a valid practising certificate issued under that Act;

*Professional
engineer*

“road lines” means any lines or other markings which are required by the Authority to be drawn on the surface of a public street for the guidance or direction of motorists or pedestrians using the public street;

“Regulations” means the Street Works (Works on Public Streets) Regulations as amended from time to time;

*The
Regulations*

“site supervisor” means a person who possesses a Certificate in Pavement Construction and Maintenance Course or holds a degree in civil engineering or holds a recognized diploma in civil engineering with at least 5 years experience in road-related works;

“SS” means the current Singapore Standards; and

“works” includes:

- (a) any construction work on a public street that is likely to affect the structural integrity and safe operation of any public street or road structure;
- (b) utility works within the meaning of Section 2 of the Street Works Act;
- (c) street works within the meaning of Section 2 of the Street Works Act;
- (d) any works for the purpose of construction or repairs of a building that require occupation of a public street or that affect the flow of traffic;
- (e) any works which are preparatory or incidental to any works referred to in paragraphs (a) to (d), such as the temporary storage or depositing of any building materials or debris or the placing of any equipment or the erection of any temporary structure, on the public street on which the works are to be or are being carried out.

PART I – INTRODUCTION

SECTION 2 STRUCTURE OF CODE

2.1 CODE STRUCTURE

2.1.1 This Code is divided into five main parts as follows :

- (a) Part I - Introduction
- (b) Part II - Submission Procedure & Requirements
- (c) Part III - Technical Requirements
 - Utility Works
 - Engineering Works
 - General Reinstatement
- (e) Part IV - Demerit Points System

2.1.2 Unless otherwise stated, references to a Regulation number (example, Regulation 12) in this Code are references to the regulations numbered in the Street Works (Works on Public Streets) Regulations, as amended from time to time.

2.2 SUBMISSION PROCEDURE AND REQUIREMENTS

2.2.1 The submission procedures and requirements for obtaining approval for permit to carry out works affecting public streets are stipulated in Part II of this Code.

2.3 TECHNICAL REQUIREMENTS

2.3.1 The technical requirements for the various types of utility services laying, engineering works and related reinstatement works are set out in Part III of this Code.

2.4 DEMERIT POINTS SYSTEM

2.4.1 Part IV of this Code stipulates the circumstances under which a contractor will be issued with demerit points and/or fined. It also sets out the criteria by which a contractor can be suspended.

Code structure

Regulations

Submission requirements

Technical requirements

Demerit point

PART II - SUBMISSION PROCEDURE AND REQUIREMENTS

SECTION 3 WORKS PROPOSAL ON PUBLIC STREETS

3.1 GENERAL

- 3.1.1 This section stipulates the procedures and requirements for obtaining in-principle pre-consultation approval for work proposals that affect public streets and/or road infrastructure before submission of application for permit to commence work.
- 3.1.2 Eight sets of plans for the following work proposals shall be submitted to the Authority for in-principle pre-consultation approval:
- (a) Work proposal that requires Master Plan Committee (MPC) adoption;
 - (b) Any improvement or upgrading schemes for utility services;
 - (c) Any excavation works of 4m depth or deeper; and
 - (d) Tunnelling works and engineering works.
- 3.1.3 The submission should include but not be limited to the following:
- (a) Proposed extent of works including route alignment and excavation area in relation to public streets;
 - (b) Preliminary impact analysis of the works on public streets or road infrastructure/s;
 - (c) Proposed feasible method of work execution i.e. open-cut, pipe-jacking, etc.; and
 - (d) Letters of clearance from other relevant authorities.

Planning approval

PART II - SUBMISSION PROCEDURE AND REQUIREMENTS

SECTION 4 APPLICATION FOR APPROVAL TO COMMENCE WORKS ON PUBLIC STREETS

4.1 GENERAL

4.1.1 This section stipulates the procedures and requirements for obtaining approval for permit to commence and carry out works that affects the public streets and/or road infrastructure. (Please see Appendix B for the submission process).

*Permit for
work
implementation*

4.1.2 Applications for permit to commence and carry out works must be submitted electronically through the “Permit for Road Occupation Management Portal (LTA.PROMPT)” at this URL- <https://prompt.lta.gov.sg>.

4.1.3 Applicants, who meet the criteria under Regulation 5 of the Regulations, must register online as an applicant with the LTA.PROMPT before they are allowed to make any submissions for permission to carry out works.

4.2 WORKS PERMIT

An application has to be submitted to the Authority for permission to carry out works on public streets after the necessary pre-consultation approvals have been obtained from the relevant authorities or agencies. The types of works shall be as defined in Section 1.5 (Definitions) of this Code. Examples of these works shall include but not be limited to the following:

- (a) excavation to lay or repair utility services;
- (b) soil investigation works;
- (c) parking of a vehicular crane on the road for the purpose of construction or repairs of a building;
- (d) external works of developments.

4.3 **DOCUMENTS REQUIRED**

Items to be submitted

4.3.1 The electronic application shall be accompanied by the soft copy of the following items:

- (a) Location and site plans of the proposed works to be carried out on the public streets;
- (b) Pre-condition photographic survey report, including but not limited to, current site photographs (with date and time-stamped) of existing roads and related street furniture (including road markings), within the influence zone of work location and etc.;
- (c) Method statement of works to be carried out;
- (d) Photographs and schematic diagrams of the extent of the existing road markings where applicable;
- (e) Notification of emergency openings, where applicable;
- (f) Engineering evaluation report accompanied by plan for engineering works, where applicable;
- (g) Certified topographic survey plans that indicate the scale, boundary lines, lot numbers and existing surrounding roads and road structures, etc (only applicable for critical engineering works involving tunnelling, piled foundation, basement construction, etc that are likely to affect the structural integrity of the public streets); and
- (h) A copy of the Public Liability Policy Schedule/Endorsement(s) for a limit of not less than S\$1million (any one accident and unlimited during any one period). The policy shall provide for the Authority's interests to be noted as "Principal". The Public Liability policy shall also include a "cross liability" clause. The policy shall indemnify the Authority against any liability, in respect of personal injury/injuries or damage to property/properties and existing services, caused as a result of the execution of the works. The period shall cover the works duration and defects liability period. All documents, including all endorsements shall be officially signed and stamped by the insurance company.
- (i) Letters of development / planning clearances, where applicable.

Engineering evaluation

Certified survey plans

4.3.2 The Authority may also require a Banker's Guarantee, of an appropriate amount to be determined by the Authority, to be submitted if it deems fit. (Please see sample formats as shown in Appendix C & D).

4.3.3 Applicants are advised to visit the LTA.PROMPT website for more information on the electronic application and the recommended formats of the attachments.

4.4 **DUTIES OF APPLICANT**

4.4.1 For works with no traffic lane reduction, the permit will be revoked if no works are commenced within 28 days (herein referred to as the "validity period") from the date approved by the Authority for the commencement of the works.

4.4.2 For works involving traffic lane reduction, the applicant shall ensure the affected roads are fully reinstated by the approved permit completion date.

4.4.3 Upon completion of the works, the applicant must notify the Authority of the actual completion date through LTA.PROMPT within 7 days. The applicant shall also submit in the same notification a post condition photographic survey report which contains relevant site photos (with date and time stamp) of reinstated works and the surrounding roads, including lane markings.

4.4.4 If the works cannot be completed by the approved permit completion date, the applicant must submit for extension of time through LTA.PROMPT, before the approved permit completion date.

Otherwise, any works beyond the approved permit completion date shall be considered as unauthorized works.

For works involving traffic lane reduction, if the applicant is unable to complete the works by the approved extended completion date, the applicant may submit a new application to continue with the remaining works subject to the road affected by the earlier work being fully resurfaced at the end of the approved extended completion date.

4.4.5	The applicant is required to submit the reinstatement test report where excavation and/or engineering work are involved, through the LTA.PROMPT to the Authority, as and when required by the Authority. The Defects Liability Period or DLP to be imposed will be determined by the Authority depending on the type of works and depth of excavation. There will be no DLP imposed for works that involve lane closure only e.g. parking of mobile crane to carry out hoisting work, etc.	<i>Defects Liability Period</i>
4.4.6	Upon expiry of the DLP, the applicant shall apply for the handing-over of the reinstatement works to the Authority through the LTA.PROMPT.	<i>Declaration on condition of reinstatement works during DLP</i>
4.4.7	The applicant shall ensure the works, for which a permit has been granted by the Authority are according to the statutory and technical requirements, guidelines and Codes of Practice for all relevant authorities and agencies and any other conditions as specified by the Authority.	<i>Handing-over of reinstatement works</i>
4.4.8	The applicant shall also ensure that appropriate traffic control plans, according to the Code of Practice for Traffic Control, are implemented on site. He shall also ensure that appropriate information signs informing road users of impending works are posted strategically on site at least 1 week in advance of the commencement of works. The signs shall contain information such as the type of works, agency responsible for the works, the start and end dates of the works and the contact numbers for enquiries.	
4.4.9	Applicant has to notify the Authority if there is a change in applicant, contractor and/or supervisor.	
4.4.10	Applicant shall provide daily update of road works, which involves lane/road closures, to LTA via LTA.PROMPT system upon commencement and cessation of the works.	<i>Daily update of road works</i>
4.5	EMERGENCY WORKS	
4.5.1	In the event of an emergency works, the applicant must inform the Authority immediately through telephone to LTA CALL CENTRE (1800-CALL-LTA) and follow up with official notification via email or facsimile within 3 working days of the emergency opening duly endorsed by an authorized officer. The application must be submitted through the LTA.PROMPT Portal within 7 working days.	<i>Emergency works</i>

4.6 **CO-ORDINATION WITH OTHER GOVERNMENT AGENCIES AND PARTIES OF INTEREST**

4.6.1 Barring the Authority's approval, the applicant shall fulfil the statutory requirements of other relevant authorities before commencement of works on public streets. The applicant shall also liaise and co-ordinate with all other relevant agencies or persons whose operations or utilities may be affected by the carrying out of the works.

4.6.2 Where the works are carried out for a building development, the applicant shall liaise closely with the Qualified Person of the development to ensure that all works on public streets including utility services connections are arranged such that they can be completed with minimum inconvenience to the public. The permanent reinstatement works shall be carried out after all the necessary works and utility services connections are completed or deemed necessary by the Authority.

4.6.3 Where scheduled bus routes are affected by the works, the applicant shall liaise with the relevant bus operators to ensure minimum disruption to the bus services.

4.7 **AVAILABILITY OF APPLICANT**

4.7.1 The applicant shall make himself/herself readily contactable at the contact information given in the application, any time of the day during the duration of the actual work.

4.8 **DUTIES OF SITE SUPERVISOR**

4.8.1 In accordance with Regulation 14, the person for whom the works to be carried out shall appoint a suitably qualified site supervisor to supervise the carrying out of works

Site safety and management

4.8.2 He shall be responsible for the overall site safety and site management and provide full-time supervision on site to supervise the works and receive directions from the Authority where necessary.

4.8.3 The site supervisor shall also ensure that the appropriate traffic control plan is being implemented on site.

4.9 DUTIES OF CONTRACTOR

4.9.1 Without prejudice to Regulations 14, 15 and 18, the contractor shall be responsible for the safe execution of the works in strict compliance with the requirements as stipulated in this Code and the permit issued by the Authority.

4.9.2 The contractor shall ensure that appropriate traffic control plans are implemented on site.

4.9.3 The contractor appointed by the applicant to carry out any works on any public street shall be registered with the Building and Construction Authority. Please refer to Appendix F on the approved categories of registered contractors for works on public streets.

The Authority may consider other categories of registered contractors to perform works on public streets that do not involve opening up of the public streets. Examples of such works are lane closure for lifting, hoisting activities and maintenance of building facade (i.e painting or washing).

4.10 DEFECTS LIABILITY PERIOD

4.10.1 The Defects Liability Period (DLP) is a warranty period that starts after the completion of a satisfactory permanent reinstatement. The applicant shall ensure that the reinstatement work is maintained in a defect-free condition during the DLP. The applicant shall monitor the condition of the reinstatement work and any defect which appears during the DLP shall be promptly rectified.

DLP

4.10.2 The DLP shall only begin when the Authority is satisfied with the permanent reinstatement. The DLP shall run for:

- (a) 1 year for works where the depth of excavation is 1.5m or less; and
- (b) 2 years for works where the depth of excavation is more than 1.5m.

PART II - SUBMISSION PROCEDURE AND REQUIREMENTS

SECTION 5 ENGINEERING WORKS PROPOSAL ON PUBLIC STREETS

5.1 GENERAL

- 5.1.1 This section stipulates the additional procedures and requirements for obtaining in-principle planning approval to commence engineering works within the public streets.
- 5.1.2 Engineering works refer to any construction work that is likely to affect the structural integrity and safe operation of any public streets or road structure.
- 5.1.3 The applicant or the appointed professional engineer is encouraged to initiate a consultation meeting with the Authority to discuss his proposal before submitting the engineering work proposal to the Authority.
- 5.1.4 Upon clearance of engineering work proposal, the applicant or the appointed professional engineer shall submit an application for permit to carry out the engineering works through the “Permit for Road Occupation Management Portal (LTA.PROMPT).
- 5.1.5 The requirements given in the written directions of the engineering works proposal shall form part of the conditions for the permit to carry out the engineering works.
- 5.1.6 No engineering work shall commence on site without the approval by the Authority issued through the LTA.PROMPT.
- 5.1.7 The Authority may impose any other requirements deemed necessary for safeguarding of the public streets and road structures.

Engineering works

Pre-consultation

5.2 APPLICATION FOR ENGINEERING WORKS PROPOSAL

- 5.2.1 An application for engineering works proposal shall be submitted by the applicant or the appointed professional engineer and accompanied by the following items :

(a) Plan for engineering works;

- (b) Engineering evaluation report;
- (c) Instrumentation proposal;
- (d) Method statement of work;
- (e) Contingency plans & Emergency procedure;
- (f) Pre-condition survey report;
- (g) Construction schedule;
- (h) Traffic control plan, where applicable; and
- (i) Relevant documents indicating planning approval from the competent authority.

5.2.2 The requirements for the above items are given in Clause 5.3 to Clause 5.11 of this section for compliance.

5.3 **PLAN FOR ENGINEERING WORKS**

5.3.1 Plan for engineering works shall be prepared and endorsed by a professional engineer.

Endorsement

5.3.2 Layout plans and cross sectional details shall indicate the following items :

Layout and cross section

(a) Scale of the plans;

Scale

(b) Location plan of proposed engineering works; and

Location plan

(c) Vertical and horizontal distances of the engineering works (site preparation, substructures and building construction works, etc.) in relation to the existing road reserve line and/or road structure, where applicable.

5.4 ENGINEERING EVALUATION REPORT

5.4.1 Engineering evaluation report shall be prepared and endorsed by the appointed professional engineer. The engineering report shall also be accompanied by the checklist for temporary earth retaining structure (Please see sample format of the checklist as shown in Appendix E).

Engineering evaluation report

5.4.2 The above report shall address the following items :

Predicted movement

(a) Predicted movements of the existing road and/ or road structures due to the proposed engineering works at various stages of construction and at completion of the works. The evaluation shall include the following items :

(i) Detailed examination of the ground conditions at site;

Ground conditions

(ii) Calculations for the derivations of the predicted movements; and

Predicted movement

(iii) Appropriate sensitivity analysis to check that the assessment would not be affected by any variation in input parameters and conditions that may occur during all stages of the construction work.

Sensitivity analysis

(b) Assessment of the likely effects of movement on the existing road structure, where applicable.

Assessment of effects

(c) Proposal for any special measures or advance works needed to minimise the susceptibility of the existing road and/ or road structure to damage and to ensure the safe operation of the public street.

Special measures or advance work

5.4.3 The Authority may specify any other requirement on the engineering evaluation report which are deemed necessary for the safeguarding of the public streets and road structures.

5.5 INSTRUMENTATION PROPOSAL

5.5.1 Instrumentation proposal shall be prepared and endorsed by the appointed professional engineer.

Endorsement

5.5.2	The proposal shall include the following items :	
	(a) Comprehensive monitoring system to monitor the movement of the existing road and/ or road structure and the ground adjacent to it;	<i>Monitoring system</i>
	(b) Layout plans and relevant cross-sections indicating the locations of proposed instruments relative to the road and/ or road structures;	<i>Layout and cross-sections</i>
	(c) Details of the instruments or equipment, including the types, function of instruments, depth of installation, etc.;	<i>Details of instruments</i>
	(d) Frequency of monitoring;	<i>Frequency</i>
	(e) Review levels, i.e. trigger, design and allowable for all instruments; and	<i>Review level</i>
	(f) Valid calibration certificates for the instruments proposed, where applicable.	<i>Calibration certificates</i>
5.5.3	A copy of the initial readings endorsed by the appointed professional engineer shall be submitted to the Authority before the commencement of works.	<i>Initial readings</i>
5.6	METHOD STATEMENT OF WORK	
5.6.1	Method statement for carrying out any engineering works shall be prepared and endorsed by the appointed professional engineer.	<i>Method statement</i>
5.6.2	The proposal shall be accompanied by the following items :	
	(a) Location plan showing the boundary line of the engineering works relative to the road and/ or road structures;	<i>Location plan</i>
	(b) Site layout plan showing the site set-out, movement of machineries and storage of plant & equipment;	<i>Site layout plan</i>
	(c) Write-up and/or plans indicating step-by-step sequence of carrying out each phase of works or activities; and	<i>Sequence of work</i>

- (d) Construction risk analysis to identify potential risk of construction activities on road users and public streets. Both the general construction hazards and geotechnical risks shall be presented with the corresponding risks assessed and precautionary measures to mitigate these risks.

Construction risk analysis

5.7 CONTINGENCY PLAN & EMERGENCY PROCEDURE

- 5.7.1 A contingency plan and emergency procedure prepared using the guidelines given in Section 5.8 below shall be endorsed and submitted by the appointed professional engineer.

Contingency plan

- 5.7.2 The contingency plan shall include immediate rectification, temporary traffic diversion/ control plans in the event that roads and/ or road structures are affected due to excessive ground movements.

Traffic diversion/ control plan

- 5.7.3 The emergency procedure shall include the project organisation chart and a list of emergency contact numbers. The reporting procedure for incident and roles of key personnel must be clearly defined.

Emergency procedure

5.8 PREPARATION OF CONTINGENCY PLAN AND EMERGENCY PROCEDURE

- 5.8.1 This section serves as a guide to the preparation of a contingency plan and emergency procedure. It aims to ensure that a set of the contingency plan and emergency procedure is in place for immediate implementation should the need arise at site.

5.8.2 IDENTIFICATION OF EMERGENCY SITUATIONS

- 5.8.2.1 An emergency situation may arise due to various incidents at site, such as:

Emergency situations

- (a) Monitoring results exceed the alert levels / work suspension levels specified by the qualified person;
- (b) Accidents such as construction material falling onto the public street, crane toppling onto the road structure; and

(c) Failure/ collapse of temporary earth retaining structure that affects the structural integrity and/ or safe operation of the public street, etc.

5.8.2.2 The appointed professional engineer shall prepare an emergency plan stating the immediate actions to be taken in the event of an emergency in order to safeguard the integrity of the public street. In addition, the follow-up actions to be taken after the implementation of control measures at site should also be provided.

Emergency plan

5.8.2.3 The appointed professional engineer shall also identify all possible hazardous situations that may arise due to the proposed works and prepare a contingency plan.

Contingency plan

5.8.3 **EMERGENCY PROCEDURE REPORT**

5.8.3.1 An emergency procedure report shall include the following items:

(a) Descriptions of the project and proposed works or activities to be carried out;

(b) List of possible hazard/ emergency situations that may arise due to the proposed works or activities;

(c) Governing criteria for initiating an emergency procedure;

(d) Step-by-step procedure or flow chart showing the actions to be taken by the appointed professional engineer and the project team should an emergency happen. Where applicable, the procedure shall incorporate the steps to review the monitoring results obtained, the re-examination of the method of work, the revision to the predictions, the review of instrumentation provisions, the contingency measures to be implemented, etc.; and

*Procedure/
flow chart*

(e) Call-up list stating the names and contact numbers of all key personnel including the qualified person, the project manager, the site supervisors, and the instrumentation specialist. A flow chart for the emergency reporting shall also be included.

Call-up list

5.9 PRE-CONDITION SURVEY REPORT

5.9.1 Condition surveys to be undertaken by a professional engineer or building surveyor shall include physical surveys of road and road structures that comprise existing footpath and drains within the influence zone of engineering works to be carried out.

Physical surveys

5.9.2 A topographical survey for road reduced levels, at 3m grid spacing along each traffic lane shall be conducted and certified by licensed land surveyor.

5.9.3 A pre-condition survey report that comprises of both condition and topographical survey of engineering works shall be prepared and endorsed by an independent person who has the appropriate qualifications, for example, professional engineer or building surveyor.

Endorsement

5.9.4 A copy of the endorsed condition survey report shall be submitted to the Authority before commencement of work.

5.10 CONSTRUCTION SCHEDULE

5.10.1 A comprehensive work programme/ schedule shall be submitted. The programme may be in the form of bar/ Gantt charts that indicate the sequence of works and the duration required.

Work programme

5.11 TRAFFIC CONTROL PLAN

5.11.1 For all works within the public streets, the requirements, specifications and arrangements of the traffic control plans (TCP) shall be in accordance with the LTA's Code of Practice for Traffic Control at Work Zone.

Code of practice for traffic control at work zone

5.12 FULL-TIME SUPERVISION

5.12.1 The applicant shall inform the Authority in writing of the appointed professional engineer or the professional engineer's assignee to provide full-time supervision on site for the engineering works.

Full-time supervision

5.12.2 The applicant shall notify the Authority in writing whenever there is a change in the professional engineer / professional engineer's assignee appointed for supervision.

Change in professional engineer

5.13 **COMMENCEMENT OF WORK**

5.13.1 The Authority will issue a letter of clearance in writing to the applicant upon approving the relevant engineering work proposal.

Letter of clearance

5.13.2 Once the letter of clearance is obtained, the applicant shall submit an application through the “Permit for Road Occupation Management Portal (LTA.PROMPT)” for the permit to commence and carry out works on public streets.

Submission for permit to commence and carry out works

5.14 **DEPARTURE OR DEVIATION FROM APPROVED PLAN**

5.14.1 In accordance with Regulation 21, amendment plan shall be submitted to the Authority for approval if any engineering works depart or deviate from the approved plan.

5.14.2 An application for approval of amendment plans shall be accompanied by one set of the following documents prepared, signed and submitted by the qualified person:

Items to be submitted

(a) A copy of the amendment plans showing the amended proposal; and

Amendment plans

(b) Engineering evaluation report accompanied by plans for engineering works, if applicable.

Engineering evaluation report

No person shall carry out any engineering works in departure or deviation from the approved plan unless the amendment plan has been approved.

PART III – TECHNICAL REQUIREMENTS

SECTION 6 UTILITY WORKS

6.1 GENERAL

- 6.1.1 This section stipulates the technical requirements, sets standards of quality of materials and workmanship when carrying out utility works within the public streets.

Utility works

6.2 RESTRICTED AREA

- 6.2.1 “Restricted area” refers to any public street where no breaking up or opening up of a street is allowed. The objective of the restriction is to enhance road safety and reduce inconvenience to road users.

Restricted area

- 6.2.2 There shall be no openings or works allowed on “restricted areas”. These areas include:

- a) Road reserves of expressway;
- b) Carriageways with ‘specially treated’ areas such as rigid pavement, semi-rigid pavement, enhanced school zone, street print, etc.;
- c) Bridges and underpasses; and
- d) Roads which are under “no-opening period”.

6.3 TRIAL HOLES

- 6.3.1 Trial holes are usually dug up to detect existing utilities and determine the available space for new utility.

- 6.3.2 A maximum of only two (2) trial holes are permitted to be opened up at any one time on carriageway along the same road.

- 6.3.3 All trial holes shall be properly backfilled and affected road surface shall be reinstated to the Authority’s requirements.

6.4.1 All utilities shall be laid at a minimum depth as prescribed in Table 6.1 below. The minimum depth of utility laid below the public streets shall be measured from the road surface/ sidetable to the top of utilities pipes/cables.

Depth requirement for laying of utility

Road Category/ Location	Minimum Depth Requirements	Alternative Depth Requirement for Fibre Optic Cables (FOC)
<u>Expressway</u>	No services allowed	
Road Carriageway		
Sidetable	No services allowed	
<u>Major Arterial</u>		
Road Carriageway	1.0m	1.0m
Sidetable	1.2m	0.3m
<u>Primary Access/ Local Access</u>		
Road Carriageway	1.0m	0.8m
Sidetable	1.2m	0.3m

Table 6.1 Minimum depth requirements for laying of utility

6.4.2 Utility owner may consider the alternative depth requirements for fibre optic cables (FOC) laying only, subject to compliance with the following conditions:

Alternative depth requirement for Fibre Optic Cables

- (a) Telecommunication companies (Telcos) /cable owners to look into necessary safeguarding measures and identification markers to protect their cables from damage.
- (b) No one after taking reasonable precautions should be held liable for damaging cables laid at shallow depth.
- (c) Telcos/ Cable owners to bear diversion costs when their cables laid at revised shallow depth are affected by public infrastructure works.

(d) Telcos/Cable owners to ensure that their cable route meets the statutory requirements of other utility agencies/service providers e.g. no new services are currently allowed to be laid over other existing services.

6.4.3 All utilities laid shall have a lateral clearance from the rigid pavement. The minimum lateral clearance is 2.0 metre or the depth of the utilities, whichever is greater, from the edge of rigid pavement.

Lateral clearance

6.4.4 Utility owner shall seek planning approval from LTA Road Works Regulation & Licensing Division (RWRL) for laying of services over / under-crossing culverts and other road structures.

6.4.5 All utilities laid shall also comply with the statutory requirements of other utility owners.

6.5 **LOCATION OF MANHOLES, VALVES, HYDRANTS AND OVER-GROUND BOXES**

6.5.1 There shall not be any new manholes, inspection chambers or valves constructed on road or on ramps of footpath and cycling track.

New manholes, chambers & valves

6.5.2 There shall not be any new Over-Ground (OG) boxes, fire hydrants or any other apparatus erected on footpath and cycling track.

New OG boxes

6.5.3 OG boxes shall be located with lateral clearance of at least 2m away from the kerb line along the major road, so as to allow adequate sight distance for drivers exiting the minor road.

6.5.4 In the event that the requirement in 6.5.3 cannot be achieved due to site constraints, OG Boxes shall be located with lateral clearance of at least 0.6m away from the kerb line with the minimum offset distance from the minor road as summarized in Table 6.2, depending on the design speed of major road. Please refer to Figure 6.1 – Illustration to locate OG Box.

Table 6.2				
Design Speed Km/hr	Left Hand Side of Minor Road (X)		Right Hand Side of Minor Road (Y)	
	Desirable (m) ¹	Absolute Minimum (m) ²	Desirable (m) ¹	Absolute Minimum (m) ²
40	10	5	25	10
50	15	10	30	20
60	20	10	45	25
70	25	15	55	35

Notes:

¹ Desirable (m) – In-line with Intersection Sight Distance values in LTA Design Criteria

² Absolute Minimum (m) – In-line with Stopping Sight Distance values in LTA Design Criteria

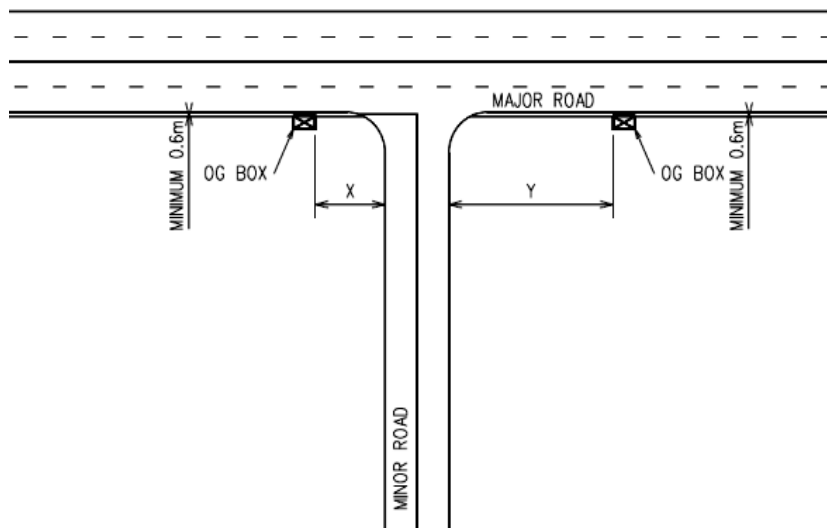


Figure 6.1 Illustration to locate OG Box

6.5.5 The placement of OG Boxes should meet the desirable offset distance from the minor road. Absolute minimum offset distance may be considered if there are valid reasons, e.g. site constraints such as short length of sidetable between road intersections, presence of existing objects or objection from 3rd party, etc.

6.5.6 The Authority may consider waiver of the requirements in this sub-section on a case by case basis. The applicant is required to submit valid reasons in writing to the Authority for consideration. If the waiver is given, the applicant shall ensure that

- the apparatus shall not be placed on the carriageway in a way that will affect the riding quality of the road e.g. manholes shall not be constructed in a cluster or along the wheel path of vehicles;
- the apparatus shall not be placed on the footpath in a way that will obstruct road-related facilities or endanger road users. The minimum passable width of 1.5m along the footpath must be maintained;
- the owner shall be responsible for maintaining the apparatus so as to ensure the safety of the road users and the riding quality of the road; and
- the owner shall bear the cost of raising, lowering or relocating the apparatus as and when required by the Authority.

6.5.7 The applicant shall seek concurrent approval from relevant authorities for erection of new Over-Ground (OG) boxes, fire hydrants or any other apparatus at back lane and service road.

Back lane

6.6 PROTECTION TO ROAD CARRIAGEWAYS/ ADJOINING STRUCTURES/ ROAD-RELATED FACILITIES

6.6.1 The applicant shall take measures to protect all road carriageways, road structures, apparatus and road-related facilities during the course of work on public streets. Any damages caused by the work shall be reinstated immediately.

Precautionary measures

6.6.2 For works above road structures, excavation by mechanical means shall not be allowed within 500 millimeters from the top of the structure.

6.6.3 Road structures includes the followings:

- a. Vehicular flyovers, viaducts and bridges;
- b. Box-culverts;
- c. Road tunnels and underpasses;

Protection to road structures

- d. Pedestrian overhead bridges; and
- e. Pedestrian underpasses.

The applicant shall propose a system to monitor the integrity of all road structures and to detect any damages or defects to these road structures. The applicant shall submit regular monitoring reports to the Authority once the system is approved. Notwithstanding the regular reports, the applicant shall inform the Authority immediately of any defects that appear in the course of work.

- 6.6.4 Road related facilities include traffic signs, traffic lights, railings, traffic light controllers and poles, street light posts, etc. The applicant shall ensure that these facilities are not damaged, moved, removed, or being obstructed as a result of the work.

Protection to road related facilities

6.7 **TEMPORARY EARTH RETAINING STRUCTURE FOR EXCAVATION WORKS**

- 6.7.1 All temporary earth retaining structures (TERS) for excavation works must be structurally safe and robust. For excavation exceeding 1.5m deep, the applicant shall ensure that the TERS is designed and endorsed by a professional engineer. The professional engineer and contractors shall take adequate precautions & considerations to ensure the safety of the public and the workers, and to protect the adjoining road carriageways and road structures in his design and construction of the TERS. The technical requirements for TERS are set out in Section 7 of this Code.

- 6.7.2 All construction materials used for the temporary earth retaining system such as sheetpiles, walers and struts shall be removed completely upon completion of the works.

6.8 **TEMPORARY TRAFFIC CONTROL**

- 6.8.1 The requirements, specifications and arrangements for temporary traffic control shall be in accordance with the latest edition of LTA's Code of Practice for Traffic Control at Work Zone.
- 6.8.2 The applicant/ contractor shall seek clearance from LTA's Intelligent Transport Systems Operations Divison (ITS Operations) before commencing works on major arterial roads and/ or near traffic junctions.

Code of Practice for Traffic Control at Work Zone

6.9 **EXTENT OF LANE OCCUPATION**

6.9.1 For contractors who need to carry out works on public streets, the occupation of carriageway for these works shall be restricted to only one (1) traffic lane width at any one time.

Occupation of carriageway

6.9.2 The roads (including slip roads) are not allowed to be closed completely at any time for any works.

No road closure

6.9.3 Traffic lane shall not be occupied during the peak hours; the applicant is required to use construction methods such as covering trenches with steel decking, pipe jacking and tunnelling to avoid the occupation of the lanes. Otherwise, the Authority may require the applicant to temporarily provide an alternative to replace the affected traffic lane.

No lane closure during Peak Hours

6.9.4 Traffic lane shall not be occupied such that it affects traffic in two or more directions e.g. traffic junctions.

Closure that affects traffic in two or more directions

6.9.5 The Authority may consider waiver of the requirements in this sub-section on a case by case basis. The applicant is required to submit valid reasons in writing to the Authority for consideration. The submission should include a study on the proposed utility works with traffic impact assessment of the affected road and the proposed traffic control plan. The submission shall be duly endorsed by a traffic consultant.

Waiver of the requirements

6.9.6 For maintenance of greenery on expressway, temporary lane occupation shall be limited to a maximum distance of 300m or before next slip road entry of expressway, whichever is shorter. The applicant shall submit a notification to LTA’s Intelligent Transport Systems Operation Division (ITS Operations) via the LTA. PROMPT prior to commencing works.

6.10 **WORKING HOURS**

6.10.1 Lane occupation for works on public streets is not permissible during the traffic peak hours, which may vary depending on the traffic condition.

Peak Hours

Traffic peak hours are generally as follows:

	Peak Hour Period
Monday – Saturday	6.00am to 9.30am 5.00pm to 8.00pm

A listing of roads with different traffic peak hours is available on LTA.PROMPT system via URL – <https://prompt.lta.gov.sg> and will be updated from time to time.

Occupation of bus-lane for works shall not be allowed during the bus-lane operation hours.

- | | | |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| 6.10.2 | The applicant shall obtain permission from National Environment Agency (NEA) and to notify all the affected stakeholders including residents, hotels, grassroots organizations, etc before the commencement of works. | <i>Permission from NEA and notification to stakeholders</i> |
| 6.10.3 | The applicant shall also notify NEA-Call Centre and LTA-Call Centre if the work has to be carried out from 7pm to 7am on weekdays or the entire day on weekends and public holidays. | <i>Notification of works during the night or on weekends / public holidays</i> |
| 6.10.4 | There shall be no noisy night work allowed in residential areas, hotels, hospitals, etc. | <i>Noise control for night works</i> |
| 6.11 | CONTINGENCY PLANS | |
| 6.11.1 | Notwithstanding the Peak Hours requirement, the affected traffic lane shall be restored and re-opened timely to traffic if the continuation of work is likely to cause traffic to pile up and the road to reach its optimal level of service. | <i>Re-opening traffic lane</i> |
| 6.11.2 | The contractor shall provide adequate standby materials, equipment and necessary resources to effect remedial action and re-open the affected traffic lane when any of the following situations is observed:
1) traffic tailback of more than 200m; or
2) motorists take 3 or more traffic cycle to clear traffic junction. | <i>Remedial action</i> |
| 6.11.3 | The contractor shall plan and limit the extent of excavation work according to the availability of his resources such that the affected traffic lane can be re-opened to traffic should the need arises. | <i>Extent of excavation work</i> |

6.12 TEMPORARY STEEL DECKING SYSTEM

6.12.1 Steel decking shall be used to cover trenches on public streets to allow traffic flow while works are being carried out beneath. The decking shall be laid flush with the road level, all joints between steel decking panels shall be firmly fixed by welding or by other appropriate means, with no gap between steel decking panels, adjacent road surface and road kerb, all affected road markings reinstated over steel decking and to ensure proper installation to avoid noise generation.

Steel decking

6.12.2 The applicant shall submit the following items prior to opening of the completed temporary decking for traffic use:

Submission requirements

- a. design calculations and construction drawings, duly endorsed by the professional engineer; and
- b. a letter certified by the professional engineer on his inspection of the Temporary Steel Decking System as constructed fully in accordance with his design calculations and details. This certificate shall be submitted within 3 days of completion of the temporary decking and prior to opening for traffic use.
- c. Letter of clearance from BCA on the temporary steel decking system.

6.12.3 The professional engineer shall ensure that the steel decking is designed to relevant code and standard to carry the traffic loading, and to maintain a skid resistance value of not less than 65 (BPN) as per BS EN 13036-4, at all times.

Skid resistance

6.12.4 Before installation of new decking, physical testing shall be carried out on two deck panels or 5% of the total number of deck panels, whichever is greater, to demonstrate that the required skid resistance value is complied with. All testing shall be carried out using the Portable Skid Resistance Tester and according to the operating procedure defined in standard BS EN 13036-4.

6.12.5 Upon deploying temporary steel decking system onsite, the applicant/ contractor shall conduct weekly visual inspection of the steel decking in the presence of the professional engineer or his/her representative. Inspection report shall include:

- a) Photographs and descriptive appraisal of temporary decking physical condition (e.g. report any defects/damages).

- b) Surface conditions – to maintain a minimum skid resistance value of 65 BPN as per BS EN 13036-4 and road markings, where affected.
- c) Condition of the structural integrity
- d) Remedial actions taken (if any)

The inspection report shall be submitted to the Authority as and when required by the Authority.

6.13 RAILWAY PROTECTION ZONE

6.13.1 The applicant shall apply and obtain clearance of the Authority's Development and Building Control Division (Rail Section) to carry out the restricted activities describe in the Rapid Transit Systems (Railway Protection, Restricted Activities) Regulations and any subsequent amendments within the Railway Protection Zone and Railway Safety Zone. *Restricted activities*

6.13.2 The applicant shall comply with the Authority's latest Code of Practice for Railway Protection in carrying out these works and services laying within the Railway Protection Zone. The Applicant may refer to the 'Guide to Carrying out Restricted Activities within Railway Protection and Safety Zones' published by the Authority for guidance. *Code of Practice for Railway Protection*

6.14 HOUSEKEEPING

6.14.1 The cleanliness of the public streets within the vicinity of temporary road access and work site, shall be supervised and maintained during the entire duration of works. *Cleanliness of Public Streets*

6.14.2 Immediate remedial actions must be taken to clear any spillage onto the surrounding public streets resulting from the works, failing which the Authority may clear the spillage and recover all cost incurred from the applicant.

6.14.3 There shall not be any parking of vehicles or deposition of debris, building materials, skip, etc. on the public streets including sidetable and footpath. *Obstruction to road users*

6.14.4 At locations where the footpath is affected, a safe alternative temporary footpath of equivalent standard to the permanent footpath shall be provided for pedestrians at all times. *Temporary footpath*

6.14.5 Any damages to the footpaths, road pavement, lane markings and other road furniture caused by the works shall be made good immediately.

Reinstatement

PART III – TECHNICAL REQUIREMENTS

SECTION 7 ENGINEERING WORKS

7.1 GENERAL

- 7.1.1 This section stipulates the technical requirements for compliance at the design and construction stages of engineering works being carried out on public street. *Technical requirements*
- 7.1.2 This Section shall be read in conjunction with Section 6 of the Code with respect to the requirements/ conditions for occupation of carriageway. *Occupation of carriageway*
- 7.1.3 Engineering works refer to construction works that are likely to affect the structural integrity and safe operation of any public streets. *Engineering works*
- 7.1.4 The Authority reserves the right to impose any additional requirements deemed necessary to safeguard the road infrastructures. *Additional requirements*
- 7.1.5 The applicant and/ or the appointed professional engineer shall also ensure full compliance with the relevant regulations e.g. Building Control Act, Rapid Transit System (RTS) Act and Regulation, etc. *Compliance with relevant regulations*

7.2 TEMPORARY EARTH RETAINING SYSTEMS (TERS)

- 7.2.1 All TERS shall be designed and executed to minimize ground movements.
- 7.2.2 The design of temporary and permanent Works shall comply with LTA's traffic loading as stipulated in the Civil Design Criteria Chapter 3. *Traffic loading*
- 7.2.3 All TERS designs shall be carried out and endorsed by a professional engineer. *Endorsement by Professional Engineer*
- 7.2.4 All TERS works which fall within the public street shall be designed for removal upon completion of works. *Removal of TERS*
- 7.2.5 TERS shall be designed such that there is no risk of damage to the adjoining road and road structures during removal.

7.2.6	All voids left in the ground due to the extraction of TERS shall be immediately filled with grout. The grout mix and method of grouting shall be proposed and endorsed by the appointed professional engineer.	<i>Grouting voids</i>
7.3	MONITORING OF ROAD AND ROAD STRUCTURES	
7.3.1	The ground shall be monitored for changes in ground conditions and movements which may result from the proposed works.	<i>Changes in ground conditions</i>
7.3.2	Typical ground instruments such as water standpipes, inclinometers, piezometers, borehole extensometers and settlement markers shall be provided where applicable.	<i>Typical ground instruments</i>
7.3.3	The type of ground instrument to be provided shall be appropriate for the ground conditions.	
7.3.4	Ground settlement points shall be installed such that the movement of the ground can be measured. Where points have to be installed on road carriageway, then the ground settlement points shall be anchored into the ground below the road pavement. Sleeves shall be provided through the road pavement so that the measured settlement is not affected by the presence of the road pavement. A grid of surface points to monitor heave or settlement shall be established with spacing between points in both directions shall not be more than 5m.	<i>Ground settlement</i>
7.3.5	The monitoring shall extend along the full length of the work, and cover the zone of influence for excavation work and engineering works.	<i>Extent of monitoring</i>
7.3.6	Adequate monitoring instruments shall be provided. The spacing of instruments shall be such that adverse changes in the ground conditions can be captured. The frequency of monitoring must tie-in with the criticality of the stage of works. Instrumentation proposal shall be submitted to the Authority for approval.	<i>Adequate monitoring</i>
7.3.7	Before termination of monitoring, the engineering works must be completed, the ground conditions and monitoring readings both shown to have stabilized and thereafter no further change is expected in the long term.	<i>Conditions for termination of monitoring</i>
7.3.8	Upon cessation of monitoring works, all instruments installed within public streets shall be removed and the ground and any affected road and road structure shall be made good to the acceptance of the Authority.	<i>Completion of monitoring</i>

7.4 **INTERVENTION VALUES FOR MOVEMENTS OF ROAD CARRIAGEWAY**

7.4.1 Intervention value defines the maximum severity of a defect at or before which remedial action must be taken.

Intervention value

The intervention values for movements of road carriageway are as follows:

Intervention values for movements of road carriageway (mm)	
Settlement	Differential Settlement
> +/- 30mm beneath a 3m straight edge	Slope > 1:100

7.5 **PROTECTION OF ROAD AND ROAD STRUCTURES**

7.5.1 Preventive measures shall be taken during construction stage of engineering work to prevent any damage to the existing road and road structures.

Preventive measures

7.5.2 The appointed professional engineer shall be responsible to:

- a. ensure that the works comply with the construction method statements and good engineering practice;
- b. monitor compliance of criteria;
- c. ensure that contingency measures are implemented in a timely manner; and
- d. take any other necessary measures to ensure that at no time shall the work being carried out pose any danger to the safety of the public.

Appointed Professional Engineer

7.5.3 The professional engineer shall exercise due diligence and reasonable care in monitoring the effects of engineering works on the road and road structures. He shall analyse the monitoring results, predict the likely trends and notify the Authority of any deviation from the predicted results and trends. He shall also make proposal to change the method of working or to implement contingency measures as a result of monitoring.

Continuous Monitoring

7.5.4	<p>Once the monitoring readings are taken, they shall be submitted to the Authority as required. A report of the review of the monitoring results endorsed by the professional engineer shall be submitted to the Authority within a week from the date of monitoring.</p> <p>All monitoring results shall be analysed and compared with the alert and work suspension levels specified by the professional engineer. The report shall also include description on progress of works and conditions of road infrastructures.</p>	<i>Monitoring results</i>
7.5.5	<p>During the progress of the works, should it become apparent from the monitoring results that the ground movement and/or the structural movement are likely to exceed the limits; the Authority may revoke the permit. The constructor shall take immediate measures to control movements within the acceptable limits, all at the cost and expense of the contractor. The work will only be allowed to resume if it can be demonstrated that the continuity of works will not adversely affect the public street and/ or road structure.</p>	<i>Additional measures</i>
7.5.6	<p>In the event of an incident relating to the works, the applicant shall notify LTA Call Centre (1800-2255582) and LTA RARL Division immediately. The interim incident report must reach LTA RARL within the next 12 hours. The detailed incident report must be submitted within the next 7 working days. (Incident report)</p>	<i>Incident report</i>
7.6	COMPLETION OF WORK	
7.6.1	<p>Condition surveys of the public streets shall be carried out upon completion of the proposed works or at intermediate stages as directed by the Authority. Defects found shall be highlighted and compared with the findings of precondition survey.</p>	<i>Condition survey</i>
7.6.2	<p>A proposal on making good of all defects arising from the work found in the public streets prepared and endorsed by the professional engineer shall be submitted to the Authority for prior approval.</p>	<i>Proposal on making good</i>
7.6.3	<p>Making good of defects arising from the work shall be completed to the satisfaction of the Authority. The contractor shall bear all direct or indirect costs arising from the rectification works. A report on the remedial work done shall be submitted upon completion of all remedial work.</p>	<i>Report on remedial work</i>

7.6.4 Defects and damages rectified shall be highlighted with photograph and compared with those found after the completion of work indicated in the final condition survey report.

Defects and damages rectified

7.7 **OTHERS**

7.7.1 The general technical requirements as in section 6.7, 6.8, 6.9, 6.10, 6.11, 6.12 and 6.13 of the Code shall be complied with for carrying out engineering works on public streets.

PART III – TECHNICAL REQUIREMENTS

SECTION 8 GENERAL REINSTATEMENT OF PUBLIC STREETS

8.1 GENERAL

8.1.1 The Applicant shall carry out the reinstatement of the affected public streets upon completion of works according to the current practices, requirements and standards of the Authority. The existing condition of the public streets may not be taken as the standards of the Authority.

8.1.2 For road pavement, the reinstated work shall comply with the permitted materials and layer thickness as specified in Figure 8.1 – Pavement Reinstatement Details.

*Pavement
reinstatement
details*

8.1.3 The reinstatements of public streets with the use of unsuitable materials, insufficient depth of backfilling, improper compaction and settlement or cave in of public streets arising from works are not acceptable. These defective reinstatements shall be rectified to the requirement of Authority at the expense of the applicant. Section 9 of Part III lists the characteristics and requirements for the reinstatement of public streets.

8.1.4 The edges shall be neatly cut with straight edge and the finished level flush with the existing road surface even if the surface is to be resurfaced for permanent reinstatement later on. Depending on site condition, the Authority may allow the finished level of the temporary reinstatement with tolerance of not more than 5mm higher than the surrounding road surface.

*Finishing of
trench
reinstatement*

8.1.5 Surfacing works by methods such as milling-and-patching or hot in-place resurfacing for the permanent reinstatement shall complete by the approved permit completion date, or by the deadline as directed by the Authority.

*Permanent
reinstatement*

8.1.6 The applicant shall notify the affected residents/developers of the scheduled resurfacing works before commencement.

*Notification to
affected parties*

8.1.7 The applicant shall bear the cost for lowering/raising of utilities manhole/s on public streets as and when required by the Authority and shall also liaise with the respective utilities owners on the lowering/raising of affected utilities manhole/s on public streets.

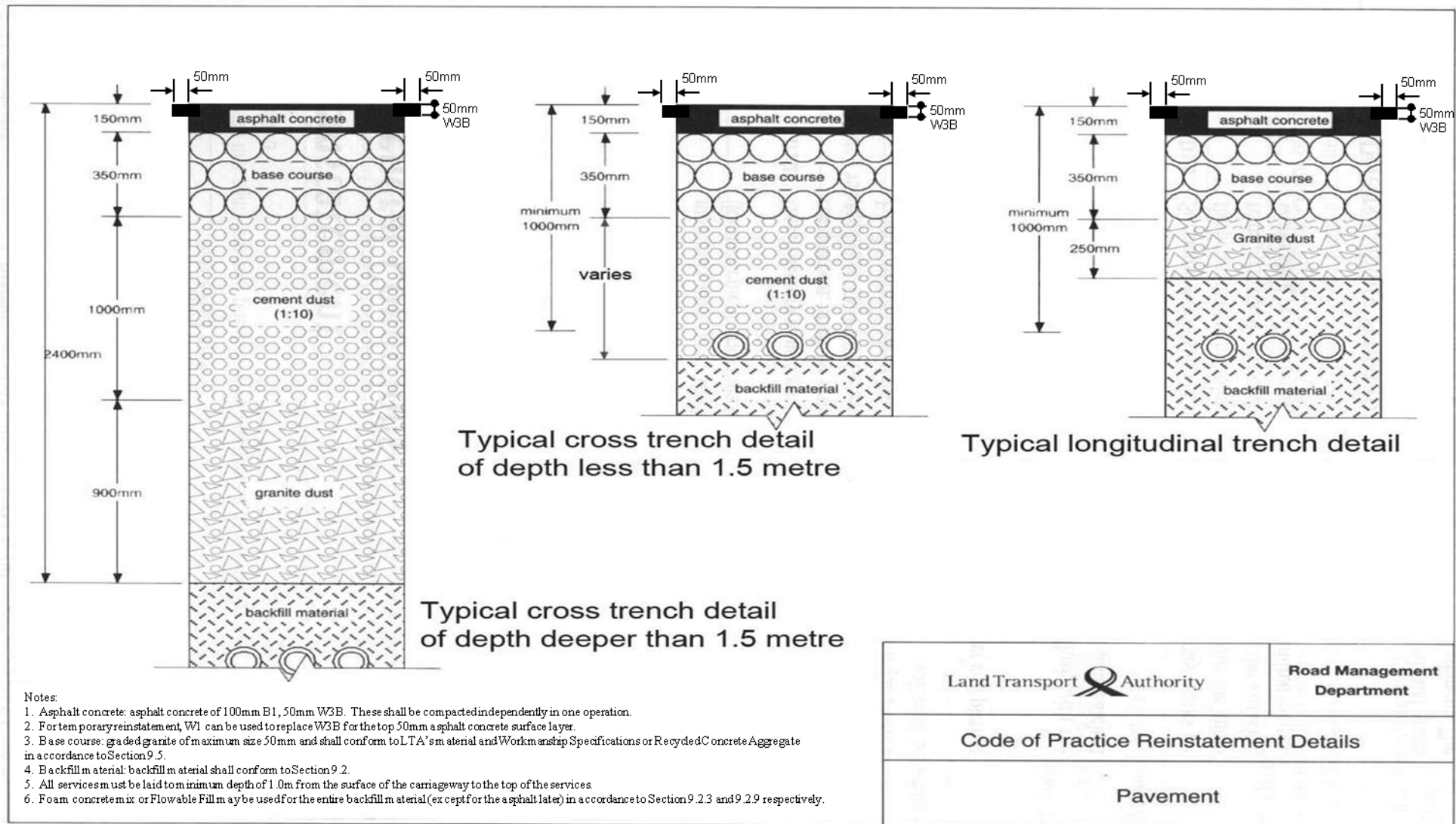


Figure 8.1 Pavement Reinstatement Details

8.2 CONDITIONS FOR REINSTATEMENT TO CARRIAGEWAY

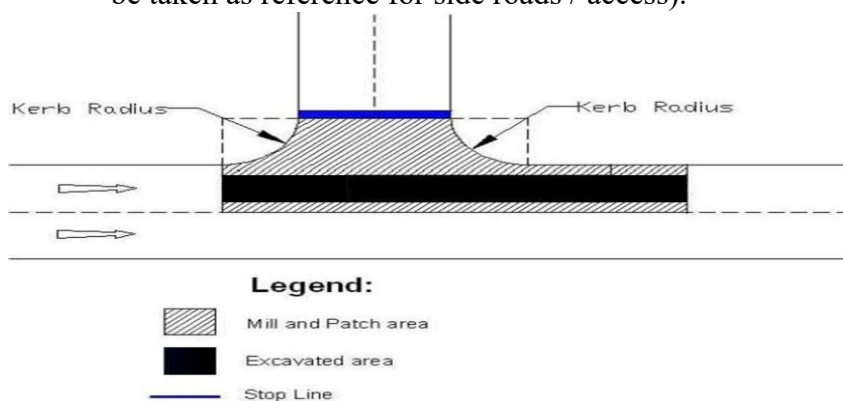
8.2.1 The following are conditions for the type of reinstatement that is required for carriageway. Notwithstanding these conditions, the Authority may specify any other conditions as and when it deems necessary.

Type of reinstatement

8.2.2 Milling and patching/ hot in-place resurfacing of asphalt concrete to the carriageway shall comply with the following:

Milling and patching/ Hot in-place resurfacing

- Minimum thickness of 50mm for W3B and 75mm for steel slag is to be laid.
- The area shall cover the full width of the affected lane within this area.
- If any two or more openings are less than 30 metres apart, the mill-and-patch/ hot in-place resurfaced area shall include the area between these openings. The area shall form a rectangular segment at full lane width covering the affected lanes.
- For opening that affects yellow box, pedestrian crossing or road hump, the full extent of the road markings shall be re-marked.
- For temporary road diversion, full width carriageway shall be resurfaced when the affected carriageway is realigned to the permanent alignment.
- For openings in front of entrance driveway and side roads, the milling and patching/ hot in-place resurfacing shall cover full width of affected entrance driveways and side roads/accesses. (“STOP” line shall be taken as reference for side roads / access).



8.2.3 Longitudinal profile of the top surface of the reinstated trenches shall meet the International Roughness Index (IRI) values specified in the Material & Workmanship (M&W) Specification published by LTA.

Measurement of roughness for longitudinal trenches

8.2.4 For reinstatement of cross trenches, the reinstatement of the road surface shall be completed so that it is flat and flush with the surrounding adjacent surface. A 3-meter straight edge shall be used to check the flatness of the completed surface with the surrounding adjacent surface. The construction tolerances at the edges and the surface of the reinstatement shall not exceed $\pm 5\text{mm}$.

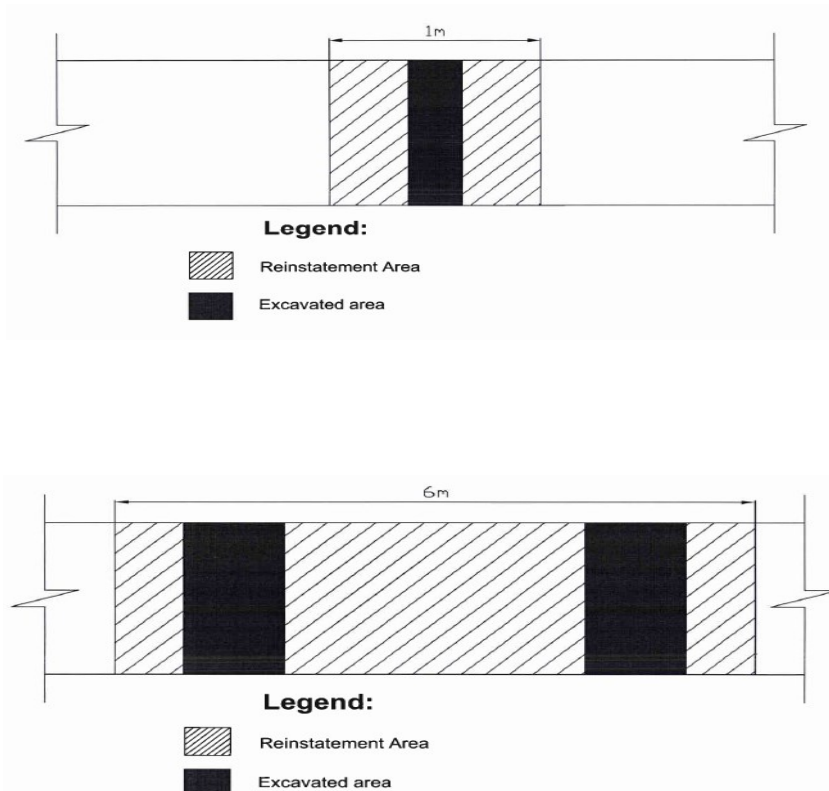
Reinstatement of cross trenches

8.3 CONDITIONS FOR REINSTATEMENT OF FOOTPATHS

8.3.1 The reinstatement of footpath shall meet the following requirements:

Footpath

- The reinstatement shall cover the full width of the footpath according to details as shown in the latest issue of LTA's Standard Details of Road Elements.
- The length of the footpath reinstatement shall be at least 1 metre. However, if there is more than one reinstatement within a single 6 meter stretch, the area between them has to be reinstated.



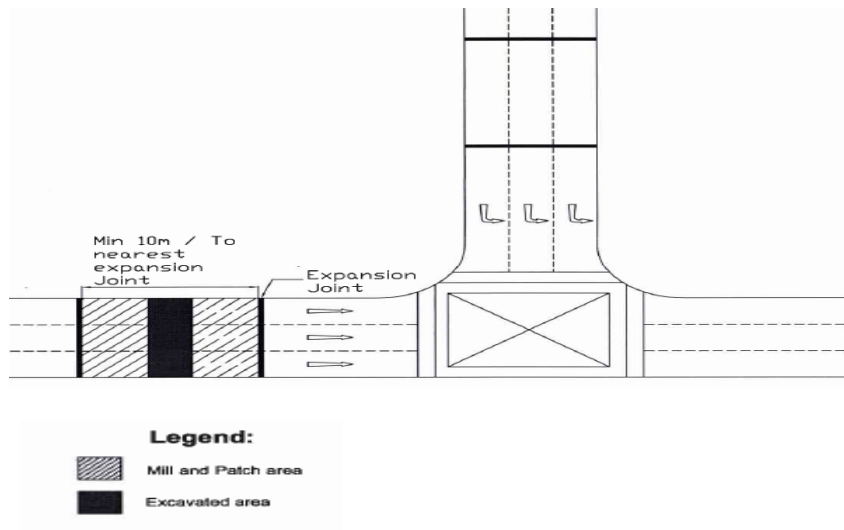
- The new tiles to be used for reinstatement to the footpath shall match existing colours and texture of surrounding tiles. If such tiles are not available/out of production, the applicant shall propose an alternative design for the Authority's approval prior to commencement of works.
- The tiled footpath shall cover 6 metre length or to the nearest joint, whichever is shorter, at full width of the footpath, forming a rectangular segment.
- The reinstatement of footpath ramp shall be in accordance with the current standards of the Authority for barrier-free accessibility.

8.4 RIGID PAVEMENT

8.4.1 All rigid pavement of carriageway shall not be opened. If the opening is unavoidable, the applicant has to reinstate the rigid pavement according to details shown in the latest issue of LTA's Standard Details of Road Elements.

8.4.2 Rigid pavements are to be constructed in panel of individual full lane width at minimum length 10 meter measured from the nearest expansion joint, or the full length between nearest expansion joints, whichever is shorter.

Rigid pavement



8.5 ROAD MARKINGS

- 8.5.1 The road lines affected by road openings shall be restored with thermoplastic road marking materials within **3** days upon completion.

However, the critical road lines including the ‘STOP’ lines, pedestrian crossing and arrow markings shall be restored immediately upon completion of works and before the reinstated area is opened to traffic.

- 8.5.2 For temporary reinstated areas that require surfacing works such as mill-and-patch works at a later date, stick on materials or any other materials approved by the authority may be used to temporarily restore the affected road lines.

8.6 WORKS AFFECTING TRAFFIC MANAGEMENT DEVICES

- 8.6.1 The Road Works Regulation & Licensing Division (RWRL) must be notified in advance of the commencement of the works if any pavement markings for school zone e.g. Street Print are affected by works.

- 8.6.2 The Deputy Director, ITS Operations Division, must be notified in writing 7 days in advance of the commencement of the works if any traffic detector loops/ feeder cables for traffic lights/ intelligent road studs are affected by the works. Please refer to section 8.6.4 for address.

- 8.6.3 For emergency opening, the applicant has to notify the Deputy Director, Traffic, Street and Commuter Facility Lighting Division via fax (fax no. 63328127) and telephone (at tel no. 63328129/ 63328130/ 63328131) immediately if detector loops/ intelligent road studs are affected.

- 8.6.4 Any accidental damage to detector loops/ feeder cables for traffic lights/ intelligent road studs must also be reported immediately in writing and by fax to:

LTA Traffic, Street and Commuter Facility Lighting Division
181, River Valley Road
ITS Operations, Level 4
Singapore 179034

Restoration of road lines

Pavement markings for school zone

Works affecting detector loops/ feeder cables for traffic lights

Intelligent road studs

Report on accidental damage

8.6.8 The Deputy Director, Road Pricing Systems Division (RPS), must be notified in writing 14 days in advance of the commencement of the works if any Electronic Road Pricing (ERP)'s structure/ associated infrastructure (i.e. controller housing, OG box and black & white strips) are affected by the works.

Works affecting ERP's structure/ detector loops

8.6.9 The applicant must report to LTA Road Pricing Systems Division in writing via email address: ERP_Ops_Support@lta.gov.sg or phone (92957316) immediately for any incidental damage to ERP's structure/ detector loops, etc.

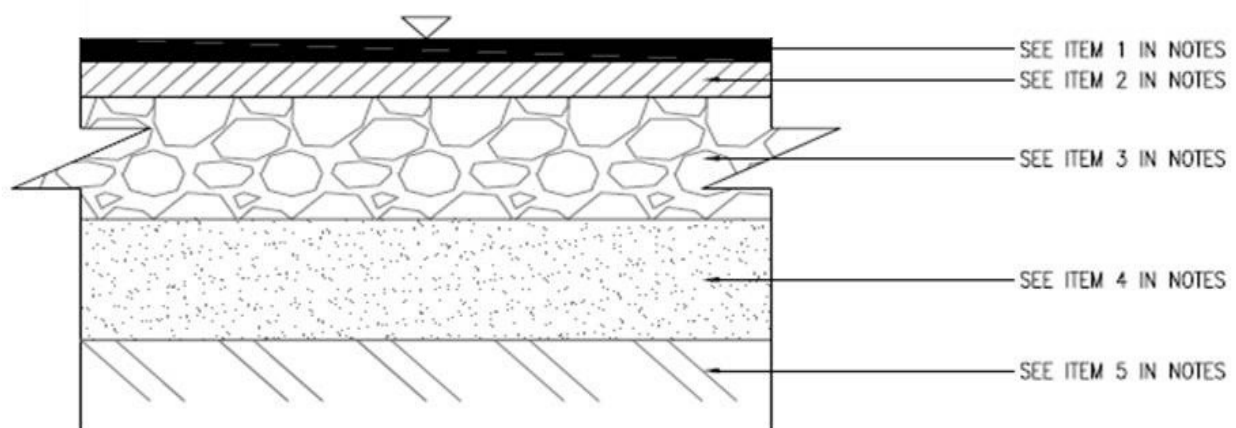
8.7 SPECIAL REINSTATEMENT MATERIALS

8.7.1 The Authority has used special materials for the roads and footpaths where necessary. If the Applicant's works affect such roads and footpaths, the Applicant shall reinstate with the same material or materials specified by the Authority. Thus the applicant shall have to satisfy the Authority that he has the expertise and the materials available to do a satisfactory reinstatement of such roads and footpaths before commencement of works.

Works affecting special materials for roads or footpath

8.7.2 For road pavement on reclaimed land at Tuas, the reinstated work shall comply with the permitted materials and layer thickness as specified in Figure 8.2 Pavement Reinstatement Details for Road Pavement on Reclaimed Land at Tuas.

Works affecting asphaltic road pavement structure on reclaimed land at Tuas



NOTES:

- ITEM 1. 75mm THICK WEARING COURSE USING STONE MASTIC ASPHALT (SMA) WITH POLYMER MODIFIED BINDER OF PERFORMANCE GRADING NOT LESS THAN PG-76.
- ITEM 2. 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".
- ITEM 3. 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.
- ITEM 4. 400mm CONSOLIDATED THICKNESS OF SUB-BASE SHALL BE OF QUARRY WASTE OR EQUIVALENT AND SHALL BE COMPACTED TO MINIMUM OF 95% OF THE MAXIMUM DRY DENSITY OBTAINED USING THE MODIFIED AASHO COMPACTION TEST OR TEST 13 OF BS 1377 AND SHALL HAVE A MINIMUM SOAKED CBR OF 30%.
- ITEM 5. THE LAST LAYER OF 500mm THICK SUB-GRADE MATERIAL SHALL HAVE A MINIMUM SOAKED CBR OF 5% AND SHALL BE COMPACTED TO MINIMUM 95% OF MAXIMUM DRY DENSITY OBTAINABLE USING THE MODIFIED AASHO COMPACTION TEST.

Figure 8.2 Pavement Reinstatement Details for Road Pavement on Reclaimed Land at Tuas

PART III – TECHNICAL REQUIREMENTS

SECTION 9 MATERIAL SPECIFICATIONS & QUALITY CONTROL

9.1 GENERAL

9.1.1 This section stipulates the basic standard of quality of materials and workmanship required by the Authority. In the absence of any other technical requirements, the latest edition of the LTA's Standard Details of Road Elements and/ or the Material and Workmanship Specifications published by LTA shall prevail.

9.1.2 Unless otherwise specified, all materials, fittings, workmanship, construction and installations for the Works, shall comply with the appropriate standard issued by the Standards, Productivity and Innovation Board (SPRING Singapore). If such a standard does not exist, then the appropriate standard issued by the British Standards Institution shall be used. Where relevant provision does not exist, the Contractor shall submit appropriate equivalent standard to the approval of the Engineer.

9.1.3 Applicant is required to check and declare that the condition(s) of final reinstatement work is in full compliance with the prevailing regulatory requirements, Code of Practices, Standard Details of Road Elements and/ or the Material and Workmanship Specifications, published by the Authority. In the event that the final reinstatement is not in compliance with requirements, the Authority reserves the right to require Applicant to carry out necessary rectification accordingly to the Authority's satisfaction.

9.2 Backfill Materials

9.2.1 All backfill materials within the road carriageway shall be granular material (see Section 9.2.2), flowable concrete, or foamed concrete.

Any other materials not stipulated above are unsuitable materials and shall not be used for back-filling. Unless otherwise approved by the Authority, materials indicated below are not acceptable:

Standards

- i) material from swamps,
- ii) peat, logs, stumps, perishable material and soft clay,
- iii) material susceptible to spontaneous combustion,
- iv) soil of liquid limit exceeding 70 and/or plasticity index exceeding 35,
- v) excavated asphalt concrete from existing road.

9.2.2 Granular materials that are used as backfill materials shall conform to the following characteristics:

- i) Not more than 35% fines passing through sieve 75µm,
- ii) The fraction passing through sieve 75µm shall have plasticity index (maximum) and liquid limit 35 (maximum),
- iii) Dry density to be 1760 kg/ m³ (minimum).

*Specification
for Granular
Materials*

9.2.3 All aggregates used for foamed concrete shall pass a 3.75mm BS sieve and shall not contain more than 5% by weight of clay contamination, determined in accordance with BS 882:1983 Clause 5.4.

*Specification
for Foamed
Concrete*

9.2.4 All foamed concentrates shall be diluted in accordance with the manufacturer's recommendations and aerated using an appropriately designed foam generating system. Foam concentrates and diluted solutions shall be stored according to the manufacturer's recommendations and used within the recommended shelf life.

9.2.5 Subject to experience of their suitability that is obtained by prior development testing, all accelerators, plasticisers, water reducing agents and other admixtures shall be used in accordance with the manufacturer's recommendations.

9.2.6 Foamed Concrete mixes shall be prepared using a ready - mixed base mortar delivered to site, and in accordance with a mix formulation proven by prior development testing.

- 9.2.7 The foamed concrete shall achieve a minimum density of 1050kg/m³. Plastic sheeting, etc., shall be provided to protect the existing utility apparatus so that foamed concrete is prevented from flowing into and blocking any damaged apparatus that exist within, or are immediately adjacent to the excavation.
- 9.2.8 Reinstatement of the surface layers shall not be carried out until the foamed concrete has attained sufficient strength to allow compaction of the asphalt materials.
- 9.2.9 Ready-mix flowable fill is a mixture of Portland cement, aggregates, water and mineral admixtures. Flowable fill has a cementitious content that is lower than that of Portland cement, and has a reduced strength development for easy removal. Chemical admixtures may also be used to modify the fill's performance properties in strength, flow, set and permeability.
- 9.2.10 The mix shall be prepared using a ready-mix base mortar delivered to site. Mineral admixtures shall be pozzolanic materials used in standard ready-mix concrete production.
- 9.2.11 Chemical admixtures shall be liquid or powder form used in standard ready-mix concrete production or other permissible products as follows:
- a) High air generators specifically designed for flowable fill to lower unit weights, reduce shrinkage and subsidence, and to control compressive strength.
 - b) Air entraining admixtures conforming to ASTM C-260.
 - c) High-range water-reducers conforming to ASTM C-494 Type F or G.
 - d) Accelerating admixtures conforming to ASTM C-494 Type C such as calcium chloride. However where metals are present in concrete or embedded members, accelerators that are non-chloride and non-corrosive shall be used.
- 9.2.12 Pipes and all other members to be encased in the flowable fill shall be temporarily secured in place to prevent displacement during the flowable fill placement. To reduce hydrostatic pressure and limit displacement potential, a high air generator admixture in the flowable fill mixture is recommended to lower unit weights.

*Specification
for Ready - mix
Flowable Fill*

9.3 PORTLAND CEMENT CONCRETE

- 9.3.1 Cement used for public streets shall be ordinary Portland cement, rapid hardening Portland cement complying with SS26, sulphate resisting Portland cement to BS4027, Sulphate-resisting cement to BS4248 or low heat Portland-blast-furnace cement to BS4246.
- 9.3.2 Cement of different manufacture and of different types shall not be used in the same mix.
- 9.3.3 Cement that becomes lumpy or has deteriorated shall not be used for concreting and shall be removed from site immediately.
- 9.3.4 Fine aggregate shall be natural sand or crushed stone sand complying with the requirements of SS31. Coarse aggregate shall be gravel or stone complying with SS31.
- 9.3.5 Water shall be clean fresh water free from chemical and organic impurities.
- 9.3.6 Concrete mixes shall generally comply with the specification in Table 9.1.

Specification for Portland cement concrete

	Grade of Concrete						
	40	35	30	25	20	15	10
Characteristic strength N/mm ² at 28 days	40	35	30	25	20	15	-
Minimum cement content in kg/m ³ of fully compacted concrete	350	350	325	300	270	205	175
Maximum cement content in kg/m ³ of fully compacted concrete	550	550	550	550	550	550	550
Maximum water/cement ratio	0.50	0.50	0.50	0.55	0.60	0.70	0.80

Table 9.1 Specifications for Concrete Mix for different grades of concrete.

- 9.3.7 Concrete shall be thoroughly mixed in a batch type mechanical mixer. No concrete shall be mixed by hand. For amount in excess of 3 m³, no in-situ mixing is allowed. Ready-mixed concrete, conforming to SS 119 and the specification as listed in Table 9.1, might be used.
- 9.3.8 The reinforcement shall be either (i) steel complying with SS 2, (ii) steel complying with SS 18, or (iii) steel fabric complying with SS 32.

9.4 ASPHALT CONCRETE

- 9.4.1 Coarse Aggregates for asphalt concrete shall be clean, well-graded, angular, crushed stone or steel slag of approved quality. They shall be free from dust, dirt and other deleterious materials; and there shall not be an excess of flat, elongated or weathered pieces. The properties of coarse aggregates shall conform to the requirements in Table 9.2 and 9.3.
- 9.4.2 Fine aggregates for asphalt concrete shall consist of clean, sound durable, angular particles produced by crushing stone, slag or gravel and shall be free from coatings of clay, silt or other deleterious materials. They shall meet the soundness and wear requirements as specified for coarse aggregate.
- 9.4.3 Filler, in addition to those naturally present in the aggregate, shall meet the requirements of ASTM D242.

*Specification
for Asphalt
concrete*

Property	Allowable Standard	Method of Testing
Impact Value	Not more than 30%	BS 812 Part 112:1985
Crushing Value	Not more than 25%	BS 812: Part 110:1985
Water Absorption (in term of surface dry mass)	Not more than 1%	BS812: Part 2:1975
Flakiness Index	Not more than 35%	BS812: Part 105.1:1985
Elongation Index	Not more than 35%	BS 812: Part 105.2 :1985
L.A. Abrasion Value (500 revolutions)	Not more than 35%	SS73:74
Silt content of raw aggregate (by weight)	Not more than 2%	BS812: Part1:1975
Silt content of aggregate in drum/hot bin (by weight)	Not more than 0.3%	BS812: Part1:1975

Table 9.2. Requirements for Properties of Coarse Aggregate (Granite Stone)

Property	Allowable Standard	Method of Testing
Crushing Value	Not more than 25%	BS 812: Part 110:1985
Flakiness Index	Not more than 25%	BS812: Part 105.1:1985
L.A. Abrasion Value (500 revolutions)	Not more than 25%	SS73:74
Silt content of steel-slag in hot bin (by weight)	Not more than 0.3%	BS812: Part1:1975

Table 9.3. Requirements for Properties of Coarse Aggregate (Steel slag). Granite filler may be used if steel-slag filler is not available.

- 9.4.4 Bitumen Emulsion shall be homogeneous and rapid-setting cationic bitumen that conforms to the requirement of Table 9.4.
- 9.4.5 Bitumen shall be approved type petroleum bitumen of 60/70 penetration grade. No mineral matter other than that naturally contained in such bitumen shall be present. The bitumen shall be homogeneous, free from water and shall not foam when heated to 175 °C. The bitumen shall conform to the requirements of Table 9.5.

Property	Grade CRS-1		Grade CRS-2		Method of Testing
	Min	Max	Min	Max	
<i>Test on emulsions:</i>					
Viscosity, Saybolt Furol at 50°C SFS	20	100	100	400	ASTM D244
Storage stability test, 24-h, % ^A	-	1	-	1	ASTM D6930
Demulsibility, 35mL, 0.8% dioctyl sodium sulfosuccinate, %	40	-	40	-	ASTM D6936
Particle charge test	positive	-	positive	-	ASTM D244
Sieve test, % ^A	-	0.10	-	0.10	ASTM D6933
<i>Distillation:</i>					
Oil distillate, by vol of emulsion, %	-	3	-	3	ASTM D6997
Residue, %	60	-	65	-	ASTM D6997
<i>Tests on residue from distillation test:</i>					
Penetration, 25°C, 100g, 5s	100	250	100	250	ASTM D244
Ductility, 25°C, 5cm/min, cm	40	-	40	-	ASTM D244
Solubility in trichloroethylene, %	97.5	-	97.5	-	ASTM D244
^A This test requirement on representative samples is waived if successful application of the material has been achieved in the field.					

Table 9.4 : Requirements for Cationic Emulsified Asphalt

Property	Unit	60/70 Penetration Grade		Method of Testing
		Min	Max	
Penetrating at 25°C 100g, 5s	0.1 mm	60	70	ASTM D5
Flash Point, Cleveland Open Cup	°C	232	-	ASTM D92
Ductility at 25°C, 5 cm per min	cm	100	-	ASTM D113
Solubility in trichloroethylene	% wt	99	-	ASTM D2042
Softening Point, Ring and Ball	°C	47	56	ASTM D36
Specific Gravity at 25°C	-	1.0	1.11	ASTM D70
<i>Thin-film oven test, 3.2 mm, 163°C, 5 hrs :</i>				
a) Loss on heating	% wt	-	0.8	ASTM D6
b) Penetration of residue at 25°C	% of original	54	-	ASTM D6
c) Ductility of residue at 25°C, 5 cm per min	cm	50	-	ASTM D113

Table 9.5 : Requirements for Bitumen

9.4.6 For Mix Design, the aggregate grading for various types of mix design shall be in accordance with the mix design specification of Table 9.8.

9.4.7 Temperature of Hot Asphalt Concrete shall not be lower than 130°C at the time of laying.

9.4.8 Cold Instant Premix that conforms to BS4987: 1988 may be used in cases where the area is small (less than 1 tonne of premix required). The binder used shall be bitumen based; and shall contain resin, adhesive, polymers, and solvent. The mix design for base course of the aggregate grading and bitumen binder content shall conform to Table 9.6 and the following:

- Bitumen Binder Content: 3.6% to 4.2%
- Type of aggregate: Grit stone

BS Sieve Passing	Percentage by mass
28.00mm	100
20.00mm	95 - 100
14.00mm	65 - 85
10.00mm	55 - 72
6.30mm	39 - 55
3.35mm	32 - 46
300µm	7 - 21
75µm	3 - 8

Table 9.6 Grading of Aggregates for Mix design for Base Course of instant premix

The mix design for wearing course of the aggregate grading and bitumen binder content shall conform to Table 9.7 and the following:

- Bitumen Binder Content : 5.0% to 6.0%
- Type of aggregate : Dolerite

BS Sieve Passing	Percentage by mass
10.00mm	100
6.30mm	80 - 100
3.35mm	25 - 45
1.18mm	10 - 30
75µm	2 - 9

Table 9.7 Grading of Aggregates for Mix design for Wearing Course of instant premix.

Type of Mix	Wearing Course						Binder Course
	WSS*	W1	W3	W3B	W5	W5B	B1
Thickness of Course(mm)	40-70	15-20	25-45	45-65	45-65	40-80	50-100
% Soluble Bitumen (60/70 Pen Grade) (% by Wt of Total Mix)	5 ± 0.5	6 ± 0.5	6 ± 0.5	5 ± 0.5	5.5 ± 0.5	4.8 ± 0.5	50 - 100
Void in mix (%)	3 - 5	3 - 5	3 - 5	4.5 - 6.5	3 - 5	4.5 - 6.5	3 - 5
Max Size of Stone(mm)	20	10	20	20	25	25	35
(BS)Passing:							
50.0mm	-	-	-	-	-	-	-
37.5mm	-	-	-	-	-	-	100
25.0mm	-	-	-	-	100	100	95 - 100
19.0mm	100	-	100	100	95 - 100	89 - 97	84 - 92
13.2mm	80 - 90	-	90 - 100	85 - 95	76 - 90	73 - 83	65 - 82
9.5mm	63 - 77	100	-	-	-	-	-
6.3mm	-	90 - 100	70 - 83	58 - 68	54 - 70	50 - 60	48 - 62
3.15mm	-	65 - 82	50 - 65	40 - 50	39 - 55	40 - 50	35 - 50
2.36mm	46 - 56	-	-	-	-	-	-
1.18mm	-	39 - 55	29 - 44	21 - 31	27 - 41	25 - 35	27 - 41
600µm	16 - 26	-	-	-	-	-	-
300µm	-	22 - 32	15 - 24	11 - 17	15 - 22	13 - 16	15 - 22
212µm	8 - 18	-	-	-	-	-	-
75µm	6.5 - 10.5	3 - 8	3 - 8	4 - 8	3 - 8	4 - 8	3 - 8

Table 9.8 Mix Specification

* Note: Only steel - slag aggregate is permitted. The use of granite filler is permitted if there is insufficient steel slag filler available.

9.5 RECYCLED CONCRETE AGGREGATE

9.5.1 The graded RCA shall be free from harmful contamination and conform to the following requirements.

- a) Coarse aggregate shall consist of sound, tough, durable particles, free from adherent coatings of clay, organic matter and other deleterious substances. The properties of coarse aggregate shall comply with the following requirements:
- b) The gradation of RCA and the liquid limit, plasticity index and linear shrinkage of fine aggregates shall comply with the requirements as shown in Table 10.3 and Clause 10.3.2.3 of the LTA's Materials and Workmanship Specification (Revision A8, 2008).

Property	Allowable Standard	Method of Testing
Impact value	Not more than 45%	BS 812 Part 112
L.A. abrasion	Not more than 50%	SS 73: 1974
Flakiness index	Not more than 40%	BS 812 Part 105.1
Fines content*	Not more than 3%	SS 73: 1974
% impurity (by mass)	Not more than 5%	**
Acid-soluble sulphate	Not more than 1%	SS EN 12620

Table 9.9. Requirements for Properties of Recycled Aggregate

* Fine is particle size fraction of an aggregate which passes the 0.063 mm sieve

** Impurities such as ferrous and non-ferrous metal, brick, plastic, wood, ceramic, asphaltic material and soil shall be removed. The percentage of impurity by mass shall not exceed 5%.

9.6 RECYCLED CONCRETE AGGREGATE DUST

9.6.1 Recycled concrete aggregate (RCA) dust is produced from the processing of construction and demolition waste. It shall be produced from a proper processing plant. The processing shall include but not limited to the following processes:

- i) Crushing via primary and secondary crushers into the required particle sizes
- ii) Removal of ferrous metals via magnetic separator
- iii) Removal of foreign materials such as brick, ceramic, wood, plastic and asphaltic material
- iv) Sieving of RCA into the required sizes

9.6.2 RCA dust shall consist of mainly granite aggregate and cementitious materials such as cement paste and mortar. It shall contain no more than 5% (by mass) of impurities such as metal, brick, ceramic, wood, plastic and asphaltic material. The gradation of RCA dust shall comply with the grading limits as shown in the Table below:

BS Sieve Size (mm)	% Weight Passing
6.70	100
4.75	70 – 100
0.600	20 – 55
0.075	6 – 20

Note: Based on LTA Materials & Workmanship Specification for quarry dust (2001)

In addition, RCA dust shall have a minimum soaked California Bearing Ratio of 30% when tested in accordance with BS 1377, using the dynamic compaction method with a 4.5kg rammer at the dry density and moisture content likely to be achieved in the field.

Recycled concrete aggregate dust material for sub-base layer

Requirements for recycled concrete aggregate dust

9.7 SPECIAL MATERIALS

9.7.1 SEMI-RIGID PAVEMENT

9.7.1.1 The semi-rigid pavement shall consist of an open graduated asphalt with a void between 25 % to 30 % by volume (Marshall), flood filled with high strength cementitious mortar possessing high fluidity and internal cohesion. It shall achieve a compressive strength of 7-10 MN/m² at 28 days and a flexural strength of approximately 3.5 MN/m². The components of the open graduated asphalt are listed in Table 9.10.

*Open-
graduated
asphalt*

Components	Percentage by weight
Bitumen (60/70 pen)	Between 3.6% to 4.6%
Lime Filler	4.0 %
Cellulose Fibres	0.2%
Crushed Aggregates	91.7%

Table 9.10. Components of open-graduated asphalt.

9.7.1.2 Coarse aggregates of semi-rigid pavement shall consist of clean, angular, crushed granite stone of approved quality, free from dust, dirt and other deleterious materials; and free from an excess of flat, elongated or weathered pieces. The proportion of the coarse aggregates shall conform to Table 9.11.

*Coarse
aggregates*

Property	Allowable Value	Method of Testing
Crushing Value	Not more than 20%	BS 812: Part 110:1985
Flakiness Index	Not more than 20%	BS 812: Part 105.1:1985
L.A. Abrasion Value (500 revolutions)	Not more than 20%	SS73:74
Silt content of aggregate in hot bin (by weight)	Not more than 0.3%	BS 812: Part 1:1975

Table 9.11. The proportion of the coarse aggregates in semi-rigid pavements

9.7.1.3 Lime filler used shall be hydrated lime.

Lime filler

9.7.1.4 Cellulose Fibres shall be raw cellulose, long fibres and grey possessing the following properties:

*Cellulose
Fibres*

- Cellulose Content : Approximately 80%
- Average fibre length : 1,100um
- Average fibre thickness : 45 um
- Bulk density : 20g/l to 40g/l
- Residue on ignition: approx. 15%(at 850°C,4 hrs)
- pH - value: 7.5±1

Air jet sieve analysis (DIN 53734) shall have the following residue on the screen:

Size of Interior Mesh Aperture	Max % of residue
300 µm	Max 60%
32 µm	Max 99%

Table 9.12. Air - jet Analysis of Cellulose Fibres.

9.7.1.5 High Strength Cementitious Mortar shall consist of a dense packing of cementitious inorganic material and shall be mixed with water to form a free flowing mortar having a high internal cohesion. It shall conform to the following requirements:

*High Strength
Cementitious
Mortar*

- Compressive strength:
1 day: 55 MN/m²
28 days: 110 MN/m²
- Flexural strength: 15 MN/m³
- Density: 2200kg/m³
- Water Absorption (DIN 52103): 6.9 by weight %
- Water Absorption (drying-out of concrete at 20°C and 65% relative humidity): 0.5 by weight %
- Chemical resistance: 3 to 5 times more resistance than grade 50 concrete
- Setting time : 8 to 12 hours

9.7.1.6 Mixing of Open Graduated Asphalt-The components shall be added in the following sequence:

- i) Crushed aggregates and cellulose fibres
- ii) Lime filler
- iii) Bitumen

The mixing temperature shall be approximately 165°C at a mixing time of between 39 and 45 seconds per batch. Storing of mix in the silo is not allowed.

Mixing of Open Graduated Asphalt

9.7.1.7 Mixing of High Strength Cementitious Mortar - Amount of water to be added shall be approximately 4.7 kg per 25 kg of high strength cementitious mortar dry powder, or the water/binder ratio shall range between 0.266 and 0.278.

Mixing of High Strength Cementitious Mortar

9.7.2 CONCRETE SURFACE PAVING

9.7.2.1 Concrete surface paving on footpath shall be approved sprayed-on acrylic modified UV stable pigmented cementitious topping with minimum thickness of 1 mm, minimum cured compressive strength of 45 N/mm² and skid resistance not less than 50.

Concrete surface paving on footpath

9.7.2.2 Concrete Surface paving on carriageway shall be approved spray-on acrylic modified UV stable pigmented cementitious topping with minimum thickness of 1mm, minimum cured compressive strength of 60 N/mm² and skid resistance not less than 65.

Concrete surface paving on carriageway

9.8 THERMOPLASTIC ROAD MARKINGS

9.8.1 Thermoplastic materials shall be used for all road markings. The material and site performance requirements for hot-applied white, yellow, red and black thermoplastics road marking materials and their constituents shall comply with Singapore Standard SS 589: 2013 - "Specification for hot-applied thermoplastics road marking materials - Materials, performance and application" or the latest Singapore Standards (SS).

Thermoplastic materials

9.8.2	The materials on definitions of coefficient of retro-reflected luminance, luminance coefficient, tables in field performance requirements and sampling are reproduced from SS 589 : 2013 – ‘Specification for hot-applied thermoplastic road marking materials – Materials, performance and application’ with the permission from SPRING Singapore. All rights reserved.	<i>SPRING Singapore</i>
9.8.3	The ratio of the luminance of the field thermoplastic road marking in the direction of observation by the luminance at the perpendicular to the direction of the incident light.	<i>Coefficient of retro-reflected luminance R_L (mcd/m²/lx)</i>
9.8.4	The ratio of the luminance of the field thermoplastic road marking in the given direction by the illuminance on the field under diffuse illumination. The field measurement of Qd value shall be obtained using a portable device complying with ASTM E7170.	<i>Luminance coefficient Q_d (mcd/m²/lx)</i>
9.8.5	The field measurement of coefficient of retro-reflected luminance R_L value shall be obtained using a portable device complying with ASTM E1710. The measurement of R_L of thermoplastic road marking during wetness shall in accordance with ASTM E2177. The average initial R_L values for thermoplastic road markings in dry and during wetness after installation shall conform to Table 9.15. It is generally agreed that the initial measure is best taken approximately one to two weeks after application. This allows time for the waxes, paint dust and coatings to be removed under traffic. It also provides time to test whether markings have been applied successfully and glass bead retention is satisfactory. The number of measurement shall conform to Table 9.14.	<i>Retro- reflection under vehicle headlamp illumination</i>
9.8.6	Take three portions, each having a mass of not less than 4kg, from the outlet of a preheater or laying apparatus, discarding the first and last 5% of the charge. Combine the three portions in a clean container clearly labelled with the contractor’s name, type of material, site and date. Do not apply heat at any stage of the sampling process once the road marking material has issued from the melting or laying apparatus. Record the temperature of the road marking material at the time of sampling. Keep half the sample for evidence in case of dispute.	<i>Test samples</i>
9.8.7	Test panels shall be made of aluminium at least 850mm long, 1500mm wide, and 0.6mm thick, prepared for test by solvent cleaning. Prepare the panel and apply the paint to the panel to give a dry film thickness of 1.5mm without glass beads.	<i>Test panels</i>

9.9 QUALITY CONTROL

9.9.1 The type and number of tests shall follow Table 9.13, 9.14 and 9.15:

Tests for reinstatement works

	L < 50m	50m < L < 1000m	L > 1000m
Depth & Thickness	1 no.	1 no. per 100m	1 no. per 200m
Compaction	N.A.	1 no. per 100m	1 no. per 200m
Compressive Strength	N.A.	1 no. per 100m	1 no. per 200m
Absorption	N.A.	1 no. per 100m	1 no. per 200m
Extraction	N.A.	1 no. per 100m	1 no. per 200m
Sieve Analysis	N.A.	1 no. per 100m	1 no. per 200m

Table 9.13 Number of tests required for different length of opening

Road marking type	Number of measurement
Line marking of 100 – 150mm width	Minimum of 3 points for every 50m marking laid
Line marking of 200 – 450mm width	Minimum of 3 points for every 25m marking laid
Area marking	Minimum of 3 points for every 3 area marking laid
* Line marking refers to lane marking, pedestrian crossing marking and etc	
** Area marking refers to zebra marking, arrow marking and etc	

Table 9.14 Number of measurement for Q_d , R_L and thickness

Road marking type & colour	Minimum R_L Initial Application		Minimum R_L After 5 months	
	At dry condition	During wetness	At dry condition	During wetness
White marking	≥ 300	≥ 150	≥ 150	≥ 80
White profile marking	≥ 260	≥ 150	≥ 100	≥ 50
Yellow marking	≥ 160	No requirement	≥ 50	No requirement
Red marking	≥ 100	No requirement	No requirement	No requirement

Table 9.15 R_L for road marking in dry condition and during wetness at initial application and after 5 months

9.9.2	The cost incurred in carrying out the various tests is to borne by the Applicant. All test results shall be submitted to the Authority electronically through the LTA.PROMPT.	<i>Submission of test results</i>
9.9.3	The Authority at its own discretion may carry out additional tests whose cost shall be borne by the Applicant.	<i>Additional tests</i>
9.9.4	All tests, except the Depth and Thickness Tests, shall be carried out by Productivity Standards Board or its accredited laboratories.	<i>Approved Laboratories</i>
9.10	DEPTH AND THICKNESS TEST	
9.10.1	The depth of utilities and the thickness of the reinstatement materials shall be determined by non-destructive equipment or by the open-cut method. The open-cut method shall be carried out before the milling and patching process.	<i>Depth and thickness test</i>
9.10.2	On completion of the test(s), the Applicant shall submit the result(s) to the Authority indicating the location(s) tested.	<i>Submission of test results</i>
9.10.3	The Depth and Thickness Test result(s) shall be endorsed by the Applicant.	<i>Endorsement</i>
9.11	COMPACTION TEST	
9.11.1	The field density of the cored samples shall be used to determine the degree of compaction of the asphalt concrete.	<i>Degree of compaction</i>
9.12	REFLECTIVITY TEST	
9.12.1	The retro-reflectivity of thermoplastic materials shall be measured in the field by the retroreflectometer. The retro-reflection readings shall conform with Singapore Standard SS 589: 2013 - "Specification for hot-applied thermoplastics road marking materials - Materials, performance and application".	<i>Retro-reflectivity of thermoplastic</i>
9.13	COMPRESSIVE STRENGTH TEST	
9.13.1	The compressive strength of concretes shall be measured by crushing tests on nominal 150 mm cubes. All sampling, curing and testing of cubes shall be carried out in accordance with BS 1881. The compressive strength of concrete shall comply with Table 9.1 of Section 9.3.	<i>Compressive strength of concrete</i>

9.13.2	Notwithstanding the above, the Authority reserves the right to instruct the Applicant to core any number of samples from any portion of the works for the purpose of determining the concrete compressive strength. The minimum depth of cored concrete sample is 75 mm for footpaths, and 100mm for slabbed-over-drains and rigid pavements. The Applicant shall supply and backfill voids with similar material left by the coring.	<i>Additional cored concrete samples</i>
9.13.3	The minimum average value of the 28th day in-situ compressive core strength shall not be less than 18 N/mm ² for 75 mm thick cast-in-situ concrete footpaths and 22 N/mm ² for 125mm thick slabbed-over-drains.	<i>Minimum compressive core strength</i>
9.13.4	The maximum allowable thickness tolerances for footpath, slabbed-over-drain and rigid pavement is ±5mm.	<i>Allowable thickness tolerances</i>
9.14	ABSORPTION TEST	
9.14.1	The quality of all the precast concrete units shall comply with LTA's prevalent Materials and Workmanship Specification. The number of test(s) required shall conform to Table 9.13 of Section 9.9.1.	<i>Quality of pre-cast concrete units</i>
9.14.2	For Precast Concrete Slab - When tested in the manner described in Appendix C of BS 368, the average increase in weight of the test pieces from each slab by absorption of water shall not exceed the appropriate values in Table 3 of BS 368.	<i>Pre-cast concrete slab</i>
9.14.3	For Precast Kerbs and Channels - When tested in accordance with Appendix C of BS 340, none of the three specimen absorptions shall exceed the appropriate values in Clause 9.3 of BS 340.	<i>Pre-cast kerbs and channels</i>
9.15	EXTRACTION TEST	
9.15.1	The Extraction Test to determine the bitumen content in asphalt concrete shall conform to Table 9.8 of Section 9.4.6 and the number of test(s) shall conform to Table 9.13 of Section 9.9.1.	<i>Bitumen content</i>

9.16 **SIEVE ANALYSIS TEST**

9.16.1 The sieve Analysis Test determines the grading of aggregates in asphalt concrete, and shall conform to Table 9.8 of Section 9.4.6.

Grating of aggregates

9.17 **SKID RESISTANCE VALUE**

9.17.1 The skid resistance value shall comply with Materials & Workmanship Specification for Civil & Structural Works, Code of Practice for Works on Public Streets, Singapore Standard SS 589 : 2013 - " Specification for hot-applied thermoplastics road marking materials - Materials, performance and application, or the latest Singapore Standards (SS).

Requirements for skid resistance value

9.18 **ASPHALT CONCRETE CORE TEST**

9.18.1 The Authority may require the Applicant to core any number of samples from any portion of the works for the purpose of examination and testing. All cored samples shall be neatly cut by a 100 mm diameter core drill. The Applicant shall supply and backfill all voids with similar materials left by coring.

Requirements for cored sample

9.18.2 The cored samples shall be used to determine the field density and for the Extraction Test shall conform to Table 9.8 of Section 9.4.6.

Number of cored samples

9.19 **RECYCLED CONCRETE AGGREGATE CORE TEST**

9.19.1 The Authority may require the Applicant to core at the rate of one per 100 m³ of graded RCA laid and at least 3 samples shall be taken for the purpose of examination and testing. For site with more than 400 m³ of graded RCA laid in a day, a maximum of 5 samples shall be taken. All cored samples shall be neatly cut by a 100 mm diameter core drill. The Applicant shall supply and backfill all voids with similar materials left by coring.

9.20 **RECYCLED CONCRETE AGGREGATE DUST TEST**

9.20.1 The Authority may require the Applicant to take at least 3 samples of RCA dust at each site in a day for the purpose of examination and testing. The samples shall be tested for aggregate grading. These samples shall be marked with the date laid and location identification, and test at an accredited laboratory.

Number of samples

9.21 **NON-DESTRUCTIVE TESTS**

9.21.1 The Authority may require the Applicant to conduct non-destructive tests where appropriate. The type of non-destructive tests may either be required by the Authority or be proposed by the Applicant. When proposing the type of test, the Applicant shall prove to the Authority's satisfaction that the test can:

Requirements for non-destructive test

- determine the thickness of the layers of reinstatement for pavement reinstatement;
- determine the type of apparatus, its depth and location.

PART IV – DEMERIT POINTS SYSTEM

SECTION 10 ADMINISTRATION OF DEMERIT POINTS SYSTEM

10.1 OBJECTIVE

10.1.1 The main objective of the demerit points system is to encourage desirable good performance, quality of works and timely completion of works.

10.2 DEMERIT POINTS SYSTEM FOR CONTRACTORS

10.2.1 Under Regulation 9 of the Street Works (Works on Public Streets) Regulations, demerit points will be meted out to the contractor who has, in the course of carrying out any works on any public street, committed any of the defaults as listed in the Schedule of the Street Works (Works on Public Streets) Regulation.

The Schedule

10.2.2 The Authority will monitor and assess the contractor's performance. Contractors who accumulate 200 or more demerit points within a calendar month (i.e. 30 days) will be suspended from carrying out new work on public streets.

Performance of contractor

10.2.3 Any contractor who has, within any one calendar month been awarded a total of 200 or more demerit points will be suspended by the Authority.

Allowable limits for demerit points

10.2.4 The length of the suspension depends on the number of suspensions that the contractor already had in the past two years. Please see Table below.

Length of suspension

Number of Suspensions in the past two years	Period of Suspension (months)
0	3
1	6
2	12
3	24

10.2.5 During the period of suspension, the defaulting contractor cannot be appointed for any new work application. However, the Authority will allow those ongoing works as listed in the Authority's record to continue till completion. It is therefore important for the applicants/contractors to notify the Authority of the start of their work as it will have a bearing on the works that can be allowed to continue should the contractor be suspended.

10.3 **PROCEDURE FOR APPEAL**

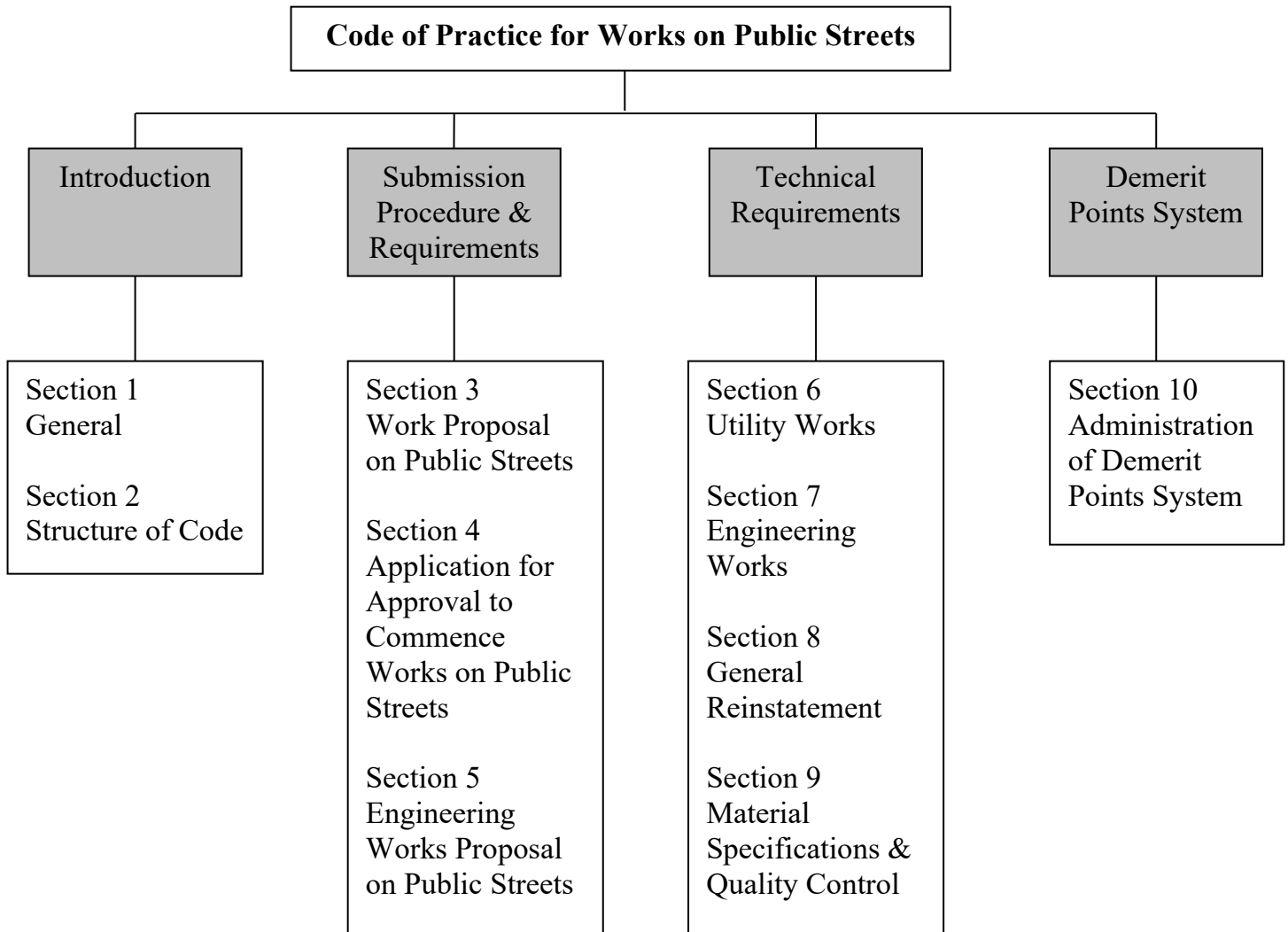
10.3.1 The recipient of the Notice of Road Opening Infringement may appeal to Deputy Director, Road Works Regulations & Licensing Division, for a waiver of the demerit points within 14 days from the date of the Notice.

The appeal must be put in writing to the following address:

LTA Road Works Regulation & Licensing Division
71 Chai Chee Street
Block 1 #03-00
Singapore 468981

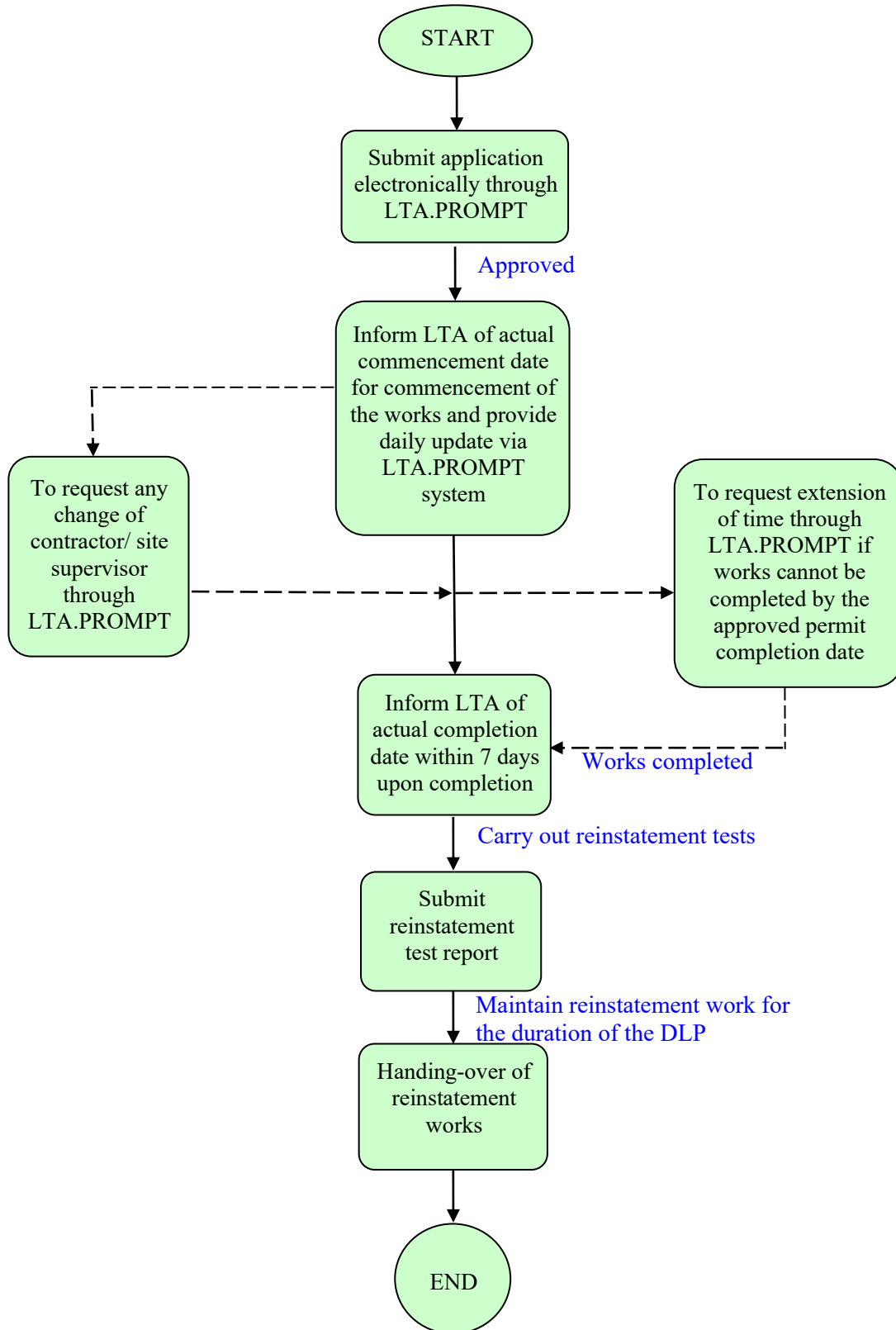
Appendix A

STRUCTURE OF CODE



Appendix B

Submission Process for Permit to Carry Out Works on Public Streets



Appendix C

Format for use for Banker's Guarantee furnished by the Applicant
Please use exact wordings

SAMPLE
DRAFT BANKER'S GUARANTEE

(To be prepared on the Bank's / Insurance Company's letterhead)

To: Deputy Director
Road Works Regulation & Licensing Division
Land Transport Authority
71 Chai Chee Street
Block 1 #03-00
Singapore 468981

THIS GUARANTEE is made the _____ day of _____

20 _____ BETWEEN _____
(Name of Bank/Insurance Company)

having its registered office at _____

(herein called "the Guarantor") of the one part and the Land Transport Authority of Singapore (herein called the "the Authority") a statutory body established under the Land Transport Authority of Singapore Act (Chapter 158A) and having an office at 1 Hampshire Road, Singapore 219428, of the other part.

WHEREAS

1 _____ of _____
(Name of Applicant) (Address)

(herein called "the Applicant") proposed to carry out works on public streets at _____

_____ for the purpose of laying service utility or any other purpose in accordance with the approved plan.

2 The Applicant made a Road Opening Application No. _____ under Regulation 5 of The Street Works (Works on Public Streets) Regulation (as amended from time to time and herein referred to as "the Regulations") for the Authority's approval to commence street works stipulating the commencement date and completion date (herein referred to as "the Completion date").

3 On such application being made as aforesaid, the Authority has determined the sum of Singapore Dollars _____ \$ _____) as the amount that is required to be deposited (hereinafter referred to as "the Security Deposit ") by the Applicant for execution of the aforesaid street works in accordance with the provision of Regulation 10 of the Regulations.

4. The Applicant has requested and the Authority has agreed to accept an unconditional guarantee covering the Security Deposit.

5. The Guarantor has agreed to enter into his Guarantee to satisfy the Applicant's obligations as above mentioned.

NOW IT IS HEREBY AGREED AS FOLLOWS:

1 The Guarantor hereby unconditionally undertakes and covenants to forthwith pay to the Authority on demand any amount or amounts which from time to time be demanded in writing by the Authority up to the maximum aggregate sum not exceeding the Security Deposit.

2 The Guarantor shall not be discharged or released from this Guarantee by any arrangement made between the Applicant and the Authority with or without the consent of the Guarantor or by any alteration in the obligations undertaken by the Applicant or by any alterations in the obligations imposed on the Applicant by the Street Works Act or regulations made thereunder or by any forbearance whether as to amount, time, performance or in any other way.

3 This Guarantee shall take effect from [insert contract commencement date _____] to [insert initial expiry date to be: Contract Period plus Defects Liability Period plus 6 months _____] provided always that the expiry date of this Guarantee and the Guarantor's liability thereunder shall be automatically extended for successive periods of 12 months unless the Guarantor gives the Authority 90 day's written notice prior to the expiry of its liability of the Guarantor's intention not to extend this Guarantee in respect of any future extension and provided further that the Authority shall be entitled, upon receiving such notice of the Guarantor's intention (and within the period specified in Clause 4 hereof), either to:

- a. Make a claim under this Guarantee; or
- b. Direct the Guarantor to pay such amount (not exceeding the Security Deposit) as the Authority may specify into a suspense account to be governed and disbursed by the Guarantor subject to the Association of Banks in Singapore's Guidelines for operation of a Suspense Account; or
- c. Direct the Guarantor to extend the validity of this Guarantee for a further period not exceeding 12 months (and this Guarantee shall then expire at the end of such further period)

4 This Guarantee is conditional upon a claim or direction as specified herein being made by the Authority by way of a notice in writing addressed to the Guarantor and the same being received by the Guarantor at (insert address of Guarantor's notification office: _____) within 90 days from the expiry of this Guarantee.

5. The Guarantor shall be obliged to effect the payment required under such a claim or direction within 14 business days of the Guarantor's receipt thereof. The Guarantor shall be under no duty to inquire into the reasons, circumstances or authenticity of the grounds for such claim or direction and shall be entitled to rely upon any written notice thereof received by the Guarantor (within the period specified in Clause 4 hereof) as final and conclusive.

6. The Authority may make more than one claim on this Guarantee.

Dated this _____ day of _____ 20_____

NAME, DESIGNATION AND)	_____	Name
SIGNATURE OF THE OFFICER)		
AUTHORISED TO SIGN FOR)		
_____)	_____	Designation
AND ON BEHALF OF THE)		
AFOREMENTIONED BANKER)		
_____)	_____	Signature
OR INSURANCE CO)		

Bank/Insurance Company Stamp

in the presence of : _____

NAME : _____

DESIGNATION : _____

SIGNATURE : _____

ADDRESS : _____

Appendix D

Format for use for Banker's Guarantee furnished by the Contractor
Please use exact wordings

SAMPLE
DRAFT BANKER'S GUARANTEE

(To be prepared on the Bank's / Insurance Company's letterhead)

To: Deputy Director
Road Works Regulation & Licensing Division
Land Transport Authority
71 Chai Chee Street
Block 1 #03-00
Singapore 468981

THIS GUARANTEE is made the _____ day of _____
20 _____ BETWEEN _____
(Name of Bank/Insurance Company)
having its registered office at _____

(herein called "the Guarantor") of the one part and the Land Transport Authority of Singapore (herein called the "the Authority") a statutory body established under the Land Transport Authority of Singapore Act (Chapter 158A) and having an office at 1 Hampshire Road, Singapore 219428, of the other part.

WHEREAS

1 _____ (hereinafter called "the Applicant") has
(Name of Applicant)
made

a Road Opening Application No. _____
under Regulation 5 of The Street Works (Works on Public Street) Regulations (as amended from time to time and herein referred to as "the Regulations") for the Authority's approval to commence

street works stipulating the commencement date and completion date (herein referred to as "the Completion Date").

2 _____ of _____
(Name of Contractor) (Address)

(herein called "the Contractor") has been appointed by the Applicant to carry out works on public streets at _____

for the purpose of laying service utility or any other purpose in accordance with the approved plan.

3 On such application being made as aforesaid, the Authority has determined the sum of Singapore Dollars _____ (\$ _____) as the amount that is required to be deposited (hereinafter referred to as "the Security Deposit ") by the Contractor for the execution of the aforesaid street works in accordance with the provision of Regulation 10 of the Regulations.

4 The Contractor has requested and the Authority has agreed to accept an unconditional guarantee covering the Security Deposit.

5 The Guarantor has agreed to enter into this Guarantee to satisfy the Contractor's obligations as above mentioned.

NOW IT IS HEREBY AGREED AS FOLLOWS:

1 The Guarantor hereby unconditionally undertakes and covenants to forthwith pay to the Authority on demand any amount or amounts which from time to time be demanded in writing by the Authority up to the maximum aggregate sum not exceeding the Security Deposit.

2 The Guarantor shall not be discharged or released from this Guarantee by any arrangement made between the Contractor and the Authority with or without the consent of the Guarantor or by any alteration in the obligations undertaken by the Applicant or the Contractor or by any alterations in the obligations imposed on the Applicant or the Contractor by the Street Works Act or regulations made thereunder or by any forbearance whether as to amount, time, performance or in any other way.

3 This Guarantee shall take effect from [insert contract commencement date _____] to [insert initial expiry date to be: Contract Period plus Defects Liability Period plus 6 months _____] provided always that the expiry date of this Guarantee and the Guarantor's liability thereunder shall be automatically extended for successive periods of 12 months unless the Guarantor gives the Authority 90 day's written notice prior to the expiry of its liability of the Guarantor's intention not to extend this Guarantee in respect of any future extension and provided further that the Authority shall be entitled, upon receiving such notice of the Guarantor's intention (and within the period specified in Clause 4 hereof), either to:

- a. Make a claim under this Guarantee; or
- b. Direct the Guarantor to pay such amount (not exceeding the Security Deposit) as the Authority may specify into a suspense account to be governed and disbursed by the Guarantor subject to the Association of Banks in Singapore's Guidelines for operation of a Suspense Account; or
- c. Direct the Guarantor to extend the validity of this Guarantee for a further period not exceeding 12 months (and this Guarantee shall then expire at the end of such further period)

4 This Guarantee is conditional upon a claim or direction as specified herein being made by the Authority by way of a notice in writing addressed to the Guarantor and the same being received by the Guarantor at (insert address of Guarantor's notification office: _____) within 90 days from the expiry of this Guarantee.

5. The Guarantor shall be obliged to effect the payment required under such a claim or direction within 14 business days of the Guarantor's receipt thereof. The Guarantor shall be under no duty to inquire into the reasons, circumstances or authenticity of the grounds for such claim or direction and shall be entitled to rely upon any written notice thereof received by the Guarantor (within the period specified in Clause 4 hereof) as final and conclusive.

6. The Authority may make more than one claim on this Guarantee.

Dated this _____ day of _____ 20_____

NAME, DESIGNATION AND)	_____	Name
SIGNATURE OF THE OFFICER)		
AUTHORISED TO SIGN FOR)	_____	Designation
AND ON BEHALF OF THE)		
AFOREMENTIONED BANKER)	_____	Signature
OR INSURANCE CO)		

Bank/Insurance Company Stamp

in the presence of : _____
 NAME : _____
 DESIGNATION : _____
 SIGNATURE : _____
 ADDRESS : _____

Appendix E

Checklist for Temporary Earth-Retaining Structures of WORKS ON, BELOW OR BESIDE THE PUBLIC STREETS (References: LTA Design Criteria (DC), Eurocodes and its Singapore National Annexes)		
Item No.	Description	Remarks
1.0	GENERAL	
1.1	The Design Brief on the approach and concepts is attached. The Design Brief addresses all points listed below for geotechnical design and structural design.	
1.2	All Temporary Earth-Retaining Structures have been designed for removal as per LTA, Design Criteria Chapter 16.	
2.0	GEOTECHNICAL	
2.1	<i>Geotechnical Parameters & Surcharge</i>	
2.1.1	All geotechnical parameters had been justified using the soil investigation data, laboratory test results and other published information (Please state relevant pages in attached calculations). <i>(For c' and ϕ', the design values should be based on p-q plot).</i>	
2.1.2	The level of the ground and the ground water table had been verified and attached. The surcharge load of 20 kPa in accordance with LTA, Design Criteria has been used.	
2.2	<i>Stability Checking</i>	
2.2.1	Toe-in stability has been checked to ensure adequate embedment of the retaining wall (Please state relevant pages in the attached design calculations). <i>(The method in NAVFAC DM-7.2 is one of the acceptable methods. Mobilisation factors should be used for the soil parameters. Both drained and undrained parameters should be used for most soil types, except for marine clay and fluvial clay).</i>	
2.2.2	The stability of the excavation base been checked against basal heave failure due to shear failure of the soil at the base. <i>(This check must be carried out for excavation in soft clay such as the marine clay, fluvial clay and peaty clay).</i>	
2.2.3	The stability of the base has been checked for hydraulic uplift. <i>(This check must be carried out if the underlying layer is more permeable than the base of the excavation, such as Old Alluvium underlying the marine clay at the base of excavation or highly weathered granite underlying</i>	

Checklist for Temporary Earth-Retaining Structures of WORKS ON, BELOW OR BESIDE THE PUBLIC STREETS

(References: LTA Design Criteria (DC), Eurocodes and its Singapore National Annexes)

Item No.	Description	Remarks
	<i>the residual soils of the Bukit Timah Granite).</i>	
2.2.4	Seepage analyses have been carried out to justify the pore water pressures used for the above stability checking. <i>(For seepage analysis, attentions should be paid to the permeability values and the boundary conditions in the model).</i>	
2.3	<i>Analysis of Retaining Walls</i>	
2.3.1	The soil profile assumed in the analysis matches with the borehole log.	
2.3.2	The design has taken into consideration situations where the loading on both sides of the excavation is not balanced.	
2.3.3	The drainage condition (drained or undrained) assumed for each soil layer matches with the permeability of the layer. (e.g., for marine and fluvial clays, undrained condition can be used; and for fluvial sand and sandy fill, drained condition should be used. For the mixed soils, such as Old Alluvium and weathered rocks, both drained and undrained conditions should be analysed and the worst of two analyses should be adopted)	
2.3.4	All the stages of excavation considered in the analyses, including the excavation, strut removal & backfilling stages had been checked. Other appropriate redundancy checks had been carried out - please state.	
2.3.5	Unplanned excavation has been safely considered for every stage of excavation as per SS EN 1997 Cl. 9.3.	
2.3.6	There is no over-stressing in the design of the retaining systems.	
3.0	INSTRUMENTATION	
3.1	The monitoring plans are attached and have been provided as per LTA, DC Chapter 19.	
3.2	The alert and suspension levels for the retaining system for each stage of excavation have been indicated in the attached Drawings. <i>(Allowable values for struts and retaining wall system should be set at the allowable capacity of the struts or the walls).</i>	

Checklist for Temporary Earth-Retaining Structures of WORKS ON, BELOW OR BESIDE THE PUBLIC STREETS

(References: LTA Design Criteria (DC), Eurocodes and its Singapore National Annexes)

Item No.	Description	Remarks
3.2	The review levels are consistent with the damage assessment to adjacent structures and utilities as per LTA, DC Chapter 20.	
4.0	STRUCTURAL	
4.1	<i>Sheetpiles</i>	
4.1.1	The sections have been checked for bending moment and shear force. Load factors should be used if the design is based on Eurocodes and its Singapore National Annexes.	
4.1.2	Where Z profile sheetpile is used, the section modulus of Z profiles will have a 15% reduction in section modulus due to 5 deg. of rotation. This has been considered in the design. (Based on CIRIA 95)	
4.2	<i>Traffic Decking</i>	
4.2.1	The temporary decking system has been designed according to LTA DC Chapter 3.	
4.2.2	The Drawings of the decking beam layout are attached. The span shown on the Drawings for all beams tally with the design calculations.	
4.2.3	The decking panels and beams have been designed as shown in attached calculations (please state pages).	
4.2.4	The connection details have been adequately designed for their structural requirements. Allowance has been made to allow for eccentricity as per SS EN 1993-1-1 Cl. 5.3 and SS EN 1993 1-8 Cl. 2.7. Drawings have been checked that the connection details tally with the design.	
4.3	<i>Strut</i>	
4.3.1	The pre-loading in struts has been specified on drawings as per LTA, M&W Specification.	
4.3.2	Allowance has been made for bending due to self-weight and any anticipated imposed loads such as access ways, intermediate struts or staging for materials.	
4.3.3	The struts have been designed for accidental loading (minimum 50kN applied normal to the strut at any point in any direction).	
4.3.4	The struts have been designed for eccentric axial loadings (Based on CIRIA 95/CIRIA C517).	
4.3.5	Both flanges of strut are restrained (by plates and bars) and these restraints have been designed according to	

**Checklist for Temporary Earth-Retaining Structures of
WORKS ON, BELOW OR BESIDE THE PUBLIC STREETS**

(References: LTA Design Criteria (DC), Eurocodes and its Singapore National Annexes)

Item No.	Description	Remarks
	SS EN 1993-1-1 Cl. 6.3.	
4.3.6	Where second hand structural steel are used, steel materials and its physical conditions shall be inspected to ensure compliance with the design requirements and BCA BC1 requirements, as shown in attached calculations. (please state pages).	
4.4	<i>Supporting /Tie Beam</i>	
	The supporting/tie beams have been designed according to SS EN 1993-1-1 Cl. 5.3 and 6.3.	
4.5	<i>Cross Bracing</i>	
	The cross bracing designed for forces as per SS EN 1993-1-1 Cl 5.3 and 6.3.	
4.6	<i>Connection Details</i>	
4.6.1	The connection details have provided for the transfer of forces from strut to waler and to the retaining wall.	

I, _____ (Qualified Person for Structural Works) hereby certified that the attached structural plans and design calculations prepared by me are/are not* fully in accordance with the above.

(QUALIFIED PERSON FOR STRUCTURAL WORKS' STAMP & SIGNATURE)

Date : _____

Appendix F

Contractor Category (Workheads/License Types) and Associated Work Type

Work Type Description	BCA Category or License Type
Asphalt Works	CR14, CW01, CW02
Connection / Supply Scheme to Development Area/Public Lighting/Traffic Light/Household Consumer	CR07, CW02
Diversion Scheme on request from other Department	CR07, CW02
Drainage Work	CW01, CW02, GB1, GB2
Engineering Works within Road Safety Zone e.g. deep excavation, retaining system, etc	CW01, CW02
Improvement Scheme Conversion/Reinforcement/Upgrading Projects	CR07, CW02
Landscaping	CR01, CR07, CR12, CR14, CW01, CW02, MW03
Lane Closure (pls specify reason)	CR01 to CR15, CW01, CW02, GB1, GB2, ME01, ME02, ME04 to ME15, MW02, MW03, MW04, RW01, RW02, SY01, SY02, SY04 to SY12, SY14
Lifting/Hoisting Operation	CR01 to CR15, CW01, CW02, GB1, GB2, ME01, ME02, ME04 to ME15, MW02, MW03, MW04, RW01, RW02, SY01, SY02, SY04 to SY12, SY14
Manhole/ Valve Chamber maintenance work	CR01, CW01, CW02, ME05, ME10, ME11, ME12, ME14, MW02
Minor Construction Works(with excavation) e.g. temporary access, minor A & A, entrance culvert, external work, etc	CR07, CW01, CW02, GB1, GB2
Minor Construction Works(without excavation) e.g. hoarding etc	CR01, CR07, CW01, CW02, GB1, GB2
New Scheme	CR07, CW02
Pipe Laying & Road Reinstatement	CR07, CW02
Private Sewer Connection	CR07, CW01, CW02
Repair Scheme Replacement/General Repairs	CR07, CW02
Road Marking	CR14, CW01, CW02
Soil Investigation, Improvement & Stabilisation Work	CR12, CW02, SB(GS)
Tree Pruning	CW01, CW02, GB1, GB2, MW03
Trial Holes	CR12, CW02, SB(GS)