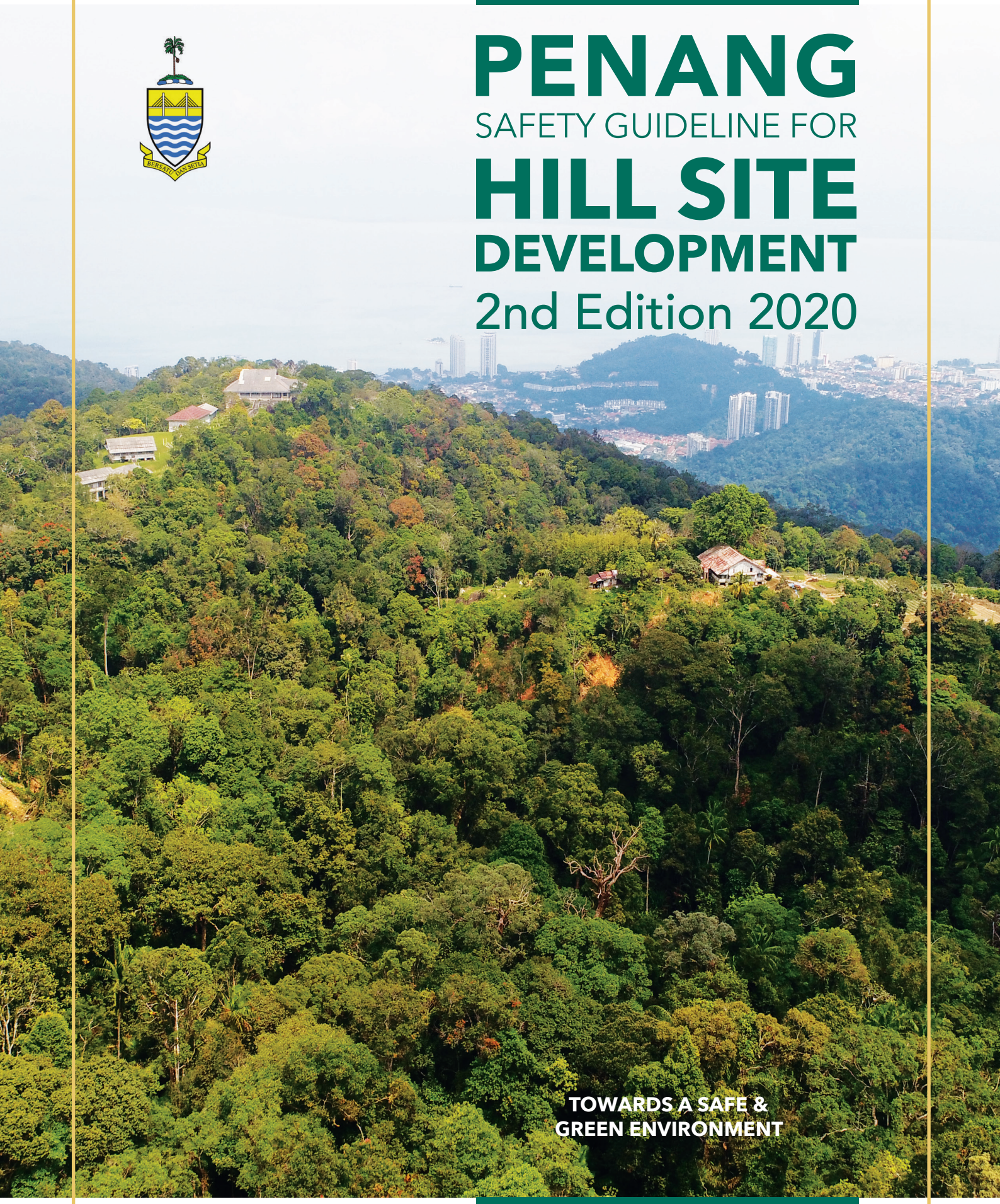
PENANG
SAFETY GUIDELINE FOR
HILL SITE DEVELOPMENT
2nd Edition 2020



TOWARDS A SAFE & GREEN ENVIRONMENT

PENANG
SAFETY GUIDELINE FOR
HILL SITE DEVELOPMENT

2nd Edition 2020

NOTICE

This Guideline is a revised version of the 2012 Guideline and has been prepared to further enhance the safety and sustainability of hill site developments.

The implementing agencies, developers, engineers, contractors, property owners and all relevant parties are to abide by this Guideline.

The prevailing and ensuing policies and conditions set by the State Government and Local Authority of Penang shall take precedence over this Guideline.

MESSAGE FROM THE RT. HON. CHIEF MINISTER OF PENANG

The first edition of the Penang Safety Guideline Hill Site Development was published in 2012 and has been an important reference for development projects especially on hill slopes specifically within Penang Island which is topographically covered by about 40% of hilly terrain.

Rapid development in Penang through the years has resulted in a constraint of land available for future development. It is a fact that more developments are being proposed on hill sites and as such, the Penang State Government is committed to ensuring the safety aspects of such developments.

Thus, it is imperative and very timely for the first edition of the Penang Safety Guideline for Hill Site Development (2012) to be further reviewed and strengthened.

The second edition further emphasises safety pertaining to the geotechnical aspects of a development from the early stages of planning, submission requirements for approval, supervision during construction and subsequently, maintenance.

The State Government recognises and appreciates the involvement and contribution of all parties including, both local authorities, State and Federal Technical Agencies and the Institution of Engineers, Malaysia (IEM) in realising the Penang Safety Guideline for Hill Site Development 2nd edition (2020). I wish to express my utmost gratitude to the Penang Technical Advisory Committee (PTAC), comprising of local and international geotechnical experts, for their continuous effort and valuable guidance in successfully leading this task.

In this respect, it is our expectation that all stakeholders, both public and private sector alike understand their roles and responsibilities and are fully committed in achieving the objectives of the Guideline.

I firmly believe that with this close collaboration and cooperation, we can endeavour to create a safe and sustainable environment for hill site developments.

YAB. Tuan Chow Kon Yeow

MESSAGE FROM THE HON. MAYOR, CITY COUNCIL OF PENANG ISLAND (MBPP)

The City Council of Penang Island (MBPP) has been continuously working to improve and upgrade public amenities with the purpose of providing a safer and sustainable living environment. Site safety, in particular developments on hill slopes, has always been an issue of concern and attention for MBPP. In view of this, much effort has been taken and considerable funds have been provided yearly to address site safety.

One of the initiatives taken by MBPP is the Penang Safety Guideline for Hill Site Development, which was introduced in 2012. There is a pressing need to further enhance the safety in development projects, especially against a prevailing backdrop of global climate change and transformation, together with an increase in high-density development on hill slopes, and not to mention the lingering memories of the several incidences within development sites over the past few years.

The Penang Safety Guideline for Hill Site Development 2nd Edition (2020) has been reviewed and improved jointly by MBPP and the Penang Technical Advisory Committee (PTAC), comprising of experts in the field of Geotechnics in collaboration with leading engineers from the Institution of Engineers, Malaysia (IEM) and various State and Federal technical agencies including JKR, JMG, JPS, JAS, DOSH, PLAN Malaysia, PDC, PHC and also the Seberang Perai City Council (MBSP).

Similar to the earlier Guideline, the main objective of the second edition is to improve and enhance safety at work sites. This Guideline serves to safeguard the concerns, interests, and well-being of all stakeholders, especially of the public, with a focus on site supervision and slope maintenance, as well as a streamlined application process for hill site development. Aside from these, the system of classification for hill land development has also been improved, to allow for more practical and easier references.

I wish to stress that constant monitoring and maintenance from all stakeholders are vital to ensure sustainability and safety of all development sites. This requires continuous cooperation, commitment and effort from all parties. MBPP sincerely hopes that all stakeholders will play their role in realising the objectives of the Penang Safety Guideline for Hill Site Development 2nd Edition (2020), for the benefit and interest of all the people.

Dato' Ar. Yew Tung Seang

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ABBREVIATIONS

For easy understanding, the following acronyms are used in the Guideline:

DEPARTMENTS /AGENCIES

		ENGLISH	MALAY
	MBPP	City Council of Penang Island	Majlis Bandaraya Pulau Pinang
	MBSP	Seberang Perai City Council	Majlis Bandaraya Seberang Perai
	JKR	Public Works Department	Jabatan Kerja Raya
	CKC	Slope Engineering Branch, Public Works Department	Cawangan Kejuruteraan Cerun, Jabatan Kerja Raya
CDLR		Committee for Development on Land With Risk, Penang	Jawatankuasa Pembangunan Tanah Berisiko Pulau Pinang
PLAN Malaysia	**JPBD**	Department of Town and Country Planning	Jabatan Perancang Bandar dan Desa
	JPS	Drainage and Irrigation Department	Jabatan Pengairan dan Saliran
DOE	**JAS**	Department of Environment	Jabatan Alam Sekitar
	JMG	Department of Mineral and Geoscience	Jabatan Mineral dan Geosains
	KPKT	Ministry of Urban Wellbeing, Housing and Local Government	Kementerian Kesejahteraan Bandar, Perumahan dan Kerajaan Tempatan
DOSH	**JKKP**	Department of Occupational Safety and Health	Jabatan Keselamatan dan Kesihatan Pekerjaan
	PTG	Lands and Mines Office	Pejabat Tanah Dan Galian
	PDT	District and Land Office	Pejabat Daerah dan Tanah
	PBBPP	Penang Hill Corporation	Perbadanan Bukit Bendera Pulau Pinang
BEM		Board of Engineers, Malaysia	Lembaga Jurutera Malaysia
OSC		One Stop Centre	Jawatankuasa Pusat Setempat
IEM		The Institution of Engineers, Malaysia	
SIRIM		Standard and Industrial Research Institute of Malaysia	Institut Piawaian dan Penyelidikan Perindustrian Malaysia

ABBREVIATIONS

For easy understanding, the following acronyms are used in the Guideline:

PERSONNEL/INDIVIDUALS

	ENGLISH	MALAY
GE	Geotechnical Engineer	
IC	Independent Checker	
PEPC	Professional Engineer with Practising Certificate	
PSP	Principal Submitting Person	
SP	Submitting Person	

ACTS/GUIDELINES/MANUALS/STANDARD PROCEDURES

		ENGLISH	MALAY
UBBL		Uniform Building By-Laws	
	RSN PP	Penang State Structure Plan	Rancangan Struktur Negeri Pulau Pinang
	MSMA	Urban Stormwater Management Manual for Malaysia	Manual Saliran Mesra Alam
OSHCIM		Occupational Safety and Health In Construction Industry (Management)	
OSHA		Occupational Safety and Health Act 1994	
FMA		Factories and Machinery Act 1967	
HIRARC		Hazard Identification, Risk Assessment and Risk Control	

1. INTRODUCTION

The Penang Safety Guideline for Hill Site Development 2012 was prepared with reference to both the existing Federal and State guidelines for hill site developments with the aim of improving slope safety and to enhance the environment. This Guideline was prepared with the main intention of preventing hill slope failures and improving site safety.

The Penang Technical Advisory Committee (PTAC) which was appointed by the Penang State Government, reviewed and revised the 2012 Guideline based on the feedbacks and experiences encountered in the implementation of the 2012 Guideline. This Guideline will be known as the Penang Safety Guideline for Hill Site Development, 2nd Edition 2020.

1.1 OBJECTIVES

The objectives of the Penang Safety Guideline for Hill Site Development, 2nd Edition 2020 are as follows:

i. Clearly classify hill sites for ease of implementation at planning stage.
ii. State the duties and responsibilities of GE and IC during the design and construction stages.
iii. Require GEs to implement good site supervision practices.
iv. Require ICs to visit project sites during construction and report any non-compliance directly to the relevant authorities for prompt enforcement.
v. Define the qualifications and experience of key personnel GEs and ICs to ensure the quality of works for hill site developments during the design and construction stages.
vi. Make it mandatory for developers to engage qualified GEs and ICs who possess the required expertise and experience on hill site developments and with sufficient competency; and capacity to design and supervise construction.
vii. Require contractors to comply with the design drawings and specifications for slope works.
viii. Require slopes to be inspected periodically and maintained accordingly.
ix. To instil awareness on the importance of maintenance.
x. Require engineered slopes, including earth retaining systems to incorporate green features to enhance Penang's natural environment.

1.2 TOWARDS A SAFE AND GREEN PENANG

The Guideline addresses and outlines measures to enhance safety, improve project implementation procedures including effective enforcement. It strives to inculcate good slope design, construction and maintenance culture. The Guideline serves to create confidence in the safety of hill site developments in Penang.

The Advisory Panel which drew up the Guideline will continue to assist the authorities to effectively implement and enforce it. This is to ensure that all stakeholders including, developers, engineers, contractors and property owners that undertake development at hill site areas comply with good engineering practices relating to the stability of slopes.

The major factors of slope failures can be summarised as follows:

i. Design – inadequate ground investigation, limited/inadequate understanding of engineering analysis and design.
ii. Construction – inadequate quality assurance and quality control by contractors and lack of proper site supervision by engineers.
iii. Maintenance – insufficient/weak slope maintenance culture prevalent in both the public and private sectors.
iv. Communication – poor communication amongst various parties involved in construction.

The resulting loss of lives, destruction to public and private properties as well as the ensuing legal tangles have triggered various reactions. These could have been avoided if more stringent rules and regulations, and better practices for hill site development had been in place.

The Guideline makes a concerted attempt to incorporate all the lessons learnt.

2. CONSIDERATIONS

2.1 This Guideline aims to enhance existing procedures and to improve the safety of hill site developments.

2.2 To further improve the safety of slopes and earth retaining systems, this Guideline has some major considerations that include:

i. Hill site classification for planning approval has been simplified for clarity and consistency.
ii. Design requirements for slopes have been strengthened through clearer definitions.
iii. The required qualifications of GEs needed for different terrain classification of slopes have been established.
iv. The requirements for IC are clearly defined and the responsibilities are extended beyond design stages to include inspection and preparation of reports from construction until project completion.
v. Maintenance of slopes needs proper input from the GE which includes designing to facilitate maintenance and to formulate slope maintenance manuals for the guidance and reference of the responsible parties.
vi. All retaining structures are not recommended to exceed the height of 4.5m. However, in designing retaining structures above a 4.5m height, the GE must give due consideration to structural and social harmony. In such instances, the Local Authority shall have the right to determine the height of the retaining structure if it exceeds 4.5m.
vii. GE shall provide solutions for man-made slopes within the proposed development.
viii. GE shall mitigate risks in earthwork construction by carrying out a risk management approach and the general principles of accident prevention.
ix. The proposed development adjacent to a potentially unstable slope, which cannot be adequately protected or strengthened for any reason such as inaccessibility and/or land issues will require a suitable buffer zone as shown in **Figure 2.1**. The width of the buffer zone shall be at least the height of the slope.
x. The proposed development on an unstable hill site as shown in **Figure 2.2**, which cannot be adequately strengthened due to inaccessibility and/or land issues, shall not be allowed.
xi. The GE and IC (if applicable) shall be responsible for all slopes and associated geotechnical issues for the project site as well as the immediate slopes outside the site boundaries.
xii. The GE and IC shall take cognisance of both the permanent and temporary works during both the design and construction stages. Temporary works are prerequisites and it shall be the responsibility of the contractors to appoint a PEPC for this purpose. Where deemed necessary, the GE shall request from the PEPC an endorsed calculation report on the temporary works.

Figure 2.1: Buffer Zone

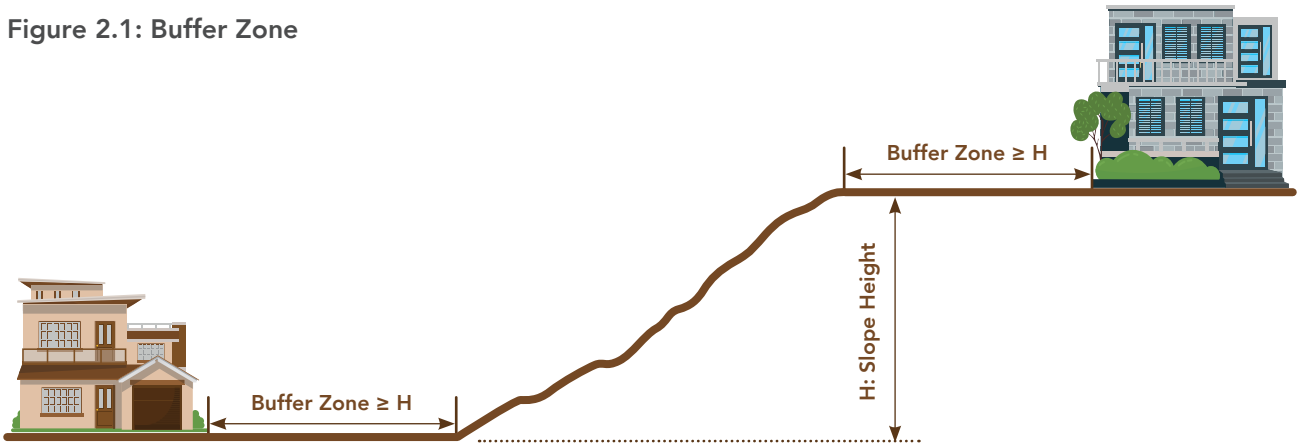


Figure 2.2: Development on Unstable Hill Site

xiii. The design of cut and fill slopes shall be in accordance with Slope Engineering Branch, Public Works Department Malaysia "Guidelines for Slope Design" (JKR 21500-0011-10) whereby all unreinforced slopes shall be designed with a Factor of Safety greater than 1.3. The minimum Factor of Safety for reinforced slopes shall be 1.5. (**Table 2** of JKR Guidelines for Slope Design)

xiv. In addition the Hong Kong "Geotechnical Manual for Slopes" and subsequent revisions, updates and associated guidelines (e.g. WBTC No. 13/99, TGN15), may be used as a reference to enhance safety particularly for natural and temporary slopes.

xv. Existing (man made) slopes more than 10 years and natural slopes including temporary slopes shall have a minimum Factor of Safety (FOS) of 1.2. A higher FOS for a temporary slope, existing and natural slopes may be warranted for a higher consequence to life and/or economic loss.

xvi. Ground investigation and/or site investigation shall include the following:

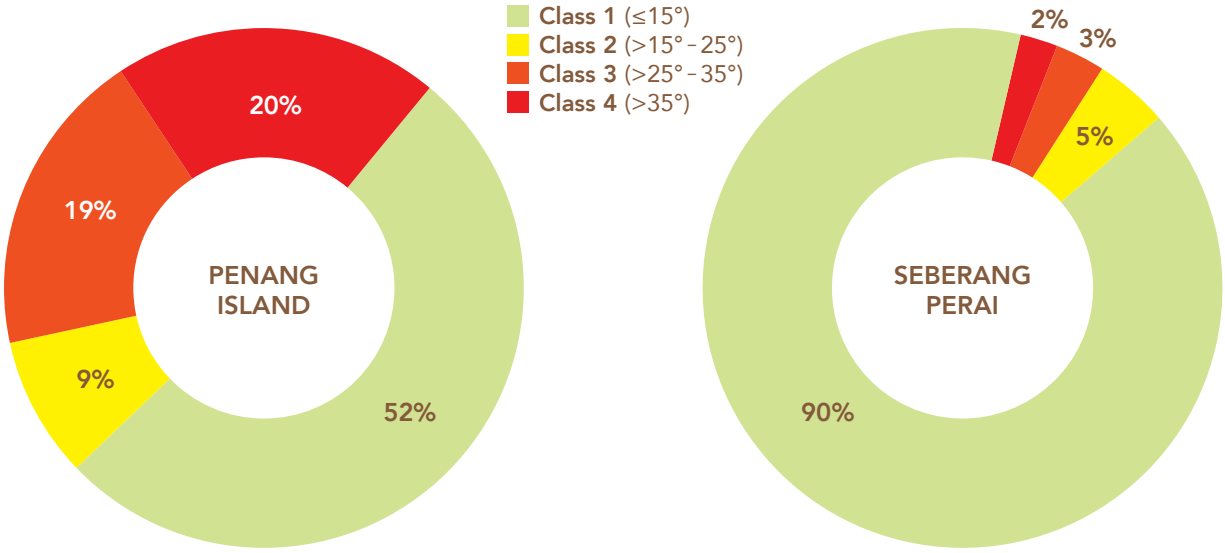
a. Consolidated Isotropic Undrained (CIU) triaxial laboratory tests shall be carried out to determine the drained soil parameters.
b. Undisturbed (UD) sample sampling shall be carried out up to SPT N value of 8, beyond which Mazier sampling shall be carried out.
c. Groundwater level monitoring shall be carried out over the medium to long-term period. Proper piezometer shall be installed for the groundwater level monitoring, instead of taking readings during the borehole drilling stage only.
d. Suitable groundwater measurement methods shall be used to capture the surge of groundwater level experienced during storms.

2.3 The guidelines by other relevant government agencies such as JPS (MSMA), DOSH (OSCHIM & HIRARC), JMG, and JAS must be taken into cognisance together with this Guideline.

3. CLASSIFICATION OF HILL SITES

3.1 The development of hill sites is affected by the gradient of the hill slope on which the site is located. **Figure 3.1** shows the distribution of hill land in Penang Island and Seberang Perai, based on a broad range of hill slope gradients.

Figure 3.1: Penang Island and Seberang Perai Hill Land Classes Distribution Chart



3.2 Classifying individual hill sites starts with a topographic plan with sufficient survey points to produce accurate contour lines at 5m intervals. More survey points shall be obtained to define local features such as slips and man-made slopes/structures. The survey shall extend by not less than 20m beyond the hill site boundary.

3.3 A hill site is to be classified separately based on hill slope gradient and the nature of man-made slopes in the site.

3.4 From the topographic plan, one can determine the hill slope classes for the site concerned using **Table 3.1**, and the percentage area of each of the four classes in the hill site. These are generally prepared as Terrain Classification Maps or Slope Gradient Maps and is generally termed as Terrain Mapping. Construction Suitability Classes are provided in some reports which could be taken as the Hill slope Classes.

3.5 The Hill Slope Class percentage coverage values are fed to the formula below:

i. Average hill slope class score = (P1 x 1 + P2 x 2 + P3 x 4 + P4 x 8) /100
ii. Where P1 is the percentage area of hill slope class 1 terrain in the site, etc.
iii. 1, 2, 4 and 8 are the hill slope class scores for hill slope classes 1, 2, 3 & 4, respectively.

The hill site class is determined from **Table 3.2**.

Figure 3.2: Classification of Slopes

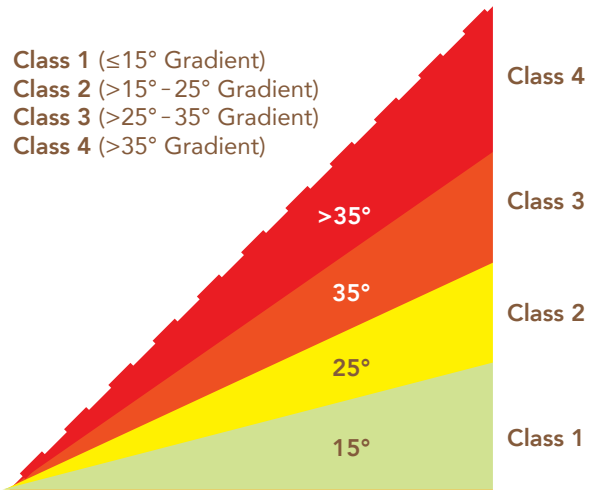


Table 3.1: Hill Slope Classes

Hill slope gradient	0° -15°	>15° -25°	>25° -35°	>35°
Hill Slope Class	1	2	3	4

Table 3.2: Hill Site Classes Based on Average Hill Slope Class Score

Average hill slope class score	≤1	> 1-2	> 2-4	>4
Hill Site Class	1	2	3	4

The steps are illustrated in **Appendix 1**

Table 3.3: Man-made slopes – Hazard Rating

Type	25° < θ ≤ 40°	40° < θ ≤ 60°	60° < θ
Soil Fill	VH	EH	EH
Soil Cut	M	H	VH
Rock Cut	H	VH	EH
Retaining wall (concrete)	M	M	M
Retaining wall (other types)	VH	VH	VH
Special stability measures	EH	EH	EH

Table 3.4: Hill Site Classes Based on Hazard Rating and Slope/Wall Height

Hazard	Ht 3-10 m	Ht > 10 m
M	2	2
H	2	3
VH	3	4
EH	4	4

Note:
θ = angle subtended by the crest-toe line.
M = moderate hazard (within the competence of an average Civil Engineer, instability possible).
H = high hazard (within the competence of an average GE; instability likely).
VH = very high hazard (needs relevant experience to handle; instability likely and the consequence could be very serious).
EH = extremely high hazard (needs relevant expertise to handle; instability likely and the consequence could be extremely serious).
Special stability measures = measures designed and constructed to stabilize slopes or retaining walls, e.g., prestressed ground anchor, dewatering system such as designed horizontal drains (critical to stability; need relevant expertise to design, construct and maintain).

3.6 A hill site may contain existing slopes and retaining walls. Its development will result in new ones, whether temporary or permanent. Their implications on hill site classes are first read off from **Table 3.3**, as the hazard rating. From the hazard rating and the slope/wall height (Ht), **Table 3.4** provides the hill site class for the particular slope or feature being considered. The hill site class in respect of man-made slopes is the highest from the range of slopes and walls on site.

See **Appendix 1** for examples of this process.

3.7 The maximum allowable hard surface footprint of a hill site depends on the hill site class as determined from hill slope gradients. The level and specifics of geotechnical control depends on the higher of the hill site classes as based on hill slope classes and on the nature of man-made slopes and retaining walls. This is described in Chapter 4.

4. SUBMISSION REQUIREMENTS

4.1 GENERAL

4.1.1. All submissions shall comply with the Penang State Structure Plan 2030 (RSN PP 2030) and all other preceding policy documents approved by Federal and State Government inclusive of Local Plan and Special Area Plan.

4.1.2. The determination of hill site classes for the submission of geotechnical report shall be in accordance to Chapter 3. This is specifically to determine the type of report to be submitted, qualification of submitting engineer and the need for ICs.

4.1.3. Submission of geotechnical report is required for Classes 2, 3 and 4 hill sites. All geotechnical reports are required to be submitted to the Committee for Development on Land With Risk, Penang (Jawatankuasa Tanah Berisiko Negeri Pulau Pinang) for approval. The submission of the geotechnical report is not required for Class 1.

4.1.4. **Table 4.1** shows the submission requirements for all the classes of hill site by Engineers. The qualifications of the Engineers indicated in **Table 4.2** state the party responsible for the appointment of GEs and ICs. It is stipulated that:

i. The Civil Engineer and GE for a particular project can be the same or a different Engineer.
ii. The GE and IC for a particular project must be different Engineers. They must also not be from the same firm.

4.1.5. The requirement for a geotechnical report and/or an earthworks design report has to be pre-determined before the submission of Planning Permission via pre-consultation. As a pre-requisite:

i. The ICs are required to register with the Local Authority concerned.
ii. The ICs for hill site Classes 3 and 4 shall be subject to the prior consent of the Local Authority.
iii. The Local Authority reserves the right to appoint the IC and the cost incurred shall be borne by the Developer.
iv. The Local Authority may require the IC to be an accredited checker if it deems necessary.
v. Geotechnical report for development projects consisting of slope classes 3 and 4 and total vertical height more than ten (10) metres shall be verified by an Accredited Checker registered with the BEM. [Ref. Section 70(2)(c); Street, Drainage And Building Act 1974 (Act 133)](2019 Revision).
vi. The Local Authority shall ultimately determine the submission requirements. The prevailing and ensuing conditions set by the relevant agencies shall be effective in parallel with these requirements.

Table 4.1: Submission Requirements and Appointment of GE and IC

SITE CLASS	SUBMISSION REQUIREMENTS	APPOINTMENT
1	Slope Stability Analysis by Civil Engineer, and submission of Geotechnical Report not required.	GE is not required.
2	Geotechnical Report by Geotechnical Engineer and to be checked and consented by IC. Geotechnical Report to submit to CDLR for approval	GE and IC
3 & 4	Geotechnical Report by GE and Geotechnical Review Report by IC to be submitted to CDLR for approval	GE and IC

Table 4.2: Qualifications of Engineers

SUBMISSION ENGINEER	QUALIFICATIONS
Civil Engineer	1. Meets relevant Local Authority's requirements. 2. Registered PEPC with the Board of Engineers, Malaysia (BEM).
Geotechnical Engineer[1]	1. Meets relevant Local Authority's requirements. 2. Registered PEPC with BEM with a minimum of five years practical geotechnical experience and at least one year of such practical experience gained in Malaysia.
Independent Checker[1]	1. Meets relevant Local Authority's requirements. 2. Registered PEPC with BEM with: • At least 10 years of relevant practical experience in the design or construction of buildings and, during the period of 7 years immediately preceding the current appointment has been engaged in geotechnical design after registration as a professional Engineer with at least one year of such practical experience gained in Malaysia and • At least 5 years of relevant practical experience in slope engineering with at least one year of such practical experience gained in Malaysia.

Note:

[1] The Qualification of the Geotechnical Engineer and Independent Checker shall be verified by the Authority concerned.

4.2 PRE-SUBMISSION CONSULTATION

4.2.1. Principal Submitting Person (PSP) or Submitting Person (SP) for One Stop Centre (OSC) submission – be it the Planner, Architect, Engineer or GE are advised to engage in pre-submission consultation with the relevant departments prior to the submission of geotechnical report for planning for all hill site development projects.

4.2.2. The SP shall compile or make available some basic documents and/or information for discussion during the pre-submission consultation with the relevant authorities. For example, land classification, land suitability, preliminary proposed layout plan, land survey plan, and terrain mapping. **Table 4.3** shows the suggested colour codes for terrain mapping.

4.2.3. The PSP or SP shall ensure that the final Geotechnical Report is consistent with the Planning Permission Plan submitted to OSC.

Table 4.3: Colour Codes for Terrain Mapping

Slope Classification	Colour	Decimal RGB Codes			Equivalent AutoCAD Colour Index #
		Red	Green	Blue	
Class 1	Light Green	212	255	170	71
Class 2	Yellow	255	255	0	2
Class 3	Orange	255	127	0	30
Class 4	Red	255	0	0	1
Man-made	Brown	129	64	0	34
Retaining Wall	Purple	189	0	189	212

Equivalent AutoCAD Colour Index # is provided for comparison and reference purposes only.

4.3 SUBMISSION OF GEOTECHNICAL REPORT & EARTHWORK DESIGN REPORT

SP/GE has the option to submit:

i. The Geotechnical Report at the Planning stage and Earthwork Design Report at Earthwork plan stage, i.e. Two-stage submission; or
ii. The Geotechnical Report that includes the Earthwork Design Report at the Planning stage, i.e. Single-stage submission.

4.3.1. Two-stage Submission

The SP/GE is allowed to submit the Geotechnical Report and the Earthwork Design Report in two stages as follows.

4.3.1.1 Planning stage: Geotechnical Report

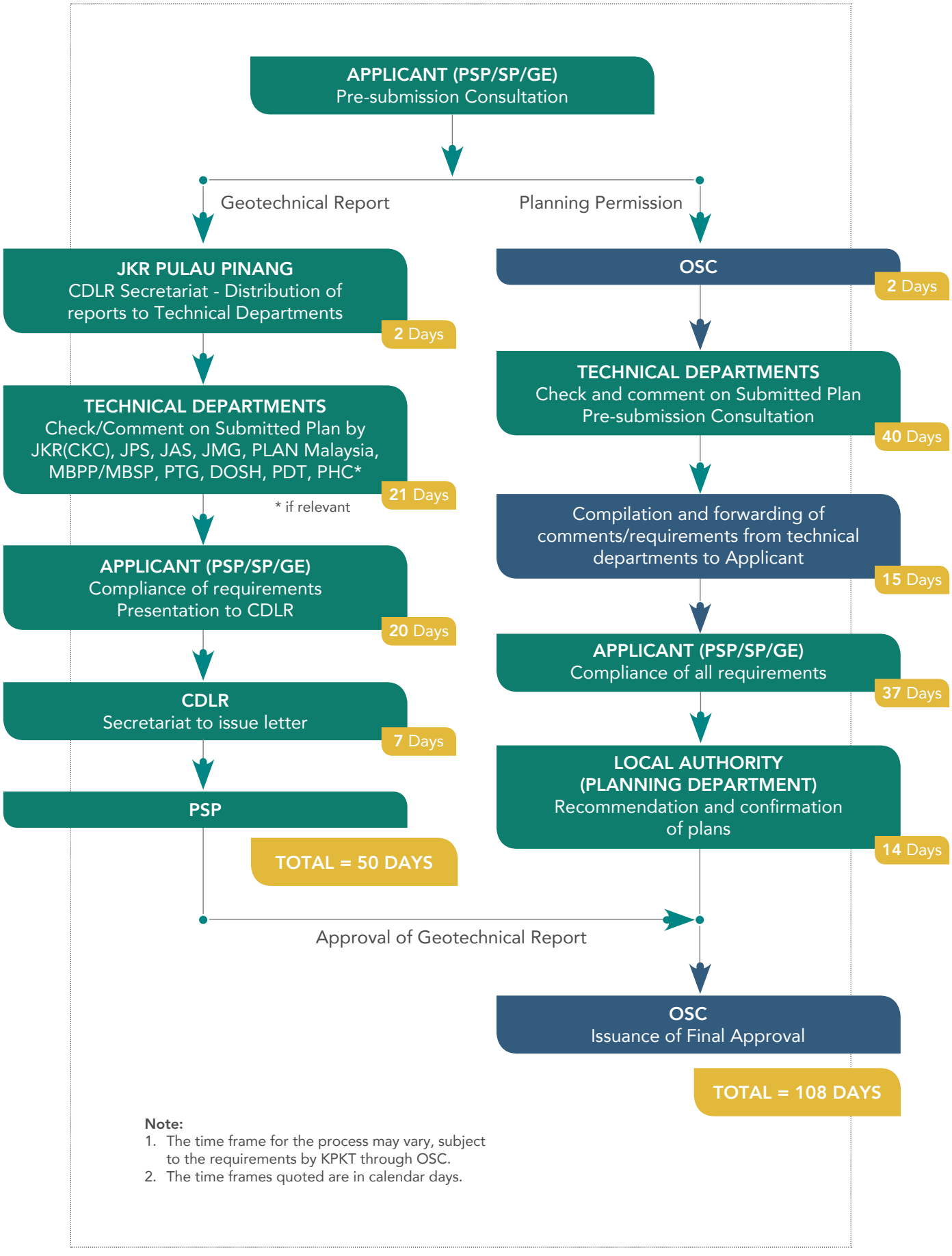
A Geotechnical Report to ascertain project feasibility is required to be submitted at Planning Permission stage and the information required shall include:

i. A proper topographic survey plan including spot levels, details and demarcation plan.
ii. Hill slope characterisation.
iii. For geotechnical interpretation (geotechnical model) of the site, at least 3 boreholes for each hill slope section would be required. Alternatively, existing soil investigation at and around the site could be referred to represent the geotechnical model for the site with reasonable judgment such as geophysical test etc.
iv. Records of the site reconnaissance in respect of all soil and rock exposures, boulder groups and isolated big boulders, in the site and its vicinity, with locations marked on the topographic survey plan, to improve the conceptual geotechnical model.
v. A layout plan showing buildings and facilities on which the Planning Permission Application is based.
vi. The proposed platforms, road and drainage layout plan and the conceptual foundation layout for the Building Plan.
vii. Earthworks design with the layout and proper geotechnical cross-sections.
viii. Feasibility assessment to include slopes immediately outside the site boundary that may have an impact on or by the proposed project to the surroundings.
ix. Water mapping.

Figure 4.1 shows the flow chart for the submission of the Geotechnical Report.

Note: The items in the Geotechnical Report as listed above are not exhaustive. Other important information shall be included where relevant.

Figure 4.1: Hill Site Development Plan Submission Flow Chart - Geotechnical Report (Concurrent Submission of Planning Permission and Geotechnical Report - Two-stage submission)



Note:
1. The time frame for the process may vary, subject to the requirements by KPKT through OSC.
2. The time frames quoted are in calendar days.

Notes to the Submission Flow Chart

i. Pre-Submission Consultation Planning Permission Plan

Engineers may engage in pre-submission consultation with the relevant departments prior to submission of Planning Permission Plan and Geotechnical Report for all projects located in hill site. SP shall compile or make available basic documents and/or information for discussion during the pre-submission consultation with relevant departments. (e.g. Land Classification, Land Suitability, Preliminary Proposed Layout plan, Land Survey plan, Terrain Mapping, etc.).

ii. Preparation of Final Planning Permission Plan and Geotechnical Report for Submission

Submitting Person is to ensure there shall be no more changes made to the layout plan and order the Final Geotechnical Report to be prepared for submission to CDLR Secretariat (JKR) concurrent to Planning Permission Plan to OSC. Changes made during the delivery process may result in re-submission of Planning Permission Plan and Geotechnical Report for approval.

iii. Submission of Geotechnical Report to CDLR Secretariat (JKR)

Upon receipt of the Geotechnical Report from PSP, CDLR Secretariat (JKR) will then forward it to the relevant departments for comments and/or clearance.

iv. Comments and Requirements from All Technical Departments

Comments, requirements and/or recommendations from various technical departments shall be submitted to CDLR Secretariat (JKR) and concurrently to the SP/GE for immediate compliance.

v. Compliance of Requirements by GE

Upon compliance of all requirements imposed by technical departments, GE shall notify the Architect/Planner of any changes, which may affect the planning layout or building design and synchronization of the drawing and design, GE shall re-submit report to JKR. Geotechnical briefing and presentation by the GE to CDLR Meeting shall be accomplished.

vi. Approval of the Geotechnical Report

Geotechnical Report shall be approved after satisfactory deliberation in the CDLR Meeting. Approval letter will be issued to PSP and forwarded to all relevant technical departments.

4.3.1.2 ***Earthwork stage: Earthwork Design Report***

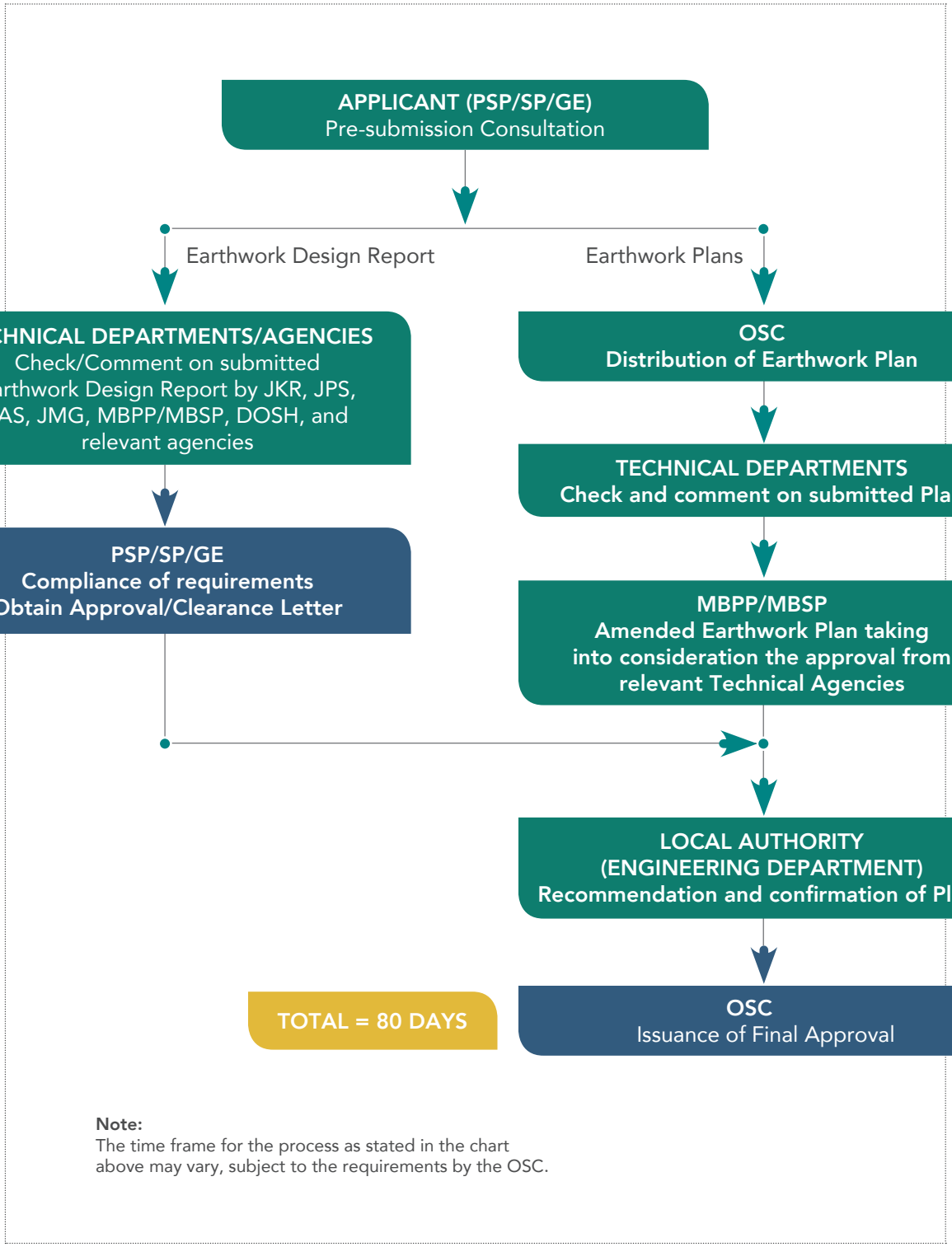
Final Earthwork Design Report is to be prepared for submission to all relevant technical departments prior to submission of Earthwork Plans to OSC. The Earthwork Design Report must be recommended for acceptance by the relevant Departments i.e. JPS, JKR, JMG, JAS, PTG, PDT, DOSH and relevant agencies as a precondition for the approval of the earthwork plan. It should include the foundation and slope stabilization plans including design of temporary earthworks. These detailed designs are to be supported by good quality site information which covers:

i. Groundwater monitoring shall be recorded for a minimum period of 12 months based on a monitoring system that could capture peak responses of groundwater to storms, either in the form of a mechanical recording system (Halcrow bucket/equivalent) or an automatic electronic recording system. This groundwater monitoring works shall continue even as the Earthwork Design Report has been submitted and carried out until the completion of the project.
ii. Detailed site investigation of sufficient coverage at the location of slopes and retaining walls, utilizing Mazier sampling and good quality triaxial testing for strength parameters.

4.3.1.3 Both Geotechnical and Earthwork Design reports are to be reviewed by the IC if required based on **Table 4.1**.

See **Appendix 2** for the proposed format of Earthwork Design report.

Figure 4.2 on the next page shows the flow chart for the submission of the Earthwork Design Report.



Note:
The time frame for the process as stated in the chart above may vary, subject to the requirements by the OSC.

4.3.2 Single-Stage Submission

For the single-stage submission, both Geotechnical Report and Earthwork Design Report shall be submitted at the Planning stage as a single comprehensive Geotechnical Report.

5. APPOINTMENT OF ENGINEERS WITH RELEVANT EXPERIENCE

5.1 The method of selecting Engineers by ability shall be as follows:

i. Technical competence
ii. Managerial ability
iii. Availability of resources
iv. Professional independence and integrity
v. Fairness of fee
vi. Quality Assurance System

5.2 These are very important criteria to be considered in selecting a competent Engineer (See **Appendix 3** for detailed explanation and examples).

5.3 The other considerations are the Engineer's attributes such as having a good commitment towards the project, communications skills and engineering judgment, and these should be well augmented with his experience in the industry.

5.4 Selection Procedure

The Selection procedure shall have the following key components:

i. Terms of reference
ii. Pre-qualification
iii. Short-listing
iv. Request for technical and fees proposals
v. Assessment of proposals

6. SITE SUPERVISION REQUIREMENTS

6.1 GENERAL

Site supervision is important to ensure the quality of the temporary and permanent works. Examples are proper placement and compaction of suitable fill and quality construction of support measures such as soil nails and rock bolts. Ground conditions and design assumptions have to be verified on site and the design suitably revised.

Good site supervision practice starts early in the design stage and concludes with proper documentation of the supervision effort upon completion of works for reference of engineers responsible for maintenance of slopes for long-term stability. The key requirements are summarized below and details are provided in **Appendix 4**.

All parties shall comply with the relevant rules and regulations related to FMA 1967 and OSHA 1994.

6.2 PRE-CONSTRUCTION

The geotechnical design engineer shall include in the Geotechnical Report, Earthwork Design Report or Slope Stability Analysis a schedule of design assumptions and parameters including testing and other requirements to verify them during construction. The design shall include a safe way of constructing the works, as well as an Erosion and Sediment Control Plan during construction.

An application for permission of first commencement of geotechnical works should include information of the geotechnical design engineer's proposed full-time supervision team to be forwarded to all related government agencies within 7 days of works commencement.

Note that the Civil Engineer and GE for a particular project can be the same or a different Engineer in accordance to **Table 4.1**.

6.3 PERSONNEL AND RESPONSIBILITIES

The geotechnical design engineer is to inspect work faces and examine testing and monitoring results to verify the design ground and groundwater models. He supervises or directs and controls a site supervision team to supervise geotechnical works on site and maintain supervision records.

The supervision team shall be full-time appointments in addition to the Design Engineer and/or Professional Engineer for the project. The Design Engineer and/or Professional Engineer can be the full-time Resident Engineer during the construction of the project. Apart from this, a site safety officer shall be part of the team. The minimum size of supervision team according to the total cost of construction works is as indicated in **Table 6.1**.

Stability of temporary cuts and temporary erosion and sediment control could be under the supervision of the PEPC of the Contractor if one is engaged by the Contractor to provide alternative designs.

For Classes 2-4 hill sites, the geotechnical design engineer is to be a GE. For Classes 3 & 4 hill sites, an IC is to inspect the site regularly to audit the state of compliance of the works to all building laws and associated documents including the design report.

Table 6.1 Minimum Supervision Team Size

Total Cost of Construction Works	Resident Engineer	Resident Engineering Technologist	Inspector of Works
Less than RM 7.5 million	-	-	Part-time
RM 7.5 million to RM 15 million	-	-	1
RM 15 million to RM 30 million	-	1	-
RM 30 million to RM 75 million	1	-	1
RM 75 million to RM 150 million	1	-	2
More than RM 150 million	2	-	3

Note: For projects above RM 150 million, at least one of the Resident Engineers shall be a PE registered with the Board of Engineers, Malaysia (BEM).

6.4 SITE REPORTS

The geotechnical design engineer and the IC are to notify MBPP or MBSP on instances of major contravention to the provisions of building laws and associated documents or likely danger to site personnel and adjacent ground.

The geotechnical design engineer is to submit a revised geotechnical report for major changes in design. This must be audited and cleared by the IC in the case of Classes 3 & 4 hill sites.

For Classes 3 & 4 hill sites, the geotechnical design engineer submits monthly geotechnical inspection reports to record the earthworks plan of the Contractor, results of inspections, tests and instrument monitoring and their assessment. The report shall also verify design assumptions and record design changes made or planned as well as record mitigation measures to non-compliances (NCR).

The IC submits monthly inspection reports on the state of compliance of the geotechnical works on site with building laws and associated documents, and the geotechnical design engineer's monthly inspection reports. See **Appendix 5** for proposed format of IC report.

6.5 AS-BUILT EARTHWORK DESIGN REPORT AND PLANS

Upon completion of works, and before the issuance of the Certificate of Compliance and Completion (CCC), the geotechnical design engineer submits the 'As-built Earthwork Design Report and Plans' based on the as-built geotechnical works layout. It is to include all ground and groundwater information from before and during construction, and the geotechnical model so interpreted. It analyses this geotechnical model to demonstrate adequate stability. It is also to provide a maintenance manual for all slopes and retaining walls following 'Guidelines on Slope Maintenance in Malaysia' (JKR 21503-0001-06, Slope Engineering Branch, Public Works Department Malaysia, August 2006) to record all information relevant to their long-term stability.

The IC, if one has been appointed for the earthwork construction, submits his review report on the as-built earthwork design report.

6.6 COMPLIANCE AUDIT

Representatives from any government agency may conduct random site visits to ascertain the compliance in relation to the approved earthwork design, the proposed supervision team, and the state of site supervision.

7. SLOPE MAINTENANCE MANUAL

7.1 All stakeholders are required to inspect and maintain slopes and retaining structures. It must be noted that safe and efficient access is important for inspection and maintenance works.

7.2 The inspection and maintenance of slopes and earth retaining structures should generally follow 'Guidelines on Slope Maintenance in Malaysia' (JKR 21503-0001-06, Slope Engineering Branch, Public Works Department Malaysia, August 2006).

7.3 A Slope Maintenance Manual shall be prepared by the GE for all hill site development projects. The Manual shall provide, among other information, the inspection and maintenance program. This shall include monitoring and review of installed instruments if they are specifically needed in the design, the threshold readings/trends/profiles, and the actions to be taken upon the threshold values being reached.

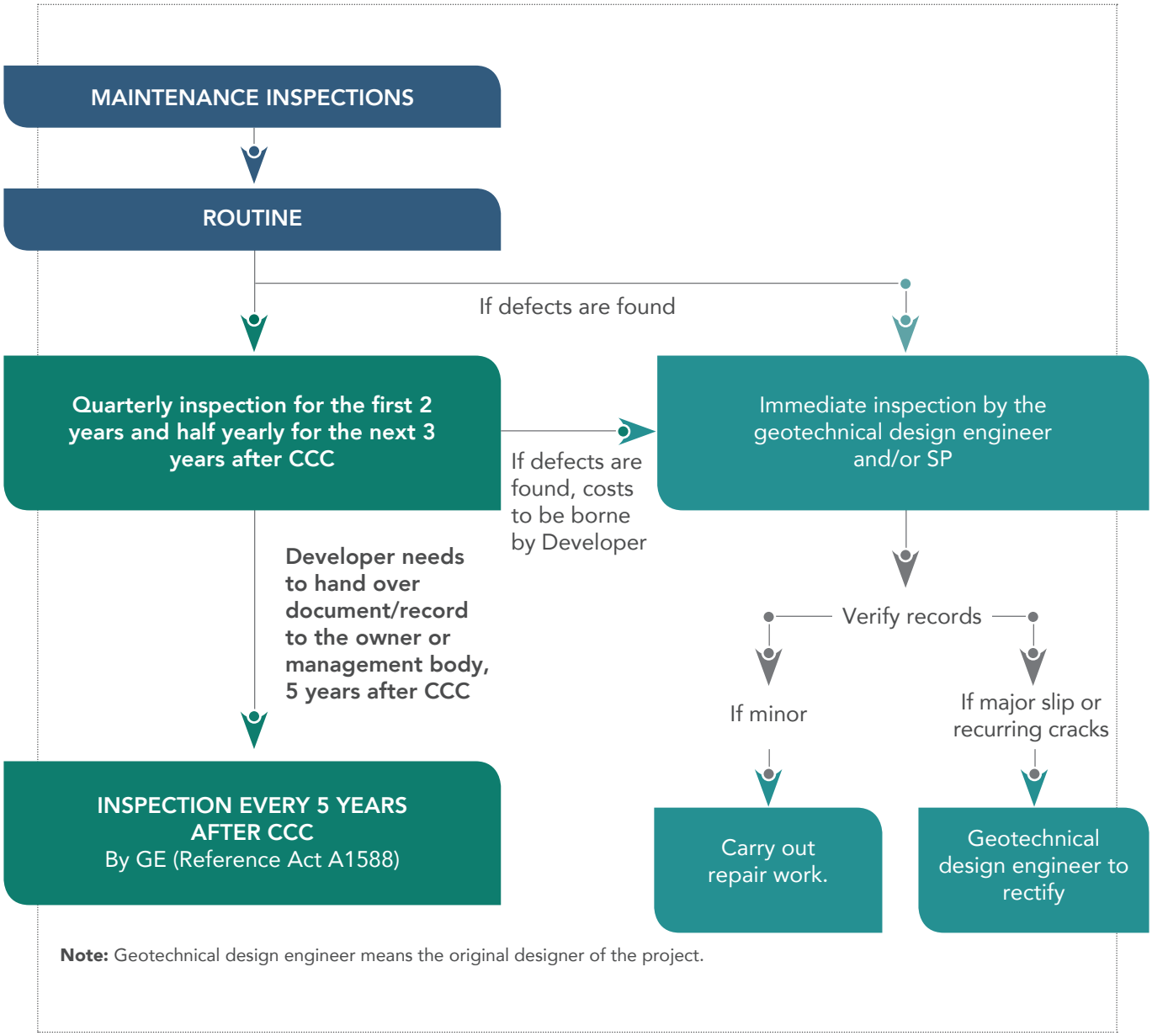
7.4 Forms as per JKR's Guidelines on Slope Maintenance in Malaysia shall be used as a basis with customisation for specific development projects.

7.5 An as-built Slope Maintenance Manual shall be ready for handing over to the owner, or the management body of the land or property before the issuance of Certificate of Completion and Compliance (CCC). The as-built Slope Maintenance Manual shall be submitted to Local Authority as part of the as-built earthwork design report and earthwork plan.

7.6 Quarterly inspection for the first 2 years and half yearly for the next 3 years after CCC shall be carried out by geotechnical design engineer/Inspection/maintenance team as per Maintenance Manual and a copy of certified inspection/maintenance report shall be submitted to the Local Authority. Subsequently, all inspection/maintenance report documents shall be handed over accordingly to the owner or management body at the end of maintenance period.

7.7 All costs for inspection, maintenance and rectification (if defects are found) within the first 5 years are to be borne by the developer. The developer shall hand over certified copies of the documents/records to the owner or management body, 5 years after CCC and a copy shall be forwarded to the Local Authority.

Figure 7.1: Typical Inspection Procedure



Note: Geotechnical design engineer means the original designer of the project.

8. THE WAY FORWARD

This Guideline will only succeed in serving its objectives and strategies if the stakeholders are fully committed in acceding to its recommendations.

Most importantly, the Guideline must be self regulating especially by the developers, contractors, engineers and site personnel for it to come to fruition. Enforcement action by the authorities should be a last resort in assuring this Guideline is adhered to by all the parties involved because at that point damage could have occurred and safety compromised.

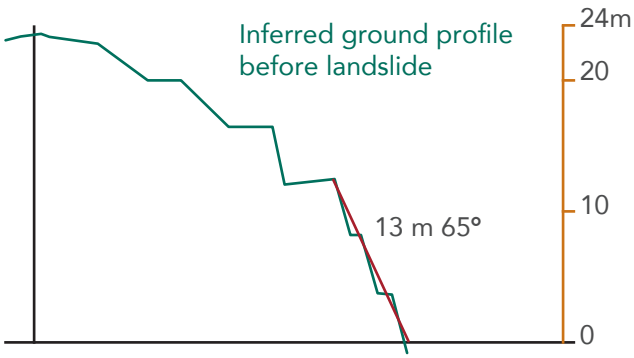
In addition, the State Government is wary and concerned about climate change which is evident from the unpredictable events happening around the world. This Guideline is another consolidated effort to enable us to be more prepared and equipped in facing climate change issues.

With technological advancements, we foresee progressive improvements in the construction industry. Improvements to building materials and methods of construction apart from the utilisation of smart systems and devices may certainly enhance site safety.

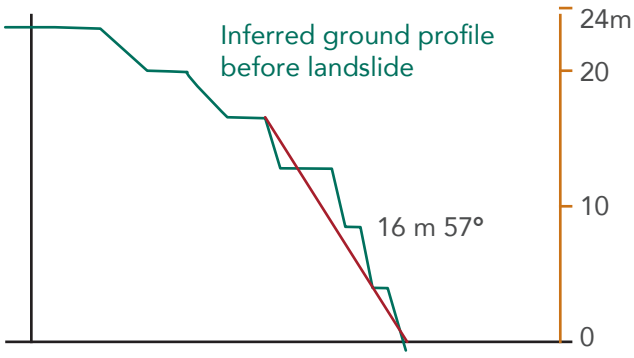
We have embarked on this journey to progressively develop a safe working culture and sustainable working environment in terms of Hill Site Development; and we believe that through this Guideline we will achieve to a certain extent what we had set out to do.

APPENDIX 1: EXAMPLES OF HILL SITE CLASSIFICATION

Example No. 1: Temporary Cut Slopes



Consideration 1: Height and average angle of the temporary cut up to the outer edge of berm 3



Consideration 2: Height and average angle of the temporary cut up to the outer edge of berm 2

Table 3.3: Man-made Slopes – Hazard Rating

Type	25° < θ ≤ 40°	40° < θ ≤ 60°	60° < θ
Soil Fill	VH	EH	EH
Soil Cut	M	H	VH
Rock Cut	H	VH	EH
Retaining wall (concrete)	M	M	M
Retaining wall (other types)	VH	VH	VH
Special stability measures	EH	EH	EH

Temporary soil cut slope, 65° x 13m

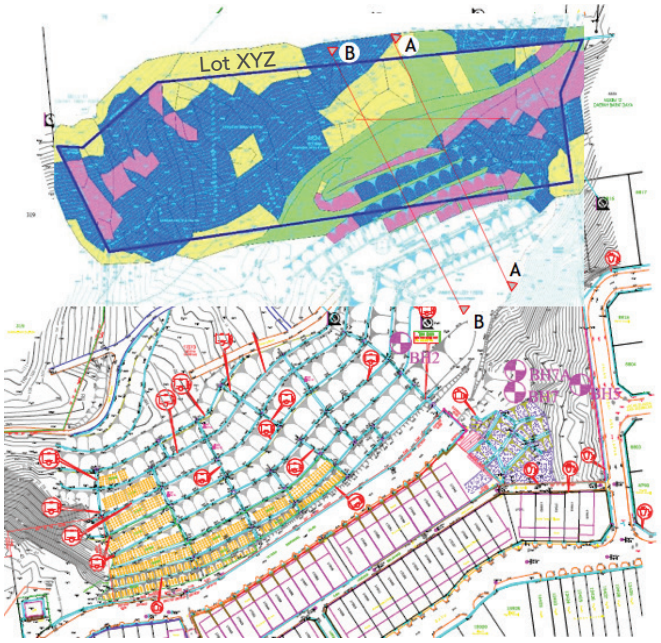
Table 3.4: Hill Site Classes

Hazard	Ht 3-10 m	Ht > 10 m
M	2	2
H	2	3
VH	3	4
EH	4	4

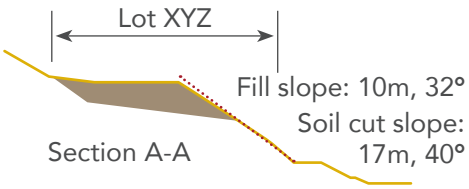
Note:
θ = angle subtended by the crest-toe line.
M = moderate hazard (within the competence of an average Civil Engineer, instability possible).
H = high hazard (within the competence of an average Geotechnical Engineer; instability likely).
VH = very high hazard (needs relevant experience to handle; instability likely and the consequence could be very serious).
EH = extremely high hazard (needs relevant expertise to handle; instability likely and the consequence could be extremely serious).

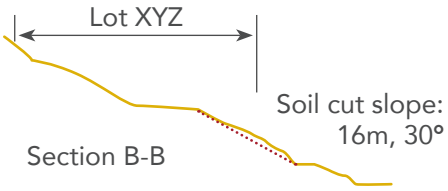
Special stability measures = measures designed and constructed to stabilize slopes or retaining walls, e.g., prestressed ground anchor, dewatering system such as designed horizontal drains (critical to stability; need relevant expertise to design, construct and maintain).

Example No. 2: New Site with Existing Slopes



Hill Slope	% area
Class 1	18.91
Class 2	15.11
Class 3	50.93
Class 4	15.05





I. Hill Site Class based on hill slope classes

Average hill slope class score = (18.91 x 1 + 15.11 x 2 + 50.93 x 4 +15.05 x 8)/100 = 3.73

Table 3.2: Hill Site Classes Based on Average Hill Slope Class Score

Average hill slope class score	≤1	> 1-2	> 2-4	>4
Hill site Class	1	2	3	4

II. Hill Site Class based on man-made slope nature

Table 3.3: Man-made Slopes – Hazard Rating

Type	25° < θ ≤ 40°	40° < θ ≤ 60°	60° < θ
Soil Fill	VH	EH	EH
Soil Cut	M	H	VH
Rock Cut	H	VH	EH
Retaining wall (concrete)	M	M	M
Retaining wall (other types)	VH	VH	VH
Special stability measures	EH	EH	EH

Table 3.4: Hill Site Classes Based on Hazard Rating and Slope/Wall Height

Hazard	Ht 3-10 m	Ht > 10 m
M	2	2
H	2	3
VH	3	4
EH	4	4

III. Overall Hill Site Class of the Lot = higher of that from hill slope classes and man-made slope nature, i.e., Hill Site Class 3

Section A-A
Fill slope: 32° – hazard rating VH (Table 3.3)
Height 10m – Hill Site Class 3 (Table 3.4)

Soil cut slope: 40° – hazard rating M (Table 3.3)
Height 17m – Hill Site Class 2 (Table 3.4)

Section B-B
Soil cut slope: 30° – hazard rating M (Table 3.3)
Height 16m – Hill Site Class 2 (Table 3.4)

Hill Site Class of the Lot based on man-made slope nature = the highest class from various combinations i.e., that due to the fill slope, (Hill Site Class 3)

APPENDIX 2: PROPOSED FORMAT FOR EARTHWORK DESIGN REPORT

EXECUTIVE SUMMARY

BODY OF REPORT

1. Project Information

1.1. Project Title
1.2. Name and contact details of Developer
1.3. Name and contact details of Architect
1.4. Name and contact details of Civil Engineer
1.5. Name and contact details of Geotechnical Engineer
1.6. Curriculum vitae of Geotechnical Engineer
1.7. Approving Authorities
1.8. PM No.

2. Earthwork Design Report

2.1. General scope
2.2. Limitations

3. Background of Development

3.1. Location and land size
3.2. Information on proposed development
3.3. Information on surrounding developments

4. Area Geology and Terrain Classification

4.1. Regional geology
4.2. General site geology, geomorphology, hydrogeology and general structural geology highlighting the presence of observable discontinuities e.g. rockslopes, cliffs, etc. Need Requirements for geologist input (if necessary).
4.3. Terrain classification (terrain map) - terrain classification map to be plotted and prepared based on the approved colour codes.
4.4. Terrain geological component
4.5. Construction suitability map

5. Site Investigation

5.1. Topographical Survey
  5.1.1. Topographical survey plans
  5.1.2. Aerial photographs

5.2 Site Reconnaissance and Desk Study
  5.2.1. Site photographs
  5.2.2. General observations and description of the site (nature of terrain, surface boulders, etc.)
  5.2.3. Observable evidence of potential slope instability, water marks or slip scars

5.3. Sub-Surface Soil Investigation
  5.3.1. Types of investigation (boreholes, mackintosh probes, etc.)
  5.3.2. Weather conditions before and during the soil investigation
  5.3.3. Subsoil profiles derived from soil investigation to be plotted and superimposed over the cross sections. Cross-sections should be perpendicular to ground contours and cross-sections need not be in a straight line.
  5.3.4. Field testing and results, rock mass mapping
  5.3.5. Laboratory testing and results
  5.3.6. Groundwater table level measurements and records
  5.3.7. Selected soil parameters for design – total and effective strength parameters and rock mass strength interpreted from mapping

5.4. Geophysical Survey (if applicable)
  5.4.1. Need and requirements for geophysical survey
  5.4.2. Type and method of geophysical survey
  5.4.3. Results of geophysical survey

5.5 Ground Information for Design
  5.5.1. Ground and groundwater models
  5.5.2. Design assumptions and parameters
  5.5.3. Testing, validating, controlling, inspection and monitoring to verify ground information and ensure compliance with standards of good practice

6. Geotechnical Design

6.1. Geotechnical Design Considerations
- 6.1.1. Geotechnical issues associated with the project
- 6.1.2. Design concepts and considerations

6.2. Slopes
- 6.2.1. Proposed cut slope
- 6.2.2. Proposed fill slope
- 6.2.3. Proposed rock cut slope
- 6.2.4. Natural slope profiles
- 6.2.5. Slope stability analyses (total or effective stress conditions, types/ methods of analysis and computer programs used)
- 6.2.6. Stability analyses and considerations of natural and man-made slopes in neighbouring developments, which may affect the stability of the current project and vice versa
- 6.2.7. Sensitivity analysis or the expected range of ground and groundwater conditions
- 6.2.8. Recommended slope stabilization/ strengthening measures
- 6.2.9. Recommended testing on the adequacy, safety and performance of slope stabilization works

6.3. Earth Retaining Structures
- 6.3.1. Types of earth retaining structures for the project
- 6.3.2. Overturning stability, sliding stability and bearing capacity checks
- 6.3.3. Global stability checks

6.4. Foundation Design
- 6.4.1. General considerations
- 6.4.2. Preliminary foundation design information/calculations
- 6.4.3. Effect of slopes on foundations and vice versa
- 6.4.4. Recommendations

6.5. Filled Platforms and Embankments
- 6.5.1. Settlement analyses
- 6.5.2. Stability analyses

6.6 Rockfall Analysis (if applicable)
- 6.6.1. Methods of analysis
- 6.6.2. Recommended measures to prevent and/or control rockfall and/ or recommended land buffer requirements

6.7. Earthwork Quantities
- 6.7.1. Estimated cut quantity
- 6.7.2. Estimated fill quantity
- 6.7.3. Estimated rock excavation quantity

6.8. Surface and Sub-surface Water Problems (if applicable)
- 6.8.1. Presence and/or evidence of surface/ sub-surface water conditions affecting the stability of slopes, retaining structures or foundation.
- 6.8.2. Recommended rectification and/or controlling measures

6.9. Temporary and permanent slope protection and surface drainage provisions

6.10. Instrumentation and Monitoring
- 6.10.1. Requirements for instrumentation and monitoring
- 6.10.2. Type, location and quantity of instrumentation
- 6.10.3. Recommended instrumentation monitoring program

7. Earthworks Construction

7.1. Temporary works
7.2. Construction control and safety provisions
7.3. Construction method statement
7.4. Erosion and sediment control plan
7.5. Controlled rock blasting requirements (if applicable)

8. Post-construction Slope and Site Maintenance

8.1. Maintenance of slopes and related facilities
8.2. Frequency of slope maintenance inspections
8.3. Responsibility for slope maintenance
8.4. Slope maintenance manual

9. Conclusions and Recommendations

10. Engineer's Declaration

Standard Declaration:

"I hereby certify that these works have been designed by me professionally in accordance with best engineering practices and that I take full responsibility for the design accuracy and adequacy, firm supervision and proper performance of the same."

11. References

12. Attachments

12.1. Planning Layout (Extracted Copy)
12.2. Survey Plan and Terrain Map
12.3. Schedule of design assumptions and parameters, and measures to verify them during construction
12.4. Slope Stability Analysis Results
12.5. Preliminary Design Calculations
12.6. Erosion Sediment Control Plan
12.7. Soil Investigation Reports
12.8. Slope Maintenance Manual

APPENDIX 3: CRITERIA FOR A RELEVANT EXPERIENCED ENGINEER

1. **TECHNICAL COMPETENCE**
   i. The Engineer should provide technical approach and methods for the project (e.g. types of foundation systems, what are the pros and cons, cost-effectiveness, long-term maintenance and serviceability).
   ii. Obtain a list of similar projects carried out by the Firm. (e.g. projects of similar technical nature and subsoil condition, constructed and handed over).
   iii. The competency, experiences and qualifications of personnel including peer recognition. (e.g. technical papers published in a seminar, conferences, etc.).
   iv. Check whether the Engineer carries out knowledge management including, Research and Development (R&D) to improve their services. (e.g. evidence of in-house engineering manuals, check-lists etc.). This is to ensure Clients get value designs which are safe, cost-effective and construction friendly.
   v. Discussions with Owners/Clients of previous projects that involved the Engineer.

2. **MANAGERIAL ABILITY**
   i. Ensure the Engineer has adequate manpower resources and the ability to maintain schedules (e.g. size of company and resources committed to being mobilised for the project).
   ii. Ensure the Engineer has similar experience in handling a project of similar scale.
   iii. Examine the Engineer's record of project achievement and success on previous projects (e.g. awards won, peer recognition, etc.). However, it is important to check whether the personnel involved in the previous successful projects are still with the company and will be involved in the project to be awarded.
   iv. Examine the Engineer's manual, check-lists or procedures of engineering that he follows in order to perform his services (e.g. to submit the list of design manual, checklists etc. for review by Client).

3. **AVAILABILITY OF RESOURCES**
   Ensure the Engineer has sufficient staff available to carry out the works and to obtain the list of staff who will be involved in the project.

4. **PROFESSIONAL INDEPENDENCE & INTEGRITY**
   Ensure the Engineer is registered with the Board of Engineers, Malaysia (BEM). Also, consult industry players on the reputation of the Engineer (e.g. integrity, competency, etc.).

5. **FAIRNESS OF FEE**
   Engineers need to be adequately paid to ensure that they are able to provide a high-quality service with proper attention to detail, alternative designs, material and method of construction.

   i. Therefore, the Engineer shall be employed based on 'Value for Money' rather than 'Lowest Price'. This is because the Engineer's fees only contribute a very small percentage to the project cost. If ineffective or non-economical designs were produced by the Engineer and used, the cost of remedial and unnecessary wastage of materials and workmanship will be SIGNIFICANTLY more than the fees paid. In addition, ineffective design may also cause DELAY to the project.
   ii. Alternatively, if the bidding process is still necessary to ensure competitiveness is observed, only Pre-Qualified Engineers shall be invited to participate.

6. QUALITY ASSURANCE SYSTEM

Quality of the project is often the most important measure of the services received. Without a Quality Assurance System, the project and its design may run a high risk of not achieving its intended purpose.

i. Clients are encouraged to engage ISO9001:2000 certified Engineering Firms (i.e. Firms certified either by SIRIM or other accrediting bodies).

ii. The Engineer shall have proper written procedures in place which are followed by the Engineers and staff to ensure that all designs are checked. This shall include having the necessary forms to record checking (examine evidence of checking and recording). The Client shall request the Engineer to submit their procedures and forms for verification.

iii. The Engineer shall have proper filing and re-tractable procedures in place. (e.g. project filing and identification and traceability, which allows documents to be traced and submitted within a short period (e.g. less than 1 day).

iv. All design (calculations, specifications, drawings, etc.) shall be properly checked and reviewed by the different persons of relevant experience within the company. The process shall have proper forms for evidence and recording purposes.

v. The Client has the right to engage another Consulting Firm with a specialist to carry out an independent review if needed.

APPENDIX 4: GOOD SITE SUPERVISION PRACTICE
Originally Chapter 4 of Chan (2019), with minor editorial changes

Note: Chan (2019) was prepared for MBPP, but would apply to MBSP as well; Sections 4.1, 4.2, 4.3 and 5.0 referred to in this Appendix are those of Chan (2019).

4.0 Clarifying Site Supervision Requirements for Penang

4.1 General

Hill site development has been going on in Penang for many years. Though there have been notable failures lately, many developments have been completed successfully. It is inconceivable that construction in these successful sites all had contractors working without engineer's supervision. Indeed, By-Law 5 of UBBL requires site supervision by the Submitting Person. However, it appears that details of site supervision requirements have not been documented.

Not having the supervision system documented presents a few problems. It is difficult to answer criticisms or objections from the lay public against developing the island by showing them the care with which the profession has exercised to protect their safety and rights. MBPP has a duty to audit the state of supervision of sites. It is unfair that practitioners do not know the standards against which they will be judged. A written set of requirements would facilitate taking lessons from cases, to ensure the continuous improvements which in turn would help the public to accept development.

After all, it is much more cost-effective to get things right from the start, instead of trying to rectify wrongs at a late stage. A written standard of good practice would benefit all parties in a development project. Anyone in doubt of this argument has only to look at the cost of delays and remedial works subsequent to any serious incident on site.

It is possible to document the site supervision practice in Penang by interviewing engineers and developers. That would take much time. The practice as documented would then have to be scrutinized for areas of improvement. This Note reverses the process, by first drawing up a list of good practice based on those of the neighbouring cities judged to be essential and practicable to Penang. This is described in the next Section. Penang practitioners could identify items that are not done here. If with good reasons, they could be taken out. They could likewise be refined to suit local practice.

4.2 Site Supervision Requirements for Penang

A simple set of good practice based on site supervision practice of Hong Kong and Singapore, which is judged workable and likely to be at least practised in part in Penang, is as follows. The set has been revised subsequent to discussions and feedback as described in Section 5.0 'Evolving Thoughts'.

4.2.1 Initiation

Earthwork design report to include a schedule of geotechnical design assumptions and parameters, and testing, validating, controlling, inspecting and monitoring required to ensure compliance with the laws and approved design and conditions imposed, and to verify ground and groundwater models.

Application for permission to first commencement of geotechnical works to include information of the geotechnical design engineer's proposed full-time site supervision team including particulars of tentative team members, and information of the Contractor's full-time site supervision team especially in respect of geotechnical works.

Upon first commencement of geotechnical works, notify MBPP of particulars of actual members of the full-time site supervision team of the geotechnical design engineers.

4.2.2 Personnel and Responsibilities

Geotechnical works are to be under the supervision of the geotechnical design engineer, or the full-time supervision of a site supervisor or a team of them under the geotechnical design engineer's control and direction.

Geotechnical design engineer for a class 1 site – a civil engineer or geotechnical engineer, for others – a geotechnical engineer.

Minimum team size and member qualification requirements – MBPP and IEM (Penang) to set guideline jointly. Tentatively, the minimum team size is as follows:

Total Cost of Construction Works	Resident Engineer	Resident Engineering Technologist	Inspection of Works
Less than RM7.5 million	-	-	Part-time
RM7.5 million to RM15 million	-	-	1
RM15 million to RM30 million	-	1	-
RM30 million to RM75 million	1	-	1
RM75 million to RM150 million	1	-	2
Above RM150 million	2	-	3

Class 3 site & above – an independent checker to review design report and work of the geotechnical design engineer.

The geotechnical engineer and the independent checker are to visit a Class 3 site at not less than once a month. This is to be increased to not less than once a fortnight for a Class 4 site.

The geotechnical design engineer is to:

i. inspect cut faces
ii. assess test results and monitoring results
iii. verify ground and groundwater models
iv. assess and, if found to be needed, revise the design
v. initiate actions against failed tests and instrument readings exceeding limits
vi. carry out duties of the site supervision team if one is not provided

The site supervision team is to, under the control and direction of the geotechnical design engineer:

i. inspect the site to identify any non-compliance of works on site
ii. provide immediate supervision of site tests and sampling, and reading of monitoring instruments, e.g., fill density tests
iii. provide immediate supervision of critical works or work elements, e.g., soil nail construction
iv. maintain site records

Stability of temporary cuts and temporary erosion and sediment control could be under the supervision of the PEPC of the Contractor if one has been engaged to provide an alternative design(s).

4.2.3 Site Records

Engineering documents

i. Approved plans and geotechnical reports, and supporting documents, e.g. site investigation reports, pre-construction survey reports
ii. All conditions imposed on the approved plans and permits for the commencement of works
iii. Supervision team memberships and personal particulars
iv. Schedule of earthworks to be carried out every three months
v. Contractor's supervision structure
vi. Alternative temporary works design, if applicable
vii. Alternative temporary erosion and sediment control plan, if applicable

Supervision Records

i. Cut face inspection records
ii. Results of laboratory tests of samples from the site and site tests
iii. Instrumentation and monitoring results
iv. Site inspection record
v. Immediate supervision records
vi. Actions taken on failed tests or instrument levels exceeding limits

Event Records

i. Record of attendance of the geotechnical design engineer, independent checker, site supervisors, and visitors with quality control roles
ii. Any events that could have resulted from or lead to non-compliance

4.2.4 Site Reports

The geotechnical design engineer to notify MBPP of instances of:

i. major contravention of provisions of building laws and associated documents
ii. major deviations from approved plans and conditions imposed on the plans
iii. danger or likely danger to site personnel or the adjacent ground
iv. mitigation actions proposed to the contraventions or deviations
v. mitigation actions taken against failed tests and instrument readings exceeding limits
vi. material changes to the design
vii. changes in supervision team composition
viii. changes in geotechnical contractor

The geotechnical engineer's monthly reports to include:

i. schedule of geotechnical works to be carried out every 3 months
ii. result of inspections, tests and instrumentation monitoring to validate geotechnical design assumptions
iii. assessment of the result of such inspections, tests and instrumentation monitoring
iv. need for or proposed design revisions
v. mitigation actions taken, with part-prints of plans showing changes
vi. notifications made to MBPP

The independent checker's inspection report to include views on the state of the site and a review of the geotechnical engineer's site supervision monthly reports.

If the geotechnical design engineer leaves the project before completion:

i. notify MBPP of the departure
ii. with the last monthly report covering the period up to the last week of his tenure

iii. copy of a letter of release, with a statement on compliance or otherwise of works and activities he had supervised

If the independent checker leaves the project before completion – actions similar to those of a departing geotechnical design engineer, as above.

4.2.5 Upon completion of works

The geotechnical design engineer to submit an as-built earthwork design report, to include:

i. as-built geotechnical works layout
ii. records of all investigation, testing, inspection and monitoring information
iii. ground and groundwater models using all available investigation, testing, inspections and monitoring information
iv. analyses to demonstrate that the as-constructed geotechnical works meet the design standards and standards of good practice
v. records of all compliance and quality test results
vi. review of all compliance and quality test results to demonstrate that the works meet quality requirements
vii. adequately documented maintenance requirements for long-term performance of slopes and retaining walls

The independent checker to review the as-built earthwork design report and, if satisfied that the report truly and accurately represents the situation on site, endorse it.

4.2.6 Application of Certificate of Completion and Compliance

The geotechnical design engineer, and the independent checker if applicable, countersigns Form G1 (Earthwork).

4.2.7 Compliance Audit

MBPP may conduct formal and random site visits:

i. to check the state of supervision
ii. for information to judge on inspection reports from the Geotechnical Engineer and the Independent Checker, and
iii. to investigate complaints and notifications of issues

4.3 Implementation

The supervision requirements described in Section 4.2 above will be implemented on projects with first commencement of earthwork on or after 1 October 2019. Promulgation will initially be by circulation of this Note to local government agencies, institutions and trade associations with stakes in hill site development projects, and the principal submitting person and submitting persons of such projects. Relevant supervision requirements will be incorporated in the Penang Safety Guideline on Hill site Development which is being updated. A channel will be found for longer-term public access of the other requirements.

For projects with first commencement of earthwork before 1 October 2019, the decision by PTAC in its meeting on 25 February 2019 applies. Each earthwork site is to retain at least one civil engineer full time on site to supervise the works.

There will be a transition period of two years. This is for all parties with stakes in the quality and safety of earthworks on site to get familiar with the requirements and to tune them for efficiency and effectiveness. Punitive actions against wilful non-compliance in this period will be the last resort.

In particular, the following will have to be worked out, preferably in the first year of the transition period.

i. Size and member qualification requirements of the site supervision team to be directed and controlled by the geotechnical design engineer,
ii. Standard forms or templates for site supervision records
iii. Whether to impose size and member qualification requirements of the works supervision team of the contractor, and

Supervision team composition will be at the discretion of the geotechnical design engineer before a decision on i). Use of standard forms or templates, if any, are not mandatory.

Towards the end of the transition period, the supervision requirements will be reviewed, tuned and consolidated to be taken forward. The transition period might be extended for not more than one year if needed.

4.4 Elaborations

In the course of discussions with stakeholders, details of the requirements were sometimes covered, as follows.

4.4.1 Enhancing Supervision Pays

The concern of stakeholders on the potential cost implication of the supervision requirements is well appreciated. Benefits from serious implementation of the requirements described in Section 4.2 should more than compensate for the cost. These include a 'level playing field' resulting from clearly stated scope of service of all parties of a construction project. This is ensured by making known the requirements to all parties, and to avail them to the public, as described at the start of Section 4.3. Other benefits of an open structured set of supervision requirements as promoted under the present exercise are described in Section 4.1.

4.4.2 Division of Responsibility between the Geotechnical Design Engineer and the Civil Engineer

The geotechnical design engineer is to ensure that:

i. slopes are completed to the designed geometry, materials, and all stability provisions
ii. retaining walls and the retained ground are completed to the designed geometry, and the latter completed to the designed material and all stability provisions
iii. temporary erosion and sediment control is properly planned and implemented

The Civil Engineer is to ensure proper execution of the following:

i. preparation of ground and stripping of topsoil for reuse
ii. bulk excavation, stacking of topsoil and suitable fill for reuse
iii. disposal of surplus materials, and
iv. others not specified to be under the geotechnical design engineer

The Civil Engineer, the geotechnical design engineer, and the independent checker where appropriate, should co-sign a Form to signify that the works supervised by the geotechnical design engineer and the independent checker comply with all legal, technical and administrative requirements. The Form is to be attached to Form G1 for application of CCC.

4.4.3 Geotechnical Design Engineer's Role in Ensuring Stable Temporary Excavations

The geotechnical design engineer should include in its design documentation at least one safe way of constructing the works he designed, and a temporary erosion and sediment control plan. The Contractor may engage a PEPC to compile an alternative design for either or both. The principle that a qualified designer is responsible for the supervision of the designed works applies. The presence of the Contractor's PEPC does not release the responsibility of

the geotechnical design engineer to report to MBPP major non-compliance or dangerous situations on site.

4.4.4 Actions to Correct Contraventions or Dangerous Site Situations Apart from Informing MBPP

The geotechnical design engineer together with the site team should first freeze the problem at its source, and then take rectification actions. The urgency of reporting to MBPP depends on the perceived risk to site personnel and the public. MBPP would intervene if the rectification action being taken or completed would leave a high residual risk to the public. A suggestion was received that the responsible person should not be prosecuted for contraventions etc reported to MBPP, to encourage reporting.

4.4.5 Whether and When to Report Design Changes

A geotechnical design should include sensitivity analyses to cover the predicted range of design ground and groundwater model uncertainties, e.g., the position of rock line, groundwater level. This would permit speedy response to actual ground conditions exposed on site.

Whether and when to report design changes beyond those analysed in the design, and minor changes in layout, would be left to the judgment of the geotechnical design engineer. Irrespective, the geotechnical design engineer is expected to check that the revision does not reduce stability and long-term performance to below the level originally adopted. He is to document such checks, for future reference. Riding on the spirit of self-regulation, the report on design changes together with the independent checker report on the same where relevant, if submitted to MBPP, will mostly be for record. Experience from another jurisdiction with a similar building control regime was an inclination to inform the authority. To do otherwise runs the risk of being viewed as having committed a reckless mistake should failure subsequently occur. A reckless action is not covered by professional indemnity insurance.

4.5 Other Ideas

Two other ideas received on drafts of this Note will be considered at a suitable time in future, separate from the present exercise.

i. The possibility of site supervision by qualified professionals other than the geotechnical design engineer
ii. Establishing a database of site supervision personnel to ensure that supervisors carry out the work for registered job sites with the committed hours, based on the practice of the Land Transport Agency of Singapore

Reference

Chan, Y.C. (2019) Enhancing Site Supervision of Hill Site Developments in Penang, Penang Technical Advisory Committee, 23P

APPENDIX 5: INDEPENDENT CHECKER REPORT FORMAT

CURRICULUM VITAE OF INDEPENDENT CHECKER

EXECUTIVE SUMMARY

BODY OF REPORT

1. Introduction

2. Limitations

3. Development description and location

4. Area geology and terrain classification

5. Site investigation
   - 5.1. Description of site
   - 5.2. Sub-surface soil investigation
     - 5.2.1. Subsoil profile
     - 5.2.2. Field test results
     - 5.2.3. Laboratory test results
     - 5.2.4. Underground water table
   - 5.3. Design sub-surface engineering parameter
   - 5.4. Geophysical survey

6. Geotechnical design
   - 6.1. Geotechnical design consideration
   - 6.2. Slopes
     - 6.2.1. Proposed cut slope
     - 6.2.2. Proposed fill slope
     - 6.2.3. Proposed rock slope
     - 6.2.4. Natural slope profile
     - 6.2.5. Slope stability analysis
     - 6.2.6. Slope stabilization measures
     - 6.2.7. Type of test for slope stabilization measures
   - 6.3. Retaining structures
   - 6.4. Foundation design considerations
   - 6.5. Slope protection and surface drainage provisions
   - 6.6. Instrumentation

7. Construction

8. Maintenance

9. Conclusion and recommendations

10. Independent Checker's declaration
    Standard Declaration:
    i. This geotechnical report/earthwork design report has been prepared by me and I am responsible for the adequacy and accuracy of the geotechnical report to the best of my knowledge.
    ii. The development at this site is safe for construction provided the recommendations and requirements contained in the report are adhered to in the detailed and construction of the development[1]

Note:

[1] The conclusion should Include a clear statement on whether the design complies with building laws and related requirements. If with reservations, the conclusion should include clear statements of the reservations with reference to parts of the text for support; declaration ii) above does not apply in that case.

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