

CHAPTER 4

PROJECT DESIGN AND ESTIMATES

The parts of the PAH shown in blue and bold should only be updated by Works Branch of Development Bureau.

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SYNOPSIS

This Chapter describes the criteria to be adopted, the procedures to be followed and the documentation that is required in the design process of civil engineering works. Emphasis is placed on the need to adopt a systematic approach, from the initial stage of conceptual design to the final stage of checking and certification, to ensure that designs are performed and recorded properly. Requirements for cost estimates and general guidance on their preparation are also described.

The procedures and documentation requirements set out in the Chapter are generally applicable to all public works projects involving civil engineering construction. However, for emergency works where there is a serious time constraint and for minor works where standard designs are used, the procedures may be applied selectively if this is necessary to avoid unnecessary delays to the Works or the production of over-elaborate documentation.

Detailed guidance on the standards and methods to be adopted for the design of works is not given in this Chapter and reference should be made to standard textbooks, codes of practices and other manuals quoted in the text.

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I. ABBREVIATION

- I.01 The meaning of the abbreviations assigned in this Chapter of the Project Administration Handbook for Civil Engineering Works shall only apply to this Chapter.
- I.02 The following list shows the meaning of the abbreviations for the common terms used in this Chapter of the Project Administration Handbook for Civil Engineering Works:

| Abbreviation | Term |
|--------------------------|---|
| ACABAS | Advisory Committee on the Appearance of Bridges and Associated Structures |
| ACSA | Anchor Certification System for Permanent Prestressed Ground Anchors |
| AFCD | Agriculture, Fisheries and Conservation Department |
| AGS | Association of Geotechnical and Geoenvironmental Specialist format |
| APE | Approved Project Estimate |
| ArchSD | Architectural Services Department |
| BD | Buildings Department |
| BIM | Building Information Modelling |
| C of P | Commissioner of Police |
| C&D | Construction and Demolition |
| C&DMMP | Construction and Demolition Material Management Plan |
| CAD | Computer-Aided-Drafting |
| CCGO | Central Cyber Government Office |
| CE | Chief Engineer |
| CE/Design | Chief Engineer/Design |
| CE/PW | Chief Engineer/Port Works |
| CE/RSS | Chief Engineer/Road Safety and Standards |
| CEDD | Civil Engineering and Development Department |
| CEO | Civil Engineering Office |
| CGE | Chief Geotechnical Engineer |
| CGE/GP | Chief Geotechnical Engineer/Geotechnical Projects |
| CGE/Mines | Chief Geotechnical Engineer/Mines |
| CGE/P&D | Chief Geotechnical Engineer/Planning & Development |
| CGE/M&T | Chief Geotechnical Engineer/ Materials & Testing |
| CHE/Bridges & Structures | Chief Highways Engineer/Bridges & Structures |
| CHE/R&D | Chief Highways Engineer/Research and Development |
| CSD | Correctional Services Department |
| CSWP | Computer-Aided-Drafting Standard for Works Projects |
| CTE | Chief Transport Engineer |
| D of Arch S | Director of Architectural Services |
| D of L | Director of Lands |
| D&B | Design and Build |

| Abbreviation | Term |
|---------------------|--|
| D1 | Directorate pay scale point 1 |
| D2 | Directorate pay scale point 2 |
| DC Certificate | Certificate of Design and Completion of slopes and Retaining Walls |
| DCED | Director of Civil Engineering and Development |
| DD/SM | Deputy Director/Survey and Mapping |
| DEMS | Director of Electrical and Mechanical Services |
| DEP | Director of Environmental Protection |
| DEVB | Development Bureau |
| DEVB TCW | DEVB Technical Circular (Works) |
| DIA | Drainage Impact Assessment |
| DLO | District Lands Officer |
| DPO | Digital Policy Office |
| DSD | Drainage Services Department |
| E&M | Electrical & Mechanical |
| EACSB | Engineering and Associated Consultants Selection Board |
| EIA | Environmental Impact Assessment |
| EIAO | Environmental Impact Assessment Ordinance |
| ELPs | Electronic Layout Plans |
| EMSD | Electrical and Mechanical Services Department |
| EPD | Environmental Protection Department |
| ERA | Estimating using Risk Analysis |
| ETW Departments | Environment, Transport and Works Departments |
| ETWB | Environment, Transport and Works Bureau |
| ETWB TCW | ETWB Technical Circular (Works) |
| FB | Finance Branch |
| FC | Financial Circular |
| FSTB | Financial Services and the Treasury Bureau |
| GEO | Geotechnical Engineering Office |
| GI | Ground Investigation |
| GIU | Geotechnical Information Unit |
| GLTMS | The Greening, Landscape and Tree Management Section under the Works Branch of Development Bureau |
| GR | General Registry |
| HAD | Home Affairs Department |
| HATS | Harbour Area Treatment Scheme |
| HKPF | Hong Kong Police Force |
| HKSARG | Government of the Hong Kong Special Administrative Region |
| HyD | Highways Department |
| HyD TC | Highways Department Technical Circular |
| LAO | Lands Administration Office |

| Abbreviation | Term |
|----------------------|---|
| LCSD | Leisure and Cultural Services Department |
| LPM | Landslip Preventive Measures |
| LPMit | Landslip Prevention and Mitigation |
| MFC | Marine Fill Committee |
| MOD | Money of the Day |
| MTR | The Mass Transit Railway |
| MTRCL | MTR Corporation Limited |
| DPO | Digital Policy Office |
| PAH | Project Administration Handbook for Civil Engineering Works |
| PDF | Portable Document Format |
| PDS | Project Definition Statement |
| PEPO(FM) | Principal Environmental Officer (Fill Management) |
| PFA | Pulverised Fuel Ash |
| PFC | Public Fill Committee |
| PGLS | Principal Government Land Surveyor |
| PLP | Public Lighting Programme |
| PWP | Public Works Programme |
| PWPIS | Public Works Programme Information System |
| PWSC | Public Works Sub-Committee |
| RAE | Resources Allocation Exercise |
| RC | Recurrent Consequence |
| SA Certificate | Certificate of Stability Assessment of Slopes and Retaining Walls |
| SE/Computer Services | Senior Engineer/Computer Services |
| SETW | Secretary for the Environment, Transport and Works |
| SFST | Secretary for Financial Services and the Treasury |
| SGE/GI | Senior Geotechnical Engineer/Ground Investigation |
| SGE/Lab | Senior Geotechnical Engineer/Laboratory |
| SLA/LA | Senior Landscape Architect/Landscape Architect |
| TB TC | Transport Bureau Technical Circular |
| TD | Transport Department |
| TPDM | Transport Planning and Design Manual |
| TFS | Technical Feasibility Statement |
| UU | Utility Undertakers |
| WBTC | Works Bureau Technical Circular. or Works Branch Technical Circular |
| WMCG | Works and Maintenance Committee on Greening |
| WSD | Water Supplies Department |

II. GLOSSARY OF TERMS

II.01 Words and expressions to which meanings are assigned in this Chapter of the Project Administration Handbook for Civil Engineering Works (PAH) shall only apply to this Chapter.

II.02 In this Chapter of the PAH the following words and expressions shall have the meaning hereby assigned to them except when the context otherwise requires:

“Government” means the Government of the Hong Kong Special Administrative Region.

“project office” means the office responsible for the planning, design and construction of the project and “project engineer” means the officer in the project office responsible for the planning, design and construction of the project.

(Where these functions are performed by different offices at different stages, the project office shall mean the office responsible at each particular stage.)

1. GENERAL CONSIDERATIONS FOR DESIGN

1.1 AUTHORITY

Preliminary and detailed design of capital works projects should commence in accordance with the project status indicated in FC No. 7/2017.

1.2 RESOURCES

The design should be undertaken either:

- (a) By in-house staff, or
- (b) By consultants, or staff of other departments/offices/divisions in cases where capacity to undertake the design does not exist in-house, or where there is a lack of in-house expertise, or
- (c) By quasi-government organisations or private parties in cases where the design and construction of the Works are entrusted to them.

Reference should be made to Chapter 1 (Project Planning) and the Handbook on the Selection, Appointment and Administration of Engineering and Associated Consultants (EACSB Handbook) on the resources planning and the procedures for the employment of consultants for design of projects respectively. Reference should also be made to Chapter 8 (Term Contract Works) regarding situations mentioned in sub-paragraph (c).

1.3 DESIGN OBJECTIVES

The basic aim of the design process is to produce a design that is:

- (a) Capable of performing the intended functions throughout the design life,
- (b) Environmentally acceptable, both during construction and in the long term,
- (c) Within the scope as defined in the PDS, TFS or as approved by Finance Committee,
- (d) Economical in terms of both capital and recurrent costs, and
- (e) Free of potential hazards and risks to the clients, frontline workers, users and maintenance parties as far as possible.

In connection with (d) above, the project engineer should exercise the best control of the project cost and the following aspects should be considered critically (DEVB's memo ref. () in DEVB(W) 505/83/04 dated 3.8.2015):

- (i) Fit-for-purpose designs are designs with appropriate optimality criterion and robustness. Such designs should be adopted and over-redundancies, such as temporary provisions and standby equipment which are not fully justified, should be cut down. In addition, the adoption of standard or precast designs for cost saving and/or better work efficiency purposes should be explored,
- (ii) Consideration on optimum contract packaging should be made from a cost saving perspective. There is no hard-and-fast rule on the sizing of contracts, but there is strong tendency that works contracts exceeding \$1 billion may exceed the capability of many Group C contractors. Splitting into contracts below this value will help upkeep tender competition,
- (iii) Where substantial electrical and mechanical (E&M) works are involved in the main building/civil engineering works contracts, consideration should be more favourably made to the direct letting of E&M works contracts or the use of nominated E&M sub-contracts as the lumping of substantial E&M works into the main building/civil engineering works contracts might lead to a higher management overhead and project risk at the E&M sub-contractors' front and hence a higher tender price, and
- (iv) Discretion should be made to look into the merits of the standardised requirements (including those in prevailing circulars, planning manuals or handbooks) which have been developed in the past for their respective justifications and may lead to additional cost in the project, and to review whether the additional cost arising from such requirements is justified. In case substantial cost can be saved without seriously affecting the original intent of the policy associated with such requirements, exemption from relevant authority (such as the Works Branch of DEVB) in complying with these requirements should be sought.

The project engineer should give due consideration to the following:

- (a) Safety, both during construction and in service,
- (b) Appearance, and compatibility with other adjacent private and public projects,
- (c) Construction methods and imposed constraints,
- (d) Possible future expansion and development,
- (e) The effect on utilities,
- (f) Future inspection, maintenance and operation,
- (g) Prevention of accidental damage requiring repair beyond the scope of routine maintenance, e.g. serious damages to bridges by vehicles/ships with illegally high loads/masts,
- (h) Adoption of energy efficient features and renewable energy technologies in government projects and installations,

- (i) Adoption of a strategic and holistic approach to greening and landscape and urban design in order to blend in with the adjacent developments and projects, and
- (j) Adoption of a flexible and balanced approach for tree planting.

The following considerations should also be borne in mind by the project engineer:

- (a) Administrative procedures, particularly that required for land and legal matters, must progress in parallel with the design. Project engineers should note that Land (Miscellaneous Provisions) Ordinance has been put into force. The administrative procedures relating to this Ordinance should be taken into account when excavation is required in the project.
- (b) The need to obtain specialist advice (architectural, structural, geotechnical, environmental, landscape, traffic, water supply, drainage, electrical and mechanical and marine works, etc.) should be identified as early as possible and sufficient lead time should be allowed,
- (c) The social, legal, economic, technological, natural and political environment should be borne in mind when selecting a preferred design option,
- (d) Government policies and traditional practice should also be considered when determining a preferred design option, and
- (e) The need to clear technical vetting requirements by the relevant Authority should be identified as early as possible and sufficient lead time allowed. A list of some common authorities is set out at Appendix 4.5. Project engineers, however, should note that the list might not be exhaustive.

With regard to safety in design, for new capital works projects (excluding Design & Build projects) with estimated construction cost equal to or exceeding \$500M, the project engineer should follow the “Design for Safety” (DfS) process to avoid introducing a hazard to the workplace by eliminating it in the first place at the planning or early design stage. The project engineer should refer to “Guidance Notes of Design for Safety” and “Worked Examples of Design for Safety” via the following link:

http://www.devb.gov.hk/en/publications_and_press_releases/publications/index.html.

For public works projects where Systematic Risk Management (SRM) under ETWB TCW No. 6/2005 is adopted, the project engineer is recommended to expand the SRM to include DfS in order to achieve the best project outcomes more efficiently.

1.4 METHODOLOGY

The design of a project is generally an iterative process, involving the following basic steps:

- (a) The formulation of a conceptual design,
- (b) The identification of suitable alternatives, and the selection of a preferred basic scheme,
- (c) The detailed design calculations and analysis, and
- (d) The drawings.

It is vital to carry out the design by going through these steps in sequential order and in a thorough, careful and systematic manner in order to ensure the integrity of the design, and to avoid any abortive work in the advanced stages of the design process.

All stages of the design should be covered by proper documentation for ease of future reference, revision and checking.

1.5 DRAWINGS

1.5.1 Organisation

Drawings for projects should normally comprise: -

- (a) A general layout plan that also shows the location of the project,
- (b) A setting out plan,
- (c) General arrangement of the major elements of the projects (e.g. structures), and
- (d) Detailed drawings including reinforcement details, drainage details, utilities, etc.

1.5.2 Standards

Standards of drawings for projects should conform to the requirements of the Computer-Aided-Drafting (CAD) Standard for Works Projects (CSWP) stipulated in ETWB TCW Nos. 38/2002 and 38/2002A. Divisions/offices should also stipulate departmental requirements on drawings for works projects to suit.

Drawings should normally be in A1 or B1 size.

The desirable scales for the drawings depend on the nature and complexity of the Works. Divisions/offices should have standardised scales, which should be chosen for the particular types of drawings to communicate information clearly and accurately.

1.5.3 Numbering

The naming of CAD drawing files should conform to CSWP requirements. In addition, divisions/offices should also standardise the numbering system for the drawings.

1.5.4 Preparation

The project engineer should ensure that the design has been correctly translated onto drawings, i.e. the details correspond with design assumptions, philosophies and calculations. (Appendix 4.1 on design checklist and delegation of design).

1.5.5 Circulation

Drawings should be circulated to all relevant parties for comments and agreement where appropriate. The general layout plan should be circulated in accordance with Section 2.5.2. General arrangement drawings, and where necessary detailed drawings, should be circulated for agreement to departments responsible for future maintenance and operation.

1.5.6 Checking and Approval

All drawings must be checked, approved and accordingly signed before issue unless they are issued as 'advance', 'provisional' or 'preliminary' copies. In general, the project engineer should sign for 'design', the checking officer should sign for 'checked' and the Chief Engineer/Regional Office Head should sign for 'approved', for each drawing, or to suit the signing arrangement considered appropriate by project offices. In some cases where other departments are involved, such as structures required by E&M installation work, e.g. pumping stations for WSD projects, the drawings should also be checked and signed by an appropriate officer in that department to ensure that the design objectives (Section 1.3) have been met and all their requirements have been incorporated (Ref.: Appendix 4.1).

1.6 SITE INVESTIGATION

A properly planned site investigation (including adequate supervision of the ground investigation and laboratory testing) is essential to identify the geotechnical problems of a site and provide sufficient data for safe and economic design and construction. A ground investigation should therefore be planned by a suitably qualified and experienced person who is thoroughly familiar with the project requirements, and it should not be delegated to junior or inexperienced members of staff.

At least four months lead time should be planned for major ground investigations. Otherwise, it may not be possible to complete the field work and laboratory testing according to the required schedule.

1.6.1 Relevant Guidelines, Standards and Sources of Information

Chapter 7 of the latest Geoguide 2: Guide to Site Investigation gives guidance on the planning of a ground investigation, and Chapter 15 of the latest Geoguide 2 advises on suitable personnel on this.

DEVB TCW No. 1/2019 gives procedures to be followed for ground investigation in the vicinity of the MTR.

Guidelines and requirements relating to tunnel works are given in the latest Geoguide 2: Guide to Site Investigation and ETWB TCW No. 15/2005.

Guidelines and requirements relating to foundation works in areas underlain by marble and marble-bearing rocks are given in GEO Technical Guidance Note No. 12, GEO Technical Guidance Note No. 26, and ETWB TCW No. 4/2004.

Guidelines on planning and implementation of ground investigation projects in ecologically sensitive areas are given in Appendix 4.20.

The Geotechnical Information Unit (GIU) of the Civil Engineering Library (CEL), Civil Engineering and Development Department should be consulted in all cases during the planning of a ground investigation. The GIU contains comprehensive records of ground investigation throughout Hong Kong, as well as laboratory test results on soil and rock samples. The operations of the GIU are described in Section 7.6.3 of Chapter 1 of PAH.

1.6.2 Procurement of Ground Investigation

The methods available to Government departments for procuring ground investigation and laboratory testing are as follows:

- (a) Ground investigation fieldwork – This shall be carried out under GEO's term contracts or under individual ground investigation contracts let by the project office or its consultants. Requests to GEO for investigations estimated to cost in excess of the financial limits stated in GEO Ground Investigation Note (available on CEDD website) will in general be considered for execution through individual contracts, depending on the nature and scope of the investigation and the current commitments of the GEO term contractors.
- (b) Laboratory testing – This shall normally be carried out at the Public Works Central Laboratories or under a soil and rock testing service contract administered by GEO. However, where an individual contract is let for the ground investigation field work, the laboratory testing should normally be included in the contract.

The Materials and Testing Division of GEO provides a service to other departments with the Government by letting and administering term contracts for land and marine ground investigations including geophysical survey. Chief Geotechnical Engineer/ Materials and Testing (CGE/M&T) is the Service Manager of the term contracts. Requests of land-GI, marine-GI and geophysical survey should be addressed to CGE/M&T (Attn: SGE/GI1 or SGE/GI2).

Soil and rock testing service contracts are managed by the Materials and Testing Division of GEO, and the Government Representative for these contracts is Chief Geotechnical Engineer/Standards & Testing (CGE/S&T). Requests for soil and rock testing should be addressed to CGE/S&T (Attn.: SGE/Lab) with submission of a detailed laboratory testing schedule.

Funds for site investigation (including ground investigation and laboratory testing) are provided as follows:

- (a) For projects in Category A, from the project vote,
- (b) For projects in Category B either,
 - (i) From block allocation, if the amount does not exceed \$50 million, or
 - (ii) By part upgrading to Category A if the amount exceeds \$50 million
- (c) For projects in Category C, or projects not included in the PWP, the procedures in (b) above, and in accordance with the FC No.7/2017,
- (d) For projects in Category D, from the block allocation, and
- (e) For LPMit works, from the LPM Block Allocation.

1.6.3 Procurement through Individual GI Contracts or Included in Works Contracts

Where provisions for ground investigations are included in contract documents for works contracts, Government departments shall ensure that these documents stipulate that only contractors on DEVB's List of Approved Suppliers of Materials and Specialist Contractors for Public Works, Category of Ground Investigation Field Work and for Category of Soil and Rock Testing shall be employed for such works, and the Materials and Testing Division shall be advised of the works.

Before the project office or its consultants calls tenders for a ground investigation contract, a copy of the proposed tender documents shall be submitted to CGE/M&T in order that they may advise on the technical aspects of the tender documents. This advice shall be obtained **prior** to sending documents to contractors on DEVB's List of Approved Specialist Contractors for Ground Investigation Field Work.

Where the project office or its consultants administers a ground investigation contract, soft copies of the priced contract documents shall be submitted to CGE/M&T. Meanwhile, all quarterly reports on the performance of the contractor shall be sent to the Materials and Testing Division.

For ground investigation works included in capital works contracts, there is no need to submit the proposed tender documents to the CGE/M&T for advice on technical aspects. Nor is there a need to submit quarterly reports on the performance of the contractor to the Materials and Testing Division.

1.6.4 Procurement through GEO's Term Contracts

GEO Ground Investigation Note describes the arrangements in which ground investigation, including laboratory testing, is to be procured through the term contracts/service contracts administered by the Materials and Testing Division of GEO. It also details the responsibilities of the parties involved. The client departments should follow the guidelines given in GEO Ground Investigation Note in order for them to obtain a satisfactory ground investigation service through the Materials and Testing Division.

Funding for the procured services, in the form of separate Allocation Warrants or Works Expenditure Authorisations, should be directed to CGE/M&T for ground investigation field work and laboratory testing, respectively.

To obtain a preliminary estimate of the cost of ground investigation works and the associated laboratory testing, and to determine the need or otherwise for an individual contract, an initial request for work, including all details of the planned land or marine investigation and the types of tests required, may be forwarded to CGE/M&T of GEO, as appropriate. CGE/M&T can also give advice on the method of procurement to be adopted and the programming aspect.

The client department or its consultants is responsible for liaising with all parties concerned before and during the ground investigation period, including resolving all matters arising from the ground investigation field work such as complaints, concerns and enquiries.

The GEO's ground investigation term contractors will not undertake excavation works that are solely for the purpose of locating public utilities. Ground investigation in close proximity to known underground utilities should not be carried out in order not to damage such utilities. However, inspection pits will be sunk by a term contractor prior to the commencement of drilling and probing works to avoid any unknown underground utilities being damaged.

All untested soil and rock samples (i.e. not delivered for laboratory testing) obtained from the GI works shall be returned to the initiating department/office/division for storage or disposed of according to their instruction. If no instruction on either storage or disposal of the untested samples is received by GEO within one month after completion of the GI Task Orders, it will be taken as that they can be disposed of by the term contractor. As for the soil and rock samples that are selected for testing, the tested and untested samples shall be returned to the project office for storage if instructed (within two weeks following the issue of the final laboratory testing report) or disposed of at the discretion of the testing laboratory if no instruction is received.

1.6.5 Supervision

The Materials and Testing Division of GEO is only responsible for the administration of the term contracts/service contracts, and the level of technical supervision appropriate to the investigation must be provided by the project office or its consultants. This is essential if a cost effective investigation of adequate quality is to be carried out. Where a consultant is to be responsible for the investigation, the project office should ensure that the costs of site supervision are allowed when obtaining funds for the project.

Guidance on appropriate levels of supervision of ground investigation can be obtained from Section 4.3 in Chapter 7 of the Project Administration Handbook, and further guidance may be obtained from the Materials and Testing Division.

Details of the site supervision proposed for a ground investigation and/or laboratory testing should be provided to CGE/M&T respectively prior to the commencement of the investigation and laboratory testing. The project office will be advised if the proposed level of supervision is considered to be inadequate and any changes needed to increase the effectiveness of the investigation will be recommended.

Requirements for the provision of adequate qualified personnel for the supervision of the GI works on site and of the laboratory testing should be written into consultancy agreements, or such provision should be provided by the project officer if consultants are not involved.

Where an individual contract is let and administered by either the project office or its consultants, the contract documents shall include requirements for the provision by the contractor of sufficient properly experienced technical staff to ensure that the works are carried out according to specification.

Project Office should also provide an appropriate level of supervision for laboratory testing. The involvement of a professional at the laboratory is essential at an early stage of the programme of laboratory testing if the maximum benefits are to be gained from the programme. The personnel responsible for specifying laboratory testing and interpreting the results should be experienced in this aspects of ground investigation. They should make periodic visits to the laboratory during routing testing, and the more complex tests should be supervised full-time.

1.6.6 Specialist Advice

It may be necessary for the project office to seek the advice of a specialist on particular aspects of a ground investigation. Guidance on this is given in Chapter 15 of the latest Geoguide 2. In certain cases, it may be advisable to involve the specialist at the planning stage of the ground investigation. For example, geological information to assist the planning of ground investigations can be sought from the Hong Kong Geological Survey, Planning and Development Division of GEO.

1.7 TREE PRESERVATION

Guidelines and requirements relating to tree preservation at the design stage are given in DEVB TCW No. 4/2020. Reference should also be made to the “Management Guidelines for Stonewall Trees”, “Guidelines on Tree Transplanting”, “Management Guidelines for Mature Trees” and “Guidelines on Tree Preservation during Development” promulgated by DEVB.

1.8 DESIGN FOR ENHANCING CONSTRUCTION PRODUCTIVITY

In order to rationalise the demand for skilled workers in trades with projected shortage, the design practices given in the “Guidelines for Enhancement of Productivity of Skilled Workers in Public Works Projects” attached to DEVB’s memo ref. (38) in DEVB(Trg) 133/8 dated 17.4.2013 should be followed. The guidelines are available on DEVB’s website via the following link:

[http://www.devb.gov.hk/filemanager/en/content_29/Guidelines_Enhancement_of_Productivity_\(Mar_2013\)_English.pdf](http://www.devb.gov.hk/filemanager/en/content_29/Guidelines_Enhancement_of_Productivity_(Mar_2013)_English.pdf)

1.9 ADOPTION OF BUILDING INFORMATION MODELLING

Capital works projects with project estimates more than \$30 Million shall use BIM technology. The policy is applicable to projects in the investigation, feasibility, planning, design or construction stages in the Capital Works Programme. This policy also applies to projects entrusted to organisations outside the Government (Airport Authority, MTR Corporation Limited, private developers, etc.), sub-vented projects and private projects to be handed over to the Government. Refer to DEVB TC(W) No. 1/2025 for details. Amd No. 2/2025

Amd No. 2/2025

2. PRELIMINARY STAGE OF DESIGN

2.1 PRELIMINARY DESIGN

The preliminary design of a project to meet the design objectives (Section 1.3) should be formulated by the project engineer after a comprehensive appraisal of the project by site visits and desktop study with reference to codes of practice, design manuals, etc.

Information contained in the project handbook (Chapter 1- Section 7.2), sketches or photographs of the site, and notes of observations made on site (e.g. location of stream courses, noise sensitive areas, surrounding landscape and ground form and general character of the area) may be useful at this preliminary design stage.

The client department, maintenance and operation authorities should also be consulted regarding their particular requirements, normally by circulation of an outline layout plan as described in Section 2.5.2.

2.2 SELECTION OF BASIC SCHEME & LIFE-CYCLE COSTING CONSIDERATION

Based on the selected preliminary design, the project office should identify the possible alternatives for the project, weigh the alternatives against the design objectives and select the optimum basic scheme. When necessary, the possible alternatives should be fully discussed and evaluated.

It may be necessary to draw up preliminary concept drawings of the available alternatives, so as to quantify and to record the conceptual considerations on paper in order to identify any constraints on, and any requirements of, the project, which may have been overlooked.

At this stage, the project office should conduct comparisons of the order of costs for alternative schemes to select the most suitable scheme. Such comparisons should be made by including use of the concept of “life cycle costing”. “Life-cycle costs” refer to the total sum of the initial capital costs and an estimate of the future maintenance, operation and disposal (where appropriate) costs discounted to a net present value. The concept takes into account the design lifetimes of alternative schemes and requires determination of an appropriate period for the life-cycle costing assessment. The estimate of future maintenance, operation and disposal costs shall include the major components only in order to avoid unnecessarily tedious and lengthy calculations. When applying this methodology, the project office should pay particular attention to those features that require extensive maintenance efforts (such as horizontal drains in slope works), and/or high-energy costs (such as mechanical and electrical plant with lighting and pumping facilities), etc. When necessary, the project office may also contact the specialist departments for assistance in preparing the cost comparisons. For example, the project office may contact CEDD for advice on typical maintenance costs for slopes and/or geotechnical works, HyD for roadworks, DSD for drainage works, and WSD for waterworks, etc. Works departments should also collect life-cycle costing data as a long-term exercise, and a feedback mechanism should be established so that maintenance, operation and disposal data are collected and made available to the designer in a useful form.

It is required to carry out a review of the preliminary design completed by consultants or entrusted works agents before proceeding with the detailed design as described in Section 3.1.

Works departments shall seek comments from Geotechnical Projects Division of GEO in accordance with DEVB TCW No. 3/2018 on the schematic design of major geotechnical works if the estimated cost of:

- (i) piling or foundation works exceeds \$500 million; or
- (ii) geotechnical works (excluding piling and foundation works) exceeds \$500 million.

GEO will provide early comments to works departments on the schematic design taking into consideration of aspects, such as types of suitable geotechnical works, general layout, building configuration, road alignment etc., with a view to enhancing the cost-effectiveness.

2.3 COMPILATION OF DESIGN MEMORANDUM

It is a good practice to document the design criteria in a design memorandum for future reference. The project engineer should prepare the design memorandum detailing the project constraints, the project requirements, the design concept and criteria and their justification (including appendices showing key design data and the key elements of work), and the selected basic scheme plus the possible alternative schemes, together with a brief account of why the basic scheme was selected. Others involved in the project design, such as operation and maintenance authorities, (e.g. EMSD) should also be consulted when preparing the design memorandum. A copy of the design memorandum should be kept in the project file. An example of a design memorandum is at Appendix 4.6 for illustration.

2.4 CHECKING AND APPROVAL OF DESIGN MEMORANDUM

The design memorandum should be submitted, after scrutiny and agreement by the relevant Senior Engineer, to the Chief Engineer/Regional Office Head for approval.

Any subsequent major alterations or deviations from the approved design memorandum should be submitted for approval.

Where appropriate, a copy of the design memorandum should be sent to the client department, and the maintenance and the operation authorities, for agreement before it is finalised and adopted.

Where the design memorandum is compiled by a consultant, it should be submitted to the Chief Engineer/Regional Office Head of the project for approval.

2.5 GENERAL LAYOUT PLAN

2.5.1 Preparation

The general layout plan of a project should contain sufficient details of the Works such as dimensions, levels and sections of the main items of the project, works sites, works areas, borrow areas, major traffic diversion schemes during construction, and a key plan showing the geographical location of the Works.

The scale of the general layout plan should be appropriate to the nature and size of the Works but generally 1:200, 1:500 or 1:1000 are preferred.

The project engineer should check to ensure that all comments received during the circulation of the outline layout plan (Section 2.5.2), if any, have been properly taken care of in the preparation of the general layout plan.

2.5.2 Circulation

The general layout plan together with an explanatory memorandum should be sent to all interested parties, including utility and public transport companies, if appropriate, who should be asked for:

- (a) Their agreement to or comments on the proposals,
- (b) Details of their existing facilities/services in the area, and
- (c) Details of any work they propose to carry out in conjunction with the project or which will be required as a result of the project (including approximate costs if this is to be borne by the project vote).

It is not normally necessary to request utility undertakers to comment on/agree the proposals. However, it is important that details of existing utilities and services be made known early, and whenever possible before commencement of ground investigation, and for information to be updated regularly on the general layout plan, where appropriate.

Each division/regional office should prepare its own explanatory memoranda for the types of project usually handled by them, and a checklist for the circulation of the general layout plan. Examples of the memorandum/letter used by WSD are shown at Appendix 4.2 for illustration. These require amendments, as necessary, to suit the needs of individual departments/offices/divisions and each particular project. In accordance with ETWB TCW Nos. 7/2003 and 7/2003A, ETW Departments should use Electronic Layout Plans (ELPs) in the circulation to utility undertakers (UU) and send hard copies of Layout Plans to UU only if there are special reasons but the number of copies should be reduced to a minimum.

Gazetting procedures and consultation with Advisory Committee on the Appearance of Bridges and Associated Structures (ACABAS) in accordance with ETWB TCW No. 36/2004 should be initiated at this stage, where appropriate.

2.5.3 Checking and Approval

The general layout plan should be checked, approved and signed in accordance with Section 1.5.6. Any major alteration to the layout plan should be submitted for approval, and re-circulated as outlined above, if necessary.

3. DETAILED DESIGN AND ASSOCIATED ADMINISTRATION

3.1 CHECK LIST FOR DETAILED DESIGN

In accordance with ETWB TCW No. 19/2003, the preliminary design of a project completed by consultants or entrusted works agents should be reviewed by the Review Committee of the project office before proceeding with the detailed design to avoid abortive work and delay to the project due to changes in site conditions, design requirements or other circumstances after completion of the preliminary design.

To ensure that the detailed design is being carried out properly, the checklist in Appendix 4.1 should be attached to the current part of the design file. The relevant officer should initial the checklist to signify the completion of his part of the process and hand over the checklist with relevant files, documents, etc., to the next officer on the list.

3.2 DESIGN CALCULATION FILE

Prior to the preparation of the design calculations, the project engineer should instruct the general registry of the office/division to open a design calculation file, which should be a sub-file of the project file. Calculations may also be kept in the form of a bound document and placed in the library for reference.

All design calculations should be properly filed sheet by sheet as soon as they are completed.

3.3 DESIGN CALCULATIONS

3.3.1 Format

All design calculations should be carried out on standard calculation sheets (Form GF 515) using a soft dark coloured pencil or pen suitable for photocopying and scanning, spreadsheets or other electronic file format.

3.3.2 Presentation

Design calculations should be properly presented to facilitate future reference, revision and checking. The following points should be noted:

- (a) Calculation sheets should be numbered and an index/table of contents be provided,
- (b) The purpose of each calculation should be made clear by appropriate headings or descriptive sentences,
- (c) The source of each formula should be given when first used,
- (d) Each symbol should be defined when first used, and
- (e) The same symbol should be used consistently for the same parameter throughout a set of calculations.

3.3.3 Contents

The design calculations should include the following, where appropriate:

- (a) An outline of the design objectives,
- (b) Any specific requirements considered, including loadings, flow capacities, clearances, exposure conditions, etc.,
- (c) Any special factors considered, such as durability requirements, access to the Site, effects of or on adjacent structures,
- (d) The design assumptions and parameters, including materials properties, soil properties (with reference to the ground investigation reports and laboratory testing),
- (e) An outline of the design philosophy and method, with justification in case non-standard design is adopted, and with references to codes and other publications,
- (f) A list of computer programs used, and
- (g) Calculations, including for example, contour plans for catchment areas, manufacturer's literature for specialist products, such as bridge bearings, etc.

3.3.4 Standard Designs

Standard designs included in standard drawings, manuals, etc., should be used where appropriate, with adequate cross-references to them given in the calculations.

3.3.5 Designs Similar to Previous Projects

Where a design, or a part thereof, is the same as a previous design, the calculations need not be repeated, but full reference must be made in the design calculations.

3.3.6 Computer Analysis

Where a computer analysis is used as part of the calculations, the programs used must be listed in the design concept record (Section 3.3.3 (f)) with a statement describing the analytical theory of the programs. Only programs independently checked and validated may be used. Approximate calculations should also be made to verify the computer program output.

The GEO maintains a system of approved computer programs for designing and analysing the behaviour of geotechnical features, including slopes, retaining walls, excavations, foundations, embankments and tunnel works. It is advisable to seek early agreement to the use of any geotechnical computer program from the Planning and Development Division of GEO.

If a new computer program is employed, a documentation of the program is required and a copy of the documentation should be filed in the design calculation file. For documentation and use of computer programs and interpretation of results of computation, personnel who are competent to practice in the particular engineering discipline, and have a

good understanding of the theory of the mathematical modelling and experience in the use of computer programs should be engaged. This requirement is particularly important for programs, which are based on numerical modelling techniques such as finite element and finite difference, as considerable experience and familiarity are needed for successful application of the models.

The computer input, output and program manuals should comprise part of the design calculations. They may, however, be filed separately provided that full cross-reference is made in the design calculations.

3.3.7 Survey Data and Computation Files

Survey data and computations may be filed separately in accordance with survey procedures. The calculation file should, however, contain full cross reference to these survey data and computations at relevant points of the design calculations.

Survey and Mapping Office, LandsD provides various types of survey and mapping products for use by government departments and their contractors/consultants. Detailed arrangement can be found in Section 7.4.6 of Chapter 1. Works departments should also provide all geospatial data of their projects to Survey Mapping Office for updating the centralised land survey and mapping information (see Section 5.4.3 of Chapter 3 of PAH).

3.3.8 Drawing List

A list showing the numbers and titles of all drawings related to the design calculations should be kept in the calculation file. This list should be updated accordingly whenever revisions are made.

3.3.9 Signing of Design Calculations

All design calculations should be signed and dated by the project engineer as they are prepared. (see notes in Appendix 4.1 on delegation of design).

3.3.10 Arithmetical Checks of Design Calculations

When the design calculations are completed, or at convenient intermediate stages, they should be passed to an officer (such as an assistant engineer, a civil engineering graduate, or a quantity surveying officer as appropriate) to carry out an arithmetical check. Every page of the calculations should be included in this check and should then be signed and dated by the officer, or a summary of these page numbers shown and signed. The purpose of this check is to ensure arithmetical mistakes are not made in the design calculations and it should not be confused with the design certification and checking in Section 3.5.

3.4 DESIGN RECORDS

3.4.1 Permanent Design Records

Permanent design records normally comprise the following:

- (a) The complete set of design calculations (including all design calculation files) (Section 3.3),

- (b) The complete set of drawings (Section 1.5),
- (c) The computer input, output and program manuals (Section 3.3.6),
- (d) The survey data and computation files (Section 3.3.7), and
- (e) Digital copies of the records, where appropriate.

Permanent design records should be maintained by the drawing office of the division/regional office. The officer in charge of the drawing office should compile, and submit to the project engineer for checking, an index for the permanent design records classified according to the types of design, e.g. bridges, piers, drainage structures, run-off calculations, geotechnical works, etc. The drawing office head shall maintain and update the index, and a copy of the updated index should be forwarded to the departmental library for reference by other departments/offices/divisions. For ease of reference and storage, it is recommended that drawing office/departmental library should keep additional electronic copies of the design calculations (in PDF format as recommended in the HKSARG Interoperability Framework published by DPO).

3.4.2 Design Notes

In dealing with problems arising from the design of particular projects, information is often acquired or design methods are evolved which may be of relevance to other cases. Information acquired and design methods evolved in this manner should be recorded as "design notes" and should be filed in the design calculation file for the project.

3.4.3 Checking of Design Records

When the permanent design records and design notes are compiled, they should be checked by the project engineer.

3.4.4 Submission of Site-specific Geotechnical Reports to the Geotechnical Information Unit (GIU)

Geotechnical reports should be compiled with the factual data (usually contractor's ground investigation and laboratory testing reports) and the interpretative information contained in separate volumes.

When any ground investigation (including land or marine geophysical survey) is carried out for a Government project, a soft copy (in pdf format) of the contractor's final ground investigation field work report(s) and any associated laboratory testing report(s) should be submitted directly to the GIU by the project office, together with any associated digital data (which should be in AGS or other recognised format) within three months upon the finalisation of the report(s). Each report should be accompanied by a completed Document Submittal Form (available from the CEL) stating that the data in the report are factual data and the report does not contain any interpretative information. If a report comprises multiple volumes, these should be listed on the Document Submittal Form. These factual reports are kept in the Public Section of the GIU. For those ground investigations carried out under either a term contract or an individual contract administered by the GEO, the necessary submissions will be undertaken directly within the GEO, and therefore no action by the project office is necessary.

Geotechnical reports which contain interpretative information and are submitted to the GEO in support of Government developments are passed to the GIU via the GEO District Divisions and are kept in the Government Section of the GIU.

The GIU does not contain any documents which are classified as Restricted, Confidential or a higher category, and such documents should not be submitted.

3.5 CERTIFICATION AND CHECKING AND AUDITING OF DESIGN PROCESSES

3.5.1 General

This Section sets out the guidelines for carrying out independent checking on new works and associated modification of existing works designed in-house and by consultants or contractors employed by the Government. These guidelines do not modify the contractual or legal responsibilities of any party for the work carried out, including without limitation the Designer as defined in Section 3.5.2 and the Checking Engineer as defined in Section 3.5.3.

The objective of the independent checking is to ensure:

- (a) compliance of the design with the project office's requirements, relevant design standards and statutory requirements;
- (b) validity of design concepts, methods and assumptions;
- (c) applicability, accuracy and validity of the computer programs and models used in the design;
- (d) accurate translation of the design into drawings and specifications; and
- (e) practicality and adequacy of key details.

3.5.2 Designer

For projects designed in-house, the Designer is generally the project engineer. For projects designed by consultants or contractors employed by the Government, the Designer is the professional, the team of professionals, the company or the organization being responsible for the design.

3.5.3 Checking Engineer

For projects designed in-house, the Checking Engineer is generally the checking officer, separate from the project engineer, responsible for the independent check of the design. The Chief Engineer/Regional Office Head is responsible for appointing a suitable checking officer.

For projects designed by consultants or contractors employed by the Government, the Checking Engineer is the professional, the team of professionals, the company or the organization separate from the Designer, except for the case (a) in Section 3.5.4, and being responsible for the independent check of the design. The project office shall arrange with the Designer the checking of the works by a Checking Engineer. The Checking Engineer proposed

to be appointed by the Designer shall be approved by the project office in advance. If the Checking Engineer is not in the same organization as the Designer, the Designer should submit to the project office documentary evidence on the engagement of the Checking Engineer, such as employment letter, for the checking by the project office. Should the project office be dissatisfied with the performance of the Checking Engineer at any time, the project office may, having given reasonable notice of dissatisfaction, order the dismissal and replacement of the Checking Engineer.

In all cases, the Checking Engineer should be a professional engineer suitably experienced in the type of Works being checked.

3.5.4 Design Checking Approach

The design should be checked as a whole using one of the following approaches corresponding to the risk and complexity of the Works:

- (a) For simple and straightforward designs, the designs should be checked by a Checking Engineer, generally for correctness of assumptions and concepts, the method of working, practicality of construction and order of size, plus some detailed checking of critical members or sections. The Checking Engineer is given the design memorandum, design calculations and drawings of the Works as designed. The Checking Engineer need not be an officer from outside the design team, although it is always desirable to have a Checking Engineer who is not associated with the design.
- (b) For complicated or unusual Works, or for Works, which could result in serious consequences if they fail, complete and thorough checking by a Checking Engineer independent of the design team should be executed. Under this approach, the Checking Engineer is given drawings of the Works as designed, the design memorandum, other information on functional/performance requirements and applicable design standards of the Works, but without the design calculations. The Checking Engineer then verifies the design as shown on drawings by executing an independent set of calculations.
- (c) For complicated Works or Works of a nature that there is limited local experience, such as a very long-span bridge, tunnelling works or major underground structures, the project office shall consider if a Checking Engineer from an independent organisation which is separate from that of the Designer should be employed to vet the structural or geotechnical design of the whole or part of the Works.

The Chief Engineer/ Regional Office Head should decide which checking approach is to be adopted for each individual project.

3.5.5 Design Checking Report

For projects designed by consultants or contractors employed by the Government, to which the design checking approach in Section 3.5.4(b) or (c) is applicable, the Checking Engineer should prepare a design checking report providing details of the design checking and submit directly to the project office, not via the Designer, for comments.

3.5.6 Design and Check Certificate

For projects designed in-house, the project engineer should certify the correct completion of the design process and the checking officer should certify the completion of the checking process in a standard certificate (Appendix 4.3) and tenders should not be invited without this certificate.

For projects designed by either consultants or contractors employed by the Government, when the design checking has been completed and all necessary amendments to the design calculations, specifications and drawings have been made and checked by the Checking Engineer, the Designer and the Checking Engineer shall sign the “Design and Check Certificate” (Appendix 4.22), or other form as agreed with the Chief Engineer/ Regional Office Head. The original copy of the “Design and Check Certificate” shall be submitted by the Checking Engineer directly to the project office, not via the Designer, for record purpose. The project office must exercise caution to examine the “Design and Check Certificates” submitted. Unless there are justifiable reasons acceptable to the project office, the Designer shall exercise every effort to ensure that no drawings shall be issued for tendering or construction until the “Design and Check Certificate” (Appendix 4.22) has been accepted by the project office.

3.5.7 Auditing of Geotechnical Aspects by GEO

The District Divisions of the GEO, CEDD exercise geotechnical control over public developments by auditing the geotechnical aspects of the designs of permanent works and, in the case of tunnel works, the associated temporary works, and the adequacy and standards of site supervision. Geotechnical submissions, as defined in Section 4.6.2, are required to be submitted to the GEO for auditing and design vetting (ETWB TCW Nos. 29/2002, 29/2002A, 4/2004 and 15/2005, and DEVB TCW No. 3/2018). For slopes and retaining walls, foundation works within the Scheduled Areas of the Northwest New Territories and Ma On Shan and the Designated Area of Northshore Lantau, tenders should not be invited for any part of the geotechnical works until the geotechnical design has been accepted by the GEO. For tunnel works, where the GEO raises major geotechnical concerns on the public safety aspects of the geotechnical design (or the related Particular Specification or the Employer’s Requirements (for Design and Build (D&B) contracts)), the project office must resolve such concerns with the GEO before tenders are invited. For projects that involve rock blasting, the project office should submit a Blasting Assessment as part of the geotechnical submissions to the GEO for comment and agreement. Tenders should not be invited for any part of the geotechnical works until the Blasting Assessment has been accepted by the GEO.

3.6 REVISION OF DESIGN CALCULATIONS, RECORDS AND DRAWINGS

Design calculations, records and drawings should be revised and updated as the need arises. Major design revisions should be checked in the same manner as the original design.

For the compilation of as-constructed design calculations, records and drawings, reference should be made to Chapter 7 (Contract Management).

3.7 DESIGNS BY CONSULTING ENGINEERS

For projects employing consultants for planning and design, the consultants shall report in the monthly progress meetings the status of design checking to enable the project office to be informed of the progress of the design checking.

The consultants should be requested to submit the complete set of design calculations, records and drawings to the client office/division at the end of the design stage, together with a certification (Appendix 4.7 of EACSB Handbook) for the proper completion of the design process and checking of the design. The consultants should be requested to undertake and warrant to the client office/division that the client office/division will become the absolute and exclusive owner of the complete set of design calculations, records, drawings and documents and all intellectual property rights subsisting therein free from all encumbrances save those intellectual property rights belonging to a third party.

3.8 DESIGNS BY AND FOR OTHERS

The agreement of the Chief Engineer/Regional Office Head should be sought for the design of projects by and for other divisions/offices. A record of such should be kept in the project file.

At the end of the design stage, the design division/office should forward the complete set of design calculations and drawings to the divisions/offices on whose behalf they have undertaken the design, together with a standard certificate (Appendix 4.3) for the proper completion of the design processes and checking of the design.

3.9 THE REASSIGNMENT OF ACTIVE PROJECTS

Projects should preferably not be reassigned between divisions/offices/departments while action is continuing in any particular phase (design, tendering, construction as the case may be). Where, however, there are compelling reasons for effecting such a transfer, the division/office/department handling the project must provide the division/office/department taking-over with handover notes highlighting the action required to complete that phase, and drawing attention to any unusual circumstances or peculiarities.

3.10 DESIGN REVIEW AND IMPLEMENTATION OF BUILDABILITY EVALUATION SYSTEM

(Ref.: DEVB TCW No. 6/2018 & DEVB TCW No. 6/2020)

The 2016 Policy Address announced that the Government should strengthen cost control on public works projects, and to reduce unnecessary design and contractual requirements. DEVB has developed a buildability evaluation system for public engineering works projects contracts funded under Public Works Programme (BES(E)) to enhance project time and cost management and increase construction productivity.

The BES(E) is developed based on the “3S+ Principle”. Apart from “Standardisation”, “Simplification” and “Single Integrated Elements”, the BES(E) has incorporated project life cycle management and coordination in order to achieve the objectives set. The BES(E) comprises 5 Modules covering

“Management and Coordination”, “Site Planning and Usage”, “Details of Design”, “Maintenance Requirements” and “Innovation and Creativity”. Further down the hierarchy, each Module is subdivided into Items and Aspects. Relative weightings are assigned to each Module / Item / Aspect of the BES(E) to reflect their relative significance in achieving productivity gain as well as time and cost saving. The weightings are mainly determined by professional judgement and will be reviewed and suitably adjusted in the course of implementation when more data are collected from completed public engineering works projects in order to make the BES(E) more robust.

BES(E) is implemented in stages and applies to works contracts funded under Public Works Programme, except Design and Build projects and projects entrusted to organisation outside Government. The first stage of implementation was completed on 31 Oct 2021 in which the BES(E) involved only data collection from completed public engineering works projects to refine the system.

The second stage of implementation started on 1 November 2021. In the second stage, BES(E) assessment and design review (without passing score) shall be conducted prior to invitation of tender for works contracts (except Design and Build projects and projects entrusted to organisation outside Government) with estimated contract values exceeding \$100 Million. Also, BES(E) assessment shall be conducted for such substantially completed works contracts with anticipated final contract values exceeding \$100M and without conducting any previous BES(E) assessment. These BES(E) assessment results of substantially completed works contracts are not required to be submitted to the Design Review Committee for review. The role of the Design Review Committee set up under the ETWB TC(W) No. 19/2003 shall be expanded to include review of detailed designs, including the BES(E) assessments, prior to invitation of tender for works contracts with estimated contract value exceeding \$100 Million. The project teams, and the consultants if engaged, shall follow paragraph 8 of ETWB TC(W) No. 19/2003 and the BES(E) Guidelines to attend the review meeting(s) and present their detailed designs and the BES(E) assessment to facilitate the vetting.

In the third stage of implementation that starts on 1 Mar 2023, BES(E) assessments and design review are conducted with passing score. The timeframe for implementation of the BES(E) is detailed in Section 2 of the BES(E) Guidelines.

A dedicated team in the DEVB has been set up for maintaining and refining the BES(E) and the BES(S) Guidelines. To facilitate the collection of buildability data, all BES(E) assessment results and the associated documents shall be submitted to the DEVB in accordance with the BES(E) Guidelines.

The BES(E) Guidelines, together with BES(E) assessment tool and user manual, are posted on the DEVB’s website and will be updated from time to time. Prior approval of the DEVB shall be obtained for any deviation from the requirements specified in the BES(E) Guidelines to suit specific needs of individual projects.

4. GUIDELINES AND POLICIES RELATED TO DESIGN

4.1 SITE FORMATION AND RECLAMATION

4.1.1 Fill Matters

The use of marine borrow areas must be approved by the Marine Fill Committee (MFC) as stipulated in WBTC No. 12/2000. If marine sand is imported for land formation or reclamation, the project office must ascertain that it is genuinely of marine origin because river sand imported from Chinese Mainland shall not be used in site formation and reclamation. It is important that suitable Construction and Demolition (C&D) materials are used in reclamation and land formation projects so that land can be formed cheaply and disposal of C&D materials in landfill can be minimised with a view to conserving the valuable landfill space (WBTC Nos. 2/93 and 2/93B). For reclamation and earth filling projects requiring the importation of more than 300,000 m³ of fill (including the fill demand for surcharge mounds and utility zones), it is a policy requirement to consider using public fill for the Works (WBTC Nos. 4/98 and 4/98A). Subject to availability, PFA may also be used as filling materials in reclamation projects. Some guidelines explaining the procedure for using PFA as general fill in reclamations can be found in WBTC No. 14/94 and its subsequent revisions. Guidelines on the design of reclamation are contained in the Port Works Design Manual Part 3 – "Guide to Design of Reclamation".

The importance of adequate compaction of new fill slopes cannot be stressed too often. The consequences of a flowslide of loosely placed fill can be disastrous. There is no excuse for allowing fill to be placed in a loose state where its failure could endanger life or property.

The Department responsible for a contract (its consultant where one is employed) must make adequate provision well before the start of a contract for site supervision and compaction control testing, to ensure that the requirement as stipulated in the "General Specification for Civil Engineering Works (2020 Edition)" is achieved.

When tender documents are issued, the Particular Specification must draw the contractor's attention to the compaction clauses. Any excuse that tender rates did not allow for proper compaction will not be accepted.

The architect or engineer for the project will be held personally responsible for ensuring compliance with the specification.

(Subsumed from PWD TC No. 13/78)

4.1.2 Submission to GEO

All proposals for borrow areas should be submitted to GEO, CEDD for auditing the design of the proposed slopes. Particular attention should be given to the maintenance requirements of the slope, including the maintenance of the services both on the surface and underground (DEVB TCW No. 6/2011).

4.1.3 Construction and Demolition Materials (termed as “construction waste” in Chapter 2)
 (Subsumed from WBTC Nos. 25/99, 25/99A, 25/99C and ETWB TCW No. 33/2002)

The requirements stipulated in the following circulars are relevant:

| | |
|------------------------|--|
| WBTC No. 2/93 | - Public Dumps |
| WBTC No. 2/93B | - Public Filling Facilities |
| WBTC No. 16/96 | - Wet Soil in Public Dumps |
| WBTC No. 4/98 4/98A | } Use of Public Fill in Reclamation and Earth Filling Projects |
| WBTC No. 12/2000 | |
| WBTC No. 12/2002 | - Specifications Facilitating the Use of Recycled Aggregates |
| ETWB TCW No. 19/2005 | - Environmental Management on Construction Sites |
| DEVB TCW No. 6/2010 | - Trip Ticket System for Disposal of Construction & Demolition Materials |
| DEVB TCW No. 2/2011 | - Encouraging the Use of Recycled and other Green Materials in Public Works Projects |
| DEVB TCW No. 9/2011 | - Enhanced Control Measures for Management of Public Fill |

Project offices in the planning and design of projects should actively seek to minimise generation of Construction and Demolition (C&D) Materials and to reuse inert materials generated, including rock, as far as possible. To achieve this, the project office is required to draw up a Construction and Demolition Material Management Plan (C&DMMP) at the feasibility study or preliminary design stage for each project, which generates more than 50,000 m³ of C&D materials including rock or which requires imported fill in excess of 50,000 m³. The C&DMMP shall be signed off by a D1 officer. Guidelines for preparing the C&DMMP are appended in [Appendix 4.9](#).

Trip Ticket System should be adopted for proper control of C&D materials disposal in public works contracts in accordance with DEVB TCW No. 6/2010. Project officers should refer to DEVB TCW No. 6/2010 to prepare the submission(s) to Public Fill Committee (PFC) through the Secretary of PFC for inert C&D materials and/or to the Director of Environmental Protection (for the attention of PEPO(FM)) for non-inert C&D materials, as appropriate. Project officers should also refer to DEVB TCW No. 2/2011 and EPD's waste reduction website for the updated list of recognised recyclers for C&D materials in case a private recycling facility is proposed as an alternative disposal ground for the C&D materials.

The project department should set up a departmental Vetting Committee on C&D material management. The responsibilities of the Vetting Committee include: (a) scrutinising and endorsing the C&DMMP to ensure that appropriate measures have been incorporated to minimise C&D material generation; (b) ensuring the project office has made every endeavour to identify outlets for beneficial reuse and/or recycling of any surplus excavated material including rock; and (c) monitoring the implementation of the

C&DMMP and its revisions. The project office should prepare and submit the revised C&DMMP for endorsement by the Vetting Committee. In the course of project delivery, the project office should also monitor the implementation of the C&DMMP and submit regular reports to the Vetting Committee.

The suggested composition and terms of reference of the Vetting Committee are appended in Appendix 4.10. Guidelines for minimising the generation of C&D material and maximising its reuse are also appended in Appendix 4.11.

Projects generating C&D materials less than 50,000 m³ or importing fill material less than 50,000 m³ are exempted from the C&DMMP. However, the project office should establish a system similar to the C&DMMP in order to minimise C&D material generation.

The Vetting Committee should monitor and check that the actual amount of materials generated does not exceed the estimates that justify the exemption. Should the estimated or actual quantities of C&D materials exceed 50,000 m³ in the course of project delivery, appropriate control measures should be implemented and the situation should be highlighted in the half-yearly status report to be submitted to the Public Fill Committee (PFC) as stated in the ensuing paragraph.

The Vetting Committee should provide PFC with detailed explanation if the latest quarterly return on any of the yearly forecast quantity of the C&D materials (with surplus public fill generation or demand in excess of 300,000 m³) for the coming three-year period differs from that of the previous return by 100,000 tonnes or more. The endorsement authority for the detailed explanation shall follow that stipulated in DEVB TCW No. 9/2011.

The project office managing the project should monitor the C&DMMP and prepare a half-yearly status report. The Vetting Committee should scrutinise the report before submitting it to the PFC in June and December. The report should include the following :

- (a) a checklist for the C&DMMP endorsed by the Vetting Committee or the PFC,
- (b) any changes to the plan with detailed justifications,
- (c) the previous and latest estimates of the total amount of surplus C&D materials including rock that is expected to be generated by the project, and a breakdown of the nature (e.g. inert C&D materials (public fill), rock, C&D waste, etc) and corresponding quantities.
- (d) the amount of surplus C&D materials including rock that has been generated during the reporting period,
- (e) the total accumulative amount of surplus C&D materials including rock that has been generated since the project's inception; and
- (f) the programme for disposal of surplus C&D materials including rock and disposal outlets.

For projects classified as “designated” projects under Schedule 2 of the Environmental Impact Assessment Ordinance (EIAO), the C&DMMP where required under this paragraph should be submitted together with the environmental impact assessment (EIA) report to PFC for approval. The flow chart for vetting the construction waste management section of the EIA report or the environmental review report is at Appendix 4.12. It is advisable that the management of C&D materials in the EIA report adopts a similar approach as the C&DMMP, where appropriate, for consistency.

For projects which are not classified as “designated” projects under Schedule 2 of the EIAO but generating surplus C&D materials in excess of 300,000 m³ or requiring imported fill exceeding 300,000 m³, the C&DMMP should be submitted to PFC for in-principle approval prior to commencement of the detailed design. The C&DMMP should be vetted and endorsed by the departmental Vetting Committee before submitting it to PFC for approval.

4.2 MARINE WORKS

Guidelines on the design of marine works are contained in the Port Works Design Manual. For proposals on dredged/excavated sediment, the rationale for sediment removal and applications for approval of dredging/ excavation proposals and allocation of marine disposal space should be submitted to the Marine Fill Committee (MFC) in accordance with Section 4.2.1 of this Chapter and WBTC No. 12/2000. In addition to the requirements in Section 4.2.1 of this Chapter, additional control measures given in Appendix 4.21 should be taken for the management of dredged/excavated contaminated sediment.

4.2.1 Management of Dredged/Excavated Sediment (Subsumed from ETWB TCW No. 34/2002)

The requirements stipulated in WBTC No. 12/2000 “Fill Management” are relevant.

Effective Date

All projects or portions of projects which involve the marine disposal of dredged/excavated sediment and the Sediment Sampling and Testing Plan (SSTP) has not been approved by the Director of Environmental Protection (DEP) shall follow Section 4.2.1 of this Chapter.

Rationale for Dredging

The allocation of sediment disposal space at sea will not be considered until the need for removal of the sediment has first been satisfactorily demonstrated. The rationale for sediment removal must therefore be provided to the Secretary of MFC for agreement, as early as possible, preferably at the Environmental Impact Assessment Stage, if one is conducted. Volumes of Category L sediment (see Appendix 4.28) below 50,000 m³ are exempted from this requirement.

Dredging of sediment will be allowed without justification in the following cases:

- (a) emergency dredging for safety reasons or averting environmental hazards;
- (b) maintenance/deepening of the harbour fairways, berths, anchorages, navigation channels or approaches; and

- (c) maintenance (but not construction) of watercourses, rivers, stream courses, drainage channels or outfalls.

In all other cases, project proponents shall plan their projects on the assumption of keeping the mud in place. Time for consolidation of mud, with treatment if necessary, and consequential programme constraints shall be allowed for in programming. Additional time required for consolidation of mud left in place will not be accepted as justification for mud dredging. MFC will scrutinise applications for exemption taking into account factors including the practicality of performance specifications, completeness of risk management strategies, and comprehensiveness of option assessments including consideration of new technology. Where cost is considered, the estimation must include a fair and complete estimate of all cost components, including the actual cost of mud disposal (obtainable from MFC Secretariat) and necessary dredging and transportation, disposal management, monitoring and other associated activities.

Classification of Sediment

DEP, as the Authority under the Dumping at Sea Ordinance Cap. 466 (DASO), will classify sediments based on their contaminant levels with reference to the Chemical Exceedance Levels (CEL) laid down in Appendix 4.28.

Determination of Sediment Quality

Guidelines on the initial data assessment, the sampling and testing procedures, the biological test criteria, and the submission requirements are set out in Appendix 4.29. DEP may waive the sediment sampling and testing requirements in cases of:

- (a) emergency dredging for reasons of safety or averting environmental hazards; and
- (b) for small scale dredging works of maintenance nature and involving dredging volumes of less than 5,000 m³ in situ.

Previously obtained data or known history of the sediment in the vicinity should be submitted to DEP for consideration of the most appropriate arrangements for handling these materials.

Upon agreement of the rationale for sediment removal by the Secretary of MFC, the project proponent (government department or office) or its consultant shall, in consultation with DEP, assess whether the existing data can conclusively demonstrate that the sediment¹ is suitable for open sea disposal. If no such conclusion can be drawn, the project proponent must submit proposals for Sediment Sampling and Testing Plan to DEP for approval. The proposals shall be copied to the Secretary of MFC, together with details of the anticipated disposal requirements.

Upon completion of the sampling and chemical testing, the project proponent shall submit a Preliminary Sediment Quality Report (PSQR) to DEP with a copy to the Secretary of MFC. This report shall include the sampling details, the chemical testing results, quality control records, proposed classification and delineation of sediment according to Appendix

¹ "The sediment" in this paragraph and subsequent paragraphs refers to the dredged/excavated sediment for disposal under a project/contract as proposed by the project proponent.

4.28, and the information and/or records as specified by DEP in his approval of Sediment Sampling and Testing Plan.

If certain Category H sediment are found in the sediment, the project proponent will be required to carry out a biological screening² in accordance with Section 3 of Appendix 4.29, and submit a formal Sediment Quality Report (SQR) to DEP for approval. This must be done at least 3 months prior to the dredging contract being tendered or at least 2 months prior to the works order for maintenance dredging being issued. In cases where biological screening is not required, subject to the approval of DEP, the PSQR will be deemed to be the formal SQR.

At the time of approval of the SQR, DEP will specify the period beyond which the reliability of the SQR data must be reviewed. This period starts on the actual date of commencement of sampling and will be not less than three years. The project proponent shall obtain DEP's prior agreement to the review methodology and sampling locations. Depending on the review finding, further sampling and testing to update the data of the SQR may be required.

The project proponent must schedule the preparation of the SQR or its subsequent review in such a way that the SQR will still be reliable for a reasonable period of time after the award of the contract, to allow the contractor to apply for a dumping permit. The project proponent should also include a particular specification clause in the contract to draw the contractor's attention to the requirement that the SQR must still be reliable at the time of applying for a dumping permit under the DASO. The clause should also state the expiry date of the reliability period of the current SQR and that it is the contractor's responsibility to carry out, at his own expense, any work required to extend the reliability period of the SQR should he fail to apply for a dumping permit before the expiry date.

Allocation of Sediment Disposal Site

MFC will determine the most appropriate open sea or confined marine disposal site on the basis of the chemical and biological test results and formally allocate disposal space in accordance with the flow chart in Appendix 4.30. For projects with disposal requirements of less than 50,000 m³ Category L sediment, the allocation of disposal space has been delegated to DEP. The project proponent may request the Secretariat of MFC to provisionally indicate an appropriate marine disposal site or sites after the rationale for sediment removal has been agreed. An estimate of the volume and quality of sediment to be dredged, supported by available ground investigation and testing data, should be provided to the Secretary of MFC at the time of submission of the request. The contract document should include the disposal requirements from MFC & DEP, and relevant guidelines given under Notes (1) to (5) in Appendix 4.30.

Application for Marine Dumping Permit

DEP controls dumping at sea by means of DASO permits which are issued to contractors or other parties responsible for the disposal of dredged/excavated sediment. The contractor who will be undertaking the works must make a formal application to DEP for a dumping permit, and if the permit is granted, it will be the contractor's responsibility to ensure that the permit conditions are met to DEP's satisfaction.

² For Category M sediment which requires cross-boundary disposal, the project proponent should refer to the requirements set out in DEVB memo ref. DEVB(W) 515/83/04 dated 6 October 2010.

It should be noted that all new marine structures in the Victoria Harbour must be designed to be of low wave-energy reflection and that project departments should obtain agreement from CE/PW, CEO of CEDD that the structures will not cause a deterioration in the wave conditions in the Harbour. CE/PW should also be consulted for advice on the design of new marine facilities or of works, which would affect adjoining marine facilities in the close vicinity. Standard details of some marine works may be found in the CEDD Standard Drawings, but they should only be adopted after detailed checking to ensure that they are in full compliance with the Port Works Design Manual. On completion of design and before calling for tenders, the general arrangement drawings of the new marine facilities should be submitted to CE/PW for comments from a maintenance viewpoint if the works are to be maintained by CE/PW upon completion.

4.3 HIGHWAYS AND ASSOCIATED STRUCTURES

4.3.1 Road Pavements, Exclusive Highway Drainage, Railings, Barrier Fences and Parapets

The design of road pavements, exclusive highway drainage, railings, barrier fences and parapets are covered by the Guidance Notes on Pavement Design for Carriageway Construction (RD/GN/042), Guidance Notes on Road Pavement Drainage Design (RD/GN/035), Guidelines for the Provision and Design of Pedestrian Railings (Transport Department Departmental Circular No. 3/2017 / Highways Department Technical Circular No. 2/2017), Guidelines for Design of End-details of Thrie-beam Barrier Fence (RD/GN/040), Supplementary Guidelines for Design of End-details of W-beam and Concrete Profile Barriers, TPDM Volume 2 Chapter 3 Section 3.9, and a series of Road Notes, Guidance Notes and Guidelines issued by HyD. Standard details of these works may also be found in the HyD Standard Drawings. It should be noted that railings should be provided where necessary; multiple railings at the same section of the road should be avoided.

Consultations regarding the design of road pavements, etc., should be addressed to CHE/R&D, HyD.

4.3.2 Structures

The design of highway structures is covered by the Structures Design Manual for Highways and Railways. CHE/Bridges & Structures, HyD may be consulted for advice on the design of highway structures, preferably at the conceptual stage of design. On completion of design, and before calling for tenders, the general arrangement drawings should be submitted to CHE/Bridges & Structures for comments.

For projects undertaken by HyD in-house, the design of highway structures are to be under the direct control of CHE/Bridges & Structures. Therefore, CHE/Bridges & Structures should be consulted as early as possible to agree on the programme of the design work. With regard to the appearance of bridges and associated structures, ACABAS should be consulted in accordance with ETWB TCW No. 36/2004.

For capital works projects, the project office should circulate the design proposal to the Sub-committee on Access under the Rehabilitation Advisory Committee for consultation purpose if the projects fall within one of the following categories:

- (a) the project has implications to the policy of access of disabilities; and
- (b) Road/footbridge projects that will remove the existing access for Persons with Disabilities (PWDs) without re-provisioning or with re-provisioning in other manners, or where some of the facilities for PWDs will be of non-standard design.

Requirements and standards in respect of installing fire mains and hydrants on new trunk roads and elevated highway structures are given in HyD TC No. 4/2010. The criteria for the provision of covers, ramps and escalators to grade separated pedestrian facilities (such as footbridge, subway, etc.) are stated in TB TC No. 2/00. The design of lift ventilation system is covered by the Guidelines on Lift Designs with Mechanical Ventilation (HQ/GN/19).

4.3.3 Highway Alignment and Traffic Management

Guidelines for highway alignment and traffic management design are contained in the TD's Transport Planning and Design Manual. SE/Standards, Road Safety and Standards Division of TD should also be consulted on the design.

In planning a transport infrastructure project, if there is a likelihood of changes to planned developments that might significantly alter the design traffic volume or vehicle mix, the designer should, in collaboration with TD, consider different possible design scenarios to cater for likely changes and to obtain the most up-to-date planning information and parameters available at the time, particularly those which may lead to different forecasts on the proportion of heavy vehicles using the road. (Ref.: Audit Report No. 53 Chapter 10)

If the design of highways projects is undertaken in-house, the design of traffic management work (including traffic aids, directional signs and traffic signals) will be undertaken by the relevant Traffic Engineering Division of TD. If the project is undertaken by a Consultant, the traffic management design should be prepared by the Consultant and forwarded to the appropriate CTE, TD and C of P for agreement.

Traffic and directional signs should normally be ordered from CSD by the project office. It is the project engineer's responsibility to ensure that the various street furniture items erected do not obscure each other thereby jeopardising road safety. Reference should be made to HyD TC No. 10/2001 on visibility of directional signs.

4.3.4 Road Lighting and Other Illuminated Traffic Aids

Guidelines on the design of road lighting and other illuminated traffic aids are contained in the Public Lighting Design Manual. HyD should be consulted as early as possible to offer advice on the design, lighting & control equipment to be adopted, power supply distribution arrangement and the specification for the lighting installations.

For details of design responsibility, installation, wiring and electricity supply for road lighting and other illuminated traffic aids, also see the Public Lighting Design Manual.

The project office needs to submit the project as an item in the PLP and to resolve the RC issue.

4.3.5 Road Safety

CE/RSS, TD should be consulted about matters related to road safety design.

The project office should liaise closely with TD in the selection of the types of road junctions and in the design for their transport infrastructure projects, having regard to the need to comply with road safety standards and taking into account the specific site and traffic conditions which may have implications on drivers' behaviour and driving discipline.

Before commissioning a new road, the project office should liaise with TD to carry out road safety checks and work inspections. If any potential hazards are identified, the project office should implement such appropriate measures in consultation with TD to ensure road safety. (Ref.: Audit Report No. 53 Chapter 10)

4.3.6 Tactile Guide Path

Tactile guide path should be designed to contrast visually with the adjoining surfaces in order to provide clear indication of the routes to the people with low vision. Tactile tiles/blocks should be made of durable and non-slippery materials. Organisations concerned should be consulted on the visual contrast. Reference should be made to TPDM Volume 6 Chapter 8 Section 8.3.2.9.

4.3.7 Street Name Plates

For naming new roads and the associated gazetting requirements, the project office should liaise with the District Survey Office of Lands Department. The project office should be responsible for the erection of the street name plates on the new roads before the new roads are opened to public. If the completed new roads have been opened to public and handed over to the Regional Offices of Highways Department for maintenance before the names of the new roads are gazetted, the Regional Offices should take up the erection of the street nameplates upon receipt of a request from the project office. However, arranging for gazetting the names of the new roads should still be the responsibility of the project office.

4.3.8 Innovative Designs or New Construction Materials

In respect of innovative designs or new construction materials, the project office should vigilantly check the tender documents and contract specifications to avoid ambiguities in them. If there are fire risks associated with the innovative design or new construction materials, the fire-services requirements should be critically assessed and the relevant departments (such as the Fire Services Department) should be consulted before incorporating the requirements into the tender documents. (Ref.: Audit Report No. 53 Chapter 10)

The project office should ensure that market research is conducted to ascertain the supply and availability of proprietary products or new construction materials before incorporating them in the tender documents. (Ref.: Audit Report No. 53 Chapter 10)

4.4 SEWERAGE AND DRAINAGE

Sewerage Manual and Stormwater Drainage Manual provide guidelines for the design of:

- (a) Stormwater drainage systems,
- (b) Sewerage systems,
- (c) Pumping Stations and Rising Mains
- (d) Sewage treatment works,
- (e) Submarine sewer outfalls, and
- (f) Village flood protection scheme.

DSD may be consulted for advice on the design of such works.

Standard details of some common drainage and sewerage installations may be found in the DSD Standard Drawings.

ETWB TCW No. 2/2006 is promulgated to stipulate the policy on the application of the Drainage Impact Assessment (DIA) process to public sector projects. The process comprises two principal elements, a project profile and, if necessary, a DIA study. If a project is likely to have an impact on drainage system, the project office should notify the relevant regional office of DSD by submitting a project profile at an early stage of the project planning and development. Nevertheless, for project with obvious and significant drainage impact, DSD may waive the requirement for project profile and require the project office to proceed directly to DIA study. DSD should be consulted if the project office is in doubt about the need to notify. The project office should refer to this Circular for detailed procedures. Any agreed mitigation measures identified should be taken into account in the detailed design, and incorporated into the contract documents.

A deep sewage tunnel system has been constructed under the Harbour Area Treatment Scheme (formerly known as “Strategic Sewage Disposal Scheme”) Stage 1 and Stage 2A. The alignment and profile of the sewage tunnel are shown on Map No. 1 in Appendix 4.31 (subsumed with amendments from ETWB TCW No. 28/2003). The sewage tunnels and associated structures have to be protected against damage, which might be caused by construction works, and site investigation works in the vicinity of the sewage tunnels. If any part of the project falls within the ‘Protection Area’ defined Appendix 4.31, submissions to DSD and GEO of CEDD for comment/agreement are required in accordance with Appendix 4.31.

The detailed plans of drainage facilities should be circulated to the relevant DSD divisions for comments as early as possible and before finalization or calling for tenders. Detailed consultation is required for non-standard drainage items such that the operation and maintenance requirements can be incorporated into the design. Access for plant, equipment and personnel for the maintenance of the drainage installation must be adequately provided.

4.5 WATERWORKS

WSD Civil Engineering Design Manual Volume II provide guidelines for the design of:

- (a) Mainlaying,
- (b) Service reservoirs,
- (c) Pumping stations, and
- (d) Treatment works.

In addition, current practices for mainlaying work can be found in the latest version of the Manual of Mainlaying Practice. For the design of thrust blocks, reference can be made to “Guidance Note on the Design of Thrust Blocks for Buried Pipelines” published by Design Division of WSD.

CE/Design, WSD may be consulted for advice on the design of such works.

Standard details of waterworks may be found in the WSD Standard Drawings.

When a metered water supply is required for a permanent structure/building to be constructed or when an existing WSD installation will be affected by the proposed construction work, the CE of the appropriate region should be consulted for advice and comments.

4.6 GEOTECHNICAL WORKS

4.6.1 Technical References

The following documents are for the guidance of engineers undertaking the design or construction of geotechnical works:

- (a) Geotechnical Manual for Slopes,
(see also Appendix 4.25 on guidance on interpretation)
- (b) Highway Slope Manual,
- (c) Not used
- (d) Geoguide 1 - Guide to Retaining Wall Design,
- (e) Geoguide 2 - Guide to Site Investigation,
- (f) Geoguide 3 - Guide to Rock & Soil Descriptions,
- (g) Geoguide 4 - Guide to Cavern Engineering,
- (h) Geoguide 5 - Guide to Slope Maintenance,
- (i) Geoguide 6 - Guide to Reinforced Fill Structure and Slope Design,

- (j) Geoguide 7 - Guide to Soil Nail Design and Construction,
- (k) Geospec 1 - Model Specification for Prestressed Ground Anchors,
- (l) Geospec 3 - Model Specification for Soil Testing,
- (m) GEO Publication No. 1/93 - Review of Granular and Geotextile Filters,
- (n) GEO Publication No. 1/2006 - Foundation Design and Construction,
- (o) GEO Publication No. 1/2007 - Engineering Geological Practice in Hong Kong,
- (p) GEO Publication No. 1/2009 - Prescriptive Measures for Man-made Slopes and Retaining Walls,
- (q) GEO Publication No. 1/2011 - Technical Guidelines on Landscape Treatment for Slopes,
- (r) GEO Publication No. 1/2023 – Deep Excavation Design and Construction ,
- (s) GEO Report No. 15 - Assessment of Stability of Slopes Subjected to Blasting Vibration,
- (t) GEO Report No. 29 - Classification and Zoning of Marble Sites,
- (u) GEO Report No. 75 - Landslides and Boulder Falls from Natural Terrain: Interim Risk Guidelines,
- (v) GEO Report No. 104 - Review of Natural Landslide Debris – Resisting Barrier Design,
- (w) GEO Report No. 136 - Guidelines on Safe Access for Slope Maintenance,
- (x) GEO Report No. 138 - Guidelines for Natural Terrain Hazard Studies,
- (y) GEO Report No. 182 - Use of Standardised Debris-resisting Barriers for Mitigation of Natural Terrain Landslide Hazards,
- (z) GEO Report No. 227 - Guidelines for Soil Bioengineering Applications on Natural Terrain Landslide Scars,
- (aa) GEO Report No. 249 - Ground Control for Slurry TBM Tunnelling,
- (ab) GEO Report No. 298 - Ground Control for EPB TBM Tunnelling,
- (ac) ETWB TCW No. 4/2004 - Checking of Foundation Works in the Scheduled Areas of Northwest New Territories and Ma On Shan and the Designated Area of Northshore Lantau,
- (ad) ETWB TCW No. 15/2005 - Geotechnical Control for Tunnel Works, and

- (ae) Requirements for Handover of Vegetation to Highways Department (available through the website of Highways Department).

A more comprehensive and updated list of technical guidance documents which are used by the GEO as the de facto geotechnical standards in Hong Kong is given in the GEO Technical Guidance Note No. 1, which can be downloaded from the CEDD website. Some geotechnical design data are available in the Geotechnical Information Unit of CEDD for reference (DEVB TCW No.4/2016).

Standard details of geotechnical works may be found in the CEDD Standard Drawings.

4.6.2 Geotechnical Submissions to GEO

The project office shall submit to the relevant District CGE of the GEO, CEDD for auditing the details of all permanent geotechnical works relating to slopes and retaining walls, together with the findings of geotechnical investigations and studies on existing slopes and retaining walls which could affect or be affected by development or re-development under the project, or if their failure could affect lives and property within or outside the site under the project (ETWB TCW No. 29/2002). There are additional requirements on special geotechnical control for public developments including slope upgrading/improvement works located in the Mid-levels Scheduled Area (ETWB TCW No. 29/2002A). For the purpose of strengthening cost-effectiveness, GEO will convene a Design Vetting Panel (DVP) chaired by the Deputy Head of relevant district to examine works departments' submissions on major geotechnical works pursuant to ETWB TCW No. 29/2002 based on a holistic approach with due considerations on the cost-effectiveness of the project (DEVB TCW No. 3/2018). The list of constituents of a submission on geotechnical works is given in Appendix 4.8. Tenders shall not be invited for any part of the geotechnical works until the geotechnical design including any acceptance limits and investigation, survey and monitoring requirements to be included in the contract (including those based on a Blasting Assessment, if any blasting is specified or permitted) has been agreed by the GEO, except for Design & Build contracts or when the GEO gives its written consent based on conditions to be mutually agreed. For a Design & Build contract where an Independent Design Checker is appointed by the project office, the GEO may consider waiving the auditing requirement provided that the criteria set out in Appendix A of the ETWB TCW No. 29/2002 can be satisfied.

A submission covering the investigation and studies of existing slopes and retaining walls within or in the vicinity of the site is required to be submitted to GEO, even when no geotechnical works are envisaged, if such slopes or retaining walls could affect or be affected by the development or redevelopment under the project or if their failure could affect lives and property within or outside the site. Where the proposed development or redevelopment could be affected by natural terrain landslide or boulder/rock fall hazard, the project office shall submit to the GEO a natural terrain hazard study and the design of any necessary mitigation measures to be carried out under the project. Such submissions should be made to and accepted by the GEO before inviting tenders for any part of the geotechnical works for the project. Reference shall also be made to 'Guidelines for Natural Terrain Hazard Studies' (GEO Report No. 138) issued by the GEO for guidance on the requirements of a natural terrain hazard study.

For geotechnical works relating to slopes and retaining walls involving designs to be carried out by the Contractor, and where the designs are required to be submitted to the GEO for auditing, the project office shall agree with the GEO the associated GEO submission requirements to be specified in the contract prior to tendering.

For the use of prescriptive measures for stabilisation and improvement of man-made slopes and retaining walls and standardised debris-resisting barriers for mitigation of natural terrain landslide hazards, guidance on the geotechnical submission requirements is given in Section 4.6.12 of this Chapter.

For permanent foundation works in the Scheduled Areas in the Northwest New Territories and Ma On Shan and in the Designated Area of Northshore Lantau, guidance on the geotechnical submission requirements is given in ETWB TCW No. 4/2004.

For projects involving tunnel works, the project office should submit to the GEO for audit the geotechnical design documentation for all tunnel works and any associated temporary works, where such works would pose a significant risk to public life or property. Details of the information to be included in the geotechnical design submission are given in Appendix A of ETWB TCW No. 15/2005. Except for Design & Build contracts and for temporary works, where the geotechnical design is to be undertaken by the Contractor, the project office must resolve any major concerns raised by GEO on the public safety aspects of the geotechnical design before tenders are invited. The project office is advised to identify clearly the scope of works that will be designed in-house or by its consultants, including temporary works, and to engage/employ professional geotechnical engineers with relevant qualification and experience to carry out the geotechnical design and risk assessment.

4.6.3 Foundation Works in the Designated Areas/Scheduled Areas

Marble containing cavities has been found to exist under areas in the Northwest New Territories, and Ma On Shan, Shatin, which have been termed "Scheduled Areas". In addition, complex geology giving rise to difficult ground conditions has been identified beneath the reclamation for Tung Chung New Town and along the North Lantau coast where the affected area is referred to as "the Designated Area of Northshore Lantau". For public works within the Scheduled Area or Designated Area, all design details of permanent foundation works shall be submitted to GEO for checking in accordance with ETWB TCW No. 4/2004.

4.6.4 Projects Incorporating Ground Anchors

Approval is required for the installation of ground anchors, whether permanent or temporary, in Government Land, and the general principles and procedures are given in PWD TC No. 7/80 and ETWB TCW No. 16/2004. All applications to install ground anchors in Government Land should be directed to the relevant DLO of Lands Department. Temporary anchors are defined as those with a service life of less than 2 years.

Where permanent prestressed ground anchor systems are proposed in Government projects, prior approval of DCED is required under the Anchor Certification System for Permanent Prestressed Ground Anchors (ACSA). Details of the ACSA are given in ETWB TCW No. 16/2004.

The use of permanent prestressed ground anchors in a project imposes a long-term monitoring commitment on the maintenance department, which usually involves appreciable recurrent cost. Also, should deficiencies be revealed, remedial works may be difficult and expensive. For these reasons, permanent ground anchors should be used in a Government project only when other methods of providing the required support are not practicable, and when the department responsible for subsequent maintenance has been consulted and its agreement obtained (DEVB TCW No. 6/2011).

4.6.5 Projects Incorporating Permanent Reinforced Fill Structures/Slopes (Subsumed from ETWB TCW No. 24/2003)

The project department shall make a submission on the proposed works to the GEO for checking in accordance with the requirements of ETWB TCW No. 29/2002 in two stages. In the first stage, external and internal stability shall be demonstrated and the reinforcing products could be specified generically. In the second stage, when the details of reinforcing product (polymeric product accepted by CEDD or metallic product) are known, another submission shall be made to demonstrate compliance with the design requirements. Approval of the submission for both stages shall be obtained from the GEO before works on the reinforced fill commence.

In the design, consideration should be given to ways of ensuring that the reinforcing products are not disrupted by future installation of drains or utilities. The department responsible for maintenance should be consulted at an early stage where the reinforced fill structure/ slope is proposed. On completion of the works, the project department should also highlight in the slope maintenance manual any specific requirements to protect the reinforcing products, and alert the maintenance department of such requirements accordingly.

Polymeric reinforcing products have temperature- and time-dependent long-term strength and stress-strain characteristics. These products require extensive and long-term testing well in advance of the normal design phase of a project and are required to be assessed and accepted by CEDD before they are used in permanent reinforced fill structures / slopes in Government projects.

The assessment process for prior acceptance examines polymeric reinforcing products with respect to the effects of material variability, construction damage, environmental effects on material durability, and other special factors including hydrolysis, creep and stress rupture. Design data sheets of accepted polymeric reinforcing products are issued by CEDD, specifying individual products' long-term design strengths, requirements for compliance testing and the conditions for use in Hong Kong. A product register which contains design data sheets of accepted polymeric reinforcing products can be found on CEDD Website. Metallic reinforcing products, of which the long-term strength and stress-strain characteristics are well established, do not require prior acceptance for use in Government projects.

When polymeric reinforcing products are adopted in permanent reinforced fill design, the contract document should require the use of polymeric reinforcing products accepted by CEDD. The model specification for reinforcing elements as recommended in Appendix A of Geoguide 6 can be used as a reference for the preparation of particular specification. The design submission of reinforced fill structure / slope to GEO should include a copy of the design data sheets of the accepted polymeric reinforcing products together with justifications that the design complies with the conditions stipulated in the design data sheets.

4.6.6 Projects Incorporating Horizontal Drains (Subsumed from WBTC No. 10/91)

Horizontal drains are installed in both rock and soil slopes in Hong Kong. The drains installed in rock slopes are typically short and are used mainly to drain individual rock joints or local areas of groundwater seepage. Longer drains tend to be installed in soil and mixed rock/soil slopes, usually with the aim of achieving an overall reduction in groundwater pressures within the slope. This paragraph is mainly concerned with the latter type of drains.

A horizontal drain system can be an effective slope stabilisation measure provided that due care is given to design requirements and construction methods. Even where such care has been exercised, it is important to ensure that the system will perform satisfactorily in the long term by carrying out appropriate monitoring and maintenance schemes. The cost of monitoring and a commitment to long-term maintenance should be considered at the preliminary design stage in comparison with other stabilisation measures before deciding whether to adopt a horizontal drain system. Before finalising the design, the designer should also obtain an agreement for monitoring of the horizontal drain system from the maintenance authority. Where the designer is a consultant, provision should be included in the consultancy agreement to ensure that this is done. The maintenance authority shall be the department responsible for maintenance of the stability of the land concerned (see Development Bureau Technical Circular (Works) No. 6/2011: Maintenance of Man-made Slopes and Emergency Works to Deal with Landslides).

The procedures described here are intended to cover horizontal drain systems that are designed to lower groundwater pressures so that the required factor of safety of a slope can be achieved (Geotechnical Manual for Slopes, Second Edition, Tables 5.1 & 5.4, which are replaced by Tables 1 and 2 in Appendix 4.25). These procedures need not be followed for other drain systems, but regular inspection and maintenance should still be carried out.

To ensure satisfactory performance of a horizontal drain system, the designer of the system should be closely involved with the monitoring and should prepare a suitable maintenance manual with monitoring criteria acceptable and understandable to the maintenance authority. The maintenance authority should appoint a suitably-experienced maintenance officer to be responsible for compiling and interpreting the maintenance inspection records. If the maintenance authority has any reason to believe that the system is not performing effectively, this should be brought to the attention of the project office without delay. This approach is consistent with the more general guidance on slope maintenance given in Chapter 2 and 3 of the Geoguide 5 : Guide to Slope Maintenance.

Special requirements concerning the monitoring and maintenance of horizontal drains are given in Appendix 4.24.

4.6.7 Restrictions on the Use of Hand-dug Caissons (Subsumed from WBTC No. 9/94)

Hand-dug caissons have been used extensively in both foundation and other geotechnical works for many years. There are technical and financial benefits associated

with this method of construction compared with other methods. However, the disturbingly high accident rate in hand-dug caisson operations and health hazards such as noise, dust, poisonous gas, collapse of caisson linings posed to workers, as reflected in findings by the Labour Department, have given cause for considerable concern.

The practicability of a total ban on hand-dug caissons is being considered by the Government. Works Branch will be in close liaison with the Labour Department and the construction industry concerning this issue. The mitigating measures for safety and health hazards, particularly in respect of improvement in air quality within a hand-dug caisson, are also being reviewed. Whilst a total ban on hand-dug caissons is deemed impracticable at this stage, works departments are urged to give the matter extremely careful consideration before hand-dug caisson construction is permitted (see Appendix 4.13).

Works departments are permitted to include the use of hand-dug caissons in future contracts only where :

- (a) the use of hand-dug caissons is the only practicable solution or there is no safe engineered alternative, and
- (b) all necessary precautionary measures are taken to safeguard workers against accidents and health hazards.

Before opting for hand-dug caissons, an assessment should be carried out covering general safety, the cost of damage arising from dewatering and the possibility of unforeseen ground conditions. The design of caisson linings must also be examined for suitability as for any other structural temporary works.

In cases where hand-dug caissons are used, the minimum clear working space inside each caisson (i.e. excluding the lining) shall be 1.8 metres in diameter.

Any use of hand-dug caissons must receive the prior approval of the Head of Department, who may consult the Labour Department to satisfy himself that all necessary precautionary measures are taken to safeguard workers against accidents and health hazards before giving consent.

One of the most important elements in the prevention of accidents in hand-dug caisson works is the engagement of suitably qualified and experienced professionals in the assessment and investigation of the site to identify potentially unfavourable conditions that may give rise to engineering problems, and to implement the necessary precautionary and preventive measures. Likewise, the employment of suitably trained and experienced construction workers, supervised by a sufficient number of competent supervisors to ensure strict adherence to stringent safety and health requirements, is also a pre-requisite.

Works departments shall keep Works Branch (attention PAS/CCC) informed in January and June of each year of the total number of hand-dug caissons sanctioned for construction, appropriately categorised into 'difficult' or 'straightforward' sites.

4.6.8 Projects Involving Man-made Slopes and Retaining Walls

The project office should ensure that a Maintenance Manual for each slope/retaining wall formed/modified is prepared by the project engineer in accordance with Geoguide 5.

The project office needs to regularly maintain slopes/retaining walls formed/modified until these slopes/retaining walls are handed over to another maintenance party.

The project office should provide GEO with updated information on the slopes and retaining walls studied, formed, modified or removed, including plans showing the boundaries of the slope features by survey. DEVB TCW No. 2/2018 sets out the procedures for the registration and updating of the Catalogue of Slopes to be followed by the project office.

It is the government's policy to landscape every newly formed government slope. Technical guidelines on landscape treatment for new man-made slopes are given in the Integrated Landscape Design Framework – Slopes, Cyber Manual for Greening (http://devb.host.ccgo.hksarg/en/landscape_design/index.html) and GEO Publication No. 1/2011. Other guidance documents as may become available from time to time as a result of continuous research and experience gained, which are used by the GEO as de facto geotechnical standards and given in GEO Technical Guidance Note No. 1, should also be adopted.

Guidance on the use of shotcrete surfacing in maintenance works given in Appendix 4.26 should be followed.

4.6.9 GEO Checking Certificate for Geotechnical Features

(Ref.: ETWB TCW No. 20/2004)

The following paragraphs promulgate the issue of GEO Checking Certificate for Geotechnical Features (hereafter referred to as GEO Checking Certificate) where the designs or stability assessments have been checked by GEO and found to be satisfactory. The Director of Agriculture, Fisheries & Conservation, Director of Buildings, Director of Housing, Director of Home Affairs and Director of Lands have also agreed to the contents of the following paragraphs relating to GEO Checking Certificate. The project office should read them in conjunction with Section 4.6.12 of this Chapter and ETWB TCW No. 29/2002.

The policy and procedure for obtaining a GEO Checking Certificate are described in the following paragraphs, which apply to all public works projects involving public geotechnical works, including those public geotechnical works entrusted to a non-government body. The project office, which arranges the entrusted geotechnical works should, before finalizing the entrustment agreement, consult the GEO for the conditions that must be included in the agreement and complied with before a GEO Checking Certificate can be issued.

For projects with the construction contract commencing after 30 September 2001, the project office shall obtain a GEO Checking Certificate for all permanent slopes, retaining walls and natural terrain hazard mitigation measures that have been constructed, modified or upgraded, or that have been subjected to a stability assessment in a project and found to meet the current geotechnical standards. When applying for a GEO Checking Certificate, the project office should submit a Certificate of Design and Completion of Geotechnical Features (DC Certificate) or a Certificate of Stability Assessment of Geotechnical Features (SA Certificate)

together with the necessary supporting documents to GEO.

(Ref.: ETWB TCW No. 20/2004)

A quality system shall be instituted to ensure that all stability assessments, designs and amendments of design with geotechnical significance are properly checked internally by the Designer (i.e. the project office or consultant firm responsible for the stability assessment or design) and are submitted to GEO for checking and that all conditions imposed by GEO are complied with. Proper records shall be kept throughout the design and construction stages.

For submitting the DC Certificate or the SA Certificate, the project office should in general adopt the standard forms (Forms GCDIST 105b to 105d), which are available for downloading from the HKSS Website (<https://hkss.cedd.gov.hk/hkss/en/facts-and-figures/slope-information-system/index.html>) for the design and stability assessment carried out by the project office or its consultants (Form GCDIST 105b), those carried out by the Contractor in a D&B Contract (Form GCDIST 105c), and the design or alternative design by the Contractor in a non-D&B Contract (Form GCDIST 105d) respectively. For other cases such as those involving mixed government/private responsibility and those involving partially stability assessed/upgraded, the project office shall agree with the GEO the arrangement and the form of DC Certificate or SA Certificate to be used prior to tendering.

The Engineer/Architect of the Contract shall work in co-ordination with the project office to obtain a GEO Checking Certificate as early as practicable and shall not withhold the issue of the Certificate of Completion for the Works on the ground that the GEO Checking Certificate is not available.

A copy of the Maintenance Manual should be sent to GEO for comment, together with the GEO Checking Certificate application. A set of as-built survey plans and/or record drawings for the permanent slopes, retaining walls and natural terrain hazard mitigation measures formed/modified under the project should be sent to the relevant District Division of GEO for record.

(Ref.: ETWB TCW No. 20/2004)

The GEO will attach the DC Certificate/SA Certificate to a completed GEO Checking Certificate (Form GCDIST 105a), for return to the project office or a written response will be given stating the reasons why the GEO Checking Certificate cannot be issued. The GEO will normally issue the GEO Checking Certificate or give the written response within 18 working days of receipt of application. If the GEO declines the issue of the GEO Checking Certificate, the project office shall take immediate steps to resolve the matters raised by the GEO and resubmit a fresh application with an appropriately amended DC or SA Certificate as soon as possible.

Checking of the design of prescriptive measures and standardized debris-resisting barriers by the GEO for slope upgrading and natural terrain hazard mitigation works can be waived under certain conditions, as given in Section 4.6.12 of this Chapter. Notwithstanding this, GEO will issue a GEO Checking Certificate for the geotechnical features involved. The project office shall submit the application in accordance with the procedures given in the preceding paragraphs after completion of the slope upgrading and natural terrain hazard mitigation works in order to obtain the GEO Checking Certificate.

For those geotechnical features constructed, upgraded or studied under projects where the construction contract commenced before 30 September 2001, the project or maintenance office is strongly encouraged to follow the above normal procedures where practicable, in order to obtain the GEO Checking Certificate. However, the arrangement described in the ultimate and penultimate paragraphs can also be adopted if the geotechnical features fall into one or more of the following special categories:

- (a) The previous design or stability assessment was checked by GEO with comments/issues yet to be followed up (e.g. submission of compaction test records, submission of groundwater monitoring records and assessment report to verify design assumptions).
- (b) The previous design or stability assessment was not submitted to GEO for checking.
- (c) The Designer and/or the Engineer for the Contract are no longer available to certify the previous design (or stability assessment) and/or the quality of construction respectively (e.g. the works have already been completed by the project office and handed over to the maintenance office).

For the aforementioned cases, the project or maintenance office should arrange to carry out a stability assessment by reviewing the previous design or stability assessment if available, taking into account any records available that had not previously been submitted to the GEO. The review should be based on as-built drawings and present-day site conditions, especially where the geotechnical feature or its surroundings have undergone significant modifications or changes subsequent to the previous design or stability assessment. The aim of the review is to assess whether the previous design is up to current safety standards and whether the performance of the geotechnical feature is satisfactory. Where key construction records (e.g. as-built drawings) cannot be located, an appropriate qualifying statement should be included in the application for the GEO Checking Certificate to indicate that these construction records are not available and the review is based on the information as contained in the design reports and drawings as well as site inspections.

If GEO is satisfied with the results of the review referred to the paragraph above, the project or maintenance office shall apply for a GEO Checking Certificate by completing a SA Certificate (Form GCDIST 105b), which is available for downloading from the HKSS Website (<https://hkss.cedd.gov.hk/hkss/en/facts-and-figures/slope-information-system/index.html>), in which case the same procedures as given in the preceding paragraphs shall be followed.

4.6.10 Projects Involving Natural Slopes

The strongly preferred technical approach is not to carry out stabilisation works to large areas of natural terrain, which would be both impractical and environmentally damaging, but to mitigate risks through adjustments to the layout of new developments and provision of buffer zones and defence measures.

For new public housing development sites formed by Works Departments, the natural terrain hazard study and any necessary mitigation works should be carried out as part of the site formation works. In cases where the layout of the housing development is not certain, and

hence the required mitigation measures cannot be determined at site formation stage, the project office should consult the Housing Department. This should be done at an early stage of planning for the site formation project to arrange the necessary mitigation measures as part of the housing development.

Natural hillsides do not require maintenance. However, the project office should ensure that maintenance requirements are included in a maintenance manual prepared by the project engineer for any natural terrain landslide hazard mitigation measure formed. A maintenance agent should be identified at an early stage. The project office shall maintain any mitigation measure formed until these features are handed over to the maintenance agent. Further guidance on maintenance requirements can be found in Geoguide 5 – Guide to Slope Maintenance. With regard to the preservation and removal of existing trees and/or old and valuable trees, Development Bureau Technical Circular (Works) Nos. 4/2020 and 5/2020 respectively, should be referred.

In general, the following criteria should be considered, in order of priority, in the determination of maintenance responsibility:

- (a) The prime objective of constructing the mitigation measures,
- (b) The primary beneficiary, and
- (c) The need for maintenance of adjoining features as an integral part of the maintenance programme.

Each case would have to be considered on its own merits. The Subcommittee on Unallocated Government Land set up under the Standing Committee on Slope Safety should be informed of the results of the slope maintenance responsibility determined by the Systematic Identification of Maintenance Responsibility of Slopes (SIMAR) Unit of Lands Department with reference to the mitigation measures and should be requested to give a ruling on dispute cases.

Technical guidelines on landscape treatment for natural terrain mitigation works are given in GEO Publication No. 1/2011. Other guidance documents as may become available from time to time as a result of continuous research and experience gained, which are used by the GEO as de facto geotechnical standards and given in GEO Technical Guidance Note No. 1, should also be adopted.

The project office shall obtain registration numbers from the Slope Safety Division of GEO and arrange registration of the mitigation measure. Registration criteria for natural terrain landslide hazard mitigation measures are given in DEVB TCW No. 2/2018.

On completion of the project, a set of as-built survey plans for the mitigation measures should be sent to the relevant District Division of GEO for record.

4.6.11 Water-carrying Services Affecting Slopes

For monitoring and maintenance of water carrying services affecting slopes, the Code of Practice on Monitoring and Maintenance of Water-Carrying Services Affecting Slopes issued by the ETWB should be followed.

4.6.12 Prescriptive Measures for Stabilization and Improvement of Man-made Slopes and Standardized Debris-resisting Barriers for Mitigation of Natural Terrain Landslide Hazards

(Subsumed from ETWB TCW No. 13/2005)

Prescriptive measures are pre-determined, experience-based and suitably conservative modules of works prescribed to a man-made feature to improve its stability or reduce the risk of failure, without the need for detailed ground investigation and design analyses. Standardized debris-resisting barriers are pre-determined and suitably conservative modules of barriers formulated by applying and extending the methodology developed by the GEO for mitigation of natural terrain landslide hazards.

Using prescriptive measures and standardized debris-resisting barriers in slope works would save time and human resources, and may be more economical in some circumstances. All project and maintenance departments should employ prescriptive measures for the following types of slope works as far as possible:

- (a) Preventive maintenance of slopes,
- (b) Repair works to landslides; and
- (c) Upgrading of substandard slopes.

The terms ‘preventive maintenance’ and ‘upgrading’ are as defined in Geoguide 5 – Guide to Slope Maintenance.

In arranging the Engineer Inspections by consultants, the consultants should be required to recommend, where necessary and applicable, prescriptive measures as a means for upgrading or preventive maintenance of the slopes. This is to bring about maximum improvement to the large number of existing old slopes in a relatively short time under the constraint of available resources.

All project and maintenance departments may apply standardized debris-resisting barriers to the following circumstances where considered appropriate:

- (a) As urgent protective works following natural terrain landslides, and
- (b) As design provisions or contingency measures in new or existing developments.

The personnel for design and construction review of prescriptive measures and standardized debris-resisting barriers is specified in Appendix 4.23.

Design of upgrading works for the whole or part of a man-made slope feature using prescriptive measures should be submitted to the GEO for checking. The design of permanent natural terrain landslide mitigation works involving standardized debris-resisting barriers should also be subject to GEO checking. GEO checking on the design of the prescriptive measures and standardized debris-resisting barriers will be waived if :

- (a) an adequate quality system is in place to ensure that the personnel requirements stipulated in the above paragraphs and the technical guidance given by the GEO are followed, and**
- (b) satisfactory documentary evidence (including proof of quality system and professional details of personnel for design and construction) is submitted to the GEO prior to commencement of the works to indicate that condition (a) will be satisfied.**

Submission to the GEO is not required for prescriptive measures used in urgent repair and preventive maintenance, and for standardized debris-resisting barriers used in urgent protective works. Notwithstanding this, the project and maintenance departments are encouraged to consult the GEO on the scope of urgent repair/urgent protective works required to remove any immediate threat to life or property following the occurrence of landslides.

Submission to the GEO for checking or agreement is, however, still required for the following:

- (a) for rock cut slopes, the assessment of the potential for global instability and the rock mass failure mechanisms not treated by prescriptive measures (the waiving of GEO checking, if given, covers only the modes of failure of rock cut slopes to be treated by prescriptive measures following GEO's technical guidance),**
- (b) for standardized debris-resisting barriers, the assessment of the design volume and the detailing of the barriers to suit the site conditions (the waiving of GEO checking, if given, covers only the assessment of the dimensions and locations of the barriers), and**
- (c) geotechnical supervision personnel to supervise the works (the requirements for geotechnical supervision are to be imposed by the GEO with due regard to the type and complexity of the works).**

Application for waiving of GEO checking, if intended, should be submitted to the relevant GEO District Divisions prior to the commencement of the works.

In all cases of application of prescriptive measures, record sheets should be completed on certification of satisfactory completion of the prescriptive works by the responsible professional engineer. Sample record sheets are given in GEO Publication No. 1/2009. There is no need to submit the record sheets, the Engineer Inspection Report and the associated desk study and site inspection records to the GEO, although copies should be made available upon request to assist the GEO in review of the technical guidance promulgated.

The Maintenance Manual for an existing man-made slope should be updated within six months of completion of the prescriptive works. Also, for natural terrain landslide hazard mitigation measures that require maintenance, a Maintenance Manual should be prepared within six months of completion of a standardized debris-resisting barrier. There is no need to submit the new/updated Maintenance Manuals to the GEO, although copies should be made available upon request.

Departments should set up their own system to maintain traceable records on prescriptive measures and standardized debris-resisting barriers certified by the responsible professional engineers.

Further details and technical guidance on application of prescriptive measures and standardized debris-resisting barriers are given in Geoguide 7 – Guide to Soil Nail Design and Construction, GEO Publication No. 1/2009, GEO Report Nos. 138 and 182 as well as any other relevant guidance documents promulgated by the GEO from time to time. For slope enhancement works and improvement works, reference should be made to GEO Publication No. 1/2011. This paragraph of PAH should be read in conjunction with ETWB TCW Nos. 29/2002 and 20/2004, and DEVB TCW No. 6/2011.

4.6.13 Projects Involving Blasting

Where designs involve substantial rock excavation, the designer should consider whether blasting would be required for the project. Rock excavation by blasting can adversely affect the stability and integrity of slopes, retaining walls, roads, railways, structures, buildings, services and utilities through ground vibrations and other effects such as fly rock and air-overpressure. The transport, storage and use of explosives for blasting may also pose a safety hazard to the public and disruption of traffic.

If blasting is specified or permitted in the construction works, a Blasting Assessment should be undertaken at the design stage to assess such adverse effects and potential hazards, and to propose adequate and necessary protective, preventive, precautionary and other mitigation measures to demonstrate the practicality of carrying out blasting works and to prevent the works from causing injury to workers and the public, significant disruption to traffic, undue vibration and movement to existing structures and services, or undue nuisance to the public.

The Blasting Assessment should be prepared by a competent person with at least four years relevant experience in blast design and supervision of blasting works, and should be submitted with the curricula vitae of its author to the GEO for agreement prior to tendering of the contract. For complex projects, such as those involving blasting in densely populated or sensitive area, a competent person with more experience would be required. The necessary content of a Blasting Assessment is given at Appendix 4.7. The project office should also consult CGE/Mines of the GEO as early as possible regarding the issues related to the transport, storage and use of explosives. These issues should be properly addressed prior to tendering for the contract and suitable contract requirements should be included.

The project office should ensure that all critical requirements and constraints identified in the Blasting Assessment are properly addressed and a realistic programme for the blasting works is included in the tender documents. The project office should also submit the curricula vitae of the key personnel of the resident site supervision team to the GEO for acceptance, prior to the commencement of the works.

In order to obtain a permission to carry out blasting under the Cap 295 Dangerous Goods Ordinance, the Contractors should demonstrate that all necessary measures have been in place to prevent the blasting works from causing damage or adverse effects to adjacent facilities and structures, significant disruption to traffic or undue nuisance to the public, or any risk of injury to the public and the people working on site. For opencast blasting, such measures should be in place for each blast before the explosives would be provided for loading into blast holes. The project office shall allow sufficient time in the contract for the application of the blasting permits and licences. Detailed information on the use of explosives and the procedures for applying the blasting permits and licences are given in Section 21 of Chapter 7.

4.7 LANDSCAPE AND GREENING WORKS

It is the government's policy to enhance the quality of our living environment through active planting, and proper maintenance and preservation of trees and other vegetation. To promote greening, greening provisions, including site coverage of greenery, roadside and median utility free planting zone (DEVB TCW No. 3/2024), soft landscape provisions for highway structures (DEVB TCW No. 1/2018), greening of slopes and retaining walls, skyrise greenery, and trees for preservation or removal (DEVB TCW No. 4/2020, "Guidelines on Tree Transplanting", "Management Guidelines for Stonewall Trees", "Management Guidelines for Mature Trees" and "Guidelines on Tree Preservation during Development" promulgated by DEVB), should be ascertained in the planning and design of public works projects. In addition, the requirements on site coverage of greenery for new Government building projects are given in DEVB TCW No. 3/2012.

It is important that a consistent planting standard is applied in public works projects. A Cyber Manual for Greening consolidating all documents on the subject of greening is available at DEVB webpage. DEVB TCW No. 3/2024 also provides some standard requirements specifically on the allocation of space for quality greening on public roads. Specialist landscape design input should be incorporated in the initial planning and design stage, through documentation and implementation to achieve the quality landscape as planned. This may include input to the alignment/layout in relation to landform, existing vegetation and potential visual impact, measures to minimise detriment to the existing landscape including measures to retain as many trees as possible, etc., advice on the configuration and finishes of hard landscape elements (paving, walks, subways, etc.), and soft landscape input. More guidelines for design on greening are covered in the Chapter 4 of the Hong Kong Planning Standards and Guidelines and Integrated Landscape Design Framework developed by the Greening and Landscape Office of DEVB. For greening of noise barriers, reference should be made to "Guidelines on Greening of Noise Barriers" promulgated by DEVB.

Advice on aspects of landscape design should be sought from in-house landscape architects. The provision of landscape works should also take note of the mitigation measures recommended for the environmental, landscape and visual impact in EIA Reports.

The management and maintenance responsibilities for public landscape works constructed throughout the Territory are given in DEVB TCW Nos. 6/2015 and 4/2020, and specialist design work should be sent to the authorities concerned for notification and agreement. A project office that finds a need for tree felling should follow the procedures laid down in DEVB TCW No. 4/2020. With regard to registration of old and valuable trees, and guidelines for their preservation, DEVB TCW No. 5/2020 should be referred.

The project office should make reference to existing greenery in the neighbourhood as well as adjacent developments and projects in order to achieve a coherent and integrated landscape design with the aim to bringing out and amplifying the character of the locality, and to avoid a cluttered streetscape with uncoordinated greenery. A more thematic approach with dominant species with special character for avenue planting should be adopted for the greening and landscape design. Reference should also be made to the planting theme and the plant palette designated for each Greening Master Plan in drawing up landscape designs for greening works. The project office may make reference to the Integrated Landscape Design Framework developed by the Greening and Landscape Office of DEVB, which provides practical guidelines on the landscape treatment for key types of public works such as open space, waterfront, roads and ancillary structures, slopes, etc.

Due to the significant biomass and environmental/ecological benefits, subject to space availability and the greening objective, trees should be given priority. Annuals are generally less cost-effective, requiring frequent replacement and maintenance. Therefore, they should only be used after a critical examination of relevant factors, in particular the maintenance implications in terms of cost-effectiveness, sustainability and the life cycle of plants. Attention should be paid to reduce yard waste, and also reuse and recycle (Guidelines on Yard Waste Reduction and Treatment, DEVB).

In selecting tree species, the “right tree for the right place” principle should be adopted for matching the opportunities as well as constraints of the planting site with the characteristics of different plant species, and balancing the design intention and maintenance concern. For instance, in the selection of trees, those with buttress roots or roots that will cause upheaving of paving should be avoided in tree pits or areas with limited space, and those with brittle branches/trunks are unsuitable for roadside planting.

A holistic and sustainable approach to landscape design that takes account not only of the aesthetic dimension, but also the life cycle maintenance issue should be promoted. The project office should make reference to the technical standards and guidelines on Proper Planting Practices formulated by DEVB, including those on appropriate planting density and depth, provision of sufficient space for future growth of canopy, selection of good nursery stock, staking and guying, greening on noise barriers, etc. These guidelines and best practices on greening and landscape have been uploaded to the internal 'Cyber Manual on Greening' as well as the dedicated greening website (<http://www.greening.gov.hk>). The project office should make reference to these guidelines in carrying out landscape planting designs. The project office should also refer to the Guiding Principles on Use of Native Plant Species in Public Works Projects which is also available for downloading in the dedicated greening website (<http://www.greening.gov.hk>).

The project office should prepare a landscape management and maintenance plan for their greening projects so that the design intent would be clearly articulated and upheld through appropriate maintenance upon project completion. Close coordination of the design and maintenance teams during the project planning and design stage is necessary and timely agreement on the maintenance arrangement should be confirmed in the design stage and before construction. A robust maintenance schedule and close monitoring of plant performance will considerably improve the situation.

The project office should engage qualified/properly trained personnel at the frontline/supervising/management levels for carrying out the planning, design, implementation and maintenance of greening works. Proper site supervision is required to ensure the quality

of greening projects. The project office should also engage qualified/properly trained personnel at the frontline/supervising/management levels for carrying out the construction works, including tree preservation in construction, tree transplanting, tree risk assessment and remedial mitigation measures on tree management. Reference should be made to “Guidelines on Pavement Renovation Works and Tree Stability”, “Management Guidelines for Stonewall Trees”, “Guidelines on Tree Transplanting”, and “Guidelines for Tree Risk Assessment and Management Arrangement on an Area Basis and on a Tree Basis” promulgated by DEVB, etc.

4.8 BUILDINGS

The D of Arch S should be consulted as early as possible and arrangements made for either:

- (a) ArchSD to design and construct buildings complete with all installations, except for plant to be maintained by EMSD or others, or
- (b) The division responsible for the project to design and construct buildings with ArchSD advising on the layout, aesthetics and finishes.

In all cases, the D of Arch S's assistance should be sought at an early stage in preparing sketch schemes, estimates and the Schedule of Accommodation (Chapter 1, Section 4.2.6). For aesthetic design of buildings, Section 4.12 should be referred.

The Fire Services Department should be consulted at an early stage on the adequacy of fire escape routes, and for dangerous goods licences for the storage of dangerous goods and chemicals. A schedule of equipment and the proposed layout of fire extinguishers should be submitted for comments and approval.

Requirements relating to green government buildings are given in DEVB TCW No. 2/2015.

4.9 ELECTRICAL AND MECHANICAL WORKS

For in-house projects (other than DSD or WSD projects), DEMS should be requested at an early stage to assist in the design, the preparation of cost estimates and the specification for the electrical and mechanical installations.

For projects employing consultants, the design work, etc., should normally be carried out by the consultants.

4.10 COMPUTER SYSTEMS

Computer systems may form part of the permanent works, such as control systems in road tunnels and sewage treatment plants. For the design of such computer systems, SE/Computer Services of the project department should be consulted in the first instance, who will give advice on the preparation of designs submissions to DPO or EMSD or any other appropriate authority for approval.

4.11 GREENHOUSE EFFECT

The policy on the approach to be adopted in designs to allow for changes in sea-level due to the Greenhouse Effect is stated in WBTC No. 6/90.

4.12 AESTHETICS/STREETSCAPE

Government projects should be planned to produce a visually pleasing appearance, taking account of all other features, which are considered necessary in the planning of a project. Aesthetics should be considered as an intrinsic part of a project, taking account of the aesthetics requirement, site planning, design, costing, documentation, implementation and subsequent maintenance. Reference should be made to DEVB's Integrated Landscape Design Framework on the aesthetic aspect of the design. Large retaining structures or impermeable slope surfaces (such as shotcreted surfaces), in particular at prominent locations with no effective planting, should be avoided as far as practicable and practicable means of reducing the scale and impact should be considered in planning stage since means of camouflaging massive unsightly retaining structures/surfaces at a late construction are usually not practicable nor effective. Where large retaining structures or impermeable slope surfaces are inevitable at the planning stage, suitable and effective landscape design such as stepped planting at appropriate levels should be considered and more land should be allowed (i.e. increase the slope boundary or land claimed for the new slope work or slope improvement work as far as applicable) to accommodate at-grade screening vegetation. Both engineering and aesthetics/landscape issues should be addressed in a holistic manner and the cost implication should also be considered in an integrated manner. A proposal to significantly increase the cost of a project simply in order to improve its appearance should be specifically drawn to the attention of the Chief Engineer/Regional Office Head when he is asked to approve the scheme.

In preparing the general layout plan of a project, an assessment of the visual impact of new developments on their surroundings should be made together with input from landscape architects for achieving a balanced and sustainable greening effect.

The architectural designs of building structures, including those prepared by consultants, or contractors in case of Design and Build contract, from all Works Departments other than those of ArchSD and those associated with bridges and highway structures that fall within the ambit of the ACABAS should be forwarded to ArchSD for advice as a mandatory requirement. The requirement shall be applicable to all projects irrespective of project value. Works Departments should earnestly consider the incorporation of ArchSD's advice in their designs. For any deviation from ArchSD's advice, the project officer concerned should justify and seek the endorsement of a D2 or above officer about the deviation.

All submissions to ArchSD shall be vetted by a D1 or above officer responsible for the project to ensure that the submission is of adequate quality prior to issue under his name to the Secretary of the Design Advisory Panel, ArchSD for advice. Reference should be made to ETWB TCW No. 8/2005.

For highway structures, ACABAS advises on the aesthetic acceptability of the design of bridges and associated structures. Submissions to ACABAS should generally be made at the preliminary design stage. The scope, terms of reference, submission and vetting procedures of ACABAS are set out in detail in ETWB TCW No. 36/2004.

The Government is firmly committed to improve the living environment through quality greening and landscape work. Landscape work should not only be confined to permanent planters with irrigation systems on footbridges and flyovers. To accomplish a coherent and integrated landscape design with greening initiatives, greening on footbridges and flyovers should be able to blend in with the existing greenery in the neighbourhood and adjacent developments. Every practicable opportunity should also be explored for greening of bridge decks, columns, abutments, roofs and noise barriers on various components of structures of footbridges and flyovers. In general, ACABAS will not consider any proposal on footbridges and flyovers without greening and associated irrigation system unless prior exemption by the WMCG has been obtained. The policy guidance is contained in DEVB TCW No. 1/2018 and should be referred when preparing submission to ACABAS.

The technical guidelines on landscape treatment for slopes contained in GEO Publication No. 1/2011 and other relevant guidance documents used by the GEO as de facto geotechnical standards, where appropriate, should be adopted for all types of slope works including new slope formation, major slope upgrading, minor slope improvement/repair/maintenance works and engineering works on natural hillsides. With regard to aesthetic aspect of slope work, guidelines can be found in the Cyber Manual for Greening at DEVB webpage (<http://devb.host.ccgo.hksarg/en/contactus/index.html>). Each department with responsibility for upgrading and maintaining slopes should set up a Slope Appearance Vetting Committee to control the use of shotcrete or other hard surfacing in slope works (but excluding emergency repairs after landslips, minor local slope repairs and temporary slopes formed during construction activities). The suggested chairman and terms of reference of the Vetting Committee are appended in Appendix 4.27. When the use of shotcrete cover is unavoidable, measures such as toe wall planters, planter boxes, tree pits, creeper holes on slope surface, and application of colour/pigments should be introduced to improve the visual appearance of the slope.

The aesthetics/streetscape design should be considered in the planning, design and implementation stages, taking account of different styles and harmony of the street furniture (such as signage, lighting, railings, paving, utility covers, pillar boxes, water meters, etc.). Relevant streetscape components should be laid out to avoid conflict and cluttering of features and, where practicable, to combine or reduce signage and screen obstructive features such as water points and pillar boxes by planting in order to achieve a pleasant quality landscape. Advice from landscape architects should be sought.

Various standard hoarding designs are being used by Works Departments to meet the functional needs of fencing off and securing sites. To enhance the aesthetic appearance of site hoarding, and to improve the image of construction sites and public's perception, an alternative hoarding design is to be considered for all capital works contracts including design and build contracts and term contracts if the situation is appropriate. Guidelines for and examples of alternative hoarding design are given in DEVB's memo ref. (0289W-01-3) in DEVB(W) 516/95/02 dated 16.8.2010.

4.13 ENVIRONMENTAL PROTECTION

All plans for engineering projects and other development must pay full regard to environmental factors including noise or other nuisance, pollution of ground, water or air, effects on fauna and flora, and landscape and visual effects (all both during and after construction), with a view to ensuring maximum mitigation of unavoidable harm, and securing significant improvements in the environment where possible and affordable.

These considerations, which should have already been made at the initial planning stage of the projects, should be reassessed at the detailed design stage as the various elements of the projects are quantified in sufficient detail.

If an EIA has been carried out at the project planning stage (refer to Chapter 1-Paragraph 4.1.3, WBTC No. 4/97 and ETWB TCW Nos. 13/2003 & 13/2003A for further details), the mitigation measures identified, both on-site and off-site, should be taken into account in the detailed design.

The following special requirements should also be noted:

- (a) **Hardwood for site hoardings, falsework and the shoring of trenches and pits shall be specified as not to be used on all contracts. Contractors must propose alternatives to hardwoods in their tenders or be directed to use specified acceptable alternatives. The various uses of hardwood on construction sites together with some suggestions for alternatives are listed in Appendix 4.14. (Subsumed from WBTC No. 32/92)**
- (b) For facilitating implementation of Environmental Management Plan, the space requirement for the environmental provisions, e.g. on-site sorting and temporary storage of C&D materials, automatic wheel washing machine, wastewater treatment facilities etc should be taken into consideration. Reference should be made to ETWB TCW No. 19/2005.
- (c) For site hoardings and signboards, all components should be specified in metal (using bolt and nut jointing method wherever possible) to reduce generation of C&D waste from construction sites. Reference should be made to WBTC No. 19/2001,
- (d) During the planning and design of a project, the project officer may wish to use recycled aggregates in lieu of virgin aggregates as environmental protection measures. If there are opportunities to generate recycled aggregates from construction and demolition materials found on that project, the project officer should consider these opportunities. However if there are no such opportunities and if there is no local supply of suitable recycled aggregates, the project officer needs to consider the use of virgin aggregates.
- (e) For tree preservation, transplanting and felling, reference should be made to DEVB TCW Nos. 6/2015 and 4/2020, DEVB's "Guideline on Pavement Renovation Works and Tree Stability", "Management Guidelines for Stonewall Trees" and "Guidelines on Tree Transplanting".

- (f) For public works projects requiring tree surveys to be carried out, potentially registrable trees in the surveys should be identified and relevant details should be submitted to LCSD or AFCD accordingly. Reference should be made to DEVB TCW Nos. 4/2020 and 5/2020.
- (g) To facilitate the sharing of information, improve understanding, enhance cooperation, and promote uniform standards across all government departments on greening, a web based manual called the “Cyber Manual for Greening” (<http://devb.host.ccgo.hksarg/en/contactus/index.html>) has been established. It is posted on the government intranet, the “Central Cyber Government Office” (CCGO) portal under the heading “Government Policy – Green Management” which is accessible by ALL government departments, and
- (h) Adoption of energy efficient features and renewable energy technologies in government projects and installations should be ascertained. Reference should be made to DEVB TCW No. 2/2015.

Reference should be made to the Structures Design Manual for Highways and Railways for noise mitigation measures on highway structures, and ETWB TCW No. 13/2003A for planning for provision of noise barriers.

For protection of natural streams/ivers from adverse impacts arising from construction works, the project officer should adopt environmentally friendly design to maintain the naturalness, landscape as well as ecological value of natural streams/ivers during the detailed design stage. Reference should be made to ETWB TCW No. 5/2005.

A project office should, in consultation with DEP if necessary, determine whether a project is a designated project under the EIA O. The procedures for completion and approval of EIA study and report for designated projects should be in accordance with the EIAO.

Before designers decide to specify use of natural boulders/cobbles/pebbles in the design of future public works, they should consider if the extraction or production of these materials at the supply end would pose unacceptable impact to the environment. It is particularly important for those mega projects that may usually involve large quantities of boulders/cobbles/pebbles. Care should also be taken when the natural boulders/cobbles/pebbles specified are not commonly available in the local market as environmental mitigation measures for the supply of these materials may not have been well developed.

Designers should assess if artificial or non-natural boulders/cobbles/pebbles could be an acceptable alternative to natural boulders/cobbles/pebbles when large quantity is involved. Whilst taking into account other project constraints such as programme and cost, they should always strike a very careful balance in the choice of construction materials in order to avoid improving our environment at the expense of other environment sectors.

4.14 WORKS BY OTHER GOVERNMENT DEPARTMENTS/ORGANISATIONS

There may be some circumstances where it would be beneficial from the project management and co-ordination points of view to have some works of a government department entrusted to other government departments. A typical example is waterworks incorporated into other capital works contracts. The procedure for such entrustment is given in WBTC No. 29/93.

Works carried out by other Government departments or offices to facilitate, or for the service of, the project, including reprovisioning works and mitigation measures, should be charged to the project, e.g. diversion of watermains.

Project offices should note that approval from SFST is required prior to entering into entrustment agreements with a private sector and a public corporation including Housing Authority and MTRCL as stated in S for Tsy's memo ref. (19) in FT 112/115 dated 21.11. 2000.

4.15 ADJACENT PROPERTY

If adjacent private property is likely to be endangered by the Works, BD should be consulted regarding safety measures necessary for the protection of the property.

Any alterations required to an adjacent private property will be arranged by LAO, Lands Department. Details of the work, the method of carrying out the work and the apportionment of costs and maintenance responsibility between Government and the owner will be agreed for each individual lot in the light of practical problems involved and the conditions of lease.

4.16 UTILITIES

Private utility companies and the appropriate Government authorities should be consulted regarding the effect of the project on their existing and proposed services and regarding any facilities required for the project. Lands Department should also be consulted as to the presence of private service lines (e.g. private seawater cooling mains laid under way-leave agreements) which might be affected by the project.

The minimum depth requirement for services underneath public roads stipulated in HyD Standard Drawing Nos. H6168, H6169 and H6170 should be observed for both new and existing services affected by the project. The basic reasons for specifying a minimum depth for underground services are to:

- (a) avoid any adverse effects on the structural integrity of the road pavement;
- (b) afford protection to the buried services from damage due to traffic loadings;
- (c) afford protection to the buried services from damage due to subsequent road opening works;
- (d) afford protection to personnel carrying out road opening works from cutting into energized services located at an unexpected shallow depth; and

- (e) maximize the use of underground space for the accommodation of services while ensuring that sufficient space is reserved for the installation of surface drainage system which is essential for the proper operation of a highway.

If the project would cause the depth of some existing services to be less than the required minimum, the utility operators concerned should be requested to lower or to divert the existing services.

Minor modifications to the design may be made to avoid disturbance to utility services but any modifications, which will materially increase the cost of the project, should not be considered without the authority of the Chief Engineer/Regional Office Head.

In general, all diversion works carried out to accommodate the project should be at the cost of the utility companies. Block Licences are issued by Lands Department to the utility companies for locating utility installations on unleased Government land. Normally there is a condition in the Block License, which requires the licensee to remove or divert the utility installations at his own cost when required by the Director of Lands (D of L).

Where diversions are made at the cost of the project, the utility companies concerned should be consulted about the cost of the diversions and provision made in the project estimate.

In view of the rapid development in the past decades, which caused continual expansion of the underground utility network, designers shall consider the limitation in space underneath public roads before making commitment for further underground installations. In addition, use of updated technology and sharing of cable network by different operators should also be explored to minimise the need for underground installations.

Construction drawings for roadworks relating to vertical and horizontal alignments should be provided to UU preferably in CAD format. UU should take these construction drawings as reference for preparing and updating their as-built records until the as-built drawings are available or the relevant digital maps are updated.

With respect to physical and legal impossibilities, unforeseen ground conditions and interference by utility work, guidelines on risk management given in ETWB TCW No. 17/2004 should be observed in carrying out the design.

4.17 PUBLIC TRANSPORT

The public transport companies should be consulted as early as possible if their facilities are likely to be affected by the project works. The costs for the diversion of tramways, the relocation of bus stops etc., to facilitate the project, are normally borne by the project.

There are special requirements for works in the vicinity of the MTRCL railways given in DEVB TCW No. 1/2019. Though there is no circular specifically covering works in the vicinity of the Light Rail, those quoted for the MTRCL railways may provide a useful reference. In any case, PM (NTN&W), CEDD and MTRCL should be consulted as early as possible. Section 4.3 of Chapter 3 should be referred for further details on rail reserves.

4.18 SURVEY MONUMENTS AND MARKS

Construction projects should be designed in such a way that survey monuments are not disturbed. Agreement from DD/SM (previous PGLS) of Lands Department must be obtained where the potential destruction of a survey monument is unavoidable. (DEVB TCW No. 5/2019).

4.19 INFRASTRUCTURE ON NEW RECLAMATION

When carrying out design for infrastructure on a new reclamation, the project office should take account of the nature of the materials used for the reclamation to cater for any potential risks.

Some of the reclamation sites might have been formed with sand extracted from local marine borrow areas, which could be littered with some unexploded ordnance in the past outside the knowledge of the relevant parties during the reclamation works. Whilst precautionary measures should have been taken under the reclamation contracts to deal with any ordnance found, residual risks posed to the subsequent infrastructure works or the future land use could not be totally eliminated. When the project office carries out planning of the infrastructure on reclamations where large numbers of unexploded ordnances were discovered during the reclamation works, it should, after consulting the future land users (such as works departments responsible for subsequent provision of infrastructure works on the reclamation) where practicable, consider specifying in the infrastructure contract safety precautionary measures that may be required, such as scanning the soils for unexploded ordnance to facilitate removal under the infrastructure contract or later development projects as appropriate.

4.20 HERITAGE IMPACT

Heritage impact assessment should be conducted if the project will affect the heritage value of the heritage sites within or in the vicinity of the project boundary. Consultation with the Antiquities & Monuments Office of LCSD is necessary.

If heritage sites are affected by the works, it is necessary to avoid or minimise adverse impact on these sites. In case adverse impact is unavoidable, public consultation engaging the relevant parties at the earliest opportunity is required. (See DEVB TCW No.1/2022 for details).

4.21 TRAFFIC IMPACT AND ROAD SAFETY AUDIT

Traffic impact assessment should be conducted in accordance with the guidelines and requirements promulgated in Transport Department's Departmental Circular No. 1/2011.

Road safety audit should be conducted in accordance with the guidelines and requirements promulgated in the Transport Planning and Design Manual Volume 5 Chapter 7.

4.22 ROCK CAVERN DEVELOPMENT

DEVB TCW No. 2/2024 Amd No. 6/2025 promulgates the policy and associated measures for Amd No. 6/2025 cavern development in Hong Kong. In brief, all new government Amd No. 6/2025 projects and land disposal/alienation proposals (including those for Amd No. 6/2025 lease modification and land exchange) that wholly or partly fall within Amd No. 6/2025 Strategic Cavern Areas (SCVAs) delineated in the Cavern Master Plan (CMP) shall be submitted for vetting by the Sub-Committee on Cavern Development (SCCD). When project proponents consider the cavern option as one of the options, they are required to first check if (i) there is a lack of suitable surface site; and (ii) there are specific needs or strong merits to relocate existing government facilities or accommodate new suitable government facilities inside caverns. If criteria (i) and (ii) are met, the project proponents should proceed to carry out the preliminary option assessments with an aim at comparing cavern and non-cavern options. If the cavern option is recommended, the option assessments report should be submitted to the SCCD for vetting and endorsement before the preparation of TFS report. Amd No. 6/2025

4.23 SAFETY AND HEALTH OF HAND-DUG TUNNELLING WORK

The Labour Department is highly concerned about the occupational safety and health of employees/workers engaged in the hand-dug tunneling work. In this regard, the Labour Department, in collaboration with relevant industry stakeholders and upon a round of comprehensive consultation, has formulated a set of “Guidance Notes on Safety and Health of Hand-Dug Tunnelling Works” for compliance by the industry.

The “Guidance Notes on Safety and Health of Hand-Dug Tunnelling Works”, among others, requires that the “heading” hand-dug tunneling method could only be adopted under exceptional conditions and where environment permits, and specifically sets out the stringent measures to be taken by the relevant duty-holders when such hand-dug tunneling work is unavoidable.

Works departments shall take the guiding principles of the “Guidance Notes on Safety and Health of Hand-Dug Tunnelling Works” into consideration when planning any trenchless/tunneling work before awarding works contracts to contractors, and remind contractors to strictly follow the occupational safety and health measures as set out in the guidance notes.

For effective monitoring the occupational safety and health performance, works departments are required to notify the Labour Department once it is intended to employ “heading” hand-dug tunneling method in works projects. In this connection, information of the works, such as site location, construction period and name of the consultant (if any), principal contractor to be involved and respective contact persons shall be provided via letter or email to Senior Divisional Occupational Safety Officer (Operations Division) (Headquarters)¹, Labour Department.

5. ESTIMATES

5.1 INTRODUCTION

Project engineers are responsible for keeping the works within the approved scope and estimate. They must ensure that estimates are carefully prepared and given the same attention to detail as other aspect of project preparation.

Any estimate must be as accurate as possible as it affects the management of public funds and it has a direct effect on fund allocation.

The relevant Financial Circulars (FCs) and Note for Public Works Subcommittee of Finance Committee are :

- | | |
|--------------------|--|
| FC No. 2/2005 | - Recurrent Consequences of Capital Projects |
| FC No. 2/2021 | - User Guide on the Finance Committee, Establishment Subcommittee and Public Works Subcommittee |
| FC No. 7/2017 | - Capital Works Programme |
| FC No. 4/2012 | - Requirements for Project Definition Statement and Technical Feasibility Statement for Capital Works Projects |
| FC No. 5/2014 | - Consultants' Fees and Resident Site Staff Costs for Works Projects |
| PWSCI (2002-03) 31 | - Estimates of Consultants' Costs for Capital Works Projects |

The standard approach for estimating and assessing contingency items is termed "Estimating using Risk Analysis" (ERA). ERA procedures and format shall be used for all Cat C, B and A estimates and whenever an estimate review is required by the resource allocation process. Any difficulty in the use of ERA or its effect on any other established procedure shall be reported promptly to the departmental representative on the Project Estimates and Cost Control Committee. If the issue raised is of general concern, it will be resolved at the Project Estimates and Cost Control Committee. A Practice Note for the use of ERA is in Appendix 4.15. (Subsumed from WBTC No. 22/93)

ETWB TCW Nos. 6/2005 and 7/2005 are promulgated to introduce the implementation of Systematic Risk Management in Public Works Projects and to provide guidelines for the procurement of Construction Related Insurance respectively. These two TCs shall be referred when preparing the estimates.

5.2 DESCRIPTION

Project scope is the approved extent of the work described in the Project Definition Statement (PDS), Technical Feasibility Statement (TFS) and PWSC paper and shall not be

changed without the approval of the appropriate authority set out in the FCs above (Section 5.1) and ETWB TCW No. 30/2003. When a scope change occurs it must be reported along with the cost (and programming) implications for approval.

Design development is any change, which occurs but remains within the scope. It can include variations and changes in quantities.

Project estimate is the overall total estimated cost for the project, and is the sum of the estimated cost of all its works packages plus the estimated cost on project scope contingency. These components shall be grouped in Category-of-Cost on the estimate spreadsheet.

Estimate description is the concise description of the limitations, assumptions and important features of an estimate, such as inclusions, exclusions, accuracy of measurement, and estimating method. It should take the form of a standard report as shown at Appendix 4.4.

5.3 TIMING

The project estimate is usually first prepared in the TFS for the project's inclusion in Cat C and thereafter shall be formally reviewed and revised as described in the following table:

| ESTIMATING SCHEDULE | |
|----------------------------|---|
| FUNDING STAGE | ESTIMATING REQUIREMENT |
| Cat C | The project estimate should be revised whenever information affecting costs becomes available (e.g. sub-surface investigation or feasibility reports). |
| For entry to Cat B | The project estimate should include up-to-date quantities, current prices and re-assessment of risk elements and contingency items. |
| Cat B | The project estimate should include further significant information affecting costs (e.g. contingency items are settled and/or eliminated, probability of occurrence and extent of risks elements are changed). Annually for the RAE, and once selected to start, this estimate is then the baseline against which cost and scope changes are compared and justified. |
| Upgrading to Cat A | An up-to-date project estimate is prepared by pricing the tender document Bills of Quantities including re-assessment of risk elements and remaining contingency items. |

Details of preparation of estimates are shown in Section 5.4 and 5.5. A project estimate shall also be prepared or updated when seeking:

- (a) Inclusion of a project in Cat D,
- (b) An increase or decrease in the APE of a Cat A or Cat D project, or
- (c) Approval for a change in scope.

In addition, any estimate may require:

- (a) Further revision/reporting to meet works department requirements, or

- (b) Further review to meet requirements from FSTB and DEVB during the annual RAE and Annual Estimates exercise.
- (c) To be revised to reflect current knowledge of work progress, changed planning and expenditure patterns.

5.4 PREPARATION

The project engineer should prepare a project estimate in accordance with the extent of work described in the PDS and TFS. This provides a clear basis for the estimate and a baseline to control changes in scope.

Estimates shall be in two parts:

- (a) The estimates description, and
- (b) The itemised estimate of cost including forecast-of-expenditure (cash flow).

The estimate description shall include all available information on the scope and the special circumstances (e.g. short construction period, particularly difficult site), explanations about assumptions made for the contingency items, and any other relevant information. It should also reconcile changes in successive estimates.

There shall be an estimate and estimate description for each works package (i.e. for each site investigation, laboratory testing, agreement, contract and so forth) at its relevant Category of Cost of the project. Each estimate shall be comprehensive and cover all costs including consultant's fees, site investigations, laboratory testing, resident site staff, supervision, construction works and contingency. Adequate resources should be allowed for the provision of a structured site supervision system for different stages of construction. Each shall be cross-referenced to PWP details for identification purposes.

Estimates shall be as fully detailed as the available information permits, and shall use the most recent relevant prices updated in line with the Civil Engineering Works Tender Price Index (DEVB TCW No.6/2017) and other appropriate Cost Index or Tender Price Index for the month or quarter in which the estimate is done. These should be adjusted if necessary to ensure they are valid prices, which reflects current market conditions.

Estimates shall be compiled to a constant price level and then converted to a Money-of-the-day (MOD) value by applying some adjustment factors (to be advised by SFST from time to time) to the cash flow. The difference in value of the MOD estimate from the constant price estimate reflects the forecast of expenditure due to price adjustment on its own and shall be recorded in the "Other" Category-of-Cost.

For Cat D projects, the estimate shall be made at a price level current at the time of the estimation together with its MOD equivalent. Particular attention should be given to avoid the actual expenditure exceeding the approved project estimate because of inflation. This is particularly important for projects with estimates close to \$50 million, the current financial ceiling of a Cat D item (Ref.: PAH Chapter 2, Section 2.2).

Cat A estimates shall not include an allowance anticipating the effect of market conditions on the tender levels.

The project estimate should include, if appropriate to the project, the following items:

- (a) Works contracts under the project,
- (b) Site investigations and laboratory testing (WBTC Nos. 14/2000 and 15/2000, PAH Chapter 5 Section 9.7), or any other special investigations,
- (c) Works for/by other divisions,
- (d) Works for/by other offices,
- (e) Works for/by other departments and authorities (e.g. entrustment to MTRCL) including any on-costs,
- (f) Resumption, clearance and compensation costs (although these costs are normally charged to the Land Acquisition Vote controlled by Lands Department),
- (g) Repositioning costs (e.g. cost of reconstruction of a replacement survey monument destroyed because of the construction project, see DEVB TCW No. 5/2019),
- (h) Diversion of utilities,
- (i) Consultants' fees and expenses with resident site staff costs for the construction phase shown separately,
- (j) Landscaping and amenities,
- (k) Site safety and welfare facilities for workers at construction sites (WBTC No. 30/2000, ETWB TCW No. 19/2005 and Chapter 3 of Construction Site Safety Manual),
- (l) Stores and equipment,
- (m) Cost of diversion of facilities of public transport companies,
- (n) Environmental measures and management (ETWB TCW No. 19/2005),
- (o) Site cleanliness and tidiness (DEVB TCW No. 8/2010),
- (p) Resources (other than in-house resources) for the geotechnical supervision personnel. (It is often necessary for the designers of geotechnical works to be involved in the supervision of the works to verify the design assumptions by observing the actual ground conditions. Guidance on the requirements for geotechnical supervision is given in Appendix 7.47 of Chapter 7), and

- (q) Resources for environmental personnel to supervise environmental monitoring and auditing under the EIAO.
- (r) Controversial or unconventional items, such as archaeological works.
- (s) The cost for Community Planting Activities in accordance with DEVB TCW No.5/2017.

It is only necessary to include works by other divisions/offices/departments which are needed for the project and not otherwise financed, e.g. Landslip Preventive and Mitigation Measures should not be included because they are usually financed from an annual block vote.

Any estimate should, in order of preference, be based on:

- (a) The most recent averaged tendered prices for work of a similar nature,
- (b) The current prices in maintenance or term contracts for work of a similar nature, and
- (c) The breakdown of the cost of labour/plant/materials.

To arrive at a realistic estimate, all risks having a significant effect on the cost of the work must be taken into account. Such factors may include:

- (a) Degree of difficulty of the work,
- (b) Site location, access and transport mode,
- (c) Need for expensive plant or unusual technique, and
- (d) Sub-surface conditions.

When reviewing any estimate, for the purposes of reconciliation, identify separately changes in scope and other contingency items and also check:

- (a) The updating for inflation since the previous estimate, and
- (b) The correction of any assumption.

Estimating needs to be structured, logical, accountable and easy to explain and trace. Estimating using Risk Analysis (ERA) requires identification of project related risks in a formal manner and provides a realistic estimated cost for each risk. ERA is required for Cat A, B and C projects in accordance with the procedures and requirements stipulated in Section 5.1.

In addition, the requirements laid down by the respective project office for submission of cost estimate to their Project Estimate Control Committee for vetting and endorsement shall also be followed.

5.5 RECURRENT COST ESTIMATES

FC No. 2/2005 is the relevant authority for the presentation, information and assessment of recurrent cost estimates.

Recurrent cost estimates shall be prepared prior to seeking upgrading of a project to Cat A, or inclusion of a project in Cat D. A rough indication of recurrent consequences is, however, required in the submission for inclusion of a project in Cat C, or for inclusion of a project in the RAE programme (i.e. upgrading to Cat B).

The estimate shall be prepared in sufficient detail and manner to allow assessment of the full financial implication of the project in the immediate and the long term. This information is useful in forecasting resource requirements.

The client department must liaise with those departments responsible for operation and maintenance, so as to include costs affecting the latter's own head of expenditure and maintenance and other costs generated for other heads.

The client department and departments responsible for operation and maintenance shall include estimates of repair and maintenance work to be undertaken by their respective works department.

The recurrent cost estimate shall be reviewed when detailed drawings and estimates for the project become available, as well as in each application for a change to a project estimate. The updated estimate shall be attached as an appendix to the PWSC submission.

5.6 REPORTING

5.6.1 Capital Works

Projects must be registered in the PWPIS, which is administered by the Public Works System Administration Section of DEVB. Works department is responsible for the recording and updating of project and contract data in the PWPIS in respect of programme, estimates, expenditure and other important information. Project officers should follow the data administration procedures in PWPIS Data Administration Manual, which is issued by DEVB and posted on PWPIS web page.

The relevant senior engineer shall advise the Chief Engineer/Regional Office Head of all significant changes in the project estimate so that the Chief Engineer/Regional Office Head can advise the Department Head of the changes. For consultant-administered projects, consultants should advise the relevant project office.

The project estimate shall be checked for correctness by the relevant senior engineer, and agreed by his Chief Engineer/Regional Office Head. The project office shall check any estimate prepared by consultants.

The calculations for any checked/agreed estimate shall be kept in the Project Handbook (or other departmental equivalent).

5.6.2 Recurrent Costs

The project engineer shall advise the Chief Engineer/Regional Office Head, through the senior engineer, of all significant changes in the estimate so that the Chief Engineer/Regional Office Head can advise the Department Head of the changes.

The calculations for any checked/agreed estimate shall be kept in the Project Handbook (or other departmental equivalent).

5.7 PRELIMINARY COST ESTIMATE

The cost estimate changes as the project develops to cater for design development, programme, forecast trend of price adjustment and tender prices, etc. To safeguard the credibility of project estimates, project office shall refrain from divulging the cost estimates to the public in planning and design stages to avoid misinterpretation by the public.

When disclosure of cost estimate to the public prior to submission to the Legislative Council for funding approval is required in exceptional circumstances, the standardised terminology “Forecast Cost per Provisional Design (暫定設計預測造價)” in MOD prices together with the following riders shall be adopted in full on every occasion to ensure proper understanding by the public:-

The Forecast Cost per Provisional Design (FCPD) of the project is \$XXX million in MOD prices. The Project Estimate will be substantially higher or lower than the FCPD as a result of design development, programme change, construction price level changes, etc.

按付款當日價格計算，暫定設計預測造價約港幣XXX百萬元。此項目的預算費用會因應隨後的設計改動及/或深化，推展日期的更改，建造價格水平變動等，而較暫定設計預測造價大幅增加或減少。

Moreover, the project office shall seek to proactively reconcile the latest cost estimates with those already in the public domain as appropriate.

6. REFERENCES

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| WBTC No. 6/90 | Greenhouse Effect - Allowance in Design |
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| WBTC No. 2/93B | Public Filling Facilities |
| WBTC No. 29/93 | Procedure for Incorporation of Waterworks into other Capital Works Contracts |
| WBTC No. 14/94 | Use of PFA as General Fill in Reclamation |
| WBTC No. 16/96 | Wet Soil in Public Dumps |
| WBTC No. 4/97 | Guidelines for Implementing the Policy on Off-site Ecological Mitigation Measures (PELBTC No. 1/97) |
| WBTC No. 4/98 | Use of Public Fill in Reclamation and Earth Filling Projects |
| WBTC No. 4/98A | Use of Public Fill in Reclamation and Earth Filling Projects |
| WBTC No. 12/2000 | Fill Management |
| WBTC No. 14/2000 | Usage of Public Works Laboratories in Public Works Projects |
| WBTC No. 15/2000 | Funding Arrangement for Public Works Regional Laboratories Operating, Monitoring and Accounting Procedures |
| WBTC No. 30/2000 | Construction Site Safety Manual Second Updating of Chapters 3 and 12 |
| WBTC No. 19/2001 | Metallic Site Hoardings and Signboards |
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| ETWB TCW No. 4/2004 | Checking of Foundation Works in the Scheduled Areas of Northwest New Territories and Ma On Shan and the Designated Area of Northshore Lantau |
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| ETWB TCW No. 17/2004 | Impossibility / Unforeseen Ground Conditions / Utility Interference |
| ETWB TCW No. 20/2004 | GEO Checking Certificate for Slopes and Retaining Walls |
| ETWB TCW No. 36/2004 | The Advisory Committee on the Appearance of Bridges and Associated Structures (ACABAS) |
| ETWB TCW No. 5/2005 | Protection of natural streams/rivers from adverse impacts arising from construction works |
| ETWB TCW No. 6/2005 | Implementation of Systematic Risk Management in Public Works Projects |
| ETWB TCW No. 7/2005 | Procurement of Construction Related Insurance |
| ETWB TCW No. 8/2005 | Aesthetic Design of Ancillary Buildings in Engineering Projects |
| ETWB TCW No. 15/2005 | Geotechnical Control for Tunnel Works |
| ETWB TCW No. 19/2005 | Environmental Management on Construction Sites |
| ETWB TCW No. 2/2006 | Drainage Impact Assessment Process for Public Sector Projects |
| ETWB TCW No. 4/2006 | Delivery of Capital Works Projects |
| DEVB TCW No. 6/2010 | Trip Ticket System for Disposal of Construction & Demolition Materials |
| DEVB TCW No. 8/2010 | Enhanced Specification for Site Cleanliness and Tidiness |
| DEVB TCW No. 2/2011 | Encouraging the Use of Recycled and other Green Materials in Public Works Projects |
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| DEVB TCW No. 3/2014 | Contractors' Designs and Alternative Designs |
| DEVB TCW No. 2/2015 | Green Government Buildings |
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| DEVB TCW No. 4/2016 | Geotechnical Information Unit |
| DEVB TCW No. 5/2017 | Community Involvement in Planting Works |
| DEVB TCW No. 6/2017 | Civil Engineering Works Tender Price Index |

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| DEVB TCW No. 2/2024 Amd No. 6/2025 | Rock Cavern Development |
| DEVB TCW No. 1/2018 | Soft Landscape Provisions for Highway Structures |
| DEVB TCW No. 2/2018 | Registration and Updating of the Catalogue of Slopes |
| DEVB TCW No. 3/2018 | Enhancing Cost Effectiveness of Geotechnical Works of Capital Works Projects |
| DEVB TCW No. 6/2018 | Implementation of Buildability Evaluation System |
| DEVB TCW No. 1/2019 | Railway Protection |
| DEVB TCW No. 4/2020 | Tree Preservation |
| DEVB TCW No. 5/2020 | Registration and Preservation of Old and Valuable Trees |
| DEVB TCW No. 6/2020 | Design Review and Implementation of Buildability Evaluation System for Public Engineering Works Projects |
| DEVB TCW No. 8/2021 | Building Information Modelling Harmonisation Guidelines for Capital Works Projects in Hong Kong |
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| GEO Geoguide 1 | Guide to Retaining Wall Design |
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| GEO Geoguide 6 | Guide to Reinforced Fill Structure and Slope Design |
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| GEO Report No. 104 | Review of Natural Landslide Debris – Resisting Barrier Design |
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| | Guideline on Pavement Renovation Works and Tree Stability |
| | Guidelines on Tree Transplanting |
| | Guidelines on Yard Waste Reduction and Treatment |
| | Guidelines for Tree Risk Assessment and Management Arrangement on an Area Basis and on a Tree Basis |
| | Management Guidelines for Stonewall Trees |
| | Management Guidelines for Mature Trees |
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| GEO Geotechnical Manual for Slopes | https://www.cedd.gov.hk/eng/publications/geo/geo-gms/index.html |
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APPENDICES

APPENDIX 4.1 CHECK LIST FOR DETAILED DESIGN

PWP No. _____

Project Title _____

Project File _____

Contract No. _____

Contract Title _____

Contract File _____

PREPARATION OF DESIGN CALCULATIONS AND DRAWINGS

| | <u>Activities</u> | <u>Initial</u> | <u>Designation</u> | <u>Date</u> |
|----|--|----------------|---------------------------|-------------|
| 1. | Instruct GR to open a design calculation file | _____ | (project engineer) | _____ |
| 2. | Pass design calculation file to project engineer | _____ | (G.R.) | _____ |
| 3. | Prepare design calculations; signed and dated | _____ | (project engineer/AE /CEG | _____ |
| 4. | Pass completed design calculations in file to an officer referred to in Section 3.3.10 for engineer/ arithmetical checks | _____ | (project engineer/AE /CEG | _____ |
| 5. | Carry out arithmetical checks on design calculations, signed and dated | _____ | (project engineer/AE /CEG | _____ |
| 6. | Return design calculations in file engineer/ to project engineer | _____ | (project engineer/AE /CEG | _____ |

CERTIFICATION AND CHECKING

| | <u>Activities</u> | <u>Initial</u> | <u>Designation</u> | <u>Date</u> |
|-----|---|----------------|---------------------------------------|-------------|
| 7. | Prepare drawings and sign for 'design' of drawings | _____ | (project engineer/AE/CEG) | _____ |
| 8. | Certify the completion of design calculations and drawings in standard certificate (Appendix 4.3 or Appendix 4.22) | _____ | (project engineer) | _____ |
| 9. | Pass certification, design memorandum, design calculations and drawings to SE | _____ | (project engineer) | _____ |
| 10. | Pass documents in activity 9 to CE/Regional Office Head | _____ | (SE) | _____ |
| 11. | Decide on checking approach to be adopted, appoint Checking Engineer and pass documents in activity 9 to Checking Engineer | _____ | (CE/Regional Office Head) | _____ |
| 12. | Check design and drawings, certify for completion of checking process in standard certificate (Appendix 4.3 or Appendix 4.22) | _____ | (Checking Engineer) | _____ |
| 13. | Check drawings, if other departments are involved in the Works, for proper incorporation of their requirements | _____ | (other department's checking officer) | _____ |
| 14. | Return documents in activity 9 and check certification to project engineer | _____ | (Checking Engineer) | _____ |
| 15. | Submit documents in activity 9 and check certification to CE/Regional Office Head | _____ | (project engineer) | _____ |

COMPILATION OF DESIGN RECORDS

| | <u>Activities</u> | <u>Initial</u> | <u>Designation</u> | <u>Date</u> |
|-----|---|----------------|---------------------------|-------------|
| 16. | Signify approval of drawings and return documents in activity 9 and check certificate to project engineer | _____ | (CE/Regional Office Head) | _____ |
| 17. | Instruct drawing office to compile permanent design records and index | _____ | (project engineer) | _____ |
| 18. | Compile permanent design records and index and pass to project engineer | _____ | (drawing office) | _____ |
| 19. | Check permanent design records and index | _____ | (project engineer) | _____ |
| 20. | Where applicable, complete design notes | _____ | (project engineer) | _____ |
| 21. | Where applicable, send design notes (project to GR for filing) | _____ | (project engineer) | _____ |
| 22. | File design notes | _____ | (GR) | _____ |
| 23. | Send permanent design records and index to drawing office | _____ | (project engineer) | _____ |
| 24. | Maintain permanent design records (drawing and index) | _____ | (drawing office) | _____ |
| 25. | Where applicable, send index to departmental library | _____ | (drawing office) | _____ |

- Notes
1. The project engineer should be an officer of professional engineer status. Notwithstanding that the project engineer can delegate parts of the design work to assistant engineers or civil engineering graduates, he should still remain responsible for the whole design.
 2. For projects designed in-house, the Checking Engineer is generally the checking officer, separate from the project engineer, responsible for the independent check of the design.
 3. For projects designed by consultants or contractors employed by the Government, the Checking Engineer is the professional, the team of professionals, the company or the organization separate from the Designer and being responsible for the independent check of the design.
 4. The checking officer should be an officer of professional engineer status or above and suitably experienced in the type of design to be checked.
 5. In the case of a simple and straightforward design where the professional engineer has delegated the design work to his assistant engineer or civil engineering graduate and he in turn checks the design, the professional engineer should sign for the relevant items in the check list for both the project engineer and the checking officer. However, it is always desirable to avoid such an arrangement, by having a checking officer outside the design team.
 6. The checking procedures may be modified to suit the practice of project office as directed by the CE/Regional Office Head.
 7. Geotechnical design of all new slopes and retaining walls, together with the findings of geotechnical investigations and studies on existing man-made slopes and retaining walls which may affect or be affected by the proposed project, are required to be submitted to GEO for checking in accordance with ETWB TCW No. 29/2002.
 8. Ground investigation works, demolition works and any necessary stabilisation works for adjoining ground, slopes and retaining walls, site formation and foundation works with clear information on the envelope of all bulk excavation works, excavation and lateral support works, groundwater drainage works, and natural terrain hazard studies and mitigation measures, within the Mid-levels Scheduled Area, shall be submitted to GEO for checking in accordance with ETWB TCW No. 29/2002A.
 9. Geotechnical design of all permanent foundation works, together with the findings of geotechnical investigations, within the Scheduled Areas of Northwest New Territories and Ma On Shan, and in the Designated Area of Northshore Lantau, shall be submitted to GEO for checking. Details of the information to be included in the geotechnical design submission are given in Appendix B of ETWB TCW No. 4/2004.
 10. Geotechnical design of all tunnel works and any associated temporary works, where such works would pose a significant risk to public life or property, are required to be submitted to GEO for audit. Details of the information to be

included in the geotechnical design submission including risk assessments are given in Appendix A of ETWB TCW No. 15/2005.

APPENDIX 4.2 EXAMPLES OF EXPLANATORY MEMORANDUM/LETTER USED FOR THE CIRCULATION OF THE GENERAL LAYOUT PLAN

便箋 MEMO

| | | | |
|-------------|--|-----------------|--------------|
| 發文人 From | Chief Engineer/ Water Supplies Department | 受文人 To | Distribution |
| 檔號 Ref | () in WSD | (經辦人 Attn. |) |
| 電話 Tel. No. | | 來文檔號 Your Ref. | |
| 傳真 Fax. No. | | 日期 dated | 傳真 Fax No. |
| 日期 Date | | 總頁數 Total Pages | |

(Project Title)

Please find enclosed for your information and comment the hard copy and electronic version of the following Layout Plans showing the Works scheduled to be carried out during the period.....

| <u>Drawing No.</u> | <u>Title</u> |
|--------------------|---------------------------|
| (a) | Alignment Plan(Sheet of) |
| (b) | Alignment Plan(Sheet of) |

2. In particular, the following information is requested :

- (a) HKPF and TD to advise on :
 - (i) Any special road opening conditions to be imposed from the traffic point of view.
 - (ii) Any location which, on particular days, will require the trench work to be completely stopped and the open trench to be backfilled temporarily for traffic reasons.
- (b) DSD to return to me one copy of each drawing marked up with their services that may be affected.
- (c) FSD to indicate the location of the fire hydrant tees required.

3. Trees located within the site as marked on Drawing No. will need to be felled to make way for the Works. AFCD/LCSD * is requested to give their consent to the tree felling.

4. Your reply, within one month from the date of this memo, will be appreciated.

for Chief Engineer/
Water Supplies Department

Distribution
AFCD)

DSD) w/ two sets

ArchSD) FSD) of drawings.
DO/HAD)
GEO, CEDD)
HKPF) w/one set
HyD) of drawings.
LCSD)
PM(), CEDD)
TD)

* delete where inappropriate (DEVB TCW Nos. 6/2015 and 4/2020)

CIRCULATION TO UTILITY UNDERTAKINGS

Dear Sirs,

Contract No.
(Title)
.....

I enclose hard copy(ies)*, an electronic version each of the following Layout Plans (and ELP-Readme.rtf) showing the proposed mainlaying work in

Drawing No.

Title

It is expected that works will be carried out during the period I should be grateful if you would return to mehard copy(ies)* and electronic version of each drawing marked up showing your services that may be affected.

Your reply, within one month from the date of this letter, will be appreciated.

Yours faithfully,

for Chief Engineer

Addressees :

| <u>For Works on H.K. Island</u> | <u>For Works in Kowloon and New Territories</u> |
|--|--|
| Hong Kong Tramways Co. Ltd. | |
| The Hongkong Electric Co. Ltd. | CLP Power Hong Kong Ltd. |
| Hong Kong & China Gas Co. Ltd. | Hong Kong & China Gas Co. Ltd. |
| Towngas Telecommunication Fixed Network Ltd. | Towngas Telecommunication Fixed Network Ltd. |
| MTR Corporation Limited | MTR Corporation Limited |
| The Kowloon Motor Bus Co., (1933) Ltd. | The Kowloon Motor Bus Co., (1933) Ltd. |
| City Bus Co. Ltd. | City Bus Co. Ltd. |
| New World First Bus Services Ltd. | New World First Bus Services Ltd. |
| Wharf T & T Ltd. | Wharf T & T Ltd. |
| Hutchison Global Communications Ltd. | Hutchison Global Communications Ltd. |
| New World Telecommunications Ltd. | New World Telecommunications Ltd. |
| New T&T Hong Kong Ltd. | New T&T Hong Kong Ltd. |
| SmartTone Communications Limited | SmartTone Communications Limited |
| Hong Kong Broadband Network Ltd. | Hong Kong Broadband Network Ltd. |
| Hong Kong Cable Television Ltd. | Hong Kong Cable Television Ltd. |

| <u>For Works on H.K. Island</u> | <u>For Works in Kowloon and New Territories</u> |
|--|--|
| PCCW-HKT Telephone Ltd. | PCCW-HKT Telephone Ltd. |
| TraxComm Limited | TraxComm Limited |
| HKC Network Ltd. | HKC Network Ltd. |
| Transport Department | Transport Department |
| EMSD | EMSD |
| HyD, Lighting Division | HyD, Lighting Division |
| DSD | DSD |

Note : Add/delete utilities as appropriate.

()* : Hard copies of layout plan should only be sent if there are special reasons.
Refer to ETWB TCW No. 7/2003A.

ELP-Readme.rtf (Sample)

ELP Drawing File Name: ELP-W20071-0 (created on 10/02/2003)

Project No. : 9257 WF
 Contract Title : Siu Ho Wan Water Treatment Works Extension
 Pui O Raw Water Pumping Station and associated Mainlaying
 Department : Water Supplies Department

Instructions for Use

1. Please read the Conditions to Use in the layer of layer name arc018_C of the ELP drawing(s) before reading, inspecting, using it/them. You are deemed to have accepted the Conditions of Use if you use whether wholly or in part the ELP drawing(s) or the layout information contained therein.
2. Please check the drawing files containing in this ELP's against the list as shown at below. Please report to WSD if there is any discrepancy.

| | | |
|---------------|-----------------------------|----------------------------|
| Drawing files | W20071Cali1.dwg | |
| | W20071Cali2.dwg | |
| Model files | WDC-W20071-P-10SW21C-E.dwg | WDC-W20071-P-10SW21D-E.dwg |
| | WDC-W20071-P-CKEYPLAN-N.dwg | WDC-W20071-P-CMAIN1-N.dwg |
| | WDC-W20071-P-CMAIN2-N.dwg | |

3. The following softwares are required to read or print the ELP:
 MS Word 97 or above - all text document
 AutoCAD 2000 or above - Drawings
 Adobe Acrobat Reader 4 or above - all "image" files
 Crypto Tools v2.4 or above - all "signed" files
4. All Layout Plans are prepared in compliance with the CAD Standard for Works Projects as stipulated at ETWB TCW No. 38/2002 and 38/2002A. All documents should be printed on A4 paper from a laser printer. For Drawings, A3 size or larger is recommended for best reading comfort.
5. All Document Files and Drawing Files are Digitally Signed. Digital Signatures are neither intended to certify that ELP's are true copies of the hard copy versions of the corresponding Layout Plans nor to validate the identities of the persons approving the Layout Plans.
6. If the Utility Undertaking (UU) wishes to obtain further information about the ELP's, the UU may contact E/Des(), Water Supplies Department at telephone no. 2829 xxxx.

APPENDIX 4.3 CERTIFICATION BY PROJECT ENGINEER AND CHECKING ENGINEER

Project Title : _____

Contract No. : _____

Contract Title : _____

Design Checking Approach:

.....

We certify that :

(a) the design has been prepared in compliance with the standards set out in :

(i) the design memorandum of the contract (copy attached).

Civil Engineering/Technical Manuals listed below:

.....

(iii) Technical Circulars and Practice Notes listed below :

.....

.....

.....

(iv) Other relevant codes of practices, standards, etc. listed below :

.....

.....

(b) the design has been accurately translated into Contract Drawings.

(c) the geotechnical design has been agreed by GEO. (Copy of GEO's memo attached)

Project (Signature :

Engineer (Name :

(Designation :

(Date :

Checking (Signature :

Engineer (Name :

(Designation :

(Date :

APPENDIX 4.4 ESTIMATE DESCRIPTION

| ESTIMATE DESCRIPTION | |
|---|--|
| | <ul style="list-style-type: none"> • Works Package • PWP Number, PWP Category • Agreement/Contract Number • Estimate Date • Date of previous estimate |
| Scope | <ul style="list-style-type: none"> • Precise description of the scope of work covered by this estimate • Precise description of any approved Trends included in the scope since previous estimate and their reference. |
| Type of Contract | <ul style="list-style-type: none"> • State type of works contract - remeasurement, cost-centre, lump-sum and so forth. • State any likely departure from GCCs. |
| Type of Estimate | <ul style="list-style-type: none"> • Stage of design • Type of Estimate • Basis for measurement • Basis for pricing |
| Assumptions | List any assumptions made |
| Special Features | List any special features stating inclusion or exclusion in the estimate (e.g. pre-production of special steel formwork - INC fabrication yard at Junk Bay - EXC temporary rail diversion) |
| Programme Assumptions | Bar chart programme and list of milestone, timing or programme considerations (e.g. shiftwork required for E&M activities handover of site areas for adjacent project) |
| Project Interfaces | <ul style="list-style-type: none"> • list interfaces with other project, illustrated with a project sketch if needed. |
| Price Change | <ul style="list-style-type: none"> • Assumptions and calculation of price change from previous estimate to current baseline date. • For awarded lump sum contracts reconcile the awarded value in terms of price change assumptions. • For awarded contracts with provision for price fluctuations, the price fluctuations shall be reported as separate items. |
| ERA | <ul style="list-style-type: none"> • Calculations of project contingency • Calculations of contract contingency |
| Design Development Allowance | <ul style="list-style-type: none"> • Basis of the calculation of allowance for increased costs due to minor changes as a result of uncertain design development at time of estimate, but not covered by project contingency. |
| Entrustments and Assigned Embedded Work | <ul style="list-style-type: none"> • Scope description, priced itemisation and details of the basis for cost apportionment of the portions of projects entrusted, or embedded in this element of work and included in this estimate. |

| | |
|---------------------------------------|--|
| Special Qualifications | Itemise other special considerations and data (e.g. - contractual inhibitions such as environmental requirements - shiftwork on reclamation - remote source of marine fill - long haul for dumping of marine mud - ground stabilisation required) |
| Reconciliation with previous Estimate | Priced itemisation and why the difference in current to previous estimate. |

APPENDIX 4.5 LIST OF SOME RELEVANT AUTHORITIES

| AUTHORITY | DESCRIPTION | REMARKS |
|-------------------------------|---|---|
| ACABAS | - Appearance of bridges and associated structures | - for advice and agreement |
| ArchSD, Design Advisory Panel | - Aesthetics of building structures | - for advice |
| GEO | <ul style="list-style-type: none"> - Geotechnical Computer programs - Design of borrow areas - Use of explosives (site storage, delivery and use) - Blasting assessment - Permanent geotechnical works (slopes and retaining walls, including natural terrain hazards mitigation works) - Permanent foundation works in Scheduled Area Nos. 2 and 4 and Designated Area in the North Shore of Lantau Island - Permanent tunnel works and associated temporary works - The following works within the Mid-levels Scheduled Area (unless with exemption by GEO): <ul style="list-style-type: none"> (i) ground investigation works; (ii) demolition works and any necessary stabilisation works for adjoining ground, slopes and retaining walls; (iii) site formation and foundation works with clear information on the envelope of all bulk excavation works; (iv) excavation and lateral support works; (v) groundwater drainage works; and (vi) natural terrain hazard studies and mitigation measures. | <ul style="list-style-type: none"> - for advice/acceptance - for advice/agreement - for advice/agreement - for advice and audit - for advice/agreement - for advice/agreement in accordance with ETWB TCW No. 4/2004 - for advice and audit - for advice/agreement in accordance with ETWB TCW No. 29/2002A |
| Marine Fill Committee | <ul style="list-style-type: none"> - Marine borrow areas - Disposal of dredged mud | <ul style="list-style-type: none"> - for approval - for advice and approval |
| Public Fill Committee | - Disposal of inert C&D materials | - for advice and approval |
| EPD | <ul style="list-style-type: none"> - Disposal of C&D waste - Sewerage Impact Assessments | <ul style="list-style-type: none"> - for advice and approval - for advice and approval |
| CEO, CE/TS | <ul style="list-style-type: none"> - Maintenance of marine works - Design of marine works | <ul style="list-style-type: none"> - for comments - for advice |
| DCED | - Permanent prestressed ground anchor | <ul style="list-style-type: none"> - for approval - Proprietary products for permanent reinforced fill |

| AUTHORITY | DESCRIPTION | REMARKS |
|---|--|---|
| DSD | <ul style="list-style-type: none"> - Operation and maintenance of public drainage/sewerage facilities - Design of drainage / sewerage works - Sewerage Impact Assessments - Drainage Impact Assessments | <ul style="list-style-type: none"> - for comments - for comments - for comments - for advice and approval |
| HyD, CHE/Regional Office HyD, SLA/LA HyD, CE/Lighting | <ul style="list-style-type: none"> - Maintenance of highways structures - Landscape design for projects under HyD - Operation & Maintenance of lighting installation - Lighting Design | <ul style="list-style-type: none"> - for comments - for advice - for comments - for advice |
| FSD | <ul style="list-style-type: none"> - Fire escape routes, dangerous goods licences - Schedule and layout of fire fighting equipment | <ul style="list-style-type: none"> - for advice - for approval |
| TD, CE/RSS TD, SE/Std | <ul style="list-style-type: none"> - Road Safety Design - Highways alignment and traffic management design | <ul style="list-style-type: none"> - for advice - for advice |
| LCSD | <ul style="list-style-type: none"> - Street names | <ul style="list-style-type: none"> - for comments |
| LandsD, DLO | <ul style="list-style-type: none"> - Ground anchor | <ul style="list-style-type: none"> - for approval |
| CEDD, SLA/LA | <ul style="list-style-type: none"> - Landscape design for projects under CEDD | <ul style="list-style-type: none"> - for advice |
| DSD, LA | <ul style="list-style-type: none"> - Landscape design for projects under DSD | <ul style="list-style-type: none"> - for advice |
| WSD, LA | <ul style="list-style-type: none"> - Landscape design for projects under WSD | <ul style="list-style-type: none"> - for advice |
| LandsD, DD/SM | <ul style="list-style-type: none"> - Destruction of survey monument | <ul style="list-style-type: none"> - for agreement |
| EMSD | <ul style="list-style-type: none"> - Operation and maintenance of E&M works - Review on the potential application of energy efficient features and renewable energy technologies as listed in para. 10(c) and (e), and Appendix A of DEVB TCW No. 2/2015 | <ul style="list-style-type: none"> - for advice- for comments |
| DPO | <ul style="list-style-type: none"> - Computer system | <ul style="list-style-type: none"> - for approval |
| AFCD | <ul style="list-style-type: none"> - Works within Country Parks | <ul style="list-style-type: none"> - for approval |
| GLTMS | <ul style="list-style-type: none"> - Non-conforming cases on site coverage of greenery for new Government building projects, which have been endorsed by departments | <ul style="list-style-type: none"> - for comments |
| WMCG | <ul style="list-style-type: none"> - Exemption of planting on footbridges and flyovers | <ul style="list-style-type: none"> - for approval |

APPENDIX 4.6 EXAMPLES OF DESIGN MEMORANDUM**A. A Design Memorandum of A Floodwater Pumping Station of DSD****1 Introduction**

- 1.1 The proposed village polder scheme comprises a protective embankment, a dry type floodwater storage pond and a floodwater pumping station.
- 1.2 The approximate 1,160 m long protective embankment protects the village (approx. 37,000 m²) from inundation.
- 1.3 During a rainstorm, surface runoff is collected by peripheral surface channels along the embankment and conveyed to the floodwater pond.
- 1.4 As the pond water rises to preset levels, pump(s) is/are triggered to operate and the pond water is lifted over the embankment and discharged into nearby Sha Po channel.

2. Design Criteria

| | <u>Criteria</u> |
|--|--|
| Hydraulic capacity of duty pump | Capable of handling runoff arising from rainstorms of 10 years return period |
| Hydraulic capacity of both duty pump and standby pump in operation | Capable of handling runoff arising from rainstorms of 50 years return period |

3. Floodwater Pumping Station

- 3.1 The station comprises one duty and one standby screw pumps. During a rainstorm, water collected in the floodwater pond passes through a bar screen at the inlet of the pumping station into the screw pump trough chambers where it is pumped over the protective bund and discharged to Sha Po channel outside the polder.
- 3.2 One duty and one standby screw pump each of capacity 1.1 m³/s at inclination of 30° are selected. The screws are to be started with their maximum capacities.
- 3.3 The pumping operation is automatic. The ON/OFF of pumps is triggered when water level at the inlet chamber reaches predetermined levels at level electrode sensors, which in turn initiates different modes of pumping operation.
- 3.4 A video surveillance system is used to save manpower in monitoring and inspection of the pumping process. Video signals are transmitted to a control centre set up at San Tin pumping station where remote monitoring and control of crucial components of the pumping station can be carried out.

- 3.5 A single storey structure is built to accommodate electrical and mechanical compliance like driving motors, control panel and other E&M appliances. Separate compartments are provided for a standby generator, fuel storage tank and CLP transformer.
- 3.6 The logic diagram for pumping operation is shown in Appendix I and the schematic diagram in Appendix II.
- 3.7 The requirement of each functional components of the pumping station is as follows:

(i) Inlet Screen

| | |
|----------------------------|---|
| Type | Manually raked bar screen |
| Number | 1 |
| Gap Width between Bars | 100 - 150 mm (exact dimensions to be determined by E&MP and ST Divisions) |
| Thickness of Bar | 25 mm (exact dimensions to be determined by E&MP and ST Divisions) |
| Dimension of Inlet Opening | 3,400 mm wide x 2,060 mm high |

(ii) Pumps

| | |
|----------------------------------|---|
| Type | Archimedean Screw |
| Number | 2 (1 duty + 1 standby) |
| Capacity (each) | 1.10 m ³ /s |
| Level of Filling Point of Screws | 1.80 mPD |
| Level of Chute Point | 6.00 mPD |
| Mode of Control | Automatic ON/OFF Control by Electrodes and Remote Control |
| Dangerous Level Alarm ON | 2.50 mPD |
| High Level Alarm ON | 2.40 mPD |
| Duty Pump ON | 1.50 mPD |
| Duty Pump OFF | 1.20 mPD |
| Standby Pump ON | 2.40 mPD |
| Standby Pump OFF | 1.50 mPD |

(iii) Standby Power Generator

| | |
|--------|-------------------------------|
| Type | To be determined by E&MP Div. |
| Number | 1 |

The power of the generator can drive both the duty and standby pumps to run at the same time.

(iv) Fuel Tank

Minimum storage of fuel to meet the need of 36-hour of operation of the generator in running both the duty and standby pumps at the same time.

(v) Penstocks

| Penstock Number | Location | Size of Opening (mm) | Operating Invert Level (mPD) | Platform Level (mPD) | Remark |
|-----------------|-----------------------------|----------------------|------------------------------|----------------------|--|
| P1 | Inlet Chamber | 1000 x 1000 | 0.44 | 3.10 | always OPEN |
| P2 | Inlet Chamber | 1000 x 1000 | 0.44 | 3.10 | always OPEN |
| P3 | Emergency Outlet (see Note) | 600 x 600 | 2.00 | 3.70 | always CLOSE (see Note) |
| P4 | Flow Control Chamber | 250 x 250 | 1.70 | 3.49 | OPEN as water level $\leq 1.95\text{mPD}$ CLOSE as water level $\geq 2.10\text{ mPD}$ |

The penstocks P1, P2, P3 and P4 can be both electrically and manually operated but P4 is also automatically controlled by level electrode sensors.

Note: Emergency opening is always closed by penstock P3. Under extreme situation such as failure of both duty and standby pumps, the emergency opening is used to release floodwater accumulated within the poldered area to the nearby channelled watercourse in a shortest possible time when the water level at the watercourse is low enough to discourage channel water from backflowing into the polder area.

(vi) Telemetry Control/Alarm System

Type Determined by E&MP Div.

Telemetry system for monitoring and remote control of the plan operation are provided in aspect of the following operations:

- Switch ON/OFF of screw pumps;
- Operation of penstock P3;
- Transmission of signals of high water alarm and dangerous level alarm to control centre at San Tin pumping station;
- Transmission of video signals received from video surveillance system

(vii) Video Surveillance System

Type Determined by E&MP Div.

Video surveillance system for visual monitoring of crucial E&M and civil works components and phenomenon as listed below:

- Water level at flood pond;
- Handraked bar screen at screw pump inlet chamber;
- Screw pumps;
- Penstock P3 at emergency outlet;
- Control panel.

(viii) Flow Measurement Device

Type Determined by E&MP Div.

This device is used to measure the pumped outflow rate. The monitoring electronic signals can be sent to the control centre.

(ix) Low Flow Pumps

Low flow pumps are used to keep the floodwater pond dry on unrainy days.

| | |
|---------------------|---------------------------|
| Location | at screw pump sump |
| Type | Centrifugal (submersible) |
| Number | 2 (1 duty + 1 standby) |
| Capacity (each) | approx. 10 l/s |
| Duty pump IN level | 1.0 mPD |
| Duty pump OFF level | not above 0.5 mPD |

B. A Design Memorandum of Water Supply to West Kowloon reclamation, stage 2 – remaining works, mainlaying along road NR9

1. INTRODUCTION

[Give information and description of project.]

2. MAINLAYING

2.1 DESIGN REFERENCE

Vertical profiles, horizontal alignments, associated fittings and thrust blocks are designed in accordance with the recommendations given in the Civil Engineering Design Manual Vol. II, the WSD's Guidance Note on the Design of Thrust Blocks for Buried Pipelines, and Manual of Mainlaying Practice, WSD.

[Stipulate the standards/references used in the corresponding structures or non-structural elements]

2.2 MATERIALS

Pipes

Ductile Iron (DI) pipe shall be used.

Concrete

Grade 20/20D for thrust blocks and concrete surround.

[State the materials for different structures or under different design criteria.]

2.3 ALIGNMENT

All the pipes will be buried.

[General description of the alignment.]

2.4 COVER

Nominal cover for pipes laying under carriageway : min. 1000 mm

Nominal cover for pipes laying under footpath : min. 1000 mm

[Give details of the cover requirement.]

2.5 DESIGN PARAMETERS

| | | |
|-------------------------------------|---|------------------------|
| Allowable vertical bearing pressure | = | 150 kN/m ² |
| Unit weight of concrete | = | 23.6 kN/m ³ |

| | | |
|---|---|------------------------|
| Unit weight of water | = | 9.81 kN/m ³ |
| Unit weight of soil | = | 19.0 kN/m ³ |
| Earth cover at testing condition | = | 0.5 m |
| Coefficient of dynamic friction between soil and concrete | = | 0.5 |
| Coefficient of passive earth pressure | = | 3 |
| Fraction of earth pressure mobilised | = | 1/6 |

[Give design parameters.]

2.6 PRESSURE

i. DN300 F.W. Mains

Top water level of Shek Kip Mei No. 2 & 3 F.W. Service Reservoir : 81.00 mAPD (refer P/R No. 20/95)

Invert level of proposed fresh water mains : 3 mAPD (approx.)

| | |
|-------------------------|-------------------------|
| <u>Working Pressure</u> | <u>Testing Pressure</u> |
| 0.8 MPa | 1.2 MPa |

ii. DN200 S.W. Mains

Maximum pumping head at Cheung Sha Wan S.W. pumping station: 133 m (refer to P/N No. 5/91)

Invert level of proposed salt water mains : 3 mAPD (approx.)

| | |
|-------------------------|-------------------------|
| <u>Working Pressure</u> | <u>Testing Pressure</u> |
| 1.4 MPa | 2.1 MPa |

[State the testing pressures.]

2.7 COMPUTER SOFTWARE

Computer spreadsheet verified by hand calculation is used for the design of thrust blocks.

3. DESIGN CODES AND REFERENCES

The following design codes and references are relevant:

1. BS8110 : Part 1 : 1985
Structural Use of Concrete : Part 1 Code of Practice for Design and Construction
2. Geoguide 1 – Guide to Retaining Wall Design, Second Edition by Geotechnical Engineering Office, Civil Engineering Department, Hong Kong (1993)
3. Water Supplies Department Standard Drawings Volume I to III (1992)

4. Civil Engineering Design Manual Vol, II, Water Supplies Department
5. Manual of Mainlaying Practice (1997), Water Supplies Department
6. Guidance Note on the Design of Thrust Blocks for Buried Pipelines, Design Division, Water Supplies Department
7. Planning Report No. 20/95 “Water Supply to West Kowloon Reclamation – Stage II”
8. Planning Note No. 5/91 “Water Supply to West Kowloon Reclamation, Reprovisioning of Cheung Sha Wan Salt Water Pumping Station”

[List the design codes and references to be used in the design.]

APPENDIX 4.7 CONTENTS OF A BLASTING ASSESSMENT

A Blasting Assessment shall consist of the following:

- (a) Site plans clearly indicating the proposed areas of blasting and locations of all sensitive receivers including streets, structures, foundations, railways, public utilities, water mains, drains, sewers, gas mains and other services, geotechnical features such as slopes, retaining walls, boulders, tunnels, caverns, etc. that may be damaged or destabilised by the proposed blasting works.
- (b) A report containing the results of a study, including the site topography, geology, ground, groundwater and surface water conditions, and the physical site constraints, sensitive receivers and site history.
- (c) A report containing examination of the conditions of the sensitive receivers on and adjacent to the site.
- (d) A report containing an assessment of the effects of blasting works to demonstrate that the proposed blasting would not cause any injury to persons or damage to property and sensitive receivers.
- (e) Proposals of preventive measures to be carried out for sensitive receivers, if considered necessary.
- (f) A list of the action limits to be specified for the implementation of blasting works, including blasting vibration limits and air-overpressure limits, etc. to ensure that the blasting works to be carried out would not cause any injury to persons, damage to sensitive receivers, significant disruption to traffic or undue nuisance to the public. The limits proposed shall take into account the existing conditions of all sensitive receivers. The source of the limits and documentary evidence of consultation and agreement, where appropriate, with the key stakeholders (e.g. owners or maintenance agents) of the sensitive receivers shall be provided.
- (g) An outline of the blast design to demonstrate that the blasting works could be safely carried out and the proposed limits and any other constraints could be satisfied.
- (h) A document setting out the safety management system to be employed, and the working procedures and sequences, where appropriate, for all blasting works.
- (i) Particulars of the site inspections, surveys and monitoring to be carried out to check and measure the effects of blasting, including plans showing the locations of the monitoring stations, the performance criteria and the action limits.
- (j) Proposals of protective and precautionary measures to be taken, including any evacuation and closure of public areas (such as roads and other facilities) and warnings needed to protect the sensitive receivers and the safety of the public and workers.
- (k) Proposals of the arrangement for delivery of explosives to the site to demonstrate the practicability of completing the blasting works and the rock excavation needed within the construction period.

- (l) If an on-site explosive store is considered necessary, a report containing an assessment of its feasibility and proposed arrangement.

APPENDIX 4.8 LIST OF CONSTITUENTS OF SUBMISSION ON GEOTECHNICAL WORKS

Submissions on geotechnical works should include drawings showing the following as appropriate:

- (i) All permanent geotechnical works for slopes, retaining walls and natural terrain, as well as the associated surface water and groundwater drainage works incorporating the requirements of the report required in para. (F) below;
- (ii) The existing nature of the site and the surrounds (including accurate survey plan with ground level contours, geological conditions, groundwater conditions and surface water conditions) and particulars of structures, foundations, public utilities, drains and sewers and other services on and adjacent to the site and within the area influenced by the proposed works;
- (iii) Precautions to be taken to protect public safety whilst carrying out the works;
- (iv) A schedule of the geotechnical design assumptions;
- (v) The sequence of the construction and methods to be employed including any restrictions to be imposed on blasting;
- (vi) The particulars of the monitoring to be carried out for structures, services and ground movements, variations of piezometric levels, blasting vibration, air-overpressure from blasting, etc;
- (vii) The supervision to be provided on site; and
- (viii) Specifications and any other relevant particulars.

The submissions should be accompanied by supporting documentation including:

- (A) An explanatory guide to the submission,
- (B) A report containing the results of a study including topography, geology, groundwater, surface water, site history, past landslides in the vicinity of the site, adjacent buildings, structures, streets and land, public utilities, drains and sewers, planned and existing pipelines, tunnels, water reservoirs, etc. and other services, and local geotechnical records. Particular emphasis should be given to all relevant geological factors,
- (C) A report containing the results of ground investigation field work and laboratory testing including comprehensive details of equipment and procedures used,
- (D) A statement of the independent supervision of the ground investigation field work and laboratory testing actually undertaken, including the names and qualifications of the supervisory staff employed,
- (E) A report containing the results of site monitoring of groundwater conditions,

- (F) A report containing critical examination and interpretation of information in paras. (B), (C), (D) and (E) above, a schedule of the geotechnical design assumptions, discussion of anticipated geotechnical problems and an outline of variations of the works which should be adopted if, during the carrying out of the works, a geotechnical design assumption is revealed to be erroneous so that the stability of the proposed works cannot be adequately maintained either during construction or in the long term, or damage due to settlement. The report should also include requirements for the design and construction of the proposed works including testing, inspecting, monitoring and maintenance requirements,
- (G) A Blasting Assessment with the contents as given in Appendix 4.7 as appropriate, and
- (H) Analysis sufficient to demonstrate that the geotechnical works will be stable both during construction and in the long term, design calculations for all permanent geotechnical works for slopes, retaining walls and natural terrain, assessment of the effects of the works and their construction on the groundwater conditions, the site and any structure, utility, geotechnical feature and members of the public, and calculations for and consideration of all other relevant geotechnical matters. All such analyses, calculations and assessments should be paginated and prefaced by a comprehensive index.

For geotechnical submission requirements for foundation works in the Scheduled Areas in the Northwest New Territories and Ma On Shan, and in the Designated Area of Northshore Lantau, see Appendix B of ETWB TCW No. 4/2004.

For geotechnical submission requirements relating to tunnel works, see Appendix A of ETWB TCW No. 15/2005.

APPENDIX 4.9 GUIDELINES FOR PREPARATION OF CONSTRUCTION AND DEMOLITION MATERIAL MANAGEMENT PLAN

(Subsumed from ETWB TCW No. 33/2002)

A Construction and Demolition Material Management Plan (C&DMMP) shall include the following information:

Purpose

- Spell out the purpose of the C&DMMP

Background

- Highlight some background information of the project including policy commitment or pledge

Scope of Project

- Spell out the scope of project (with layout plans)

Implementation Programme

- Supply an implementation programme (with critical paths shown)

Development Constraints

- Highlight the development constraints and assess whether these could be overcome

Development Options

- Spell out the preferred development option
- Give full justifications for adopting the preferred option
- Spell out other development options considered
- For each development option, estimate the quantity of C&D materials produced or imported fill required and the associated technical, financial and programming implications

Management of C&D Materials

- Give an overview of:
 - Total quantity of C&D materials generated with breakdown of different types of materials (e.g. inert soft C&D materials, Grade II or above rock (granitic or volcanic or others), Grade III or below rock, C&D waste, etc.)
 - Ways to minimise the generation of C&D materials
 - Ways to maximise the use of inert C&D materials

- **Ways to maximise the reuse of C&D materials and/or rock on site**
- **Ways to maximise the use of recycled C&D materials**
- **Disposal programme for each type of surplus C&D materials (i.e. inert soft portions, rock and non-inert portions, etc.)**

Conclusions

- **Sum up the C&DMMP**

Recommendations

- **Give recommendations on the way forward**

**APPENDIX 4.10 DEPARTMENTAL CONSTRUCTION AND DEMOLITION
MATERIAL VETTING COMMITTEE SUGGESTED
COMPOSITION AND TERMS OF REFERENCE COMPOSITION
(Subsumed from ETWB TCW No. 33/2002)**

Chairman : D2 or above level
Secretary : senior professional rank or above
Members : at least one D1 officer and one senior professional
(both of whom are not involved in the project being examined)

Terms of Reference

- (a) To scrutinise and endorse construction and demolition material management plan (C&DMMP) and its revisions prepared by project proponent;**
- (b) To monitor the implementation of the C&DMMP;**
- (c) To submit a half-yearly status report on the implementation of C&DMMP in June and December to the Public Fill Committee (PFC) for consideration; and**
- (d) To review those projects exempted from the C&DMMP and check if the actual quantities of materials generated exceed the estimates that justify the exemption. If so, take appropriate control measures and highlight the situation in the half-yearly report for submission to PFC.**

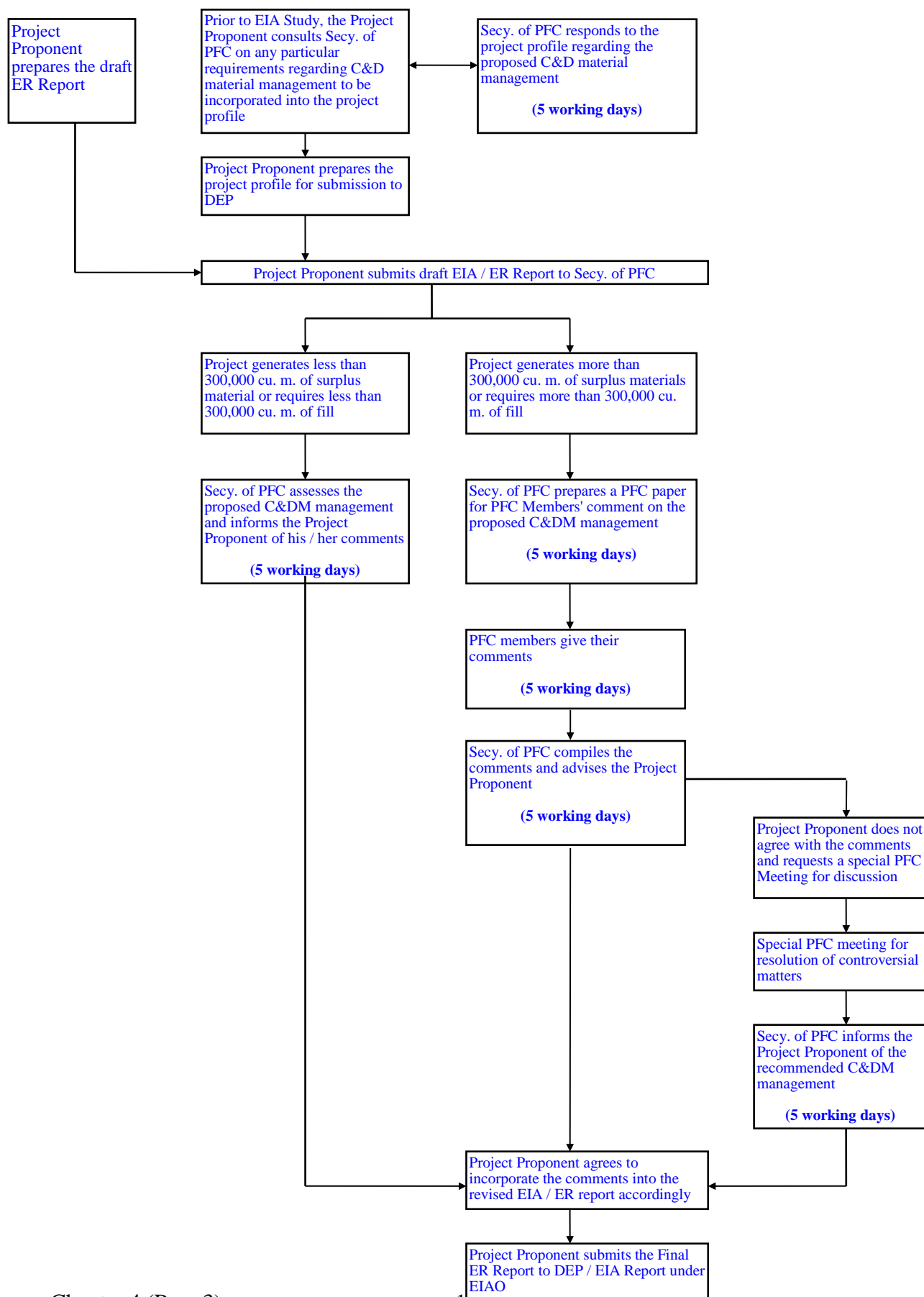
**APPENDIX 4.11 GUIDELINES FOR MINIMISING THE GENERATION AND
MAXIMISING THE USE OF CONSTRUCTION AND
DEMOLITION MATERIALS**
(Subsumed from ETWB TCW No. 33/2002)

- (a) For reclamation or earth-filling projects, maximise the use of inert C&D materials (known as public fill) in lieu of imported sand or fill from other sources. Consideration should also be given wherever possible to raise the formation level of the project to increase the receiving capacity for public fill.
- (b) For large-scale site formation projects, considerations should be given wherever possible to adopt a terracing design for the platform, and/or raise the platform level with a view to maximising filling or minimising cutting with retaining structures and other slope stabilisation techniques.
- (c) For large-scale site formation projects involving disposal of large amount of surplus rock, consideration should be given at feasibility study or preliminary design stage :
 - (i) to introduce an advance quarry contract or on-site crushing facilities to process the surplus rock for on-site or off-site use; and
 - (ii) if (i) is not practicable, arrangements should be made to process the good quality rock at existing quarries.

Where necessary, project officers should consult the Chief Geotechnical Engineer of the Mines Division, GEO for advice on the appropriate arrangement to put to full use the good quality rock.

- (d) Maximise the reuse of inert C&D materials on site.
- (e) Maximise the use of recycled inert C&D materials or products with recycled aggregates such as concrete or paving blocks.
- (f) Maximise the use of steel or aluminum formworks and falseworks.
- (g) Identify and make provisions for on-site sorting as far as practicable.
- (h) Project departments should monitor the annual amount of surplus C&D materials generated from all their projects, with a view to limiting the annual surplus to less than 0.3 million m³ for each project wherever possible.

APPENDIX 4.12 FLOW CHART FOR VETTING OF EIA / ER REPORT (Subsumed from ETWB TCW No. 33/2002)



APPENDIX 4.13 TECHNICAL GUIDANCE ON USE OF HAND-DUG CAISSONS (Subsumed from WBTC No. 9/94)

1. Examples of situations where the use of hand-dug caissons should not normally be permitted include :-

- (a) coastal reclamation sites with high groundwater table,**
- (b) sites underlain by cavernous marble,**
- (c) deep foundation works (e.g. in excess of say 50 metres),**
- (d) landfill or chemically-contaminated sites,**
- (e) sites with a history of deep-seated ground movement,**
- (f) sites in close proximity to water or sewage tunnels,**
- (g) sites in close proximity to shallow foundations, and**
- (h) sites with loose fill having depths in excess of say 10 metres.**

2. Examples of situations where the use of hand-dug caissons could be permitted provided there are no further unfavourable factors include :

- (a) steeply-sloping sites with hand-dug caissons of less than 25 metres in depth in soil, and**
- (b) sites with difficult access or insufficient working room where it may be impractical or unsafe to use mechanical plant.**

3. Where hand-dug caissons are permitted, consideration should be given to the following precautionary measures and preventive works, as appropriate :

- (a) pre-grouting around each hand-dug caisson to increase the shear strength and reduce the permeability of the ground,**
- (b) installation of cut-off walls or curtain grouting around the site boundary to limit inflow of water,**
- (c) installation of dewatering wells within the site, possibly supplemented by recharge wells around the periphery of the site to limit the groundwater drawdown in adjacent ground,**
- (d) construction of the caissons in a suitable sequence,**
- (e) reduction in depth of each caisson digging stage,**

- (f) provision of immediate temporary support for the excavated face prior to the casting of the concrete liner,
- (g) provision of reinforcement to the concrete liner,
- (h) provision of a drainage or relief well at the position of each caisson in advance of manual excavation,
- (i) avoidance of the introduction of new caisson gangs into partly-completed excavations,
- (j) completion of proper grouting of ground investigation boreholes and old wells in the vicinity of hand-dug caissons,
- (k) provision for good ventilation,
- (l) use of well maintained and checked equipment,
- (m) safety inspections,
- (n) provision of safety equipment,
- (o) making an assessment of the risks by a safety professional to the health and safety of the workers whilst at work in caissons and implementing, monitoring and reviewing the measures to comply with the requirements under all existing safety legislation,
- (p) monitoring and control of the potential health hazards e.g. poisonous gases, oxygen deficiency, radon radiation and silica dust, and
- (q) monitoring the ground water table and possibly the ground and sub-soil movement by installing piezometers and inclinometers around the site boundary when carrying out the foundations works.

References

- Hong Kong Institution of Engineers (1987). *Guidance Notes on Hand-dug Caissons*. Hong Kong Institution of Engineers, Hong Kong, 15 p.
- Occupational Safety & Health Council (1993). *Code of Safe Working Practices for Hand-dug Caissons*. Occupational Safety & Health Council, Hong Kong, 42 p.
- (GEO, 2006). *Foundation Design and Construction* (GEO Publication No. 1/2006). Geotechnical Engineering Office, Hong Kong, 376 p.

APPENDIX 4.14 VARIOUS USES OF HARDWOOD ON CONSTRUCTION SITES AND SOME SUGGESTIONS FOR ALTERNATIVES (Subsumed from Appendix A of WBTC No. 32/92)

Possible Uses of Hardwood

1. Hardwood is being used for the following purposes :-

- | | |
|--------------------------|---|
| (a) Site Hoardings | - in both the framing and the panelling. |
| (b) Formwork | - defined as the mould against which concrete is cast and which gives the shape and finish to the concrete surface and which may be permanent or temporary. |
| (c) Falsework | - defined as a temporary structure used to support formwork and a permanent structure until the permanent structure is self-supporting. |
| (d) Trench support | - defined as the shoring, strutting and propping used to support temporary openings below surface ground level. |
| (e) Primary fix | - for example as framework for non load bearing walls. |
| (f) Secondary fix | - for example as doors, door frames, architraves, skirtings, dado rails, cornices and trims. |
| (g) Fitted furniture | - for example, as framing, worktops, and clashing strips. |
| (h) Building maintenance | - to replace existing, for example at refurbishment, wooden block and strip floors. |

2. All of these areas of construction work can be carried out using alternatives to hardwood.

Site Hoardings

3. Site hoardings were traditionally built of hardwood. Some alternatives to hardwood had been recommended by ArchSD. These alternatives include metal frames and metal sheet coverings, softwood framing and softwood veneered plywood and composite boards. These or other alternatives or combinations have already been in use since 1 March 1993.

Formwork/Falsework and Trench Support

4. Temporary formwork/falsework is a major consumer of hardwood.

5. **There are alternative materials for formwork :-**
 - (a) plain or profiled steel sheeting as formwork to support in-situ concrete
 - (b) precast concrete
 - (c) structural steel sections
 - (d) softwood based plywood/medium density fibreboard
6. **There are alternatives to falsework and trench support :-**
 - (a) softwood
 - (b) metal props
 - (c) propriety steel systems.
7. **Each alternative should be considered during the design stage and where benefits can be gained in using one over another, this is to be encouraged. The requirements for the use of materials other than hardwood for temporary formwork/falsework and trench support should be stated in the contract.**

Primary and Secondary Fix and Fitted Furniture

8. **The use of hardwood for primary, secondary fix and fitted furniture should be carefully considered at the design stage, and alternatives should be explored.**
9. **The question that needs to be addressed is whether or not hardwood should be used to execute a piece of work. It is arguable that any piece of unseen carpentry or joinery work should not be in hardwood and that only exposed items of carpentry or joinery work should be considered for a hardwood finish.**
10. **Designers are encouraged to pay more attention to their detailing and where the use of hardwood is unnecessary because it can be replaced by an alternative finish which meets the design criteria, then the alternative should be given preference.**

Building Maintenance

11. **It is a fact of life that if hardwood is used in the original construction it will be replaced at maintenance by similar when worn out. The designer should recognise this fact.**
12. **It is equally important that perpetuation of the use of hardwood to replace hardwood should be reconsidered by all involved in the maintenance of buildings and refurbishment work, and where its incorporation in the works is unnecessary an alternative material should be considered as the replacement.**

Conclusion

13. With the proliferation of building materials available more thought is required at the pre-tender stage to consider alternatives to hardwood. Further action on the reduction in the use of hardwood on construction sites is being investigated and reductions in the use of hardwood will be extended to other areas of construction.

**APPENDIX 4.15 ESTIMATING USING RISK ANALYSIS (ERA) PRACTICE
NOTE
(Subsumed from WBTC No. 22/93)**

ESTIMATING USING RISK ANALYSIS

(ERA)

PRACTICE NOTE

CONTENTS

- 1.0 WHAT IS FINANCIAL RISK?**
- 2.0 WHY ESTIMATING USING RISK ANALYSIS?**
- 3.0 DEFINITIONS**
- 4.0 ESTIMATING USING RISK ANALYSIS**
- 5.0 IDENTIFYING SIGNIFICANT RISKS**
- 6.0 ASSESSING PROBABILITY AND RISK ALLOWANCES**
- 7.0 RECORDING RISK DATA**
- 8.0 QUESTIONS AND ANSWERS SHEET**

Annex A - Typical Risk in Construction Projects

Annex B - Probability Graph

Annex C - Format and Worked Example

Annex D - Questions and Answers Sheet

Annex E - Calculation Proforma Sheets

1.0 WHAT IS FINANCIAL RISK ?

- 1.1 Financial risk comes from the uncertainty about the cost consequences of incomplete information. It means both uncertainty about the feature in question (its scope) and the result of that uncertainty (its value).**
- 1.2 Risks can arise from planning decisions, where the outcome cannot be adequately costed. The majority of risks however, arise from matters yet to be decided (e.g. incomplete brief or no site investigation). Risk assessment of the cost of uncertain features will be present at all stages of a project. The number of risks will normally decrease as a project progresses through the stages of the Public Works Programme and as the design and planning develop, but new risks may appear after planning is complete and even during construction.**
- 1.3 Risk can be referred to as a "contingency", or a "significant risk allowance" or a "risk feature" or similar. The terms mean the same thing i.e. the probable cost of uncertainty.**

2.0 WHY ESTIMATING USING RISK ANALYSIS?

- 2.1 All too often risk is either ignored or dealt with in an arbitrary way by simply adding (about) 10% "contingency".**
- 2.2 The traditional manner of preparing a project estimate allows little scope for provision against risks. Any allowance made for \$ value of risk is included on a once and for all basis with no formal method of updating it other than for inflation. Risks are not separately identified for methodical evaluation and the allowances are often set too high or double accounted in an item and again in a general contingency sum.**
- 2.3 Risk analysis should be one of the most creative but also exacting tasks of project management. It should generate realism by encouraging problem solving.**
- 2.4 Estimating needs to be structured, logical, accountable and easy to explain and trace. Estimating using Risk Analysis (ERA) does this.**
- 2.5 ERA is a procedure to identify project (or contract) related risks in a formal manner and then to give a realistic estimated cost for each risk which makes the relevant importance of each risk immediately apparent.**
- 2.6 As the project is developed towards the tender stage(s) the object is to resolve as much of the uncertainty as possible, concentrating on the major risks.**

3.0 DEFINITIONS

3.1 There are two types of estimate viz :

- (a) Base Estimate The "risk free" part i.e. the certain features, the work that is unlikely to change, prepared by pricing the known features using current rates and prices and standard techniques appropriate to the stage of the project.
- (b) Average Risk Estimate The total of all Average Risk Allowances (see 3.3) plus the Base Estimate. It is the figure reported as the estimate in PWSC/FC papers and the like.

3.2 There are two types of Risk Assessment viz :

- (a) Fixed Risk Assessment A risk which will be incurred as a whole or not at all. Although an "all or nothing" allowance, the likelihood of it occurring can vary and this likelihood or probability also needs to be assessed.
e.g. A secondary access road can be required in total or not at all. The need or probability may be assessed as "likely", therefore the probability might be decided as a 65% chance of being required (see Annex B).
- (b) Variable Risk Assessment A (usually certain) risk relating to an event or feature which can occur in varying degrees, with correspondingly varying probabilities.
e.g. Piling, where the design and cost vary depending on the sub-strata. Both the probability of using a particular piling solution as well as the probable length of the piles have to be assessed to estimate the allowance.

3.3 There are two types of Risk Allowance viz :

- (a) Maximum Risk Allowance The estimated sum of money required if a risk were to occur to its full extent. It is only used as the basis of comparison with the Average Risk Allowance, and is not added into the estimate build-up.
- (b) Average Risk Allowance
 - (i) For a Fixed Risk, it is the product of the Maximum Risk Allowance and the assessed probability of the risk occurring – i.e. paras 3.2(a) x 3.3(a).
 - (ii) For a Variable Risk, it is the estimated sum of money which is assessed as having a fifty/fifty chance (i.e. 50% probability) of being exceeded. This may be anywhere on the probability chart (Annex B).

In each case the project team is using their experience and judgment

to decide the probability.

4.0 ESTIMATING USING RISK ANALYSIS

4.1 ERA is not limited to projects (or contracts) of any particular type or value. It is essentially a brain-storming process of compiling realistic forecasts and answers to "what happens if?"

4.2 The main activities in ERA are :

- (a) identifying significant risks,**
- (b) assessing the probability and extent of those risks occurring, and**
- (c) establishing appropriate \$ values for the risks.**

4.3 Any estimate is made up of two separate parts -

- (a) the work, and**
- (b) the pricing.**

ERA concentrates on (a), though if the accuracy of the prices is suspect, it might be treated as a significant risk.

4.4 ERA is most useful when the unknowns are greatest i.e. Cat C and B. At Cat A the work should be almost "risk free", but the estimate presentation should not change.

4.5 The benefit of ERA will only be realised where risks are considered by the project team (and when appropriate the client department) who should initiate enquiries, obtain information and evaluate the risks together. Identifying risks and assessing probabilities is a collective responsibility which avoids the risk of incomplete commitment and inconsistent decisions.

4.6 Each significant risk is estimated separately. Only those risks which are considered significant are included in the risk analysis. What constitutes a significant risk will vary between projects.

4.7 The extent or scope of the work included in any estimate shall be set down in a concise description of key features, referred to as the Estimate Description.

4.8 As the project is developed the uncertainties are resolved. This continuing process can identify cost reductions.

4.9 At each stage of re-estimating, each resolved risk becomes a known requirement and its cost allowance is then added to the Base Estimate. If the re-estimated cost of the resolved risk differs from its previous cost allowance, this difference is -

if greater added as part of the re-estimated cost to the Base Estimate (i.e. the total re-estimated cost is included and the increase funded from the contingencies);

or if less held in the general contingencies to cover the cost of unresolved risks that on review exceed the previous anticipated cost, or used to compensate for any additional cost of other resolved risks transferred to the Base Estimate, or for entirely new risks.

i.e. As a general rule surplus money from identified savings is held in the general contingencies, not "lost" by reducing the Average Risk Estimate. This is very important when the total value of unresolved risk is relatively high (e.g. when the works will have to be remeasured). Where there is a relatively low total unresolved risk value (e.g. lump sum contracts) it may be possible for the Cat A estimate to be reduced by the value of savings made on resolved risks, particularly if the resolved risk savings are from Fixed Risks. Judgment needs to be used.

4.10 The terms "general contingencies" and "contract contingencies" are used in the example (at Annex C) to separate these contingencies from the term "project contingencies". Whilst they are in effect the same thing, project contingencies have a special meaning in ACP cost control procedures.

5.0 IDENTIFYING SIGNIFICANT RISKS

5.1 ERA requires the identification of those features of a project (or contract) that are at risk of changing. The project team (and client department when appropriate) should meet to analyse the risks at the feasibility stage and thereafter when necessary to achieve the degree of information necessary to identify all significant risks and reduce or eliminate them.

5.2 The risks included in any previous analysis shall be reviewed and identified new risks included.

5.3 The approach to risk analysis is not based upon any established risk classification. Risks identified as relevant and significant should be arranged in the most appropriate groupings and order at each estimating stage. The inclusion of a risk under a particular heading does not exclude it from another (i.e. separating the Fixed Risk and the Variable Risk elements).

5.4 The project team should keep sufficient notes on file to ensure that the reason(s) for the inclusion or exclusion of a risk is sufficiently documented to enable the origin to be easily identified at each review.

5.5 As each risk is identified its significance, whether it is a 'fixed' or a 'variable' risk and its probability must be agreed.

- 5.6 Having identified and placed a value on each risk, the object is to concentrate on resolving those with the highest cost
- 5.7 Preparing the Base Estimate and calculating Average Risk Allowances to arrive at the Average Risk Estimate should be carried out by the officer (in consultation, see para 4.5) responsible for compiling the overall project estimate at each estimating stage.
- 5.8 A list of circumstances giving rise to risk in construction projects is at Annex A. The list is not exhaustive.

6.0 ASSESSING PROBABILITY AND RISK ALLOWANCES

- 6.1 The process of assessing probability is the most unfamiliar aspect of ERA. A scale of probability from 0% (chances are nil) to 100% (certain) is used. In the former case the circumstance is not a risk and would not be considered in the estimate. In the latter case the circumstance is also not a risk but would be considered in the calculation of the Base Estimate. Anything between the two extremes would be considered in the Risk Analysis calculation if the risk was considered significant.
- 6.2 Assessment of probability is not an exact science, therefore it is appropriate to use familiar language, which can be translated into a probability percentage, as set out in Annex B. Examples from this are -

| Statement | Meaning | Probability Suggested for ERA |
|--------------------|--|-------------------------------|
| Highly unlikely | Very little chance | 10-20% |
| "Little chance" | Not more than slight probability - of occurrence (fixed risks) - of exceeding (variable risks) | 31-40% |
| "Unlikely" | - | 41-50% |
| "Better than even" | Average likelihood - of occurrence (fixed risks) - of exceeding (variable risks) | 51-60% |
| "Likely" | - | 61-70% |
| "Highly likely" | - | 81-90% |

- 6.3 The technique for assessing probability differs for Fixed Risks and Variable Risks.

For Fixed Risks the probability is assessed against the Maximum Risk Allowance and the Average Risk Allowance is

calculated from it (see para 3.3). The cost consequences are assessed as in para 6.2 i.e. "little chance" through to "highly likely" to be exceeded.

For Variable Risks the probability of "Average" is pre-determined (see para 3.3(b)). The "Average" allowance has no constant relationship to the Maximum Risk Allowance i.e. the probability of a fifty/fifty chance that the estimated cost will be exceeded does not automatically equate to 50% of the Maximum Risk Allowance. However, the cost consequences must be assessed as for a Fixed Risk i.e. using Annex B.

- 6.4 Risk can also be interdependent (e.g. design solutions can affect the tenderer's pricing, the contractor's operations and the client's cash flow). Interdependent risks that are not individually significant should be listed and treated as a single group. If the group is considered to be significant, the combined risk allowance for it will equal the sum of the separate figures for each feature in the group. But, any risk considered to be significant must be assessed and allowed for separately.

7.0 RECORDING RISK DATA

- 7.1 The record that should be kept at each estimating stage is indicated in the Worked Example at Annex C. ERA calculations should be to a standard format varied to meet special needs. The proforma is at Annex E.

8.0 QUESTIONS AND ANSWERS SHEET

- 8.1 A number of questions have been asked during ERA workshops. They are set out, with answers at Annex D.

Typical Risk in Construction Project

The list indicates the estimating stages at which the itemised risks are likely to have significant cost consequences.

| | Feasibility | Cat C | Cat B | Cat A |
|---|-------------|-------|-------|-------|
| CLIENT | | | | |
| Schedule of Accommodation/Engineering Conditions/Specification | | | | |
| - Additional buildings/facilities | * | * | | |
| - Access roads | * | * | | |
| - Special facilities | * | * | * | |
| - Air conditioning/ventilation | * | * | * | |
| - Design development | * | * | * | |
| Timing | | | | |
| - Early/phased hand-over | * | * | * | * |
| - Delayed start on site | * | * | * | * |
| - Availability of funds | * | * | * | * |
| Financial/Contractual | | | | |
| - Unconventional tender action | * | * | * | * |
| - Special contract arrangements | * | * | * | * |
| - Availability of funds | * | * | * | * |
| Statutory Requirements | | | | |
| - Delay due to meeting requirements | * | * | * | * |
| - Fire service requirements | * | * | * | * |
| Quality Assurance/Standards | | | | |
| - Client department requirements | * | * | * | * |
| Site/Physical | | | | |
| - Difficulty of access | * | * | * | * |
| - Sub-strata type and variability | * | * | * | |
| - Ground water conditions | * | * | * | |
| Site/Environmental/Legal/Planning | | | | |
| - Planning requirements | * | * | * | |
| - Sewerage/waste treatment | * | * | * | |
| - Noise abatement | * | * | * | |
| - Availability of services | * | * | * | |
| - Occupied site | * | * | * | * |
| DESIGN | | | | |
| Suitability | * | * | * | * |
| Site Constraints | | | | |
| - Structural/foundation requirement | * | * | * | |

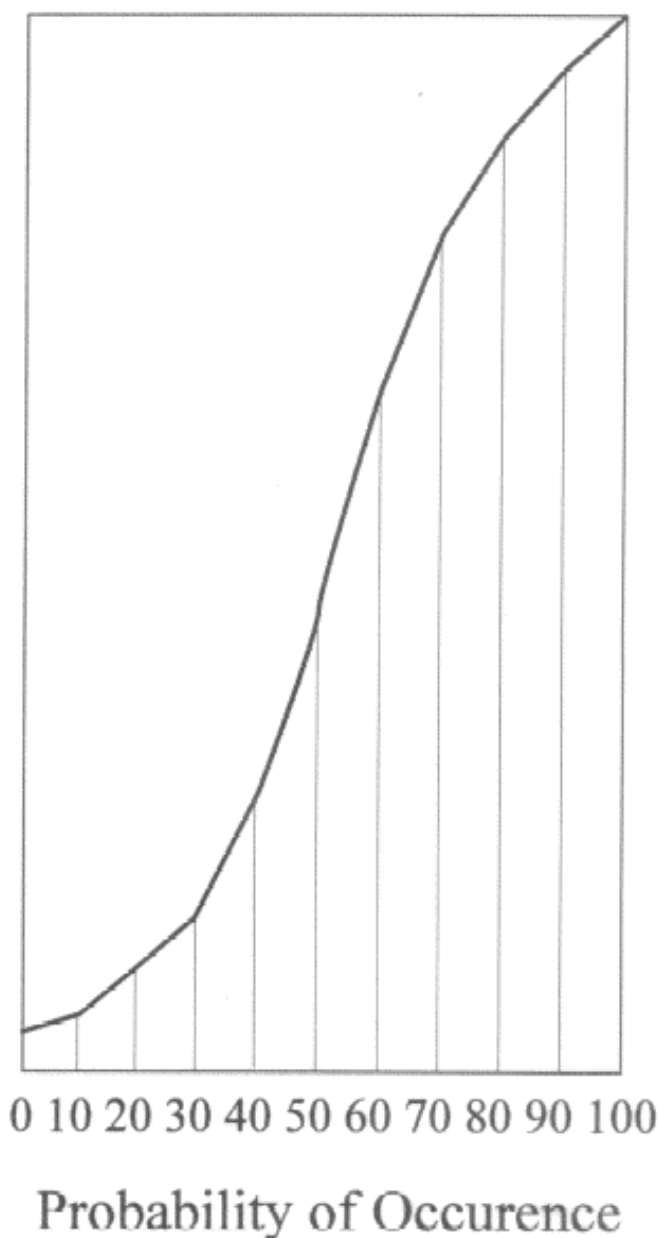
| | | | | |
|---|---|---|---|---|
| Unfamiliarity | | | | |
| - Pioneer design | * | * | * | * |
| - Experience of design team | * | * | * | * |
| - Continuity of team | * | * | * | * |
| ESTIMATING/PRICING | | | | |
| Quality of pricing data | | | | |
| - Improvement in quality from the Feasibility Stage | * | * | * | * |
| Accuracy of Pricing | | | | |
| - Changes of labour/materials/plant costs | * | * | * | * |
| Market Conditions | | | | |
| - Tenderers response to anticipated market situation at time of tendering | * | * | * | * |
| - location | * | * | * | * |
| Pricing data for Tenderers | * | * | * | * |
| CONSTRUCTION | | | | |
| Bankruptcy/Insolvency of Contractor(s) | * | * | * | * |
| Variations | | | | |
| - Effect on contract duration and price | * | * | * | * |
| - Effect of number of orders | | | | |
| Construction Delays | | | | |
| - Availability of labour/materials/plant | * | * | * | * |
| - Likelihood of claims | * | * | * | * |
| Number of Sub-Contractors | * | * | * | * |
| Site Management/Supervision | * | * | * | * |

This page should only be updated by Works Branch of Development Bureau.

Probability Graph

Statement

Almost certainly
Highly likely
Very good chance
Probable
Likely
Probably
We believe
Better than even
We doubt
Improbable
Unlikely
Probably not
Little chance
Almost no chance
Highly unlikely
Chances are slight



Architectural Services Department
January 1993

Example of ERA Calculation

PROJECT DETAILS

1.0 Estimating Stage

1.1 Outline Sketch Design Stage (Jan 91)

1.2 Inclusion in Category C

2.0 Information Known

2.1 The project is a new fifteen storey Multi-user Government Office Building at Tuen Mun.

2.2 Client brief given at inception was in outline form with only basic space standards stated. The brief contains a requirement for a functional area of 18 260 m² but there is a good chance that a further 10% will be needed. Ancillary and circulation adds 15% to area.

2.3 No site survey or site investigation has been undertaken but the area is known for difficult ground conditions and piling is needed in most cases.

2.4 Crisis in the Middle East is threatening the price of oil, interest rates and availability of credit.

2.5 Air-cooled A/C fan coil units is proposed but this may have to change to seawater cooled which would incur increased mains water costs.

2.6 The plot ratio is 1:15 and the position of the building has not been decided on the site.

2.7 ASD are acting as Project Managers and QS's but all other disciplines are different consultants.

2.8 Base Estimate $18\,260\text{m}^2 + 15\% = 20999\text{m}^2$
say $21\,000\text{m}^2 \times \$8,000.00/\text{m}^2 = \$168,000,000.00$

Assessment of Risk

| | | | \$ |
|----------------------------------|---|---|-------------|
| Design Development V | : overall cost 21 000m ² x \$8,000 | = | 168,000,000 |
| | <i>maximum likely</i> say 7.5% | = | 12,600,000 |
| | <i>average risk</i> say 5% | = | 8,400,000 |
| Additional Space F | : <i>maximum likely</i> say 2 100m ² x \$8,000 | = | 16,800,000 |
| | <i>average risk</i> : probably say 70% | = | 11,760,000 |
| Site Conditions V | : substructure 21 000m ² x \$375 | = | 7,875,000 |
| | <i>maximum likely</i> additional Piling Cost | = | 1,000,000 |
| | <i>average risk</i> say another \$25 per m ² | = | 525,000 |
| Market Conditions V | : indices based on TPI average | | |
| | Available : 3rd Qtr 90 = 582 | | |
| | Projection : 1st Qtr 91 | | |
| | say 610 + 5% location = say 640 | | |
| | : this is the TPI level of the OSD estimate. | | |
| | <i>maximum likely</i> = (670 - 640)/640 x \$168m | | |
| | = \$7,875,000 say \$8,000,000 | | |
| | but is this enough in today conditions | | |
| | i.e. Middle East crisis? | | |
| | Suggest we use \$8,500,000 | = | 8,500,000 |
| | <i>average risk</i> is based on the current | | |
| | conditions and we feel that it's as likely as | | |
| | not that the average of the TPI will not be | | |
| | enough : use say 655 | | |
| | <i>average risk</i> (655 - 640)/640 x \$168m | | |
| | = \$3,937,500 say | = | 4,000,000 |
| A/C Cooling Source V | : <i>maximum likely</i> : | | |
| | extra cost incl. mains supply say | = | 1,250,000 |
| | <i>average risk</i> : | | |
| | extra cost of sea-water pipework say | = | 250,000 |
| Access Road F | : cost of long access road | | |
| | <i>maximum likely</i> say | = | 500,000 |
| | <i>average risk</i> : | | |
| | better than even say .50 probability | = | 250,000 |
| Additional Client Requirements V | : <i>maximum likely</i> say 2.5% | = | 4,200,000 |
| | <i>average risk</i> say 1% | = | 1,680,000 |
| Contract Variations V | : <i>maximum likely</i> say 7.5% | = | 12,600,000 |
| | <i>average risk</i> say 5% | = | 8,400,000 |
| Project Co-ordination V | : <i>maximum likely</i> say | = | 1,500,000 |
| | <i>average risk</i> say | = | 500,000 |
| Maintaining Contract Period F | : Completing additional requirement in original | | |
| | anticipated Contract Period of 18 months | | |
| | <i>maximum likely</i> say | = | 1,750,000 |
| | <i>average risk</i> : likely say .60 probability | = | 1,000,000 |

Note : For maximum likely risk a probability factor of 1 in 10 of being exceeded has been assumed.

V = variable risk

F = fixed risk

ERA Calculation

| (1) | (2) Type | (3) Probability of Occurrence (Fixed Risks Only) | (4) Average Risk Allowance \$ | (5) Max. Risk Allowance \$ | (6) Spread (5) - (4)\$ \$ x 10 ⁻⁵ | (7) Spread Square \$ |
|------------------------------------|-------------|---|--|-------------------------------------|---|-------------------------------|
| Design Development | V | | 8,400,000 | 12,600,000 | 42 | 1764 |
| Additional Space | F | .70 | 11,760,000 | 16,800,000 | 50.4 | 2540.16 |
| Site Conditions | V | | 525,000 | 1,000,000 | 4.75 | 22.56 |
| Market Conditions | V | | 4,000,000 | 8,500,000 | 45 | 2025 |
| A/C Cooling Source | V | | 250,000 | 1,250,000 | 10 | 100 |
| Access Road | F | .50 | 250,000 | 500,000 | 2.5 | 6.25 |
| *Additional Client Requirements | V | | 1,680,000 | 4,200,000 | 25.2 | 635.04 |
| *Contract Variations | V | | 8,400,000 | 12,600,000 | 42 | 1764 |
| *Project Co-ordination | V | | 500,000 | 1,500,000 | 10 | 100 |
| Contract Period | F | .60 | 1,000,000 | 1,750,000 | 7.5 | 56.25 |
| Subtotal : | | | 36,765,000 | | | √ 9013.26 |

Sq root = 94.94

Maximum Likely Addition=\$9,494,000

Average Risk Estimate = Base Estimate + Average Risk Allowance = \$204,765,000 (21.88% on base)

Maximum Likely Estimate = Base Estimate + Average Risk Allowance + Maximum Likely Addition
= \$214,259,000 (27.54% on base)

| | | | |
|----------------------------------|--------------------------|-----------------------|--------------------|
| The Project Estimate : | Base Estimate | \$ 168,000,000 | |
| Average Risk) | * Contract Contingencies | \$ 10,580,000 |) Sub total at (4) |
|) | | |) split decided by |
| Allowances) | General Contingencies | \$ 26,185,000 |) project team |
| The Average Risk Estimate | | \$ 204,765,000 | |

Note : Significant risk should be resolved as soon as possible because of high probability/high impact.

V = variable risk

F = fixed risk

Example of ERA Calculation

PROJECT DETAILS

1.0 Estimating Stage

1.1 Final Sketch Design Stage (Jan 92)

1.2 Inclusion in Category B

2.0 Information Known

- 2.1 The project is a new fifteen storey Multi-user Government Office in Tuen Mun.**
- 2.2 Client brief now firmed up and space standards know. Actual gross floor area is 22 250m².**
- 2.3 Site investigation and site survey undertaken. Indication is that piling over 30m will not be required but the ground bearing capacity will dictate the number of piles and their bearing strengths. Site now found to be on partially filled land with many obstructions hidden in ground.**
- 2.4 Crisis in Middle East resolved, oil price stabilises, interest rates drop as inflation comes under control.**
- 2.5 Decision made to provide sea-water cooling for fan coil units, new mains required.**
- 2.6 Building positioned at rear of site with long access road.**
- 2.7 End users identified for office block. We believe there is a possibility that the external cladding will need to be enhanced. We may be restricted to front elevation but we feel there is little chance that this will happen and all elevations will be involved.**
- 2.8 So far the interaction of the design disciplines has been very good.**
- 2.9 Base Estimate 22,250m² x \$8,080.00/m² say = \$180,000,000.00**

Assessment of Risk

| | | | \$ |
|-----------------------|---|---|-------------|
| | : overall cost $22\,250\text{m}^2 \times \$8,080$ | = | 180,000,000 |
| Design Development | <i>maximum likely</i> say 5% | = | 9,000,000 |
| V | <i>average risk</i> say 3% | = | 5,400,000 |
| Additional Space | : no longer a risk, in base estimate | | |
| Site Conditions | : obstructions in ground | | |
| V | <i>maximum likely</i> say | = | 750,000 |
| | <i>average risk</i> say | = | 250,000 |
| Market Conditions | : indices based on TPI average | | |
| V | Available : 3rd Qtr91 = 573 | | |
| | Projection : 1st Qtr 91 | | |
| | say $610 + 5\%$ location = 640 | | |
| | : market recession | | |
| | <i>maximum likely</i> = $(655 - 640)/640 \times \$180\text{m}$ | | |
| | = \$4,218,750 say | = | 4,250,000 |
| | <i>average risk</i> : market recession | | |
| | chances are slight say 0% | = | 0 |
| A/C Cooling Source | : all cost included in base estimate | | |
| Access Road | : all cost included in base estimate | | |
| External Cladding | : concern over external cladding, public access | | |
| V | and building location : likely to cost extra | | |
| | <i>maximum likely</i> | | |
| | say \$500 per m^2 cladding = $9\,000\text{m}^2 \times \500 | = | 4,500,000 |
| | <i>average risk</i> | | |
| | say \$350/ m^2 cladding = $9,000\text{m}^2 \times \$350$ | = | 3,150,000 |
| Redesign | : redesign increases ground floor area by 25% | | |
| F | other changes balance out because of better | | |
| | wall/floor ratio's etc | | |
| | <i>maximum likely</i> = $1,500\text{m}^2 \times 25\% \times \$8,080$ | = | 3,030,000 |
| | <i>average risk</i> : probable : 75% probability say | = | 2,275,000 |
| Additional | | | |
| Client Requirements | : <i>maximum likely</i> now reduced to 2% | = | 3,600,000 |
| V | <i>average risk</i> say 1% | = | 1,800,000 |
| Contract Variations | : <i>maximum likely</i> say 7.5% | = | 13,500,000 |
| V | <i>average risk</i> say 5% | = | 9,000,000 |
| Project Co-ordination | : <i>maximum likely</i> a nominal \$500,00 | = | 500,000 |
| V | no <i>average risk</i> as management is so good | = | 0 |
| Maintaining | : Completing additional requirement in original | | |
| Contract Period | anticipated Contract Period of 18 months | | |
| F | <i>maximum likely</i> say | = | 2,000,000 |
| | <i>average risk</i> : highly likely : .90 probability | = | 1,800,000 |

V = variable risk

F = fixed risk

ERA Calculation

| (1) | (2) Type | (3) Probability of Occurrence (Fixed Risks Only) | (4) Average Risk Allowance \$ | (5) Max. Risk Allowance \$ | (6) Spread (5) - (4)\$ \$ x 10 ⁻⁵ | (7) Spread Square \$ |
|---------------------------------|-------------|---|--|-------------------------------------|---|-------------------------------|
| Design Development | V | no longer a RISK | 5,400,000 | 9,000,000 | 36 | 1296 |
| Additional Space | F | | | | | |
| Site Conditions | V | | 250,000 | 750,000 | 5 | 25 |
| Market Conditions | V | no longer a RISK | 0 | 4,250,000 | 42.5 | 1806.25 |
| A/C Cooling Source | V | | | | | |
| Access Road | F | | | | | |
| External Cladding | V | no longer a RISK | 3,150,000 | 4,500,000 | 13.5 | 182.25 |
| Redesign | F | | 2,275,000 | 3,030,000 | 7.55 | 57 |
| *Additional Client Requirements | V | | 1,800,000 | 3,600,000 | 18 | 324 |
| *Contract Variations | V | | 9,000,000 | 13,500,000 | 45 | 2025 |
| *Project Co-ordination | V | | 0 | 500,000 | 5 | 25 |
| Maintaining Contract Period | F | | 1,800,000 | 2,000,000 | 2 | 4 |
| Subtotal : | | | 23,675,000 | | | 5744.50 |

Sq root = 75.792

Maximum Likely Addition = \$7,579,200

Average Risk Estimate = Base Estimate + Average Risk Allowance = 203,675,000 (13.15% on base)

Maximum Likely Estimate = Base Estimate + Average Risk Allowance + Maximum Likely Addition
= \$211,254,200 (17.36% on base)

| | | | |
|------------------------|---------------------------|----------------|--------------------|
| The Project Estimate : | Base Estimate | \$ 180,000,000 | |
| Average Risk) | * Contract Contingencies | \$ 10,800,000 |) Sub total at (4) |
|) | | |) split decided |
| Allowances) | General Contingencies | \$ 12,875,000 |) by project team |
| | The Average Risk Estimate | \$ 203,675,000 | |

Note : Significant risk should be resolved as soon as possible because of high probability/high impact.

V = variable risk

F = fixed risk

ERA - Questions and Answers

| <u>Question</u> | <u>Answer</u> |
|--|--|
| 1. In the example, why use the square/square root? | The full effect of all the significant risks occurring is unlikely. This calculation produces a more accurate Maximum Likely Addition. When added to produce the Maximum Likely Estimate, the latter can be used as a benchmark to assess the overall reliability of the Average Risk Estimate. |
| 2. The Variable Risk 50/50 chance of being exceeded concept is hard to understand. | There is no easy explanation. One way of looking at it is by reference to the probability chart (Annex B). Alternatively, gauge the sum of money that your experience tells you that the "level" is about right, the sum of money that reflects the average likely price for the risk and to go any lower would mean that the chance of being exceeded is higher than 50/50. |
| 3. Given the way the probability chart if used, the word "average" does not seem correct. | Strictly speaking that is right. "Average" implies "in the middle" when assessing a risk allowance. We use the word in the context of estimating the general price-level of the risk. |
| 4. Market conditions are a major risk. How do we deal with it? | Whatever else we do, FB rules say we don't forecast the market. The estimate is always done at current prices i.e. the pricing data is up-dated to reflect the prevailing market conditions and ignores any obvious trend i.e. the expected overall tender response to the project should be allowed for by adjusting the pricing data used in preparing the estimate. Are the tenders likely to price higher/lower than the pricing data? |
| 5. If we cannot include an inflation forecast in the estimate, how do we arrange for and pay fluctuations? | This appears to be an anomaly between the FB rules and what has to be done in practice. When asked, FB will refund money paid against fluctuations. We initially deal with it by using the contingency sum, which strictly speaking should only be used for design development and for the wholly unexpected (within the original scope of the works) and only ask FB if we run out of money. This point has been raised with FB. |

| <u>Question</u> | <u>Answer</u> |
|---|---|
| 6. How do we present the estimate in PWSC/FC paper? | It will look the same i.e. a list of the main scope of work items, plus a contingency sum. The price of each outstanding risk is added to the appropriate work item, with the contingency sum reflecting the design development allowance plus the amount of "general" contingencies held (see below). |
| 7. What is the difference between "contract" and "general" contingencies? | At each stage in the PWP the project estimate may represent more than one contract. Each contract will include a design development contingency. As the uncertainties are removed and if savings are identified, they are "held" in a general contingency until the team is happy that other existing risks will not turn out to be much higher than expected, or that some new risks won't occur. In which case the savings can be reflected by reducing the general contingency and the estimate, usually when all or part of the project is to be upgraded to Cat A. |
| 8. The rates are a major risk. If they are wrong, the whole exercise is a waste of time. What is being done? | ERA focuses on exposing uncertainty so that the major uncertainties affecting the estimate can be answered. The estimate still needs to be realistically priced. For engineering projects we are working on a schedule of standard descriptions, and standard basic elements, to be computerised so that pricing information can be quickly up-dated. A computerised data base is already available in ArchSD. If you feel that the pricing data is not appropriate, do a further risk assessment on the pricing data. |
| 9. What if there is a fixed risk that if it occurs, is a variable risk (e.g. in access road in a cutting where soil/rock conditions are not known)? | The estimated price for the road is included in the Base Estimate. All other significant risks associated with it are categorised as fixed or variable risks and included in the Average Risk Estimate. |

ANNEX E

Project (Title):

Programme No/Item No (or other identifier):

Client:

Project Status: (eg Cat C, B, A)

Design Stage (eg. Outline, Sketch, Detailed)**Description of Works:**

Layout Drawing No(s):

Scope Approval

Agreed by Client (Name & Post):

Dated

Agreed by Department (Name & Post/Committee):

Dated

Base Estimate

(Latest measured Estimate and Estimate Description is attached) **YES/NO**

Prepared By:

Post:

Date:

Checked By:

Post:

Date:

[illegible]

* based on current prices for similar work

This page should only be updated by Works Branch of Development Bureau.

ANNEX E**Description of Potential Risks and Uncertainties:**

This page should only be updated by Works Branch of Development Bureau.

Assessment of Risk

This page should only be updated by Works Branch of Development Bureau.

ANNEX E

ERA - CALCULATION

[illegible]

The Project Estimate at date:

Base Estimate

\$

Average Risk Allowances

(split of sub total at (4) decided by ERA estimator)

| | |
|---------------------------|----|
| {* Contract Contingencies | \$ |
| { General Contingencies | \$ |

The Average Risk Estimate

\$

| Prepared by: | Post | Date: |
|--------------|------|-------|
|--------------|------|-------|

Approved by: _____ Post _____ Date: _____

File Ref:

APPENDIX 4.16 NOT USED

APPENDIX 4.17 NOT USED

APPENDIX 4.18 NOT USED

APPENDIX 4.19 NOT USED

APPENDIX 4.20 GUIDELINE ON PLANNING AND IMPLEMENTATION OF GROUND INVESTIGATION PROJECTS IN ECOLOGICALLY SENSITIVE AREAS

Purpose

1. Ground investigation (GI) projects are often carried out to support studies and public works projects. The purpose of this guideline is to provide guidance to project officers/consultants on the planning and implementation of GI projects in ecologically sensitive areas. The aim is to provide guidance on implementation of GI projects (especially on the associated access route/haul road) under the Environmental Impact Assessment Ordinance (EIAO) (Cap. 499).
2. In this document, “ecologically sensitive areas” refer to those land-based areas, including country parks or special areas, conservation areas, and sites of special scientific interest, listed in Item Q.1 of Schedule 2 of the EIAO. This guideline will not cover sites of cultural heritage³ or other non-land based ecologically sensitive areas (including marine parks or marine reserves)⁴.

Introduction

3. Under ETWB Technical Circular (Works) No. 13/2003, “Guidelines and Procedures for Environmental Impact Assessment of Government Projects and Proposals”, subject to the advice of Director of Environmental Protection (DEP), ground investigation which is for the purpose of detailed design and is not considered as the first phase of a designated project can be classified as a non-designated project. Special attention should be given to checking against whether the proposed GI works are within the sensitive areas listed in Item Q.1 of Schedule 2 of the EIAO. If the proposed GI investigation works fall within the ecologically sensitive areas and the works involved are not minor in respect of environment impact, such works may become a designated project and if required by the DEP the project proponent should follow the statutory EIAO procedure.

General Principles

4. GI projects commonly comprise GI works such as boreholes, trial pits, slope surface stripping, etc. These works involve a very small amount of excavation and require a small working area. However, where access routes or haul roads to the GI stations are required to be formed, they may involve site clearance, excavation and removal of massive quantities of soil, rock or trees, and disturbance to adjacent flora and fauna. These works might result in significant and irrevocable damage to the environment.
5. The project office/consultants planning and managing a GI project in an ecologically sensitive area should make a submission to EPD for their confirmation on whether the project can be classified as a Non-Designated Project under the EIAO. EPD will consider each GI project on a case-by-case basis. EPD will normally respond within 21 days upon

³ For GI projects within or affecting sites of cultural heritage, they should be conducted following the procedures and requirements given in Development Bureau Technical Circular (Works) No. 1/2022 “Heritage Impact Assessment Mechanism for Capital Works Projects”.

⁴ For GI projects within or affecting other non-land based ecologically sensitive areas, they should be considered case by case. Proponents are encouraged to liaise with DEP about the implementation procedures and requirements.

receipt of a finalised GI project proposal and the Director of Agriculture, Fisheries and Conservation's confirmation of no in-principle objection to the proposed GI works from the project office/consultants. The GI project proposal should include a plan showing the locations of proposed GI stations and access routes or haul roads, and contain explanatory statements on the purpose, nature, scale and scope of the GI project. The project office/consultants should confirm the compliance with this guideline. Relevant information should also be provided by the project office/consultants to address the issues mentioned in para. 11 and 12 of this guideline.

Planning of Ground Investigation Works

6. The general principles of mitigating ecological impacts, in order of priority, are avoidance, minimisation and compensation. In planning the GI projects, project offices/consultants must avoid potential impacts to the maximum extent practicable such as adopting suitable alternatives. Unavoidable impacts shall be minimised by taking appropriate and practicable measures. The loss of important species and habitats may be provided elsewhere as compensation. For details of guidelines for ecological assessment, project officers/consultants may refer to the Technical Memorandum on Environmental Impact Assessment Process.
7. Some GI projects may be contiguous projects to designated projects under the EIAO. Project officers/consultants are advised to seek EPD's confirmation in accordance with para. 3 of this guideline.
8. Although the volume of excavated soil/rock from individual GI stations is very small, the project office/consultants planning the GI project should pay attention to their aggregate effect on the environment. In this regard, they should keep the scale of the GI works, in terms of areal extent and excavation volume, to the minimum possible, taking into account the project requirements and the site conditions.
9. The project office/consultants should carry out a joint site reconnaissance with the GI contractor, the land owner/maintenance agent and other concerned parties, to identify suitable locations for GI stations and access routes which would involve the minimum excavation and disturbance to existing vegetation and natural habitats. In an ecologically sensitive area, appropriate authorities including AFCD, WSD (for GI works within water gathering grounds) and EPD should be consulted, to give advice on areas within their jurisdiction and on the conditions to be followed in the planning and carrying out of the GI project.
10. If at the investigation stage an individual GI contract is to be let (and hence the GI contractor is not yet on board), the project office/consultants should still carry out the joint site reconnaissance with the land owner/maintenance agent and other concerned parties, and consult the relevant authorities as described in para. 9 of this guideline. The agreed locations of the GI stations and access routes or haul roads, together with the conditions laid down by the relevant authorities, should be stated in the tender documents for compliance by the GI contractor.
11. Where trees of particular value (e.g. Old and Valuable Trees) and/or vegetation of protected/endangered/rare/precious species are found, the project office/consultants should ensure that the GI stations and access routes or haul roads are set at a sufficient distance away or otherwise protected to avoid adverse impacts. The project

office/consultants should consider positioning some of the GI stations near the edge of the sensitive area for easy access from immediately outside the area.

12. The access routes should be planned in advance and carefully constructed to avoid adverse impacts on the sensitive receivers such as water courses, wildlife habitats and places of high visual value. In an ecologically sensitive area, the GI contractor should not be allowed to carry out earthworks involving excavation of massive quantities of soil or rock or clearance of a large number of trees to form an access route or a haul road. The existing paths/tracks should be used as far as possible. In all areas, prior agreement/approval should be obtained from land owners and relevant authorities before commencement of works.
13. The project office/consultants should instruct the GI contractor to erect temporary scaffolding platform and/or ladders for the purpose of providing access across sloping ground and/or densely vegetated areas. The size of the scaffolding platforms should be kept to the minimum necessary and the associated works for erecting the platforms should avoid felling/trimming of trees as far as possible.
14. Where necessary, e.g. road access to the GI stations would require earthworks involving excavation of massive quantities of soil or rock or clearance of a large number of trees, the project office/consultants should instruct the GI contractor to deploy helicopters for transport of plant and equipment to the GI stations instead of using road access.
15. The GI contractor should be required to ensure that the working area for each GI station is kept to the minimum necessary (e.g. normally 8m x 2m for boreholes and 4m x 2m for trial pits).
16. Where suitable flat working space is not available for drilling rigs, the project office/consultants should instruct the GI contractor to erect temporary scaffolding platforms and not to carry out earthworks involving excavation of massive quantities of soil or rock or clearance of a large number of trees.
17. The Director of Agriculture, Fisheries and Conservation is the Country and Marine Parks Authority under the Country Parks Ordinance (Cap. 208). For GI works that fall within Country Parks or Special Areas, prior written consent from the Country and Marine Parks Authority must be obtained before commencement of any works. The Country and Marine Parks Authority will lay down conditions in giving consent to proposals on GI to be carried out in country parks or special areas (see para. 20).
18. Where it is necessary to fell trees, the project office/consultants should obtain advice/approval of land owners and relevant authorities. Relevant Government circulars and guidelines on this are available at the Cyber Manual for Greening (<http://devb.host.ccgo.hksarg/en/contactus/index.html>). Reference should also be made to para. 4.10 of PAH Chapter 3, and DEVB TCW Nos. 4/2020 and 5/2020.

Implementation of Ground Investigation Works

19. The project office/consultants should provide site supervision to ensure that the GI contractor complies with the conditions laid down by AFCD and EPD (EPD's recommended pollution control clauses for construction contracts are shown in **Annex A**) and other authorities (e.g. by WSD for GI works in water gathering grounds) to protect

the environment, and that he will not carry out works in such a manner that would cause undue adverse impacts on the sensitive receivers.

20. Upon completion of sampling, logging and insitu testing, the GI contractor should be required to backfill all the GI stations, remove carefully all the temporary works and surplus construction and excavation materials, and reinstate the site to its original condition as far as practicable, in accordance with the specification.
21. The project office/consultants should take date-stamped photographs before, during and after the works for record.

Annex A**Recommended Pollution Control Clauses for Construction Contracts****1. General**

- 1.1 The Contractor shall undertake environmental protection measures to reduce the environmental impacts arising from the execution of the Works. In particular, he shall arrange his method of working to minimise the effects on the air, noise, water quality as well as nuisance of waste within and outside the Site, on transport routes and at the loading, dredging and dumping areas.
- 1.2 The Contractor shall observe and comply with relevant environmental protection and pollution control ordinances. He shall maintain on site, and provide one copy for the Engineer, with copies of the relevant enacted ordinances and their regulations, which shall include, but not be limited to, the following:
 - a. Air Pollution Control Ordinance (Cap 311);
 - b. Waste Disposal Ordinance (Cap 354);
 - c. Water Pollution Control Ordinance (Cap 358);
 - d. Noise Control Ordinance (Cap 400);
 - e. Dumping at Sea Ordinance (Cap 446);
 - f. Environmental Impact Assessment Ordinance (Cap 499);
 - g. Factories and Industrial Undertakings Ordinance (Cap 59);
 - h. Buildings Ordinance (Cap 123);
 - i. Buildings Ordinance (Application to New Territories) Ordinance (Cap 123);
 - j. Public Health and Municipal Services Ordinance (Cap 132);
 - k. Public Cleansing and Prevention of Nuisances (Regional Council) By-Laws (Cap 132);
 - l. Public Cleansing and Prevention of Nuisances (Urban Council) By-Laws (Cap 132);
 - m. Summary Offences Ordinance (Cap 228);
 - n. Merchant Shipping (Oil Pollution) (Hong Kong) Order;
 - o. Waste Disposal (Chemical Waste) (General) Regulation;

- p. Air Pollution Control (Open Burning) Regulation;
 - q. Air Pollution Control (Construction Dust) Regulation;
 - r. Air Pollution Control (Furnaces Ovens and Chimneys) Installation and Alteration Regulation.
- 1.3 The Contractor shall design, construct, operate and maintain pollution control measures to ensure compliance with the contract provisions as well as the environmental ordinances and their regulations. The Contractor shall also conduct compliance monitoring following a programme as agreed with the Engineer, and submit the monitoring results to the Engineer.
- 1.4 General mitigation measures shall include, but not be limited to, the following:
- a. The Contractor shall take every precaution to prevent earth, rock or debris from depositing on public or private rights of way as a result of his operations including any deposits arising from the movement of plant or vehicles. In the event of any earth, rock or debris from construction works being deposited on public or private rights of way, all such earth, rock or debris shall be immediately removed and the affected rights of way restored to their original state by the Contractor to the satisfaction of the Engineer.
 - b. In the event of any spoil or debris from construction works being deposited on adjacent land or seabed or any silt washed down to any area, all such spoil, debris or material and silt shall be immediately removed and the affected land or seabed and areas restored to their natural state by the Contractor to the satisfaction of the Engineer.
- 1.5 The Contractor shall make due allowance in his rates and in his programme for the carrying out of the Works in compliance with the environmental protection control requirements under the Contract.

2. Water Pollution Control

2.1 Water pollution control - general requirements

- 2.1.1 The Contractor shall observe and comply with the Water Pollution Control Ordinance and its subsidiary regulation.
- 2.1.2 The Contractor shall carry out the Works in such a manner as to minimise adverse impacts on the water quality during execution of the works. In particular he shall arrange his method of working to minimise the effects on the water quality within and outside the Site, on the transport routes and at the loading, dredging and dumping areas.
- 2.1.3 The Contractor shall follow the practices, and be responsible for the design, construction, operation and maintenance of all the mitigation

measures as specified in the Professional Persons Environmental Consultative Committee Practice Note (ProPECC PN) 1/94 “Construction Site Drainage” issued by the Director of Environmental Protection. The design of the mitigation measures shall be submitted by the Contractor to the Engineer for approval.

2.2 Marine Plant and Equipment

2.2.1 Two weeks before commencement of any marine works, the Contractor shall submit to the Engineer for approval the proposed methods of working and the marine plant and equipment to be used.

2.2.2 The marine plant and equipment to be used on the Works shall meet the requirement in Clauses 2.3.1 and 2.3.3 and shall be operated to achieve the water quality requirements. The Contractor shall provide all necessary facilities to the Engineer for inspecting or checking such plant and equipment and shall not use such plant and equipment for the execution of the Works without the agreement of the Engineer. The Engineer may require the Contractor to carry out trials of any plant and equipment to prove their suitability.

2.2.3 After commencement of the Works, if the plant and equipment or work methods are in the opinion of the Engineer causing unacceptable adverse impacts which can be checked against the Technical Memorandum on Effluent Standards issued under the Water Pollution Control Ordinance, then the Engineer may notify the Contractor in writing and the Contractor shall immediately initiate remedial measures so as to halt such deterioration. If the contractor fails to initiate remedial measures, the Engineer may stop the Works. Where such remedial measures include the use of additional or alternative plant and equipment, such plant and equipment shall not be used on the Works until agreed by the Engineer. Where remedial measures include maintenance or modification of previously approved plant and equipment, such plant and equipment shall not be used on the Works until such maintenance or modification is completed and the adequacy of the maintenance or modification is demonstrated to the satisfaction of the Engineer.

2.2.4 The Contractor shall comply with the conditions of dumping permits obtained from the Director of Environmental Protection. The permits shall be prominently displayed in the Chinese and English language on site and also on the dredgers and barges.

2.3 Avoidance of pollution during dredging, transporting and dumping of marine mud

2.3.1 Pollution avoidance measures shall include, but not be limited to, the following:

- a. All equipment shall be designed and maintained to minimise the risk of silt and other contaminants being released into the water column or deposited in locations other than designated location;

- b. Mechanical grabs shall be designed and maintained to avoid spillage and shall seal tightly while being lifted;
- c. Where trailing suction hopper dredgers for dredging of marine mud are in use, overflow from the dredger and the operation of lean mixture overboard systems shall not be permitted unless expressly approved by the Engineer in consultation with the Director of Environmental Protection;
- d. Cutterheads of suction dredgers shall be suitable for the material being excavated and shall be designed to minimise overbreak and sedimentation around the cutter;
- e. All vessels shall be sized such that adequate clearance is maintained between vessels and the sea bed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash;
- f. All pipe leakages shall be repaired promptly and plant shall not be operated with leaking pipes and all pipe leakages shall be repaired promptly;
- g. Before moving the vessels which are used for transporting dredged materials, excess material shall be cleaned from the decks and exposed fittings of vessels and the excess materials shall never be dumped into the sea except at the approved locations;
- h. Adequate freeboard shall be maintained on barges to ensure that decks are not washed by wave action;
- i. The Contractor shall monitor all vessels transporting material to ensure that no dumping outside the approved location takes place. The Contractor shall keep and produce logs and other records to demonstrate compliance and that journey times are consistent with designated locations and copies of such records shall be submitted to the Engineer;
- j. All bottom dumping vessels shall be fitted with tight fitting seals to their bottom openings to prevent leakage of material;
- k. Loading of barges and hoppers shall be controlled to prevent splashing of dredged material to the surrounding water, and vessels shall not be filled to a level which will cause overflowing of material or polluted water during loading or transportation; and
- l. The Engineer may monitor any or all vessels transporting material to check that no dumping outside the approved location nor loss of material during transportation takes place. The Contractor shall provide all reasonable assistance to the Engineer for this purpose.

- 2.3.2 The Contractor shall be responsible for obtaining all necessary dumping permits as stipulated in Section 4.2.1 of Chapter 4 of the PAH – Management of Dredged/Excavated Sediment. The dredged marine mud shall be deposited at a disposal site as designated in the dumping permit.
- 2.3.3 When dredging, transporting and disposing of contaminated marine mud, the Contractor shall implement adequate measures for the avoidance of pollution which shall include, but not be limited to, the following:
- a. Dredging of contaminated marine mud shall be undertaken by a suitable grab dredger using closed watertight grab;
 - b. Transport of contaminated marine mud shall be by split barge of not less than 750 m³ capacity, well maintained and capable of rapid opening and discharge at the disposal site;
 - c. The material shall be placed into the disposal pit by bottom dumping;
 - d. Discharge from split barges shall take place within a radius of 100 metres of centre of the area allocated for the disposal of contaminated marine mud;
 - e. Discharge shall be undertaken rapidly and the hoppers shall then immediately be closed, material adhering to the sides of the hopper shall not be washed out of the hopper and the hopper shall remain closed until the barge next returns to the disposal site; and
 - f. The dumping vessel shall be anchored throughout the dumping operation.
- 2.3.4 The Contractor shall ensure that all marine mud is disposed of at the approved locations. He shall be required to ensure accurate positioning of vessels before discharge and shall be required to submit proposals for accurate position control at disposal sites to the Engineer for approval before commencing dredging and dumping.
- 2.3.5 The Contractor shall ensure that all unsuitable material is disposed of at the approved landfill or other designated location.
- 2.3.6 The Contractor shall only employ vessels equipped with automatic self-monitoring devices as specified by the Director of Environmental Protection for disposal operation, and shall co-operate with and facilitate the Director of Environmental Protection to inspect the device and retrieve the record stored in the device on a regular basis.
- 2.3.7 The Contractor shall provide experienced full time personnel on board all dumping vessels to ensure that appropriate methods to minimise pollution are implemented.

2.4 Protection of Water Quality at Water Intakes

- 2.4.1 When dredging mud or placing fill in the vicinity of water intakes, the Contractor shall protect the water intake by surrounding it with a suitable silt screen to prevent excessive suspended solids from entering the intake. The silt screen shall be designed to ensure that the concentration of suspended solids entering the intake meets intake user requirements.

2.5 Silt Curtains

- 2.5.1 If silt curtains shall be used to contain sediment losses during dredging and placing fill, the Contractor shall be responsible for the design, installation and maintenance of the silt curtains to minimise the impacts on the water quality and the protection of water quality at water intakes as described in Clause 2.4.1. The design and specification of the silt curtains shall be submitted by the Contractor to the Engineer for approval.
- 2.5.2 Silt curtains shall be formed from tough, abrasion resistant, permeable membranes, suitable for the purpose, supported on floating booms in such a way as to ensure that the sediment plume shall be restricted to within the limit of the works area.
- 2.5.3 The silt curtain shall be formed and installed in such a way that tidal rise and fall are accommodated, with the silt curtains always extending from the surface to the bottom of the water column. The removal and reinstallation of such curtains during typhoon conditions shall be as agreed with the Director of Marine.
- 2.5.4 The Contractor shall regularly inspect the silt curtains and check that they are moored and marked to avoid danger to marine traffic. Any damage to the silt curtain shall be repaired by the Contractor promptly and the works shall be stopped until the repair is effected to the satisfaction of the Engineer.

2.6 Refuse containment booms and floating refuse

- 2.6.1 The Contractor shall provide and install refuse containment booms before commencing public dumping to confine the floating debris arising within the site as a result of public dumping. Details of the refuse containment booms shall be submitted to the Engineer for approval before their use on site.
- 2.6.2 It is expected that public dump material may contain refuse, timber debris, or oil contamination and these shall be removed by the Contractor. The Contractor shall segregate all inert construction waste material suitable for reclamation. All non-inert construction waste material shall be disposed of at a public landfill.
- 2.6.3 Plastic buoys for the refuse booms will be provided by the Employer. The plastic buoys shall be collected from and returned to the Civil Engineering and Development Department Technical Services Division's Store at

North Point after use and cleaning.

- 2.6.4 The Contractor shall provide adequate sinker blocks and lit marker buoys to ensure that the booms are visible above the water line and securely anchored. The lights on the marker buoys shall be quick flashing yellow light visible all round the horizon at a distance of at least 2 km and details shall be submitted to the Engineer for approval. The maximum spacing between the flashing yellow lights shall be 30 metres. The Contractor shall properly maintain and operate the booms to the satisfaction of the Engineer throughout the progress of public dumping of the Site and shall replace the same if necessary when they are under repair or beyond repair.
- 2.6.5 The Contractor shall deploy sufficient sampans and labour for collecting floating refuse and preventing floating refuse within the Site from drifting into public waters. The frequency of collecting floating refuse shall be as agreed by the Engineer. Floating refuse collected shall be disposed of off Site by the Contractor.
- 2.6.6 The Contractor shall make due allowance in programming the public dumping for the provision, installation, operation and maintenance of the refuse booms and the regular collection of the floating refuse throughout the progress of the reclamation work.
- 2.6.7 The Contractor's attention is drawn to the SCC Clause No. () on the Employer's power to carry out the work by person other than the Contractor if the Contractor shall fail to carry out any work required under this Particular Specification Clause.

2.7 Surface Runoff

- 2.7.1 The Contractor shall contain within the Site all surface runoff generated from foundation works, dust control and vehicle washing, etc.

2.8 Discharge into sewers and drains

- 2.8.1 The Contractor shall not discharge directly or indirectly or cause or permit or suffer to be discharged into any public sewer, stormwater drain, channel, stream-course or sea any trade effluent or foul or contaminated water or cooling or hot water without the prior written consent of the Engineer in consultation with the Director of Environmental Protection and Director of Water Supplies, who may as a condition of granting his consent require the Contractor to provide, operate and maintain at the Contractor's own expense to the satisfaction of the Engineer suitable works for the treatment and disposal of such trade effluent or foul or contaminated or cooling or hot water. [The design of such treatment works shall be submitted to the Engineer for approval not less than one month before the commencement of the relevant works.]
- 2.8.2 If any office, site canteen or toilet facilities is erected, foul water effluent shall be directed to a foul sewer or to a sewage treatment and disposal facility either directly or indirectly by means of pumping or other means

approved by the Engineer.

3. Noise Control

3.1 Noise control - general requirements

3.1.1 The Contractor shall observe and comply with the Noise Control Ordinance and its subsidiary regulations.

3.1.2 The Contractor shall ensure that all plant and equipment to be used on the Site are properly maintained in good operating condition and noisy construction activities shall be effectively sound-reduced by means of silencers, mufflers, acoustic linings or shields, acoustic sheds or screens or other means, to avoid disturbance to any nearby noise sensitive receivers.

3.1.3 For carrying out any construction work other than percussive piling during the time period from 07:00 hr to 19:00 hr on any day not being a general holiday (including Sundays), the Contractor shall comply with the following requirements

- a. The noise level measured at 1 m from the most affected external facade of the nearby noise sensitive receivers from the construction works alone during any 30 minute period shall not exceed an equivalent sound level (Leq) of 75 dB(A).
- b. The noise level measured at 1 m from the most affected external facade of the nearby schools from the construction works alone during any 30 minute period shall not exceed an equivalent sound level (Leq) of 70 dB(A) [65 dB(A) during school examination periods]. The Contractor shall liaise with the schools and/or the Examination Authority to ascertain the exact dates and times of all examination periods during the course of the contract.
- c. Should the limits stated in the above sub-clauses (a) and (b) be exceeded, the construction shall stop and shall not re-commence until appropriate measures acceptable to the Engineer that are necessary for compliance have been implemented.
- d. The Contractor shall adopt, where necessary, the use of quiet construction equipment (QCE) and/or shall employ the quietest practicable working methods when carrying out demolition works, and/or road opening works during restricted hours.
- e. Diesel hammers are not to be used for percussive piling works.
- f. Blasting should not be carried out during 7 p.m. to 7 a.m. and any time on a general holiday, including Sunday, to avoid noise impact at sensitive hours.

- 3.1.4 Before the commencement of any work, the Engineer may require the methods of working, plant equipment and sound-reducing measures to be used on the Site to be made available for trial demonstration inspection and approval to ensure that they are suitable for the project.
- 3.1.5 The Contractor shall devise, arrange methods of working and carry out the Works in such a manner so as to minimise noise impacts on the surrounding environment, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.
- 3.1.6 Notwithstanding the requirements and limitations set out in Clause 3.1.3 above and subject to compliance with Clauses 3.1.2 and 3.1.5 above, the Engineer may upon application in writing by the Contractor, allow the use of equipment and the carrying out of any construction activities for any duration provided that he is satisfied with the application which, in his opinion, is considered to be of absolute necessity and adequate noise insulation has been provided to the schools to be affected, or of emergency nature, and not in contravention with the Noise Control Ordinance in any respect.
- 3.1.7 The Contractor shall, when necessary, apply for a construction noise permit in accordance with the Noise Control (General) Regulations prior to the commencement of the relevant part(s) of the works, display the permit as required and provide a copy to the Engineer.
- 3.1.8 Measures that are to be taken to protect adjacent schools and other adjacent noise sensitive receivers, if necessary, shall include, but not be limited to, adequate noise barriers. The barriers shall be of substantial construction and designed to reduce transmission of noise (simple plywood hoarding will not be sufficient). The barriers shall be surmounted with baffle boxes designed to reduce transmission of noise. The barriers shall be designed to BS 5228:1997. The location and details of the barriers shall be submitted to the Engineer for approval before works commence adjacent to schools and other noise sensitive receivers.

4. Air Pollution Control

4.1 Air pollution control - general requirements

- 4.1.1 The Contractor shall observe and comply with the Air Pollution Control Ordinance and its subsidiary regulations, particularly the Air Pollution Control (Open Burning) Regulation and Air Pollution Control (Construction Dust) Regulation and Air Pollution Control (Smoke) Regulation.
- 4.1.2 The Contractor shall undertake at all times to prevent dust nuisance and smoke as a result of his activities.
- 4.1.3 The Contractor shall ensure that there will be adequate water supply/storage for dust suppression.

- 4.1.4 The Contractor shall devise, arrange methods of working and carrying out the works in such a manner so as to minimise dust impacts on the surrounding environment, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.
- 4.1.5 For better smoke control, the Contractor shall not use diesel hammer for percussive piling.
- 4.1.6 Before the commencement of any work, the Engineer may require the methods of working, plant, equipment and air pollution control system to be used on the site to be made available for inspection and approval to ensure that they are suitable for the project.

APPENDIX 4.21 ADDITIONAL CONTROL MEASURES FOR MANAGEMENT OF DREDGED/EXCAVATED CONTAMINATED SEDIMENT

(The volume mentioned in this Appendix refers to bulk volume)

To ensure that maximum effort is made by the project proponent to reduce the consumption of the very limited mud pit capacity, it is necessary to tighten the control on management of dredged/excavated contaminated sediment, including the stepping up of sampling requirement at early stage of project planning, the exhaustive examination of options to reduce sediment generation and disposal, the requirement for cross-boundary disposal of Category M sediment and the enhancement of accountability of sediment disposal proposal. The control measures below are to tighten up the control on management of dredged/excavated contaminated sediment as stipulated in Section 4.2.1 of Chapter 4 of the PAH – Management of Dredged/Excavated Sediment:

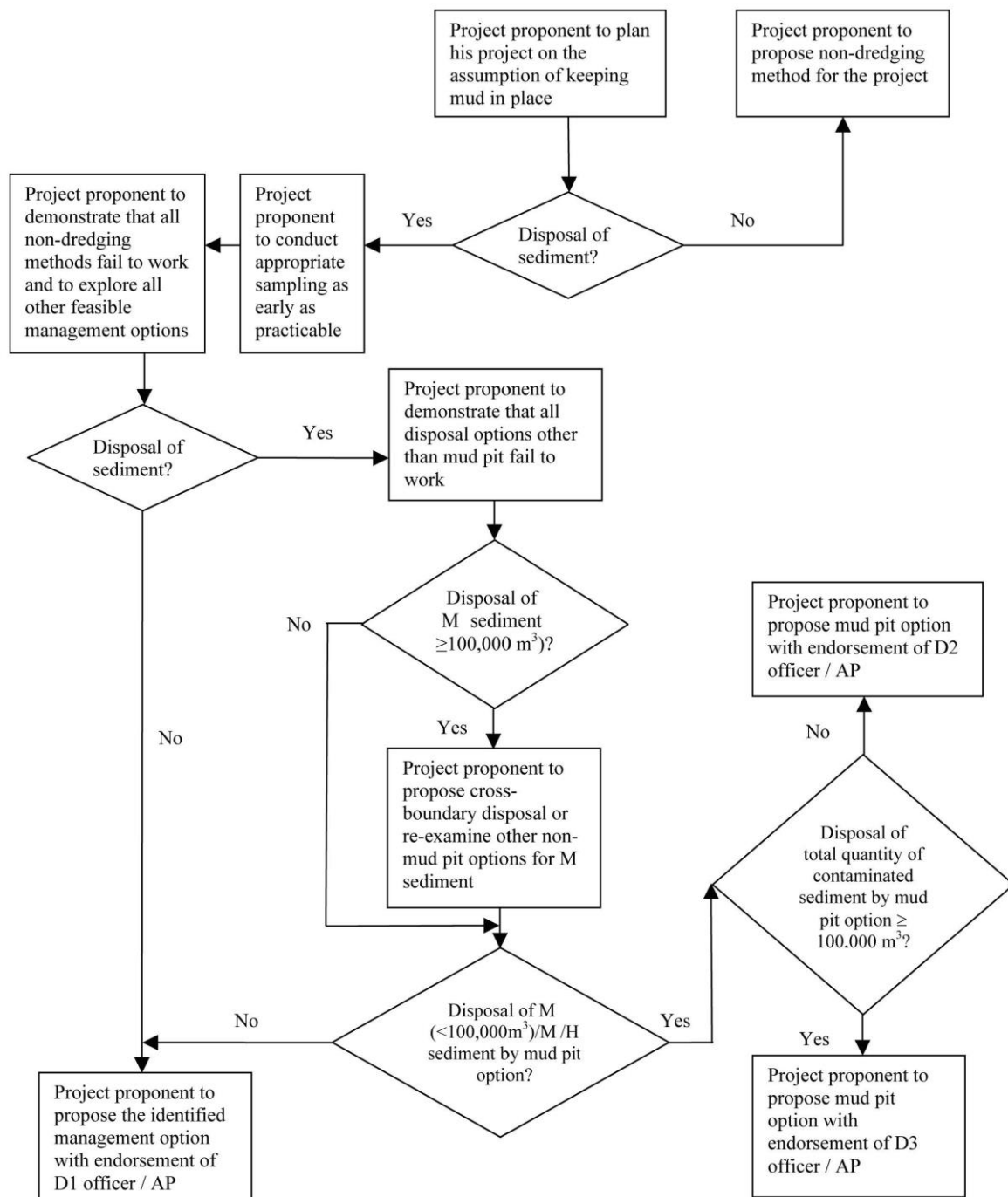
- (a) To enable a more accurate estimate of mud disposal volume to be made available for consideration when provisional agreement for sediment disposal allocation is sought for projects involving dredging and excavation in areas where the expected contamination level is Category M/H, Marine Fill Committee (MFC) requires that the project proponent should take sediment samples at a 200 m x 200 m grid. The samples should be continuous and with a vertical profile. The top level of the sub-samples should be at seabed, 0.9 m down, 1.9 m down, 2.9 m down and then every 3 m to the bottom of the dredged layers. The project proponent should as early as practicable submit the proposed sampling plan to the Dumping At Sea Ordinance (DASO) Team of the Environmental Protection Department (EPD) for comment.
- (b) The project proponent is required to carry out an assessment on sediment management as outlined on the “Flow Chart for Management of Contaminated Sediment” at **Annex A**. This requirement ensures that the project proponent has exhausted all management options to keep the sediment in place and explored in detail all possible ex-situ treatment, disposal and beneficial reuse options before a decision is made to remove the sediment off site. Reference should be made to the consultancy study – FM01/2007 by the Civil Engineering and Development Department (CEDD) on various management options. A copy of the report is available on CEDD’s website via the following link: https://www.cedd.gov.hk/filemanager/eng/content_662/Final_Report_on_Assessment_of_Management_Options_Rev_A.pdf
- (c) Project proponents should apply for cross-boundary disposal of Category M sediment generated from their projects in accordance with the Agreement on Cross-boundary Marine Dumping and the Implementation Scheme on the Management of Cross-boundary Marine Dumping unless the genuinely estimated quantity of Category M sediment is less than 100,000 m³. Other non-mud pit options for Category M sediment should also be examined. In case the application is not successful and there is no other feasible non-mud pit options, the project proponent should liaise with the Secretary of MFC about fall-back options.
- (d) To enhance the accountability of the sediment disposal proposal, endorsement by the appropriate directorate officer of the works departments or the Authorised Person (AP) of the private project as indicated on the attached Flow Chart at **Annex A** is required to be obtained prior to submission of the disposal option to the Secretary of MFC. Project proponents may seek advice from the Secretary of MFC, if necessary.

- (e) Project proponents are required to exhaust all management options, work out the estimated quantities of contaminated sediments to be disposed of, based on the results of the sampling carried out, as early as practicable according to (a) above and seek provisional agreement from MFC on allocation of disposal space at mud pit. Such allocation will have to be re-confirmed after the sediment quality report (SQR) is completed and approved by DASO team of EPD during the detailed design stage. During construction, a project proponent should review from time to time the estimated final quantity of contaminated sediment disposal and advise MFC of any changes in advance before the actual disposed quantity has reached 80% of the approved quantity. If the latest estimated final quantity **exceeds** the approved quantity by 5,000 m³ (or 5% of the approved quantity, whichever is more), the project proponent should seek further approval from MFC as a new application with appropriate endorsement as follows:

| Scenario | | Endorsement |
|----------------------------------|---|--|
| (I) Public Works Projects | | |
| (i) | The estimated final quantity does not exceed the approved quantity by 100,000 m ³ (or 5% of the approved quantity, whichever is more) | By a D2 officer for MFC's approval |
| (ii) | The estimated final quantity exceeds the approved quantity by 100,000 m ³ (or 5% of the approved quantity, whichever is more) | By a D3 officer for MFC's approval |
| (II) Private Projects | | Endorsement by the AP for MFC's approval |

Examples illustrating how the threshold quantities are determined and how the requirements of new applications and endorsements apply are shown in **Annex B**.

- (f) If a public project proponent disposes of a quantity of 5,000 m³ (or 5% of the approved quantity, whichever is more) more than the approved quantity without the prior approval of MFC, or a quantity less than the approved quantity by more than 5,000 m³ (or 5% of the approved quantity, whichever is more) without prior notification to MFC, the respective Director should personally provide an explanation to MFC and copy it to the Permanent Secretary for Development (Works).

Flow Chart for Management of Contaminated Sediment[#]

[#] This flow chart shall be read in conjunction with Appendix 4.30 of Chapter 4 of the PAH.

Note: The volume refers to bulk volume.

Annex B

Examples to illustrate how the threshold quantities are determined and how the requirements of new applications and endorsement apply

| | Example | Threshold quantity for requirement of new application | Threshold quantity for requirement of endorsement by a D2/D3 Officer |
|-----|--|---|---|
| | | 5,000 m³ or 5% of the approved quantity, whichever is more | 100,000 m³ or 5% of the approved quantity, whichever is more |
| (a) | Project with large quantity of contaminated sediment Approved Quantity: 2,500,000 m ³ Estimated Quantity: 2,750,000 m ³ (i.e. increase by 250,000 m ³) | 125,000 m³ because 5% of approved quantity, i.e. 125,000 m ³ , is more than 5,000 m ³ . A new application is required because the increase in quantity, i.e. 250,000 m ³ , exceeds 125,000 m ³ . | 125,000 m³ because 5% of the approved quantity, i.e. 125,000 m ³ , is more than 100,000 m ³ . The new application shall be endorsed by a D3 officer because the increase in quantity exceeds 125,000 m ³ . |
| (b) | Project with medium quantity of contaminated sediment Approved Quantity: 120,000 m ³ Estimated Quantity: 132,000 m ³ (i.e. increase by 12,000 m ³) | 6,000 m³ because 5% of approved quantity, i.e. 6,000 m ³ is more than 5,000 m ³ . A new application is required because the increase in quantity, i.e. 12,000 m ³ , exceeds 6,000 m ³ . | 100,000 m³ because 100,000 m ³ is more than 5% of the approved quantity, i.e. 6,000 m ³ . The new application shall be endorsed by a D2 officer because the increase in quantity does not exceed 100,000 m ³ . |
| (c) | Project with small quantity of contaminated sediment Approved Quantity: 10,000 m ³ Estimated Quantity: 11,000 m ³ (i.e. increase by 1,000 m ³) | 5,000 m³ because 5,000 m ³ is more than 5% of approved quantity, i.e. 500 m ³ . A new application is <u>not</u> required because the increase in quantity, i.e. 1,000 m ³ , does not exceed 5,000 m ³ . | NA |

* The threshold quantities determined for the respective example cases are shown in bold.

APPENDIX 4.22 DESIGN AND CHECK CERTIFICATE

Agreement No.: _____ **(if appropriate)**

Project Title: _____

Project Office: _____

Design Checking Approach:

1. This Design and Check Certificate refers to submission No. _____
which comprise

- (a) Works covered by this Certificate
(*nature and description of the submission*)

in respect of:
(*description of the works to which the submission refers*)

- (b) Contents of this submission are listed in Schedule A below.

2. Designer's certification

I/ We certify that

- (a) the design of the works, as illustrated and described in the documents listed in Schedule A below, complies with the standards set out in the Agreement or _____ (any form of agreement as appropriate) and with amendments agreed to by the Director's Representative or _____ (any relevant authorities as appropriate);
- (b) all reasonable and professional skill, care and diligence have been exercised in designing the works, as illustrated and described in the documents listed in Schedule A below; and
- (c) a self-check has been undertaken and completed to confirm the completeness, adequacy and validity of the design of the works as illustrated and described in documents listed in Schedule A below.

Signed:

(Name)
(Position)
(Organization)

(Date)

3. Checking Engineer's certification

- (a) I/ We certify that the design has been independently checked in accordance with the agreed design criteria using all reasonable skill and care and that I/we am/are satisfied that the design checked complies in all respects with the agreed design criteria.
- (b) I/ We further certify that I/ We am/are satisfied that the checking of the above design is completed.

Signed: _____

(Name)
(Position)
(Organization)
(Date)

Schedule A

Submission No. _____ comprises the followings:

Documents: (Title, reference number and revision)

Drawings: (Title, reference number and revision)

Others: (Please Specify)

APPENDIX 4.23 PERSONNEL FOR DESIGN AND CONSTRUCTION REVIEW OF PRESCRIPTIVE MEASURES FOR STABILIZATION AND IMPROVEMENT OF MAN-MADE SLOPES AND STANDARDIZED DEBRIS-RESISTING BARRIERS FOR MITIGATION OF NATURAL TERRAIN LANDSLIDE HAZARDS (Subsumed from ETWB TCW No. 13/2005)

Prescriptive Measures for Stabilisation and Improvement of Man-made Slope Features

1. The prescriptive measures items should be specified by a geotechnical engineer professionally qualified and experienced in Hong Kong, as should the construction review. A suitable qualification is Registered Professional Engineer (Geotechnical). For preventive maintenance works which involve only surface protection and surface drainage prescriptive measures, the prescriptive design and construction review may also be carried out by a professionally qualified civil engineer competent in site formation and drainage works.
2. For preventive maintenance works, it is often more cost-effective to ask the same professional engineer who undertakes the Engineer Inspection for the slope to also specify the items of prescriptive measures required as part of the preventive maintenance recommendations. This should be arranged wherever possible.
3. Construction review includes a review of the suitability and adequacy of the specified prescriptive measures items during construction and giving recommendations on any design modifications necessary to take into account the actual site and ground conditions revealed. It should always be carried out for prescriptive measures specified as upgrading and preventive maintenance works. It should also be undertaken for prescriptive measures specified as urgent repair where practicable. The professional engineer undertaking this work should be familiar with all available information collected in the desk study and site reconnaissance. Where it is possible to arrange for the same professional engineer who has specified the prescriptive measures items to carry out the construction review, this should be done.

Standardised Debris-resisting Barriers for Mitigation of Natural Terrain Landslide Hazards

4. A team of geotechnical engineers and engineering geologists working together is normally required to assess the natural terrain landslide hazards and design the necessary mitigation works. The location and sizing of a standardised debris-resisting barrier, together with the necessary local site formation works for the construction of the landslide mitigation measures, should be specified by a geotechnical engineer professionally qualified and experienced in Hong Kong. A suitable qualification is Registered Professional Engineer (Geotechnical). Engineering geological expertise is needed for certain elements of the assessment of natural terrain landslide hazards. Assistance from an experienced engineering geologist should therefore be sought by the responsible geotechnical professional, as necessary.
5. For continuity, it would be preferable if the personnel responsible for the assessment

of natural terrain landslide hazards could also be made responsible for applying the standardised debris-resisting barrier framework.

- 6. Regular reviews should be carried out during construction. These should include an inspection of the site and an assessment of the geology, groundwater conditions and the environmental effect of works during the various stages of construction. The suitability of the layout of the barriers and drainage provisions should also be reviewed, taking due account of the actual site conditions. The professional engineer undertaking the review should be conversant with the design assumptions.**

APPENDIX 4.24 MONITORING AND MAINTENANCE OF HORIZONTAL DRAINS

(Subsumed from WBTC No. 10/91)

Monitoring Requirements

1. As part of the initial design stage, the designer should devise an instrumentation scheme which is suitable for the project, including the type, number and location of piezometers for groundwater monitoring and the techniques to be used for drain flow measurement. Allowance should be made in the contract for the maintenance and replacement of defective instruments and for any subsequent period when instrument monitoring is likely to be required. The piezometers should be installed at an early stage, preferably at the same time as the ground investigation for the design of the horizontal drain system is carried out. Open hydraulic piezometers are commonly used for long-term observation (Geoguide 2 : Guide to Site Investigation, Section 20.2.3). Automatic groundwater measuring devices are often installed in the piezometer tubing to capture and store data of groundwater levels at regular time intervals. For a large drain installation, the water from individual drains may be conducted to a single point through a system of pipes and channels to facilitate drain flow measurement.
2. The monitoring of piezometric levels and drain flow rates should be carried out at least once every two months during the dry season and weekly during the wet season. The latter should be carried out within two days of any heavy rainstorm (e.g. rainfall > 100 mm in 24 hours). All drains and piezometers on the site should be monitored. The need for frequent site visits and manual monitoring can be avoided by using computerised automatic recording systems, but before adopting such a system the designer should consider carefully his requirements in relation to the cost and necessary support services.
3. The monitoring of piezometric levels should start at the earliest stage and should preferably cover two wet seasons before the design is finalised. If this is not possible, then the results from continuing monitoring during the period of design and preparation of tender documents should be used to make a final review of the design. The data should be used to establish the "base groundwater levels" in the wet and dry seasons prior to drain installation. The monitoring of both piezometric levels and drain flow rates should be carried out both during and after the installation of the system. Monitoring should be terminated in accordance with the procedures described in paragraph 8. The data obtained during construction may be used in an "observational approach" to design, whereby the design parameters, such as the spacing of the drains, are modified during construction in accordance with the monitoring results. This approach is particularly helpful for horizontal drain installation because the performance of individual drains is sensitive to the heterogeneous nature of the ground conditions commonly encountered in Hong Kong.
4. Particular attention should be given in monitoring programmes to cases where the existing groundwater regime may be modified significantly by adjacent development or pumping works.

Evaluation of Drain Performance

5. The effectiveness of a horizontal drain system should be gauged by considering, in descending order of significance, the following aspects of overall groundwater response

at the site :

- (i) the piezometric levels after drain installation should not rise above the design level in heavy rainstorms,
- (ii) the "base groundwater level" after drain installation should be lower than the preinstallation value,
- (iii) the range of groundwater fluctuations (storm response) should be lower than the preinstallation values, and
- (iv) the rate of drop of piezometric level after a rainstorm should be faster than the preinstallation rate, with the level returning to normal within a few days after the rainstorm.

6. In addition to the above, drain flow rates due to similar rainfalls measured shortly after installation and subsequently after a long period of time should also provide an indication of the long-term performance of the drains.

7. Other factors which the designer should consider in the evaluation of drain performance include the adequacy of the acquired data, reliability of the design data (including the assumed groundwater conditions), the number of heavy rainstorms during the monitoring period, and the degree of contribution of the drains to the calculated factor of safety.

Termination of Monitoring

8. The designer should plan groundwater monitoring with the object of assessing the effectiveness of a horizontal drain system before the end of the Contract Maintenance Period. However, monitoring should be continued beyond this period if the designer considers it necessary on the basis of the criteria given above. Once the effectiveness of the system has been fully assessed, the designer should then decide either to terminate the monitoring if he is satisfied with the performance, or to recommend remedial measures if he considers that the system is not performing effectively. If remedial works are to be carried out, monitoring of piezometers and drain flows should continue in order to gauge the effectiveness of the improved new system. Further remedial works may be necessary. This process should be continued until the designer is satisfied that the system is performing effectively.

9. Subsequently, if there is evidence of possible substantial changes in existing groundwater conditions (e.g. large variation in drain flows, signs of new surface seepage), this should be brought to the attention of the project office by the maintenance authority. The designer can then assess whether the monitoring should be reactivated.

Maintenance Requirements

10. Regular maintenance of horizontal drains is required to ensure that they function properly and do not become clogged. Materials likely to clog drains are organic elements (plant roots, fungi or algae), fines washed out the surrounding soils, and precipitates of calcium, magnesium, iron and other compounds. In most cases, flushing with a clean

water jet should be adequate to restore the drain function. The pressure of the water jet should be controlled so as to avoid causing any adverse effect on the stability of the slope. If soil deposits have dried up in the drain, then it is necessary to brush the drain during the flushing. Cleaning of the drain should commence from the deep end and proceed toward its outlet. This process should be repeated until the water flowing out of the drain appears clean.

11. The programme of maintenance, details of the maintenance procedures including flushing arrangements, and the "as built" details of the drain system should be prepared by the designer and handed over to the maintenance authority. Maintenance of the drains should be carried out at least once within 6 months after the installation of the drains and then once annually thereafter. The designer should allow such specific requirements and appropriate payments in the contract. The maintenance work should include inspection of the drains and surroundings, removal of weeds, clearing of outlets and flushing the drains with a water jet (as described above). Site trials may be required at the contract stage to establish the effectiveness of the designed flushing system. In addition, if the drains contain removable inner liners, these should be replaced where considered necessary on the basis of the site inspection, the flushing operations and previous observations (e.g. where the drains are found to be blocked or where drain flows are substantially reduced). All the drains at the site should be examined and maintained. A record of the observations made in the maintenance inspections and details of the work done should be kept for future reference in the maintenance inspection record. A note should also be made in the maintenance inspection record if any significant changes in drain flows or new areas of surface seepage are observed (see paragraph 9). If large increases in flow are recorded, the discharge should be tested and the surrounding area inspected to assess whether the water originates from leaking services. If this appear to be the case, the appropriate department should be notified and requested to trace and repair the leak.

12. In some special cases (e.g. an extensive drain system in a natural hillslope where access to the outlet locations is difficult), a more cost-effective maintenance plan may consist of monitoring the effectiveness of the system using permanently-installed piezometers, and carrying out the cleaning and flushing of drains only if shown to be necessary by the monitoring. Routine inspections and clearing of the drain outlets should still be carried out regularly.

13. In all cases, it is necessary for a suitably-experienced maintenance officer to examine the system when the annual maintenance is being carried out. This will enable problems to be identified and corrected at an early stage.

APPENDIX 4.25 GEOTECHNICAL MANUAL FOR SLOPES - GUIDANCE ON INTERPRETATION

(Subsumed from WBTC No. 13/99)

1. This Appendix provides guidance on, and clarification of, the interpretation of some aspects of the Geotechnical Manual for Slopes (2nd Edition).

2. Terminology

2.1 The use of the term "risk" in the Geotechnical Manual for Slopes (Manual) to mean "consequence in the event of failure" has led to some misunderstanding. For this reason, the term "risk" shall be replaced by "consequence". This is consistent with international usage. The two types of consequence classification of slope failure given in Tables 5.2 and 5.3 of the Manual shall be referred to as "consequence-to-life" and "economic consequence" respectively.

2.2 The descriptive terms "high", "low" and "negligible" are intended to reflect the likely relative severity of the failure consequence, but these have also resulted in misconceptions. To avoid possible confusion, the three categories of consequence-to-life shall be denoted as Categories 1, 2 and 3 respectively instead of "high", "low" and "negligible". For the same reason, a new system is also adopted to denote the different categories of economic consequence. The three categories of economic consequence shall be denoted as Categories "A", "B" and "C" respectively instead of "high", "low" and "negligible".

2.3 A combined notation shall now be used to indicate both the consequence-to-life and the economic consequence of a feature. For example, a Category 2A feature refers to one having the second highest consequence-to-life and the highest economic consequence in the new three-tier classification system.

3 Consequence-to-life Categories

3.1 The recommended minimum safety factors for slopes given in Tables 5.1 and 5.4 of the Manual are related to assessed consequence-to-life categories. Because of the change in terminologies (see section 2), these Tables shall be replaced by Tables 1 and 2 in this Appendix respectively. The consequence-to-life category reflects the severity in terms of loss of life in the event of failure. Table 5.2 of the Manual, which gives typical examples of each consequence-to-life category, shall be replaced by Table 3 in this Appendix.

3.2 In determining the consequence-to-life category of a slope, the designer should use his own professional judgement in assessing the "severity in terms of loss of life in the event of failure" in each particular case, giving due consideration to the types of buildings and facilities that may be threatened, and how the buildings and facilities would be affected in the event of slope failure. In assessing the effects of a slope failure on buildings and facilities, account should be taken of such factors as possible mechanisms and scale of failure, site conditions, proximity of the buildings and facilities to the slope and their likely density of occupation and frequency of usage in the event of failure, travel distance of the landslide debris, resistance of the buildings and facilities to debris impact and vulnerability of occupants and users.

3.3 Examples (1) and (2) of Table 3 refer to situations where the buildings or facilities lie within the expected travel distance of the landslide debris, and hence the severity in terms of loss of life is high, and the consequence-to-life category is "1". No examples are given in the Table on situations where the buildings or facilities are located further away from the slopes. Following the consequence-to-life definition given in the Manual, where the buildings or facilities lie beyond the expected travel distance of the debris and the severity in terms of loss of life in the event of failure is less, the consequence-to-life category may be downgraded to "2". Where the buildings or facilities lie beyond the possible extreme limit of landslide debris, the consequence-to-life category may be taken as "3". Similar considerations apply to buildings and facilities located behind the slope crest with respect to the expected and the possible extreme limits of the area affected by the landslide.

3.4 In consequence-to-life classification for the purposes of slope design and stability assessment, bus shelters or similar sheltered public waiting areas shall be regarded as occupied buildings (example 1 in Table 3).

3.5 Further technical guidelines for the classification of the consequence-to-life category for slopes and retaining walls are given in GEO Technical Guidance Note No. 15, which can be downloaded from the CEDD website.

4 Economic Consequence Categories

4.1 Table 5.3 of the Manual, which gives typical examples of each economic consequence category, shall be replaced by Table 4 in this Appendix.

4.2 Although Table 1 recommends the minimum safety factors for slopes for different economic consequences, the choice of safety factors against economic loss is a decision which must be made by the owner upon the advice of the designer. In advising the owners, the designer should decide for himself the degree of economic consequence and should balance the potential economic consequence in the event of a failure against the increased construction costs required to achieve a higher factor of safety.

5 Safety Factors for Existing Slopes

5.1 The minimum safety factors recommended in Table 2 may be used for the stability assessment of and design of modifications to any existing slope which is associated with new works, as long as rigorous geological and geotechnical investigations are conducted (which should include a thorough examination of slope maintenance history, groundwater records, rainfall records and any slope monitoring records) and there is sufficient knowledge of the geology, groundwater and performance history of the slope. Under these conditions, Table 2 can be used for stability assessment for known changes in imposed loadings, and for the design of remedial or preventive works, including slope flattening, improvements to surface and subsurface drainage, and the installation of support measures.

5.2 As Section 5.2.2 of the Manual indicates, the designer is able to adopt with confidence a lower factor of safety for an existing slope because he has the benefit of the performance history and other information that is not available for the design of a new slope. This does not imply that the standards of safety deemed to be acceptable for existing slopes are lower than those recommended for new slopes. Reference should be

made on discussion of the philosophy of this approach by Malone (1985). There will often be instances, however, where particular circumstances (such as lack of adequate groundwater and rainfall records) will lead the designer to adopt, for remedial and preventive works, the standards specified for new slopes.

6 Safety Factors for Temporary Works

6.1 Section 5.2.4 of the Manual shall be replaced by the following.

The safety factors required for the design of temporary works (i.e. works undertaken during construction which are not part of the permanent works) shall be the same as those for permanent new works (Table 1), but with due regard for the conditions which are likely to exist during the life of the temporary works. In some cases, for example, the consequence-to-life category during construction may be classified as "2" or "3", compared with consequence-to-life category "1" once the buildings are completed and occupied.

7 Reliability of Slope Design

7.1 The reliability of slope design is discussed in Section 5.3.6 of the Manual and should be considered in deciding on the minimum safety factor to be adopted.

7.2 Different design solutions, e.g. open-cuttings and cuttings with structural support, have different levels of uncertainties associated with the various components of investigation, design and construction. They will have different reliability indices (hence different levels of safety) even if the assessed factor of safety is the same. In order to have a meaningful comparison of options, a higher minimum safety factor needs to be adopted for the solution with a lower reliability index than the solution with a higher index.

8 Compaction of New Fill Slopes

8.1 The design and construction of new fill slopes are governed by Sections 5.5.1 and 9.5 of the Manual respectively. It should be noted that in some exceptional cases, such as fill forming a large platform that will not support structures, the requirement for a compacted density of 95% of maximum dry density (GEO, 2017d) can be relaxed to 90% for the interior of the platform. This may be done provided that the fill at formation level and the fill forming the peripheral slopes is compacted to 95% of maximum dry density for a vertical thickness of at least 1.5 metres and 3 metres respectively. Please note that Figure 9.1 of the Manual illustrates only one of many configurations which can be adopted. In any case, it is good engineering practice to provide adequate subsurface drainage to avoid build-up of groundwater pressure at the rear of the less permeable peripheral slopes.

8.2 Fill in reclamations, or behind retaining structures and in other small areas of flat land, does not generally need to meet compaction requirements for slope stability reasons. It is therefore for the designer to determine the compaction requirements based on other criteria.

9 Treatment of Existing Fill Slopes

9.1 Section 5.5.2 of the Manual defines the standard treatment of existing loose fill slopes by recompaction of the surface fill to a vertical depth of 3 metres. This treatment does not need to be prescribed, however, if:

- (a) a fill slope is of consequence-to-life category "3",
- (b) the fill slope is judged to be too small to pose a significant hazard, or,

(Note: The size of a fill slope which may be regarded as "too small to pose a significant hazard" would depend on the distance to and the type of the facilities being affected, the topography of the ground below the slope, the liquefaction potential of the fill body, etc. Professional judgement should be exercised in individual cases in determining the size of a fill slope which could be considered as such.)

- (c) the fill slope has a cover of mature vegetation which is beneficial to the stability of the slope, and where there is a reasonable alternative engineering solution.

9.2 Reference should be made to the Report on the Slope Failures at Sau Mau Ping (Government of Hong Kong, 1977) for background on the standard treatment of existing fill slopes as recommended in the Manual.

10 Superseded Chapters/Sections and Other Relevant Technical Guidance

10.1 The following Chapters/Sections of the Manual are no longer applicable, having been superseded by later publications:

- (a) Chapter 1 and Section 2.3.3 are superseded by the Geological Survey Maps and Memoirs and Geoguide 3 (GEO, 2017c).
- (b) Chapter 2 (except Section 2.3.3), Section 3.5 and 10.2 are superseded by Geoguide 2 (GEO, 2017b).
- (c) Section 4.6 is superseded by GEO Publication No. 1/93 (GEO, 1993).
- (d) Chapter 7 (except the parts relevant to the design of remedial or preventive works to existing gravity retaining walls as given in Section 7.3.3) is superseded by Geoguide 1 (GEO, 2017a), GEO Publication No. 1/2023 (GEO, 2023) and GEO Circular No. 33 (GEO, 2018a).
- (e) Chapter 11 is superseded by Geoguide 5 (GEO, 2018b).
- (f) References to BS 1377:1975 concerning Phase 1 tests described in Works Branch Technical Circular 6/94 are replaced by Geospec 3 (GEO, 2017d).
- (g) "The Hong Kong Bibliography" referred to in the Manual is the Bibliography on Geology and Geotechnical Engineering of Hong Kong (Brand, 1984). Please refer to the updated bibliography online at [the Hong Kong Slope Safety website](#).

10.2 Please also read the latest updates promulgated in the following GEO Technical Guidance Notes:

- (a) GEO Technical Guidance Note No. 30.**
- (b) GEO Technical Guidance Note No. 39.**
- (c) GEO Technical Guidance Note No. 40.**
- (d) GEO Technical Guidance Note No. 41.**
- (e) GEO Technical Guidance Note No. 43.**

11 Related Documents

The following is the list of related documents.

- (a) Brand, E.W. (1984). Bibliography on Geology and Geotechnical Engineering of Hong Kong to December 1984, 79 p.**
- (b) GEO (2023). Deep Excavation Design and Construction (GEO Publication No. 1/2023). Geotechnical Engineering Office, Civil Engineering and Development Department, HKSARG Government, 146p.**
- (c) GEO (1993). Review of Granular and Geotextile Filters (GEO Publication No. 1/93). Geotechnical Engineering Office, Hong Kong, 131 p.**
- (d) GEO (2017a). Guide to Retaining Wall Design (Geoguide 1) (Continuously Updated E-Version released on 29 August 2017). Geotechnical Engineering Office, Civil Engineering and Development Department, HKSAR Government, 245 p.**
- (e) GEO (2017b). Guide to Site Investigation (Geoguide 2) (Continuously Updated E-Version released on 18 December 2017). Geotechnical Engineering Office, Civil Engineering and Development Department, HKSAR Government, 349 p.**
- (f) GEO (2017c). Guide to Rock and Soil Descriptions (Geoguide 3) (Continuously Updated E-Version released on 29 August 2017). Geotechnical Engineering Office, Civil Engineering and Development Department, HKSAR Government, 171 p.**
- (g) GEO (2017d). Model Specification for Soil Testing (Geospec 3) (Continuously Updated E-Version released on 29 August 2017). Geotechnical Engineering Office, Civil Engineering and Development Department, HKSAR Government, 324 p.**
- (h) GEO (2018a). Guidelines for Assessment of Old Masonry Retaining Walls in Geotechnical Studies and for Action to be Taken on Private Walls (GEO Circular No. 33). Geotechnical Engineering Office, Hong Kong, 16 p.**
- (i) GEO (2018b). Guide to Slope Maintenance (Geoguide 5, 3rd Edition) (Continuously updated e-version released on 20 November 2018). Geotechnical Engineering Office, Civil Engineering and Development Department, HKSAR Government, 116 p.**

- (j) **Government of Hong Kong (1977). Government of Hong Kong (1977). Report on the Slope Failures at Sau Mau Ping, August 1976. Hong Kong Government Printer, 104 p. plus 8 drgs.**
- (k) **Malone, A.W. (1985). Factor of Safety and Reliability of Design of Cuttings in Hong Kong (Oral Discussion). Proceedings of the Eleventh International Conference on Soil Mechanics and Foundation Engineering, San Francisco, vol. 5, pp 2647.**

Table 1 - Recommended Minimum Factors of Safety for New Slopes for a Ten-year Return Period Rainfall

| ECONOMIC CONSEQUENCE \ CONSEQUENCE-TO-LIFE | Category 1 | Category 2 | Category 3 |
|--|-------------------|-------------------|-------------------|
| Category A | 1.4 | 1.4 | 1.4 |
| Category B | 1.4 | 1.2 | 1.2 |
| Category C | 1.4 | 1.2 | >1.0 |

Notes :

- (1) **In addition to a minimum factor of safety of 1.4 for a ten-year return period rainfall, a slope in the consequence-to-life category 1 should have a factor of safety of at least 1.1 for the predicted worst groundwater conditions.**
- (2) **The factors of safety given in this Table are recommended minimum values. Higher factors of safety might be warranted in particular situations in respect of loss of life and economic loss.**

Table 2 - Recommended Minimum Factors of Safety for the Stability Assessment of Existing Slopes and for Design of Remedial or Preventive Works to Slopes for a Ten-year Return Period Rainfall

| Consequence-to-life | Category 1 | Category 2 | Category 3 |
|--|-------------------|-------------------|-------------------|
| Recommended Minimum Factor of Safety Against Loss of Life for a Ten-year Return Period Rainfall | 1.2 | 1.1 | >1.0 |

Notes :

- (1) **These factors of safety are appropriate only where rigorous geological and geotechnical studies have been carried out, where the slope has been standing for a considerable time, and where the loading conditions, the groundwater regime**

and the basic form of the modified slope remain substantially the same as those of the existing slope.

- (2) The factors of safety given in this Table are recommended minimum values. Higher factors of safety might be warranted in particular situations in respect of loss of life and economic loss.
- (3) Should the back-analysis approach be adopted for the design of remedial or preventive works, it may be assumed that the existing slope had a minimum factor of safety of 1.0 for the worst known loading and groundwater conditions.
- (4) For a failed or distressed slope, the causes of the failure or distress must be specifically identified and taken into account in the design of the remedial works.

Table 3 - Typical Examples of Slope Failures in Each Consequence-to-life Category

| EXAMPLES | CONSEQUENCE-TO-LIFE ⁺ | | |
|--|----------------------------------|-------------|-------------|
| | Category 1* | Category 2* | Category 3* |
| (1) Failures affecting occupied buildings (e.g. residential, educational, commercial or industrial buildings, bus shelters ^{×#} , railway platforms). | ✓ | | |
| (2) Failures affecting buildings storing dangerous goods. | ✓ | | |
| (3) Failures affecting heavily used open spaces and recreational facilities (e.g. sitting-out areas, playgrounds, car parks). | | ✓ | |
| (4) Failures affecting roads with high vehicular or pedestrian traffic density. | | ✓ | |
| (5) Failures affecting public waiting areas (e.g. bus stops [#] , petrol stations). | | ✓ | |
| (6) Failures affecting country parks and lightly used open-air recreation areas. | | | ✓ |
| (7) Failures affecting roads with low traffic density. | | | ✓ |
| (8) Failures affecting storage compounds (non-dangerous goods). | | | ✓ |

× Item added in 1995 to clarify the intention of the consequence categories.

- + Prior to March 1996, "Consequence-to-life" was referred to as "Risk-to-life".
- * Prior to March 1996, "Category 1", "Category 2" and "Category 3" were referred to as "High", "Low" and "Negligible" respectively.
- # In the context of this Table, bus shelters are those with a cover that shelters people waiting there from direct sunlight or rainfall, while bus stops are those without such a cover.

Table 4 - Typical Examples of Slope Failures in Each Economic Consequence Category

| EXAMPLES | ECONOMIC CONSEQUENCE ⁺ | | |
|---|-----------------------------------|-------------|-------------|
| | Category A* | Category B* | Category C* |
| (1) Failures affecting buildings, which could cause excessive structural damage. | ✓ | | |
| (2) Failures affecting essential services [#] which could cause loss of that service for an extended period. | ✓ | | |
| (3) Failures affecting rural or urban trunk roads or roads of strategic importance. | ✓ | | |
| (4) Failures affecting essential services [#] which could cause loss of that service for a short period. | | ✓ | |
| (5) Failures affecting rural (A) or primary distributor roads which are not sole accesses. | | ✓ | |
| (6) Failures affecting open-air car parks. | | | ✓ |
| (7) Failures affecting rural (B), feeder, district distributor and local distributor roads which are not sole accesses. | | | ✓ |
| (8) Failures affecting country parks. | | | ✓ |

- + Prior to March 1996, "Economic Consequence" was referred to as "Economic Risk".
- * Prior to March 1996, "Category A", "Category B" and "Category C" were referred to as "High", "Low" and "Negligible" respectively.
- # Essential services are those that serve a district and are with no or very inferior alternatives. Examples are mass transit facilities and trunk utility services.

APPENDIX 4.26 GUIDANCE ON THE USE OF SHOTCRETE SURFACING IN MAINTENANCE WORKS

(Subsumed from WBTC No. 17/2000)

- 1) In general shotcrete surfacing should not be used, whether as routine or preventive maintenance, on slopes of consequence-to-life Category 3 as defined in Appendix 4.25. As part of future maintenance programmes departments should progressively replace any existing shotcreted (partially or fully) surface covers on Category 3 slopes, if geotechnically acceptable and practicable, with a vegetated surface cover. Failing this, other forms of hard surface cover should be considered with a view to blending the slopes with their surroundings.**
- 2) Generally shotcrete should not be used as part of maintenance works to cover hard, fresh to moderately decomposed (grade I – III) rock where the joints are tight and with average spacing wider than 60mm. Application of shotcrete may be warranted on more closely-jointed (i.e. joint spacing <60mm) rock, rock containing joints with open apertures or rock deteriorating quickly when exposed to weather, but the need should be confirmed by a suitably-experienced geotechnical engineer. Weepholes should be provided at appropriate locations based on a site assessment of the locations of discontinuities and seepage in the rock mass (see guidance in Figure 5.4 of the Geotechnical Manual for Slopes (GEO, 1984)).**

**APPENDIX 4.27 DEPARTMENTAL SLOPE APPEARANCE VETTING
COMMITTEE SUGGESTED CHAIRMAN AND TERMS OF
REFERENCE**
(Subsumed from WBTC No. 17/2000)

| | Chairman |
|---|---|
| For departments the slope works of which carry significant visual impacts (viz. the Highways Department, Lands Department, Water Supplies Department and Civil Engineering and Development Department) | D1 or above level |
| For other concerned departments (viz. Agricultural, Fisheries and Conservation Department, Architectural Services Department, Drainage Services Department and Housing Department) | Senior professional officer or above |

Terms of Reference

To review and, where satisfied, endorse the need for and details of shotcreting or any other hard surfacing to be carried out as part of maintenance or upgrading works to existing slopes or new slopes formed in public works projects (but excluding emergency repairs after landslips, minor local slope repairs and temporary slopes formed during construction activities).

The scope of review shall cover the following:

- (a) first-time shotcreting or application of any other hard surfacing to an existing or new slope, and;
- (b) renewal/retention of an existing hard surface on a slope as part of the proposed works.

APPENDIX 4.28 SEDIMENT QUALITY CRITERIA FOR THE CLASSIFICATION OF SEDIMENT

| Contaminants | Lower Chemical Exceedance Level (LCEL) | Upper Chemical Exceedance Level (UCEL) |
|--|--|--|
| Metals (<i>mg/kg dry wt.</i>) | | |
| Cadmium (Cd) | 0.8 | 4 |
| Chromium (Cr) | 80 | 160 |
| Copper (Cu) | 65 | 110 |
| Mercury (Hg) | 0.3 | 1 |
| Nickel (Ni)* | 40 | 40 |
| Lead (Pb) | 75 | 110 |
| Silver (Ag) | 1 | 2 |
| Zinc (Zn) | 200 | 270 |
| Metalloid (<i>mg/kg dry wt.</i>) | | |
| Arsenic (As) | 20 | 42 |
| Organic-PAHs (<i>µg/kg dry wt.</i>) | | |
| Low Molecular Weight PAHs | 550 | 3160 |
| High Molecular Weight PAHs | 1700 | 9600 |
| Organic-non-PAHs (<i>µg/kg dry wt.</i>) | | |
| Total PCBs | 23 | 180 |
| Organometallics (<i>µg TBT/L in Interstitial water</i>) | | |
| Tributyltin* | 0.15 | 0.15 |

* *The contaminant level is considered to have exceeded the UCCEL if it is greater than the value shown.*

The sediment is classified into 3 categories based on its contaminant levels:

- Category L: Sediment with all contaminant levels not exceeding the Lower Chemical Exceedance Level (LCEL). The material must be dredged, transported and disposed of in a manner which minimizes the loss of contaminants either into solution or by resuspension.
- Category M: Sediment with any one or more contaminant levels exceeding the Lower Chemical Exceedance Level (LCEL) and none exceeding the Upper Chemical Exceedance Level (UCEL). The material must be dredged and transported with care, and must be effectively isolated from the environment upon final disposal unless appropriate biological tests demonstrate that the material will not adversely affect the marine environment.
- Category H: Sediment with any one or more contaminant levels exceeding the Upper Chemical Exceedance Level (UCEL). The material must be dredged and transported with great care, and must be effectively isolated from the environment upon final disposal.

APPENDIX 4.29 GUIDELINES FOR SEDIMENT ASSESSMENT

The purpose of these guidelines is to set out the requirements for assessing, sampling, testing and categorising the sediment. The sampling and testing procedures are critical to the accurate evaluation of the sediment contamination, and close supervision by the project proponent is therefore necessary. All project departments/offices, consultants, developers or contractors (hereinafter called the "project proponent") must comply with these requirements when notifying Director of Environmental Protection (DEP) and Marine Fill Committee (MFC) of an intention to dredge/excavate and dispose of the sediment.

The sampling and testing procedures and the subsequent submission of a Sediment Quality Report normally require 8 months to complete.

A list of accredited laboratories capable of carrying out biological testing stipulated under these guidelines is kept and updated by DEP.

1. TIER 1 - Review of Existing Information for Site Contamination Assessment

The purpose of Tier I screening is to review available information to determine whether the sediment belongs to Category L material suitable for open sea disposal. If the project proponent considers that there is insufficient information to arrive at such a conclusion, the project proponent may proceed directly to Tier II screening.

(a) Submission requirements

The project proponent shall submit a formal proposal to DEP and copy to the Secretary of MFC in the Civil Engineering Department. The proposal should contain the following information:

- (i) project name;
- (ii) plan showing detailed location and boundary of the dredging/excavation site;
- (iii) estimated volume of dredged/excavated sediment requiring disposal;
- (iv) timetable for dredging/excavation operation and the corresponding disposal space required;
- (v) previous dredging/excavation history of the site;
- (vi) previous use of the site; and
- (vii) other available site specific information (e.g. sediment grain size, total organic carbon (TOC), geotechnical data and previous testing results).

(b) Necessity to proceed to Tier II - chemical screening

DEP will examine the submission and advise whether:

- (i) the information is sufficient to conclude that the sediment is suitable for open sea disposal and the submission can be accepted as a formal Sediment Quality Report; or
- (ii) Tier II - chemical screening is required.

2. TIER II - Chemical Screening

Tier II screening is designed to categorise the sediment based on its chemical contaminant levels, and to determine whether the sediment is suitable for open sea disposal without further testing.

(a) Submission requirements

The project proponent shall submit for approval a test proposal to DEP and copy to the Secretary of MFC. The proposal should contain the following information:

- (i) project name;
- (ii) plan showing detailed location and boundary of the dredging/excavation site;
- (iii) estimated volume of dredged/excavated sediment requiring disposal;
- (iv) the anticipated timetable for taking the sample, carrying out the tests, and producing the Sediment Quality Report for chemical & biological screening;
- (v) a plan showing the area to be dredged, the locations to be sampled and their Hong Kong metric grid coordinates;

In general, the following sampling arrangement should be adopted:

Sampling Arrangement

The purpose of the sampling arrangement is to collect representative samples for characterisation of the sediments of the dredging site. The sampling locations should be representative and reflecting the actual situation of the dredged materials as accurately as possible.

Minimum Sampling Station Requirement

A volume-based approach is recommended for determining the minimum sampling station as illustrated in the Table below:

| Estimated Total Volume of Dredged Materials (10,000 m ³) | Number of Sampling Station |
|--|----------------------------|
| <2.5 | 3 |
| 2.5 to <10 | 8 |
| 10 to <50 | 12 |
| 50 to <200 | 20 |
| 100k to <100k +100 | (16+4k) |
| k is an integer which is larger than or equal to 2 | |

Sampling Design

Appropriate sampling design should be proposed by the project proponent, taking into consideration the sampling programme and site-specific conditions.

If the dredged materials are homogenous in nature and there is no identifiable source of anthropogenic contamination, the sampling stations should be evenly distributed across the entire dredging area using a grid pattern.

If the source of contamination is identified or the contamination gradient is known (e.g. near outfalls, or nullahs), the sampling stations should be placed from dense to sparse along the gradient from highly contaminated to less or unlikely contaminated. Vertical samples should be taken to identify the contamination extent when contaminated sediments are identified.

Sample of Reference Sediment

When biological screening is anticipated, samples of reference sediment should also be taken. Reference sediment required for the test may be collected from reference sites in Hong Kong waters designated by DEP from time to time. Alternative reference sites may be used. However, these alternative sites should be outside the influence of previous disposal operations but close enough to reflect similar natural environmental characteristics (e.g. grain size and TOC) of potential disposal sites. The project proponent should furnish information on these alternative sites to show that their sediments are clean and are of similar natural characteristics to that of the disposal sites.

- (vi) a schedule of the types of samples to be taken (e.g. grab samples, gravity coring, piston samples, vibrocores, etc.) with their locations and depths;

Where vertical profiles of samples are to be taken, samples should be continuous, and the top level of the sub-samples should be the seabed, 0.9m down, 1.9m down, 2.9m down, and then every 3m to the bottom of the dredged layers.

The size of samples collected should be adequate for this tier of chemical testing as well as the next tier of biological testing described in subsequent sections.

| Parameters to be tested | Sample size* |
|-------------------------|--------------|
| Metals and metalloid | 0.5 litre |
| Organic | 0.5 litre |
| Biological response | 6 litres |

* Quantity to be confirmed by testing laboratory. The quantity of reference sediment to be collected needs to be separately worked out for each case, especially if biological dilution tests are anticipated.

- (vii) a schedule of tests to be carried out on the samples.

Unless otherwise specified, all samples shall be tested for all the contaminants (except Tributyltin (TBT)) stated in Table 1 - Analytical Methodology at the end of this Appendix. Analysis for other contaminants, such as TBT, Dichloro-diphenyl-trichloroethane (DDT), other organo-chlorine compounds, and other hazardous chemicals which arise from specific industrial discharge or spillage, may also be required by DEP in areas where contamination by such compounds is suspected. The composite samples for biological testing should also be tested for moisture content, grain size (% <63µm), TOC and ammonia (as mgN/L) and salinity in porewater.

(b) Sampling and testing requirements

- (i) Sampling practice and sample storage

All sampling bottles should be labelled with the station number, sample length, diameter and depth, sampling date and time, together with a full description of the sample.

The recommended types of sampling bottle and pretreatment methods are:

| Parameters to be tested | Sampling bottle | Pretreatment Procedure [#] |
|-------------------------|---|---|
| Metals and metalloid | High density polyethylene bottles [*] | USEPA SW-846 ⁺ Chapter 3 |
| Organic | Wide mouth Borosilicate glass bottles with Teflon lined lid | USEPA SW-846 Chapter 4 |
| Biological response | Wide mouth Borosilicate glass bottles with Teflon lined lid or high density polyethylene bottles [*] | USEPA SW-846 Chapter 3 or Chapter 4 as appropriate. |

* Heavy duty plastic bags may be used for the storage of sediment sample for testing metals, metalloid and biological response.

Other equivalent methods such as “The specification for marine monitoring – Part 3: Sample collection, storage and transportation” (GB17378.3-2007) may be used subject to the approval of DEP.

+ Test methods for evaluating solid waste: physical/chemical methods, SW-846, 3rd edition, United States Environmental Protection Agency.

The samples should be kept at 4°C in the dark and should not be frozen. All samples should be promptly analysed. If this is impractical, the recommended maximum holding time is:

| Sample type | Maximum holding time |
|-----------------|----------------------|
| Chemical test | 2 weeks |
| Biological test | 8 weeks |

(ii) Analytical methodologies for chemical screening

The analytical method used for detecting each contaminant should be in accordance with the methodology described in Table 1 - Analytical Methodology at the end of this Appendix.

(c) **Quality assurance/quality control (QA/QC) requirements**

All tests must be conducted by laboratories accredited by Hong Kong Laboratory Accreditation Scheme (HOKLAS) or, in case of overseas laboratories, by equivalent national accreditation for these tests.

(d) **Necessity to proceed to Tier III - biological screening**

There is no need to proceed to Tier III for Category L and M sediments. However, the project proponent must proceed to Tier III for further analysis of certain Category H sediment. Tier III screening is only required if one or more contaminant levels exceed 10 times the Lower Chemical Exceedance Level (LCEL).

3. **TIER III - Biological Screening**

The purpose of Tier III screening is to identify the most appropriate disposal option for certain Category H sediments.

(a) **Submission requirements**

The project proponent shall submit for approval a test proposal to DEP and copy to the Secretary of MFC. The proposal should contain the following information:

- (i) the number of biological tests;
- (ii) the arrangement for preparing the composite samples; and
- (iii) the test species and test conditions.

In general, all biological tests should be conducted on composite samples. Composite sample is prepared by mixing up to 5 samples of the same category which are continuous in vertical or horizontal profile.

Sediment classified as Category H and with one or more contaminant levels exceeding 10 times LCEL shall be subjected to the following two toxicity tests in a diluted manner (dilution test):

a 10-day amphipod toxicity test; or

a 20-day polychaete toxicity test.

and

a 48-96 hour larvae (bivalve or echinoderm) toxicity test.

The samples shall be prepared prior to toxicity testing as follows:

| Sediment characteristics | Preparation method |
|--|---|
| Category H sediment (> 10 x LCEL) | Sample to be mixed with 9 portions of reference sediment |
| Category H sediment (> 10 x LCEL) suspected of ammonia contamination | Additional set of sample (after dilution for Cat. H sediment) to be purged [#] for ammonia removal (for amphipod test only). |

If the ammonia concentration in the overlying water of the test system is ≥ 20 mg/L, purging of sediment is required. This is performed by replacing the overlying water at a rate of 6 volume replacements/24 h for 24 hours, and repeated once only if the ammonia level still exceeds 20 mg/L.

(b) Testing requirements

The test endpoints and decision criteria are summarized in Table 2 at the end of this Appendix. The sediment is deemed to have failed the biological test if it fails in any one of the two selected toxicity tests.

Only ecologically relevant species should be used for carrying out the biological screening tests. The species to be used for each type of test are as following:

| Test Types | Species | Reference Test Conditions* |
|---|---|----------------------------|
| 10-day amphipod toxicity test | <i>Ampelisca abdita</i> | U.S.EPA(1994)/PSEP(1995) |
| | <i>Leptocheirus plumulosus</i> | U.S.EPA(1994) |
| | <i>Eohaustorius estuarius</i> | U.S.EPA(1994)/PSEP(1995) |
| | <i>Grandidierella japonica</i> | GB 30980-2014 |
| | <i>Ampelisca bocki</i> | GB 30980-2014 |
| | <i>Ampelisca brevicornis</i> | GB 30980-2014 |
| 20-day polychaete toxicity test | <i>Neanthes arenaceodentata</i> | PSEP(1995) |
| | <i>Neanthes japonica</i> | GB 30980-2014 |
| | <i>Glycera chirori</i> | GB 30980-2014 |
| | <i>Neohytys californiensis</i> | GB 30980-2014 |
| 48-96 hour larvae (bivalve or echinoderm) toxicity test | Bivalve: <i>Mytilus</i> spp. | PSEP(1995) |
| | <i>Crassostrea gigas</i> | PSEP(1995) |
| | <i>Acrassostrea rivularis</i> | GB 30980-2014 |
| | Echinoderm : <i>Dendraster excentricus</i> | PSEP(1995) |
| | <i>Strongylocentrotus</i> spp. | PSEP(1995) |
| | <i>Anthocardaris crassipina</i> | GB 30980-2014 |

*U.S.EPA (U.S. Environmental Protection Agency) 1994. Methods for assessing the toxicity of sediment-associated contaminants with estuarine and marine amphipods. Office of Research and Development. U.S. Environmental Protection Agency, Cincinnati, OH. EPA/600/R94/025.

PSEP (Puget Sound Estuary Program) 1995. Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments.

GB 30980-2014. The assessment procedure for marine dumping of dredged material.

(c) Quality assurance/quality control (QA/QC) requirements

All biological tests must be conducted by laboratories with appropriate accreditation.

The biological test shall include appropriate quality assurance/quality control such as:

- (i) Negative Control
- (ii) Positive Control

4. Reporting Requirement after Completion of Chemical & Biological Screening

Submission requirements

Upon completion of each stage of screening (chemical and biological), the project proponent shall submit to DEP and copy to the Secretary of MFC a report on the results covering all tests conducted so far. The report should include the following information where appropriate:

- (i) plans showing the delineation of each of the 3 categories of dredged/excavated material and the corresponding types of disposal required based on the chemical and biological screening results, and
- (ii) the following information:
 - Name and location of the testing laboratory
 - Location of samples and source of reference sediments, method of collection, handling, preservation and storage, dates and times of sample collection and receipt at the testing laboratory

(For chemical screening)

- Dates of analysis
- Analytical methods and detection limits
- Tabulated sample results with units, including reporting basis (e.g., wet, dry, TOC normalized)
- QA/QC results
- Explanations for all departures from the standard protocols and discussion of possible effects on the data

(For biological screening)

- Test species information such as the source, size, history and age of test organisms
- Source of control seawater and control sediment used, including any pretreatment
- Preparation procedures for test sediment sample and test organisms
- Test conditions for each test including any deviation from standard procedures and discussion of possible effects on the data
- Water quality measurement during testing
- QA/QC results
- Effect measurements, end point results and their statistical significance

Table 1 - Analytical Methodology

| Parameters | Preparation Method <i>US EPA Method</i> | Determination Method <i>US EPA Method</i> | Reporting Limit |
|---|--|--|----------------------------|
| Metals <i>(mg/kg dry wt.)</i> | | | |
| Cadmium (Cd) | 3050B | 6020A or 7000A or 7131A | 0.2 |
| Chromium (Cr) | 3050B | 6010C or 7000A or 7190 | 8 |
| Copper (Cu) | 3050B | 6010C or 7000A or 7210 | 7 |
| Mercury (Hg) | 7471A | 7471A | 0.05 |
| Nickel (Ni) | 3050B | 6010C or 7000A or 7520 | 4 |
| Lead (Pb) | 3050B | 6010C or 7000A or 7420 | 8 |
| Silver (Ag) | 3050B | 6020A or 7000A or 7761 | 0.1 |
| Zinc (Zn) | 3050B | 6010C or 7000A or 7950 | 20 |
| Metalloid <i>(mg/kg dry wt.)</i> | | | |
| Arsenic (As) | 3050B | 6020A or 7000A or 7061A | 1 |
| Organic-PAHs <i>(µg/kg dry wt.)</i> | | | |
| Low Molecular Weight PAHs+ | 3550B or 3540C and 3630C | 8260B or 8270C | 55 |
| High Molecular Weight PAHs++ | 3550B or 3540C and 3630C | 8260B or 8270C | 170 |
| Organic-non-PAHs <i>(µg/kg dry wt.)</i> | | | |
| Total PCBs+++ | 3550B or 3540C and 3665A | 8082 | 3 |
| Organometallics <i>(µg TBT/L in interstitial water)</i> | | | |
| Tributyltin | Krone et al. (1989)* - GC/MS UNEP/IOC/IAEA** | Krone et al. (1989)* - GC/MS UNEP/IOC/IAEA** | 0.015 |

- Footnotes: (i) The reporting limits shown in this table are the most stringent limits which will be specified by DEP. Project proponents should consult DEP on the required limits in the preparation of proposals for sampling and chemical testing of the sediment.
- (ii) Other equivalent methods such as “The Specification for Marine Monitoring – Part 5: Sediment Analysis” (GB17378.5-2007) may be used subject to the approval of DEP.
- + Low molecular weight PAHs include acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene
- ++ High molecular weight PAHs include benzo[a]anthracene, benzo[a]pyrene, chrysene, dibenzo[a,h]anthracene, fluoranthene, pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, indeno[1,2,3-c,d]pyrene and benzo[g,h,i]perylene
- +++ The reporting limit is for individual PCB congeners. Total PCBs include 2,4' diCB, 2,2',5' triCB, 2,4,4' triCB, 2,2',3,5' tetraCB, 2,2',5,5' tetraCB, 2,3',4,4' tetraCB, 3,3',4,4' tetraCB, 2,2',4,5,5' pentaCB, 2,3,3',4,4' pentaCB, 2,3',4,4',5 pentaCB, 3,3',4,4',5 pentaCB, 2,2',3,3',4,4' hexaCB, 2,2',3,4,4',5' hexaCB, 2,2',4,4',5,5' hexaCB, 3,3',4,4',5,5' hexaCB, 2,2',3,3',4,4',5 heptaCB, 2,2',3,4,4',5,5' heptaCB, 2,2',3,4',5,5',6 heptaCB (ref: the "summation" column of Table 9.3 of *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual (The Inland Testing Manual)* published by USEPA).
- * Krone et al. (1989), A method for analysis of butyltin species and measurement of butyltins in sediment and English Sole livers from Puget Sound, *Marine Environmental Research* 27 (1989) 1-18. Interstitial water to be obtained by centrifuging the sediment and collecting the overlying water.
- ** UNEP/ICO/IAEA refers to IAEA's Marine Environment Laboratory reference methods. These methods are available free of charge from UNEP/Water or Marine Environmental Studies Laboratory at IAEA's Marine Environment Laboratory. Interstitial water to be obtained by centrifuging the sediment and collecting the overlying water.

Table 2 - Test Endpoints and Decision Criteria for Tier III Biological Screening

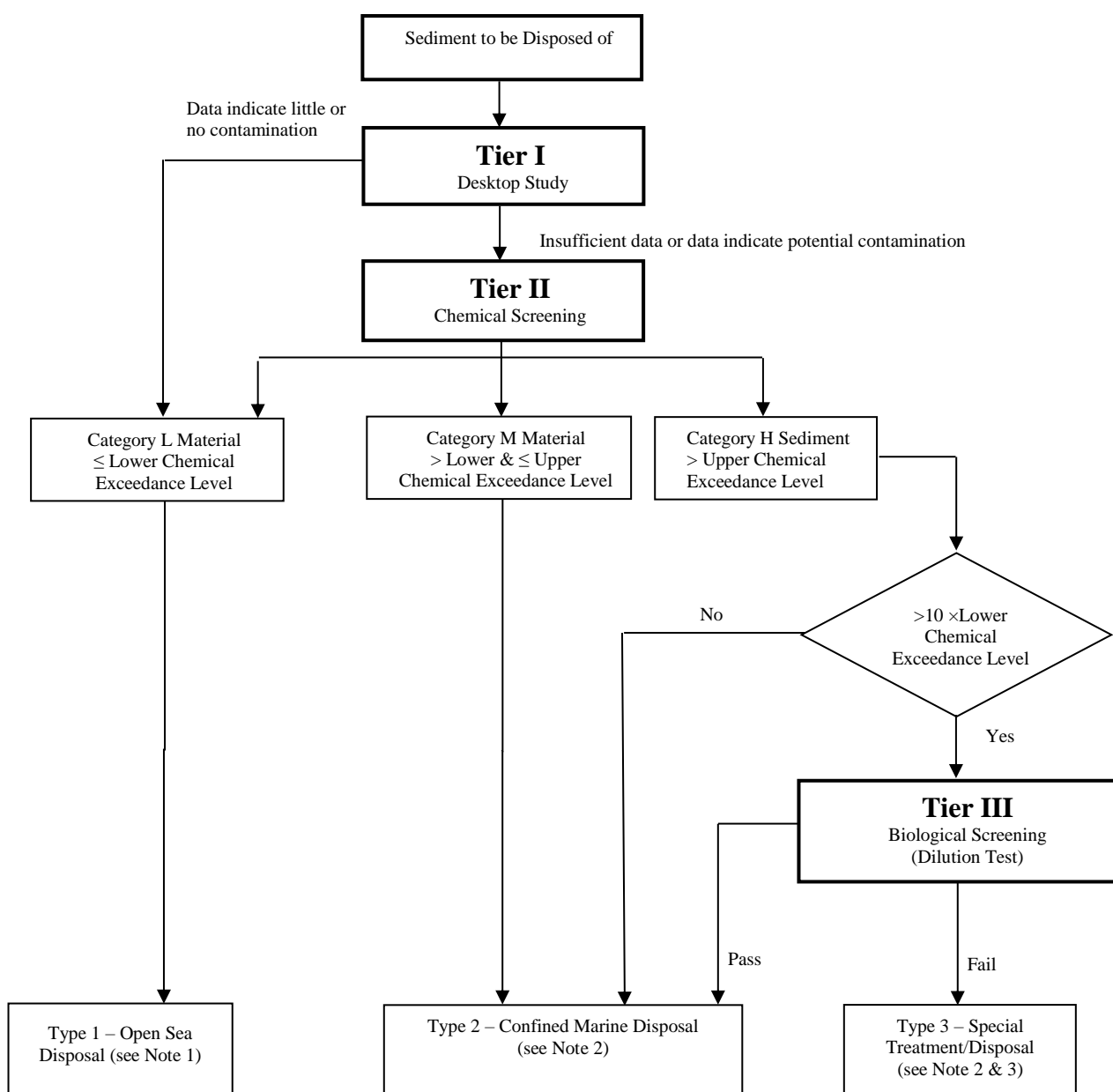
| Toxicity test | Endpoints measured | Failure criteria |
|---|---------------------------------|---|
| 10-day amphipod | Survival | Mean survival in test sediment is significantly different ($p \leq 0.05$) ¹ from mean survival in reference sediment and mean survival in test sediment < 80% of mean survival in reference sediment. |
| 20-day polychaete worm | Dry Weight ² | Mean dry weight in test sediment is significantly different ($p \leq 0.05$) ¹ from mean dry weight in reference sediment and mean dry weight in test sediment < 90% of mean dry weight in reference sediment. |
| 48-96 hour larvae (bivalve or echinoderm) | Normality Survival ³ | Mean normality survival in test sediment is significantly different ($p \leq 0.05$) ¹ from mean normality survival in reference sediment and mean normality survival in test sediment < 80% of mean normality survival in reference sediment. |

¹ Statistically significant difference should be determined using appropriate two-sample comparisons (e.g., *t-tests*) at a probability of $p \leq 0.05$.

² Dry weight means total dry weight after deducting dead and missing worms.

³ Normality survival integrates the normality and survival end points, and measures survival of only the normal larvae relative to the starting number.

APPENDIX 4.30 MANAGEMENT FRAMEWORK FOR DREDGED/EXCAVATED SEDIMENT



Notes

- (1) Most open sea disposal sites are multi-user facilities and as a consequence their management involves a flexibility to accommodate varying and unpredictable circumstances. Contract documents should include provisions to allow the same degree of flexibility should it be necessary to divert from one disposal site to another during the construction period of a contract.
- (2) For sediment requiring Type 2 or Type 3 disposal, contract documents should state the allocation conditions of MFC and DEP. At present, East Sha Chau mud pits are designated for confined marine disposal.

- (3) If any sediment suitable for Type 3 disposal (Category H sediment failing the biological dilution test) is identified, it is the responsibility of the project proponent, in consultation with DEP, to identify and agree with him/her, the most appropriate treatment and/or disposal arrangement. Such a proposal is likely to be very site and project specific and therefore cannot be prescribed. This will not preclude treatment of this sediment to render it suitable for confined marine disposal.
- (4) The allocation of disposal space may carry a requirement for the project proponent to arrange for chemical analysis of the sediment sampled from 5% of the vessels en-route to the disposal site. For certain Category H sediment, the chemical tests will be augmented by biological tests. Vessel sampling will normally entail mixing five samples to form a composite sample from the vessel and undertaking laboratory tests on this composite sample. All marine disposal sites will be monitored under the general direction of the Civil Engineering Department. However, exceptionally large allocations might require some additional disposal site monitoring. These will be stipulated at the time of allocation.
- (5) Trailer suction hopper dredgers disposing of sediment at East Sha Chau must use a down-a-pipe disposal method, the design of which must be approved in advance by DCE. The dredging contractor must provide equipment for such disposal.

APPENDIX 4.31 PROTECTION OF HARBOUR AREA TREATMENT SCHEME STAGE 1 AND STAGE 2A SEWAGE TUNNELS (Subsumed with amendments from ETWB TCW No. 28/2003)

Background

1. A key component of the Harbour Area Treatment Scheme or HATS (formerly known as the Strategic Sewage Disposal Scheme or SSDS) Stage 1 and Stage 2A is the construction and operation of a deep tunnel system to convey the sewage from fifteen existing preliminary treatment works in Kowloon and Hong Kong Island to the Stonecutters Island for further treatment. The project was implemented by DSD and the sewage tunnels are now being operated and maintained by DSD. The treated effluent is discharged through a sewage outfall tunnel at the Western Dangerous Goods Anchorage. The Stage 1 sewage tunnels are about 25 kilometres in length with diameters ranging from 1.2m to 5m and the Stage 2A sewage tunnels are about 21 kilometres in length with equivalent diameters¹ ranging from 0.9m to 3m. All the sewage tunnels are, in general, located at a depth more than 70m below the ground surface. The Stage 1 and Stage 2A sewage tunnels were completed and commissioned in December 2001 and December 2015 respectively. A sketch showing the alignment and profile of the sewage tunnels is attached as Map No. 1. The subsequent paragraphs lay down the procedure to be followed by all Works Departments for the circulation of proposals for construction works and ground investigation works in the vicinity of the sewage tunnels.

Sewage Tunnel Outer Protection Area for Construction Works other than Ground Investigation Works

2. A "construction protection boundary" for Stage 1 and Stage 2A sewage tunnel facilities is demarcated on plans numbered KCE/S/G/774A, 775A, 776A, 777A, 778A, 779A, 780A and 90806/STPA/2001B, 2002A, 2003A, 2004A. The "construction protection boundary" is generally 100m each side from the centreline of the sewage tunnels. The area within this boundary is called the "Sewage Tunnel Outer Protection Area". A complete set of these plans has been deposited with all Works Departments and also with the Buildings Department and the Housing Department.
3. Other than the exceptions allowed in Paragraph 13 below, no construction work is to take place within the Sewage Tunnel Outer Protection Area unless the proposals have first been forwarded to DSD and GEO for agreement and the departments proposing the construction works have confirmed to DSD that any measures necessary to protect the sewage tunnels as may be stipulated by DSD have been or will be complied with.

Sewage Tunnel Protection Area for Ground Investigation Works

4. The "ground investigation protection boundary" for sewage tunnel facilities is generally 50m each side from the centreline of the sewage tunnels. The area within this boundary has been officially designated as the "Sewage Tunnel Protection Area" (STPA) and is shown on plans numbered KCE/S/G/765C, 766C, 767C, 768C, 769C, 770C, 771C and 90806/STPA/1001B, 1002B, 1003B, 1004B for Stage 1 and Stage 2A sewage tunnel

¹ The sewage tunnels from North Point to Sai Ying Pun and from Aberdeen to Sai Ying Pun consist of twin oval pipes. The sewage tunnel from Ap Lei Chau to Aberdeen consist of twin circular pipes. The largest sewage tunnel from Sai Ying Pun to Stonecutters Island consist of single circular pipe of 3m in diameter.

facilities. A complete set of these plans has been deposited with all Works Departments and also with the Buildings Department and the Housing Department.

5. Other than the exceptions allowed in Paragraph 13 below, no ground investigation works is to take place within the Sewage Tunnel Protection Area unless the proposals have first been forwarded to DSD and GEO for agreement and any measures necessary to protect the sewage tunnels as may be stipulated by DSD are complied with.

Procedures

6. For public works or housing projects proposed by Works Departments or the Housing Department, it is the responsibility of the relevant Department to check whether any part of the project falls within the Protection Areas and, if so, to forward the relevant proposals to DSD and GEO for comment/agreement.
7. While DSD is responsible for vetting and agreeing to proposals which may affect the sewage tunnels, GEO will provide specialist advisory services to DSD for the appraisal of submitted proposals based on the standards and requirements mentioned in this Circular. It is therefore necessary to submit the proposals for works to be carried out within the protection boundary to both DSD and GEO. Detailed submission requirements are described in Paragraphs 8 and 9 below.
8. Submissions to DSD and GEO shall include all relevant drawings, an explanatory memorandum explaining the scope and programme of the proposed works, ground investigation reports together with an assessment report to assess the effects of the proposed works on the sewage tunnel and any further information as may be required by DSD/GEO. Submissions to DSD shall be addressed to the Chief Engineer of the District Division of DSD in which the works lie. The geographical areas covered by these Divisions, designated as Hong Kong and Islands, and Mainland South Divisions, are shown on the attached Map No. 2. Submissions to GEO shall be addressed to the Chief Geotechnical Engineer of the District Division of GEO in which the works lie. The geographical areas covered by these Divisions, designated as Island, Mainland East and Mainland West Divisions, are shown on the attached Map No. 3.
9. For projects where geotechnical submissions are required under the relevant circulars, the assessment report on the effects of the proposed works on the sewage tunnel shall preferably be submitted together with the geotechnical submission to facilitate coherent consideration under the project. For avoidance of doubt in these cases, the submitter should indicate that the submission of the assessment report to GEO is made under this circular.
10. Submissions shall be sent to DSD direct with a copy to GEO at the same time and at an early stage since additional information may be required to assess the proposals properly. GEO shall provide DSD with comments on geotechnical conditions and protective measures to be complied with by the project proponent for the consideration of DSD within 21 days of receipt of the submission. DSD shall reply to a submission incorporating GEO's comments where appropriate as quickly as possible and in any case within 28 days of receipt of the submission, either agreeing to the proposals with or without conditions, or stating why they are not agreed.

Technical Notes for Guidance

11. The "Technical Notes for Guidance in Assessing the Effects of Construction/Ground Investigation Works on Harbour Area Treatment Scheme Stage 1 and Stage 2A Sewage Tunnels" attached as Annex A to this Appendix provides guidance on the measures and requirements likely to be stipulated to protect the sewage tunnels and further details on the requirements of submissions to DSD and GEO.
12. The Technical Notes are for guidance only, and in case of doubt as to whether any proposed works will affect adversely the sewage tunnels, DSD and GEO must be consulted.

Exemptions

13. The above procedures do not apply to the following works:
 - (a) Road opening, road and highway structure maintenance where piling works are not involved, and road pavement construction.
 - (b) Excavation works or trial pits on land within a depth of 10m and is not closer than 30m from the nearest point of any HATS sewage structure such as drop shafts, connecting conduits and approach chambers. In case of doubts as to the separation from these sewage structures, DSD should be consulted.
 - (c) Maintenance dredging and minor marine maintenance works at locations other than the Stage 1 Outfall at the Western Dangerous Goods Anchorage provided that the dredging or excavation level is not more than 5m below the base of the existing marine deposit.
 - (d) Landscaping and planting.
 - (e) Erection of street lighting, shallow footing construction for minor works, laying and maintenance of underground utility services and water mains within a depth of 10m, except where piling works are involved.
 - (f) Upgrading or hazard mitigation works, maintenance and urgent repairs to slopes, including natural hillsides.
 - (g) Emergency repairs of existing underground utility services, such as water mains, sewers, drains and highway structures.

**Technical Notes for Guidance in Assessing
the Effects of Construction /Ground Investigation Works
on Harbour Area Treatment Scheme Stage 1 and Stage 2A Sewage Tunnels**

These technical notes apply to works situated on or adjacent to the alignment of the Harbour Area Treatment Scheme Stage 1 and Stage 2A sewage tunnels.

General

2. “Sewage tunnel” means an underground tunnel and associated underground structures for the transfer of sewage. A shaft connecting to a sewage tunnel is part of the sewage tunnel. Drawings showing details of the sewage tunnels are available from the relevant District Divisions of DSD. The extent of a shaft in soil is defined as the external shaft diameter; in rock it is defined as the internal diameter plus 2.5 metres each side. DSD should be consulted if there is any query concerning the route and extent of sewage tunnels.

3. Shafts of sewage tunnels are located within permanent land allocations to DSD. Tunnels constructed or to be constructed between these shafts are generally deep with at least 30 metres of rock cover except for both ends of the tunnel section between Ap Lei Chau Preliminary Treatment Works and Aberdeen Preliminary Treatment Works which are under soil or shallow rock cover. Most of the construction works on the ground surface will not have any significant effect on sewage tunnels and no restrictions on these works will be necessary.

4. The main risks of damage to sewage tunnels arise from either site formation or foundation works or tunnel/cavern works constructed immediately adjacent to shaft sites or from boreholes, wells, shafts, tunnels, grouting or other deep works constructed close to sewage tunnels. There is also a risk from ground or marine investigation works for a project requiring deep boreholes close to the sewage tunnels.

5. For the purposes of these notes the term “rock” is defined as Grades I, II and III rock material as classified in Table 4 - Classification of Rock Material Decomposition Grades - in Geoguide 3 (Guide to rock and soil descriptions) published by the Geotechnical Engineering Office. The term “soil” is defined as Grades IV, V and VI rock material (also classified in Geoguide 3), reclamation materials, and marine and alluvial deposits.

6. Leakage of sewage and the migration of gas from or into sewage tunnels poses health and safety risks. These risks must be evaluated when considering any proposed works near sewage tunnels, especially in respect of any dewatering works where there is the potential for the migration of hazardous substances in the groundwater.

Site Formation or Foundation Works or Tunnel/Cavern Works

7. Where construction works (including site formation, foundation works or excavation for basements, shafts, tunnels, cavern and the like) other than ground investigation works are proposed within the area as described in Paragraph 2 of this Annex, the effects of such works shall be within the following limits:

- (a) The vertical or horizontal pressure on any sewage tunnel structure in soil due to the above operations (including filling and dewatering) and due to additional loads

transmitted from foundations (including loads arising during construction) shall not be varied by more than 20kPa or by 5% of the total overburden pressure for structures at depths greater than 20m. For sewage tunnel structures in rock, where it is not possible to assess the change in ground pressure due to the above operations, the hydrostatic pressure shall not be increased or decreased by more than 50kPa.

- (b) Differential movement resulting from the works shall not produce a calculated final diametric distortion exceeding 0.1% of the shaft or sewage tunnel internal diameter and the calculated total movement in any plane shall not exceed 20mm.
- (c) The peak particle velocities at any sewage tunnel structures resulting from blasting (where permitted) or from driving or withdrawing of piles or any operation which can induce prolonged vibration shall not exceed 25mm/sec for blasting and 15mm/sec for other operations.
- (d) No holes or excavations shall be sunk or excavated within a distance of 3m from any point of any sewage tunnel structure without prior agreement by DSD and GEO for the works and the method to be employed.
- (e) No pile, foundation, well, soil nail, horizontal drain, or rock bolt/dowel shall be driven or constructed within a distance of 3m in any plane of any point of any sewage tunnel structure.
- (f) Any part of a ground anchor and /or other geotechnical installation shall be more than 3m from any part of any sewage tunnel structure.

8. Proposals for monitoring the effects on sewage tunnels shall be submitted, when required, to DSD and GEO before works commence and subsequent data together with interpretation shall be submitted to DSD and GEO for the duration of the works. Where the proposed works or any part of the proposed works shall come within a distance of **10m** from any point of any sewage tunnel structure, the submission shall also include detailed method statements on the method to be employed for constructing the proposed works and for monitoring the alignment/depth of the proposed works.

Ground Investigation Works

9. Where ground investigations are proposed within the area as described in Paragraph 4 of this Annex, it is necessary for the following to be submitted to DSD and GEO:

- (a) details of the exploration and locations of the proposed exploration holes, field testing or instrumentations relative to sewage tunnels;
- (b) proposed depth of holes, pits, trenches, field testing or instrumentation; and
- (c) a method statement for checking and monitoring the alignment of holes when the minimum distance from a hole to any point of a sewage tunnel is less than 50m should holes be sunk to a depth within 3m from the highest point of the sewage tunnels.

10. Any proposal will also be judged against the following technical guidelines :

- (a) The vertical and horizontal pressure on any sewage tunnel structure in soil due to ground investigation works including field testing such as plate load test, pressuremeter test, packer test or any operation should not be increased or decreased by more than 20kPa or by 5% of the total overburden pressure for structures at depths greater than 20m. For sewage tunnel structures in rock, where it is not possible to assess the change in ground pressure due to the above operations, the hydrostatic pressure shall not be increased or decreased by more than 50kPa.
- (b) The peak particle velocities at any sewage tunnel structure resulting from -
 - (i) artificial shocks generated either by the detonation of explosives or a mechanical blow at ground surface or at depth within a hole should not exceed 25mm/sec; and
 - (ii) percussion drilling, hammer drilling or any operation which can induce prolonged vibration, should not exceed 15mm/sec.
- (c) The method to be employed for sinking/excavating deep holes and for monitoring the hole alignment/depth to ensure that no hole is within a distance of 3m from any point of any sewage tunnel structure.

Dewatering Works and Wells

11. Assessment shall be made regarding the leakage of sewage and the migration of gas in respect of all dewatering and well proposals within 100 metres of sewage tunnels. Monitoring proposals shall be submitted to DSD and GEO for the duration of the dewatering or extraction.

