

Layman's Guide to Slope Maintenance



LAYMAN'S GUIDE TO SLOPE MAINTENANCE

**GEOTECHNICAL ENGINEERING OFFICE
Civil Engineering and Development Department
The Government of the Hong Kong
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FOREWORD

All man-made slopes and retaining walls need regular maintenance work, even for those designed and constructed to acceptable standards. Under the Hong Kong climatic conditions, a man-made slope or retaining wall that is not maintained will deteriorate. In time it may become unstable and collapse, causing injury to persons, damage to property and disruption to normal life. If this happens, suffering and hardship may result and great expense may be incurred in reinstating the ground and making it safe.

The Code of Practice on Building Management and Maintenance produced in accordance with Section 44(1)(b) of the Building Management Ordinance (Chapter 344) stipulates that “Any slope or retaining wall from which an owner is responsible shall be maintained in a state of good condition in accordance with Geoguide 5 – Guide to Slope Maintenance published by the Geotechnical Engineering Office of the Civil Engineering Department.” This Layman’s Guide tells the general public how to maintain man-made slopes and retaining walls and hence it provides very useful information and guidance for property owners, owners’ associations and property managers to discharge their slope maintenance duties as imposed under the Code of Practice.

The first edition of this document and the more comprehensive Guide to Slope Maintenance (Geoguide 5) were published in 1995. Since the promulgation of these Guides, slope maintenance has been implemented in a more systematic manner for man-made slopes and retaining walls. The experience gained enables us to conduct a review on the requirements and standards for slope maintenance and leads us to the third edition of the Geoguide 5. Opportunity is taken to include the revised standards as promulgated in the new Geoguide 5 in the third edition of the Layman’s Guide.

For more detailed guidance, readers may refer to Geoguide 5, third edition.



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December 2003

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1. INTRODUCTION

1.1 PURPOSE AND SCOPE OF THIS GUIDE

Regular maintenance is essential for all man-made slopes and retaining walls to ensure their functionality and to avoid deterioration.

The Code of Practice on Building Management and Maintenance (HAD, 2000) produced under Section 44(1)(b) of the Building Management Ordinance (Chapter 344) stipulates that “Any slope or retaining wall from which an owner is responsible shall be maintained in a state of good condition in accordance with Geoguide 5 – Guide to Slope Maintenance published by the Geotechnical Engineering Office of the Civil Engineering and Development Department.”

The purpose of this Guide is to recommend a standard of good practice for the maintenance of man-made slopes and retaining walls. It is aimed at the general public, including property owners and agents for slope maintenance to assist them to discharge their duties as stipulated in the above Code of Practice. This Guide is an abridged version of the more comprehensive *Guide to Slope Maintenance (Geoguide 5)* (GEO 2003).

This Guide deals basically with the maintenance inspections and maintenance works necessary to keep in good condition well-designed and properly constructed slopes and retaining walls. The maintenance inspections and works recommended herein can also reduce the probability of instability of slopes and retaining walls which are not up to the current geotechnical standards for design and construction.

Maintenance inspections are sub-divided into four categories:

- (a) Routine Maintenance Inspections, which can be carried out by any responsible person with no professional geotechnical knowledge,
- (b) Engineer Inspections for Maintenance, which should be carried out by a professionally-qualified geotechnical engineer,
- (c) Regular Check of Buried Water-carrying Services, which should be carried out by a specialist leakage detection contractor, and
- (d) Regular Monitoring of Special Measures, which should be carried out by a firm with special expertise in the particular type of monitoring service required. Such monitoring is only necessary where the long term stability of the slope or retaining wall relies on specific measures which are liable to become less effective with the passage of time.

In this document, general guidance on Routine Maintenance Inspections is provided, and the requirements for Engineer Inspections for Maintenance, Regular Check of Buried Water-carrying Services and regular Monitoring of Special Measures are outlined. For

detailed recommendations and technical guidance on maintenance inspections by professionally-qualified geotechnical engineers, specialist leakage detection contractors or specialist firms, the reader should refer to Geoguide 5.

Natural hillsides do not require maintenance and the purpose of maintenance for hazard mitigation measures is confined to ensuring their physical integrity and satisfactory performance. Disturbed terrain features are tracts of natural hillside modified by human activities or landslides and they may contain man-made items (e.g. surface channels and surface protection measures which require maintenance to ensure their adequate functioning). Readers should refer to Geoguide 5 for detailed guidance on the maintenance requirements for natural terrain hazard mitigation measures and disturbed terrain features.

1.2 MAINTENANCE RESPONSIBILITY

In Hong Kong, the responsibility for maintenance of land, including slopes and retaining walls, rests with the owner, as defined in the Building Management Ordinance, or the party assigned such a responsibility. Ownership is conferred by a lease document issued by the Lands Department, such as a Government lease or conditions of grant, conditions of sale, conditions of exchange, etc. The public can have access to these lease documents and records of owners at the Land Registry.

Occasionally, the lease document issued by the Lands Department may include a clause relating to maintenance responsibility for an area outside a lot boundary, as shown on a site plan attached to the lease document. Owners may also be liable for maintenance of land adjoining their lot, without such responsibility being stated in the lease document, when they have given themselves responsibility by their actions. For example, they may have cut into adjoining land, an action which could render them responsible for the slope maintenance under common law.

Private owners, including owners of individual flats in a multi-storey building, have opportunities to examine the lease documents on purchase. They should carefully examine the lease documents to ascertain the extent of the land they are required to maintain. Where appropriate, professional advice may need to be sought from lawyers or estate surveyors on the interpretation of the lease documents in respect of maintenance responsibilities.

The Geotechnical Engineering Office maintains a Catalogue of Slopes that registers sizeable man-made slopes and retaining walls within the Hong Kong Special Administrative Region. Up-to-date information of these registered slopes and retaining walls is contained in the Slope Information System which can be accessed from the “Hong Kong Slope Safety” web site (<http://hkss.cedd.gov.hk>).

The Lands Department maintains a Slope Maintenance Responsibility Information System (SMRIS) to provide a quick and convenient preliminary reference for the public to identify the owner or party who is responsible for the maintenance of the registered slopes and retaining walls in the Catalogue of Slopes. The public can access the SMRIS from the Internet web site (<http://www.slope.landsd.gov.hk/smr/s/>).

2. MAINTENANCE MANAGEMENT

2.1 MAINTENANCE MANAGEMENT ACTIONS

A slope or retaining wall that is not properly maintained will deteriorate and may become so unstable that it may collapse and cause injury to persons or damage to property. If this happens, great expense may be incurred in the remedial works. Retaining walls, except masonry walls, demand less maintenance on the wall structure but routine maintenance of the drainage provision to the wall is essential. Examples of well-maintained and poorly maintained slopes and retaining walls are shown in Plates 1 to 4.

Owners or parties required to maintain land should undertake regular maintenance inspections and works. They can do this themselves or through an agent. For slopes and retaining walls maintained by a single owner, arranging maintenance action is fairly straightforward. For owners of individual flats in a multi-storey building, it is necessary in practice for an Owners' Corporation to discharge the maintenance responsibility on behalf of the individual owners, usually through a property management company.

If maintenance of slopes or retaining walls has not been effected before, there are two necessary actions for owners or parties required to maintain land as given below. Thereafter, maintenance inspections and necessary maintenance works should be carried out regularly as recommended in the Maintenance Manual.

- (a) Start Routine Maintenance Inspections and then carry out the maintenance works needed.
- (b) Commission the first Engineer Inspection for Maintenance as soon as possible, particularly for slopes and retaining walls with no Maintenance Manual.

The Government has set up a scheme that provides loan to individual owner of private buildings who wish to obtain financial assistance in carrying out maintenance and repair works to reinstate or improve the safety conditions of their slopes. The scheme is administered by the Buildings Department. Individual owners may apply for the loan whether to carry out such works voluntarily, or in compliance with statutory orders, including slope repairs, regular slope maintenance works and removal of unauthorised building works. Further information about the loan scheme can be obtained from the Buildings Department.

2.2 MAINTENANCE MANUALS

A Maintenance Manual constitutes a key part of maintenance management. It should be prepared by the engineer who designs a slope or retaining wall as part of his design services.

For existing slopes or retaining walls for which a Maintenance Manual is not available, the owner or party required to maintain the land should ask the engineer commissioned for Engineer Inspection for Maintenance or the engineer responsible for any upgrading works to prepare this reference document. Where a Maintenance Manual is available, it needs to be updated by the engineer, where necessary, in each Engineer Inspection for Maintenance.

2.3 CO-ORDINATED APPROACH TO SLOPE MAINTENANCE

Sometimes maintenance actions such as Routine Maintenance Inspections, Engineer Inspections for Maintenance, Regular Monitoring of Special Measures and Regular Checks of Buried Water-carrying Services are carried out by different maintenance parties and at different time. In such circumstances, the person or party responsible for overseeing slope maintenance, such as the property management agent should review all records of maintenance inspections and works. The purpose of this integrated review is to examine all relevant records together to provide insightful information for making a decision on whether additional maintenance works or other actions are required to be carried out.

2.4 MAINTENANCE RECORDS

Maintenance manuals, all records of maintenance inspections and subsequent maintenance works should be kept by the owner or the appointed agent, or by the party required to maintain land. In practice, it is advisable to keep duplicate copies of all records and to store them in separate locations. Comprehensive and accurate record keeping is important for good maintenance management. In addition, where the owner or the party required to maintain land is responsible for the maintenance of a large number of slopes and retaining walls, considerations should be given to keeping the Maintenance Manuals and maintenance records in electronic format for effective record management.

3. MAINTENANCE REQUIREMENTS FOR MAN-MADE SLOPES AND RETAINING WALLS

3.1 ROUTINE MAINTENANCE

3.1.1 Purpose and Scope of Routine Maintenance Inspections

Typical features of slopes and retaining walls that require maintenance are illustrated in Figure 1. As a minimum, it is recommended that Routine Maintenance Inspections are carried out to ascertain the need for maintenance of man-made items, including:

- (a) clearance of accumulated debris from drainage channels and slope surface,
- (b) repair of cracked or damaged drainage channels or pavement,
- (c) repair or replacement of cracked or damaged slope surface cover,
- (d) unblocking of weepholes and outlet drainpipes,
- (e) removal of any vegetation causing severe cracking of slope surface cover and drainage channels,

- (f) re-grassing of bare soil slope surface areas,
- (g) repair of missing or deteriorated pointing in masonry walls,
- (h) removal of loose rock debris and undesirable vegetation from rock slopes or around boulders,
- (i) repair of leaky exposed water-carrying services,
- (j) repair or replace rusted steel slope furniture, and
- (k) maintenance of landscape treatment on the slope.

In addition, a Regular Check of Buried Water-carrying Services on or adjacent to soil slopes or retaining walls should be undertaken (Section 3.3).

Where leakage is suspected from buried water-carrying services such as water pipes, water supply mains, sewers, stormwater drains or their ducting systems, prompt arrangement should be made for the investigation and repair of the services. Examples of suspected leakage are a significant increase in moisture on the surface or an increase in seepage from weepholes in slopes or retaining walls or from joints between masonry blocks.

Abnormal features on slopes or retaining walls should also be noted and an immediate Engineer Inspection for Maintenance should be arranged if necessary (Section 3.1.5).

Where repeated maintenance works are required for a particular aspect of a slope or retaining wall, such as repair of cracked drainage channels or surface cover, clearance of severely silted-up drainage channels, or reinstatement of areas of serious erosion, the problems should be investigated.

3.1.2 Frequency and Timing of Routine Maintenance Inspections

In general, Routine Maintenance Inspections for private slopes or retaining walls should be carried out at least once every year. The designer or the engineer undertaking the Engineer Inspections for Maintenance may, where appropriate, specify a frequency more than or less than once a year taking into account of its size, the stabilisation measures adopted, the cost-benefit of the maintenance inspections and the consequence in the event of failure. Slope owners should follow the recommended frequency to arrange Routine maintenance Inspections.

If Routine Maintenance Inspection is carried out not more than once a year, it should preferably be carried out between October and February, and any required maintenance works should be completed prior to the onset of the wet season in April.

In addition, it is good practice to inspect the drainage channels and clear any blockage after a heavy rainstorm.

3.1.3 Personnel for Routine Maintenance Inspections

Since the primary purpose of Routine Maintenance Inspection is to establish the need for basic maintenance of man-made items, such inspections do not demand professional geotechnical knowledge and can be carried out by any responsible person, including property management staff or maintenance staff.

3.1.4 Routine Maintenance Works

As a result of Routine Maintenance Inspections, typical routine maintenance works that may be needed are given in Table 1.

Most of the routine maintenance works can be carried out by general building or civil engineering maintenance contractors. The Government holds a list of Registered Contractors who have indicated their willingness in carrying out slope maintenance works. This list is available for public reference at the Buildings Department and District Offices.

Soft landscape treatment of slopes and retaining walls is normally designed to be ecologically sustainable and self-supporting once fully established. Routine maintenance should be carried out to prevent the soft landscape treatment from adversely affecting the functions of drainage channels. This includes clearing of litter and local trimming of overgrown vegetation near drainage channels or slope access. For specific maintenance works related to the soft landscape treatment and natural vegetation including existing trees, such as pest and disease control, and tree surgery works, advice from horticulturists or specialist contractors should be sought where necessary. Guidance on the maintenance requirements for landscape treatment is given in the GEO Publication No. 1/2011: “Technical Guidelines on Landscape Treatment for Slopes” (GEO, 2011). An abridged version of this document (GEO, 2012) has also been prepared for the general public.

3.1.5 Need for Immediate Engineer Inspections for Maintenance

During Routine Maintenance Inspections, particular note should be taken of anything considered to be unusual or abnormal, such as signs of leakage, widening of cracks, settling ground, bulging or distortion of masonry walls, or settlement of the crest platforms. Some examples of such defects can be seen in Plate 5. These defects or observations have to be reported promptly to the owner or the party required to maintain the land, who should then appoint a professionally-qualified geotechnical engineer without delay to undertake an immediate Engineer Inspection for Maintenance, and to recommend any necessary actions.

Where a change in the land use in the vicinity of a slope or retaining wall is noted in a Routine Maintenance Inspection, the inspection personnel should report it to the owner or the party required to maintain the land. The responsible party should then review whether this would result in any change in the consequence-to-life category of the slope or retaining wall and the required frequency of maintenance inspections. Advice should be sought from a professionally-qualified geotechnical engineer when needed.

Table 1 Typical Routine Maintenance Works for Slopes and Retaining Walls

Man-made Item	Typical Maintenance Works Required	Guidance
Surface Drainage Channels, Catchpits and Sand Traps	(a) Clear debris, undesirable vegetation and other obstructions. (b) Repair minor cracks with cement mortar or flexible sealing compound. (c) Rebuild severely cracked channels. (d) Replace missing or deteriorated joint fillers and sealant.	(a) Works may be required outside site boundaries to prevent debris from blocking the drainage system. (b) Where large tree roots have damaged drainage channels, appropriate portions of the roots should be removed, taking care not to jeopardise the stability of the tree. Alternatively, the channels may be realigned.
Weepholes and Drainage Pipes	(a) Clear obstructions (e.g. weeds and debris) in weepholes and pipe ends. (b) Probe with rods for deeper obstructions.	(a) Pipes are prone to being blocked. Where pipes have been used on slopes and are leaky or severely blocked, they should be replaced with drainage channels where possible.
Impermeable Surface Cover (e.g. chunam and shotcrete)	(a) Remove undesirable vegetation growth. (b) Repair cracks or spalling. (c) Regrade and repair eroded areas. (d) Replace surface cover that has separated from underlying soil. (e) Replace missing or deteriorated joint fillers and sealant. (f) Remove dead, decaying or unstable trees.	(a) Cracked impermeable surface cover should be repaired by cutting a chase along the line of the crack, which is to be filled with a similar slope cover material or a flexible sealant. (b) Where large tree roots have damaged the surface cover, the cover should be replaced and tree rings should be provided. (c) Specialist advice may be sought in treating trees. Tree felling application should be obtained from relevant authority where necessary.
Vegetated Surface Cover	(a) Regrade eroded areas with compacted soil followed by re-planting. (b) Replant vegetation in areas where the vegetated surfacing has died. (c) Trimming of vegetation if overgrown. (d) Remove dead, decaying or unstable trees.	(a) Where erosion is shallow and does not affect the performance of existing surface drainage channels, the eroded area may be regraded by trimming, without backfilling. (b) Surface erosion may indicate possible inadequacy of the drainage system. The source of concentrated flow should be identified and rectified. (c) Specialist advice may be sought on types of cover or species in areas where there is insufficient sunlight to support vegetation growth.
Rock Slopes and Boulders	(a) Repair cracked or spalled concrete surface and support. (b) Remove loose rock debris. (c) Remove undesirable vegetation growth.	(a) It is not advisable to remove all vegetation indiscriminately but tree roots giving rise to prising action in rock joints should be removed. The entire stump of the tree should be removed.
Facing	(a) Re-point deteriorated mortar joints on masonry face. (b) Repair cracking or spalling of concrete surface and replace missing or deteriorated joint fillers and sealant.	(a) Continual distress (e.g. widening cracks) of a wall should be reported to the owner or the party required to maintain the land.

Note: Safe and efficient access is important for maintenance works.

3.1.6 Records of Routine Maintenance

Indicative record sheets for Routine Maintenance Inspection and works are shown in Appendix A. The record sheets should be completed in two stages, namely, on completion of Routine Maintenance Inspection and on completion of maintenance works.

3.2 ENGINEER INSPECTIONS FOR MAINTENANCE

3.2.1 Scope of the Inspections

A model brief for an Engineer Inspection for Maintenance is given in Appendix B. This is to facilitate private owners in procuring such a service.

An Engineer Inspection for Maintenance is not intended to determine whether or not a slope or retaining wall meets the geotechnical standards specified in the Geotechnical Manual for Slopes (GEO, 1984).

3.2.2 Frequency of the Inspections

The frequency of Engineer Inspections for Maintenance should normally be recommended by the designer in the Maintenance Manual, or as considered appropriate by the engineer commissioned to carry out the Engineer Inspection. An Engineer Inspection for Maintenance may also be requested by those who carry out the Routine Maintenance Inspection. In general, the frequency of maintenance inspections should be once every five years.

The designer or the engineer undertaking the Engineer Inspections for Maintenance may, where appropriate, specify a frequency more than or less than once every five year taking into account of its size, the stabilisation measures adopted, the cost-benefit of the maintenance inspections and the consequence in the event of failure. Slope owners should follow the recommended frequency to arrange Engineer Inspections.

3.2.3 Personnel for the Inspections

An Engineer Inspection for Maintenance should be carried out by a professionally-qualified geotechnical engineer in Hong Kong. A suitable qualification is Registered Professional Engineer (Geotechnical), information on which can be obtained from the Engineers Registration Board.

Where considered necessary, the inspecting engineer should advise the owner or party required to maintain the land to consult a professionally-qualified structural engineer, e.g. a Registered Professional Engineer (Structural), for any suspected structural problems identified during the inspection.

3.3 REGULAR CHECKS OF BURIED WATER-CARRYING SERVICES

3.3.1 General

Leakage from buried water-carrying services, e.g. water supply mains and stormwater drains, may not produce visible signs on the surface of a soil or retaining wall and yet may adversely affect its stability. Therefore, owners or parties responsible for maintaining water-carrying services that may affect slopes and retaining walls should arrange for Regular Checks of Buried Water-carrying Services, regardless of whether signs of suspected leakage have been observed. If a ducting system has been provided to the services, regular checks of the ducting system should also be carried out to detect any water flow in and leakage from it.

Occasionally, water-carrying services owned or maintained by other parties may traverse a private lot. The owner of the private lot should allow access to the services' owner to carry out regular checks of the water-carrying services. Such requirements are sometimes stipulated explicitly in the lease or grant document, such as areas designated as drainage reserves in the lease.

3.3.2 Frequency for Regular Checks of Water-Carrying Services

For those buried water-carrying services belonging to the slope owner or the party required to maintain the land, the Maintenance Manual should specify the frequency of the regular checks. Otherwise, the engineer appointed for the Engineer Inspection for Maintenance should recommend the frequency of the regular checks.

The frequency and extent of the examination of the services should take account of the nature of the material and construction of the pipes (e.g. rigid or flexible system), performance history in respect of leakage, the possible presence of loose fill, and likely effect on the stability of the slope or retaining wall should leakage occur. Reference should also be made to "Code of Practice on Monitoring & Maintenance of Water-carrying Services Affecting Slopes" (ETWB, 2006).

3.3.3 Methods for Checking Buried Water-Carrying Services

Checking of buried drains, sewers, water pipes, water mains and ducting systems should be carried out by specialist leakage detection contractors. Guidance on methods for checking buried water-carrying services is given in the "Code of Practice on Monitoring & Maintenance of Water-carrying Services Affecting Slopes" (ETWB, 2006).

3.3.4 Repairs of Services

Any buried water-carrying services that are found to be damaged or leaky should be repaired without delay. Care should be taken to ensure that any repair works do not impair the hydraulic performance of the pipes.

3.3.5 Records of the Checks

The forms and records for Regular Checks of Buried Water-carrying Services should be designed by the engineer who recommends the regular checks, or by the specialist leakage detection contractor who conducts the regular checks.

3.4 ACCESS AND SAFETY PRECAUTIONS

Many slopes and retaining walls are high and steep, and care has to be taken for personal safety when inspections are carried out. Densely vegetated slopes may pose difficulties in access.

Guidance on the provision and arrangement of access for slope maintenance that is safe for maintenance personnel, visually pleasing and where necessary, secure against trespassers, is given in GEO Report No. 136 entitled “Guidelines on Safe Access for Slope Maintenance” (Lam J.S., Siu C.K. & Chan Y.C, 2003). Some examples of typical access arrangements for the inspection and maintenance of slopes and retaining walls are given in Plate 6.

For the personal safety of the inspecting personnel, it is prudent for the maintenance inspections to be carried out by at least two persons.

3.5 REGULAR MONITORING OF SPECIAL MEASURES

3.5.1 Need for the Monitoring

Regular Monitoring of Special Measures is only necessary in fairly rare circumstance. Such requirements are normally established by the designer. Details of the monitoring are given in a Monitoring Schedule, forming part of the Maintenance Manual.

If there are Special Measures (such as prestressed ground anchors or subsoil drainage system) but there is no such Monitoring Schedule in the Maintenance Manual, then the owner or party required to maintain the land should commission the engineer undertaking the Engineer Inspection for Maintenance to prepare one.

Regular Monitoring of Special Measures will need to be carried out by specialist firms. The monitoring should be conducted at the recommended frequency, or more frequently as required. Where the results of monitoring exceed the ‘alert levels’ given in the Monitoring Schedule, the owner or the party required to maintain the land should promptly appoint a professionally-qualified geotechnical engineer to implement the stipulated contingency actions and to determine whether upgrading works are required. Such events should also be brought to the attention of engineers undertaking subsequent Engineer Inspections for Maintenance.

The forms and records for Regular Monitoring of Special Measures should be designed by the designer or the specialist firm that conducts the inspection.



Figure 1 Typical Man-made Items on Slopes and Retaining Walls that Require Maintenance



(1) Vegetated Surface



(2) Shotcreted Surface



(3) Chunam Surface

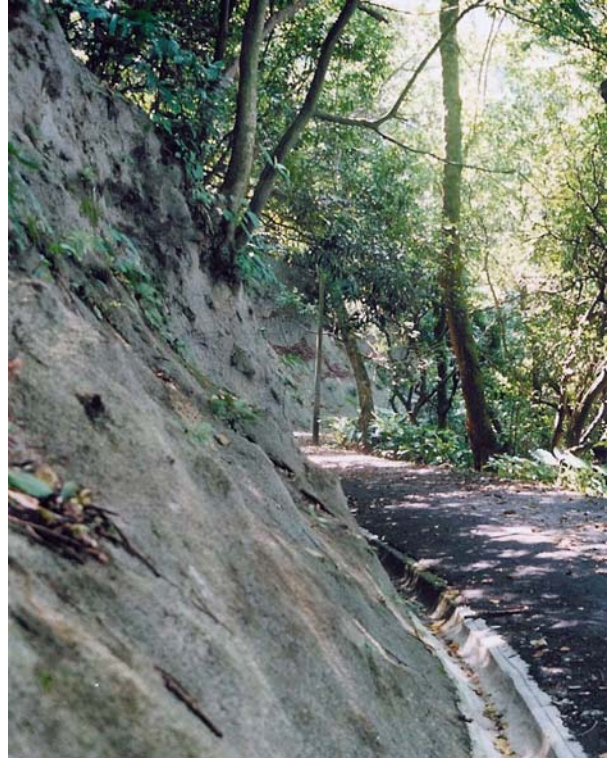


(4) Stone-pitched Surface

Plate 1 Well-maintained Slope Surface Cover



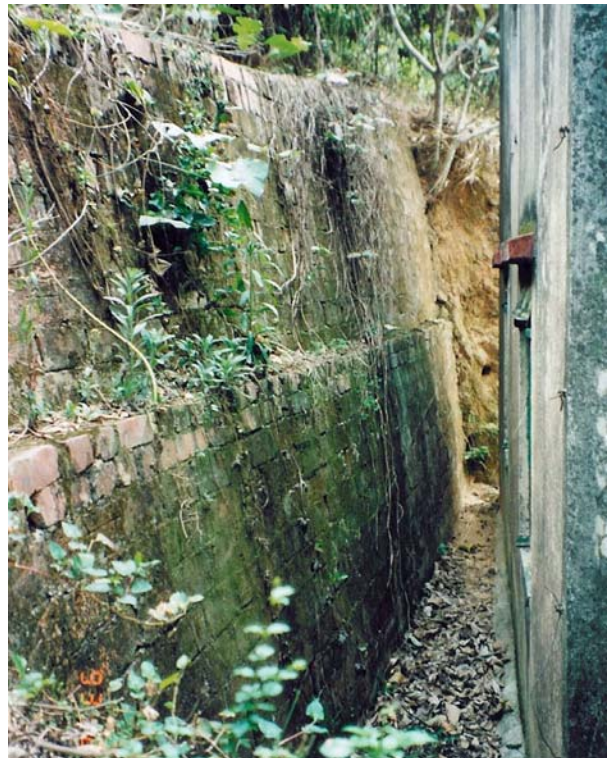
(1) Vegetated Surface



(2) Shotcreted Surface



(3) Chunam Surface



(4) Masonry Facing

Plate 2 Poorly-maintained Slope Surface Cover



(1) Exposed Down Pipe on Retaining Wall



(2) U-channel along Toe of Slope



(3) U-channel and Catchpit



(4) Stepped Channel

Plate 3 Well-maintained Surface Drainage Measures



(1) U-channel along Crest of Slope



(2) U-channel along Berm of Slope



(3) Catchpit at Toe of Slope

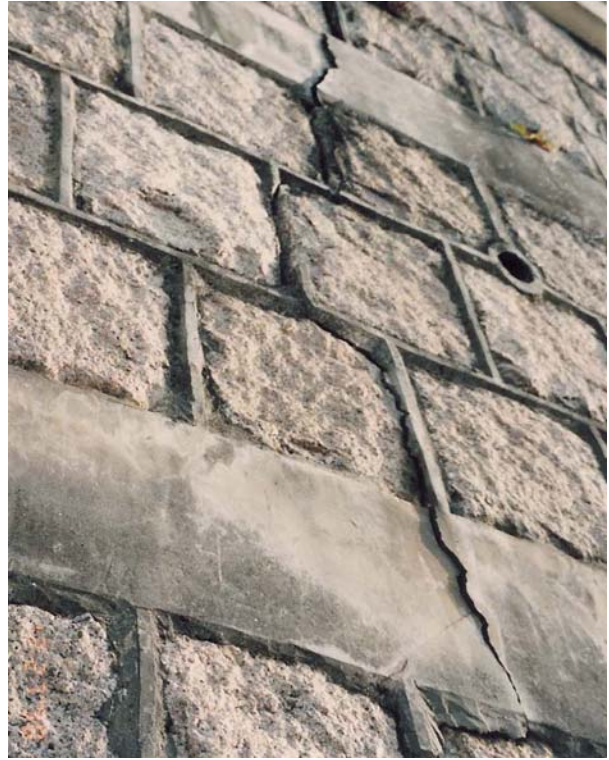


(4) Catchpit at Crest of Slope

Plate 4 Poorly-maintained Surface Drainage Measures



(1) Tension Crack on Slope



(2) Crack in Retaining Wall



(3) Cracked Chunam Surface



(4) Cracked Surfacing and Wall

Plate 5 Abnormal Features



(1) Concealed Access to Stairway



(2) Ladders with Safety Loops



(3) Fencing Recessed into the Vegetated Land



(4) Combined Stepped Channel and Stairway

Plate 6 Examples of Access for Slope Inspection and Maintenance

4. SOURCES OF INFORMATION

4.1 INFORMATION PROVIDERS

Useful information relating to the maintenance of slopes and retaining walls can be obtained from a number of organisations.

The Geotechnical Engineering Office of the Civil Engineering and Development Department operates a Slope Maintenance Hotline (Tel.: 2760 5800), which provides advice to the general public on matters relating to maintenance of slopes and retaining walls, and suggests appropriate sources for more specific information. The public can also access the hotline through the 1823 (Tel.: 1823) for enquiry. The Geotechnical Engineering Office manages a Slope Information System that contains up-to-date information on registered man-made slopes and retaining walls, disturbed terrain features and mitigation measures within the Hong Kong Special Administrative Region. The Slope Information System can be accessed from the “Hong Kong Slope Safety” web site (<http://hkss.cedd.gov.hk>).

The Geotechnical Information Unit forms part of the Civil Engineering Library, which is operated by the Geotechnical Engineering Office of the Civil Engineering and Development Department. The Geotechnical Information Unit contains records of previous ground investigations and landslides, and reports on Stability Assessment and upgrading works carried out by the Geotechnical Engineering Office under the Landslip Preventive Measures Programme and the Landslip Prevention and Mitigation Programme. In addition, other records of existing slopes and retaining walls are made available upon request.

The Engineers Registration Board holds a list of Registered Professional Engineers (Geotechnical).

The Buildings Department and District Offices keep a list of Registered Contractors who have indicated their willingness to carry out maintenance works for slopes and retaining walls.

The Home Affairs Department manages the Building Management Resource Centres to assist building owners, residents, owners’ corporations, mutual aid committees and management bodies in improving the standards of management, safety and maintenance of their buildings.

The Hong Kong Association of Property Management Companies Limited may be consulted for general information about property management. The Association keeps a list of property management companies in Hong Kong.

The Lands Department is responsible for land administration. Information about land records, land boundaries, lease conditions and slope maintenance responsibility can be sought from the Lands Department. Large-scale plans and topographic maps can also be purchased from the Lands Department. The Slope Maintenance Responsibility Information System (SMRIS) contains information on the maintenance responsibility for registered man-made slopes and retaining walls and can be accessed from the Lands Department’s web site (<http://www.slope.landsd.gov.hk/smr/s/>).

Records of property owners, lease documents and Deeds of Mutual Covenant are kept at the Land Registry, where the public can make a search of these records.

The Water Supplies Department provides information on the location of water supply mains upon request.

The Drainage Services Department maintains as-built records of public stormwater drains and foul sewers, whereas the Buildings Department holds similar records for private lots.

Information on gas, electricity, telephone and similar services, including both the locations and details of existing facilities and the provision of future services, are available from the private companies supplying the services.

Further information regarding the services provided by the relevant government departments and their contact details can be found at the web site of the Government of the Hong Kong Special Administrative Region (<http://www.gov.hk>).

4.2 DOCUMENTS

More comprehensive guidance on the technical aspects of maintenance inspections is given in the “Guide to Slope Maintenance” (Geoguide 5) published by the Geotechnical Engineering Office of the Civil Engineering and Development Department. In addition, a “Layman’s Guide to Landscape Treatment of Slopes” (GEO, 2012) has also been prepared to provide guidelines to owners and encourage them to adopt landscape treatment to slopes and retaining walls when planning for the maintenance and upgrading works. Copies of this layman’s guide are available free of charge at District Offices and can be downloaded from the “Hong Kong Slope Safety” web site (<http://hkss.cedd.gov.hk>).

The Government of the Hong Kong Special Administrative Region has prepared a code of practice entitled “Code of Practice on Monitoring & Maintenance of Water-carrying Services Affecting Slopes” (ETWB, 2006), which can be downloaded from the “Hong Kong Slope Safety” web site.

5. REFERENCES

- ETWB (2006). *Code of Practice on Monitoring and Maintenance of Water-carrying Services Affecting Slopes. (Second edition)*. Environment, Transport and Works Bureau, Hong Kong Government, 93 p.
- GEO (1984). *Geotechnical Manual for Slopes. (Second edition)*. Geotechnical Control Office, Hong Kong, 302 p (Reprinted, 2011).
- GEO (2003). *Geoguide 5 - Guide to Slope Maintenance. (Third edition)*. Geotechnical Engineering Office, Hong Kong, 132 p.

- GEO (2011). *Technical Guidelines on Landscape Treatment for Slopes (GEO Publication No. 1/2011)*. Geotechnical Engineering Office, Hong Kong, 217 p.
- GEO (2012). *Layman's Guide to Landscape Treatment of Slopes*. Geotechnical Engineering Office, Hong Kong, 29 p.
- HAD (2000). *Code of Practice on Building Management and Maintenance*. Home Affairs Department, 16p.
- Lam, J.S., Siu, C.K. & Chan, Y.C. (2003). *Guidelines on Safe Access for Slope Maintenance (GEO Report No. 136)*. Geotechnical Engineering Office, Hong Kong, 58 p.

APPENDIX A**INDICATIVE RECORD SHEETS FOR ROUTINE MAINTENANCE INSPECTIONS AND WORKS**

RECORD OF ROUTINE MAINTENANCE INSPECTION				(SHEET 1 OF 4)	
SLOPE/RETAINING WALL REFERENCE NO.⁽¹⁾					
SLOPE/RETAINING WALL LOCATION (ADDRESS)					
DATE OF INSPECTION:			WEATHER:		
Date of Last Engineer Inspection for Maintenance:					
Due Date of Next Engineer Inspection for Maintenance:					
Maintenance of Man-made Item	Location Reference	Action Required		Works Completion Date	
		No	Yes		
Clear drainage channels of accumulated debris					
Repair cracked/damaged drainage channels or pavements along crest and toe of slope or retaining wall					
Repair or replace cracked or damaged impermeable slope surface cover					
Remove surface debris and vegetation causing severe cracking of slope surface cover and drainage channels					
Remove loose rock debris and undesirable vegetation from rock slopes or boulders					
Re-vegetate bare soil slope surface					
Repair pointings in masonry walls					
Unblock weepholes and outlet drainpipes					
Repair leaky exposed water-carrying services					
Repair or replace rusted steel furniture (e.g. metal gates, boundary fences and stairs)					
Remove debris from defence measures					
Others (specify works and give details)					
RECOMMENDED DATE FOR COMPLETION OF ABOVE WORKS:					
Note: (1) Upon request, the Geotechnical Engineering Office can provide a slope or retaining wall reference number if applicable.					

RECORD OF ROUTINE MAINTENANCE INSPECTION**(SHEET 2 OF 4)****SLOPE/RETAINING WALL REFERENCE NO.**

SITE PLAN (Reference numbers should be assigned to locations of man-made items for which maintenance works are required. The corresponding reference numbers should be quoted in the photographic records)

Note: Add additional record sheets for site plan as necessary.

APPENDIX B

MODEL BRIEF FOR ENGINEER INSPECTIONS FOR MAINTENANCE FOR PRIVATE SLOPES

1. Objective of the Assignment

The objective of this Assignment is to carry out an Engineer Inspection for Maintenance, including the preparation of an Engineer Inspection Report and the preparation/updating* of a Maintenance Manual, and, if required, the design, management and supervision of works, for slope/retaining wall* number _____, the location and extent of which are shown on the attached plan.

2. Description of the Assignment

The Assignment shall consist of the following items of work:

- (a) to assess the state of maintenance and condition of the slope/retaining wall*,
- (b) to establish if Stability Assessments of the slope/retaining wall* have previously been carried out and, if so, to carry out a review of these previous Stability Assessments,
- (c) to determine whether a Stability Assessment and/or preventive maintenance or urgent repair works or access provision are necessary,
- (d) to recommend, arrange, supervise and certify the satisfactory completion of any necessary works*, and
- (e) to prepare/update* the maintenance documentation and recommend improvement for the maintenance process.

The review of previous Stability Assessments required in (b) above is not intended to certify or endorse any part or the whole of the previous Stability Assessments. It only aims to identify whether the previous Stability Assessments contains any obvious deficiencies in engineering approach or assumptions in the light of current local geotechnical engineering practice and safety standards, any monitoring records indicating deficiency in the design assumptions, and to judge whether the stability of the slope/retaining wall would be affected by any visible changes in conditions identified during the site inspection.

3. Deliverables

The Engineer shall submit _____ copies of the Engineer Inspection Report covering the tasks listed in Section 4 below and enclosing the Records of Engineer Inspection for Maintenance /and _____ copies of the Maintenance Manual to the Employer.

4. Services to be Provided by the Engineer

This Assignment shall be carried out by a professionally-qualified geotechnical engineer in Hong Kong. A suitable qualification is Registered Professional Engineer (Geotechnical). As the inspecting engineer, the geotechnical engineer shall prepare and sign the Records of Engineer Inspection for Maintenance. The geotechnical engineer shall also prepare and sign the Engineer Inspection Report.

Part 1 - Information Collection

- (a) Starting from the sample checklist in Appendix H of Geoguide 5, prepare a checklist for the agreement of the Employer indicating the types of documents to be collected under this Assignment.
- (b) Collect available documentary information pertaining to the slope/retaining wall* and the nearby areas which could have implications on its stability.

Part 2 - Site Inspection

- (a) Carry out an inspection of the slope/retaining wall* and the nearby areas and prepare Records of Engineer Inspection for Maintenance according to the Indicative Record Sheets given in Appendix F of Geoguide 5. In particular,
 - (i) evaluate the adequacy of access to the slope/retaining wall for maintenance inspections taking into account the requirements of safety regulations and provide recommendations in accordance with Part 4(b) below,
 - (ii) identify visually any discrepancies between the records of previous engineer inspections for maintenance, maintenance manuals, the works as constructed, actual site conditions and the plans in the Stability Assessment Reports, design reports, drawings or as-built records,
 - (iii) identify all visible changes including landslides, unauthorised constructions, formation of unauthorised cultivation areas, appearance of tension cracks, or other signs of distress, that have taken place at or in the vicinity of the slope/retaining wall*, in particular any changes since the last Stability Assessment and Engineer Inspection, which could have implications on its stability, and to judge whether these might be significant,
 - (iv) identify the presence of buried and exposed water-carrying services (including any ducting systems housing the services) and unauthorised services, on or in the vicinity of the slope/retaining wall* (including relevant areas outside the lot boundary), both visually and with reference to the record plans for the services,
 - (v) check for signs of leakage of any exposed and buried water-carrying services (including any ducting systems housing the services) and identify the source of any leaky water-carrying services where possible and provide recommendations in accordance with Part 4(c) below, and

- (vi) look for and consider the implications of problems that are not explicitly included in the list of maintenance for man-made items, and bring to the attention of the Employer any immediate and obvious danger noted and provide recommendations in accordance with Part 4(d) below.

Part 3 - Assessment

Based on the tasks of Parts 1 and 2 above, carry out the following tasks:

- (a) Evaluate the relevance and completeness of all information collected with reference to the checklist agreed by the Employer (see Part 1(a)). Determine whether Stability Assessments covering parts or the entirety of the slope/retaining wall* have previously been carried out. If so, review the previous Stability Assessment reports to check whether the engineering approach used, the assumptions and the conclusions made in these reports are reasonable in the light of current practice and safety standards.
- (b) Re-assess the consequence-to-life category of the slope/retaining wall*, as set out in the standards and guidance documents promulgated by the Geotechnical Engineering Office.
- (c) Check that Routine Maintenance Inspections and the recommendations for routine maintenance works have been carried out and documented satisfactorily.
- (d) Check that Regular Checks of Buried Water-carrying Services (including any ducting systems housing the services) and/or Regular Monitoring of Special Measures (if required) and the recommendations arising from the checks have been carried out and documented satisfactorily.
- (e) Assess the adequacy of routine maintenance works and supplement the list of basic maintenance works items, as necessary.
- (f) Re-assess the required frequency of Routine Maintenance Inspections, Engineer Inspections for Maintenance, and Regular Checks of Buried Water-carrying Services (including any ducting systems housing the services).

Part 4 - Recommendations

- (a) Recommend any necessary preventive maintenance works.
- (b) Based on the task of Part 2(a)(i), recommend any necessary access to be provided for maintenance inspections and works.
- (c) Based on the task of Part 2(a)(v), recommend any necessary immediate detailed leakage check, regular checks, repair and re-routing of the services. Where leaky water-carrying services are found, advise the services' owners and appropriate authorities for actions. Update the Maintenance Manual to include a provision to initiate an out-of-turn Engineer Inspection for Maintenance whenever anomalies due to leaky services are observed.

- (d) Based on the work of Part 2(a)(iii) & (vi), recommend any necessary emergency measures (e.g. cordoning off works), urgent repair or investigations.
- (e) Advise whether a Stability Assessment of the slope/retaining wall* is needed taking into consideration the results of the tasks in Parts 2 and 3 and the results of the previous Stability Assessment(s), if any.

Part 5 - Reporting

- (a) Prepare an Engineer Inspection Report covering the above tasks and enclosing the Records of Engineer Inspection for Maintenance for submission to the Employer.
- (b) Explain the findings and recommendations of the Engineer Inspection to the Employer, in particular whether Stability Assessment or works are required to be carried out, with justifications and cost estimates including any site supervision costs, and answering any queries.

Part 6 - Preparation/Updating* of the Maintenance Manual

- (a) Prepare/update* the Maintenance Manual to include all relevant information extracted from the previous Stability Assessment(s), and the desk study, records and details of any previous landslides and subsequent repair works, and site inspection(s) under this Assignment, with traceability to all source documents used.
- (b) Prepare/update* the Maintenance Manual to include a statement of landscape design highlighting the rationale for the choice of the landscape items for the slope/retaining wall.

Part 7 - Design, Management and Supervision of Works (Optional Items)

- (a) Prepare specifications and plans for the necessary routine and preventive maintenance works, urgent repair, and access provision based on the tasks of Part 4(a), (b) & (d) above.
- (b) Recommend the requirements of a construction design review for the works in Part 7(a) above.
- (c) Obtain or arrange to obtain all statutory approvals (e.g. from Building Authority) and agreements from any parties, as appropriate, required for the execution of the necessary maintenance works.
- (d) Seek approval/agreement from the relevant authorities (e.g. Transport Department, Police, and District Lands Offices) and any affected parties (e.g. utility companies), if necessary, for the execution of the items of works on the slopes/retaining walls.
- (e) Prepare the works contract, invite tenders, and provide recommendations for the Employer to appoint the most suitable Contractor to undertake the works.

- (f) Undertake supervision of the items of works and all contract administration. Check whether the works have been carried out in accordance with the works contract requirements and if so certify payment for works that are satisfactorily completed.
- (g) Carry out any necessary construction design reviews and liaise with the Contractor and the Employer as necessary.
- (h) Prepare and certify the as-built construction records, including any design reviews carried out, and update the Maintenance Manual to document the works done, based on site inspections and the as-built records of the works. Submit relevant documents to statutory authorities certifying the completion of works.

5. Programme of Implementation

The due date for the commencement of the Assignment shall be _____.

The due date(s) for the completion of Parts 1 to 6 of Section 4 of the Assignment, including the submission of Record of Engineer Inspection for Maintenance and any relevant documents and reports, shall be _____.

6. Standards and Specifications

The Engineer shall adopt such technical and design standards and specifications as are applicable to and in current use by the Government of the Hong Kong Special Administrative Region or, if non-existent, international Codes of Practice and Specifications. Reference can be made to Technical Guidance Note (TGN) No. 1 which contains a list of guidance documents being used by the Geotechnical Engineering Office as the de facto geotechnical standards. The TGN can be found at the Civil Engineering and Development Department web site at <http://www.cedd.gov.hk>.

7. Information Provided by the Employer

All available information held by the Employer and relevant to the Assignment will be provided to the Engineer.

Notes: (1) * Deleted if not applicable.

- (2) The agreement should be priced on the basis of all the tasks included in Parts 1 to 6 of Section 4 only. The fee for the tasks in Part 7 of Section 4, if found necessary, should be negotiated separately.
- (3) The programme for the tasks in Part 7 of Section 4 should be agreed after completion of the tasks in Parts 1 to 6 of Section 4.

