

GUIDELINES ON SAFE ACCESS FOR SLOPE MAINTENANCE

GEO REPORT No. 136

J.S. Lam, C.K. Siu & Y.C. Chan

**GEOTECHNICAL ENGINEERING OFFICE
CIVIL ENGINEERING DEPARTMENT
THE GOVERNMENT OF THE HONG KONG
SPECIAL ADMINISTRATIVE REGION**

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**This report was originally produced in June 2002
as GEO Special Project Report No. SPR 4/2002**

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First published, June 2003

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PREFACE

In keeping with our policy of releasing information which may be of general interest to the geotechnical profession and the public, we make available selected internal reports in a series of publications termed the GEO Report series. The GEO Reports can be downloaded from the website of the Civil Engineering Department (<http://www.info.gov.hk/ced/>) on the Internet. Printed copies are also available for some GEO Reports. For printed copies, a charge is made to cover the cost of printing.

The Geotechnical Engineering Office also publishes guidance documents as GEO Publications. These publications and the printed GEO Reports may be obtained from the Government's Information Services Department. Information on how to purchase these documents is given on the last page of this report.



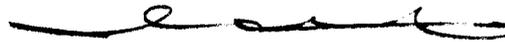
R.K.S. Chan
Head, Geotechnical Engineering Office
June 2003

FOREWORD

Geoguide 5 prescribes the standard of good practice in slope maintenance. It requires that safe access be provided for use of maintenance personnel. In 2000, the Geotechnical Engineering Office (GEO) of the Civil Engineering Department, on behalf of the Works Bureau, worked with the Labour Department on forms of safe access that satisfy the requirements of the law. Later the Highways Department, who maintains a large number of Government slopes, commissioned a study on the provision of safe slope access. The study led to the formulation of a system of acceptable access forms and procedures of implementing the system.

The public has expressed concerns on the appearance of permanent access on slopes. Security issues were also raised.

This document integrates the findings of the study by the Highways Department and considerations to reduce visual impact and security risks associated with permanent safe access for slope maintenance. It was prepared by Mr David Lam and Mr C.K. Siu under my supervision. The Works Bureau, Works Departments, the Labour Department, the Agriculture, Fisheries and Conservation Department and green groups viewed drafts of the document and provided useful comments and information. Their contributions and assistance are gratefully acknowledged.



Y.C. Chan
Assistant Director (Geotechnical)/Development

ABSTRACT

This report presents guidelines on the design of safe access for slope maintenance, taking into consideration three major aspects: safety, visual quality and security.

Slope maintenance, which is vital to the continued stability of slopes, often involves working at height. The first part of this report focuses on the provision of safe access for slope maintenance, taking into consideration the requirements of the law. It has drawn extensively from the recent completed Highways Department consultancy reports (HyD, 2001 a, b & c). A wide range of methods, some in the form of permanent access and others ad hoc measures, are identified for access provision. The hierarchy for selection of safe access methods was also discussed.

Some components of the safe access may reduce the visual quality of the slope and its surroundings. Basic guidelines on making these access provisions as inconspicuous as possible are provided.

Access installed on a slope may lead to trespassing, causing concerns on invasion of privacy and safety of the trespassers. Measures to discourage such act are discussed in the later part of the report.

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1. INTRODUCTION

Regular maintenance is essential to the continued stability of slopes. Geoguide 5: Guide to Slope Maintenance (GEO, 1998) describes the standard of good practice. It requires that safe access be provided for use of maintenance personnel. Some components of such provision may be visually intrusive. The access to slopes may also encourage trespassing that may either lead to intrusion of privacy or safety concern.

This document provides guidelines on the design of slope access that are safe to maintenance personnel, visually pleasing and, where necessary, secure against trespassers. It draws extensively from published reports on relevant issues which should be referred to for more details.

2. BACKGROUND INFORMATION

In Hong Kong, provisions of safe working practices are set down in the Occupational Safety and Health Ordinance, Cap 509 (OSHO), the Factories & Industrial Undertakings Ordinance, Cap 59 (FIUO) and their respective subsidiary regulations, e.g. the Construction Sites (Safety) (Amendment) Regulations (CSSR(A)). Appendix A is a summary of the salient aspects of the legislation applicable to the provision of safe slope access. It is adapted from the study report by the Highways Department (HyD, 2001a). The study also produced two complementary reports that document other findings and general consensus on safe maintenance access (HyD, 2001 b & c).

In respect of landscape treatment of slopes and retaining walls, guidelines are given in GEO Publication No. 1/2000 (GEO, 2000) produced by the Geotechnical Engineering Office of the Civil Engineering Department.

3. SLOPE ACCESS

3.1 Type

Drainage channels are provided to carry surface water away from slopes. Where the channels are not steep enough to be self-cleansing, ready access is needed to facilitate regular inspection and clearing. This situation is common for channels on berms and around the periphery of slopes. Such access is also useful for general inspection of, and if necessary, staging ad hoc access facilities for closer inspection and maintenance works on other parts of the slope. That part of this access that is in form of permanent access is referred to as primary access in this document for easy reference.

Ad hoc access is usually used for close inspection and minor works of the slope face and other parts not within reach of the primary access. Occasionally, parts of a slope may demand regular attention. A conceivable example is a piezometer that has to be read frequently. Permanent access to them may also be justified.

Sometimes, the primary access of a slope is detached from footways, roads or other land features accessible to the public. Ad hoc access may be used for maintenance personnel to reach the primary access.

3.2 Safe Access

Safe access is prescribed by law, salient aspect of which is summarised in Appendix A. It could be in form of permanent access or ad hoc access.

Permanent access comprises ground or structure on which maintenance personnel can stand and carry out the intended activities, and provided with fencing if fall over 2 m is possible. Apart from gradient, what constitutes suitable ground for permanent access also depends on whether the surface is slippery, and what plant and equipment is to be used. Generally, paving is not essential for permanent access on gently sloping ground. Steps of various forms could be provided on steeper ground. Steps, and concrete paving where needed, should be of sufficient but not generous width to minimise land-take. Ladders are needed on very steep ground.

Fencing could be of various forms for different degree of visual impact and operational convenience. See Appendix B for details.

Ad hoc access could be temporary safe access or static working platform. It could also be by provision of secondary fall-protection measures to ground on which personnel can stand and carry out the intended activities.

Temporary safe access is mobile or portable access facilities including mobile platform, temporary ladder and temporary stairway. Appendix C describes main features and the merits and limitations of each of them.

Static working platform includes scaffolding of various forms as described in Appendix D.

Appendix E describes common forms of secondary fall-protection measures.

The choice of ad hoc access methods for use should follow the hierarchy of temporary safe access, static working platform and secondary fall-protection measures. This spirit is summarised in the charts at Appendix F abstracted from HyD (2001b).

In exceptional cases, abseiling or boatswain chairs (Appendix G) could be the only practical means for maintenance access. This method is prohibited by law and exemption is required from the Labour Department before it can be adopted.

The Labour Department requests that a risk assessment be carried out before inspection and works on a slope, by a person who has the knowledge and experience and who is suitably trained on risk assessment and relevant safety regulations. He could be the technical supervisory grade. A Professional Engineer should countersign the assessment record form to confirm that he has reviewed the risk assessment and take responsibility for it. Appendix H is a sample record form. For government slopes, works are usually carried out by Contractors who should conduct their own assessments taking into consideration the nature of works.

4. AESTHETICS

Aesthetic considerations should form part of the design of slope access systems. The basic principle is to make components as inconspicuous as possible.

For steps and paths along the periphery of the slope, this could be achieved by recessing them into vegetated land or the ground. Figures 4.1 and 4.2 illustrate the idea.

A range of fencing options (Appendix B) and secondary fall-prevention measures (Appendix E) are not visible to people at the toe except for the brief period when they are in use. These include provisions for temporary fencing, folding fencing and independent lifeline for safety ropes. However, some of the folding fencing may still be regarded as visually intrusive when viewed from height on the opposite side of the slope.

From the operational and maintenance point of view, fixed fencing is the best. It could be visually conspicuous when viewed from the front. The effect could be particularly unfavourable for slopes that are not high, so that the fencing may appear to be out of proportion. Fixed fencing is much less an issue on slopes vegetated with shrubs or trees, Figure 4.3.

Fencing along maintenance access is subject to loading much less taxing than that of roadside fencing. It could be tailor-designed to be the least visible for the loading required. This would include the use of metal flats instead of the usual 50 mm tubes, and vertical members at wider spacing. Figure 4.4 simulates the visual effect of tailor-made fencing.

Matching the fencing form to the surrounding (Figure 4.5), planting shrubs at the front or recessing the permanent access into vegetated land (Figure 4.6) may also reduce the visual impact of fixed fencing.

Colour can further render fixed fencing and slope access less conspicuous. Avoid solid colour, even if they are green or brown. No vegetation is continuously solid green, and no soil or rock is continuously heavy brown. Bright and light colours that stand out against the background are also to be avoided. Fuzzy colours that average the surrounding may be more effective. Append I records the result of a trial by Highways Department on colour schemes.

Where gates are provided to keep out trespassers, they could be made less conspicuous by recessing from the slope toe or into vegetated land (Figure 4.7). They should likewise be fabricated from less substantial structural members.

Where possible, seek views from landscape architects on the design of slope access. If a permanent cat-ladder or stairway has to be provided on open slope, wall face or other prominent positions, consult a landscape architect.

5. SECURITY

People other than the maintenance personnel may trespass on the slope using the slope access. Entry points to permanent slope access should always be posted with warning signs against unauthorized entry.

Where the presence of the trespassers on the slope may risk their safety or intrude into the privacy of local residents, measures should be provided to discourage trespassing. An example of the former is where falling from over 2 m is possible for someone standing on the slope. This includes all cases for which fencing is needed but forms other than fixed fencing has been provided.

Where habitation exists at the immediate neighbourhood of a slope, and where anyone on the slope can see the activities on the habitation to an extent one could not otherwise see, trespasses may result in intrusion of privacy.

Measures to discourage trespass include provision of proper gates on strategic points of the primary access, and reducing the number of permanent links between the primary access and land accessible to the public. Figures 5.1 and 5.2 illustrate the general concept of reducing links. Figure 5.3 shows concealed entry point to the primary access which is therefore less likely to attract trespassing. Figure 5.4 is an example in which not extending the primary access to public footway could improve both the visual appeal and security against trespassing.

6. DESIGN OF PERMANENT ACCESS

Designing safe, visually pleasing permanent access that is secure against trespassing is an integrated process. Where possible, it should start with the design or revision of the surface drainage system.

Figure 6.1 summarises the main steps of designing permanent access.

From the operational and economic points of view, providing permanent access for maintenance is preferable. For a low slope in visually sensitive areas, permanent access may appear out of proportion and hence visually intrusive. If temporary access and static working platforms (Appendices C & D) can cover the whole slope and its surface drainage system, the higher operational cost and operational inconvenience of not providing permanent access might be justified on aesthetics ground.

Where there is conflict in demand among safety, visual quality and security, safety must take precedent.

7. MAINTENANCE ACCESS BEFORE CONSTRUCTION OF PERMANENT ACCESS

About fifty four thousand sizeable man-made slopes have been registered in Hong Kong. Government is responsible for the maintenance of about 70% of these. It takes time to design and provide permanent access to all. Many will be without permanent access for some time although the number will reduce rapidly with progress on the permanent works. For these slopes, ad hoc access such as temporary safe access (Appendix C), static working platform (Appendix D) and secondary fall-protection measures (Appendix E) will have to be used.

Aesthetics is not an issue with ad hoc access. Security against trespassing should be

provided to the extent appropriate for construction activities. Highways Department (2001b) describes in detail the use and choice of ad-hoc access. Users should refer to the document for guidance.

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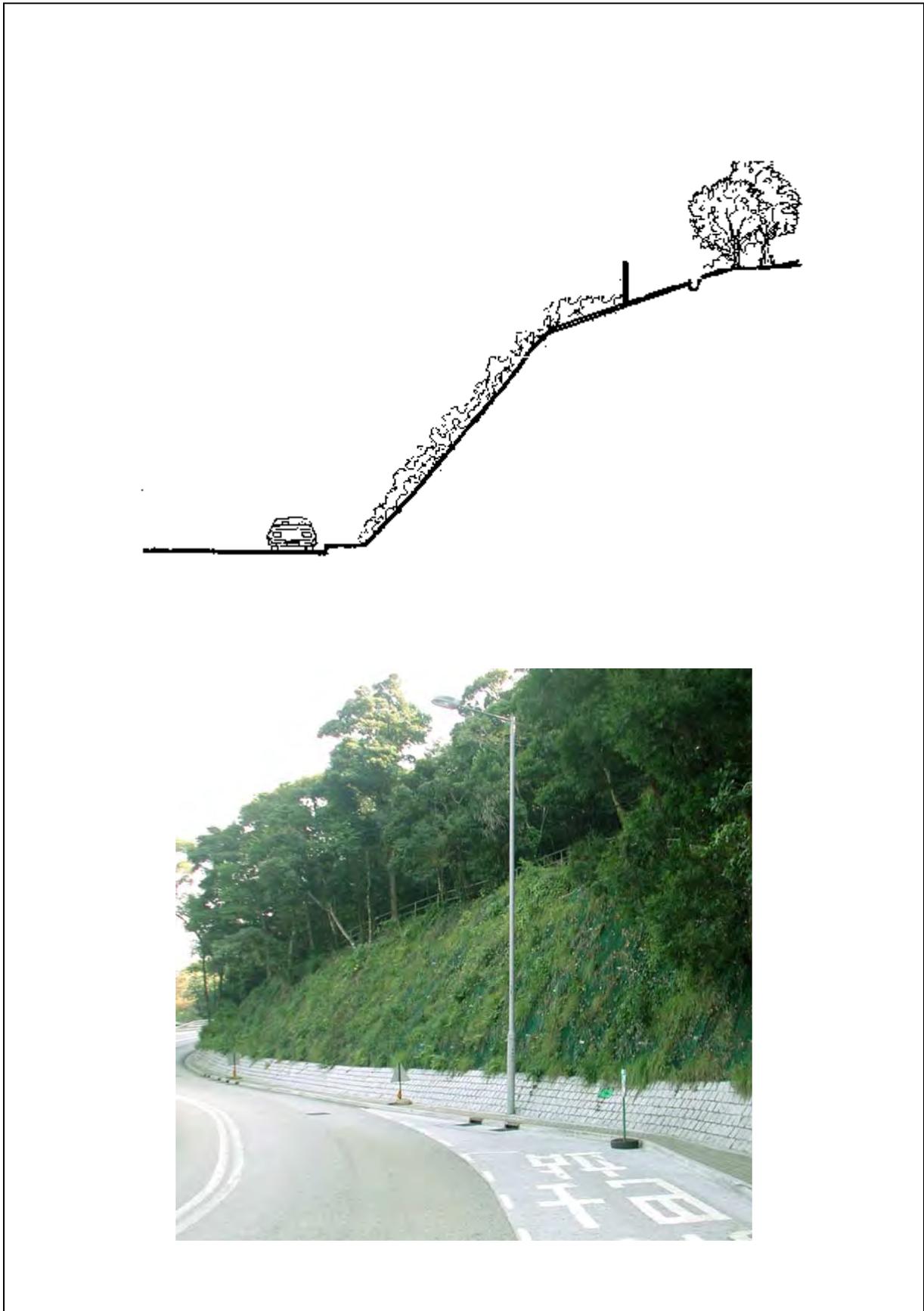
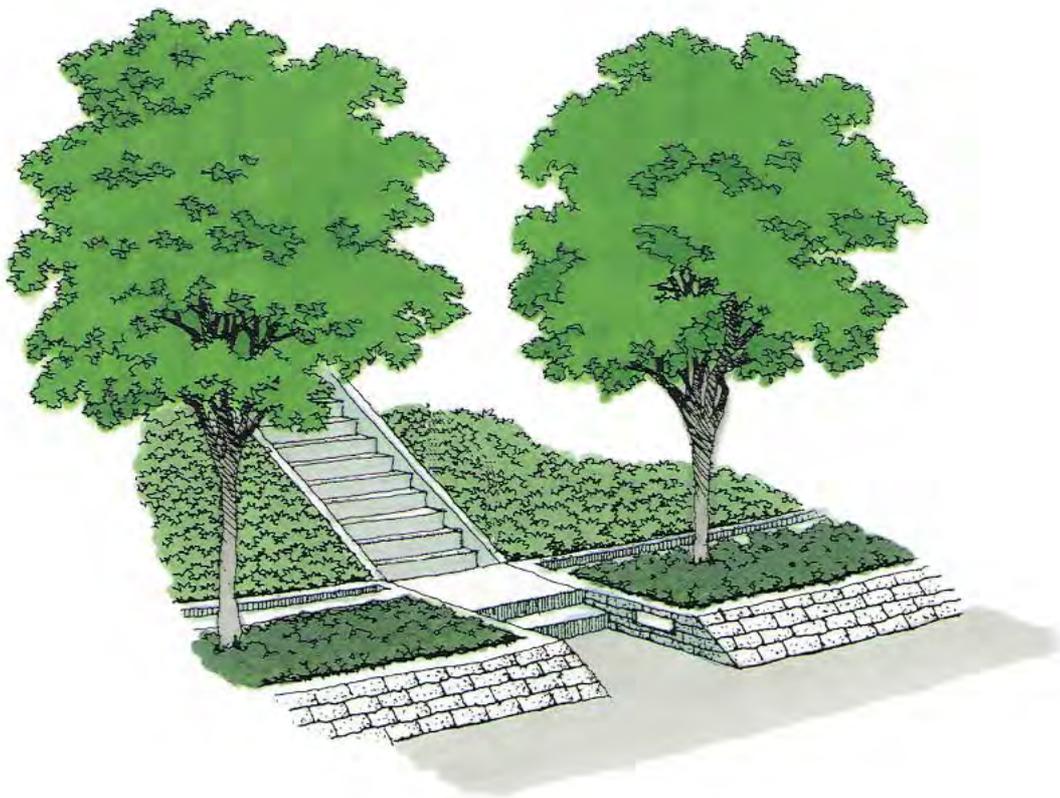


Figure 4.1 - Access Recessed into Vegetated Land



Note: Figure extracted from GEO Publication No. 1/2000.

Figure 4.2 - Access Recessed into the Ground



Figure 4.3 - Fixed Fencing Not Apparent on Vegetated Slope



Conventional Fencing Using 50 mm Diameter Tubing



Fencing Using Thin-section Members are Less Eye-catching
(Computer Simulation)

Note: See Figure B1 for Fencing Design Standards.

Figure 4.4 - Tailor-designed Fencing for Slope Access

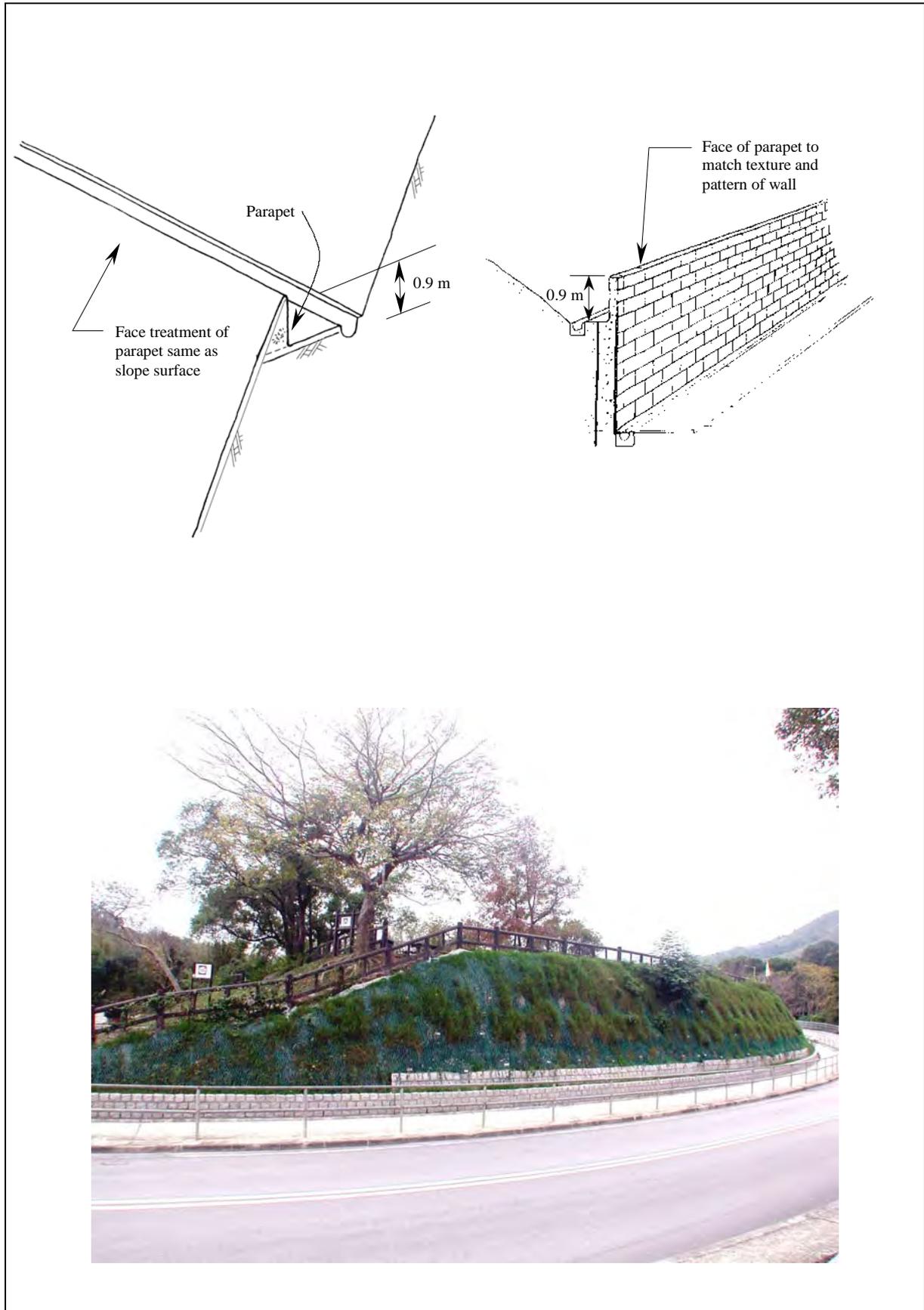
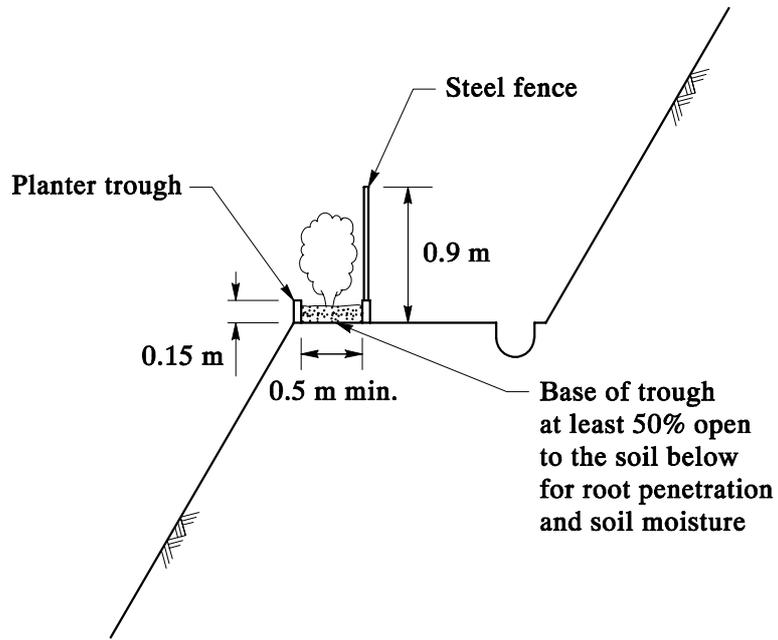


Figure 4.5 - Fencing Matching Surrounding



Planting to Obscure Fencing



Fencing Recessed into Vegetated Land

Figure 4.6 - Fencing Obscured by Vegetation



Figure 4.7 - Security Gate Recessed into Vegetated Land



Primary Access Detached from Public Path at One End

Figure 5.1 - Improving Security Against Trespassing - I

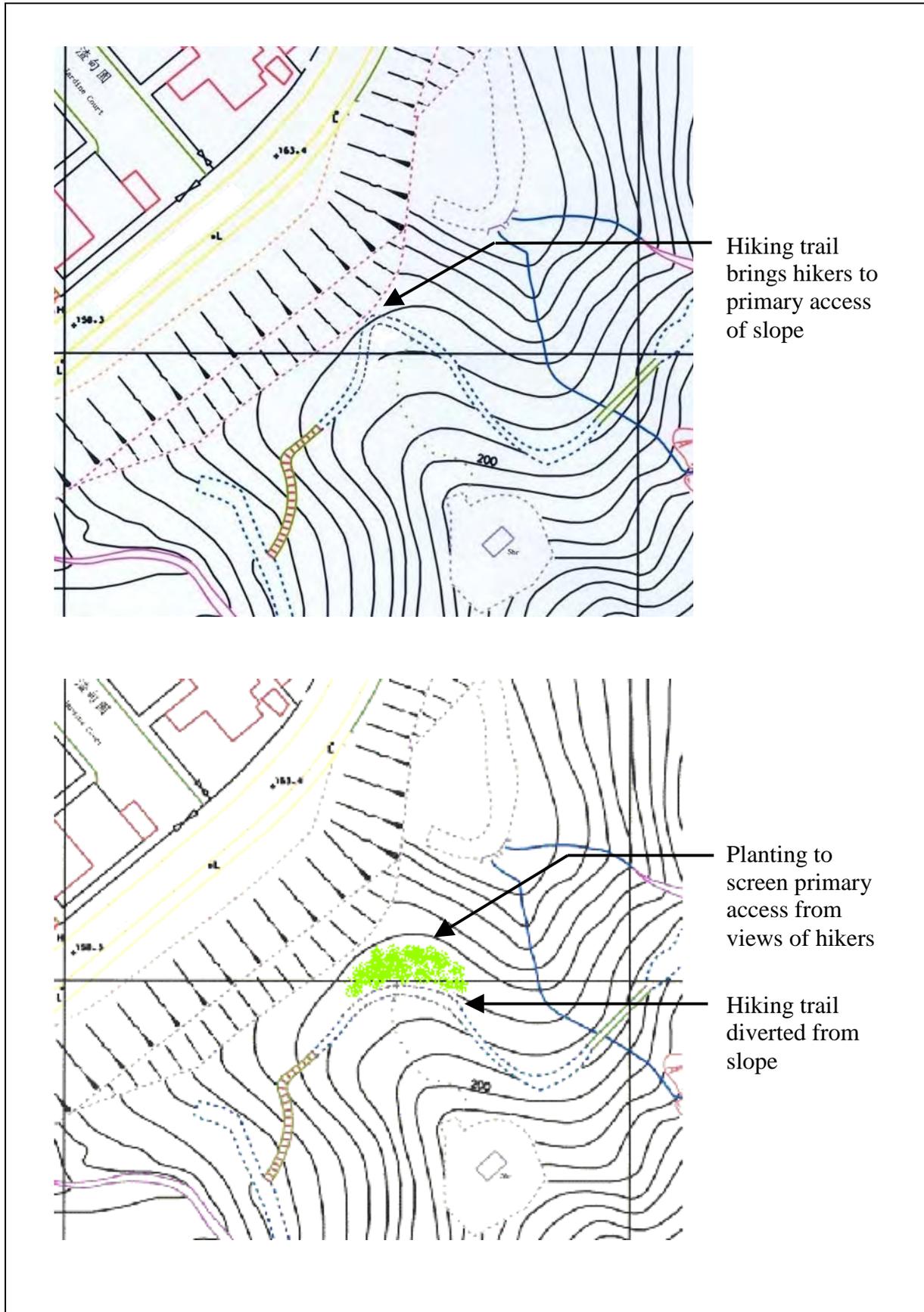
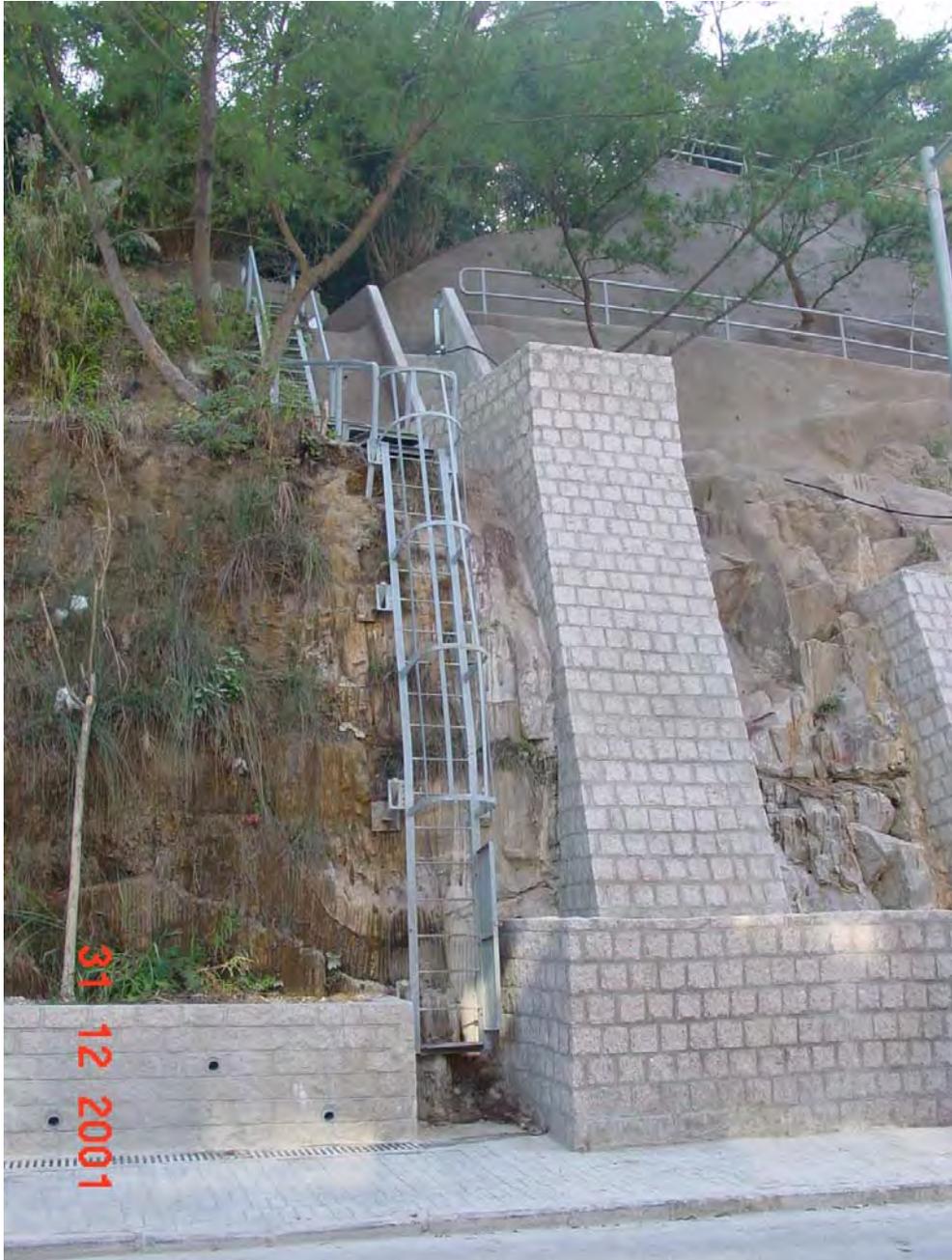


Figure 5.2 - Improving Security Against Trespassing - II



Concealed Interception of Primary Access with Public Path

Figure 5.3 - Improving Security Against Trespassing - III



Visual Appearance and Security Against Trespassing Could Be Improved by Using Ad Hoc Access Instead of Providing the Cat-ladder

Figure 5.4 - Improving Security Against Trespassing - IV

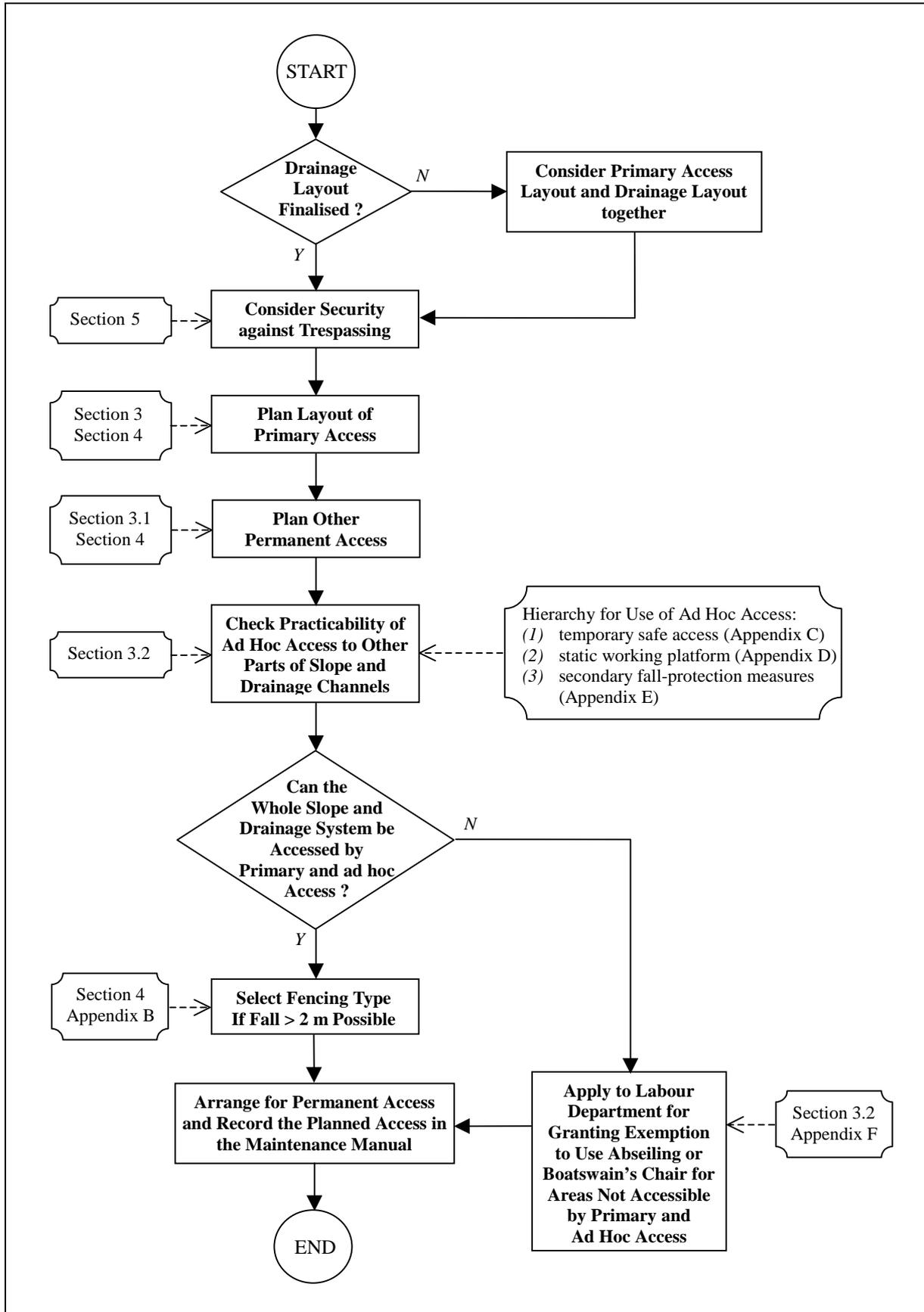


Figure 6.1 - Design of Permanent Access

APPENDIX A

A BRIEF SUMMARY OF CONSTRUCTION SAFETY LEGISLATION
IN HONG KONG

SAFETY LEGISLATION IN HONG KONG

In Hong Kong, provisions of safe working practices are set down in law in the Occupational Safety and Health Ordinance, Cap 509 (OSHO) and the Factories & Industrial Undertakings Ordinance, Cap 59 (FIUO), and their respective subsidiary regulations.

The OSHO provides general requirements for a duty of care on the part of the employer to safeguard as far as reasonably practicable the safety and health of its staff. It covers any workplace.

The FIUO stipulates detailed safety and health standards for the industrial sector, which includes construction works. The Ordinance defines “construction works” as being “the construction, erection, installation, reconstruction, repair, ... of any structure or works specified in the Third Schedule”. The Third Schedule includes the term “road” and “drainage” but does not specifically refer to slopes.

The Construction Sites (Safety) Regulations (CSSR) is a subsidiary regulation of the FIUO. It contains several regulations related to slope works:

Regulation 38B(1) states that “the contractor responsible for any construction site shall take adequate steps to prevent any person on the site from falling a height of 2 metres or more”.

Regulation 38(B)(2) states that “ ‘adequate steps’ shall include the provision, use and maintenance of one or more of the following-

- (a) working platforms;
- (b) guards rails, barrier, toe-boards and fences;
- (c) coverings for openings;
- (d) gangways and runs”.

Regulation 38(G) states that “the contractor responsible for a construction site shall ensure that no boatswain chair or similar plant (not being a boatswain’s chair or similar plant or equipment which is raised or lowered by a power-driven lifting appliance) is used on the site”.

The interpretation and implications of relevant safety legislation with respect to slope inspection and maintenance works were reviewed during the Highways Department consultancy study (Agreement No. HKR 1/2000). Salient points are extracted from the reports as follows:

“Binding and Non-Binding Legislation

The General Clause Ordinance, CAP 1 states that “no Ordinance...shall...be binding on the State unless it is therein expressly provided...that the State is bound thereby.”

The OSHO expressly states that “this Ordinance binds the Government”. The FIUO contains no such declaration and therefore neither the FIUO nor CSSR(Amendment) expressly binds the government. However, the General Regulations Chapter IV

Clause 700 states that “... government workshops ... should, nevertheless, conform in all respects to ... the Ordinance and subsidiary legislation”. Hence, the FIUO and the CSSR(Amendment) do not expressly bind the government but the government is required to comply them.”

“Maintenance Works are Interpreted as Being Construction Works

The definition of construction works includes the construction and maintenance of specified works in the Third Schedule of the FIUO. The Schedule includes ‘roads’ and ‘drainage’ but does not specifically refer to slopes. However, maintaining roads is considered to include implicitly the maintaining of the adjoining slopes and maintaining slope drainage is considered to be covered by the term ‘drainage’. Therefore, maintenance works are construction works.”

“Inspection is Interpreted as Being Construction Works

Inspection is merely a visual survey and involves no work to the slope. In isolation, such work is not covered by the definition of construction work. However, the Labour Department views inspection and maintenance works as being dependent and interrelated to each other. In their view, inspection leads to maintenance works and therefore both are indispensable to the process of slope maintenance works. Consequently, both inspection and maintenance works are construction works in the opinion of Labour Department, even though inspection involves no work on the slope.”

“Working at Height on Slopes

If the worker is liable to fall 2 m or more, he is working at height and subject to the risk of fall. However, if the worker is on sloping ground it is debatable whether such a worker is operating at height. The issue of what constitutes working at height on sloping ground is complex. Factors influencing it include slope angle; height of the operation above the toe; slope surface cover, the availability of suitable footholds; the nature of the hazards posed by the slope surface and the toe after a fall.”

“Use of Rope Access

The CSSR (Amendment) states that the practicability of using working platforms, guard rails, etc. should be explored first. Working platform can include a scaffold platform, suspended working platform or mobile platform for example. Where the provision of a working platform is not practicable, the use of safety net and safety belt can be considered in accordance with Regulation 38H of the CSSR(Amendment). Finally, in special circumstances, a boatswain’s chair or similar equipment can be used but only when exemption from Regulation 38(G) of the CSSR(Amendment) has been granted by the Labour Department.

Exemption is only applicable if the use of working platforms, guard rails, safety belts and safety nets is impracticable. Primary factors for consideration of exemption include:

- (1) use of other equipment is impracticable;
- (2) work duration very short;
- (3) emergency situations; and
- (4) security considerations.

Rope access is similar equipment to a boatswain chair if 'such rope access equipment is used solely to support the entire weight of the worker, or to facilitate the worker to gain access to or egress from a workplace, in the course of work. Other uses of rope access, such as to use it to enhance positioning or as a secondary fall protection, will render it not as similar equipment to boatswain chair. The question of exemption, under such circumstances, will not apply'.

The Labour Department requires that the determination of when rope access is similar to a boatswain's chair to be made on a slope-by-slope basis. They do not accept, as a permanent measure, the adoption of a single, benchmark slope angle to serve as such a definition. The factors affecting whether the rope is or is not similar equipment to a boatswain's chair include:

- a. the presence of adequate footholds;
- b. the nature of the slope surface (sprayed concrete, grass, trees, etc.); and
- c. the nature of the equipment and the type of works to be carried out."

APPENDIX B
FENCING TYPES FOR PERMANENT ACCESS

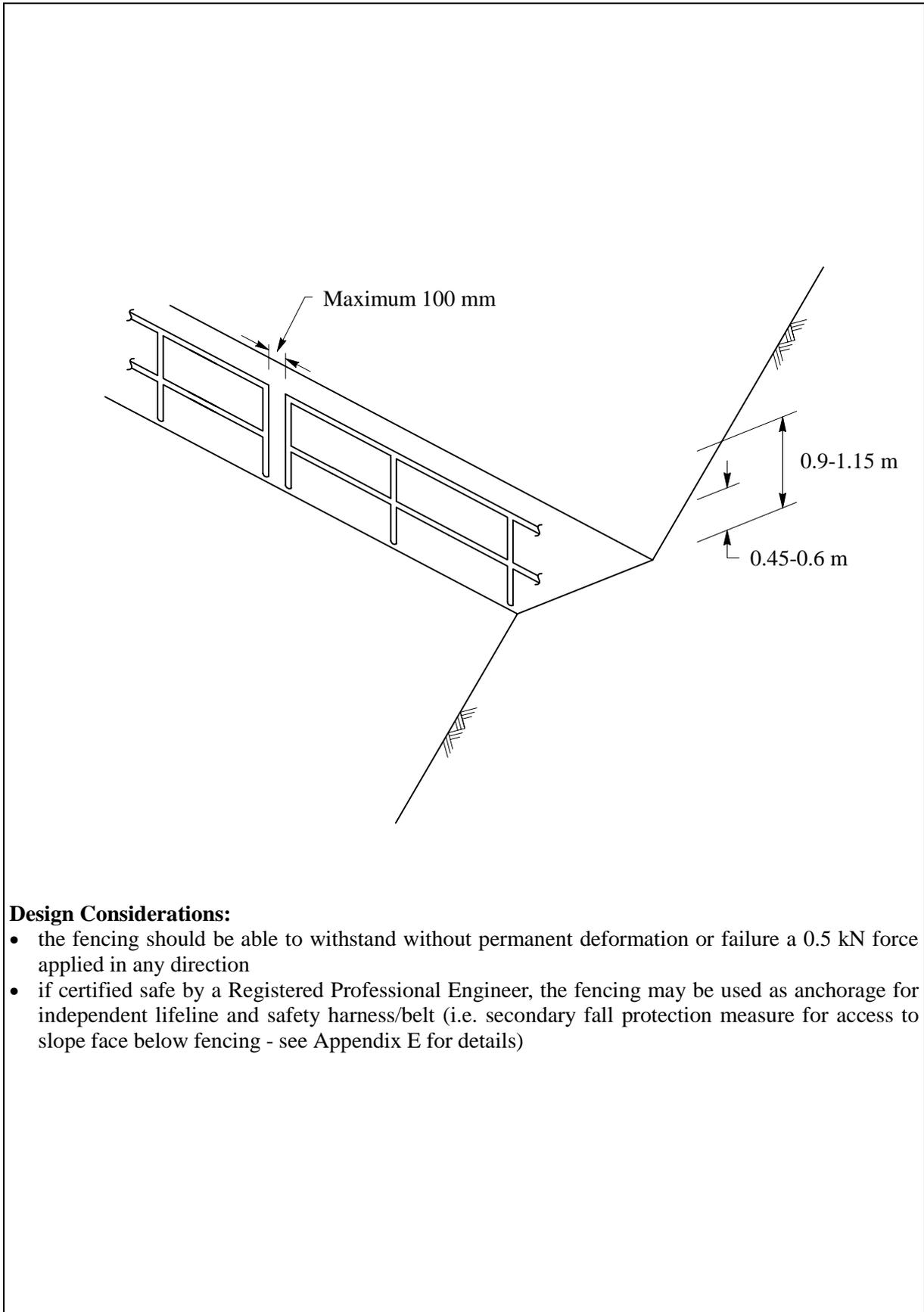
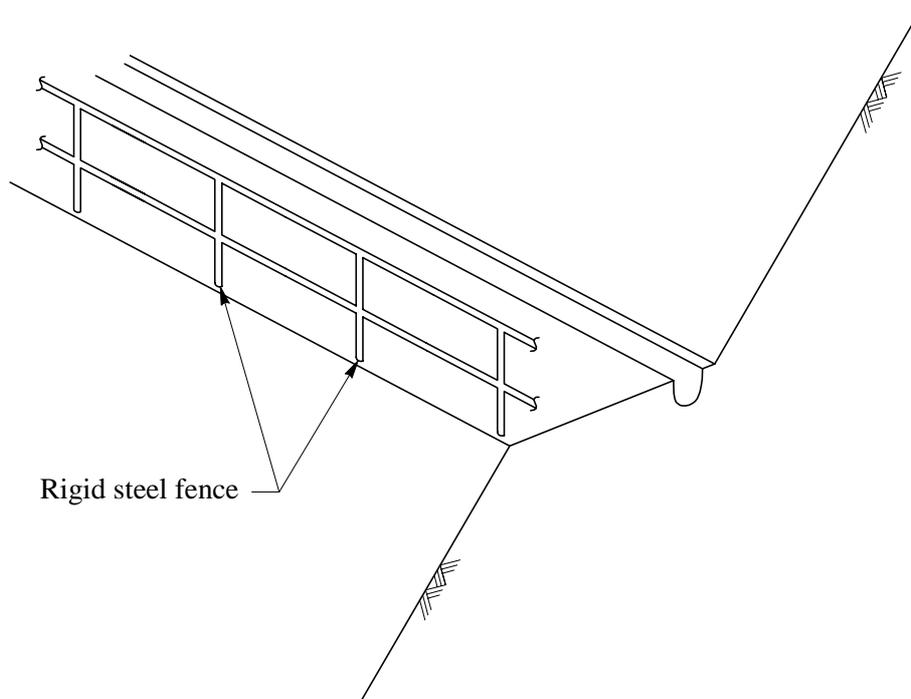


Figure B1 - Fencing Design Standards



General Descriptions/Applications:

- to render working platform safe for inspection and maintenance works

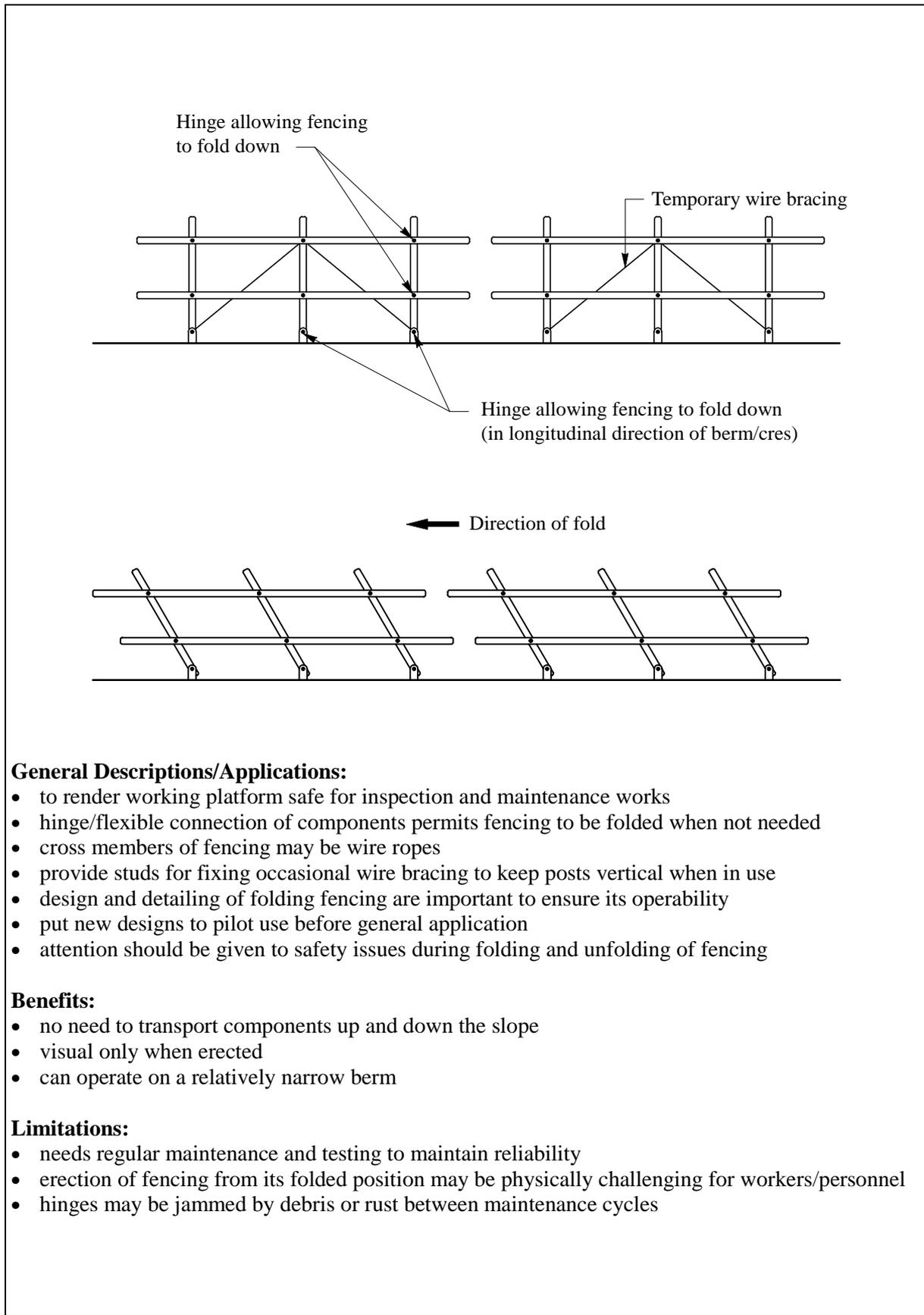
Benefits:

- most convenient to personnel
- minimal maintenance requirement

Aesthetic Considerations:

- visually more intrusive than other forms of fencing
- remedies include:
 - recessing fencing into vegetated land (Figure 4.6)
 - optimise size of members (such as using thin-section metalwork)
 - use open structure
 - matching fencing to the environment
 - colouring

Figure B2 - Fixed Fencing



General Descriptions/Applications:

- to render working platform safe for inspection and maintenance works
- hinge/flexible connection of components permits fencing to be folded when not needed
- cross members of fencing may be wire ropes
- provide studs for fixing occasional wire bracing to keep posts vertical when in use
- design and detailing of folding fencing are important to ensure its operability
- put new designs to pilot use before general application
- attention should be given to safety issues during folding and unfolding of fencing

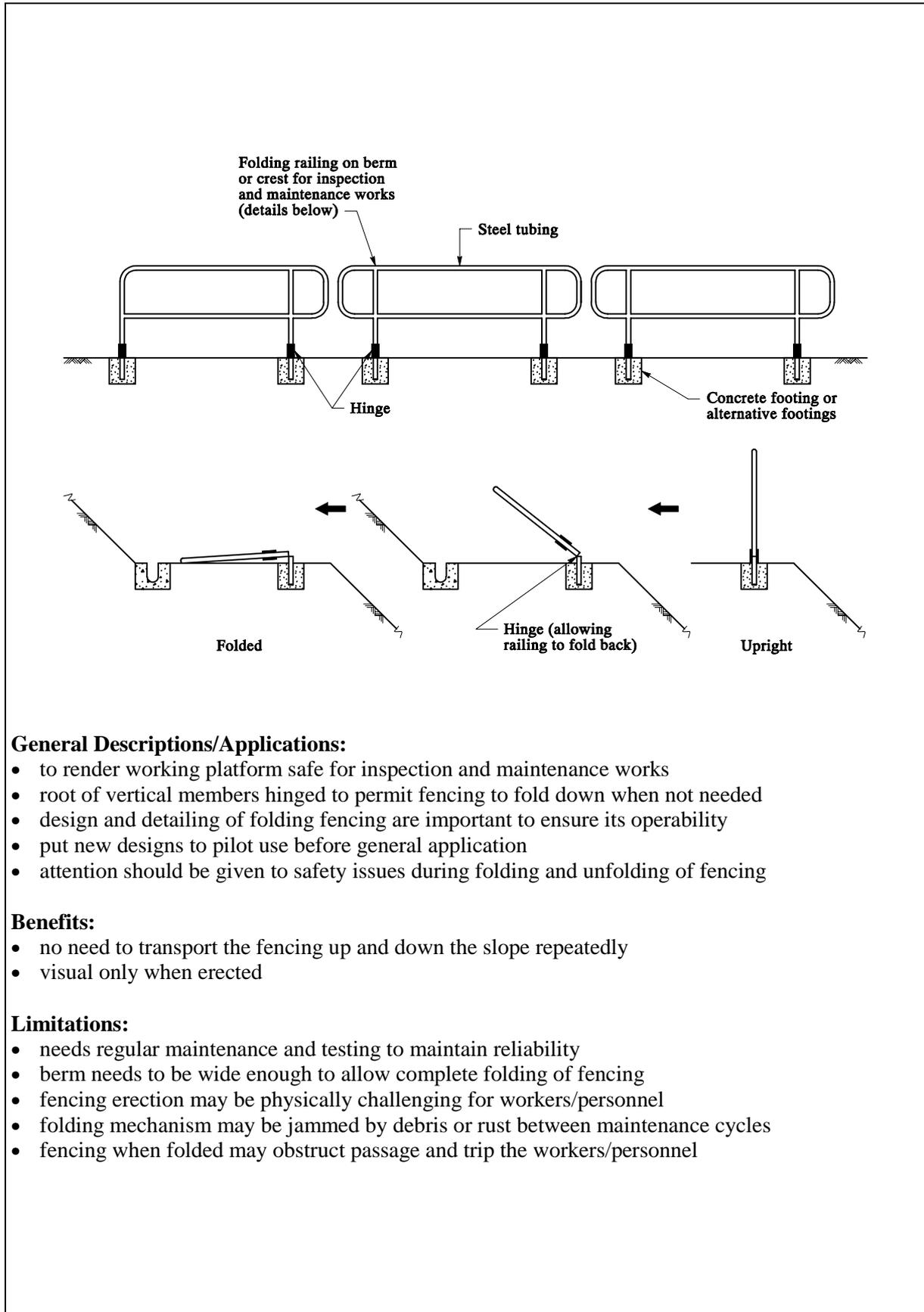
Benefits:

- no need to transport components up and down the slope
- visual only when erected
- can operate on a relatively narrow berm

Limitations:

- needs regular maintenance and testing to maintain reliability
- erection of fencing from its folded position may be physically challenging for workers/personnel
- hinges may be jammed by debris or rust between maintenance cycles

Figure B3.1 - Folding Fencing (Option 1)



General Descriptions/Applications:

- to render working platform safe for inspection and maintenance works
- root of vertical members hinged to permit fencing to fold down when not needed
- design and detailing of folding fencing are important to ensure its operability
- put new designs to pilot use before general application
- attention should be given to safety issues during folding and unfolding of fencing

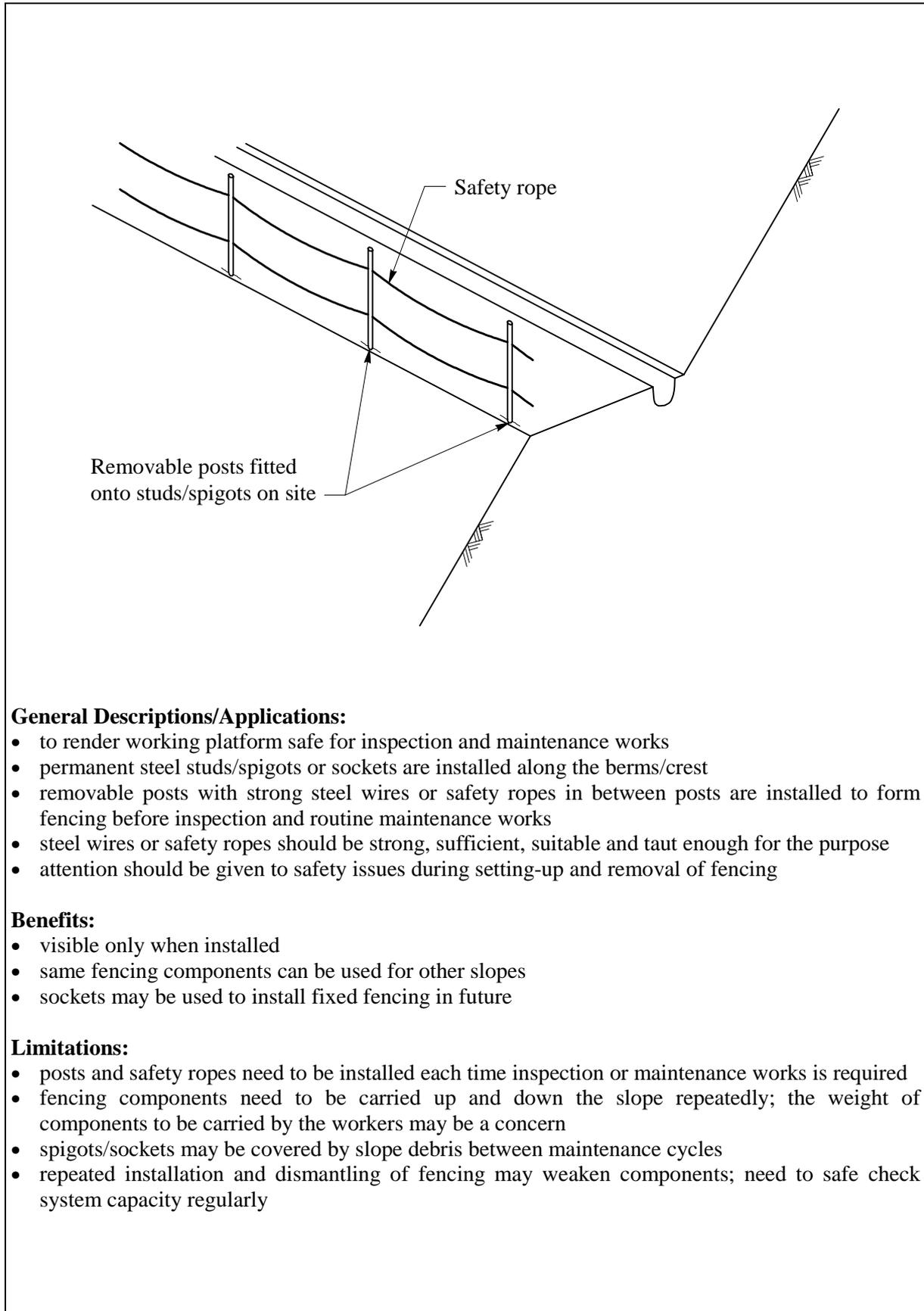
Benefits:

- no need to transport the fencing up and down the slope repeatedly
- visual only when erected

Limitations:

- needs regular maintenance and testing to maintain reliability
- berm needs to be wide enough to allow complete folding of fencing
- fencing erection may be physically challenging for workers/personnel
- folding mechanism may be jammed by debris or rust between maintenance cycles
- fencing when folded may obstruct passage and trip the workers/personnel

Figure B3.2 - Folding Fencing (Option 2)



General Descriptions/Applications:

- to render working platform safe for inspection and maintenance works
- permanent steel studs/spigots or sockets are installed along the berms/crest
- removable posts with strong steel wires or safety ropes in between posts are installed to form fencing before inspection and routine maintenance works
- steel wires or safety ropes should be strong, sufficient, suitable and taut enough for the purpose
- attention should be given to safety issues during setting-up and removal of fencing

Benefits:

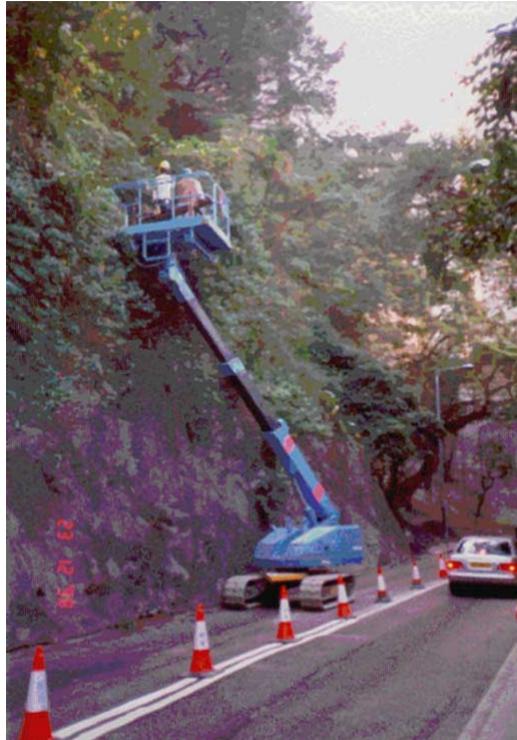
- visible only when installed
- same fencing components can be used for other slopes
- sockets may be used to install fixed fencing in future

Limitations:

- posts and safety ropes need to be installed each time inspection or maintenance works is required
- fencing components need to be carried up and down the slope repeatedly; the weight of components to be carried by the workers may be a concern
- spigots/sockets may be covered by slope debris between maintenance cycles
- repeated installation and dismantling of fencing may weaken components; need to safe check system capacity regularly

Figure B4 - Removable Fencing

APPENDIX C
TEMPORARY SAFE ACCESS



General Descriptions/Applications:

- can be truck-mounted, trailer-mounted or self-propelled (see Figure C1.2)
- very versatile for slope inspection and minor maintenance works
- load carrying capacity of the platform generally limited to between 200 kg and 250 kg

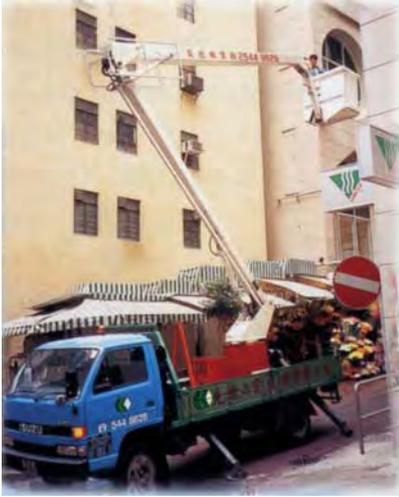
Benefits:

- avoids erection of scaffolds, platform or ladder
- system is mobile and can be set up quickly
- inspection/minor maintenance works may be carried out from the platform
- can operate easily over uneven slope surfaces
- minimises duration of occupying the toe area (desirable where road closure is a concern)

Limitations:

- vehicular access to slope toe is required
- a safe working area is required at the slope toe
- limited outreach and working height limit the range of slopes on which the platform can be used (see Figure C1.3)
- most models have to work on level ground
- may not reach some parts of the slope if obstructed, e.g. by vegetation
- heavily blocked channels may be difficult to clear from the platform

Figure C1.1 - Mobile Hydraulic Platform



Truck-mounted Mobile Hydraulic Platform



Self-propelled Mobile Hydraulic Platform



Trailer-mounted Mobile Hydraulic Platform

Figure C1.2 - Various Types of Mobile Hydraulic Platform

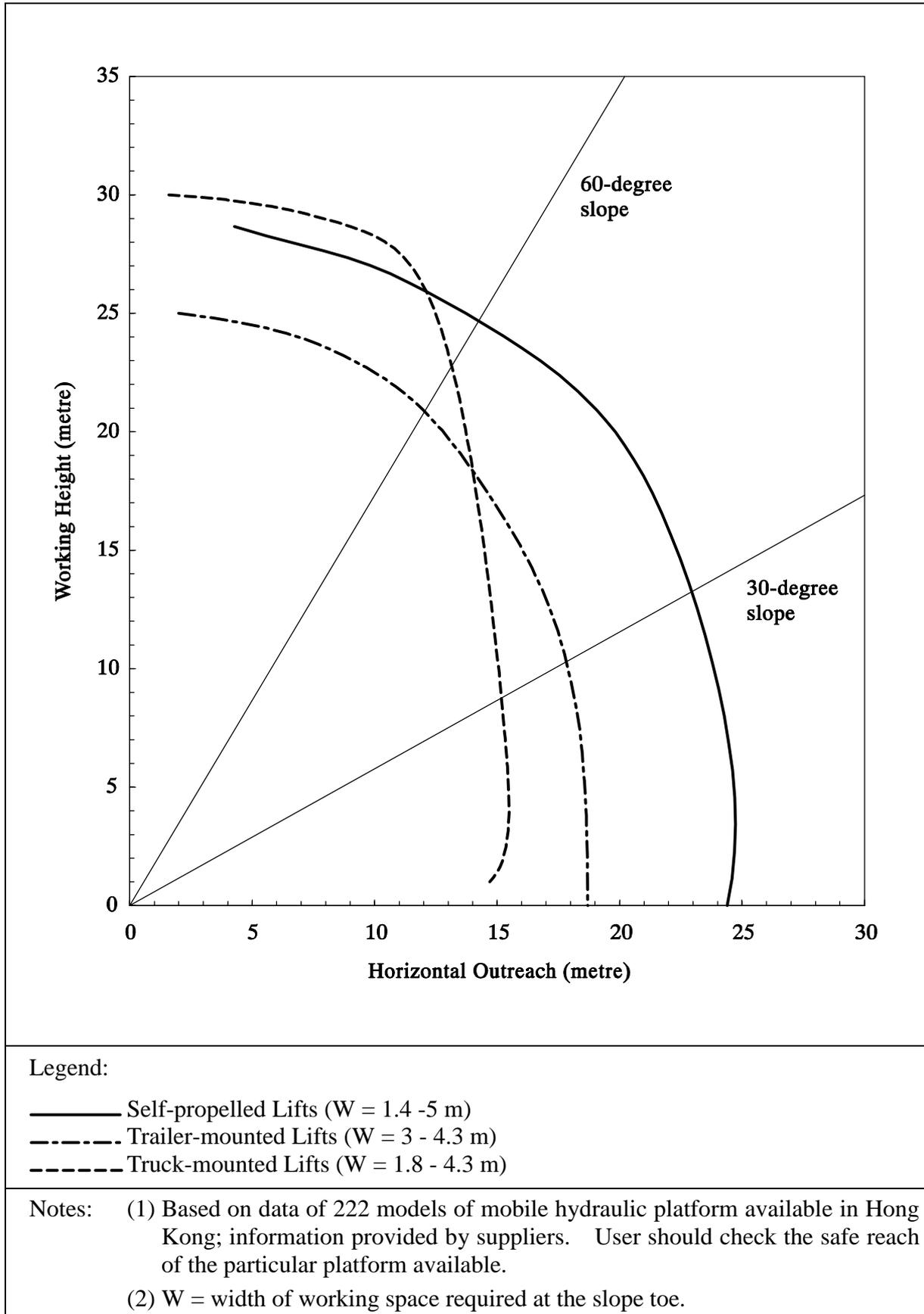
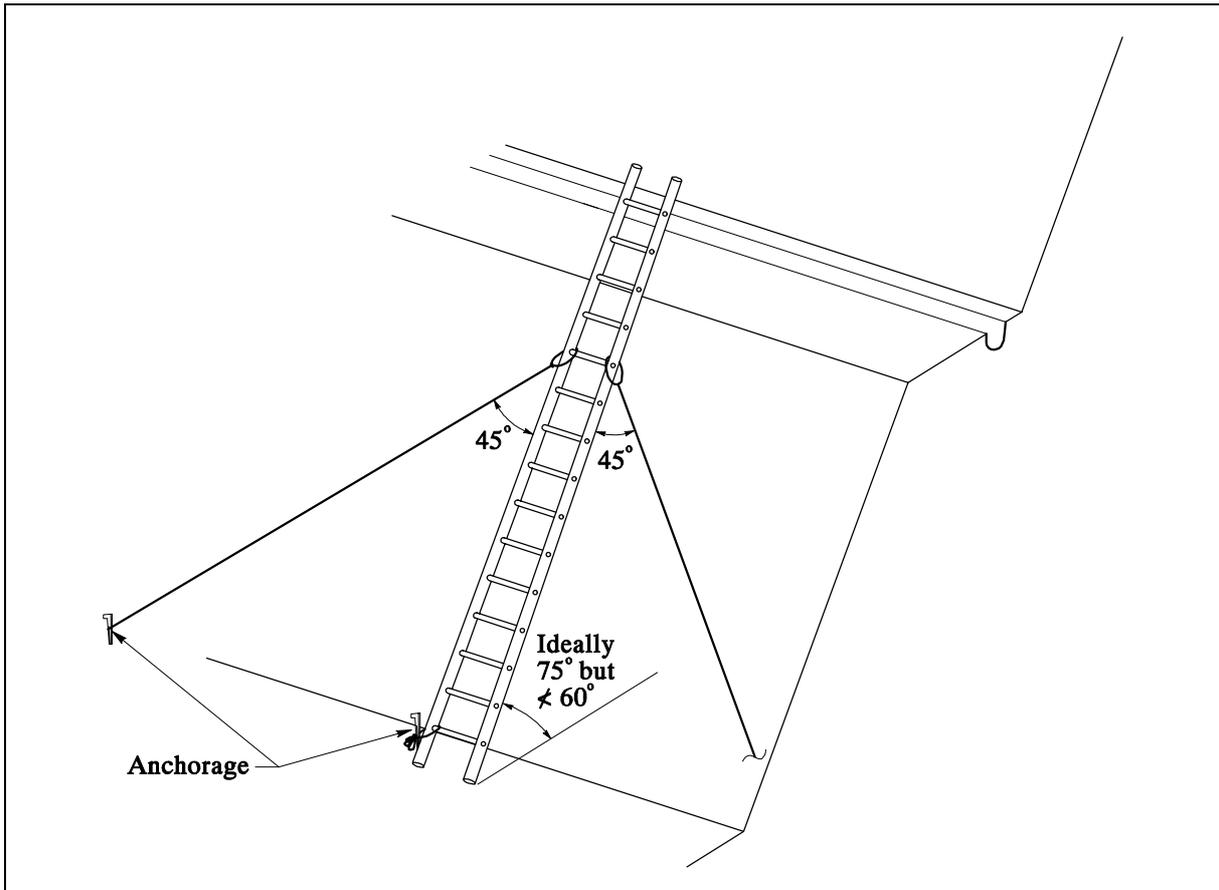


Figure C1.3 - Limit of Reach of Mobile Hydraulic Platforms



General Descriptions/Applications:

- for gaining access to particular points on slope
- difficult for use on berm, more appropriate for use from toe
- can be used for inspection but should not be used as a place of works
- telescopic ladders for higher reach are available
- important to secure the ladder at the toe and at the top (or near the top)
- sufficient foothold and handhold should be provided
- workers using ladders should be equipped with a suitable fall arresting system, such as safety harness/belt with proper anchorage, as suggested in the “Guidance Notes on Classification and Use of Safety Belt and their Anchorage Systems” published by Labour Department (1998)
- refer to Sections 2.2.6 and 7.5 of the “Construction Site Safety Handbook” published by Works Bureau (2000) for more detailed guidance on the use of ladder and fall protection

Benefits:

- mobile and adaptable
- convenient to be erected from berms and slope toe

Limitations:

- reach of a ladder is fairly limited (maximum reach is typically about 4 m to 5 m)
- a ladder should be operated by a team of at least 2 persons
- when used on berms, special provision such as a stopper or recess at the toe of the ladder should be considered

Figure C2 - Temporary Ladder



General Descriptions/Applications:

- for gaining access to particular points on slopes
- can only be used for inspection and should not be used as a place of works
- sufficient foothold and handhold should be provided
- Civil Engineering Department Standard Drawing No. C2504A shows typical details
- scaffolds and platforms should comply with the Code of Practice for Metal Scaffolding Safety and the Code of Practice for Bamboo Scaffolding Safety issued by Labour Department

Benefits:

- adaptable

Limitations:

- erection takes some time and effort
- normally erected as part of scaffolding

Figure C3 - Temporary Stairway

APPENDIX D
STATIC WORKING PLATFORM



General Descriptions/Applications:

- provides a safe working platform for inspection and maintenance works
- suitable fencing including top and intermediate horizontal members and toe-boards should be provided
- scaffolds or scaffold platforms need to be inspected by a competent person as required under Regulation 38F of CSSR(Amendment)

Benefits:

- can provide access to a large area of the slope
- can be erected over undulating slope face
- platform level easy to adjust
- no long-term visual impact

Limitations:

- requires a sizable area at the slope toe
- may occupy the toe area for an extended period of time (undesirable where road closure is a concern)

Figure D1 - Double Row Scaffold with Working Platform



General Descriptions/Applications:

- provides a safe working platform for inspection and maintenance works
- suitable fencing including top and intermediate horizontal members and toe-boards should be provided
- scaffolds or scaffold platforms need to be inspected by a competent person as required under Regulation 38F of CSSR(Amendment)
- should comply with the Code of Practice for Metal Scaffolding Safety and the Code of Practice for Bamboo Scaffolding Safety issued by Labour Department

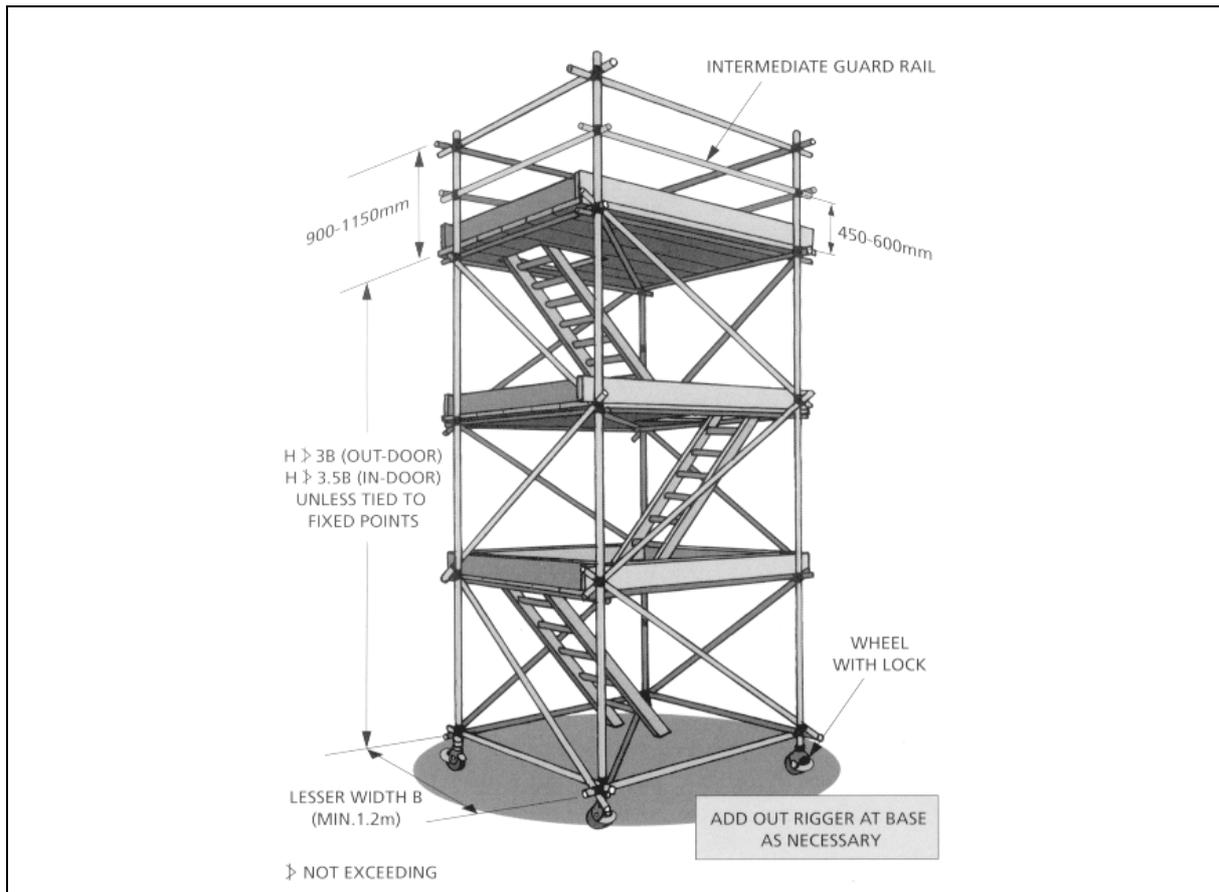
Benefits:

- requires relatively small working space at slope toe
- can be set up/moved around quickly over different areas of the slope
- platform can be accessed from both slope toe and crest
- no long-term visual impact

Limitations:

- can access only relatively small areas of the slope at any time
- temporary stairway usually needed for reaching truss-out platform
- may be difficult to set up if slope surface is undulated or obstructed by vegetation

Figure D2 - Single Row Scaffold with Truss-out Working Platform



(Diagram extracted from Construction Site Safety Handbook (Works Bureau, 2000))

General Descriptions/Applications:

- provides a safe working platform for inspection and minor maintenance works
- needs to be inspected by a competent person as required under Regulation 38F of CSSR(Amendment)
- refer to Section 2.2.4 of “Construction Site Safety Handbook” published by Works Bureau (2000) for more details on safety requirements
- height of toe-boards should be not less than 200 mm
- should comply with the Code of Practice for Metal Scaffolding Safety and the Code of Practice for Bamboo Scaffolding Safety issued by Labour Department

Benefits:

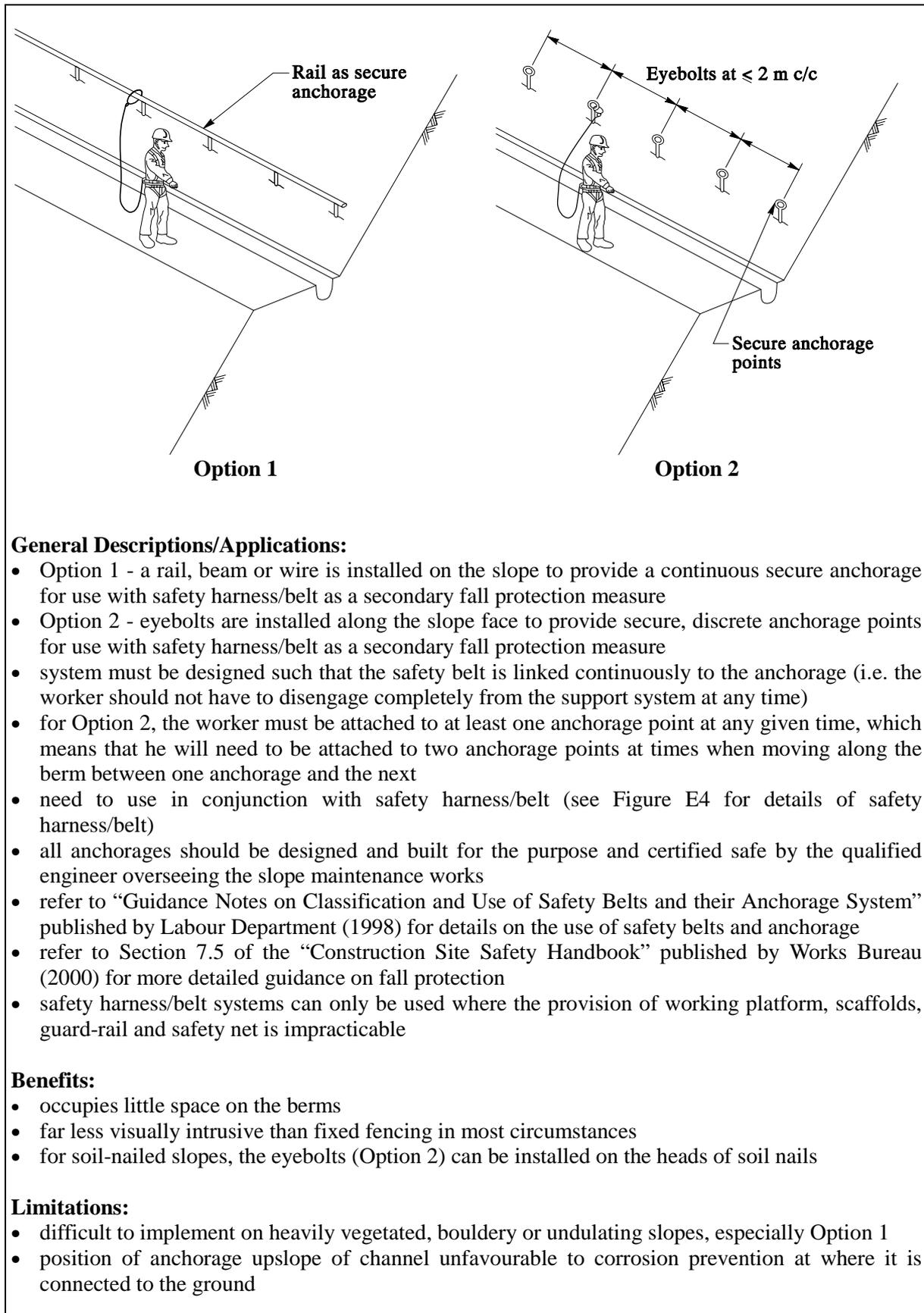
- can be set up/moved around quickly for accessing steep slope and wall
- wide range of systems available
- no long-term visual impact

Limitations:

- only suitable for vertical and sub-vertical faces
- can access only a small area of the wall/slope face at any time
- needs firm and horizontal ground at toe of wall/slope face

Figure D3 - Scaffold Tower (for Sub-vertical Slopes and Retaining Walls)

APPENDIX E
SECONDARY FALL-PROTECTION MEASURES



General Descriptions/Applications:

- Option 1 - a rail, beam or wire is installed on the slope to provide a continuous secure anchorage for use with safety harness/belt as a secondary fall protection measure
- Option 2 - eyebolts are installed along the slope face to provide secure, discrete anchorage points for use with safety harness/belt as a secondary fall protection measure
- system must be designed such that the safety belt is linked continuously to the anchorage (i.e. the worker should not have to disengage completely from the support system at any time)
- for Option 2, the worker must be attached to at least one anchorage point at any given time, which means that he will need to be attached to two anchorage points at times when moving along the berm between one anchorage and the next
- need to use in conjunction with safety harness/belt (see Figure E4 for details of safety harness/belt)
- all anchorages should be designed and built for the purpose and certified safe by the qualified engineer overseeing the slope maintenance works
- refer to “Guidance Notes on Classification and Use of Safety Belts and their Anchorage System” published by Labour Department (1998) for details on the use of safety belts and anchorage
- refer to Section 7.5 of the “Construction Site Safety Handbook” published by Works Bureau (2000) for more detailed guidance on fall protection
- safety harness/belt systems can only be used where the provision of working platform, scaffolds, guard-rail and safety net is impracticable

Benefits:

- occupies little space on the berms
- far less visually intrusive than fixed fencing in most circumstances
- for soil-nailed slopes, the eyebolts (Option 2) can be installed on the heads of soil nails

Limitations:

- difficult to implement on heavily vegetated, bouldery or undulating slopes, especially Option 1
- position of anchorage upslope of channel unfavourable to corrosion prevention at where it is connected to the ground

Figure E1 - Anchorage Rail/Wire and Anchorage Points Systems

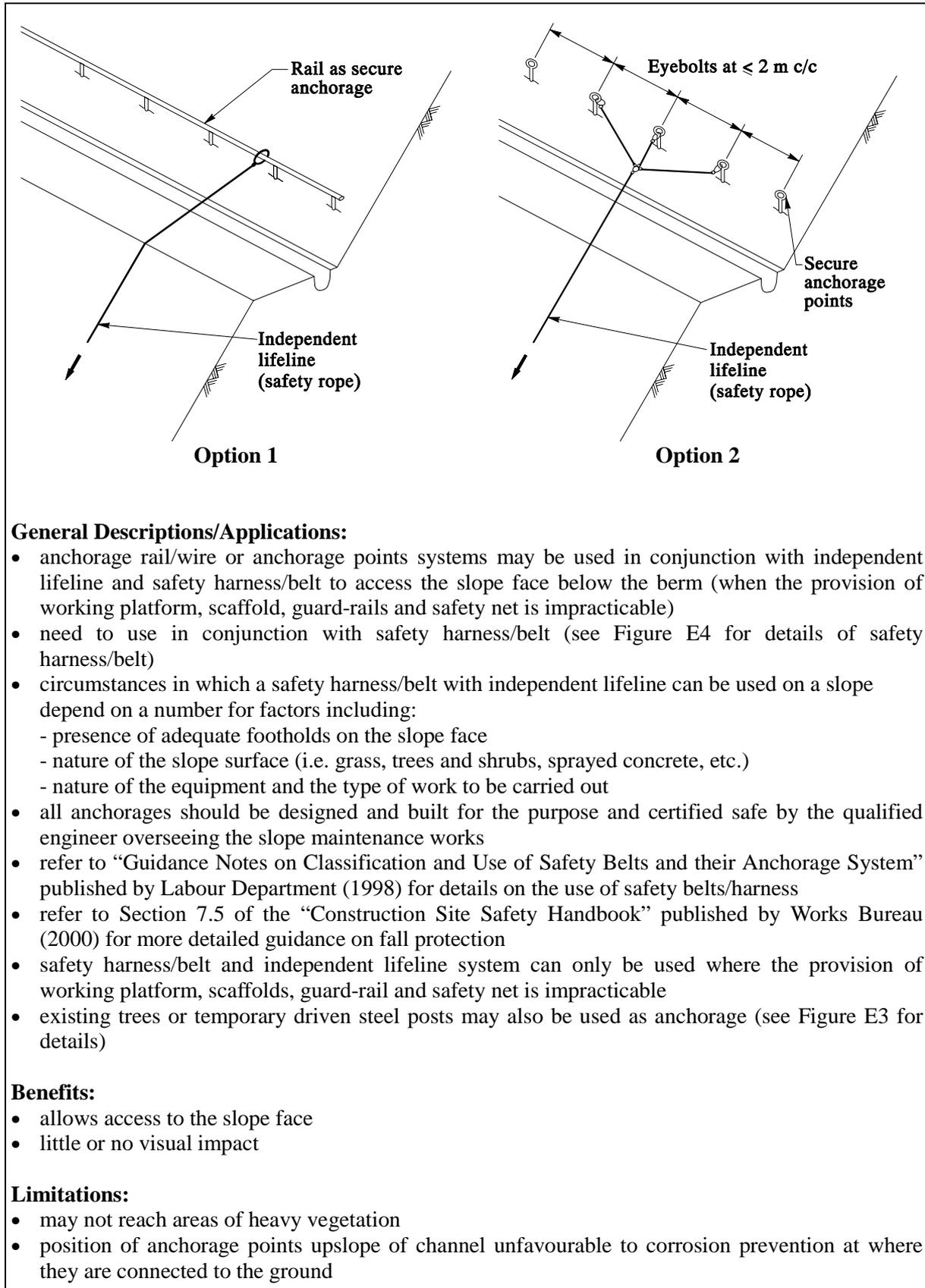
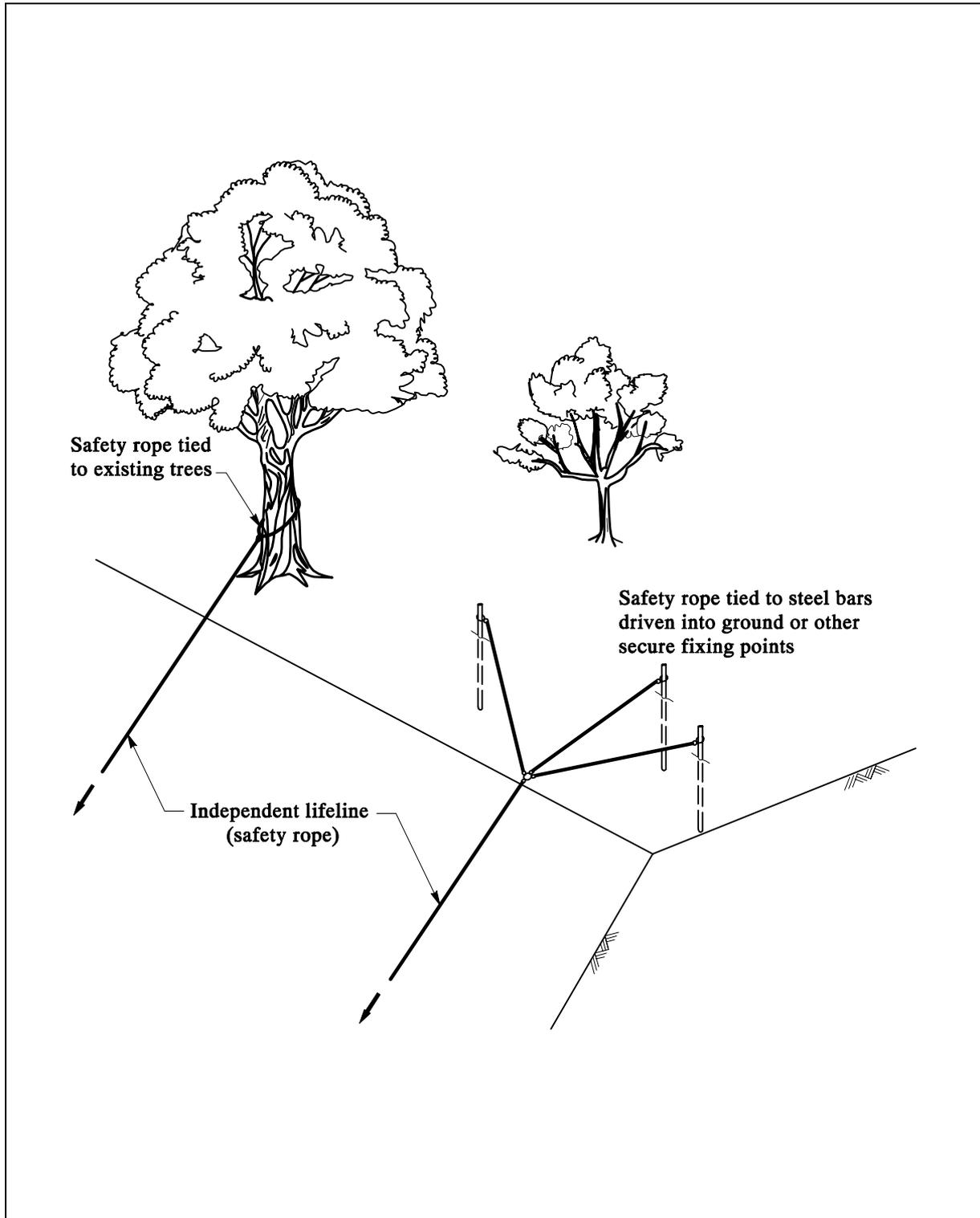
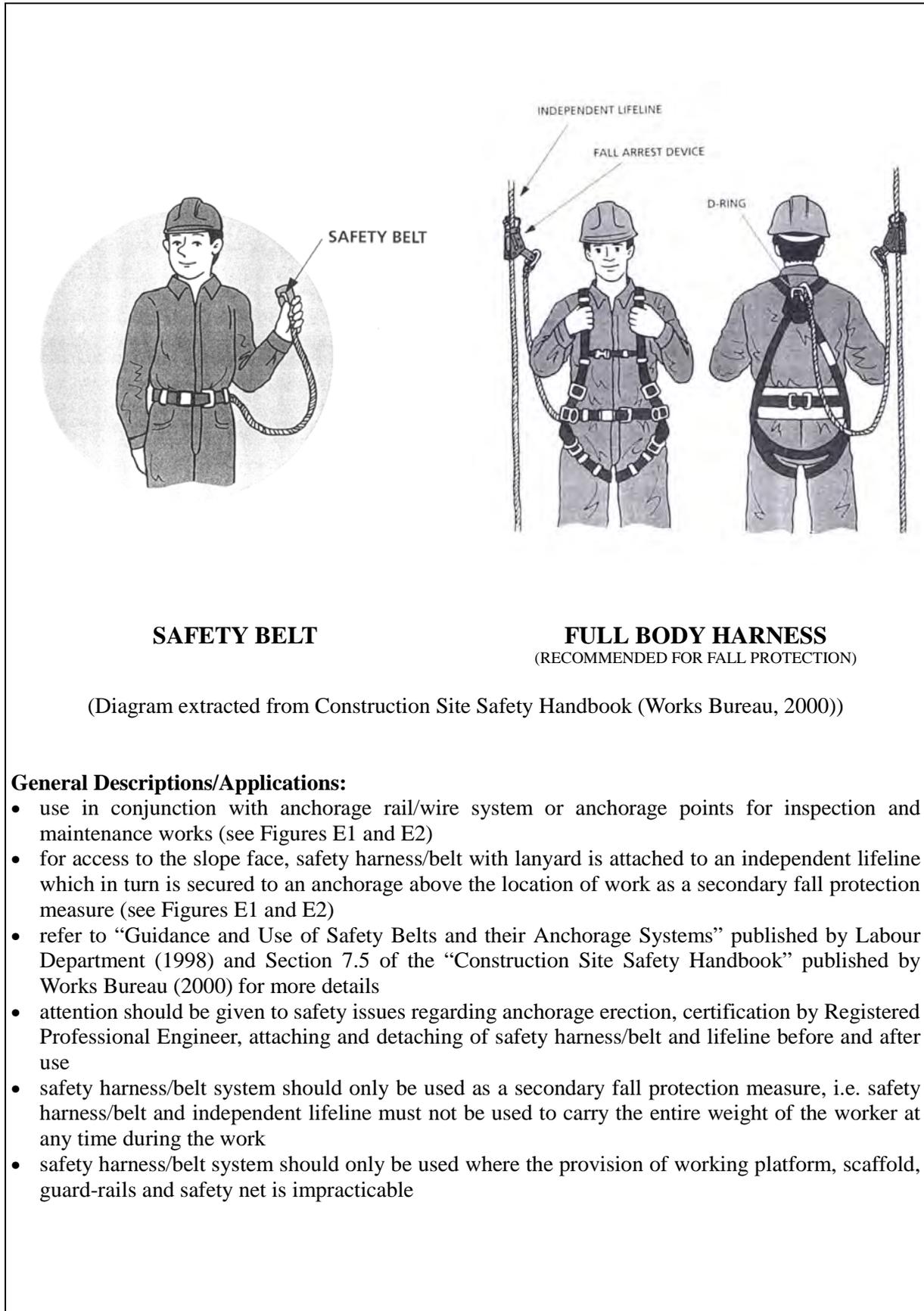


Figure E2 - Use of Anchorage Rail/Wire and Anchorage Points Systems with Independent Lifeline



- Notes:
- (1) Trees or steel bars used as anchorage must be tested, examined and certified safe by a Registered Professional Engineer. The use of tree(s) as an anchorage is, in general, discouraged by the Labour Department.
 - (2) See Figure E2 and E4 for details on the use of independent lifeline, safety harness/belt and anchorage systems.

Figure E3 - Use of Existing Trees or Temporary Driven Steel Posts as Anchorage Points



SAFETY BELT

FULL BODY HARNESS
(RECOMMENDED FOR FALL PROTECTION)

(Diagram extracted from Construction Site Safety Handbook (Works Bureau, 2000))

General Descriptions/Applications:

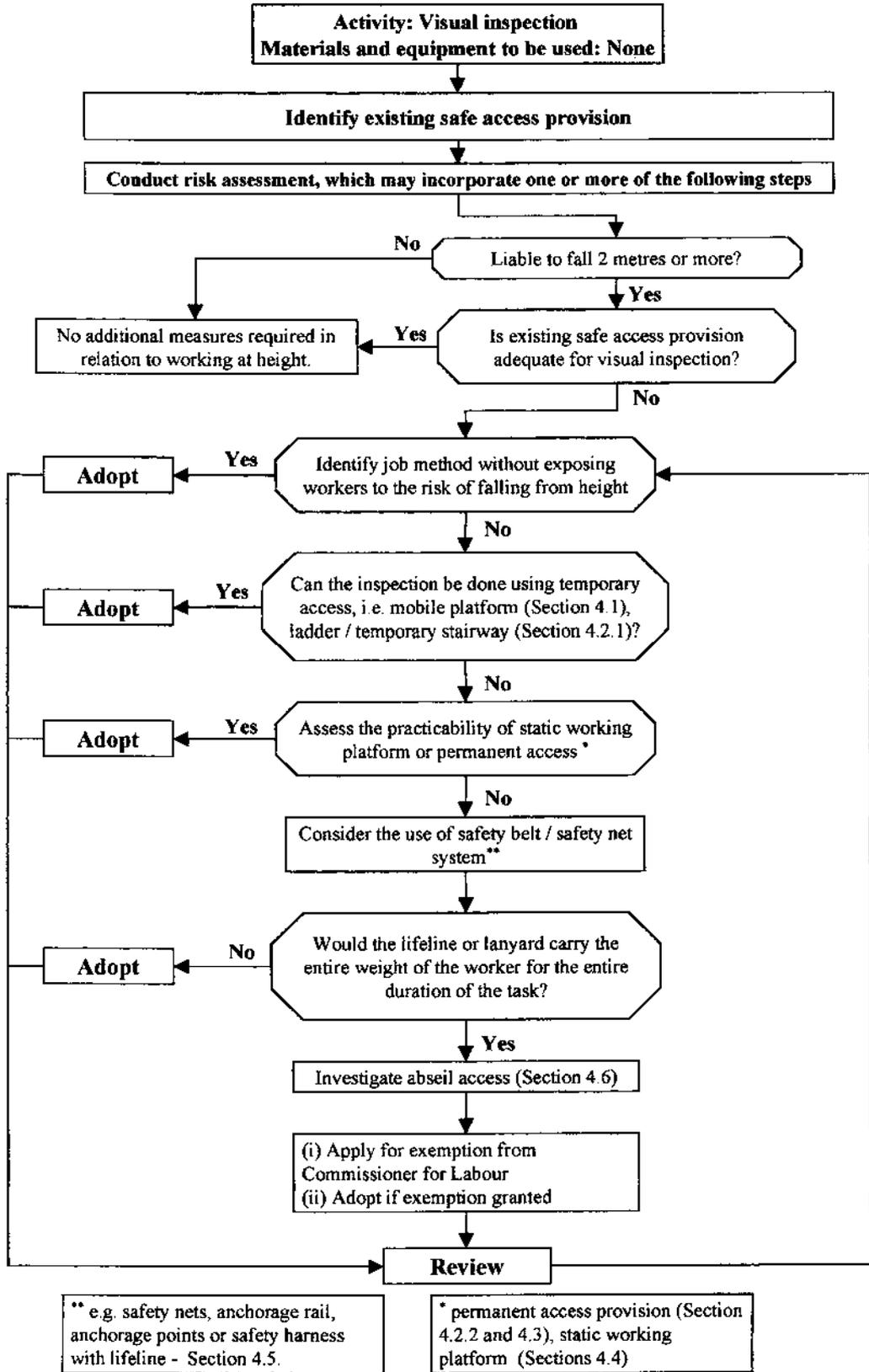
- use in conjunction with anchorage rail/wire system or anchorage points for inspection and maintenance works (see Figures E1 and E2)
- for access to the slope face, safety harness/belt with lanyard is attached to an independent lifeline which in turn is secured to an anchorage above the location of work as a secondary fall protection measure (see Figures E1 and E2)
- refer to “Guidance and Use of Safety Belts and their Anchorage Systems” published by Labour Department (1998) and Section 7.5 of the “Construction Site Safety Handbook” published by Works Bureau (2000) for more details
- attention should be given to safety issues regarding anchorage erection, certification by Registered Professional Engineer, attaching and detaching of safety harness/belt and lifeline before and after use
- safety harness/belt system should only be used as a secondary fall protection measure, i.e. safety harness/belt and independent lifeline must not be used to carry the entire weight of the worker at any time during the work
- safety harness/belt system should only be used where the provision of working platform, scaffold, guard-rails and safety net is impracticable

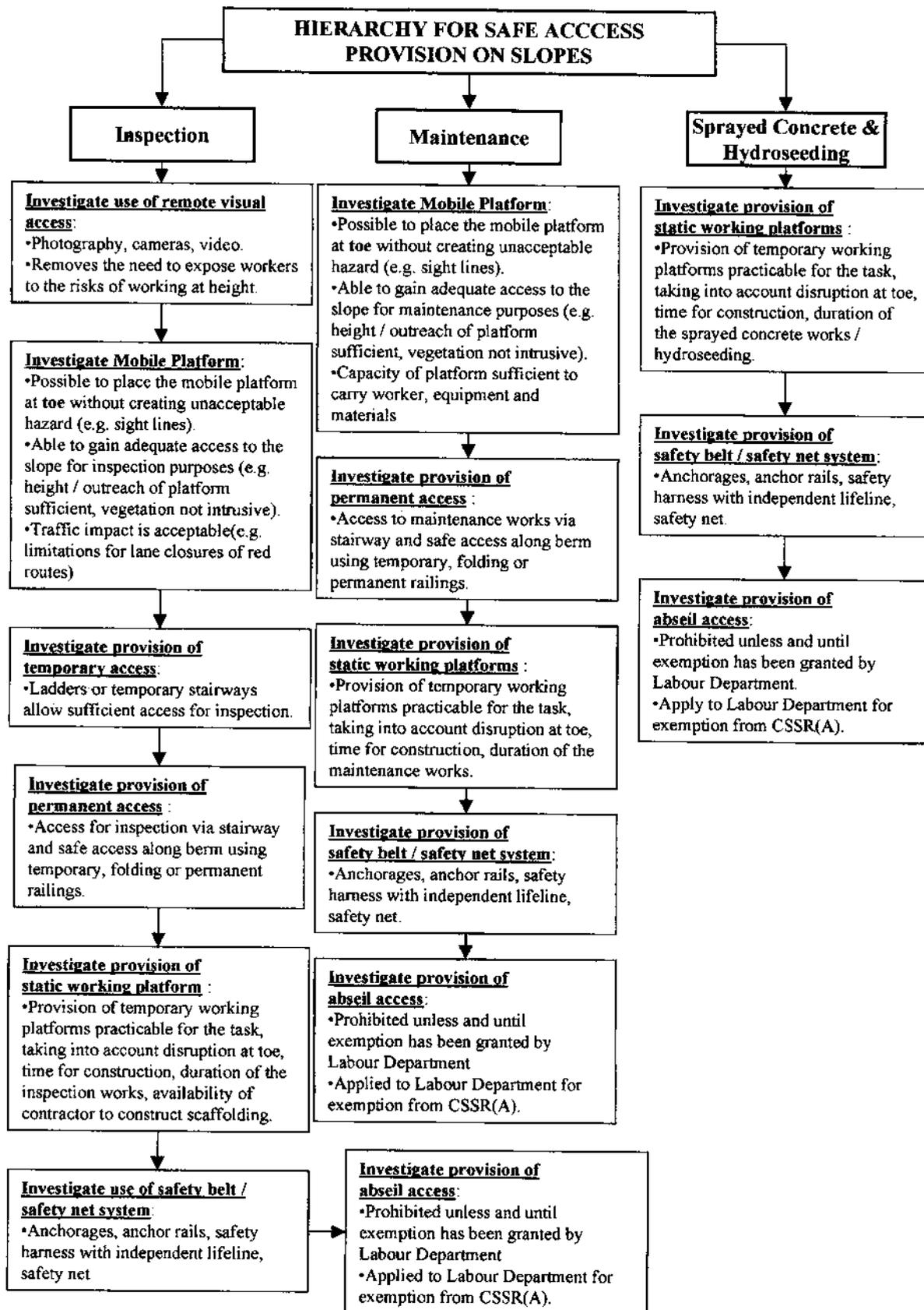
Figure E4 - Safety Harness/Belt

APPENDIX F

CHARTS SHOWING HIERARCHY OF
SAFE ACCESS PROVISIONS
(Extracted from HyD(2001a))

FLOW CHART FOR PROVISION OF SAFE ACCESS FOR SLOPE INSPECTION





APPENDIX G

ABSEILING AND BOATSWAIN'S CHAIR



(Photograph extracted from US Federal Highway Administration Publication No. FHWA SA-93-085, Rockfall Hazard Mitigation Methods)

General Descriptions/Applications:

- in this document, abseiling means a technique where the rope carries the entire weight of the worker/personnel or provides access to or egress from the place of work and is considered as a similar plant or equipment to a boatswain's chair
- use of abseiling is prohibited under CSSR(Amendment), except with the prior approval for exemption from the Labour Department (refer to the "Report on Rope Access Applications" issued by the Labour Department (1999) for further details)
- use of abseiling can only be considered if the use of working platform, guard-rails, safety belt and safety net is impracticable, i.e. absolutely the last resort

Benefits:

- can access a large area of the slope face very effectively
- less inhibited by vegetation and undulating slope face

Limitations:

- secure anchorages above the point to be accessed have to be establish
- anchorage points and equipment have to be tested, examined and certified safe by a Registered Professional Engineer
- bear in mind safety during anchorages erection, examination by RPE, and attaching and detaching of safety belt/independent lifeline before and after use
- expert training of personnel is essential

Figure G1 - Abseiling and Boatswain's Chair

APPENDIX H

SAMPLE SLOPE ASSESSMENT PROFORMA
(Extracted from HyD(2001a))

SAFE ACCESS PROVISION FOR SLOPE INSPECTION

BASIC SLOPE INFORMATION

Feature Reference No:	
Location:	
Slope Sub-section:	
Date:	
Weather:	

SLOPE

Material:			
Maximum Height (m):			
Length (m):			
Angle (°):			
Berm No:		Width (m):	
Slope Surface Cover:			
% Bare:			
% Vegetated:			
Vegetation Type:			
% Sealed:			
Seal Type:			

EXISTING SAFE ACCESS PROVISION

Stairs, steps, footholds etc.:

To berms	
To crest	

Transverse access along berms, crest (e.g. railings, anchorages):

Along berms	
Along crest	

INSPECTING / CERTIFYING PERSONNEL

Assessment:		Review:	
Signature:		Signature:	
Name of Assessor:		Name of Professional Engineer:	
Post/Job Title:		Post/Job Title:	
Organisation:		Professional Qualification:	
Date of Slope Access Inspection:		Date of Review of the Risk Assessment:	

SAFE ACCESS PROVISION FOR SLOPE INSPECTION

Feature Reference No:	
Location:	
Slope Sub-section:	
Date:	
Weather:	

STEP 1: FALL OF 2m OR MORE

Are the slope inspection personnel liable to fall 2m or more? (Answer 'Yes' for all slopes over 45°)	Yes	No
--	------------	-----------

(If Yes, proceed to Step 2)

STEP 2: EXISTING SAFE ACCESS PROVISION

Is the existing safe access provision adequate to prevent a fall of 2m or more?	Yes	No
---	------------	-----------

(If No, proceed to Step 3)

STEP 3: REMOTE VISUAL ACCESS

Can the slope inspection be satisfactorily carried out using one of the following remote techniques?

Photography from nearby vantage point	Yes	No
Video from nearby vantage point	Yes	No
Binoculars / Telescope from nearby vantage point	Yes	No
Other (please specify)	Yes	No

(If all are No, proceed to Step 4)

STEP 4: TEMPORARY SAFE ACCESS PROVISION

Can the inspection be carried out using one of the following forms of temporary safe access provision?

Mobile Hydraulic Platform*	Yes	No
Ladder	Yes	No
Temporary Stairway	Yes	No

* Typical Working Envelopes

Slope Angle	Typical Maximum Slope Height
45°	10m
55°	15m
65° and above	20m

(If all are No, proceed to Step 5)

STEP 5: PERMANENT ACCESS PROVISION

Can the inspection be carried out using one of the following types of permanent safe provision?

Permanent stairway	Yes	No
Temporary railings on berm / crest	Yes	No
Folding railings on berm / crest	Yes	No
Permanent railings	Yes	No

(If all are No, proceed to Step 6)

SAFE ACCESS PROVISION FOR SLOPE INSPECTION

STEP 6: STATIC WORKING PLATFORM

Can the inspection be carried out using one of the following forms of static working platform?

Single row scaffold with working platform	Yes	No
Double row scaffold with working platform	Yes	No
Tower scaffold (for subvertical slopes and walls)	Yes	No

(If all are No, proceed to Step 7)

STEP 7: SAFETY BELT / SAFETY NET SYSTEMS

Can the inspection be carried out using a safety belt / safety net system attached to a suitable anchorage?

Anchorage Rail on berm / crest	Yes	No
Individual Anchorages on berm / crest	Yes	No
Safety Harness and Independent Lifeline	Yes	No
Safety Net	Yes	No

(If all are No, proceed to Step 8)

STEP 8: ABSEIL ACCESS

Abseil access is banned by the Construction Sites (Safety) Regulations but exemption can be applied for from the Labour Department in exceptional circumstances. The procedure for applying for exemption is described in the "Report on Rope Access Application". Before proceeding, answer the following questions.

Are all of alternative types of safe access provision impracticable?	Yes	No
Are the inspection personnel trained to work at height using abseil equipment?	Yes	No

(If all are Yes, apply for exemption)

Exemption from Section 38G of the Construction Sites (Safety) Regulation will only be granted if the Labour Department are satisfied that all other safe access techniques are impracticable, that abseil access is the only available method and the personnel who will do the work are competent to use this method.

INSPECTING / CERTIFYING PERSONNEL

Assessment:

Signature:	
Name of Assessor:	
Post/Job Title:	
Organisation:	
Date of Slope Access Inspection:	

Review:

Signature:	
Name of Professional Engineer:	
Post/Job Title:	
Professional Qualification:	
Date of Review of the Risk Assessment:	

APPENDIX I

SAFE ACCESS ON SLOPES WITHIN THE TSING MA CONTROL AREA
REPORT ON COLOUR SCHEMES FOR RIGID HANDRAILING

TMCA DIVISION, HIGHWAYS DEPARTMENT

**Safe access on slopes within the Tsing Ma Control Area
Report on colour schemes for rigid handrailing**

TMCA Division, Highways Department

Summary

Rigid handrailing are installed on some slopes within the Tsing Ma Control Area. Based on the results of painting trials at 4 staircases in the North West Tsing Yi Interchange and on selected slopes at the Ting Kau Bridge area, the Landscape Unit has recommended the following painting schemes can be adopted to mitigate the visual impact of handrailing on slopes:

Location	Colour scheme
Stairway	'Python' (code 10C39 to BS4800)
Staircase on shotcreted slopes	'Python' (code 10C39 to BS4800)
Staircase on vegetated slopes	'Thyme' (code 12B25 to BS4800)
Berms on shotcreted slopes without planters	'Python' (code 10C39 to BS4800)
Berms on shotcreted slopes with planters	'Thyme' (code 12B25 to BS4800)
Berms on vegetated slopes	'Thyme' (code 12B25 to BS4800)

Introduction

Rigid handrailing are installed on some slopes within the Tsing Ma Control Area. Two painting trials have been conducted to investigate whether alternative colour schemes to the standard light grey colour would be more effective in mitigating the visual impact caused by the handrailing on slopes to the surrounding landscape.

Painting Trial at North West Tsing Yi Interchange on 28/29 January 2002

2. Four staircases in the North West Tsing Yi Interchange were selected to be painted with the following colours:

Colour (BS4800 colour code)	Recommended by	Figure
Seacrest (14E51)	TMCA Operator	1
Python (10C39)	HyD Landscape Unit	2, 4
Thyme (12B25)	HyD Landscape Unit	3, 4
Mixture of the above	As directed by HyD Landscape Unit on site on 29.1.2002.	5

3. Having inspected the painted handrailing, the Landscape Unit observed the following:

- (a) handrailing with suitable colour(s) would blend in with the background when the slope was viewed from afar;
- (b) the colour 'Seacrest' was deemed too conspicuous and should not be used;
- (c) the colour 'Python' blended in well with the aged shotcrete background. It should be used for handrailing installed on stairways, staircase and berms fronting a shotcreted slope surface;
- (d) the colour 'Thyme' blended in well with the aged shotcrete background and would also be a good choice for handrailing installed on berm fronting a vegetated slope surface or shotcreted slope surface with berm planters;
- (e) the random overpainting of colour 'Seacrest' on colours 'Python' or 'Thyme' were deemed too conspicuous and should not be adopted;
- (f) the random overpainting of colour 'Thyme' on colour 'Python' blended in well with a shotcreted slope surface and would also be a good choice for a vegetated slope surface. However, as the slopes would be viewed from a distance,

the ‘camouflage’ effect of this mixed-colour scheme would not be noticeable and hence would not justify the additional painting cost.

4. Taking into account the results of the painting trial, the Landscape Unit suggested the following choices of colours to be applied to handrailing at different locations:

Location	Colour scheme
Stairway	‘Python’ (code 10C39 to BS4800)
Staircase on shotcreted slopes	‘Python’ (code 10C39 to BS4800)
Staircase on vegetated slopes	‘Thyme’ (code 12B25 to BS4800)
Berms on shotcreted slopes without planters	‘Python’ (code 10C39 to BS4800)
Berms on shotcreted slopes with planters	‘Thyme’ (code 12B25 to BS4800)
Berms on vegetated slopes	‘Thyme’ (code 12B25 to BS4800)

5. It was further suggested that the above painting schemes should be applied to handrailing on selected slopes on a larger scale so that further assessment could be made on whether they were effective in mitigating the visual impact of the handrailing.

Site inspection of slopes at Ting Kau Bridge area on 14 May 2002

6. Handrailing on roadside slopes at the Ting Kau Bridge were painted with the colour schemes recommended by the Landscape Unit. Selected sections of railing was left with their original grey colour (BS5252F code 06A07, ref: CED Standard Drawing no. C2103A) for comparison purpose (refer to Figures 7 to 11).

7. Having observed that the recommended colours of Thyme and Python were more effective in mitigating the visual impact of the handrailing to the surrounding landscape than the original grey colour, the Landscape Unit confirmed its suggestion that the colour schemes as stated in paragraph 4 above should be adopted for TMCA slopes.

Conclusion

8. As the Landscape Unit have found alternative colour schemes, namely Thyme and Python, to be effective in mitigating the visual impact of the rigid handrailing on slopes, these colours are proposed to be adopted for future painting of handrailing within the TMCA. The criteria for the application of the alternative colours are recapped as follows:

Location	Colour scheme
Stairway	'Python' (code 10C39 to BS4800)
Staircase on shotcreted slopes	'Python' (code 10C39 to BS4800)
Staircase on vegetated slopes	'Thyme' (code 12B25 to BS4800)
Berms on shotcreted slopes without planters	'Python' (code 10C39 to BS4800)
Berms on shotcreted slopes with planters	'Thyme' (code 12B25 to BS4800)
Berms on vegetated slopes	'Thyme' (code 12B25 to BS4800)

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Figure I1 - Colour 'Seacrest' (code 14E51 to BS4800) Applied to Existing Staircase Handrailing



Figure I2 - Colour 'Python' (code 10C39 to BS4800) Applied to Existing Staircase Handrailing



Figure I3 - Colour 'Thyme' (code 12B25 to BS4800) Applied to Existing Staircase Handrailing



Figure I4 - Comparison of Colours 'Thyme' (code 12B25 to BS4800) and 'Python' (code 10C39 to BS4800)



Figure I5 - Comparison of Randomly Overpainted Colour Schemes

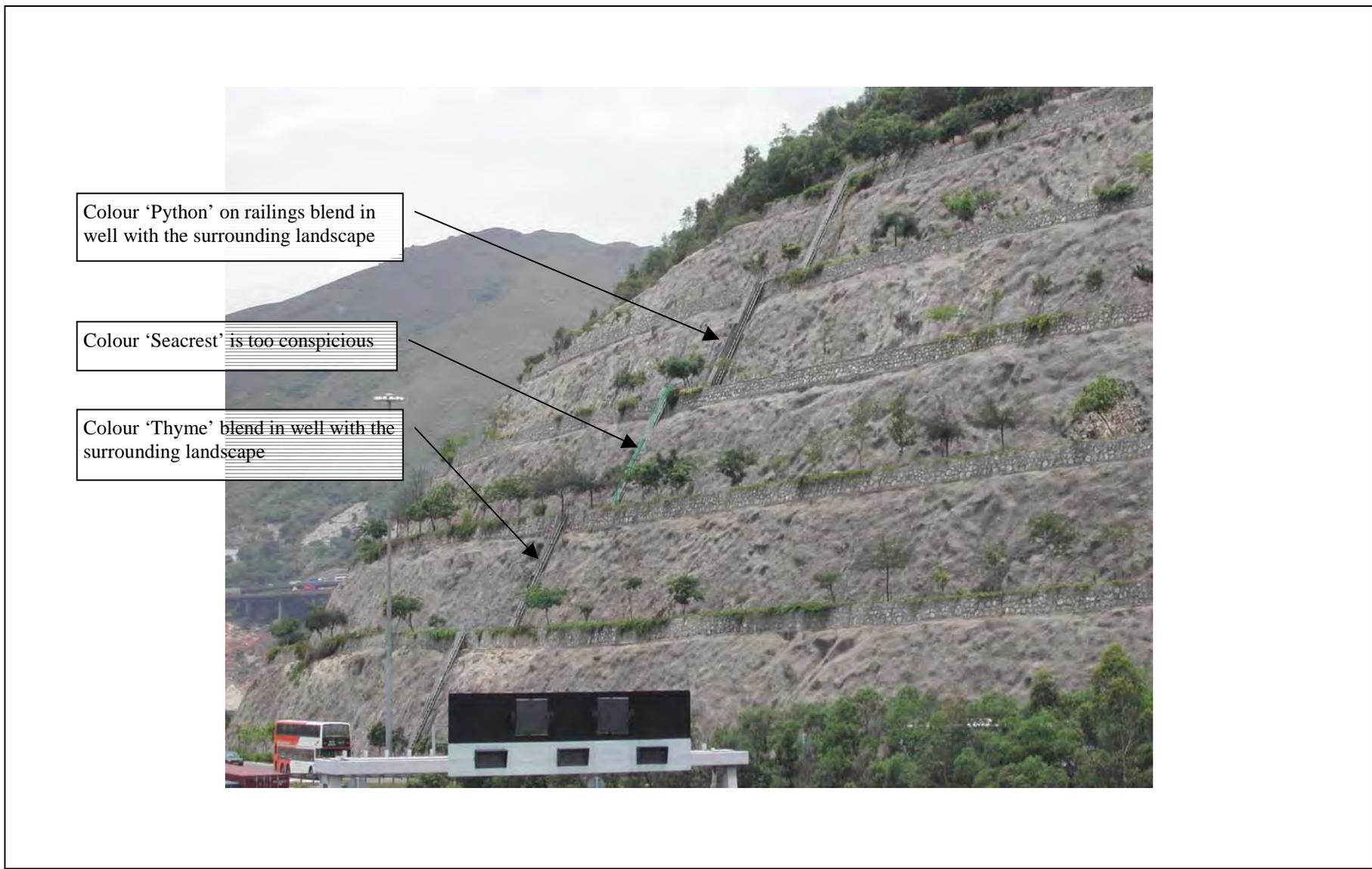


Figure I6 - General View of Alternative Colour Schemes on Staircases



Figure I7 - Handrailing on Slopes along Ramp G of Ting Kau Bridge Painted in Colour 'Thyme' (code 12B25 to BS4800)



Figure I8 - Handrailing on Slopes along Ramp H of Ting Kau Bridge Painted in Colour 'Thyme' (code 12B25 to BS4800)



Standard light grey colour on stairway handrailing is more conspicuous

Figure I9 - Close-up View of Handrailing on Slopes along Ramp H of Ting Kau Bridge Painted in Colour 'Thyme' (code 12B25 to BS4800)



Figure I10 - Close-up View of Handrailing on Slopes along Ramp H of Ting Kau Bridge Painted in Colour 'Thyme' (code 12B25 to BS4800)

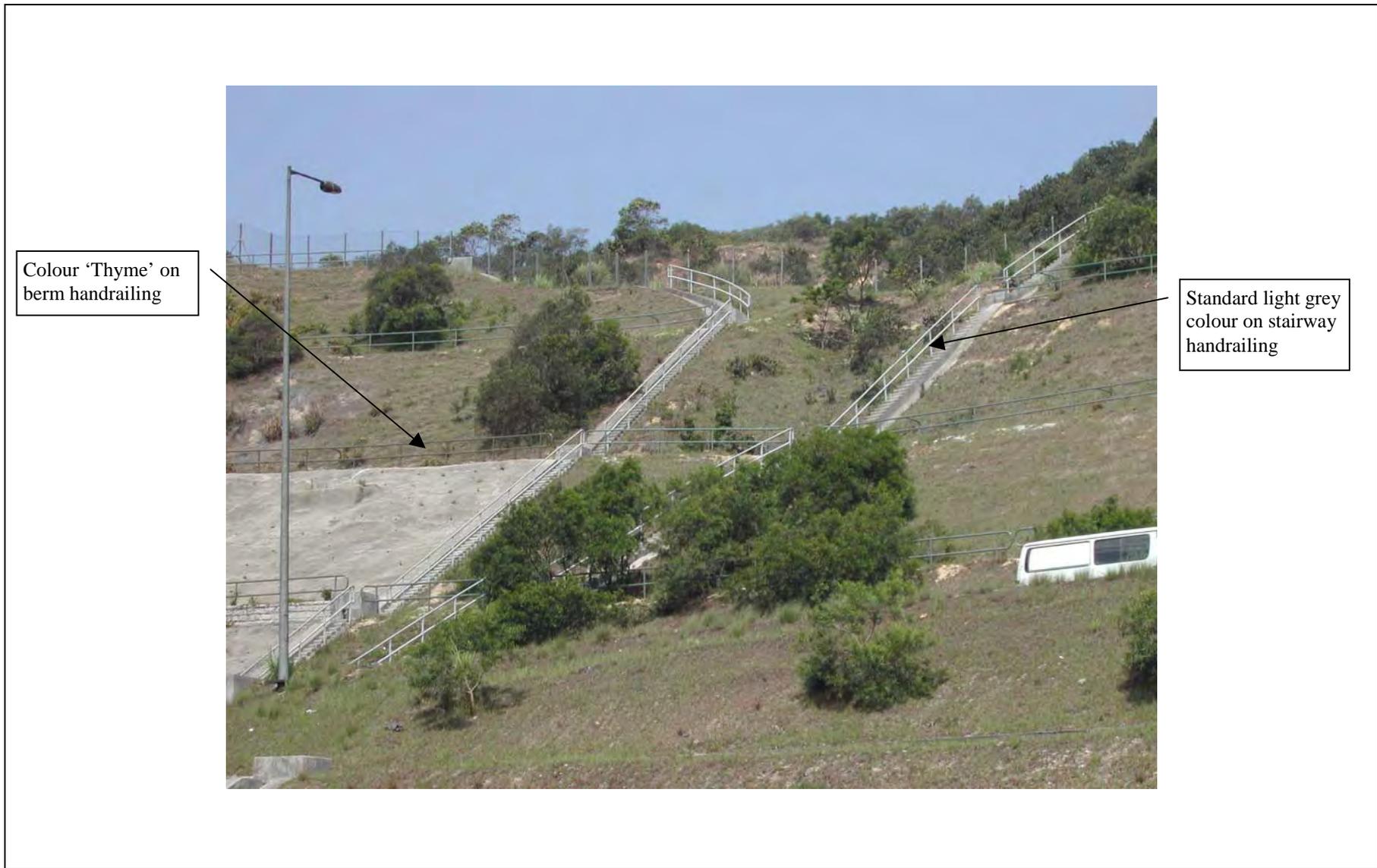


Figure I11 - Existing Grey Colour on Stairway Handrailing is More Conspicuous than the Alternative Colour Schemes on Berm Handrailing