

GUIDELINES ON SLOPE MAINTENANCE FOR PUBLIC



MESSAGE FROM THE RIGHT HONOURABLE CHIEF MINISTER OF SELANGOR

Let us all be grateful for the grace and blessing of the Almighty ALLAH S.W.T, the Guide Book – 'GUIDELINES ON SLOPE MAINTENANCE FOR PUBLIC' is now successfully published. This is the result of the collaboration and ideas of the MPAJ, Resident Associations and Public Works Department Malaysia.

The Guide Book is an important strategic step towards beginning a new development of public awareness on the risks at hillside areas and also understanding of how to maintain slopes.

This Guide Book has been compiled to answer questions you may have about the maintenance slopes. Hence, MPAJ has taken steps to ensure the safety of the residents by publishing this Guide Book in an effort to emphasize on the public's participation in monitoring the safety of slopes and hillside surrounding.

Finally, it is my hope that the Guide Book - GUIDELINES ON SLOPES MAINTENANCE FOR PUBLIC will become an important input and reference point for the public. I would also like to congratulate and thank MPAJ and all parties who have been involved in the publication of this Guide Book including the Public Works Department Malaysia and the Coalition of Bukit Antarabangsa Resident Associations (COBARA).

Y.A.B. TAN SRI DATO` SERI ABD KHALID BIN IBRAHIM

DATO` MENTERI BESAR SELANGOR

FOREWORD

A result of the collaboration and sharing information between MPAJ, Public Works Department and the Bukit Antarabangsa Resident Associations the publication of this guidebook 'Guidelines on Slope Maintenance for Public' is now materialized.

Simple maintenance on slopes can contribute a lot for the safety of residents living in the hill slopes area. There is a need for the residents equipped with the basic maintenance knowledge of how to take care man made slopes. This guidebook 'Guidelines on Slope Maintenance for Public' explained simple maintenance actions that can be carry out by residents living in the hill slopes area.

By giving a step-by-step pictorial form of maintenance guidance, residents at all level can easily understand of how to take care of their surrounding area. However, this book does not replace professional advice or in any way constitute a guideline or repair manual.

This book has referred to 'Guidelines on Slope Maintenance in Malaysia' prepared by Slope Engineering Branch, Public Works Department, 'Slopes Made Simple' book by Ir. Shaik Abdul Wahed Dato' Hj. Rahim and write-ups by the Coalition Of Bukit Antarabangsa Resident Associations (COBARA). A special thank you to all the parties and I hope that this guidebook Booklet 'Guidelines on Slope Maintenance for Public' can be useful for everyone.

Y.B. DATO' MOHAMMAD YACOB
YANG DIPERTUA
MAJLIS PERBANDARAN AMPANG JAYA

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Introduction

The Guide Book aims to enhance public awareness on the risks at hillside areas. It explains the precautionary measure possible to reduce risks to the public.

This Guide Book explained how to maintain slopes besides gives a few monitoring tips for easy understanding of how to maintain slopes. By the end of the book, it shows signs of landslide in the form of pictorial view for guidance.

Finally, relevant authorities contact numbers are given for the public to make a report if there is any emergencies related to landslide.

1.0 TYPICAL ROUTINE MAINTENANCE WORKS FOR SLOPE AND RETAINING STRUCTURE

Man-made Item	Typical Maintenance Works Required	Guidance
Surface Drainage Channels, Sumps and Silt Traps	<ul style="list-style-type: none"> (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. 	<ul style="list-style-type: none"> (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 jeopardize the stability of the tree. Alternatively, the channels may be realigned.
Weepholes and Horizontal Drains	<ul style="list-style-type: none"> (a) Clear obstructions (e.g. weeds and debris) in weepholes and pipe ends. (b) Probe with rods for deeper obstructions. 	<ul style="list-style-type: none"> (a) Pipes/ Horizontal Drains are prone to being blocked. Where pipes have been used on slopes and are leaky or severely blocked, they should be replaced.
Impermeable Surface Cover (e.g. guniting and shotcrete)	<ul style="list-style-type: none"> (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. 	<ul style="list-style-type: none"> (a) Cracked impermeable surface cover should be repaired by cutting a chase along the line of the crack, which is to be filled with similar slope cover material or 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.	<ul style="list-style-type: none"> (a) Regrade eroded areas with compacted soil followed by replanting. (b) Replant vegetation in areas where the vegetated surfacing has died. (c) Trim vegetation if overgrown. (d) Removed dead, decaying or unstable trees. 	<ul style="list-style-type: none"> (a) Where erosion is shallow and does not affect the performance of existing surface drainage channels, the eroded area may be regarded by trimming and make good to normal condition. (b) Surface erosion may indicate an inadequate drainage system. Possible sources 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.	<ul style="list-style-type: none"> a) Repair cracked or spalled concrete surface and support. b) Removed loosed rock debris. c) Removed dead, decaying or unstable trees. 	<ul style="list-style-type: none"> a) Trees giving rise to prising action in rock joints should be removed. The entire stump of the tree should be removed.
Facing	<ul style="list-style-type: none"> (a) Repair deteriorated mortar joints on masonry face. (b) Repair cracked or spalled concrete surface and replace missing or deteriorated joint fillers and sealant. 	<ul style="list-style-type: none"> (a) Continual distress (e.g. widening cracks) of wall should be reported to the owner of party required maintain the land.

2.0 TECHNICAL ASPECT OF MAINTENANCE

i. Surface Protective Cover On Soil

Many slopes are protected by impermeable surface covers that could be rigid or flexible. Rigid surface covers, such as guniting, shotcrete and rubble-pitched facing are susceptible to cracking. Bitumastic covers, though more flexible, may also crack. Details of cracking should be included in the inspection records and recommendations for the necessary repair works should be made. Inspections should also be made for displaced, cracked or weathered stones on rubble-pitched facings.

ii. Surface Drainage

The surface channels at the crest or on the berms of soil slopes or at the top of retaining structures should be checked for the presence of gaps in the ground alongside the channels because such gaps permit surface water to infiltrate into the ground.

iii. Groundwater Seepage

Seepage traces on and adjacent to slopes or retaining structure should be recorded in photograph or detailed hand-sketched drawing. Flow from seepage sources, weepholes, cut off drain, joint between masonry blocks, horizontal drains, etc. should be recorded and examined for signs of migration of sold material to check whether internal erosion of the ground is taking place. Account should be taken of those seepage traces that indicate the highest seepage level.

Where there are signs of abnormal seepage from, or moisture on, the surface of the slope or masonry wall, or signs that the seepage has increased substantially and suddenly, the causes should be investigated.

Arrangements should be made for clearing weepholes where blockages are suspected.

Where there are traces of seepage from a slope or retaining structure in an area where weepholes, horizontal drains or proprietary drainage mats have not been provided, the source of seepage should be determined and consideration should be given to recommending adequate drainage to be installed.

iv. Rock Slopes

Many failures in rock slopes involve minor rockfalls. Rock slopes should be examined for the presence of loose blocks and these should be removed or stabilized if found.

3.0 ROUTINE MAINTENANCE INSPECTIONS FOR MITIGATION MEASURES.

Routine maintenance inspections should be carried out to identify any maintenance works required to ensure the integrity and physical condition of the hazard mitigation measures and continued satisfactory performance of the measures.

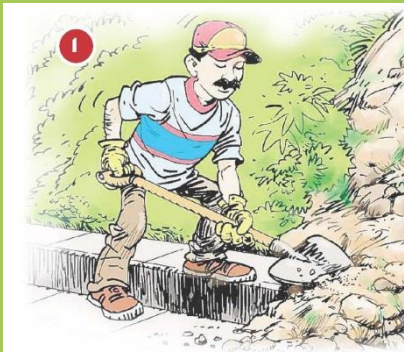
Routine maintenance inspections should cover the measures, the area containing the measures and the surrounding area. In general, the inspection should assess the need for carrying out maintenance works of man-made items such as:

- i. Clearing debris from stormwater facilities, e.g. drains, sumps, trap facilities and trash screen,
- ii. Repairing or replacing damaged outlets,
- iii. Clearing weepholes and drainage outlets,
- iv. Removing any vegetation that has caused severe cracking of channels or hard surfaces,
- v. Repairing or reinstating the ground adjoining the measures if affected by severe erosion,
- vi. Other routine maintenance works to upkeep the integrity and function of the measures, and
- vii. Removal of loose boulders or rock blocks on the natural slopes or rock slopes.

4.0 TAKING CARE OF SLOPE

Slope need be maintained. Normally, it is the responsibility of the slope owner to maintain slope, but simple maintenance tips can also done by residents living nearby.

Here are ten maintenance tips for the following sign:



Debris in drains on slopes

Drain need to be clear and free from any blockages, or this will impede the drainage of water away from the slope. As mentioned previously, excess water and poor drainage is the main cause of landslides, hence the importance of keeping drains flowing. If you see blockages, simply clear the drain.



Damaged drain

If there is damage, proper repair work needs to be done to ensure water flows where it should. Simply placing a brick or a stone into a crack in the drain will not be sufficient as water can still flow into the crack. Alert the slope owner of the damage and keep tabs on it to ensure that repair work is done.



Crack on slope or wall surface

The same with damaged drains, the slope owner should be alerted to the damage so proper repair work can be done.



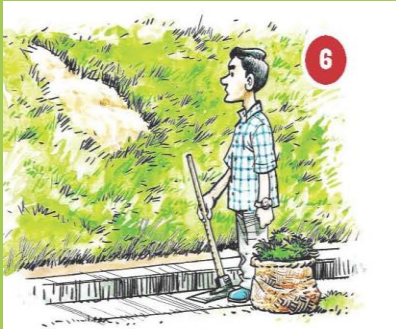
Blocked weepholes and drain pipes

As these are vital parts of the slope drainage system, they should always be unobstructed so that water can flow through them.



Vegetation growing in cracks

Any vegetation growing in cracks of slope surfaces should be removed immediately. If left unchecked, the growth of the plant can enlarge the cracks and make the damage worse.



No vegetation on slope surface

Surface of slopes should always be covered and should never be bare. Bare patches on slopes can be replanted with grass or other types of plants that have a good rooting system.



Voids or missing pieces in the wall

Missing parts of a wall means the integrity of the structure has been compromised. Proper repair work needs to be done to replace any missing pieces.



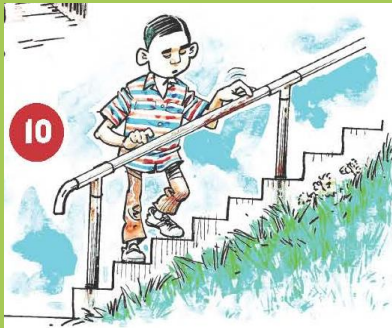
Loose rocks or debris on slope

Watch for loose rock or debris from slopes, inform the slope owner and do not park your car or stand near the base of such slopes.



Leaking water pipes

Water pipes are often buried below ground and any leaks will be very difficult to spot. However, it is a vital part of slope maintenance and your local water authority must be informed immediately if there is suspicion of a failed or failing water pipe.



Rusted metal structures

Slopes can be tricky to climb and rusted handrails and staircases should be replaced with new ones so you can be safe while performing inspection of the slope.

5.0 Monitoring Slopes

Why Monitor Slopes?

- ❖ Learn how to monitor your surroundings for signs of failures and landslides



monitoring

SLOPES

LEARN ABOUT HOW TO MONITOR YOUR SURROUNDINGS FOR SIGNS OF LANDSLIDES

LEARN ABOUT HOW TO MONITOR YOUR SURROUNDINGS FOR SIGNS OF LANDSLIDES

Bulging ground appears at the base of a slope or retaining wall.

2 Water breaks through the ground surface in new location near a slope.

3 Water appears at the base of slope.

 Fences, retaining walls, utility poles or trees tilt or move.

5 Cracks appear on the slope.



Water pipes break.



7 Cracks appears on the ground or in the foundation of houses, buildings and other structures.

8 Doors or windows stick or jam for the first time.



Slowly developing widening cracks, appear on the ground or on paved areas such as streets or driveways.



Land movement
and small slides.



Outside walls, walks or stairs begin pulling away from the building.



Be Alert

Landslide occur without public warning. If you live in a landslide-prone area, ***be alert*** – particularly during monsoon seasons or periods of heavy rainfall. If you see signs of a landslide, you yourself must make the decision to evacuate.



Make a report

Much emphasis on the public's participation in the monitoring of landslides. If you suspect that a landslide is about to occur or see changes in your hillside surrounding, ***make a report***.



Be a part of the early warning system

When communities are aware of the signs of a landslide, they can work together to form a community-based early warning system program. Call 999 for reporting emergencies. For signs of slope failure, call the engineering department of your local authority or JKR Cawangan Kejuruteraan Cerun (JKR aduan)



On or Around Slopes

Bulging ground appears at the base of a slope or retaining wall



On or Around Slopes

Evidence of broken underground utility lines



On or Around Slopes

Water breaks through the ground surface in new location



On or Around Slopes

Water appears at base of slope



On or Around Slopes

Fence, retaining walls, utility poles or trees tilt or move



On or Around Slopes

Cracks appear on the slope



On or Around Slopes

Detachment of soil at toe of slope



On or Around Slopes

Erosion at slope surface



On or Around Slopes

Water unexpectedly gushes out from a slope



Rivers and Streams

Water from a slope suddenly turns from clear to muddy



Around Your House

Crack appear on the ground or in the foundation of house, building and other structures



Around Your House

Soil moving away from foundations



Around Your House

Structures such as decks and patios tilting and/or moving away from the main house



Around Your House

Doors or windows stick or jam for the first time



Around Your House

Tilting or cracking of concrete floors and foundations.



Around Your House

Broken water lines and other underground utilities (seepage).



Around Your House

Springs, seeps or saturated ground in areas that have not typically been wet before



Around Your Community Grounds

Sunken or down-dropped road beds



Around Your Community Grounds

Outside walls, walks or stair begin pulling away from the building



Around Your Community Grounds

Slowly developing, widening cracks appear on the ground or on paved areas such as streets or driveways.



Around Your Community Grounds

New cracks appear in plaster, tile, brick or foundations



Around Your Community Grounds

The ground slopes downward in one direction and may begin shifting in that direction under your feet



When Driving

Collapsed pavement, mud fallen rock and other indications of possible debris flow can be seen when driving (embankments along roadsides are particularly susceptible to landslides)

6.0 Signs of a Landslide

Moment before a landslide

a) Sound

A faint rumbling sound that increases in volume is noticeable as the landslide near. Unusual sound, such as trees cracking or boulders knocking together, might indicate moving debris

b) Visual

Rapid increase in creek water levels and water may become cloudy and suddenly includes driftwood from the trees above and sudden decrease in creek water levels though rain is still falling or just recently stopped

7.0 Reporting Emergencies

Find out who to contact for
emergencies and sign

999

One Nation, One Number

Reporting Signs

For sign of slope failure, call

❖ The Engineering Department of
MPAJ (03-42968010 / 03-42968100)

❖ JKR Cawangan Kejuruteraan
Cerun (03-2696 7351)



Cawangan Kejuruteraan Cerun
JKR Malaysia



References

1.0 Slopes Made Simple by Ir Shaik Abdul Wahed Dato' Hj. Rahim.

2.0 Guidelines on Slope Maintenance in Malaysia by Slope Engineering Branch, Public Works Department Malaysia.

3.0 TBU Newsletter by Dec 2009