Updated Policies and Procedures for Engineering Control of Hill-Site Developments

by ***Drafting Committee On Hillsite Development***

THIS document presents an update to the original recommendations by the Task Force of The Institution of Engineers, Malaysia (IEM) entitled "Policies and Procedures for Mitigating the Risk of Landslide on Hill-Site Development" dated 4 April 2000.

It has been necessitated by numerous incidences of landslides around the country impacting residential buildings resulting in fatalities culminating in the disastrous Bukit Antarabangsa landslide on 6 December 2008 in which five people died, many people injured, 14 bungalows demolished and numerous homes were declared unsafe. Other reported landslides had damaged properties and disrupted infrastructures.

The following are recommendations after due considerations of all factors for safety in hill-site developments:

1) Under existing legislations, the Local Authorities are entrusted with the certification of the safety status of structures and building sites. It is recommended that the Local Authorities shall act on the advice of the new federal agency on all technical matters as elaborated in Item 2.

2) The formation of a new centralised federal agency called Agency for Control of Developments with Slopes (ACDS) is recommended. This Agency having a regulatory role shall not be placed in private hands. The Agency shall have the following roles:
   a) The Agency shall investigate and advise the Local Authorities on the approval and control of the safety of all future developments on or adjoining slope sites.
   b) The Agency shall monitor and track the implementation of registered recommended mandatory maintenance procedures/programmes and to advise the Local Authorities to implement such maintenance procedures/programmes in the event that the relevant responsible parties fail to do so.
   c) All developments, falling under the jurisdiction of the Agency, shall be required to obtain the consent of the Agency prior to the development being issued with the required certification for occupation by the Local Authorities.
   d) All proposed land use conversions to residential and

Slope Class	Suitability for Development	Details	Engineering Evaluation
1	Suitable	NATURAL TERRAIN - gradient ≤ 15° OR CUT SLOPES - gradient < 15°, Gross Height < 30m	Normal
2	Suitable	Crest of ridges OR NATURAL TERRAIN - 15° ≤ gradient < 25° for areas with no signs of past instabilities	Normal
3	Suitability of site to be assessed with detailed engineering studies	NATURAL TERRAIN - 25° ≤ gradient < 35° for areas with no signs of instabilities	Independent Review Required by Engineer other than the Submitting Engineer
4	Normally Discouraged. Under exceptional circumstances, the Developer with his Building Consultant Professionals may liaise closely with the Local Authorities and the Agency to establish that a given site is safe for development: all in accordance with the practices recommended in this PP.	NATURAL TERRAIN - gradient ≥ 35° for areas with no signs of past instabilities	Independent Review Required by Engineer other than the Submitting Engineer

commercial purposes in the country shall take into account the hill-site safety issues as stated in this paper and shall follow advice from the Agency.

e) If necessary, the technical department of the Local Authority may be required to be upgraded in order to have efficient communication with the Agency for effective implementation.

3) An adapted version of the Slope Classification system used in Hong Kong is recommended to be adopted exclusively by all approving and enforcement agencies to ensure consistency and ease of communication. The suitability for development shall be as in the following table:

4) Any Qualified Person who undertakes the review of design documents for slope stability and slope drainage works prepared by the Submitting Engineer shall, after certifying his satisfactory acceptance of the design, be required to continue to audit their construction for compliance and, upon satisfactory completion of construction, to endorse the as-built records (complete with recommended mandatory maintenance procedures/programmes) prepared and endorsed by the Submitting Engineer for submission to and registration with the Agency and Local Authority.

5) Notwithstanding the above, the landowner shall be solely responsible for the maintenance, safety and integrity of his property and the consequential damages to the adjacent properties resulting from slope instability in his/her properties.

6) All new developments located on or adjoining slope sites of Class 3 and Class 4 slopes shall have engineering evaluations for safety reviewed independently by Qualified Persons other than the Submitting Engineer.

All new developments requiring retaining walls more than 3.0m in height with or without surcharge shall have the engineering design of such elements reviewed independently by Qualified Persons other than the Submitting Engineer.

7) All approved developments located on or adjoining slope sites of Class 3 and Class 4 slopes be reviewed independently on an urgent basis by Qualified Persons other than the Submitting Engineer to determine if upgrading to the safety of any slope at any such development is required to be implemented and to advise the Agency and Local Authority to order such works before permitting building construction works to continue.

All approved developments (in the process of construction) requiring retaining walls more than 3.0m in height with or without surcharge shall have the engineering design of such elements reviewed and assessed by Qualified Persons other than the Submitting Engineer to determine if upgrading to the integrity of any wall at any such development is required to be implemented and to advise the Agency and Local Authority to order such works before permitting building construction works to continue.

8) All existing completed developments located on or adjoining slope sites of Class 3 and Class 4 slopes be urgently assessed by Qualified Persons other than the Submitting Engineers to determine if upgrading to the safety of any slope at any such development is required to be implemented and to advise the Agency and Local Authority to order such works immediately.

All existing completed developments with retaining walls more than 3.0m in height with or without surcharge shall have the engineering design of such elements assessed by Qualified Persons other than the Submitting Engineer to determine if upgrading to any wall is necessary and to advise the Agency and Local Authority to order such works immediately.

Any alterations to an existing completed construction shall be referred back to the Agency.

9) Uncompacted tipped fill construction of development platforms including filled up slopes shall be disallowed. All fills must meet compaction/density requirements for engineered fills.

10) All surface drains on slopes shall be designed and constructed capable of self-cleansing for soil particle sizes up to 1mm under the three months return period flow.

11) Geotechnical engineering modules in undergraduate civil engineering courses must include the form of soil mechanics appropriate for use in slope stability evaluations.

12) A Qualified Person (as defined in the Street, Drainage and Building Act) in the context of this paper shall possess the relevant geotechnical engineering experience and expertise. The relevant experience should include that in the field of Project Management, Civil Engineering Construction processes, Structural Engineering, Earthworks Construction, Surface and Sub-surface Drainage and other fields deemed necessary by the Agency. The Qualified Person may seek engineering input from other Registered Engineers if so required.

a) An existing Accredited Checker should be further examined

to have similar relevant experience as stated above.

b) Further, to serve the needs of this country, the list of qualified Accredited Checker needs to be significantly expanded to service the immense requirements of the country.

c) The IEM Geotechnical Division being an Independent expert entity should participate in setting up proper Guidelines on the qualification of Accredited Checkers to suit the needs of the country; and the BEM thus informed. The IEM is convinced that if the above recommendations are implemented, the Mitigation of Landslide Hazards in this country would be advanced.

SUPPLEMENTARY INFORMATION –

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The following are the explanatory information on salient items for the Update:

a) Agency for Control of Developments with Slopes (ACDS)

It is considered that a dedicated federal agency needed to take charge of all matters encompassing developments with slopes should adopt a fresh wholesome approach to the issue and should not be unencumbered by past practices in similar areas. The Agency shall be staffed and managed with key personnel who shall possess capabilities and experience adequate for slope engineering issues.

As the Agency is expected to function also as the repository for documents and records for management and maintenance of all slope engineering activities nationwide, it will need to be equipped with the necessary facilities for efficient electronic data entry, filing, archival and retrieval of all documents received. The capabilities also need to include the ability to timely prompt the Agency for scheduled upcoming activities especially maintenance and retrofits as well as to report on missed schedules so that appropriate follow-on actions may be taken. Such tasks should be straightforward given the state of information technology available.

The Agency is intended to function through the current system of local authorities in an advisory capacity.

As with any body empowered with regulatory functions, the Agency must not come under private ownership.

b) Slope Classification System

The slope classification system being adopted is an adaptation of that successfully utilised in Hong Kong and is familiar to most Local Authorities already.

The continued use of a familiar system will make for a trouble free operation by planners and other less technically endowed personnel.

c) Review Engineer to Certify and endorse as-built drawings

The requirement for the participation of a review engineer, particularly an Accredited Checker, stems from the reasoning that the submitting engineer often does not possess the necessary expertise for slope engineering matters. Presently, reviews and accredited checkings are confined to the design stage.

The current involvement of review engineers where they are limited to reviewing the design documents is inadequate. It leaves a vacuum of competence in the construction phase which is at least as important as the design if not more so. The review/checking engineer assumes no responsibility whatsoever in the completed works which is not satisfactory in spite of his documented participation in the works.

The update to the Position Paper requires the review engineer's participation to cover the entire engineering design and construction process and to assume joint responsibility with the submitting engineer.

d) Hydraulic Design of Slope Drains

A common finding with distressed slopes has been non-functioning drains owing to chokage with sediments and other debris. The Position Paper Update recommends that slope drains be designed and constructed to have self-cleansing capabilities even at low flows. This aims at obviating the need to undertake high frequency maintenance work to such areas of mostly difficult access.

e) Landowner Solely Responsible

The registered owner of the land is always responsible for ensuring the stability of the land at all times. He/she shall also be liable for any consequential damage to adjacent properties as the result of slope instability in his/her own property.

f) Developments Located on or adjoining Slope Sites of Class 3 and Class 4 Slopes

Sites more severe than Class 2 involve natural terrain slopes with gradients that approach or exceed the friction angle of many common geological materials. For this reason, the Position Paper Update recommends increasingly stringent controls on developments with Class 3 and Class 4 slopes.

g) Checking and Certifying Already Completed Constructions

Slope failures have been occurring unabated from since way back in the past to the present day irrespective of the age of construction. It would suggest that the same past inadequacies in slope engineering have been propagated to the current time.

For that reason, all past and present constructions need to be reviewed in the same manner that new constructions are to be subjected to. Where established to be inadequate, such already completed constructions will need to be retrofitted accordingly before being certified satisfactory.

h) Soil Mechanics Teaching

Classical soil mechanics teachings preached the existence of cohesion strength against shearing in soil bodies especially where the materials are perceived to comprise significant proportions of fine particles. The employment of cohesion strength renders the stability evaluation of a slope considerably less adversely affected by the action of water pressures in the ground but instead more by its height and the density of the slope body.

The geotechnical engineering community has been informed of studies on actual slope failures and landslides covering a wide spectrum of geological materials commencing with Skempton (1970) that repeatedly arrived at the same conclusion whereby soil strengths or resistances available on the respective shearing surfaces to resist the instability of slopes are the 'fully softened strengths' (an Imperial College, London, terminology) without the existence of cohesion or any significance of it. A similar statement had been made in Bolton (1993) though the term used is 'critical state strength'. The implication of these positions is also that any additional component of strength available from dilatation will not come into play in resisting the shearing process associated with the failure of slopes.

Engineers working on slope issues will also need to expand their repertoire of tools to include a proficiency in conducting analysis with shear surface geometries created by specific pre-existing boundaries between blocks where the mobilisable strengths may generally be significantly lower than those of the intact blocks. ■

REFERENCES

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