

1984/56. Preliminary ideas on the development of guidelines for consultants undertaking slope stability assessments

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Abstract

The development of guidelines for consultants undertaking slope stability assessments should be carried out in three stages. The first stage should be an internal review of how decisions on stability assessments are made within the Department of Mines. This should be followed by discussions with consultants during which approaches to stability assessments are presented. Suggestions and comments about actual guidelines are included in this report to stimulate discussion but the final version of the guidelines can only be produced after internal review and outside discussion.

INTRODUCTION

The need for guidelines for stability investigations has been pointed out by W.L. Matthews in a memorandum to the Supervising Geologist, Engineering Geology Section (Appendix 1). The purpose of this report is to present ideas on how these guidelines might be developed. The ideas are recorded to stimulate discussion, rather than as definite proposals.

It is suggested that the development of guidelines for consultants should be a three stage process. Firstly, there should be an internal review of how decisions on stability assessments are made within the Department. This should be followed by discussions with consultants, during which approaches to stability assessments are presented. Finally, the guidelines themselves should be produced. In this report consideration of these three stages is followed by discussion.

This is the final report of a series of four (the others are Moon 1984b, 1984c, and 1984d) on various aspects of slope stability work in Tasmania. The Master of Science thesis (Moon, 1984a) is complementary to this series of reports.

INTERNAL REVIEW

The purpose of the internal review is to establish clearly how decisions on stability assessments are made within the Department. This is necessary to ensure that a uniform approach can be presented to the consultants and can be reflected in the guidelines.

It is the writer's opinion that this internal review will not result in any radically different approach to stability assessments to that adopted in the past. It is unlikely that the approach, and decision made about the stability of any particular slope, would be very different now to what it was ten years ago, or to what it will be in ten years time. The degree of confidence in the geological model, is, and always will be, fundamentally important.

References that are specifically related to the internal review are not given here as each geologist's individual experience, all previous reports by the Department, and, in fact, the entire literature on slope stability assessments can be considered relevant.

One approach to the internal review would be to arrange an Engineering Geology Section meeting, but informal discussions both within, and outside,

the Department will be important.

DISCUSSION WITH CONSULTANTS

The purpose of the discussions with consultants is to explain the Department's approach to slope stability assessments and to find out what other approaches are being used. Few consultants are involved in this area in Tasmania and it is suggested that initial contact should be informal, one to one, discussions. More formal seminars, although a good idea in theory, may be difficult to arrange in practice, because of the uncertainty of consultants' availability and because of their varying expertise and experience. Discussions with consultants are essential, as the guidelines cannot succeed if fundamentally different approaches to slope stability assessments are being adopted.

During these discussions the consultants should be made aware of the Department's reports in the slope stability area and should be given copies of relevant reports in which they show particular interest. Copies of useful references, such as Simons and Menzies (1978), should also be made available. The non-specialised consultants who operate in Tasmania cannot be expected to keep up with the relevant literature in all specialised fields.

The fundamental importance of understanding the geology of a slope will need to be emphasised, especially to those consultants who have little geological experience. Natural exposures, cuttings, test pits, and boreholes should be carefully logged (Moon, 1980). If this information is not recorded and presented in the consultant's report, the Department cannot assess the validity of the geological model used in the stability analysis.

Effective shear strength testing is another area in which the Department has to assess the quality of submitted data. Geologists within the Department have the expertise and experience to assess the quality of residual strength data determined with a reversing shear box but this can only be done if details of the test procedures and the full results are submitted. Departmental geologists will find triaxial test results harder to review. In these cases outside advice can be sought (e.g. R.A. Rallings or B.F. Cousins). Effective shear strength parameters are discussed by Knights (1977) and Moon (1984a, d, and e).

IDEAS ON GUIDELINES

In this section suggestions and comments are made about guidelines for some aspects of slope stability assessments. The final version of the guidelines can only be prepared after the internal review and discussions with consultants. The principal suggestion here is that consultants and the Department should work closely together at all stages of stability investigations. This is likely to remain the most important guideline/suggestion when the final guidelines are produced.

It is unlikely that even the final guidelines will be detailed and specific, and they cannot be expected to anticipate every aspect of particular projects. The following list of suggestions and comments covers some of the areas where guidelines may be useful:

- (1) Great importance must be attached to the recording and presentation of all available surface and subsurface geological data. Information on the regional geological setting can be obtained from published maps, explanatory notes, or reports while information at or close to

the particular site may need to be obtained by the investigator.

- (2) In most cases it is not practical to establish field monitoring programmes to obtain information on pore water pressures at particular sites. However, consultants should be aware of the pore water pressure monitoring that has been carried out in Tasmania and of relevant studies elsewhere.
- (3) Movement monitoring is not usually possible during short site investigations carried out over a few days. However, if the consultant has long term involvement in particular slope stability projects, movement monitoring by repeated surveys should always be considered. Such monitoring is cheap and it provides vital information on the location and magnitude of slope movements.
- (4) If strength testing is considered it must be remembered that effective shear strength parameters are required (Simons and Menzies, 1978; Moon, 1984a, d, and e). Effective shear strength testing is time consuming and expensive and, in general, will only be undertaken for major projects. In the study of natural slopes where past instability may have occurred the residual strength parameters should be investigated by slow drained multi-stage tests in a reversing shear box or ring shear apparatus.

The Department of Mines can provide advice on testing procedures.

- (5) For the long term stability of natural slopes and cuttings only effective stress analysis should be considered. Methods of slope stability analysis are presented and discussed with examples by Moon (1984a, b, c, and d). Measured slope profiles should be presented with any stability analysis. The profile should include the entire slope, irrespective of the project area, and should include relevant topographical and geological detail. Slope stability analysis which does not include consideration of the confidence in the geological model is of limited value.

DISCUSSION

The suggestions presented in this report are preliminary ideas only. They may be modified or changed following the internal review of the Department's approach or after discussion with consultants. The final guidelines should be produced after the review and discussion processes. Engineers and geologists outside the Department (e.g. B.F. Cousins, R.A. Rallings, and A.T. Moon) will be willing and able to contribute to the formulation of useful guidelines and their advice and assistance should be sought.

REFERENCES

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APPENDIX 1

Memorandum by W.L. Matthews

GUIDELINES FOR STABILITY INVESTIGATIONS

The need for guidelines for stability investigations undertaken by consulting engineers has become apparent from a recent situation that has developed concerning land at Opossum Road, Launceston, as well as from previous investigations in other locations. The Department of Mines is unable to undertake detailed subsurface investigations on all land with questionable stability that owners desire to subdivide. As the availability of flatter land becomes less, there will be more pressure to develop the land with marginal stability. When consulting engineers undertake stability assessments, it is usually up to the Department of Mines to examine their reports before final approval for development is given. If the methods employed by the engineers are not in accord with the methods considered appropriate for that piece of land, then it is unlikely that the conclusions will be completely accepted and the owner wishing to develop the land has spent money needlessly.

The problem at present arises where detailed (and time consuming) subsurface work is required. This is mainly in areas where signs of old landslips are visible and in areas of steep, apparently unfailed slopes underlain by soft rocks. The main concern is the method of determining the strengths of materials for stability analyses. Although this is only one aspect of stability assessment, quite a lot of reliance is usually placed on these measurements.

The paper by C.J. Knights (1975; Tech.Rep.Dep.Mines Tasm. 19:93-99) outlines what are regarded as appropriate methods of strength determinations in various situations with particular reference to Tamar valley sediments. The thesis work of A.T. Moon largely supports the conclusions of this paper on testing procedures, as well as describing different mechanisms of shearing with particular reference to basalt soil. It would seem that these two reports should form the basis of any guidelines on strength testing for stability analyses.

In areas where old landslips are obvious from the landscape, or at least suspected, the likelihood of reactivation is the most important factor that should be investigated. Residual strength parameters should be considered when testing samples in the vicinity of the probable slip surface. Samples from the zone of the probable slip surface should be collected for strength measurements, as there is little point in only testing samples from near-surface when the slip surface may be 8-10 m deep. Near-surface samples may have a bearing on the possibility of shallower slides. Are residual or fully softened parameters more appropriate for these samples?

For steep slopes underlain by clay that show no signs of past movements (such slopes may be hard to find), fully softened parameters may be the most appropriate strength measurements.

In future consulting engineers who become involved in stability assessments should be encouraged to enquire broadly from the Department of Mines what procedures to adopt in their investigations of a particular piece of land (some already do). Usually someone from the Department of Mines will have examined the land on the surface. The above two reports (or extracts) or a separately prepared document outlining acceptable procedures should be made available to consultants. This should prevent situations

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where some data from subsurface investigations are regarded as inappropriate to the situation. It has to be assumed, however, that the most appropriate samples are tested.