

## SESSION 14: LANDSLIDES

Papers:

PHYSICAL MODELLING OF SEQUENTIAL SLOPE FAILURE  
M. Dunbavan; vol 2, 41-45

ASSESSING THE PROBABILITY OF RAPID MASS MOVEMENT  
M.J. Crozier and R.J. Eyles; vol 2, 47-51

THE GEOMECHANICS OF SOIL CONSERVATION  
J.G. Hawley and P.G. Luckman; vol 2, 53-60

Paper by M. Dunbavan

In the absence of the author, the paper was presented by Dr H. Bock of James Cook University of Queensland.

Mr G. Salt asked if the numerical analysis successfully predicted the occurrence and location of internal secondary failure surfaces. Dr Bock replied that theoretical investigation using differing criteria had enabled a certain predictive capacity for the whole system; ie, three slip planes and two wedge systems.

Mr J.H.H. Galloway commented that the smoothness of the bentonite rather than the thickness was the more important, and the author should not be dismayed that the bentonite thickness proved to be an insensitive parameter.

Mr G. Boyd asked if the development of the final reverse angled shear occurred at an attitude predictable by either Rankine stress states or Mohr-Coulumb failure criteria? Dr Bock said that it was found not easy to apply either failure criterion.

Mr P. Gray asked if the author had done any numerical studies where the cohesion is zero, to determine the relative shear strengths of the two layers. At what point would the failure surface change to a circular or planar failure, thus establishing criteria differentiating between circular or two wedge failure? Dr Bock replied that shear strength tests on the sand and bentonite had been done. The constraints imposed by model geometry and material present meant that a simple planar failure was not possible.

Paper by M.J. Crozier and R.J. Eyles

Mr Man-Kwong Pan noted that this and another paper by the author refers to work by Lumb in Hong Kong. There is a general similarity in approach except that Lumb used a 15-day antecedent rainfall and did not use decay. Lumb also concentrated on catching 'disastrous and serious events' only and he did not use the decay factor for three reasons:

- a) Weather was overcast with high humidity
- b) Vegetation and soil were sparse or absent

c) Permeability of soil was high.

Could the author comment on how these factors relate to the New Zealand situation?

Dr Eyles replied that as the parameters used from the Wellington Meteorological Office data satisfied 90% of the problems in Wellington, it was thought the correct antecedent time with decay had been chosen. Similarly for the Wairarapa where slope failure could take place under low rainfall conditions.

Mr P.C. Stevenson asked how slips were reported to give data of this quality, and if Landsat photography had been used. Dr Eyles explained the close cooperation with the City Corporation and Local Catchment Boards and said that Landsat data had not been used.

Prof D. Stapledon asked if seismic events might have triggered any of the landslides. The authors did not think this was the case with the slopes they examined.

Prof Fukuoka explained that in Japan intensity (mm/hr) of rainfall was used rather than daily rainfall in this type of work. Dr Eyles agreed that this might be a better approach but explained that rainfall intensity data were not available. He then added that the average annual rainfall in Wellington is about 1200 mm/yr, although recent years have recorded a higher rainfall. Evaporation accounts for half to two-thirds of this.

Mr G. Boyd wondered if soil saturation was possible for seepage coming from bedrock as well as from rainfall. Dr Eyles stated that in Wellington rainfall was the mechanism that could account for saturation in failed slopes.

Paper by J.G. Hawley and P.G. Luckman

Mr D. Raisbeck asked the author to expand on the use of infra-red photography in identification of wet and dry areas. Dr Hawley replied that this allowed the prediction of what will happen, and where and when; for example, land might eventually become only useful for forestry. It enabled decisions to be made about the plots to use for productivity tests so that (for example) old slip scars which are undetectable to the eye, would not be used.