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1988/24. Comments on the investigation of cracked buildings at the TSIT Campus at Launceston

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INTRODUCTION

Presumably because I originally proposed the trio of Smith, Sale and Burbury; the Department of Mines; and Dr Ingles to conduct the investigation into the building cracking at the Tasmanian State Institute of Technology campus at Newnham, Launceston, I have been asked to comment on the investigation to date. These comments include Dr Ingles report and the correlation of all the subsurface information from previous reports on the site which have now become available to Smith, Sale and Burbury. This correlation is now being undertaken by J. Baker, the engineer replacing G. Taplin from Smith, Sale and Burbury.

INGLES REPORT - GENERAL

Ingles has convincingly proved that the deep expansive clay soil which was drilled in the two diamond-drill holes at the site in 1987 is the primary cause of the existing cracking of these buildings. Consolidation, landslide, and traffic vibration etc. are no longer tenable as possible explanations for this cracking. This is a major step and alone justifies the investigation.

Dr Ingles' report should be mandatory reading for any future design engineer and building contractor for any new building on this difficult site. To ignore this report, or to put it on the shelf because of some technical difference of opinion or because it would be too expensive to implement, as unfortunately does happen with controversial consultant reports, would be a serious mistake.

Equally, the report is not designed, and should not be used as, a blanket answer to replace a thorough site investigation of any future building site on the campus. Ingles clearly states "These values are quoted only as a general guide and do not replace the necessity for individual measurements to be made on each proposed building site."

EXPANSIVE SOILS

On reading the Ingles report it is easy to imagine the initial effect on most Launceston engineers. They are likely to be shocked by the report's figures which show that a total of 190 mm movement, and a differential movement of 90 mm, is possible at this site because of the expansiveness of the clay. These figures are based on drying and wetting fronts penetrating to depths beyond four metres in the clay.

Ingles' figures approximate the estimates of the Department of Mines of 140 mm total and 70 mm differential movement, based on linear shrinkage tests of the clay from a series of drill holes next to four cracked houses at Legana. These cracked houses were investigated during the drought of 1981-83, a period where, more importantly, there was a lack of winter rains. The technique used by the Department was to drill a series of holes in the clay in the drought period, and redrill the holes after the

heavy winter rains, thereby comparing moisture content profiles and soil suction profiles between the two periods. The depth of moisture fluctuations appeared to be at least 3.0 m and probably between 3.5-4.0 metres. At Legana the grey, red-mottled and orange clay was drilled at seven metres depth.

It was heartening to read in the report "Concerning the TSIT clay soil, this difficult site ..... the second most expansive soil the writer has met in a long career". During a visit by the International Landslide Conference delegates to Windermere (East Tamar) in June 1987, where similar clay to that at the TSIT exists, the overseas delegates were frankly sceptical of the Department of Mines soil laboratory results on the clay of the Launceston Beds of the Tamar Valley.

SEISMIC RISK

Until reading the Ingles report, the writer has never seriously considered the seismic risk of Launceston, other than being vaguely low. Basically this is because his youth and geological training were in the seismically very active areas of Hawkes Bay and Wellington of New Zealand. Consequently, no comment can be made on seismic risk conclusions of the Ingles report. It is recommended that Dr Underwood, seismologist at the Hydro-Electric Commission, be consulted covering this section of the report.

RECENT UPLIFT - TAMAR VALLEY

Pleistocene uplift is known to occur in north-east Tasmania. The tectonic movement in this region started in the Cretaceous times, forming the Boobyalla Trench (Moore *et al.*, 1984) and appears to continue in this region through the Tertiary to the Pleistocene. This E-W faulting is associated with the opening up of Bass Strait and the forming of sedimentary basins between Tasmania and mainland Australia.

NW-SE faulting of Pleistocene age occurs along Macquarie Harbour. It is possible that recent faulting of the same NW-SE direction has caused uplift to occur in the Tamar trough, but the writer knows of no fault on which recent movement has been proved.

At Windermere palynological evidence suggests that the grey mottled clay is possibly a refill Tertiary deposit in a trench at or near river level, and considerably younger than the underlying silty clay. The grey clay and silty clay may not only be a lithological break but may mark a localised discontinuity (plate 1). If this erosion and reworking, followed by deposition at different geological periods of time within the Tertiary is proved, it would make calculations of over-consolidation etc. specific to that location in the Tamar Valley.

LITHOLOGICAL VARIATION WITHIN THE LAUNCESTON BEDS OF THE TAMAR VALLEY

Because of their mode of deposition, fluvial sediments are notorious for rapid facies changes, and the Launceston Beds of the Tamar Valley are no exception. In the dominantly clay and mudstone succession, minor gravel, sand, silty sand and lignite lens occur which interfinger laterally as well as at depth. They also change from unconsolidated gravel and sand to

cemented sandstone and conglomerate within short distances. These lithological variations all contribute to the engineering geology problems of the Tamar Valley, such as landslides, expansive soils and differential foundation movements.

Because of this rapid sedimentary change all the previous investigation information on sites such as the TSIT should be retained and made available for the next building site investigation. The delayed release of the previous site investigations did a serious disservice to the present investigation. The correlation of all the lithological information gained from previous investigation bores should preferably have been undertaken before the siting of the drill holes of this latest investigation.

CORRELATION BETWEEN PREVIOUS INVESTIGATION DRILL HOLES

It was with the knowledge that all the information from previous investigations was now available that the present investigation was restricted to two diamond-drill holes by all three parties to this investigation. These holes encountered only limited lithological variation but these variations were exposed in the excavation of the Nurses Training Building (Plate 2). Therefore, it is essential that the location and lithological correlation of the previous site drill holes be undertaken by Smith, Sale and Burbury's Launceston office. Only when this research is completed and the geological cross-sections drawn between previous investigation drill holes will it be possible to establish and try and understand the complex geology of the existing campus site. With this site compilation completed, and combined with the soil laboratory results and lithological control of the two investigation diamond-drill holes covered by the Ingles' report, hopefully the pattern of cracking and the reasons why it is confined to a certain number of the existing buildings should be better understood. It should then be possible to judge the adequacy of the individual building foundations in relation to the soil on which they are built.

By building up this geological understanding it may be possible to predict future areas of expansion on the campus where the risk of cracking is not as great, as clay may not be as thick or may be replaced by less expansive silt clay etc. It must be stressed that any future predictions are only guidelines and do not replace an adequate site investigation, backed by soil laboratory measurements at each site.

REFERENCES

MOORE, W. R.; BAILLIE, P. W.; FORSYTH, S. M.; HUDSPETH, J. W.; RICHARDSON, R. G.; TURNER, N. J. 1984. Boobyalla Sub-basin: A Cretaceous onshore extension of the southern edge of the Bass Basin. *APEA Journal* 24:110-117.

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Plate 1. *Grey and bauxitic red clay above sandy clay and clayey sand. Boundary shown by bench.*

Plate 2a

Plate 2b

Plate 2c

Plates 2a - 2c. *Lithological variation illustrated in the excavations for the Nurses Training Building.*