Development of EC7 Malaysia National Annex for the Design of Embankment Stability on Soft Ground

The "Paper Series on Structural Codes : Development of EC7 Malaysia National Annex for the Design of Embankment Stability on Soft Ground" authored by Ir. Tan Yean Chin was published in 2 parts in the September 2010 and October 2010 issues of JURUTERA. JURUTERA received the following views performing to the author's presentation of the results from a prototype test embankment to persuade the use of small Partial Factors in the Malaysia National Annex to EC7, a design guidance document being developed by The Institution of Engineers, Malaysia. – Editor

Comments from Ir. Yee Thien Seng

The Author is arguing that provisions in the British National Annex (UK-NA) to EC7 are not completely suited for application in Malaysia owing to a number of specific factors; most notably amongst them being geology and sub-soil conditions. He suggested that the UK-NA was formulated for use in medium to stiff London Clay and, therefore, may not be of relevance to the soft coastal alluvium in this country. In insinuating that the British do not construct embankments on very soft ground, obviously the Author is clearly ignorant of documented experiences in Britain of such constructions from as early as 1953 (Golder and Palmer, 1955). These were constructed for sea defences.

Very soft soils also prevail significantly in Europe. The Author is not correct in his Section 4.2 (e) to imply that soft soils do not exist in Europe. In fact, it was in Scandinavian Europe that the birth of the world's systematic soft clay engineering practices took place with the construction of the Vasby trials in 1945 (Chang, 1981).

It seems strange to cite differences in geology as a defining factor to discredit the possible adoption of engineering design philosophies laid out in the UK-NA. Engineers, particularly ground engineers, have had always to employ mechanistic procedures in their analysis work and this can only be realistically made in the presence of quantifiable data which have to be obtained by meaningfully testing the ground or samples of it. Geology only accords a qualitative treatment of the ground conditions and provides little basis for quantitative engineering undertakings.

In support of his case, the Author has used his back-analysis to an experimental section constructed for the program of Trial Embankments on Malaysian Marine Clays (MHA, 1989). The section concerned an embankment construction deliberately built up in a very well controlled manner until failure was induced at the fill thickness of 5.4 m. Without modifying any data documented in MHA (1989), the Author's back-analysis produced the failure thickness of just 3.4 m. for the same construction; an unusually large under-estimate given the full availability of the documented high quality data. It is

unlikely that there would be better quality data available in any other real-life construction.

The Author is attempting to pass off his stability evaluation procedure as the 'Malaysian Method' for dealing with such issues. (He has not enumerated on his analysis method.) In the first place there does not exist a procedure for embankment stability analysis that can be branded as such. Further, it is clear that he has chosen to ignore the existence of past literature on similar back-analysis work on the very same experimental section.

Of note is the effort of Chee (1999), an evaluation on the same experimental section using the data in MHA (1989) with the outcome showing that an industry practice would produce an only marginally conservative analysis. Chee (1999) also reviewed another 2 sections in the same trial embankments program (so had exactly the same embankment material characteristics and construction techniques) that experienced structural failures; the outcomes of which suggest that the same analysis practice would have resulted in unconservative results unless the undrained shear strength values in the same ground are reduced by quite a significant amount. This would point to a lack of full reliability in the stability analysis procedures available to industry; a fact borne out by the huge spread in the pre-symposium participants' predictions (MHA, 1989). Yee (2004) postulated that the incomplete conventional model used to represent mobilisable shear strength distribution in the ground was the prime cause for the less than satisfactory stability analyses.

It is not clear why the Author's back-analysis should produce such an enormous under-estimate for the failure thickness given the existence of earlier published literature on the same case to the contrary. It is noted that his Section 4.2 (b) tries to justify the under-prediction by suggesting that there was 'gain in strength of the subsoil with time'. This is completely contradictory to his assertion in Section 4.1 which clearly declared that 'there was an insignificant gain in strength in the low permeability fine grained subsoil'.

In any case, his effort constitutes nothing more than a single case study. And, just as for any scientific development, it is unprecedented to employ just a single piece of evaluation (even if truthfully correct) to shape the engineering industry practice for an issue as important as embankment stability.

Had the technique, which the Author claims to be a country-wide practice, yielded the large reserve against actual failure he is now saying the construction industry should be relatively free from embankment failures by now; irrespective of how unrepresentative the ground data would have been. But this is certainly not the case. A check with the insurance industry reveals collapses during embankment constructions still occurred with frequent regularity in these last 2 years, including several in key transportation projects in Peninsula Malaysia alone. And, interestingly enough, a number of these had their analyses and designs undertaken by individuals or groups indulging in energetic efforts to shape geotechnical engineering practice in the country.

So the Author's clamour for Partial Factors all round to be reduced from those incorporated in the UK-NA lacks credibility. Particularly when earlier efforts from others point to the contrary coupled with the lack of full reliability in stability analysis techniques available. The latter may actually warrant greater Partial Factors instead. The Institution of Engineers, Malaysia, a learned society with an implied obligation to look after public interests, has the duty of care not to commit members of the institution and profession to reckless acts nor to abet in the same.

Authors' reply

There is no argument that there is soft ground in Europe. What the author stressed on is, for the development of a new code such as the Malaysian Annex (MY-NA) for EC7 to be adopted in Malaysia, there should be proper considerations of existing practices in the industry, especially the latest methodology and development (e.g. for the last 10 to 15 years and not that of 30 to 50 years ago as there should be improvement with time) on the selection of parameters (e.g. soil strength, permeability and stiffness), analysis and design, construction control and factor of safety (FOS) which have been widely used in our country for the last 10 to 15 years. Reference should also be made to the accepted analysis and methodology adopted for the latest major infrastructure development in our country (e.g. for the last 10 to 15 years) that have been successfully constructed and operated, which covers sizeable reclamation, highway, expressway, railway embankment, etc.

Any recommendation to follow UK Annex (UK-NA) of EC7 in Malaysia without these detailed investigations or studies would not do justice to the industry specifically and the nation as a whole. This is because if a higher than normally accepted FOS is adopted (e.g. follow exactly UK-NA values), it would lead to additional cost (e.g. more ground treatment needed) which will hinder development and the higher cost being transferred to the public (you and me as taxpayers). On the other hand, dangerously low FOS would lead to a higher risk of failure that could affect public safety.

The paper presented factual information of the Muar Trial Embankment and the interpretation and analysis by the author is self-explanatory. It is important to note that as professional engineers, it is our responsibility to obtain reliable soil parameters and other information needed for a proper analysis, design and construction control. As for obtaining reliable and good quality soil parameters, it can be achieved by putting an effort into planning, selection of contractors, full time proper supervision, checking and correct interpretation. The author is against using a higher FOS because of the "myth" of not being able to obtain reliable and good quality parameters or the engineer is unable to carry out the work properly due to a lack of capacity or capability.

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