SESSION 7: REINFORCED EARTH

Papers:

REINFORCED EARTH APPLICATIONS IN AUSTRALIA AND NEW ZEALAND
M.S. Boyd; vol 1, 143-148

DESIGN OF REINFORCED EARTH FOR NEW ZEALAND CONDITIONS
B.B. Prendergast and G. Ramsay; vol 1, 155-161

Paper by M.S. Boyd

Mr M.C. Ervin expressed reservations about designing a structure with a finite life; ie, at the end of the 70-100 year design life of a reinforced earth structure, should it be pulled down? He also asked about the required compaction standard during construction of a reinforced earth wall especially concerning the subgrade region of the pavement. Mr Boyd replied that some definitive figure is required for the design life of a structure, in this case in the order of 100 years for reinforced earth applications. He suggested that the practical useful life of reinforced earth could be longer, and at the end of the design life the structure could be rebuilt or restored (using ground anchors etc). In general, compaction requirements for reinforced earth were the same as for any other embankment. In this case 90% of modified compaction was used. Settlement problems would be no worse than for any normal earth structure.

Mr P.J.N. Pells commented that numerical analyses conducted at Sydney University by Dr P. Brown indicated that the maximum strip stress was at or close to the wall. The holes in the strips to tie to the facings were usually drilled after the strips were galvanised. Therefore maximum stress occurred at areas that were only partly protected by galvanising and he queried the long term stability. He also inquired about the patent challenge in the UK and the legal responsibility of Reinforced Earth Co if failure occurred. The author stated that patent rights had been settled in the UK between Vidal and the Department of Transport so that work would continue. He agreed that in a working stress situation maximum tension shifted away from the face. All design calculations on connection capacity had a correction for corrosion and the strips were now punched before galvanising to remove this corrosion problem. Reinforced Earth took responsibility for any failures that occurred in the design life provided the structure was built to specifications.

Dr P.R. Goldsmith wanted to know the limitations of the Reinforced Earth concept and areas where further research might be required. Mr Boyd stated that since, in general, the structure was massive, it was not economic in a cut situation, but apart from this the limitations were as for normal structures. Many aspects of the reinforced earth concept required further research, such as soil strip friction characteristics, internal behaviour of the earth mass etc. At present the design method was conservative but not so as to destroy the economy of the method.

Mr W. Robertson inquired whether in a bridge abutment situation there was evidence for the reinforced block influencing the distribution of transverse settlement when constructed on a compressible foundation. Mr Boyd replied that at present no allowance was made for this effect as there had been no evidence of this influencing any structure that had been built.

Mr L. Doyle asked what jointing system was used to prevent material loss in tidal situations such as Bluff Harbour and in other structures where loss could occur with deterioration of the joint filler. Also Mr Doyle wondered about the feasibility of joining walls together when they occurred in parallel units. Mr Boyd stated that at Bluff Harbour a filter fabric was extended up from the base to prevent soil loss in the walls. In normal use, a polyfiller was applied internally to the joints and therefore was not exposed to UV attack and so should last the life of the structure. Parallel reinforced earth walls were in general placed so far apart that the two earth blocks were not in contact. If there was contact it was preferable to overlap the blocks, since a different design approach would be required for continuous strips and problems with construction would be severe.

Mr Ho asked what percentage of organic matter or any other deleterious matter was allowed in the backfill. Mr Boyd replied that at present there was no limit on organic material in the backfill and any limit would be difficult to define. A visual inspection would probably be adequate.

Mr T.A.H. Dodd asked whether any method had been found to assess the strength left at the end of the design life, whether the structure could be strengthened to prevent catastrophic failure and whether an existing reinforced earth wall could be heightened. Mr Boyd replied that there was no easy method to examine the internal condition of a structure, although this problem was being studied. The use of test specimen strips in the structure that were able to be inspected, was mentioned. A reinforced earth structure at the end of its life could be strengthened by methods such as ground anchors as mentioned before. Increased height could be achieved, however, there could be problems as there might be a need for increased width of reinforcement.

Paper by B.B. Prendergast and G. Ramsay

Prof Fukuoka stated that he felt that the method used by the authors to determine seismic loading on the wall was erroneous. Static and earthquake earth pressures should be measured first, a detailed study made of the phenomena of rupture and then design earth pressures proposed. Vertical motions as well as horizontal motions should be considered. Mr Prendergast replied that the design was considered adequate and the Mononobe-Okabe method to determine seismic loadings was in general usage. Although this method was likely to be conservative, the idea was to subject the wall to earthquake pressure in a similar manner to concrete walls by the best method available. Modern trends seemed to indicate that outward displacement was acceptable.