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Evaluation of finite element predictions for constructional behaviour of a rockfill dam

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In our study of the behaviour of the Llyn Brianne Dam, the movements of 26 steel plates buried in the downstream rockfill on the major section of the dam were measured during and after construction. A complete record of the constructional movements was published,[9, 23] and this has been of benefit to the Authors and others[21, 24] in developing methods of movement prediction.

56. In Fig. 10 it is unfortunate that the comparison of strains is between observed major principal strains and predicted vertical strains and observed minor principal strains and predicted horizontal strains. Clearly it would be preferable to compare like with like. The observed vertical and horizontal constructional strains are presented in references 20 and 25. The observed vertical and major principal strains are very similar, but there are significant differences between the horizontal and minor principal strains. However, the agreement between observed horizontal strain and the predicted horizontal strain shown in Fig. 10 is still poor.

57. Having carried out two-dimensional and three-dimensional elastic analyses and various forms of non-linear elastic and elastic-plastic analyses, the Authors conclude that the best agreement between observed and predicted deformations was obtained using a simple elastic analysis. This simple elastic analysis is very similar to that used in references 9 and 23. The reasons why simple elastic parameters derived from one-dimensional compression tests can predict the deformation behaviour of rockfill embankments reasonably well are discussed in reference 26. This type of parameter is likely to prove inadequate in describing the behaviour of the rockfill immediately adjacent to the outer face of the rockfill. The Authors may be correct in listing as a primary cause of discrepancies between observed and predicted deformations, the simple modelling of the clay core behaviour. In reality its behaviour is extremely complex and it is unlikely to correspond closely to the nearly incompressible, highly deformable elastic model. It is clear that improved predictions can come only from a better understanding of soil behaviour, and until this is obtained increasingly sophisticated forms of analysis are of little practical help.

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Detailed records of movements and pore pressures in embankments during and after construction are essential to the further development of numerical methods. If the analyst is to make good use of field records he requires as much information as possible

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about the structure—particularly material property data. The dissemination of detailed material property data for instrumented structures is to be encouraged.

59. We agree with Dr Penman and Dr Charles that elastic parameters derived from one-dimensional compression tests can be used successfully to predict constructional deformations in rockfill embankments. Parameters so obtained will be adequate while strains in the embankment approximate to such conditions. In the Llyn Brianne Dam the clay core exerted a considerable lateral thrust on the rock fill and therefore made a significant contribution to the deformation pattern of the dam. A successful numerical analysis of the dam must therefore include a suitable model of the clay core. This will require a constitutive model appropriate to the fluid nature of the core but one which permits consolidation and the associated development of shear strength and stiffness.

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