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Reply to the discussion by Tran and Mitachi on "Analytical and Numerical Solutions for a Single Vertical Drain including the Effects of Vacuum Preloading"

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The writers are grateful for the interest and the feedback provided by the discussers. Responses to their concerns are addressed in the following:

Applied vacuum pressure for the equivalent plane strain condition

The Authors agree that the applied vacuum pressure in the equivalent plane strain condition will be the same as that in the axisymmetric condition. However, the improtant findings in this paper are the possible variation of vacuum pressure with time, and the most appropriate approach to model the consolidation process via PVDs incorporating vacuum preloading.

Smear zone simulation for finite element analysis

Hird et al. (1992) approach tends to average the soil properties of axisymmetric smear zone across the entire plane strain unit cell. Therefore, it is not an explicit way of modeling the smear zone, although good accuracy can often be obtained. This method also affects the predicted results such as excess pore pressures which are usually measured and compared at a particular point rather than an average value across the unit cell. In contrast, the Authors have incorporated the smear zone explicitly in the plane strain solution. Although, as correctly indicated by the Discussers, this method may increase the number of elements, the modeling materials and therefore the computational time, the proposed method produces better accuracy for multi-drain analysis where high performance personal computers are available. The Authors have verified this through several recent case histories (Indraratna et. al., 2005).

Simulation of vacuum pressure

As suggested by the discussers, the negative vacuum pressure can be simulated by setting the negative pore pressure at the top of the drain, expecting that this will then propagate to the bottom of the drain according to the drain characteristics. However, according to the laboratory measurements provided by Indraratna et al. (2004), it clearly indicated that vacuum pressure propagates immediately and decreases significantly down the drain length. Therefore, the analysis with fixed pore pressure boundary along the drain length as proposed by the Authors will be more realistic in actual practice. For a given applied vacuum pressure, the various vacuum distribution patterns resulting in different settlement magnitude (i.e. constant or varying vacuum pressure) can be simulated directly by the Authors' method, whereas the equivalent vacuum pressure applied at the top of drain has to be arbitrarily adjusted, if vacuum loss occurs.

The use of eight-node quadratic elements with biquadratic displacement and bilinear pore pressure nodes

To minimize the accuracy and precision issues in the finite element analysis, the Authors have selected higher order (eight-node quadratic) elements with biquadratic displacement and bilinear pore pressure nodes for the selected case histories at the Second Bangkok International Airport reported by Indraratna et al. (2005). As suggested by the Discussers, in some cases, the use of lower degree of freedom elements may be adequate. The Authors have investigated many case histories from all over the world (e.g. Indraratna and Chu, 2005), and subsequently analyses by them indicate that the role of the mesh elements is also a function of the complexity of soil structure discretisation, soil properties, boundary conditions, etc. It is the Authors' experience, that the eight nodes quadratic elements have performed better than say 4-node (bilinear) elements in many such cases.

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