33.3: Ground Settlement and Centrifuge Modelling Experiments

In a mud slide, pore pressure does not have time to drain because the grains of earth are small and the pathways for drainage between the grains are too narrow. Therefore, under suitably adverse conditions, gravity can cause a mud slide where there is soft clay and where structures for building such as a road embankment are built.

In general with disturbed soil, as the pore water drains and the grains of earth are able to grow into close contact, settlement of the ground surface occurs over time. Where tunnels are constructed in soft clay beneath urban areas, there is the possible risk that above these tunnels, settlement of the ground surface can cause problems such as the partial or total collapse of buildings at street level.

The engineering problem of ground settlement can be modelled at reduced scale and increased acceleration using a large centrifuge with a hopper which places a sand embankment on a clay model foundation. Since mathematically, settlement is a diffusion problem, the shearing in compression of the clay over time will take place in centrifuge experiments at a reduced time scale of $1/n^2$ where $n$ in the multiple in terms of gravitational force $g$ to which the soil is subjected in the experiments.

Therefore, in a centrifuge experiment in which testing is undertaken at 100g, the reduction in time is a factor of $10^4$. Hence, a suitably designed seven hour centrifuge experiment at 100g can enable reliable predictions to be made about ground settlement over a period equivalent to 8 years at ground level on the Earth under $g$. 

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