FINITE ELEMENT ANALYSIS OF THE EFFECTS OF RISING GROUNDWATER

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The problem of rising groundwater levels is prevalent in many major cities such as Paris, New York, Tokyo, and London. In the late nineteenth and early twentieth centuries, many of these cities sustained considerable industrial activity, with an associated demand for water which was satisfied by abstraction from deep aquifers. In time this caused water levels in the overlying strata to fall by several tens of metres, and/or created pore water pressure profiles which were significantly less than hydrostatic. The migration of industry away from city centres led to reductions in groundwater abstraction and a subsequent reversal of falling phreatic and/or piezometric levels.

Many structures in these cities were built when pore water pressures were relatively low. Values of soil strength and compressibility used in the design would have reflected the beneficial effects of increased effective stress levels. The subsequent recharge of pore water pressures to their original hydrostatic (or even artesian) values may, therefore, have potentially serious consequences for the stability and serviceability of these structures.

This presentation will look at some numerical studies conducted over the past decade which have investigated the effects of rising groundwater on earth-retaining structures, deep basements and tunnels in the London area. In each case, coupled analysis has been used in CRISP to simulate a variety of present day and future pore water pressure conditions. Some of the examples are real case histories, whilst others are hypothetical (though representative). Some of the additional deflections and changes in internal forces (shear and bending) caused by rising groundwater will be shown.