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Evaluating the Potential for Earthquake-Induced Liquefaction in Practice

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Hydraulic and other loose sand fills and recent alluvium with a high water table:

- Simplified methods of evaluation apply, but you really don't need them.

- It should have been obvious that recent alluvium along the Avon River in Christchurch was susceptible to liquefaction just as it should have been obvious to more people that the active tectonics that are very visible in the North Canterbury Fold and Thrust Belt are concealed by the sediments that underlie the Canterbury Plain. ***

All other cohesionless soils:

- Simplified methods do not apply because they are calibrated principally to observed behavior in hydraulic and other loose fills and recent alluvium with a high water table.

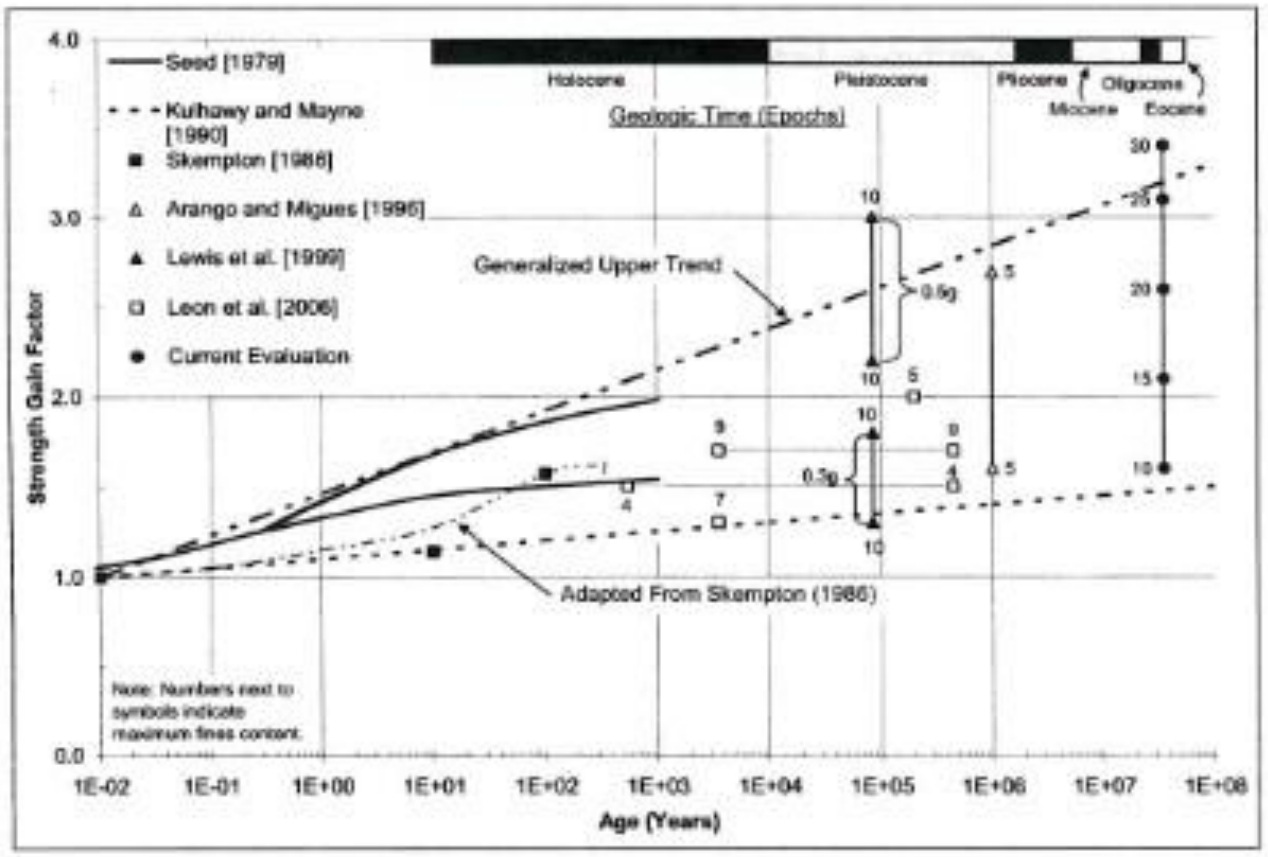
- Liquefaction and lateral spreading and seismically induced settlement are usually not a big problem. [Estimates of settlement from canned programs and spreadsheets are especially conservative.] ***

Why not?

- Partial saturation and partial drainage
- Presence of clayey fines (reduces penetration resistance, increases resistance to liquefaction and settlement)
- Lack of continuity of cohesionless soils (soft inclusions in a stiffer matrix are not subjected to the same strains as continuous layers of a soft soil)
- Soil fabric, and hence the time under sustained pressure, or age, the previous shear strain history, the coefficient of lateral earth pressure and overconsolidation

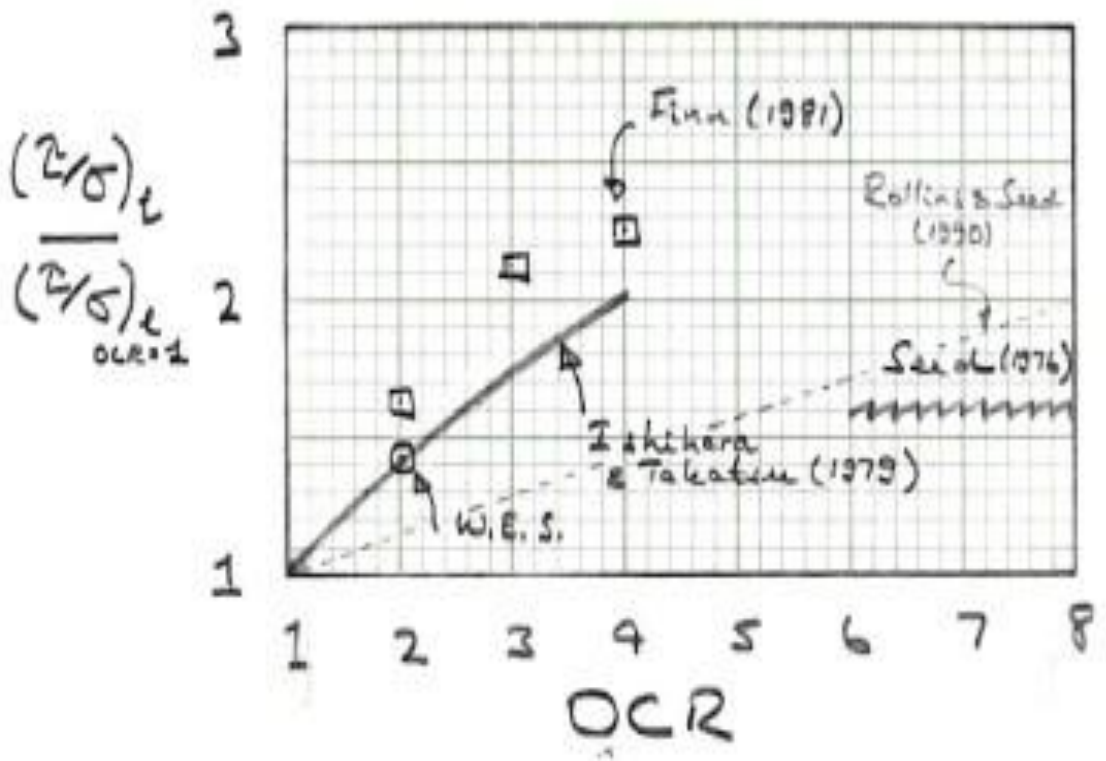
Effect of ageing:

From Lewis et al. (2005)



Effect of overconsolidation:

- Greater than suggested just by the increase in the coefficient of lateral earth pressure ***



Three case histories are summarized in the paper:

- Australia
- New Zealand
- California

Hard to escape the conclusion that consultants, reviewers and specialty contractors benefit financially from creating problems rather than solving them!

Conclusion 1:

- Shear wave velocity is generally a more useful index than static or dynamic penetration resistance. ***

Conclusion 2:

- Rather than just emphasizing use of simplified methods, academics should be pursuing more studies of the kind recommended by Dobry et al. (2015) including "*further laboratory and field research toward clarification of the specific factors causing the observed increased liquefaction resistance of natural sands discussed in the paper, such as geologic age and preshaking by previous earthquakes*."