Half-Day Seminar entitled "Excavation Design, Case Histories and Geotechnical Safety in Relation to Water Pressures"

By: Ir. Chua Chai Guan

The half-day seminar entitled "Excavation Design, Case Histories and Geotechnical Safety in Relation to Water Pressures" took place at Tan Sri Chin Fung Kee Auditorium Hall of Wisma IEM on 12 July 2011. The speaker was Professor Brian Simpson, a Director in Ove Arup & Partners Ltd and a principal of Arup Geotechnics. He was also the Rankine Lecturer in 1992 and is the Chairman of the BSI committee on geotechnical codes, B/526, which is responsible for the National Annex of Eurocode 7. The seminar attracted 60 participants.

Prof. Simpson started the seminar by introducing Section 9 of Part 1 of Eurocode 7 (2004) which encompasses the eight main elements for the design of retaining structures. He explained in detail about the serviceability limit state and ultimate limit state, actions, geometrical data, design situations, design and construction considerations as well as determination of earth pressures & water pressures.

Prof. Simpson highlighted that the design aspects frequently overlooked were the ***allowance of 10% for over excavation***, ***the equilibrium in vertical direction for embedded wall*** and ***adverse wall friction***. He also cautioned the audience that the recommended analytical procedure in EC7 for obtaining limiting values (K_a & K_p) was more conservative than Caquot & Kerisel when ϕ and δ/ϕ were large, see Figure 1.

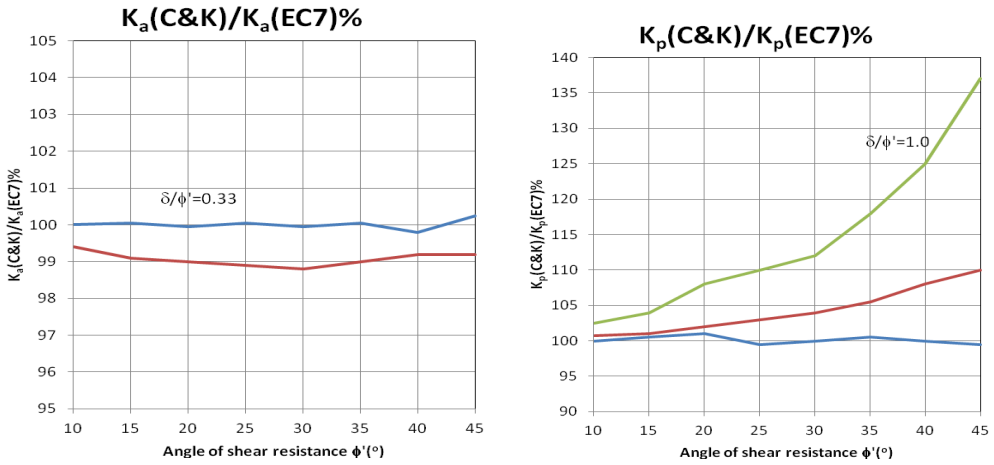


Figure 1 Ratio between coefficients of active and passive earth pressures from Kerisel and Absi and from EC7 Equation G12 (after Simpson, 2011)

Prof. Simpson also presented the comparison between different design methods for an 8m high propped wall. In this case, ***the design approach of EC7 appeared relatively more economical*** as it provided the least embedded wall length and bending moment compared with that of CIRIA 104 and BS8002 (Figure 2).

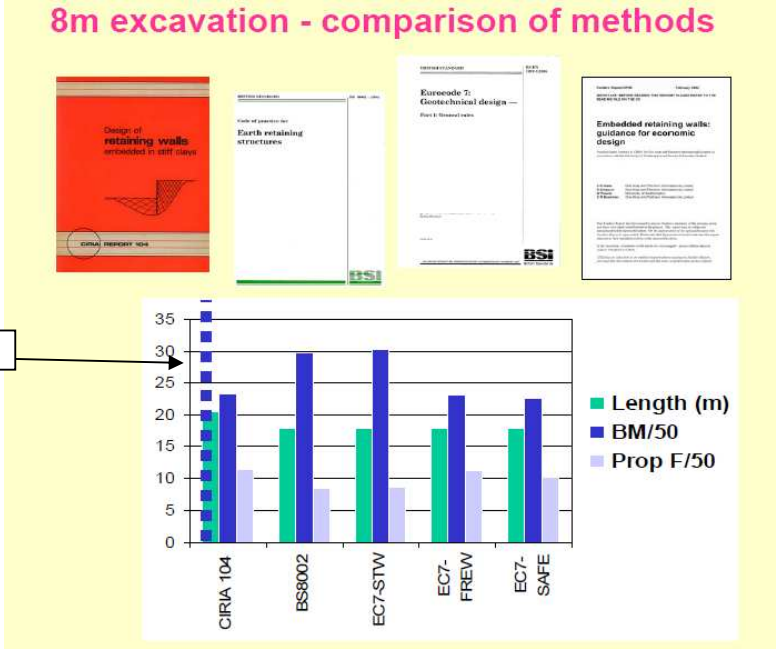


Figure 2 – Comparison of different methods for designing an 8m high propped wall (after Simpson, 2011)

Prof. Simpson went further to share with the audience a few case histories of geotechnical failures which he was engaged as an expert witness or forensic consultant. One of them was the collapse of the Nicoll Highway excavation in Singapore. The back-analysis of the incident was presented in a systematic way by examining the chronology of events, possible contributory causes, geotechnical design, steel work, design review when "design level" exceeded and reaction to the signs of imminent danger. The back-analysis was not just a matter of matching observed wall deflection using sophisticated finite element program but rather to demonstrate every possible causes and piecing them together as a complete picture based on actual facts and situation. He stressed that ***engineers should be brave enough to raise alarm and know how to put precautionary plans in place when they realised there was a potential danger to the public***.

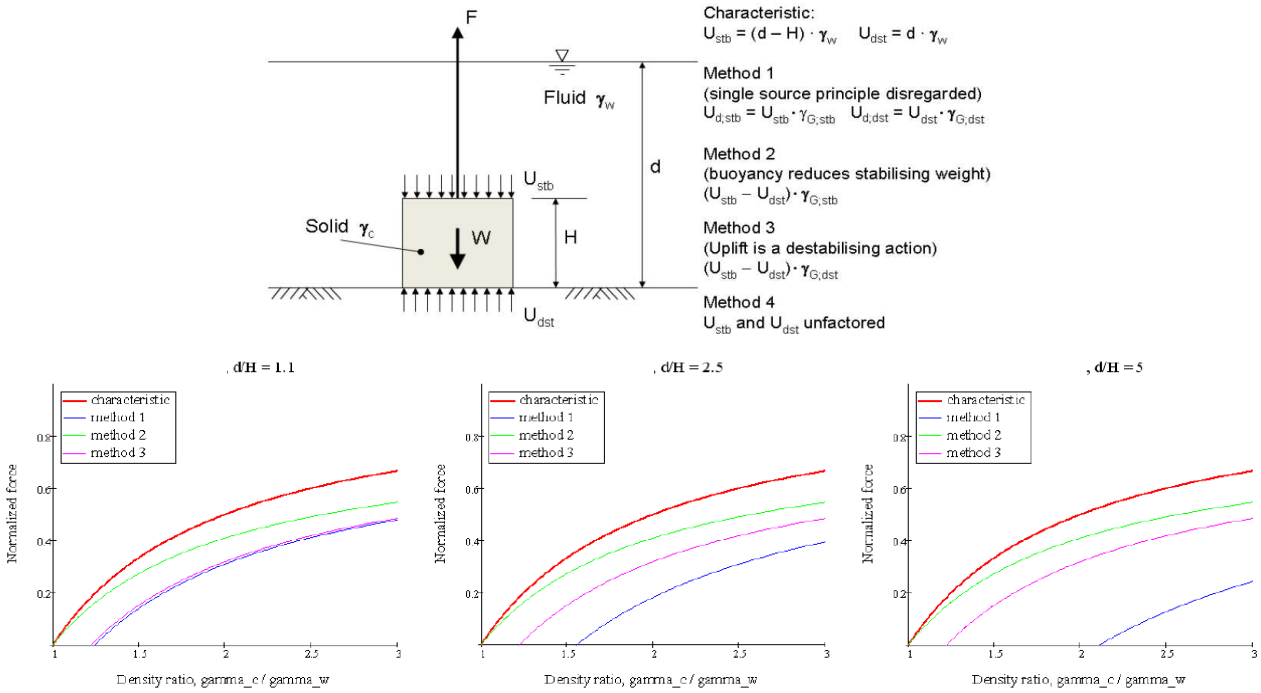
Prof. Simpson also presented some case histories of failures caused by water pressure and reviewed the safety provisions related to water pressure in some existing geotechnical codes. In the context of EC7, it is essential to identify actions of either stabilising force or destabilising force. This is particularly important whe dealing with water pressures in order for the corresponding partial factor to be applied accordingly. Prof. Simpson demonstrated four possible ways of applying partial factors via an example of submerged anchor block as illustrated in Figure 3. Some of his recommendations are highlighted as follows:-

a) ***Designers must explicitly accommodate the worst water pressures that could reasonably occur.***
b) ***Application of partial factors to the density of water should generally be avoided.***
c) ***The single source concept should be applied whenever possible.***
d) ***For problems dominated by water pressures, partial factors can be applied to action effects rather than to action themselves***.

There was active interaction between the audience and the speaker in the ensuing Q&A session. At the end of the seminar, the organiser thanked Prof. Simpson for his excellent works by presenting him a token of appreciation. For those who would like to know more about the seminar, the seminar material is downloadable from the IEM web portal http://www.myiem.org.my/events/eventregistration.aspx?id=364.

References

1. Simpson. B, 2011, IEM Half-Day Seminar on Excavation Design, Case Histories & Geotechnical Safety in relation to Water Pressures.



Observation: in Method 1, the acceptable force decreases as the depth of water increases Factoring water pressures.
Observation: in Method 2, the acceptable force approaches the characteristic force as the density of the block approaches that of water
Observation: Method 3 may be better, but still factoring the density of water.

Figure 3 – Submerged anchor block & allowable anchor force in relation to density of block *(after Simpson, 2011)*