



Talk on “Insights from Reliability-Based Design to Complement Eurocode 7 Design Approach” by the Recipient of the 2019 Thomas A. Middlebrooks Award from ASCE

by Ir. Dr Gue Chang Shin

Ir. Dr Gue Shang Shin is currently the Secretary/Treasurer in Geotechnical Engineering Technical Division (GETD).

It was a great honour for the Geotechnical Engineering Technical Division (GETD) of IEM, to have Ir. Dr. Low Bak Kong, Assoc. Prof. of Nanyang Technological University of Singapore, to deliver the technical talk on “Insights from Reliability-Based Design to Complement Eurocode 7 (EC7) Design Approach”, at the Malakoff Auditorium, Wisma IEM on 8th August 2019. The speaker is the recipient of the 2019 Thomas A. Middlebrooks Award from the American Society of Civil Engineers (ASCE), and the talk was mainly based on his award-winning paper. The Thomas A. Middlebrooks Award is given to the author or authors of a paper published by ASCE and judged worthy of special commendation for its merit as a contribution to the field of geotechnical engineering. It is also considered to be the highest award for geotechnical engineering research, given by ASCE. The talk was also live broadcast to the IEM Perak branch with a total of 72 participants including those in the Malakoff Auditorium. The talk was chaired by Ir. Dr. Gue Chang Shin.

The speaker laid out the main objective of this technical talk, which was to show how Reliability-based design (RBD) via the first-order reliability method (FORM) can complement EC7 approach. He noted that most practitioners are unfamiliar with the concepts and procedures of RBD using FORM. In contrast, EC7 principles are easier to understand. It was stressed that RBD-via-FORM cannot replace EC7 at this stage; however RBD-via-FORM can play a valuable complementary role to EC7, for example in situations with parameters not covered in EC7, different parametric sensitivities across different problems, cross-correlated or spatially autocorrelated parameters, and design aiming at a target reliability or failure probability.

Ir. Dr. Low compared the design points of EC7 and FORM. The design point in FORM reflects parametric uncertainties, sensitivities, and correlations, and is obtained without relying on partial factors. Whereas EC7 design point values are obtained by applying partial factors to characteristics values. Figure 1 shows an example of the reliability index β in terms of soil cohesion c' and friction angle ϕ' , where the limit state surface is the boundary between safe and unsafe domains. The FORM reliability index β provides an estimation of the probability of failure. Design can aim at higher target of β if the consequence of failure is high.

Insights from RBD for some geotechnical engineering examples were presented, including a semi-gravity concrete retaining wall, an anchored sheet pile wall, a footing foundation and a laterally loaded pile. The differences and similarities between the design points in RBD and those in EC7 were discussed. Limitations of RBD-via-FORM were also mentioned, including imprecise statistical inputs due to limited data, and neglected factors such as human factors. He also pointed out that the RBD-via-FORM presents greater language and conceptual barriers to practitioners than EC7.

Finally, Ir. Dr. Low concluded the probability of failure must be regarded as notional and indicative rather than precise. In comparison to EC7, the statistical data and correlations are open to view in RBD. Case-specific scrutiny and counter-suggestions for more reasonable statistical inputs and mechanical model in RBD are more likely to result in advancements and improvements. It was suggested that RBD-via-FORM can be conducted in tandem with partial factor design methods like EC7 in order to overcome EC7's limitations and ambiguities. During the Q&A session, there were active discussions from the floor over the subject matter and mutual exchange of opinions.

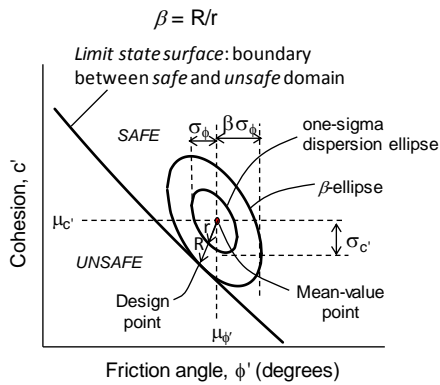


Figure 1: Reliability index β , and the limit state surface, in relation to shear strength parameters c' and ϕ'

The course ended with rounds of applause from the audience and an appreciation memento was presented by the Deputy Chairman of GETD, Ir. Dr. Chan Swee Huat to Ir. Dr. Low Bak Kong (Figure 2).



Figure 2: Appreciation memento presented by Ir. Dr. Chan Swee Huat to Ir. Dr. Low Bak Kong