# One-Day Course on "The Design, Analysis and Performance of Reinforced Soil Structures"

GEOTECHNICAL ENGINEERING TECHNICAL DIVISION

*reported by*

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On 17 June 2016, IEM's Geotechnical Engineering Technical Division (GETD) organised a one-day course on "The Design, Analysis and Performance of Reinforced Soil Structures", conducted by Mr. Michael Dobie, Regional Manager of Tensar International Limited for Asia Pacific. The talk at Kristal Ballroom, Hilton Hotel Petaling Jaya, saw the attendance of 57 participants.

The course covered the basics of reinforced soil structures (including those constructed using polymer reinforcement), from material parameters to methods of calculation used and the factors required to ensure a safe design. It included both basic information and ideas, as well as more advanced techniques, including possible approaches to design, according to EC7 and EC8.

Mr. Dobie pointed out that EC7 does not cover design for reinforced soil structures. The design guidance in United Kingdom is currently from British Standard BS8006-1:2010. The British Standard provides design advice for reinforced soil retaining walls and steep slopes. The factors and advice are not consistent with EC7 (yet).

He emphasised that reinforced soil structures like those in Figure 1 are 99.9 % soil. The key elements of reinforced soil structures were presented, which included:

*Figure 1: Example of Reinforced Soil Structures*

- Material design parameters – geo-reinforcement, soils.
- Calculation procedures.
- Factors in design.
- Performance.

The geo-reinforcement is of high consistent quality, being factory-manufactured and extensively tested, while the soil parameters are variable and can only be obtained from a carefully conducted investigation programme.

The contributions to stability from geo-reinforcement, as visualised from the 2-part wedge mechanism, are from sliding resistance and pull-out resistance. The calculation procedures aim at creating cost-efficient structures that meet the ultimate limit state (ULS) and adequate serviceability (SLS).

Mr. Dobie pointed out the differences in the geo-reinforcement's function between the walls, slopes or hybrid structures as shown in Figure 2.

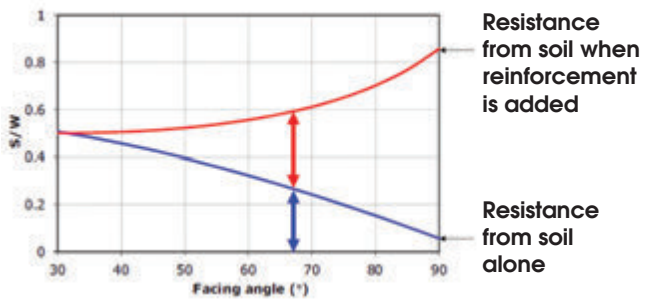


*Figure 2: Relationship between Wall/Slope and Facing Angle*

In a wall configuration (with steep facing angles), a high proportion of the internal stability is provided by the reinforcement while for slopes, the most of the resistance is provided by the soil.

He then illustrated the calculation procedures, using 2-part wedge method in Advice Note HA68/94 "Design Methods for the Reinforcement of Highway Slopes by Reinforced Soil and Soil Nailing Techniques" (Design Manual for Roads and Bridges, Volume 4, Section 1, Part 4).

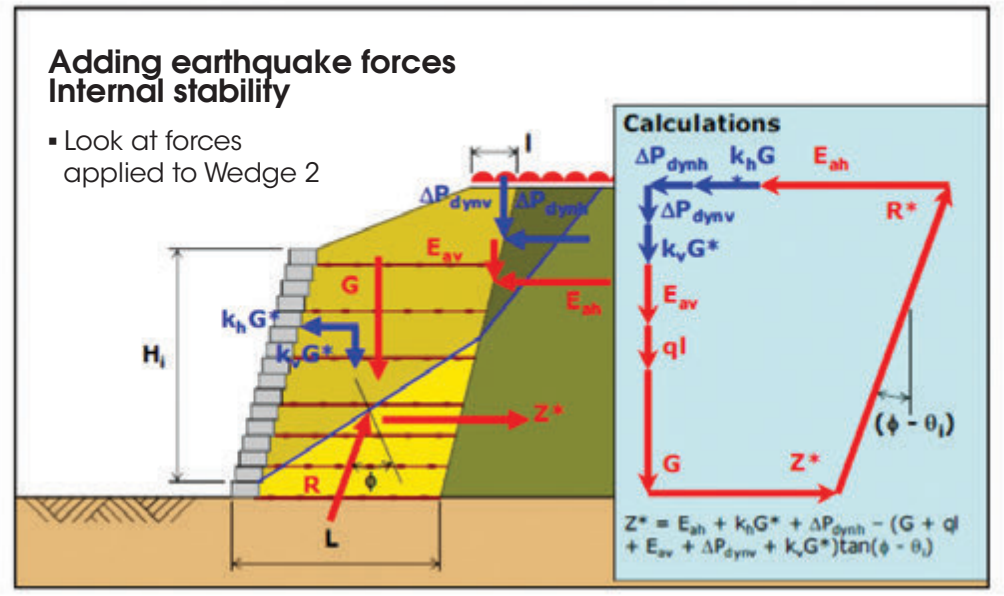


*Figure 3: Adding Earthquake Forces into 2-part Wedge Calculation Procedures*

He reported on the static test performance of an instrumented 8m high reinforced soil wall (from day 11 to day 732 after construction), built in 1995 in Japan.

For seismic designs, earthquake forces are added in the calculation procedures using the polygon of forces as shown in Figure 3.

Mr. Dobie then showed earthquake test results from shaking table tests, particularly the full scale test of a 6m high wall at University of San Diego, USA.

For stability analysis, it is vital to carry out global stability checks. The various available methods of slices involving circular and non-circular slip surfaces were presented, especially the usage of the non-circular "Simple Genetic Algorithm" (SGA).

At the end of the course, Mr. Dobie took numerous questions from the participants, followed by a big round of applause after he was presented a token of appreciation by Ir. Dr Ooi Teik Aun. ■

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