



## **Myths and Common Problems Discovered in Geotechnical Forensic Engineering**

by Ir. EG Balakrishnan

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In engineering practice, only a small percentage of designs fail to live up to their expectations. The art and science of forensic engineering then, is to unearth the cause or causes of failure so as to eliminate the chance of a recurrence.

On 12 January 2015, Ir. Liew Shaw Shong was invited by the Geotechnical Engineering Technical Division (GETD) to deliver a talk on Myths and Common Problems Discovered in Geotechnical Forensic Engineering, attended by 39 participants.

The talk covered several areas: causation factors for non-compliance at both SLS and ULS; contributing and triggering factors; remedial solution based on root cause; attributing responsibility and damage recovery; and prevention of occurrence of similar events in future.

In order to achieve the goals, Ir. Liew introduced a general forensic framework which included desk study, data collection, developing chronological events leading to the failure or distress, developing proper soil models, failure analysis and remedial designs. He also discussed the backward logic and forward logic mechanisms used in the failure analysis.

There is no simple route to perform forensic engineering works of a failure, however. Ir. Liew said some of the issues to be addressed were: “accessibility to the incident site; timing between the incident occurrence and commission of investigation; uncooperative attitude of the involved parties; release of critical data; conflicting details or facts; representativeness of interpreted information; establishment of event sequences, etc”.

Ir. Liew highlighted the myths faced from simple postulations of potential mechanism, fundamentals of mechanics and kinematic movement traces, matching of performance data, cherry picking of facts, uniqueness of cause-and-effect relationship, soundness of data, compliance of codes, etc.

In the later part of the talk, three types of case history on geotechnical forensic works were discussed. In each type of case history, Ir. Liew highlighted the applications of engineering principle in forensic geotechnical investigation, difficulties encountered, professional responsibility to reveal the truth of causation factors, and lessons learnt.

### ***Three types of case history***

In the first type, it involved two case studies of collapsed temporary excavation using contiguous bored pile wall (CBP). The first failure was due to excessive movement of CBP wall of 10.5m excavation with soil berm and one level of inclined strut. The second failure

(total 12.85m excavation) was the result of two rows of CBP wall (one reinforced and other unreinforced) constructed with soil berm and one level of steel strut against the completed building. Water pipe burst contributed to the failure of the steel strut which in turn caused the wall to collapse.

In the second type, it involved slope failure of high cut slope in high ground area of elevation RL 300-350m with 5-6 berms and slope gradient of 1(V): 1(H). It was a major slope failure after a heavy rainfall. The site was underlain by granite formation. The rise in the piezometric level contributed to the failure.

In the third type, it involved the failure of reinforced soil wall on pile foundation subjected to extreme lateral loading (heavy rainfall) and underlain by 4-8m of soft soil layer and 3-3.5m deep monsoon drain in front.

Ir. Liew gave another example to explain the third type failure. It involved an excessive movement of piled embankment on a bridge approach underlain by deep soft soils. The embankment height of 5.4m underlain by 10m soft clay layer and large consolidation settlement of 0.4 to 1m observed below the piled embankment due to the working platform fill.

