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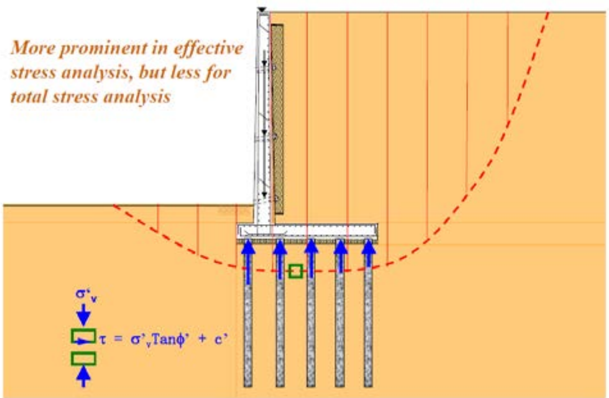
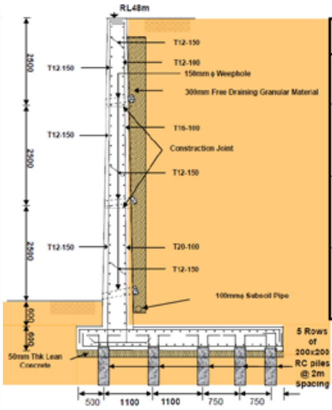
Common Blind Spots in Ground Investigation, Design, Construction, Performance Monitoring and Feedbacks in Geotechnical Engineering: Shaw-Shong Liew, G&P Geotechnics Sdn Bhd, *Kuala Lumpur, Malaysia*

In geotechnical engineering dealing with risks and uncertainties, the processes involved start from the investigation with the fundamental intention to attain better understanding of the subsurface conditions and acquisition of the engineering parameters for the subsequent engineering analyses, designs, detailing, tender documentation and calling, followed by design validation tests at field and construction problem solving. With the forensic investigation experiences by the author in the past, some interesting findings and surprises are compiled in this paper to illustrate these common blind spots at the aforementioned engineering processes. The importance of desk study and sound geological knowledge in planning of investigation programme have not received sufficient emphasis in the higher education system, thus resulting in significant wastage by the trained graduate in using the investigating tools and generating excessive amount of redundant information. Some of the mistakes are fundamental errors in perceiving the engineering behaviours when using the software with intuitive and illusive perception rather than based on sound engineering understanding. There is also strain compatibility issue in mobilising material strength of composite materials with drastic stiffness contrast when approaching failure state of a soil structure interaction problems. Design validation tests are crucial to ensure design methods adopted able to reasonably behave as intended. However, the tests usually do not reveal the overall behaviours of the design in actual scale and time factors, but rather a behaviours of a special case or prototype. Geotechnical instrumentation on a larger scale with time might be a more representative of practical performance with totality. This will be more useful for review and back-analysed of a big picture performance of the geotechnical structures.

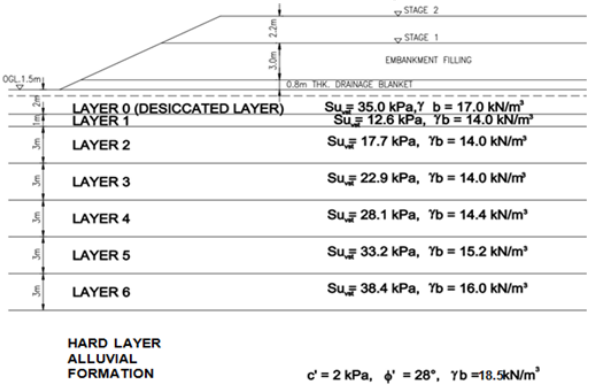




FOS Adequacy			
GWT	Over-turning	Sliding	Global Stability
RL45m	✓ 2.9>2.0	× 0.97<1.0 (Failure)	× 1.13/1.17
RL42.5m	✓ 3.7>2.0	× 1.34<1.5	✓/× 1.19/1.25
RL40.4m	✓ 3.8>2.0	× 1.5	✓/× 1.16/1.24

Bearing Capacity is never a concern as pile foundation is designed to take the vertical loading of wall

Case 1: Erroneous FOS Computation in Effective Stress Strength of Piled Supported Wall



Stage	Mobilised Tensile Load / Strain	Maximum Lateral Deflection at Edge of Embankment (mm)
S1	40.6kN/m / 0.68%	267
R1	41.8kN/m / 0.70%	295
S2	64.6kN/m / 1.08%	400
R2	67.4kN/m / 1.12%	425

Case 2: Strain Incompatibility of Basal Reinforcement at Embankment with Ground Improvement

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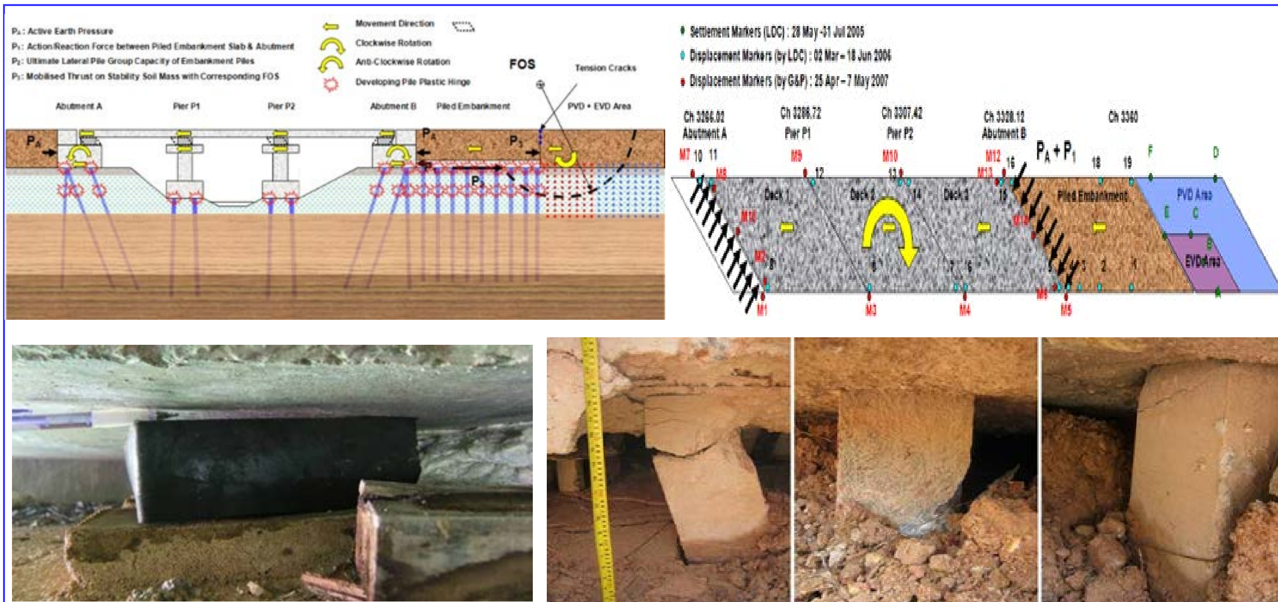
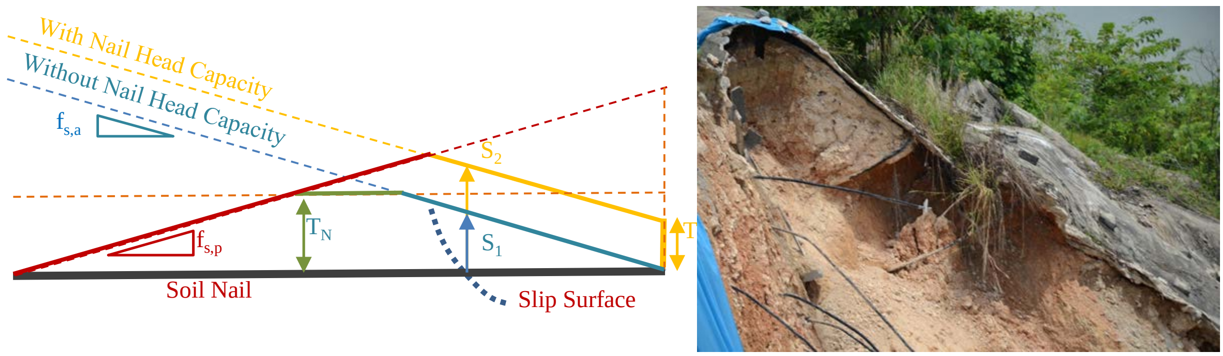
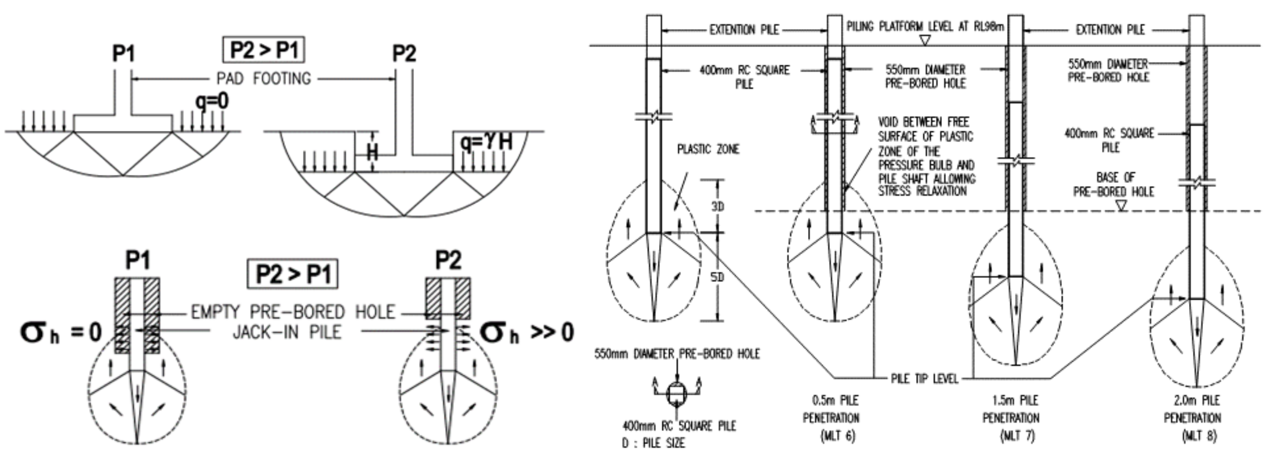


Case 3: Bridge Abutment Distresses due to Piled Embankment Failure



Case 4: Unreliable Facing Capacity of Shrinking Soil Nail Strengthened Slope



Case 5: Unreliable End Bearing Pile Capacity in Hard Founding Stratum with Insufficient Pile Toe Embedment

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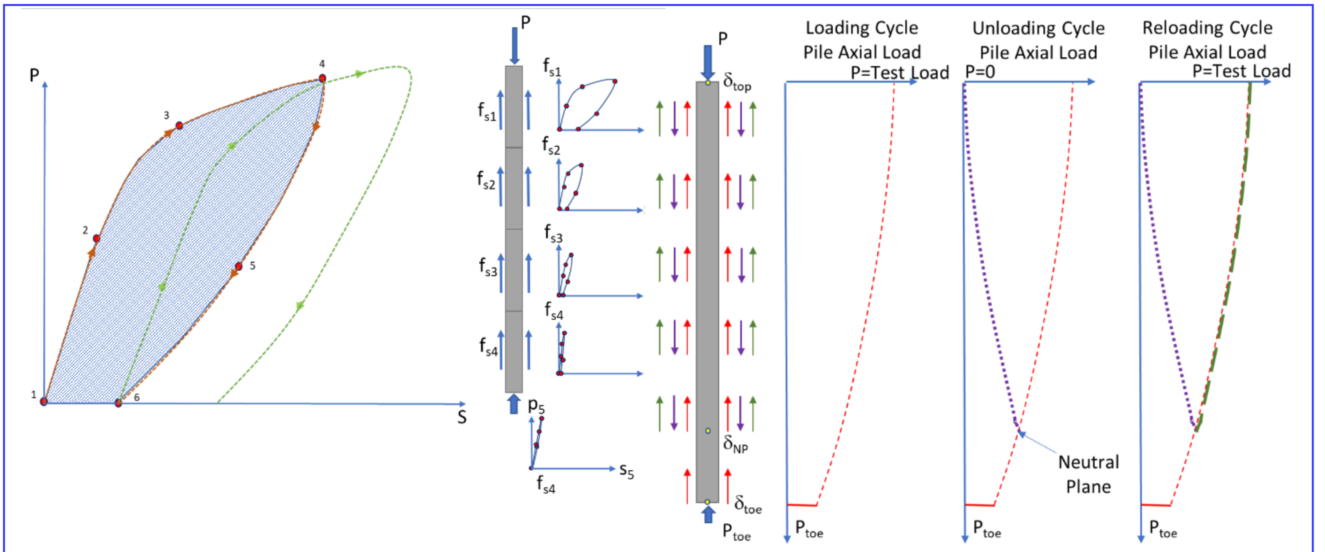

Case 6: Non-linearity in Elasto-Plastic Behaviour and Hysteresis Phenomenon of Pile-Soil Interacting Performance

CONCLUSIONS

The following messages can be summarised for this paper:

- Desktop study will help to optimise the planning of geotechnical investigation for subsequent engineering design and construction purpose. Exploratory boreholes and testing shall not be abused to obtain repeated and redundant data.
- The danger of unrealistic soil resistance in computing the safety factor of global stability for a piled retaining wall with no account taken to reduce the effective vertical stress from the pile support wall self-weight has clearly demonstrated.
- Inappropriate design parameter from technical data sheet of basal reinforcement used in permanent embankment design leads to problem of incompatible strain mobilisation with respect to the weak supporting subsoil.
- The incompatibility of stiff bridge abutment and weak lateral pile support of piled embankment has attracted remarkable lateral load to structurally fail the vulnerable abutment piles and embankment piles. The settlement of temporary working platform shall not be overlooked in soft ground condition that potentially results in large free standing pile length and reduces the pile lateral resistance.
- Soil shrinkage of fully covered shotcrete surface in a soil nailed slope due to depletion of moisture content can reduce the nail head capacity substantially, which subsequently reduces safety factor of slope stability.
- Stress relaxation and softening can significantly reduce pile toe capacity in mostly end-bearing jack-in pile in weathered meta-sedimentary formation. The relaxation can be due to insufficient confining stress near to the pile toe resulting from empty pre-boring hole for ensuring minimum pile penetration.
- The non-linearity and hysteresis in pile behaviour are mostly due to interface slippage and soil yielding with soil grain dislocation, which cause lock-in load in the pile and stiffening the pile-settlement performance.
- For practical determination of maximum test load in a pile test, it is suggested to have the pile loaded reaching the plastic state and record the final stable pile loading in the static equilibrium with specified limit of creep settlement rate.