

Data-Driven Empiricism: Applying Machine Learning Across the Geotechnical Project Lifecycle

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Managing uncertainty is a key part of geotechnical engineering. Ground conditions can change significantly over very short distances, and these changes can greatly affect how projects are designed and built. Over the years, engineers have developed practical design methods based on experience and field testing. Examples include Barton's Q-system and the soil nail design guidelines published by the Geotechnical Engineering Office of the HKSAR Government. These tools have provided an important foundation for geotechnical practice.

With the rapid growth of computing power, the industry is now moving towards a new approach that makes better use of data. This presentation describes how Machine Learning (ML) can transform large amounts of historical project data into predictive models that support decision-making throughout the project lifecycle, including planning, design, construction, and monitoring. By combining engineering expertise with ML, geotechnical engineers can move beyond relying mainly on experience and judgment. Instead, they can use data-driven insights to improve predictions, manage risks more effectively, and make better-informed decisions while maintaining strong engineering oversight.