

## **Report on Technical Seminar on Ground Improvement by Deep Cement Mixing Method**

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### Introduction

Engineer Warren Dou delivered a seminar on deep cement mixing (DCM), a ground improvement technique used to treat soft clays and enhance their engineering properties. By blending soft clay with injected cement, the strength of the soil can be increased, and post-construction ground settlement is minimized. The speaker presented a case study on the utilization of DCM in the Hong Kong International Airport (HKIA) 3rd Runway System, highlighting the characteristics of laboratory and field-mixed DCM.

### Case Study – HKIA 3rd Runway System

DCM was adopted for reclamation works within the HKIA 3rd Runway System due to its advantages in environmental and geotechnical aspects. Given that 40% of the reclamation area lies within contaminated mud pits, DCM enabled the stabilization of soft clay within these pits without compromising surrounding water quality.

During the project, a systematic test program was established to determine the dosages applicable to the actual site, involving laboratory trials, field trials, and mass installation. The quality of the DCM was continuously evaluated against specified criteria, specifically the unconfined compressive strength (UCS), to meet project performance requirements.

### Laboratory Trial

Laboratory samples of DCM columns were prepared and tested to explore the relationship between DCM strength and various influential factors. Results from the laboratory mix revealed that specimen strength increases with dosage and age, while decreasing with moisture content. A field-to-laboratory strength ratio of 0.67 was adopted based on published literature, considering uncertainties and deviations in actual field conditions.

### Field Installation

Field trials were proposed based on laboratory findings, and DCM installation took place using barges on site. A barge setup consisted of components such as a mixer, agitator, grout pumps, and rigs equipped with vertical shafts and mixing blades for blending injected cement with soft clay during installation for homogeneity. Wall-type and column-type DCM clusters were employed to support the seawall and platform respectively. "W" curves illustrated repetitive blade penetration and withdrawal during the DCM installation process when the required level of the stiff clay layer was reached. The encounter of obstructions was reflected by abnormal decrease in penetration speeds of the shafts and increase in hydraulic pressure of the gauges and it further triggered the alerts for blade withdrawal to prevent damage of the blade and avoid unfavorable impacts on mixing quality and strength of DCM.

Field samples were retrieved and tested to verify the mix performance. DCM strength after 21 days exceeded the target UCS, significantly improving the strength of clay except for stiff clay due to poor mixing in field. Besides, field mixes performed consistently with laboratory results as similar relationships between 28-day strength, w/c ratio, and dosage were observed. The field-to-laboratory strength ratio was found to be 0.6 on average, aligning with the assumption adopted in the preparation of field mix.

## Conclusion

The project demonstrated the viability of DCM in reclamation works as it has significantly improved the strength of treated soil; and laid the groundwork for future studies and practical applications. It was proven that DCM strength primarily depends on in-situ soil properties like the moisture content, binder dosage, and age of mix.