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Aging effects on liquefaction resistance of sand estimated from laboratory investigation

Hirofumi Toyota, Susumu Takada

[Outline]

Liquefaction resistance increases over time after construction or sedimentation

→ Mechanisms of this aging effect have not been elucidated.

The research is vital for improving predictive models for liquefaction potential, particularly in sands where aging could influence engineering properties.

[Methods]

Cyclic undrained triaxial tests, local small strain (LSS) tests using bender elements

Laboratory penetration tests (Toyoura sand's liquefaction resistance).

Specimens were subjected to long-term consolidation for up to 360 days to evaluate changes in the CRR, shear moduli, and penetration resistance.

[Results]

CRR of Toyoura sand at a Dr 40% increased by about 14% for specimens consolidated for 360 days in cyclic undrained triaxial tests.

CRR↑ evaluated from G_0 was negligible, from penetration resistance tests, (about 2%)

Secant shear modulus (G_{sec}) showed a better correlation with the increases observed in the triaxial tests, suggesting that measures at small shear strains (0.01%) might better predict aging effects than those at initial strains.

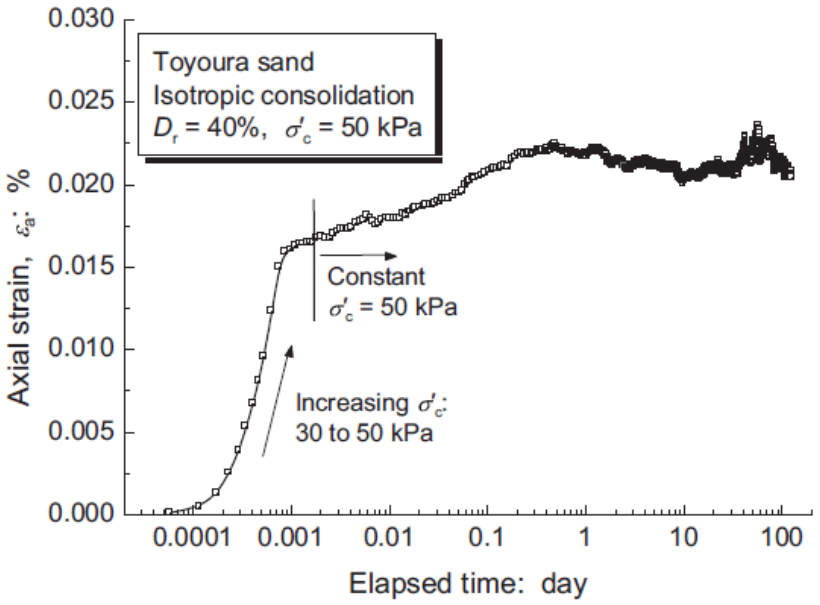

Fig. 3. Axial strain variation during long-term consolidation.

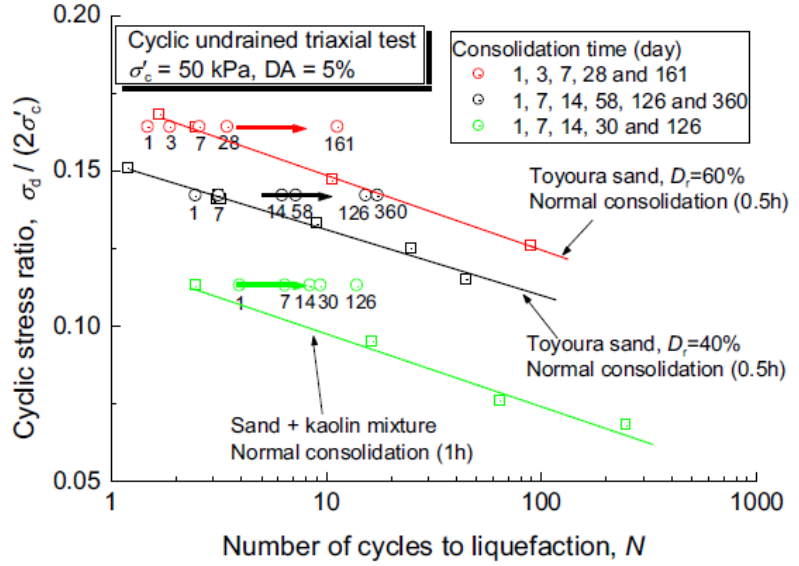

Fig. 5. Aging effects on CSR in Toyoura sand of $D_r = 40\%$, Toyoura sand of $D_r = 60\%$, and sand + kaolin mixture.

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Analysis of the behaviour of retaining structures through a novel data interpretation approach

A. Dobrisan, S.K. Haigh, C. Deng, Y. Ishihara

[Outline]
Retaining structures, conventional measurement techniques ~ indirect methods

[Methods]
Developed a new fitting method
: Integrates data from multiple types of instruments (strain gauges & inclinometers)
Approach utilizes advanced statistical techniques to fit discrete, sparse, and inaccurate data into continuous, differentiable curves that make geotechnical sense.

[Results]
The novel fitting approach was able to successfully integrate and interpret data from different instruments
Compared to traditional methods, this approach reduced reliance on potentially inaccurate data points by providing more flexible and robust analysis tool.
The novel method could predict complex interactions and variations in soil pressure and wall movement more effectively than existing models.

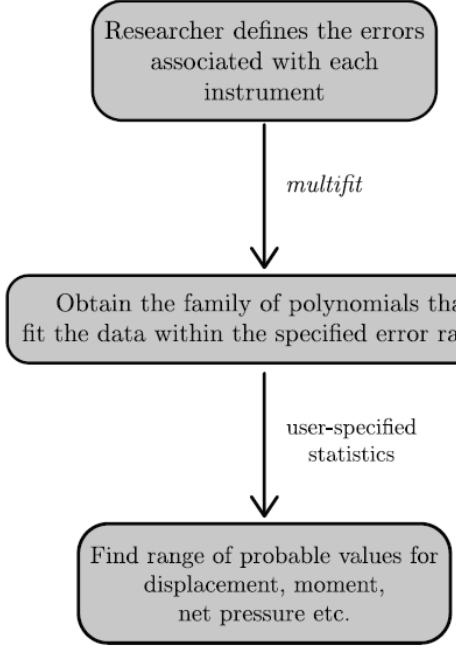

Fig. 3. Diagram of *multifit* procedure.

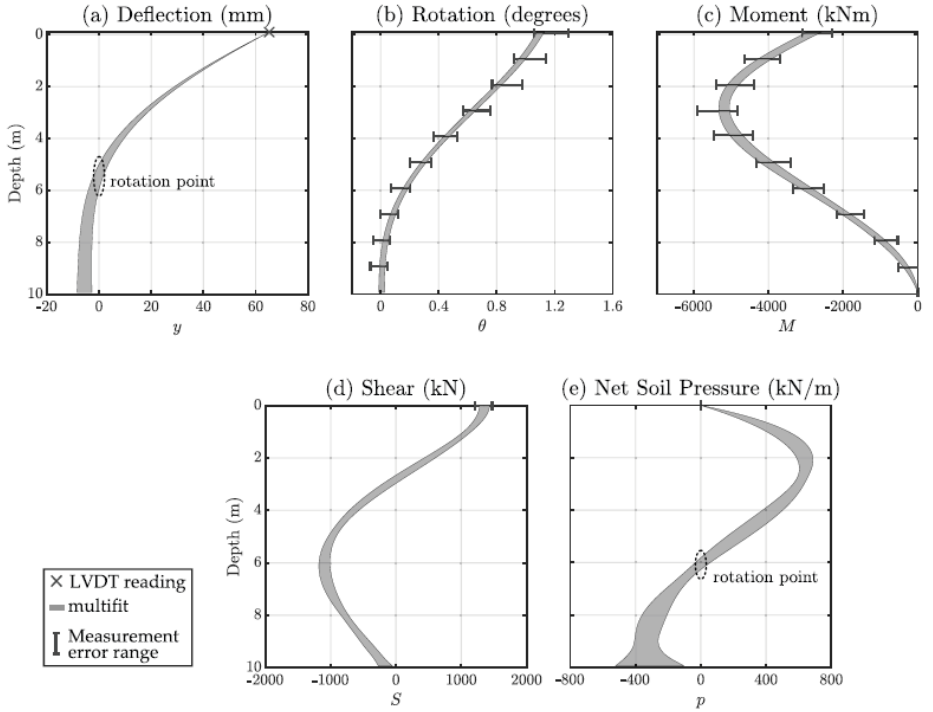

Fig. 10. Multifit analysis results for 1.339MN of horizontal loading through hydraulic jack.

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A pre-trained deep-learning surrogate model for slope stability analysis with spatial variability

Haoding Xu, Xuzhen He, Biswajeet Pradhan, Daichao Sheng

[Outline] Numerical analysis slope stability can be computationally intensive, stochastic analyses for spatial variability
Growing need for efficient computational models, rapidly predict slope stability + spatial variability, reducing the reliance on extensive numerical simulations.

[Methods] ABAQUS, Spre-trained deep-learning, open-source software GSTools
Surrogate model was trained on a substantial dataset containing over 12,000 instances

[Results]
The surrogate model demonstrated a mean absolute percentage error of about 6% when validated against the testing dataset
It was effective in handling cases with different soil parameters, slope angles, and even complex slope geometries not included in training set, showing robust generalization capabilities.
Model reduced computational time for stochastic analyses.

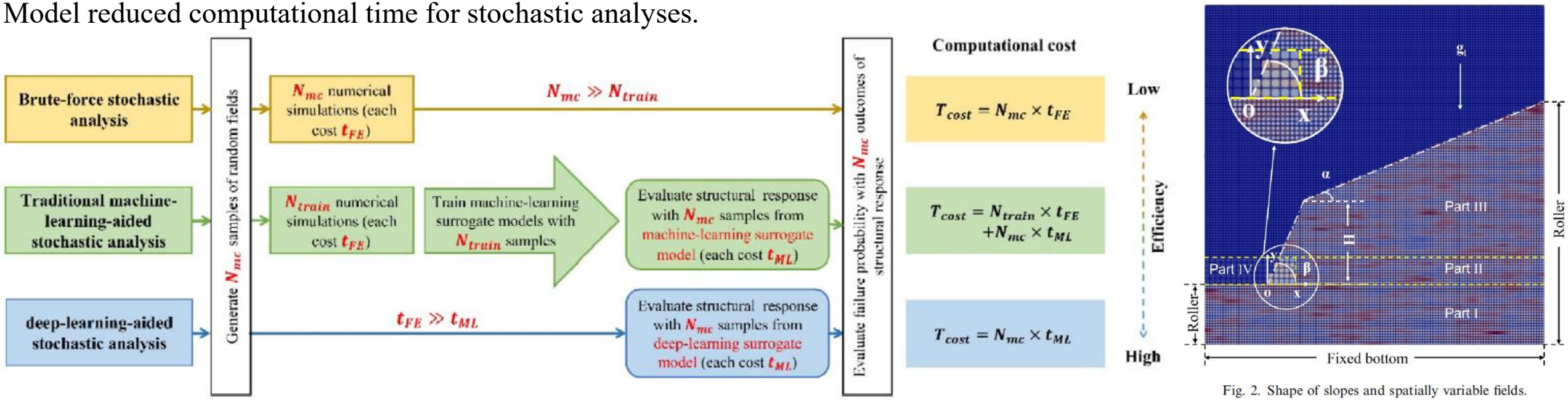

Fig. 2. Shape of slopes and spatially variable fields.

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Assessment of shear strength for clay liners using a dynamic probe

Muawia Dafalla, Abdullah Shaker, Abduallah Almajed, Kehinde Lemboye

[Outline]
Liner-cover layer; apply landfill sites, directly affected climate
=> need to be investigated.
The testing method should effective, quick, and cheap.

[Methods]
Dynamic cone penetrometer; S, sand-clay cover liners ρ
Laboratory tests, including fall cone tests; verify the trends of penetration and the influence of dry ρ on S
Mixtures of sand and bentonite, subjecting them to varying w and compaction energies, measuring the penetration resistance using both field and laboratory.

[Results]
linear relationship exists between cone penetration and moisture content within the wet of the optimum zone, with a cone penetration rate of 0.15 cm per blow translating to a dry ρ of 1.95 gm/cm³.
Max dry ρ for a mixture of 5% bentonite and 95% sand was reported as 1.7 gm/cm³ at an optimum w of 14%.
Undrained S was computed as 26 kPa at a w of 14%, with the S dropping as moisture content increased.

a- Compacting a layer to the required density

b-Testing points using a dynamic pentrometer

Fig. 1. Preparation of laboratory model for a sand-clay liner cover layer.

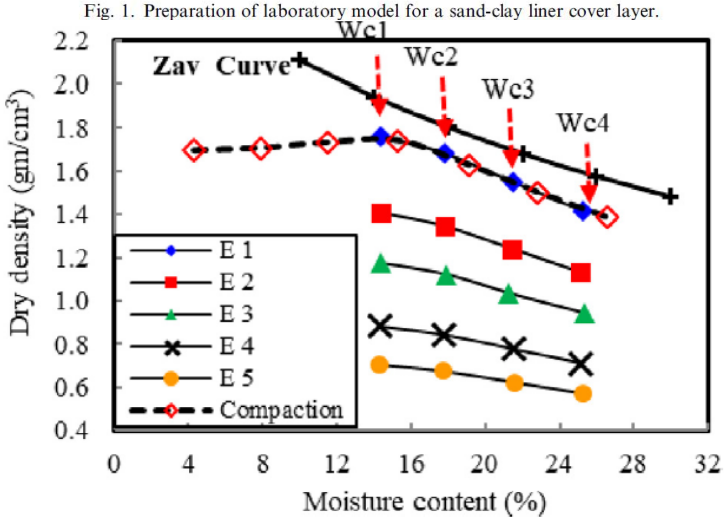

Fig. 8. Compaction curve of soil used and the variation of dry density with moisture contents.

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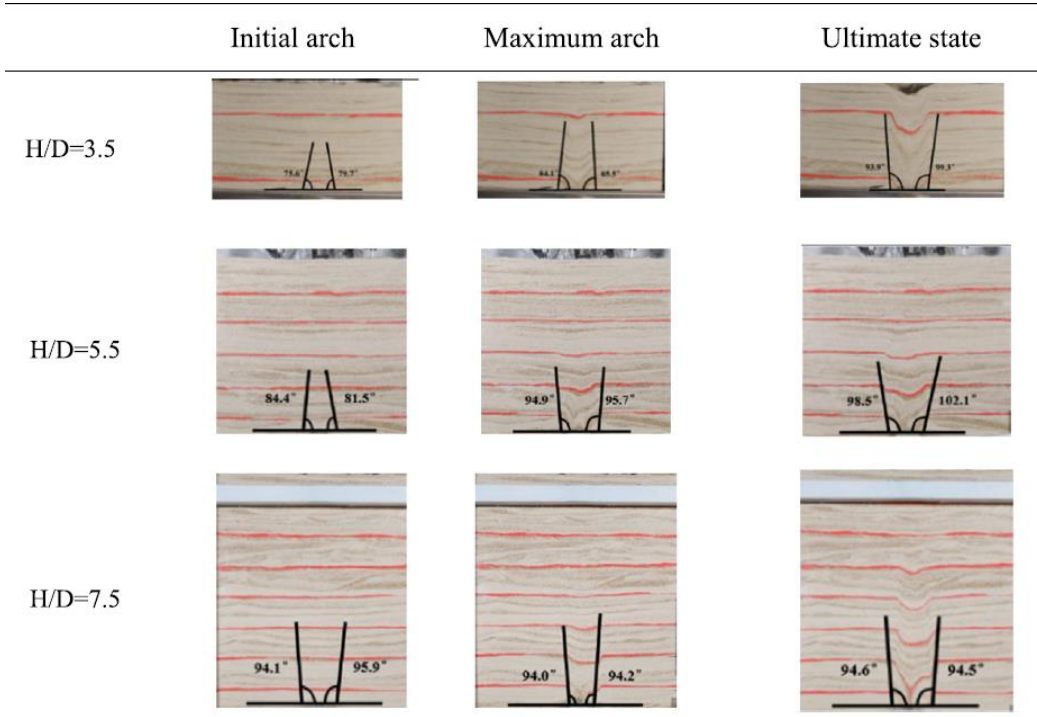
A two-dimensional experimental study of active progressive failure of deeply buried Qanat tunnels in sandy ground

Yanfei Zhang, Xianfeng Liu, Shengyang Yuan, Jinyang Song, Weizhi Chen, Daniel Dias

[Outline]
Understand the collapse mechanisms of ancient underground water system.
Qanats have experienced various degrees of aging and collapse
→ leading to significant ground settlement and potential disasters.
focusing on soil arching effect and stress distribution changes.
[insights into the progressive failure process in sandy ground]

[Methods]
1g physical model test, PIV
To simulate step-wise failure process of Qanat tunnel using water or air bags.
3 model tests; on dry sand with Qanats buried at different depths, analyzing soil displacement and pressure changes at each stage of the collapse.

[Results]
Collapse of Qanat leads to progressive evolution of soil arching effect, with earth pressure redistribution occurring as collapse progresses.
Pressure near collapse decreases while pressure on both sides increases.
Max arching and initial point of limit state correspond to volume losses of 12.5% and 50%, respectively.
Surface settlement varies with depth, and buried Qanats have a smaller effect on surface settlement.



Photos during Qanat tunnel collapse

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Centrifuge model test study on micro-pile reinforcement of shallow foundation

Zixi Li, Ga Zhang

[Outline]

Reinforcement of existing shallow foundations using micro-piles

Micro-piles are useful in reinforcing foundations due to their small size and ability to be installed with minimal disruption to existing structures.

Detailed analysis of the interaction mechanisms between shallow foundations and micro-piles is required

[Methods]

Centrifuge model tests

3 different setups: a shallow foundation alone, a micro-pile foundation alone, and combined shallow foundation with micro-piles.

[Results]

Coupled foundation (shallow foundation with micro-piles) reduced settlement and increased bearing capacity compared to shallow foundation alone.

At a vertical load of 2880 kN, the settlement for pure micro-pile foundation stabilized, indicating ultimate bearing capacity.

Coupled foundation exhibited a more uniform soil deformation and increased load-bearing capacity beyond initial stages of loading.

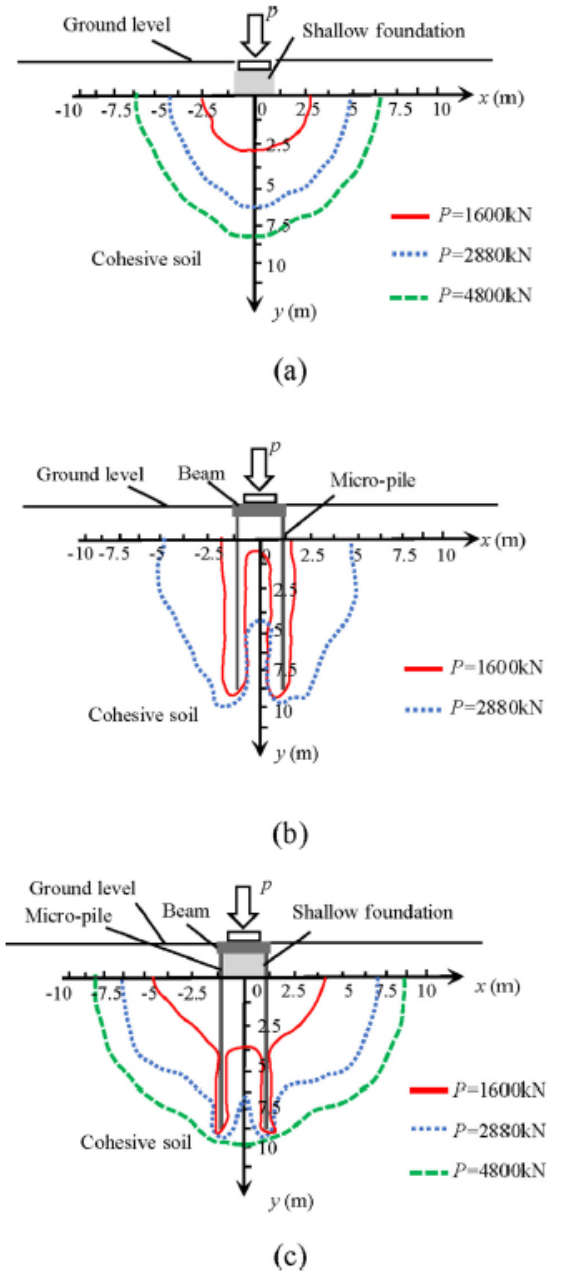

Fig. 12. Loading influential zones at different vertical load for various foundations. (a) shallow foundation; (b) pile foundation; (c) coupled foundation. *P*, vertical load.

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Design optimization and observed performance of a super-large foundation pit excavation subjected to unsymmetrical loading in water-rich floodplain: A case study

Bo Liu, Dingwen Zhang, Yuanyuan Wang, Ningning Wang, Wen Xu

[Outline]
Challenges of constructing super-large foundation pits in water-rich floodplains with unsymmetrical loading, which pose significant risks
Novel approach by proposing optimized control measures, including use of diaphragm walls and central-island style zoned excavation, to manage the size and loading effects

[Methods]
Numerical analysis to "size effect" and "unsymmetrical loading effect" on the foundation pit's deformation and force behaviors.
Optimal control measures based on these simulations
Design optimizations of the supporting, waterproof systems

[Results]
Deflection of retaining wall increased nonlinearly with excavation length, with a max deflection of 7.00 mm for an 80 m long foundation pit
Ground settlement behind retaining wall increased linearly with length-to-width ratio, reaching a maximum of -6.64 mm.
Applying inner ring wall as a control measure reduced the max retaining wall deflection by 61.1%, showcasing effectiveness

Fig. 1. Photo of the super-large foundation pit.

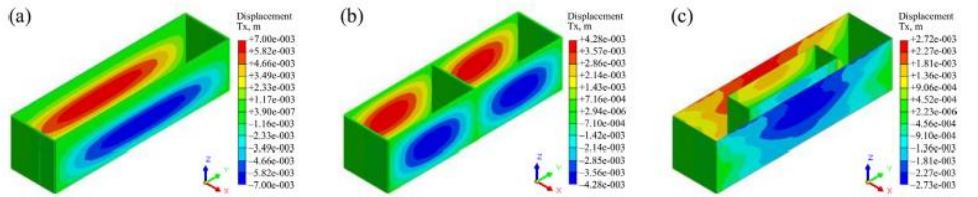

Fig. 10. Retaining wall deflections under different conditions: (a) Condition 1; (b) Condition 2; (c) Condition 3.