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Bearing capacity and failure mechanism of ground improved by deep mixed columns

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Ground improvement and failure









Ground improvement with columns

Failure of ground with columns

Embedment effects

The influence of embedment depth on the bearing capacity of ground improved by deep mixed columns is unknown.

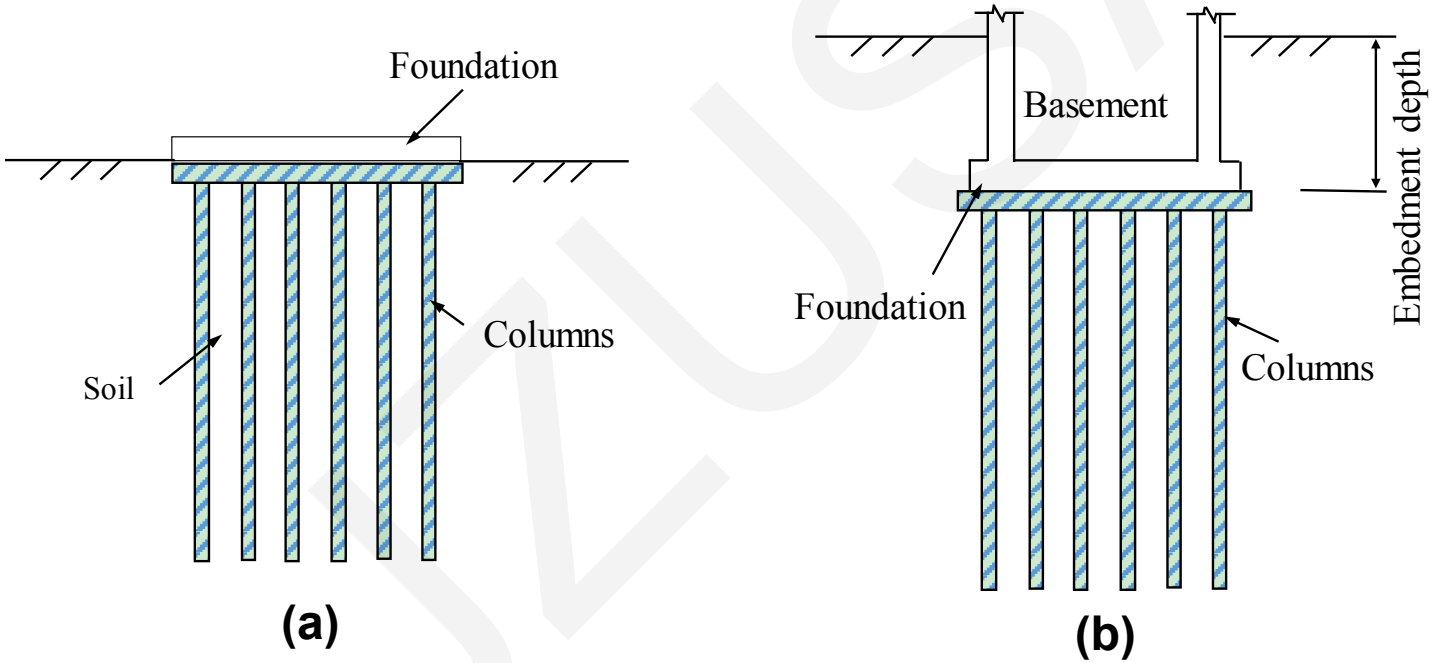
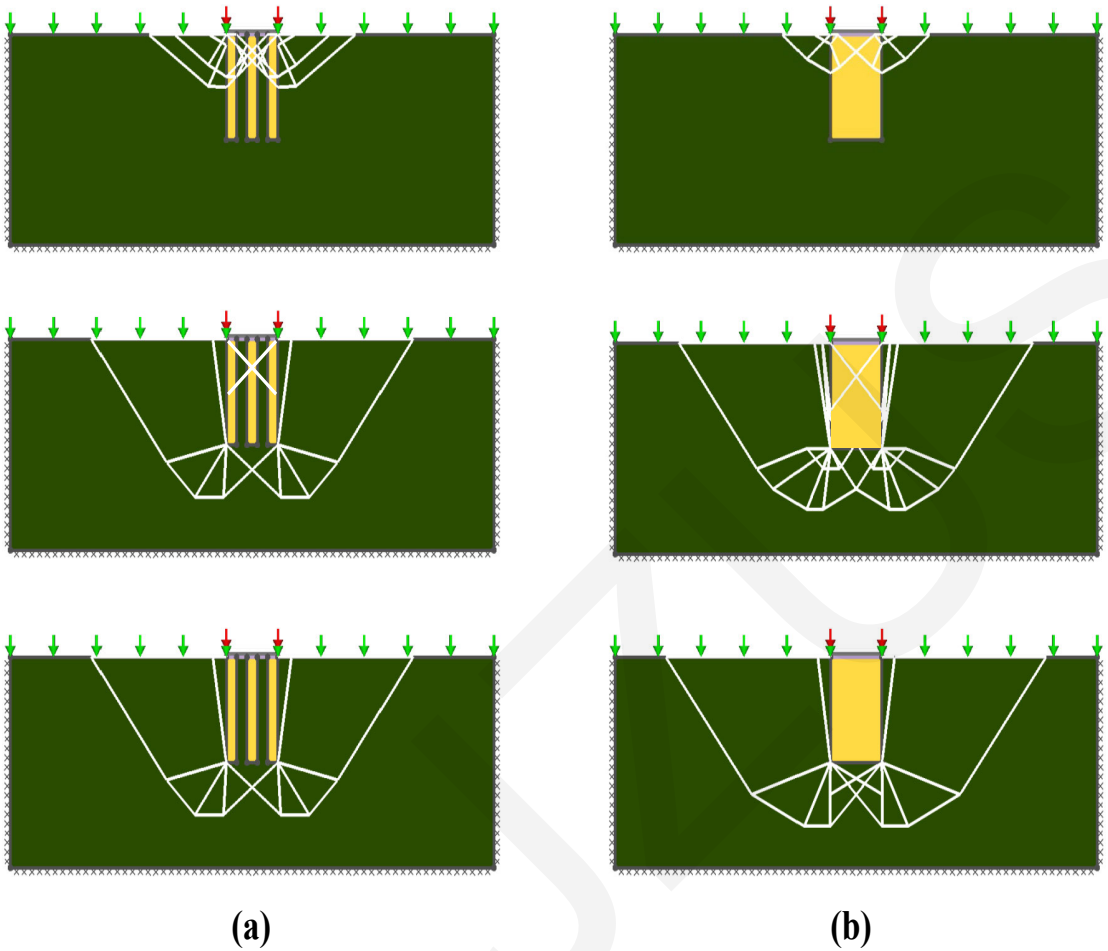


Fig. 1 Schematic of ground reinforced by DM columns with and without embedment: (a) without embedment and (b) with embedment.

Failure mechanism



- Three types of failure patterns can be categorized: general shear failure, local shear failure, and block failure.
- The predictions of failure mechanism between the individual columns model and the equivalent area model are similar.

Fig. 2 Failure mechanism of composite ground reinforced by DM columns: (a) individual-column model and (b) equivalent-area model.

Design charts

A set of design charts of bearing capacity coefficients, which is used for preliminary engineering design, is produced with a special focus on the N_q values and failure mechanism.

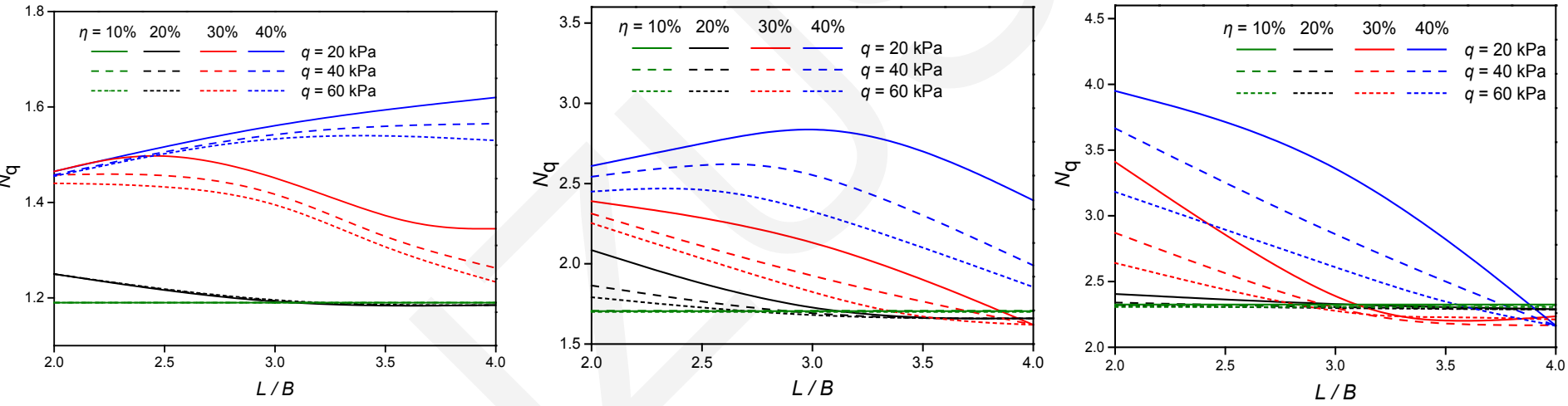


Fig. 3 Bearing capacity charts for coefficient N_q: (a) φ = 2° ; (b) φ = 6° ; (c) φ = 10° .

Discussion

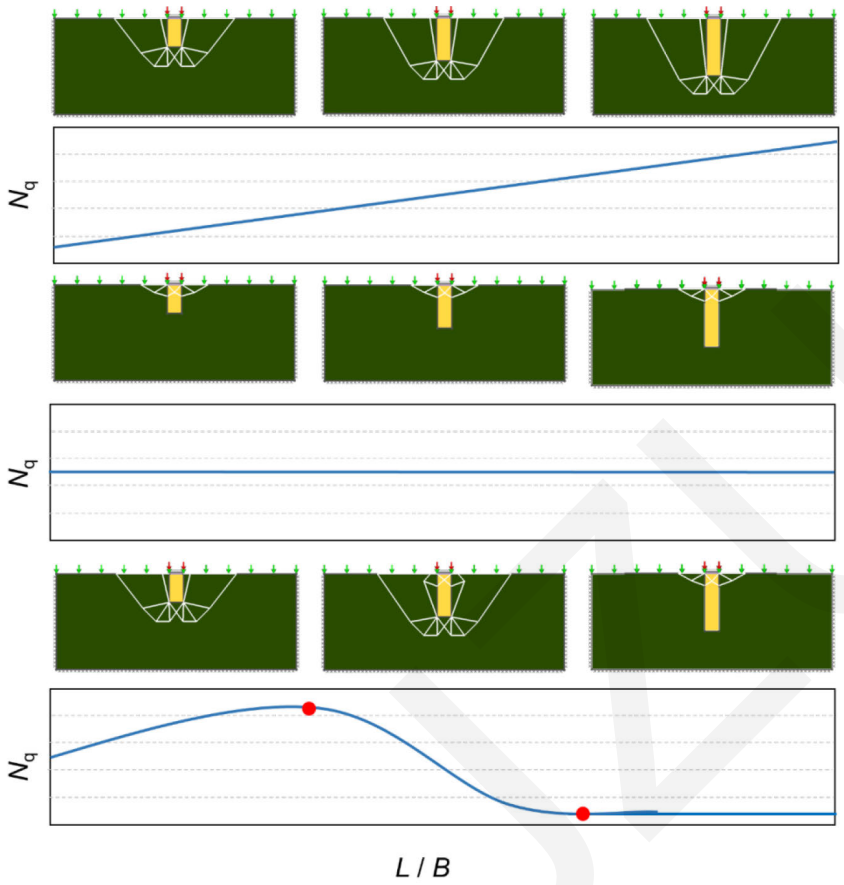


Fig. 11 Schematic of coefficient N_q and the corresponding failure mechanism.

- **Block failure: the N_q value increases with L/B because the increasing column length.**
- **General failure: the N_q value is insensitive to the additional column length.**
- **An initial increase of N_q with the increasing column length as the deepened surface slip. Then, N_q begins to decrease and reaches a constant value because of the local shear failure and the general shear failure.**

Conclusions and publications

Conclusions

- The bearing capacity factors are governed by the critical failure mechanism.
- The limit load are complex when the embedment depth is considered.

Relative publications

- Hai-zuo ZHOU, Yu DIAO, Gang ZHENG*, Jie HAN, Rui JIA, 2017. Failure modes and bearing capacity of rigid footings on soft ground reinforced by floating stone columns. Acta Geotechnica, 12(5): 1089-1103.
- Hai-zuo ZHOU, Gang ZHENG*, Xin YIN, Rui JIA, Xin-yu YANG, 2018. The bearing capacity and failure mechanism of a vertically loaded strip footing placed on the top of slopes. Computers and Geotechnics, 94: 12-21..
- Hai-zuo ZHOU, Gang ZHENG*, Xiao-pei HE, Xiao-min XU, Tian-qi ZHANG, Xin-yu YANG, 2018. Bearing capacity of strip footings on c - φ soils with square voids. Acta Geotechnica. (online)
- 郑刚, 周海祚, 刁钰, 刘景锦. 饱和黏性土中散体桩复合地基极限承载力系数研究. 岩土工程学报, 2015, 37(3): 385-399.
- 郑刚, 杨新煜, 周海祚, 孙佳羽. 基于连续破坏的刚性桩支承路堤的稳定性分析和稳定性控制. 岩土工程学报. 2017, 39(4): 581-591.