



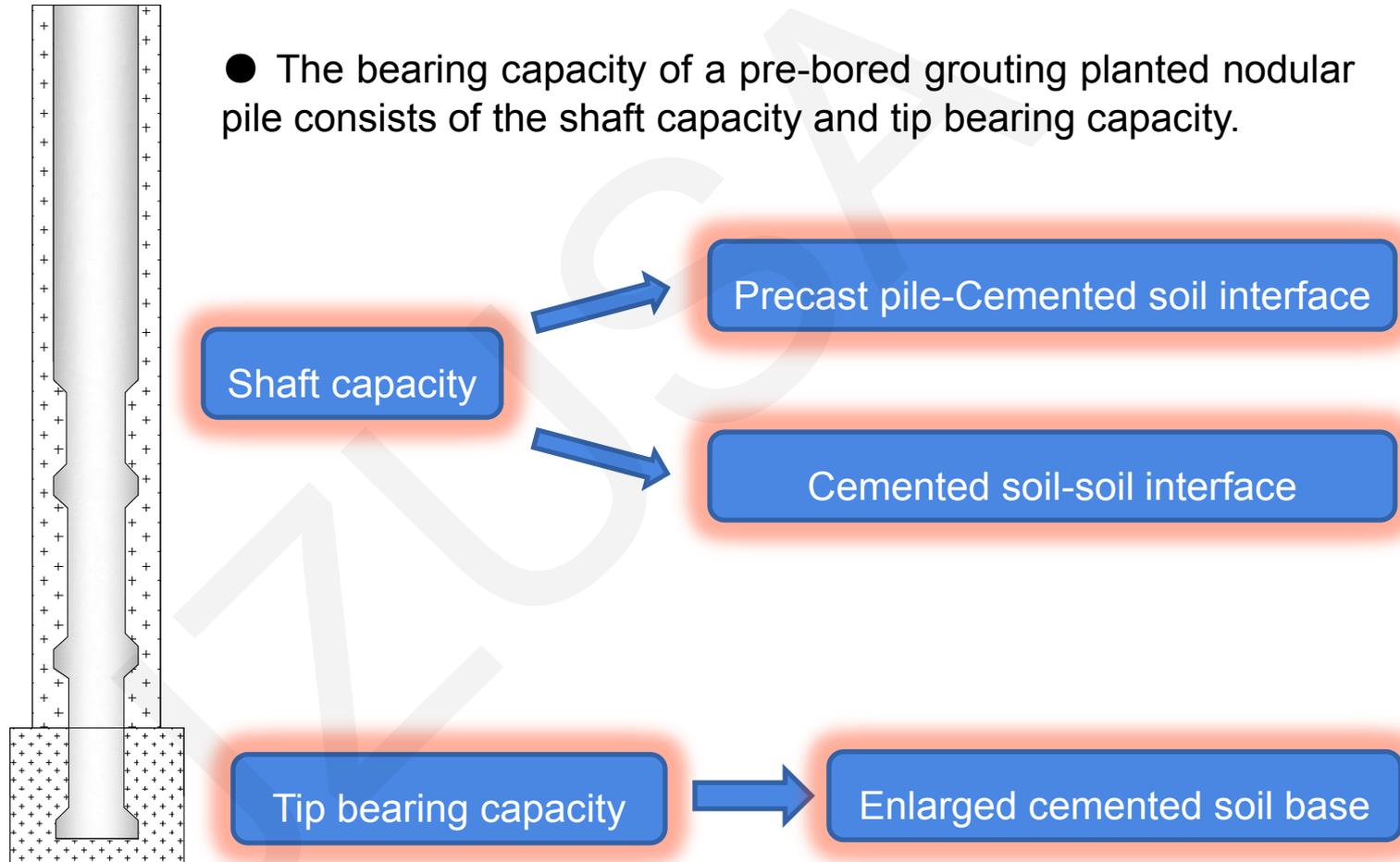
# A simplified nonlinear calculation method to describe the settlement of pre-bored grouting planted nodular piles

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# The pre-bored grouting planted nodular pile

- The bearing capacity of a pre-bored grouting planted nodular pile consists of the shaft capacity and tip bearing capacity.



Shaft capacity

Precast pile-Cemented soil interface

Cemented soil-soil interface

Tip bearing capacity

Enlarged cemented soil base

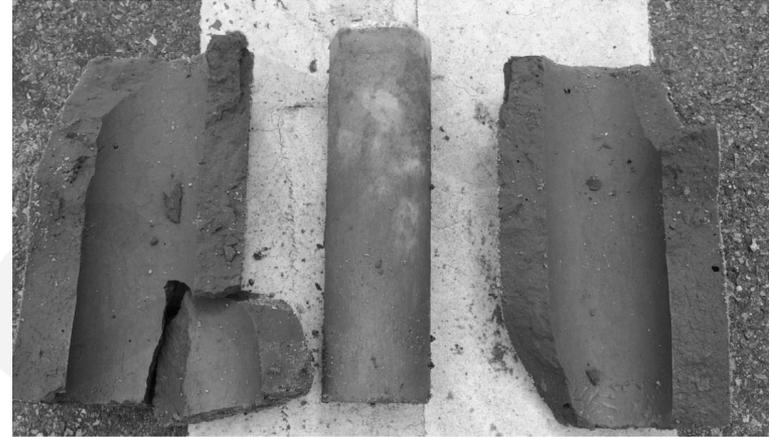
Pre-bored grouting planted nodular pile



# Pile-soil interface shear test



Shear test apparatus

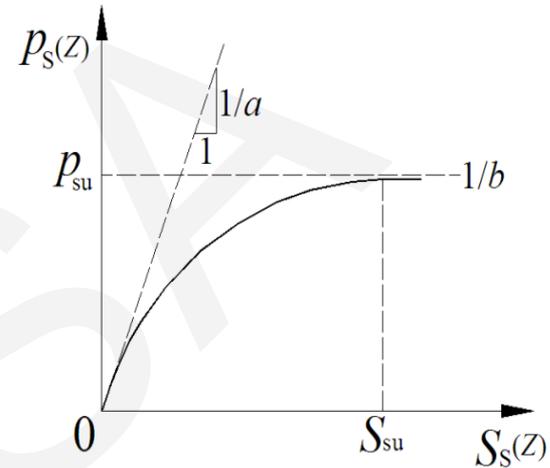
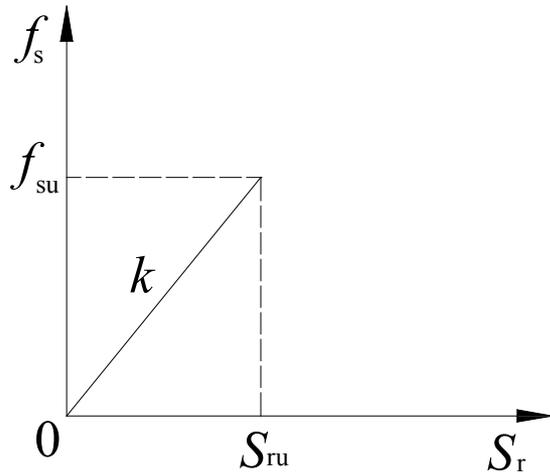


Failure surface of the shear test

- The failure occurred just at the contact surface between the concrete and cemented soil.
- Abrupt failure occurred when the friction reached the ultimate value.



# Algorithm for the behavior of a single pile



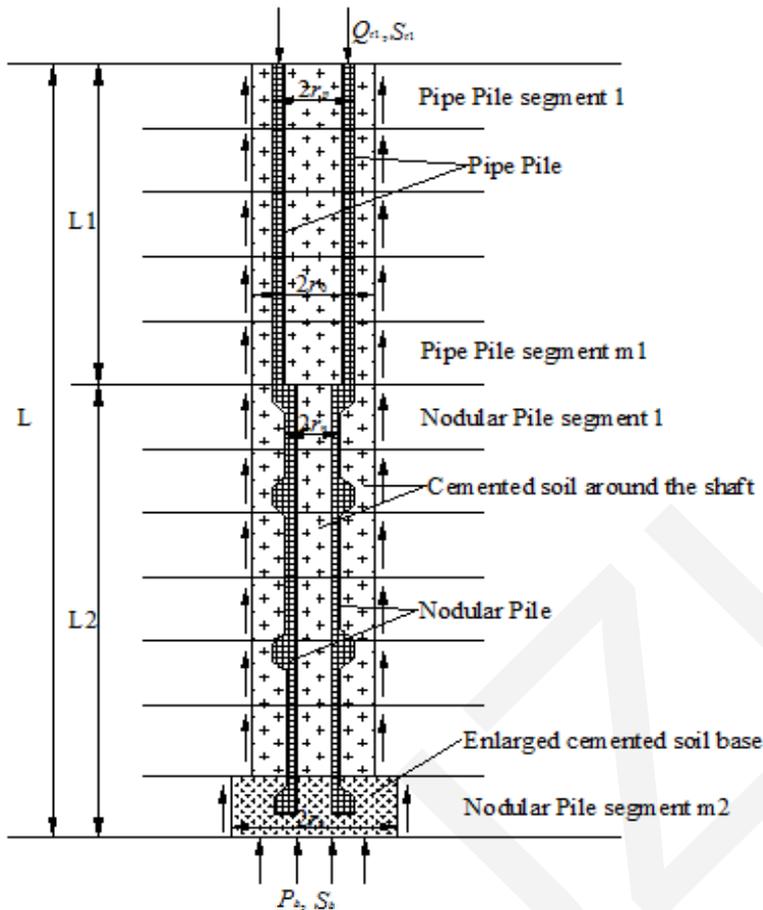
Assumed linear model for the concrete-cemented soil interface

Assumed hyperbolic nonlinear model for the cemented soil-soil interface

- The values of the parameters in the adopted models were all determined based on the field and model test results.



# Algorithm for the behavior of a single pile



- The PGPN pile is divided into  $(m_1+m_2)$  segments. The PGPN pile shaft which contains the pipe pile is divided into  $m_1$  segments, and the shaft which contains the nodular pile is divided into  $m_2$  segments.

- The precast pile-cemented soil interface and the cemented soil-soil interface were both considered in the proposed simplified analytical approach.

- The changing pile shaft modulus along the shaft and the existence of the enlarged cemented soil base are also considered in the approach.

A single PGPN pile  
embedded in layered soils



# Conclusions

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- The proposed approach is efficient and suitable for the analysis of a single PGPN pile embedded in layered soils by considering the influence of cement paste injection, the varying pile shaft modulus and the existence of the enlarged pile base.
- Based on the calculated results, the enlarged cemented soil base is considered to be effective in promoting the behavior of a short PGPN pile, and an increase in the diameter of cemented soil is efficient in promoting the compressive bearing capacity of a long PGPN pile.
- The proposed simplified approach can also be used for the analysis of similar precast pile-cemented soil composite piles which have two interfaces of the pile shaft.

