Uniaxial Compressive Performance of Hollow Circular High-strength Precast Concrete-filled Steel Tubular (CFST) Piles

Tokyo Institute of Technology Kono Laboratory JASINDA Clarissa

Background

Damage on foundation structures can cause a functional upper-structure to be completely dysfunctional. It is laborious to repair or retrofit damaged foundation structures and most of the time the structures have to be demolished, which can cause major and unnecessary economical loss. While Hollow precast CFST piles are in use, by far, there is no dedicated standards or guidelines covering the design of these piles for severe earthquakes.

Specimen Description & Experimental Program

Hollow precast CFST piles are manufactured in the factory by centrifugal concrete casting technique using high-strength concrete ($f_c' > 80$ MPa) for the concrete shell. In the experiment done by our research group, the parameters are variations of concrete shell thickness (t_c), steel tube thickness (t_s), absence or presence of concrete infill, concrete infill strength (f_{ci}'), and absence or presence of soil-cement.

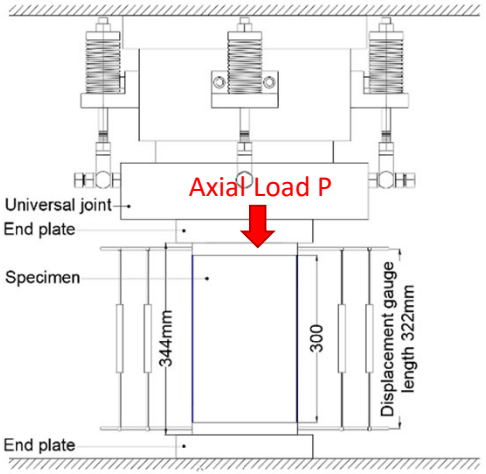

Fig. 1 Schematic of loading system

Fig. 2 Photo of specimen

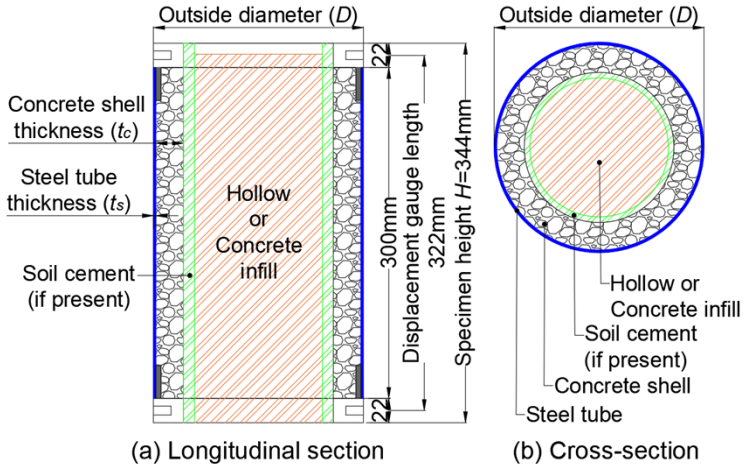

Fig. 3 Specimen cross-section

Results

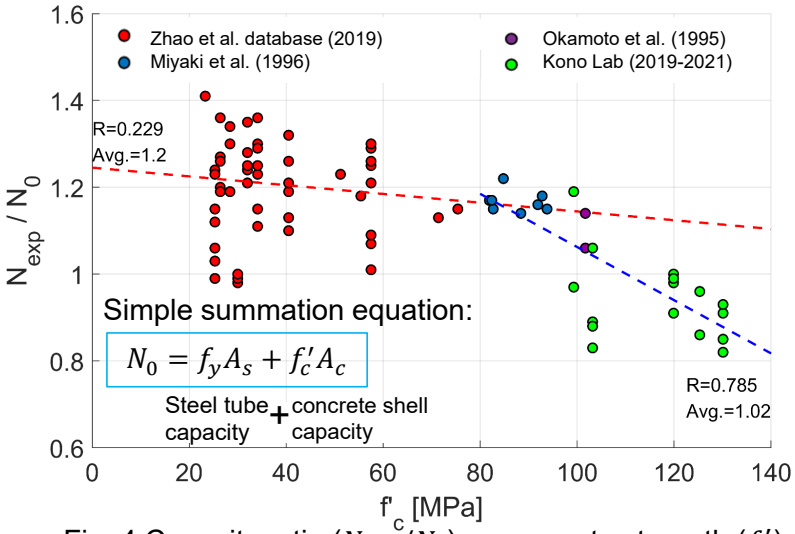

Fig. 4 Capacity ratio (N_{exp}/N_0) vs concrete strength (f_c')

The results is focused on the hollow CFST (without concrete infill). Red regression line is fitted for $f_c' < 80$ MPa and blue regression line is from $f_c' > 80$ MPa. It can be observed that the blue regression line have a larger slope than the red regression line.

Conclusions

It was found out that hollow CFST piles with high-strength concrete ($f_c' > 80$ MPa) showed a different tendency from its normal-strength counterpart. It is clear that there is a distinctive behavior for hollow CFST piles with high-strength concrete. Therefore, a different approach to evaluate the compressive capacity needs to be established, considering possible influencing parameters.

Contributions to Society

Results from this study will be used to assess the mechanism of non-ductile post-peak flexural behavior of hollow precast CFST piles under high compressive load, and to propose a method to improve the ductility of hollow precast CFST piles. Ultimately, the findings will be used to update the existing design codes in order to establish a more efficient and safe structures.