Flexural performance of cast-in-place concrete-filled steel tube (CFST) piles under varying axial load

Naresh Subedi, Kono Laboratory, Tokyo Institute of Technology

1. Research background and introduction

In recent earthquakes, tilting of the building and subsidence have been reported due to damage to the pile foundations Many of the buildings had to be reconstructed or demolished, which **hinders the continuous use and functionality of the buildings.**

Therefore, damage to pile foundation is a serious concern for building and infrastructures that need to operate immediately after an earthquake

- **Currently, there is no legal obligation to design pile foundations for large earthquakes (Level-II design).**
- **There are limited experimental studies for cast-in-place CFST piles under large earthquakes, especially for CFSTs with large diameter and large D/t.**
- **The actual performance of piles during the high axial loads (compression and tension), which the piles are subjected to during large earthquakes, has not been confirmed experimentally.**

To address these issues, in this research …

Flexural behavior of cast-in-place concrete-filled steel tube piles is evaluated. The purpose is to examine the bending performance of large–scale CFST piles (D=1200mm, D/t= 125) under different axial load ratios (-0.21 to 0.38)

2. Experiment details

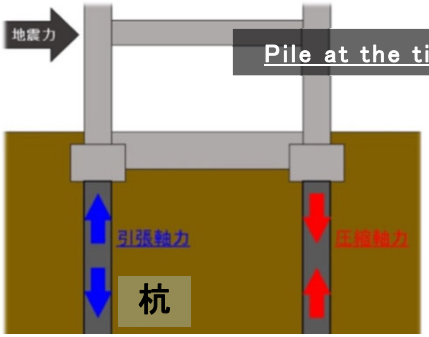
Total number of specimens: 5

Pile diameter: 1200mm, Full length: 8m, Steel tube thickness: 9mm

Axial Load range: Compressive axial Load (6.8 to 19.0 MN)

Tensile Axial Load (−3.3 to −4.2 MN)

The moment capacity, hysteretic response, damage progression, strain distribution, and strain limits of the CFST pile are determined.

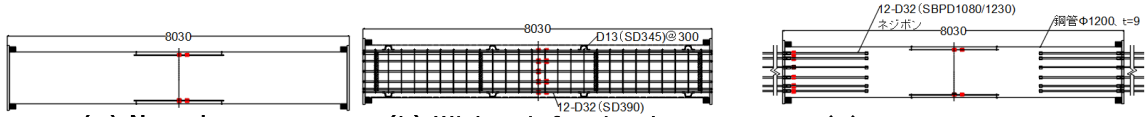


Pile at the time of a big earthquake

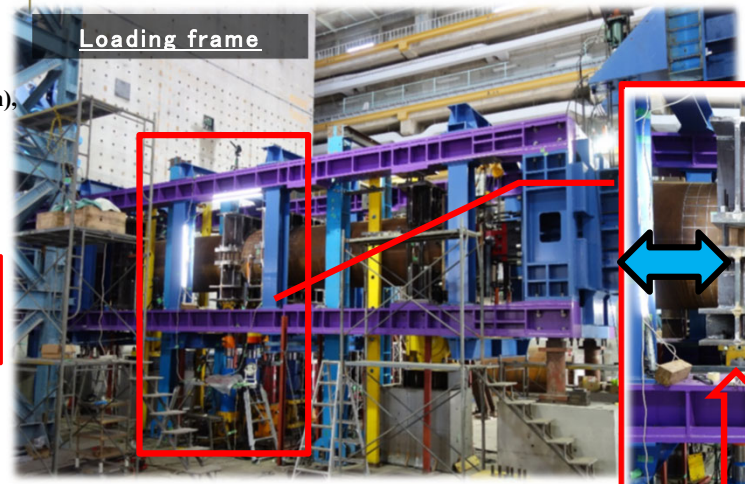
Actual test piece

What is cast-in-place CTST pile?

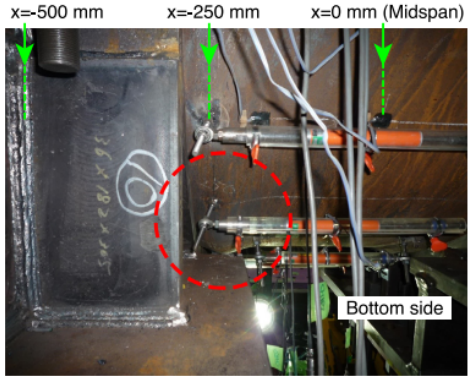
Pile constructed on-site by inserting a reinforcing cage into the ground and pouring concrete after digging a hole is called a 'cast-in-place concrete pile' . In a CFST pile, a steel tube is inserted together with the reinforcing bar (or only a steel tube is inserted). The following three types of CFST piles are tested in this study.

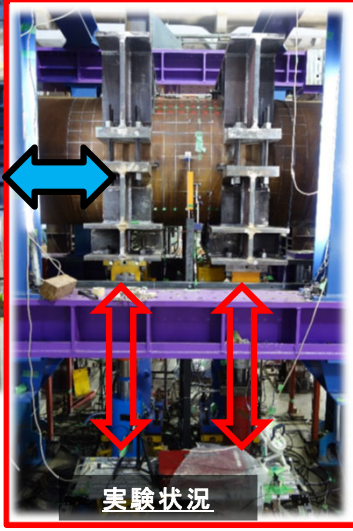


(a) No rebar (b) With reinforcing bars (c) Only at the end

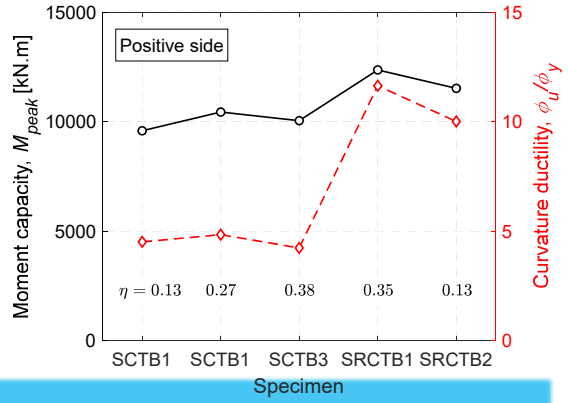


Observed Local Buckling in tube





For this experiment, a four-point bending setup as shown in the figure is adopted. The pile is placed horizontally and a set of horizontal jacks attached to the pile end applies axial force ranging from high compressive force to tensile force. Two sets of vertical jacks are installed near the center to apply the lateral load to the pile.



3. Findings

- **Local buckling of the tube did not cause strength degradation and immediate failure of piles.**
- **Ultimate (failure) condition of CFST piles is governed by rupture of steel tube. The pile specimen were able to sustain initial axial load even after rupture.**
- **Flexural stiffness, moment capacity and deformation capacity were larger for specimen tested under compression due to increased contribution from concrete in compression.**