# Performance Evaluation of Earthquake-Resistant Steel-Encased Concrete Piles Based On Prestressed Concrete Member Design Criteria

### Shreya Thusoo, Advisor: Prof. Susumu Kono, Tokyo Institute of Technology

Table 1 Criteria for performance evaluation of SC piles based on the 2015 AIJ guidelines for flexural PC members

Background

Is the building safe for occupancy?

Does it need to be retrofitted?

How much would the repair cost?

**Seismic performance evaluation** of structure is done to identify its damage state based on onsite evaluation after an earthquake. This information is used to decide future course of action for building.



Fig. 1 Onsite damage assessment after 2016 Christchurch earthquake.
Source: Thornton Tomasetti

However, it is difficult and almost impossible to assess state of foundation components by visual inspection. Hence, a framework using observable data and data collected from a pre-installed system is needed for performance evaluation of foundation components.

# Objectives

Data obtained from large-scale experiments on 7 steel encased (SC) piles tested under different axial load and geometric conditions is used to check the applicability of existing performance evaluation criteria (Table 1) based on observed concrete compressive strain, steel casing strain and residual drift.

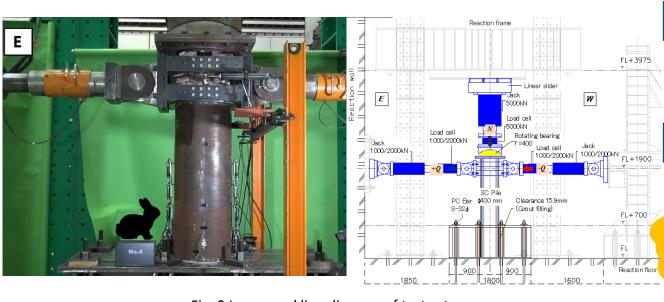
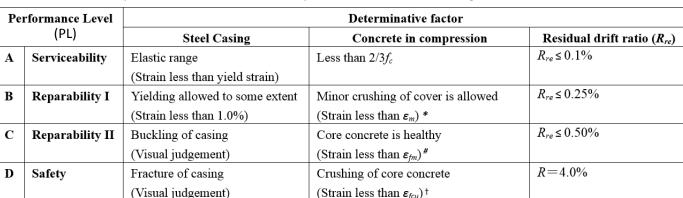
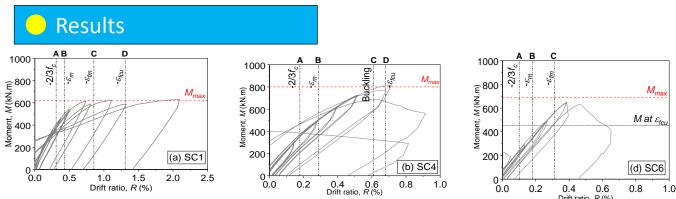


Fig. 2 Image and line diagram of test setup.



\*  $\epsilon_m$ : Strain at compressive strength of plain concrete; value taken from material test data; \*  $\epsilon_{fm}$ : Strain at compressive strength of confined concrete;  $\epsilon_{fm} = (1 + 231C_c)\epsilon_m$ ; †  $\epsilon_{fec}$ : Strain at ultimate strength of confined concrete;  $\epsilon_{fcu} = (1 + 361C_c)\epsilon_u$ , where,  $\epsilon_u$  is strain at ultimate strength of plain concrete  $\epsilon_u = 1.314\epsilon_m$ ; () texts inside parentheses are interpretations of guidelines by the authors and are not part of the guidelines.



- Strain level in concrete is the determinative factor that governed almost all the PLs.
- Separate criteria based on observed buckling condition of casing should be set.
- The limits set for performance based on residual drift  $(R_{re})$  for PC members are very large and hence could not be directly applied to the tested SC piles.

#### Conclusions

The criteria based on the 2015 AIJ guidelines could not be directly applied to the tested SC piles with respect to steel and residual drift ratio. Separate criterion based on buckling should be introduced and the limits for residual drift should be made stricter.

## Contribution to Society

This research will help to save lives by enabling engineers to make better judgement about state of buildings after an earthquake.

