

Effect of monotonic lateral load on the performance of reinforced graded concrete column, an experimental study



M. Mirza Abdillah Pratama¹, B. Sri Umniati¹, Gista Prasiwi¹, Han Ay Lie², Buntara Sthenly Gan³, Puput Risdanareni¹, and Zhabrinna Zhabrinna⁴

¹Department of Civil Engineering, Faculty of Engineering, Universitas Negeri Malang, Indonesia

²Department of Civil Engineering, Faculty of Engineering, Diponegoro University, Indonesia

³Department of Architecture, College of Engineering, Nihon University, Koriyama, Japan

⁴School of Engineering and Physical Science, University of Birmingham, The United Kingdom

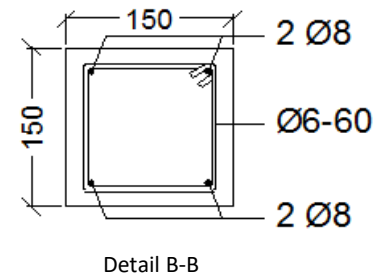
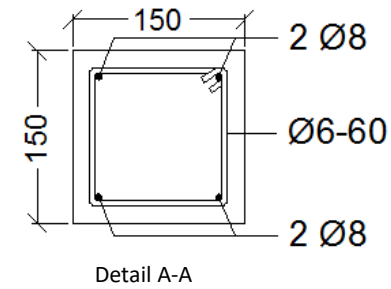
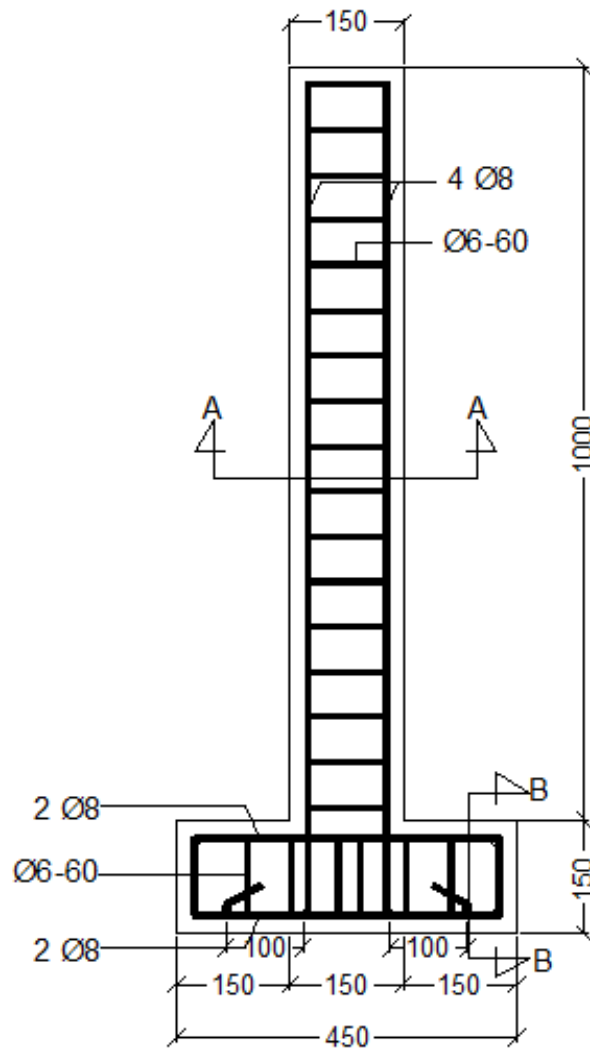
Introduction

- Previous studies show that the height-to-width ratio of concrete elements affects the material's homogeneity because of the presence of segregation.
- The segregation causes the element to create a graded structure.
- The effect of concrete uniformity on columns subjected to monotonic lateral load is investigated experimentally in this study.

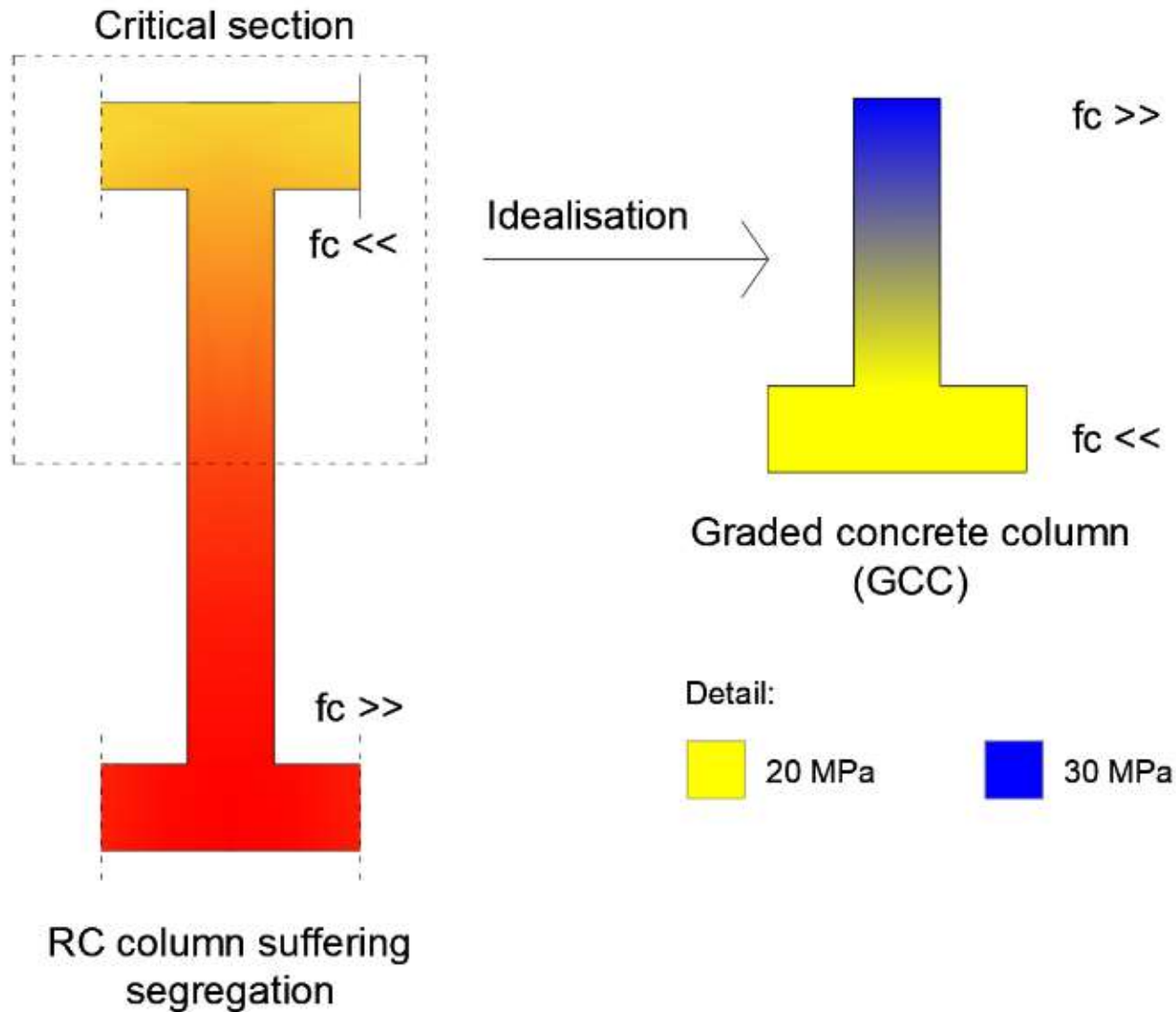
Design of RC column

- Reinforced concrete columns with cross-sectional dimensions of 150 x 150 mm and a height of 1000 mm are prepared as graded concrete column (GCC) specimens and controlling specimens.
- The columns are designed with a reinforcement ratio of 1% and are predicted to undergo an under-reinforced failure mode.
- Two concrete mixes with a strength of 20 MPa and 30 MPa are cast in moulds using the gradual compaction procedure to create a satisfactory strength transition throughout the specimens' height.

Design of RC column



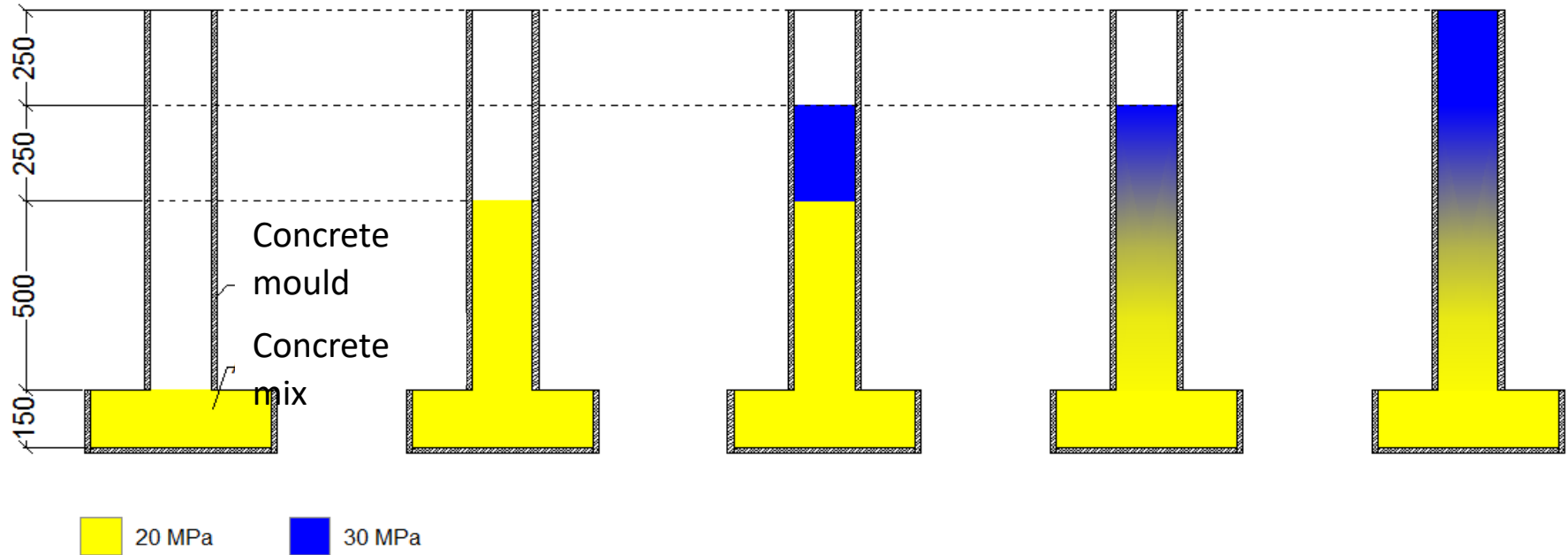
Design of RC column



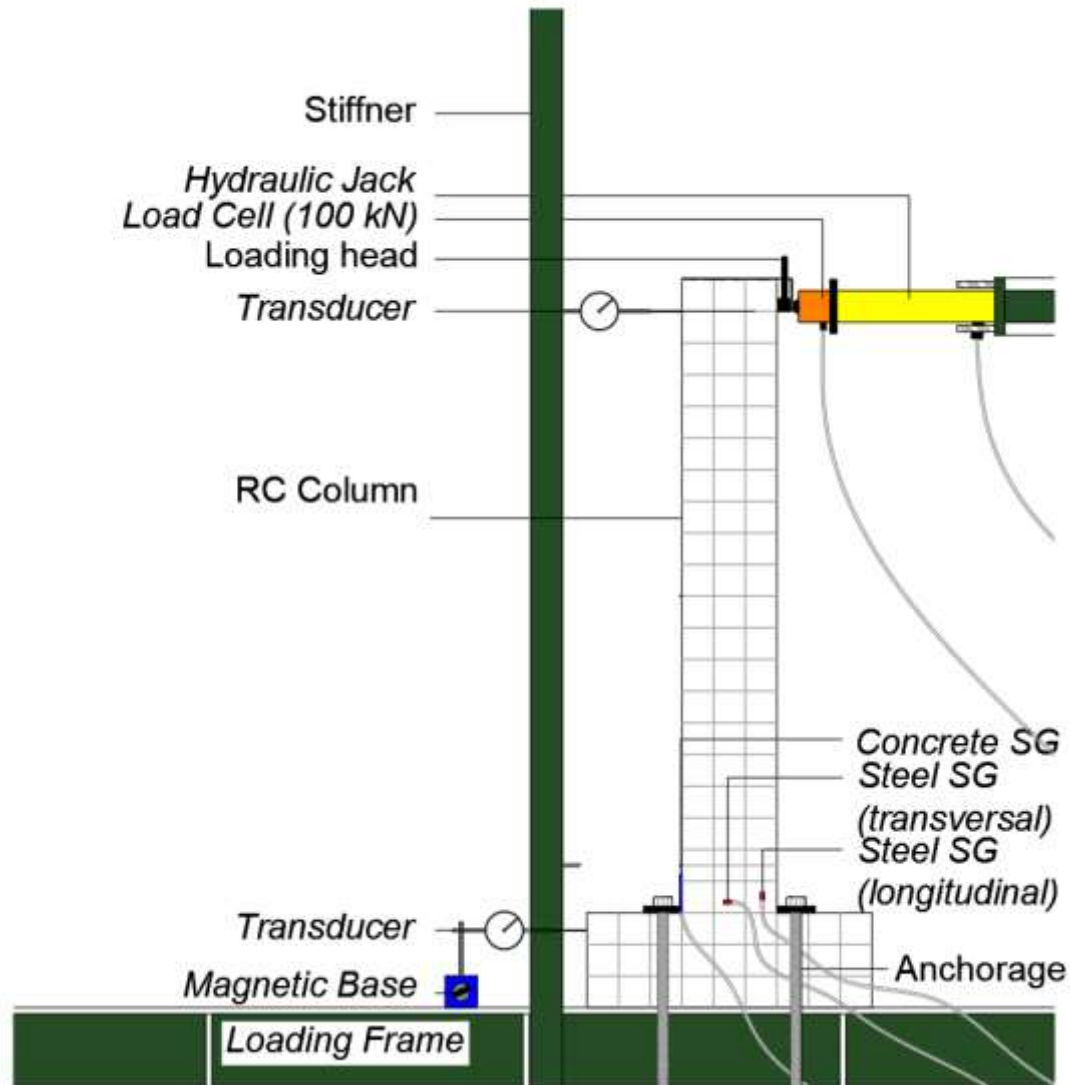
Concrete mix proportion

Concrete strength (MPa)	Ratio to cement weight				
	Cement	Water	Fine agg.	Coarse agg.	Superplasticiser
20	1.00	0.61	2.44	2.00	0.006
30	1.00	0.50	1.94	1.59	0.006

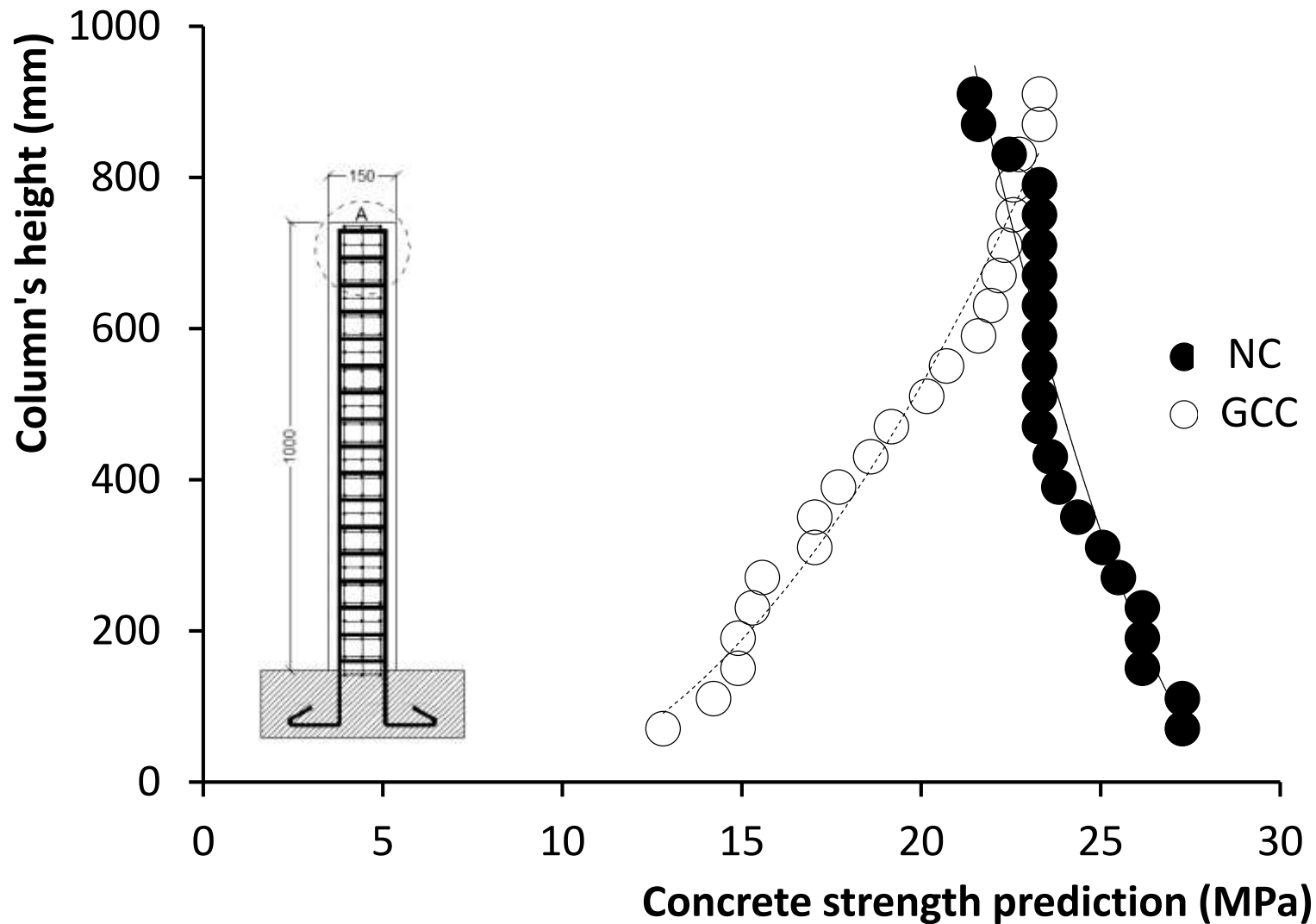
Specimen making and curing



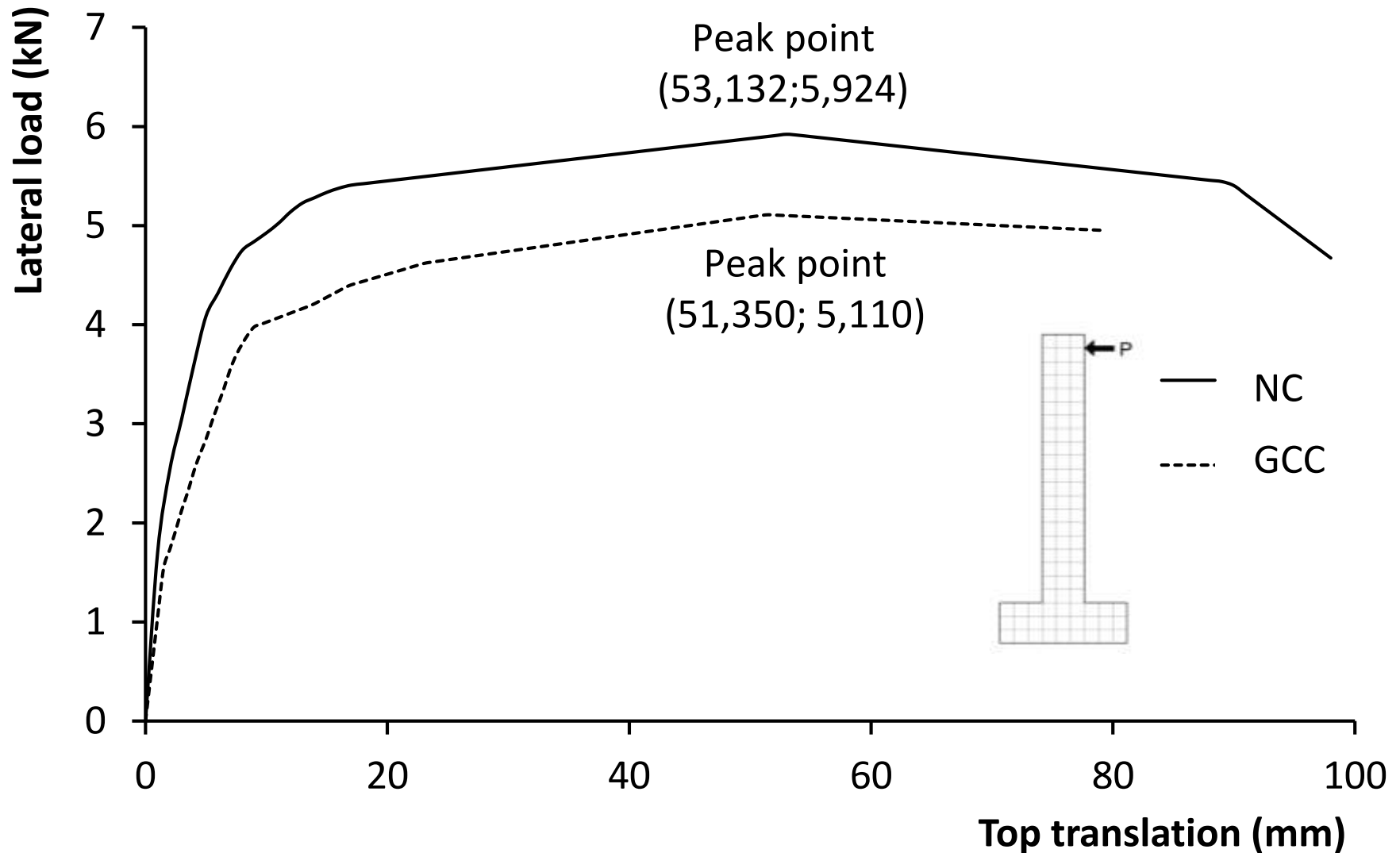
Lateral loading test set-up

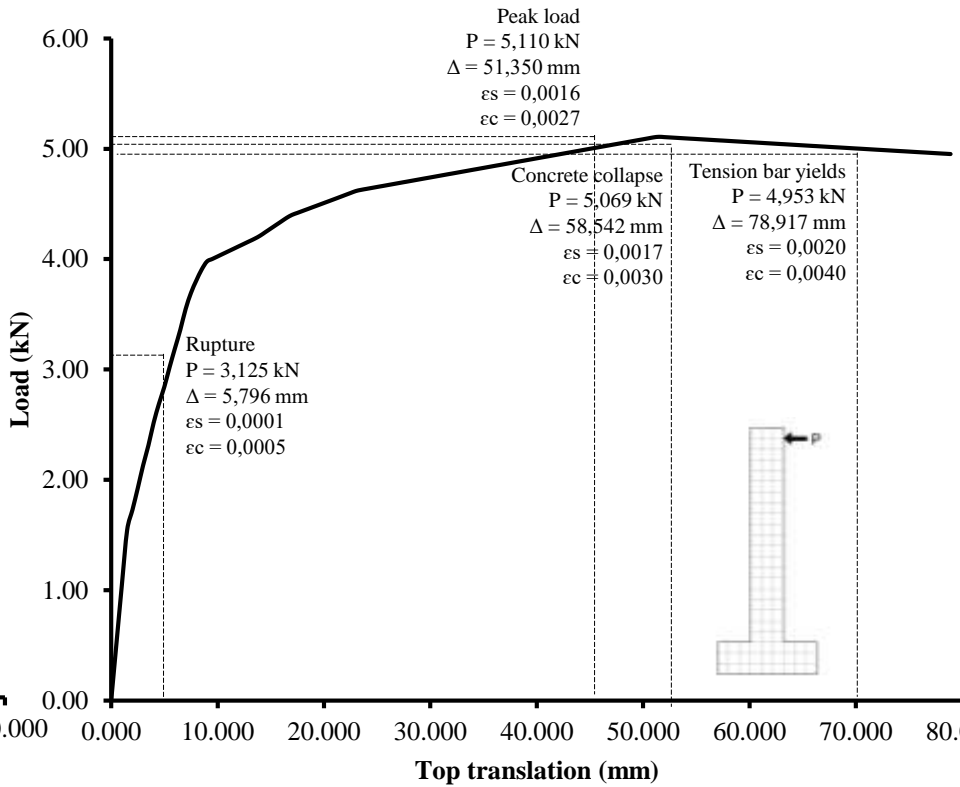
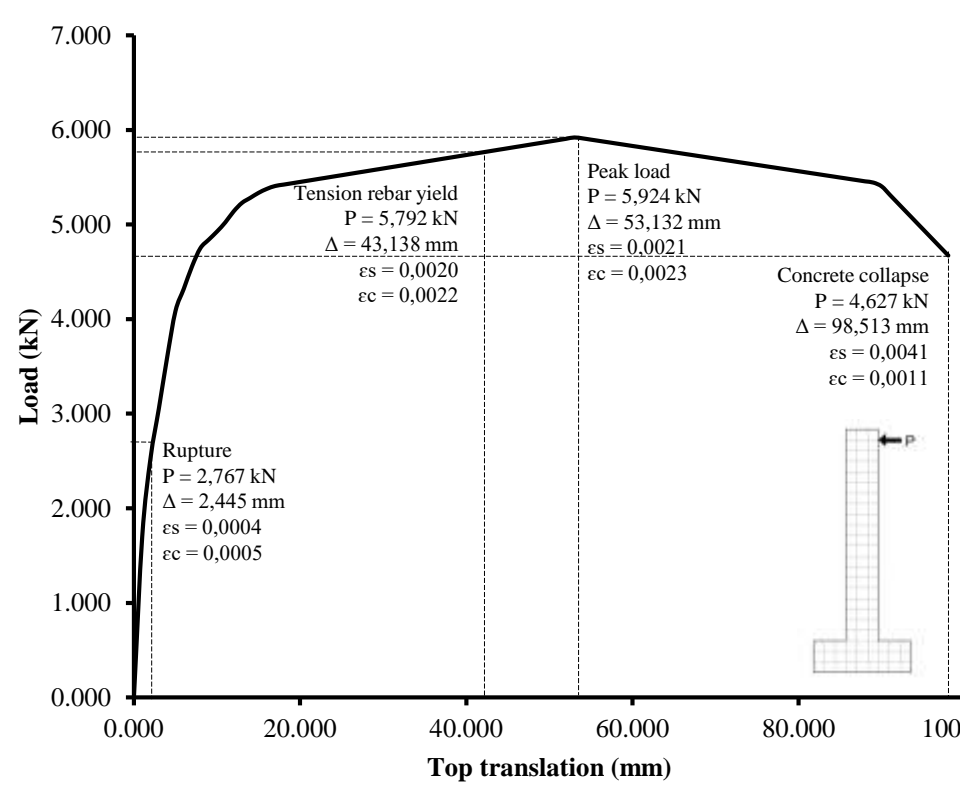


Hammer test result



Load - top translation





Conclusions

- Static segregation on a high element such as a column is unavoidable due to the effect of dimension ratio and the characteristics of the concrete material.
- Concrete strength gradation in a column decreases the capacity of the lateral load by 15.93% to the normal concrete column and decreases the maximum translation up to 3.47%.
- Concrete segregation can change the failure mode from tension-controlled failure to compression-controlled failure.



