

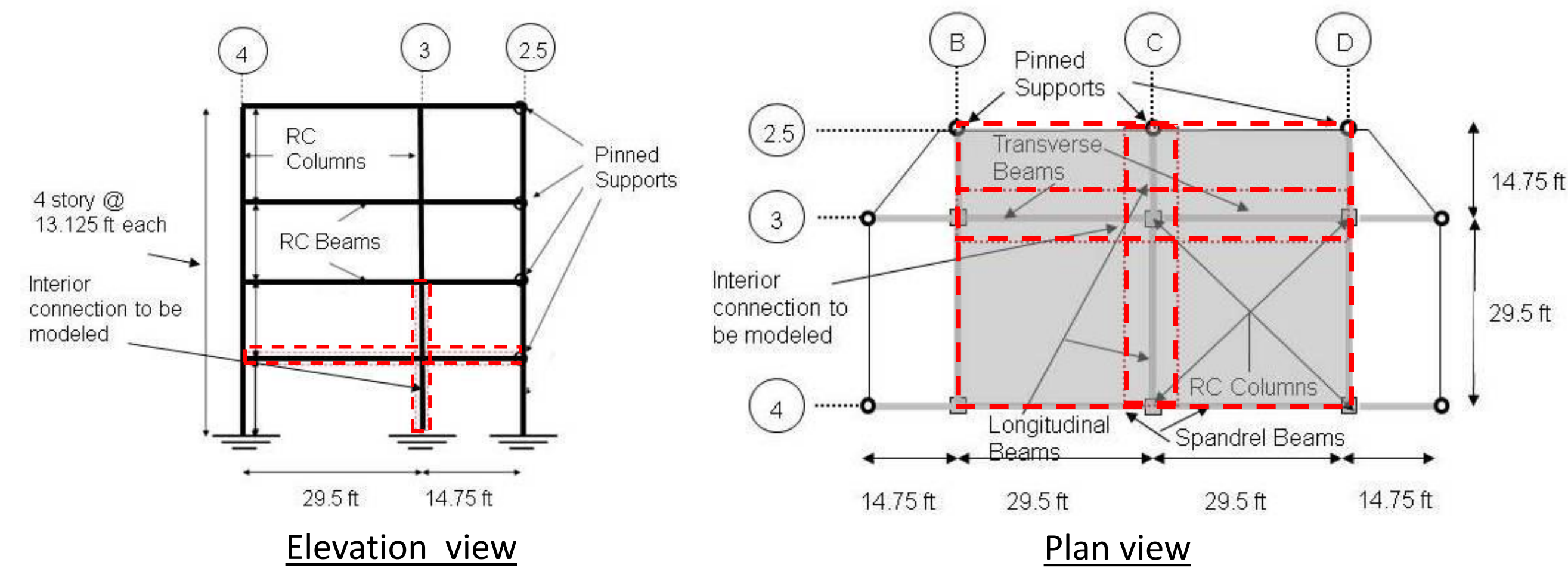
# CHARACTERIZING A REINFORCED CONCRETE BEAM-COLUMN-SLAB SUBASSEMBLAGE CONNECTION FOR PROGRESSIVE COLLAPSE ASSESSEMENT

## Introduction

A simplified structural element based finite element (FE) model for reinforced concrete (RC) interior beam-column-slab connection had been developed. This simplified FE model serves as an alternative to the more complex predominantly continuum based FE model and could be use as a platform to develop a fast running tool for progressive collapse assessment of a whole building frame.

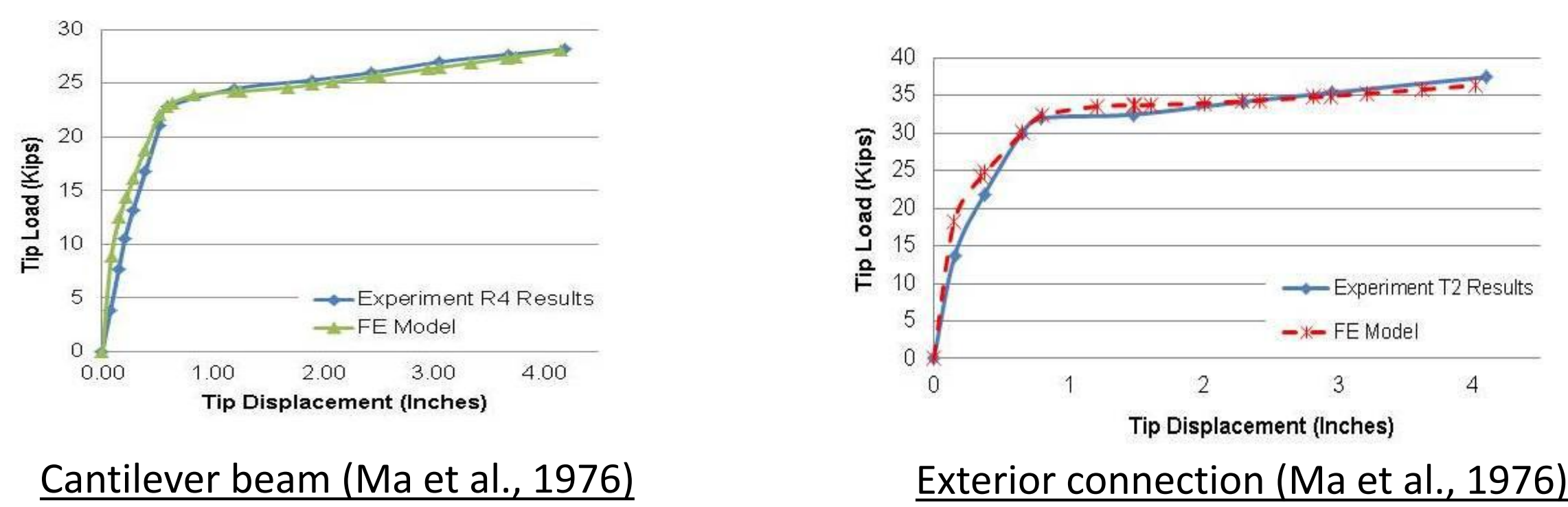
## Prototype Building

- 4 story RC frame structure with column clear height of 13.125 ft
- Interior connection modeled
  - Interior column (21.75" x 21.75")
  - Longitudinal and transverse beams (12" x 21.75")
  - Spandrel beams (12" x 17.75")
  - Slab (10")



## Validation of Abaqus/Standard

- The FE code Abaqus/Standard was validated using three experimental cases prior to be used to simulate the interior connection of the prototype building shown above
- Overall, the FE model results of the three validation cases provided reasonably-accurate results, as shown below

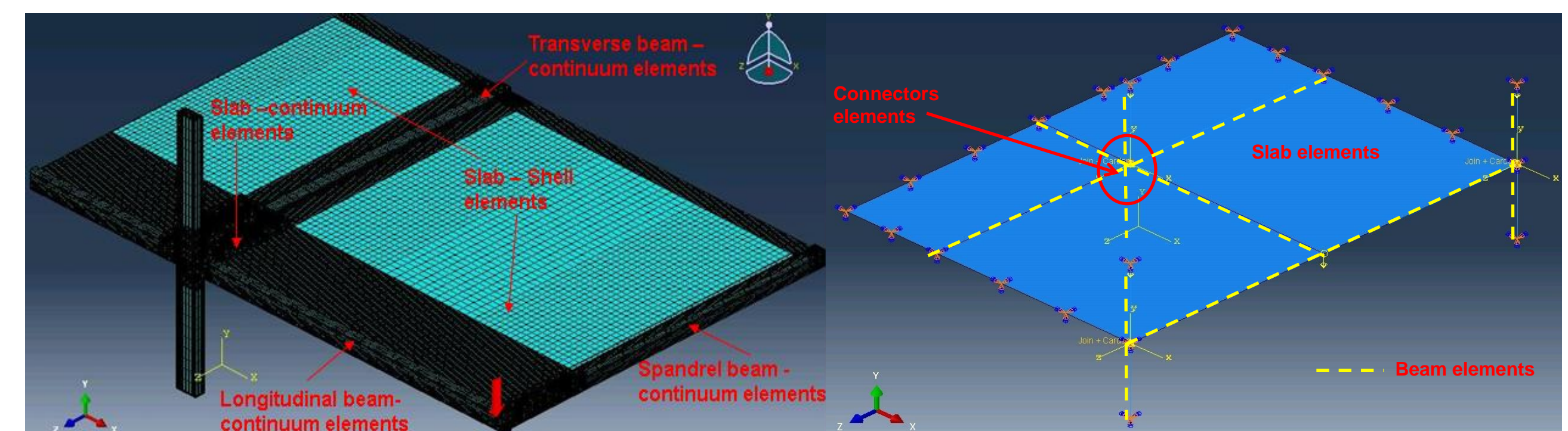


## Predominantly Continuum Based FE Model

- Symmetry was used to reduce the size of the FE model
- 8-node brick elements were used to represent the RC column, beams, and part of the slab
- 2-node beam elements were used to represent steel reinforcing bars for columns, beams, and slab
- 4-node shell elements were used to represent slab

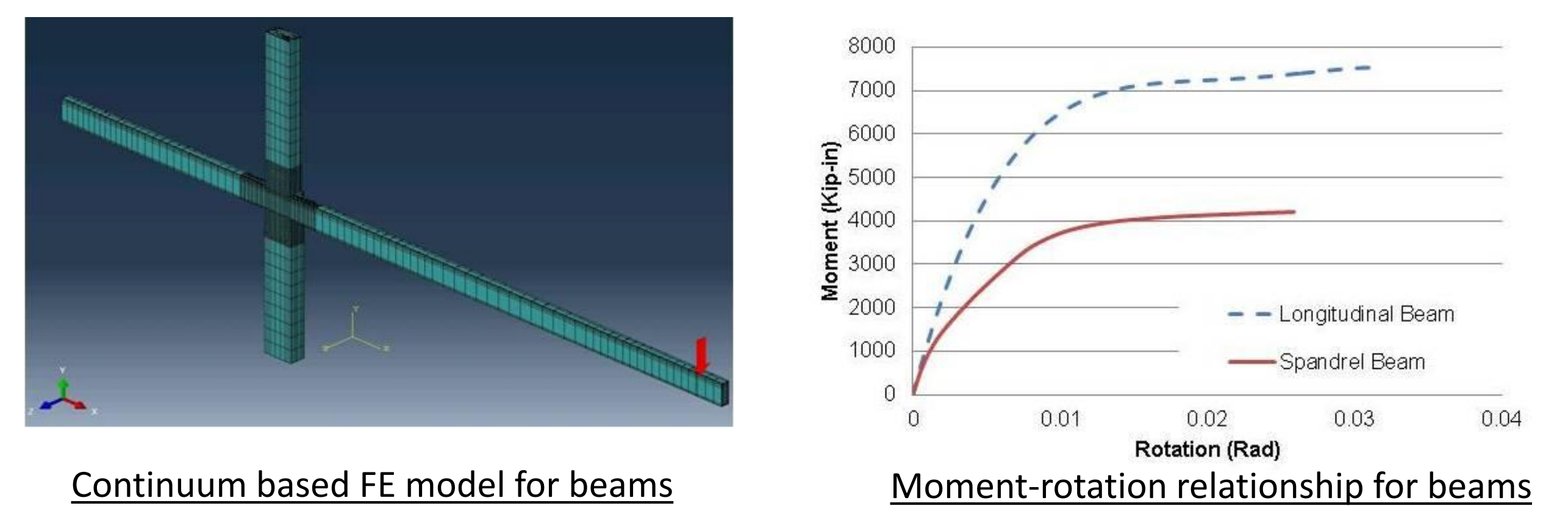
## Simplified Structural Element Based FE Model

- Used as an alternative to the time consuming predominantly continuum based FE model
- Consist of the following components:
  - Beam elements: 2-node beam elements used to represent structural column and beam components
  - Slab elements: 4-node shell elements used to represent slab components
  - Connector elements: used to represent the moment-rotation resistance of a beam-column connection



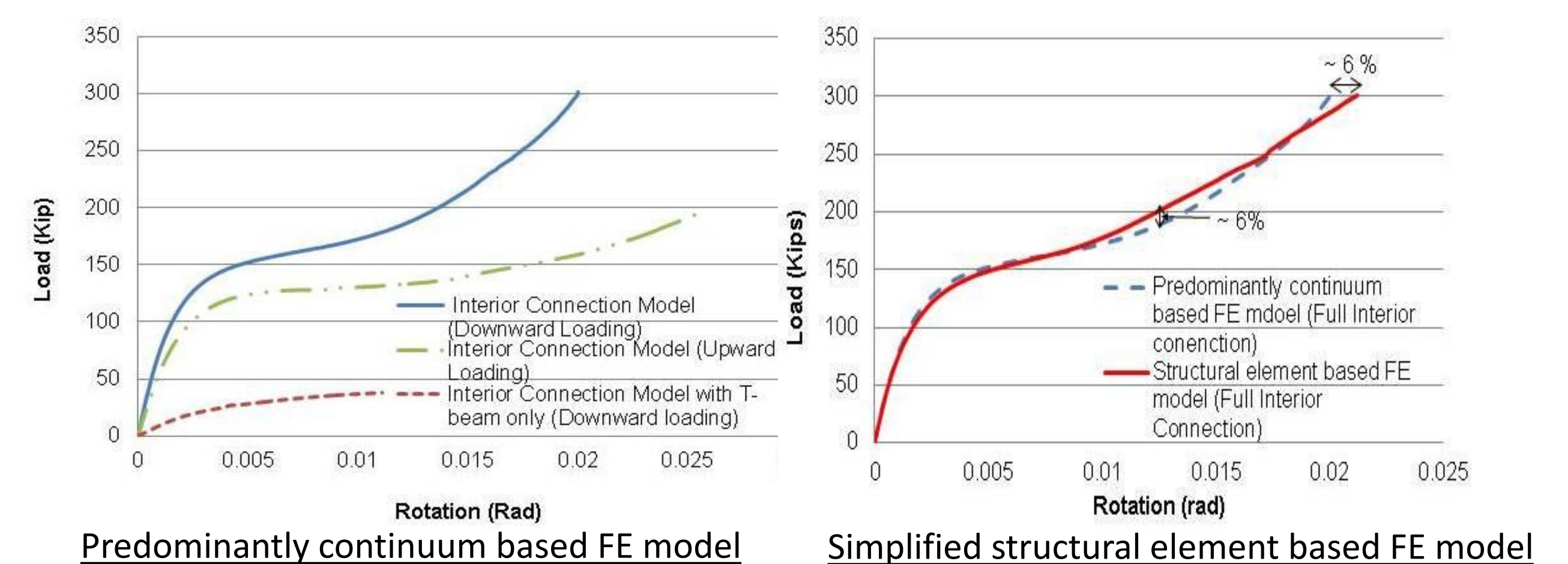
## Connector Elements

- Connector element springs to connect beams to columns
- Moment-rotation relationship obtained from continuum based FE model for beams with rectangle cross-section only



## Results

- Interior connection of prototype building were simulated
- Effect of slab on the load-rotation behavior is significant
- Two-dimensional effects of the slab should be considered
- Simplified structural element based FE model provides reasonably close estimates at a fraction of the time
- Feasible as an alternative to the time consuming continuum based FE model



Comparison of computation time between FE models

	Numbers of Dofs	Simulation Time (mins)
Predominantly Continuum Based FE Model	749208	7620
Structural Element Based Simplified FE Model	83448	18