# Collapse Analysis of RC Walls and Sensitivity to Constitutive Model Parameter Uncertainty

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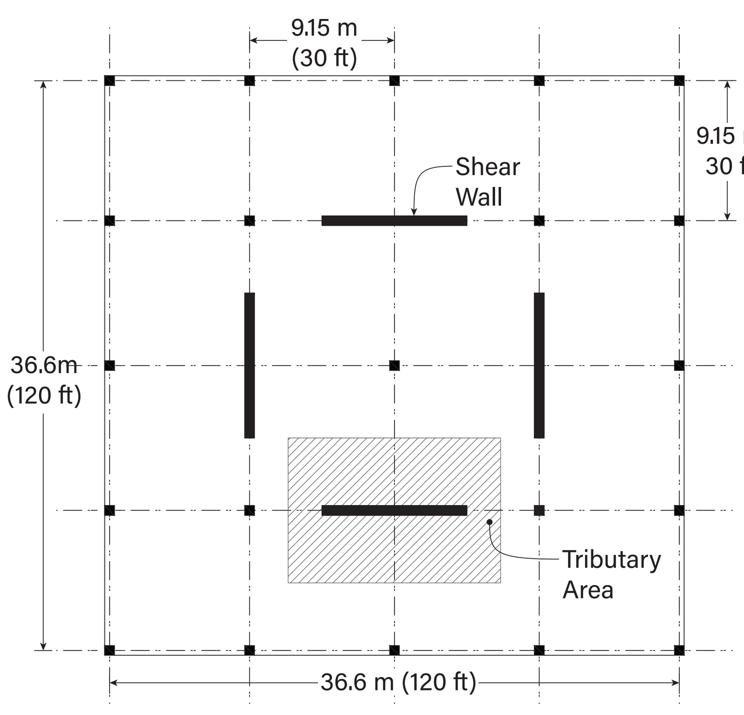
## Background and Motivation

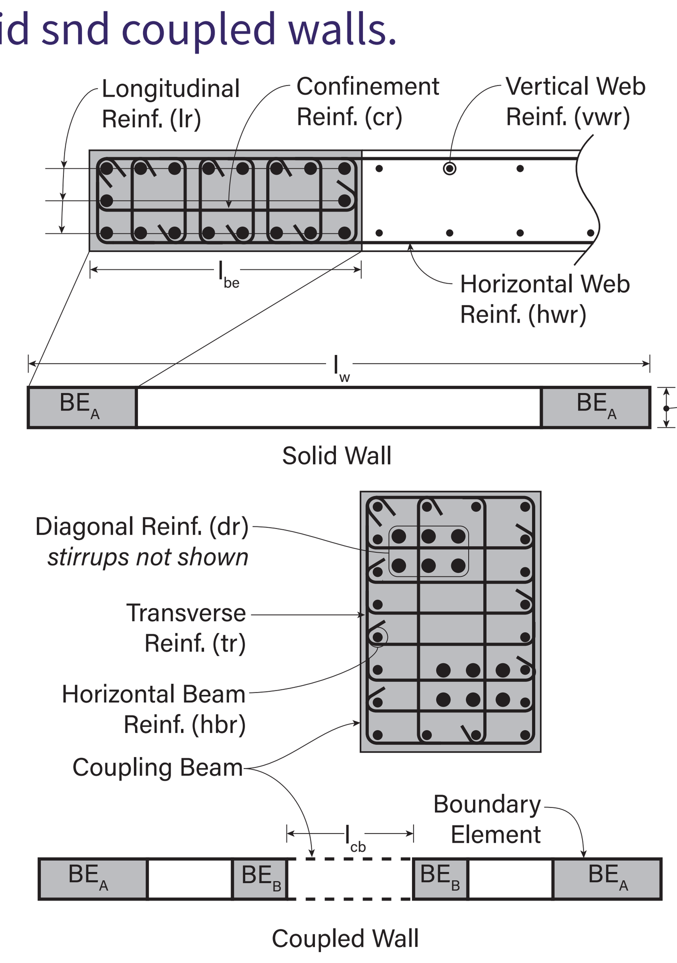
- Reinforced concrete walls are a common lateral load resisting system for buildings in regions of high seismicity.
- There are many underlying assumptions in concrete wall design and modeling that could affect the collapse probability in the maximum considered earthquake.
- The work presented here quantifies the sensitivity of collapse probability to these assumptions and identifies design decisions that can reduce earthquake collapse risk.

## Archetypes

- Collapse analysis of 4-, 8-, and 12-story RC solid snd coupled walls.
- Using FEMA P695 methodology.
- Designed for FEMA P695 $D_{max}$ Site.

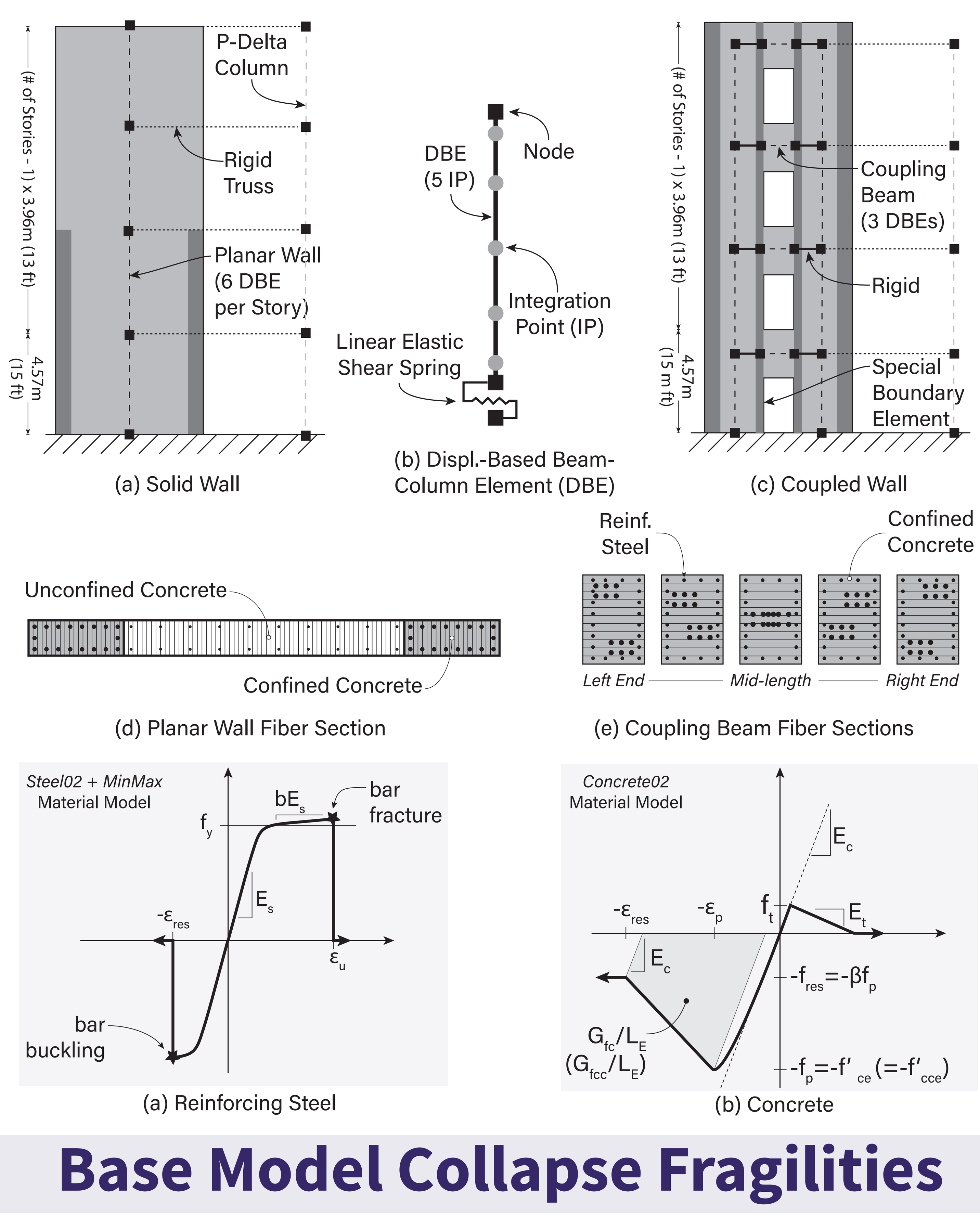



Typical Archetype Floor Plane



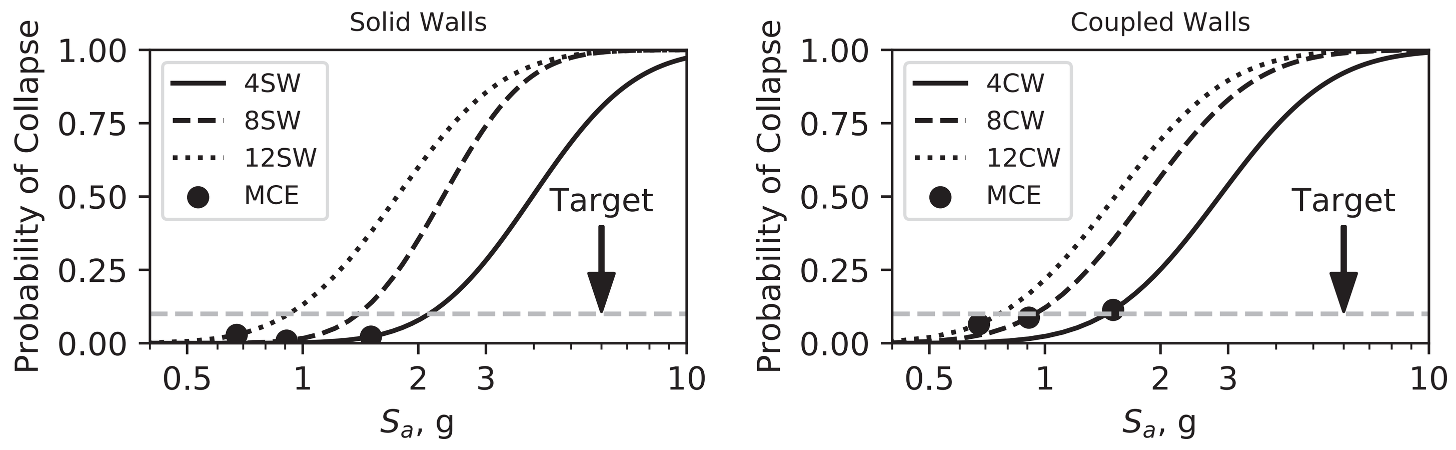

## Non-linear Modelling

- Non-linear models in OpenSees
- Calibrated to +20 planar-wall tests (Marafi et al. 2018)
- Regularized concrete compressive energy to reduce mesh sensitivity (Pugh et al. 2015)




## Base Model Collapse Fragilities

- All archetypes (base model) are below the target 10% conditional probability of collapse in the maximum considered earthquake.



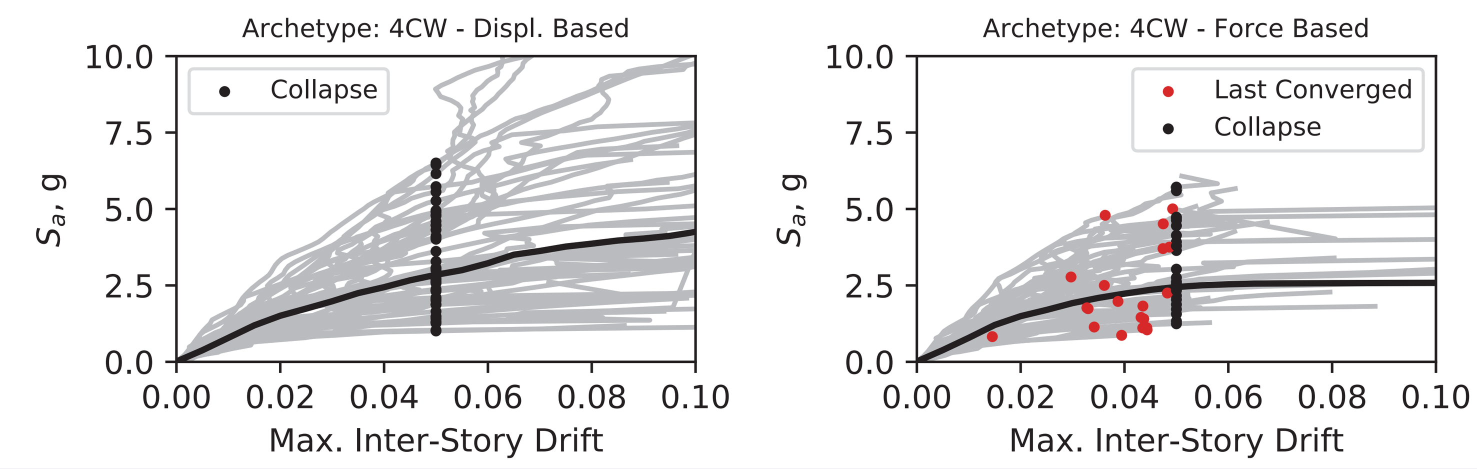

## Parameter Study

The following design decisions and modelling parameters were varied:

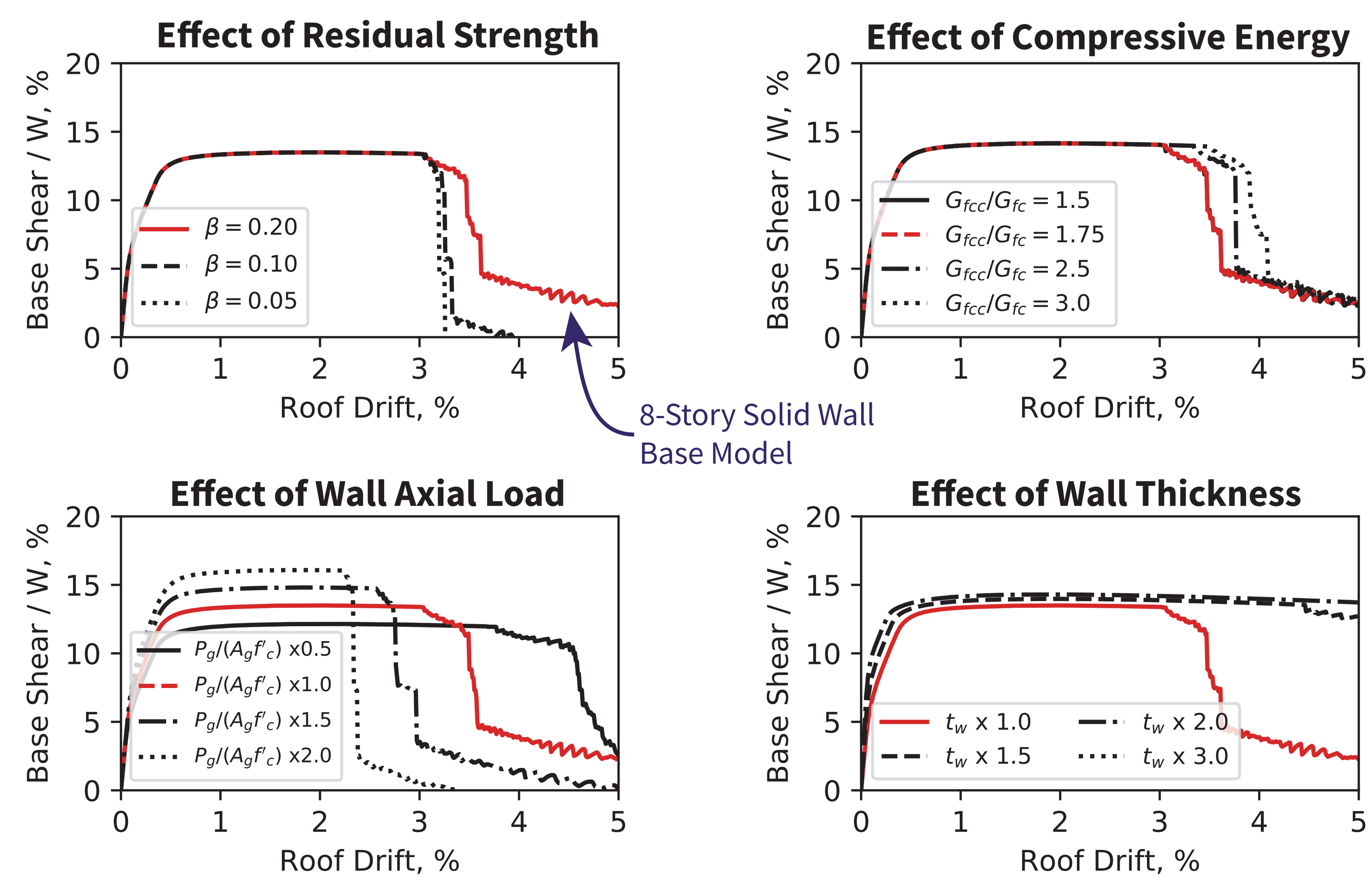
- Non-linear Beam-Column Element Formulation (FBE vs. DBE)
- Confined Concrete Model
- Concrete Residual Strength (boundary element and web region)
- Concrete Compressive Energy
- Steel Ultimate Strain
- Wall Axial Load Ratio
- Wall Thickness
- Gravity System Drift Capacity

## Force-based vs. Displ.-based Elements

- The probability of collapse is larger in force-based elements due to many instances of non-convergent analyses.

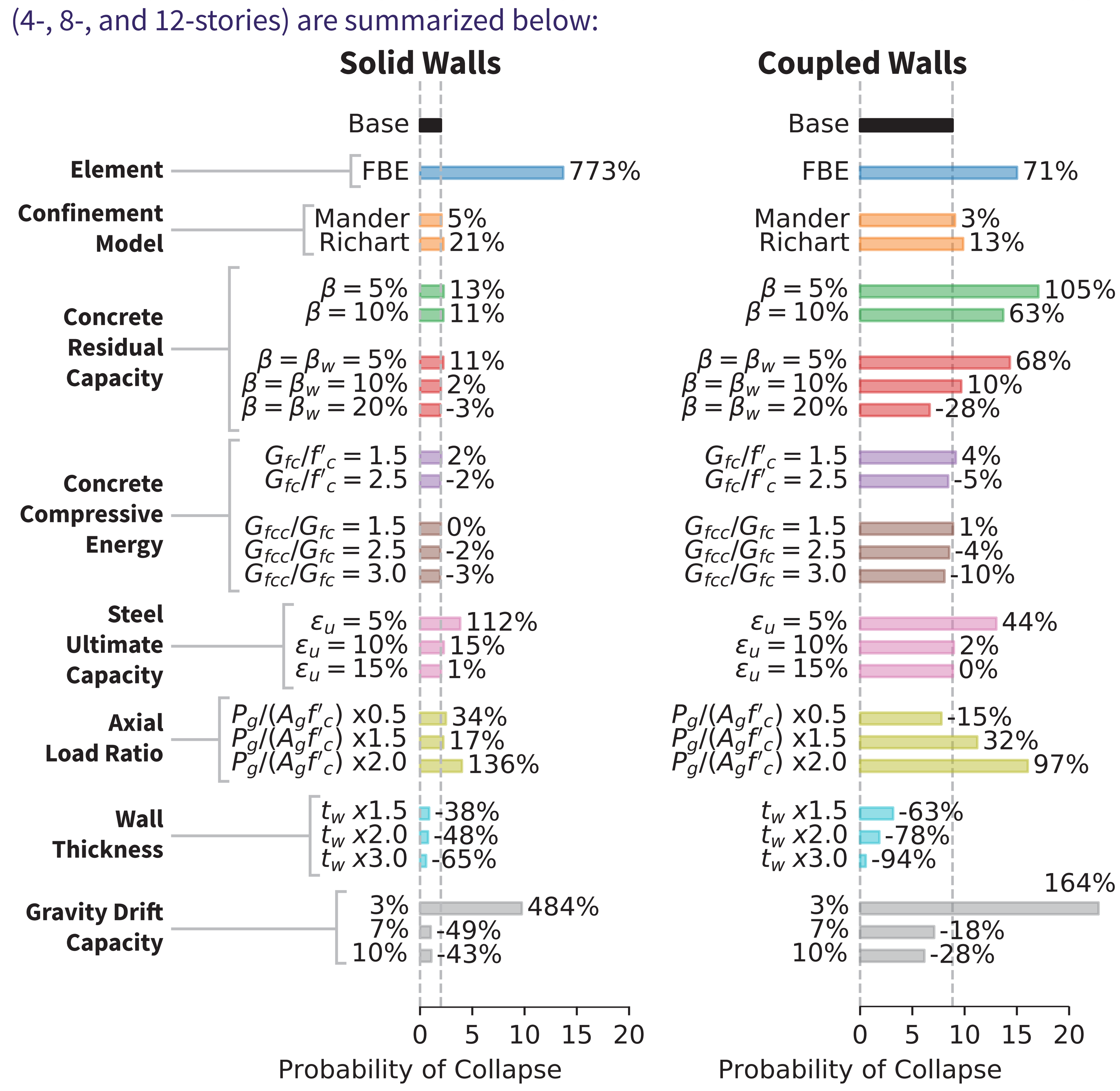



## Pushover Response




## Results Summary

The average change in collapse probability for the solid and coupled wall archetypes (4-, 8-, and 12-stories) are summarized below:




## Conclusion

For both solid and coupled walls, the element formulation and gravity system drift capacity affected the collapse probability. For coupled walls, the residual concrete residual strength and the axial load ratio mostly affected the collapse probability.

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