

Seismic Performance Limit-States of Steel Bridge Piers with Socket-type Connections

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Introduction

- Steel pile-to-cap element welded connection was found to exhibit premature brittle failure under cyclic loading (Fulmer et al., 2011).
- The **GSS connection**, short for **G**outed **S**hear **S**tud connection was developed to relocate damage to columns (Fulmer et al., 2015).
- Need for **displacement-based design recommendations** for socket-type connections was realized.
- This study (Jayaprakash, 2020) was undertaken to address this need.

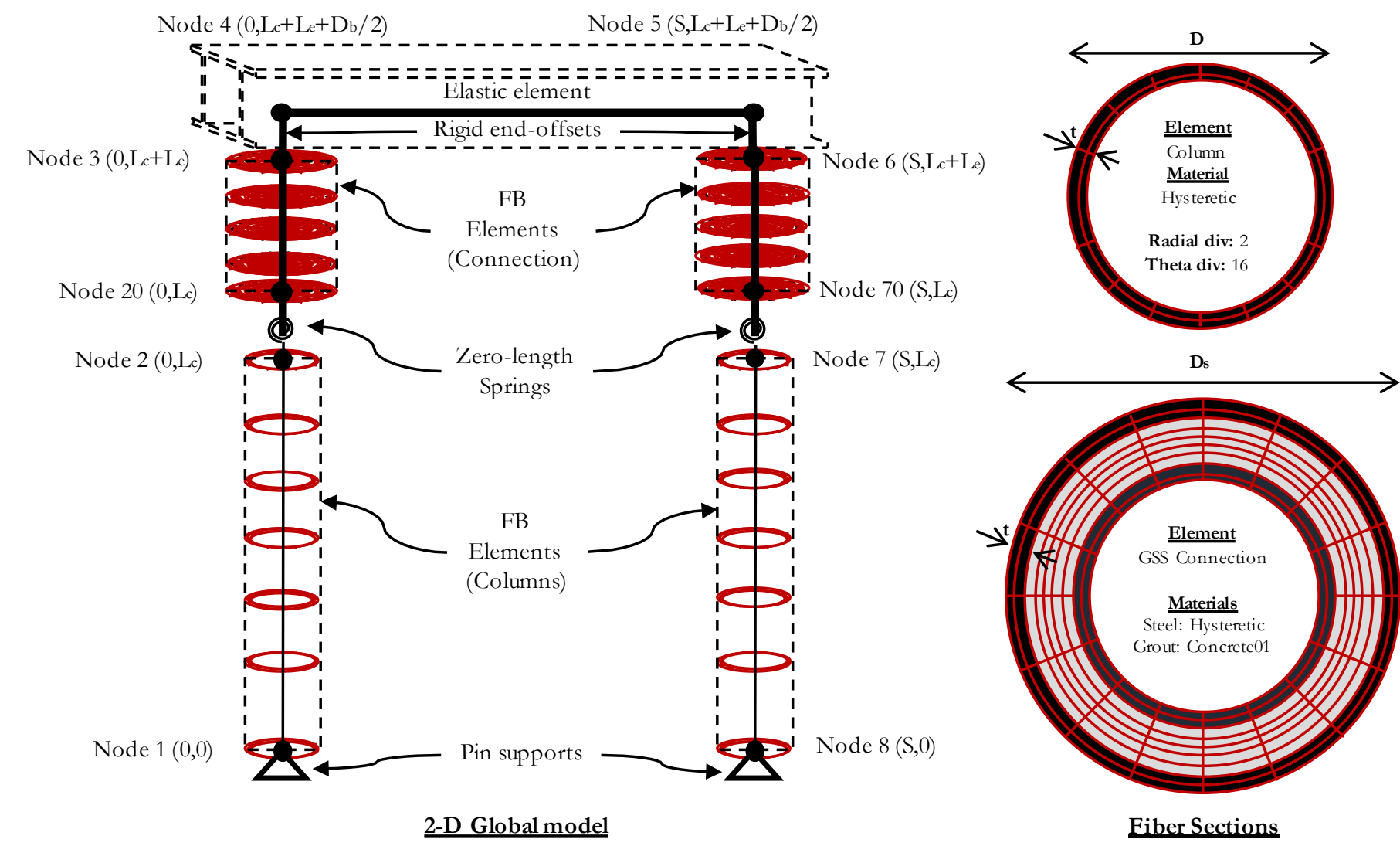
Methods

Experimental:

We performed large-scale structural tests on two-column steel bridge pier specimens with GSS connections (see photograph to your right).

Numerical Modeling:

We developed fiber-based OpenSees models (see below) to capture full cyclic behavior of these piers.



Parametric Studies:

We performed parametric studies using calibrated numerical models to develop semi-empirical equations.

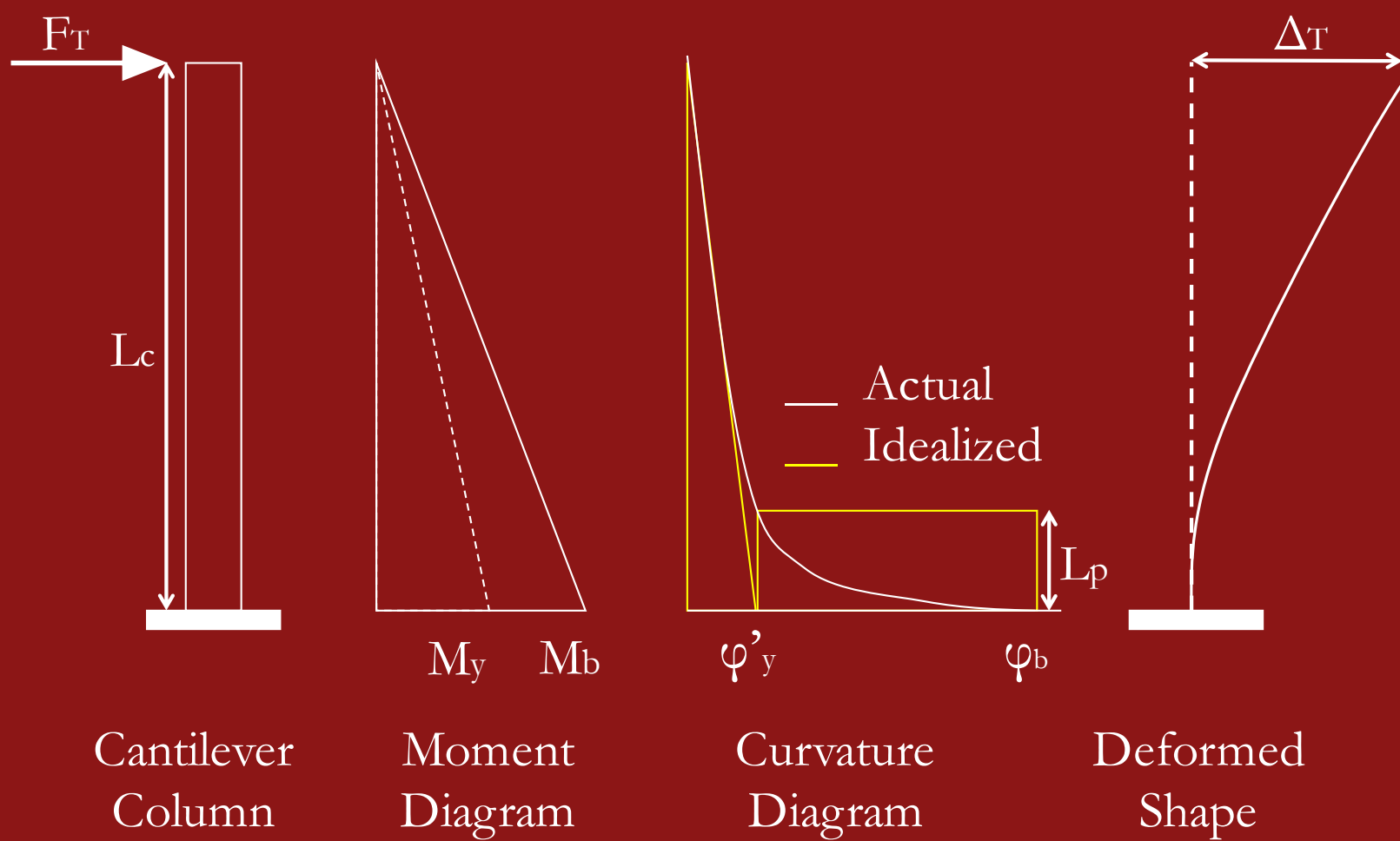
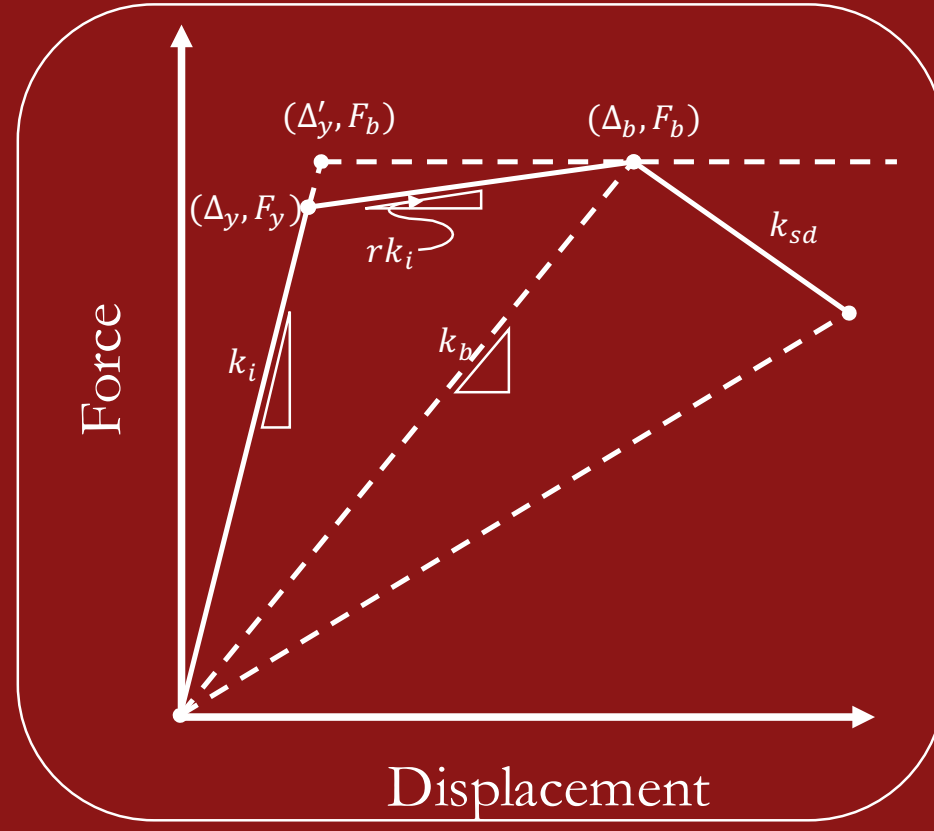
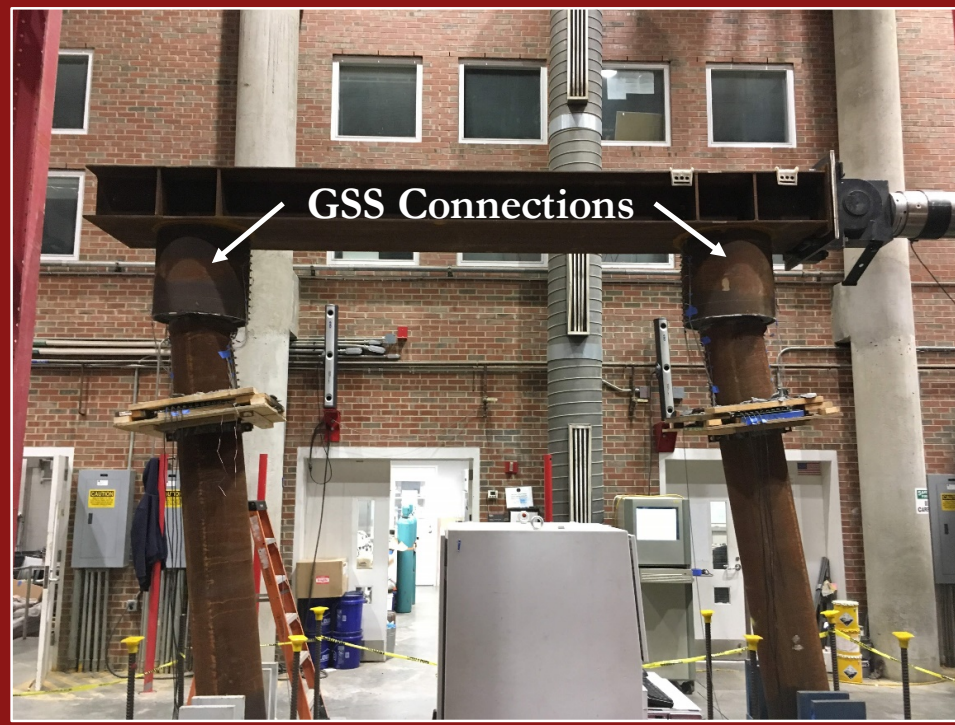
Result and Broader Impact

A set of equations that can predict the force and displacement of these types of systems at various key performance limit-states.

This model is a crucial component in displacement-based seismic design and assessment of steel bridge piers with socket connections.

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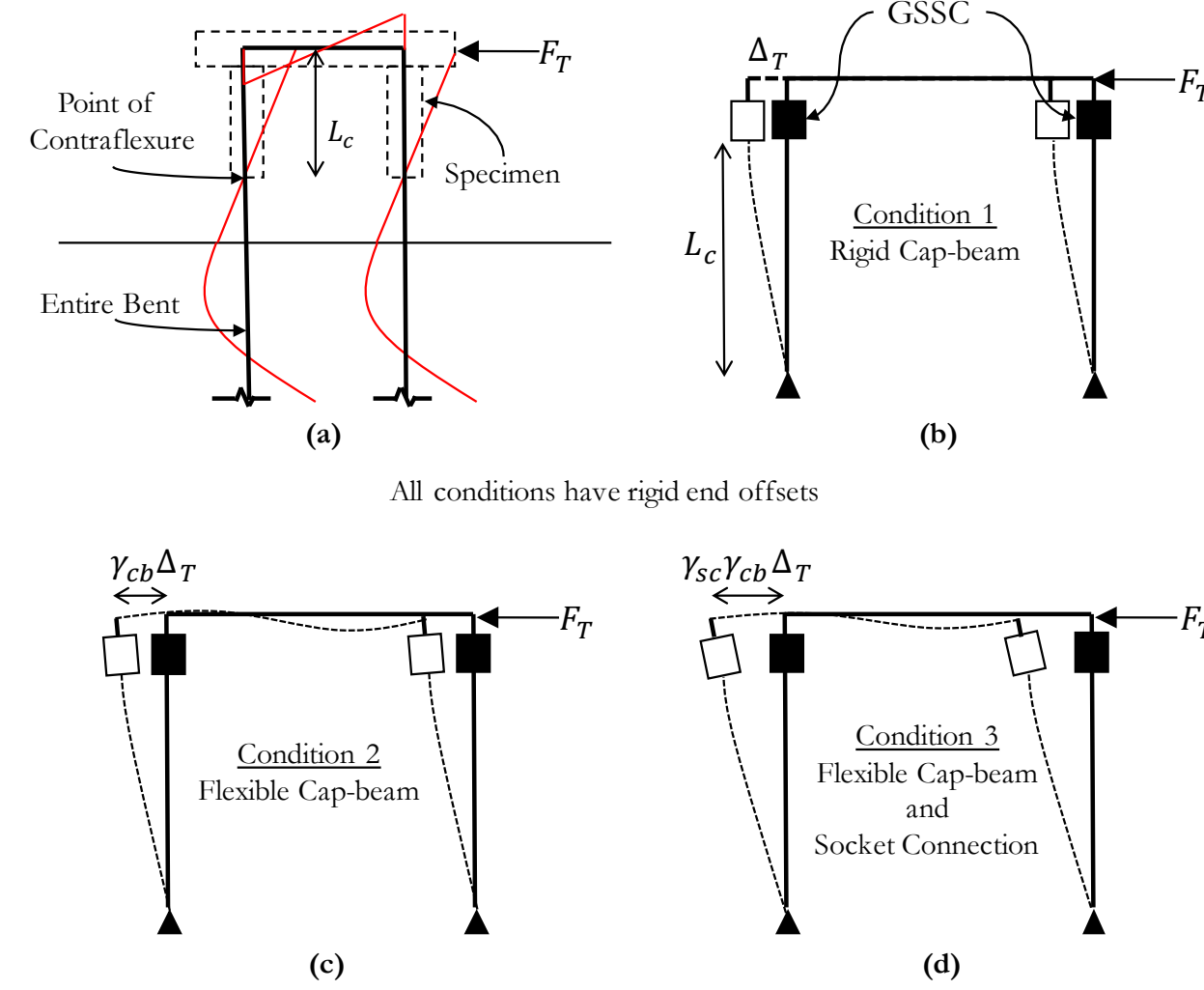
We propose a simple hand-calculation model that can estimate the complete non-linear response of two-column steel bridge piers under cyclic lateral loading.



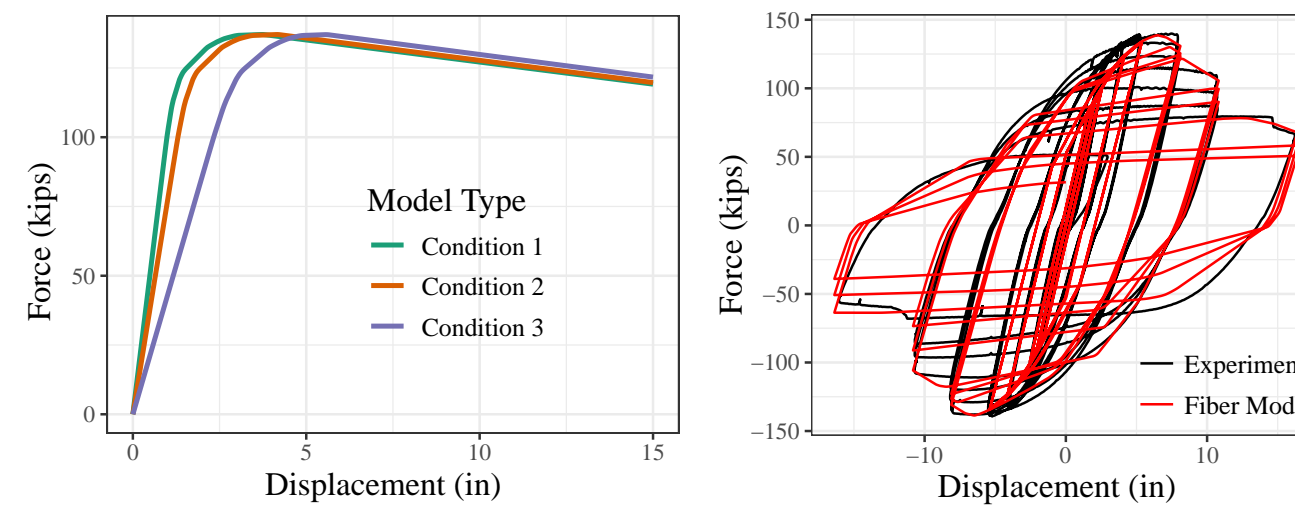
Scan the QR-code to get the model equations & more

Supplemental Information

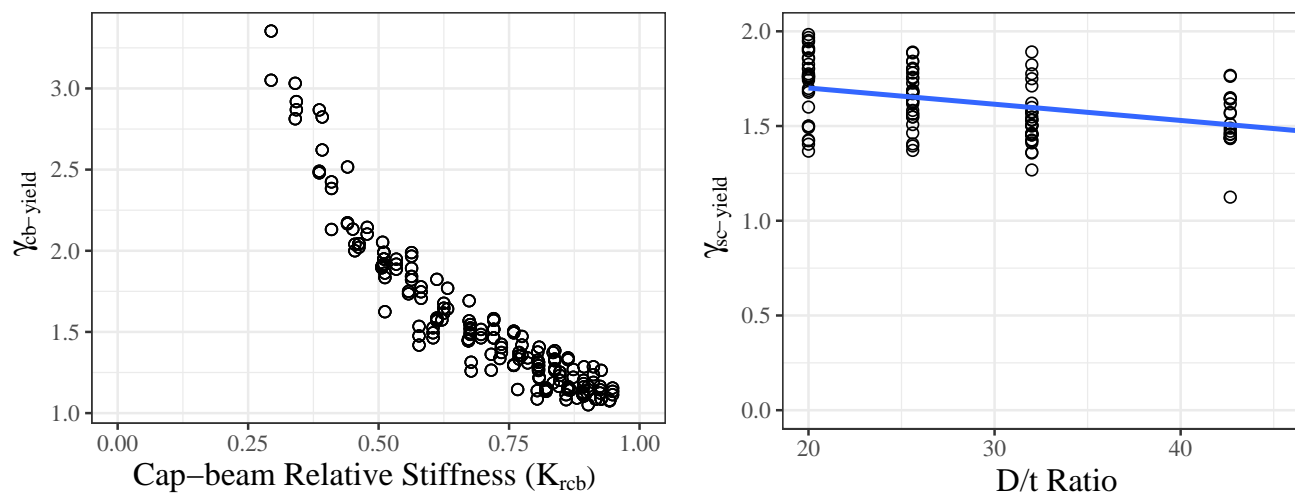
Flexibility Correction Coefficients, γ_{cb} and γ_{sc} :



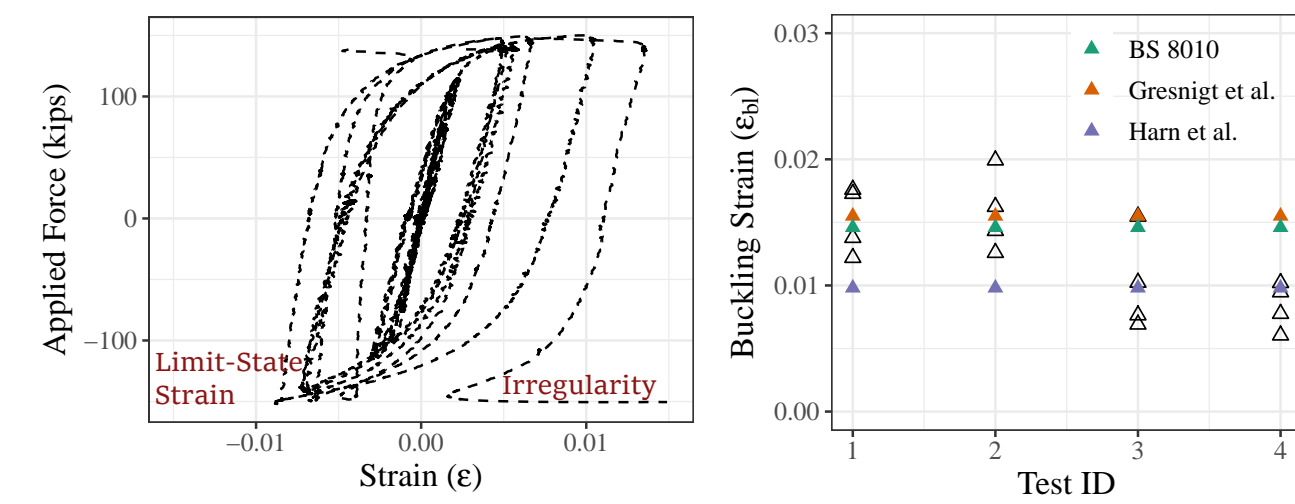
Model Calibration:



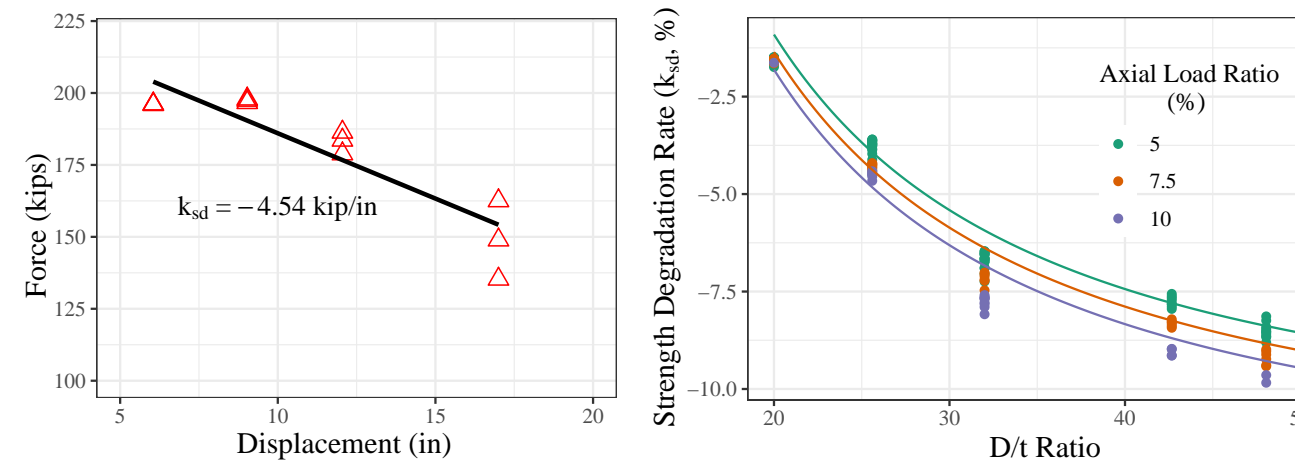
Yield Limit State, ϵ_y :



Buckling Limit State, ϵ_b :



Strength Degradation Rate, k_{sd} :



What the model looks like:

