Introduction
In general, light-frame residential buildings have demonstrated to be generally safe and resilient against collapse in the event of a major earthquake. However, the damage afflicted to these structures can result in large economic losses for a region.

To enhance the life cycle of these types of structures, researchers have begun to explore a seismic design method called the unibody approach, which involves strengthening and stiffening partition walls so they too can help a house resist more lateral force. Typically, the contribution of architectural partition walls in light-frame residential buildings is highly penalized or neglected. The unibody approach amends this design flaw by rendering these walls structural through the use of adhesive, anchorages, and holdowns. In addition to fasteners, adhesives possess the ability to strengthen and stiffen the bond between framing elements and sheathing in the construction of light-frame structures.

Structural tests have been performed to understand the hysteretic behavior of light-frame unibody structures; however, very few computer models have been constructed to further this research.

Research Objective
This project seeks to develop a simplified hysteretic OPENSEES model for the unibody approach that accounts for the addition of anchorages, holdowns, and adhesive between gypsum wallboard and wood framing elements for light-frame residential buildings. A model is proposed and then compared to the test data of 2 wall specimens and a room specimen.

Model Structure
The proposed model incorporates the following key features:
1) it draws on existing experiential and analytical data,
2) it employs diagonal non-linear link elements to represent the fasters’ and adhesive’s behaviors,
3) it uses the SAWS Material Model to represent mechanical screws’ hysteretic behavior and the MODIMKPeakOriented Model for the adhesive, and
4) it assumes all other components act linearly, i.e. framing elements and roof/floor diaphragms, modeling such elements as rigid.

Model Verification
Wall Specimens:

- Comparison of OPENSEES Analysis to the Test Data for Specimen Wall 1
- Comparison of OPENSEES Analysis with the Test Data for Specimen Wall 2

Room Specimen:

- Comparison of OPENSEES Analysis with the Test Data for Specimen Room 1

Conclusions
1) The proposed model for light-frame unibody residential buildings overall correlates well with the empirical data.
2) In particular, it matches the pinching behavior well.
3) The model performs better at lower levels of displacement, failing to match the data for the tested specimens at large non-linear deformation.

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References