Global response simulation of Non-structural Reinforced Concrete Walls subjected to simulated cyclic loading

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Background

In Japan, the non-structural (NS) walls are not designed to resist earthquake load, which makes them vulnerable to relatively low levels of seismic excitation. The 2011 Tohoku earthquake and 2016 Kumamoto earthquake have shown that even if there is minor or no damage to structural components, damage to non-structural walls can cause severe dysfunction. Therefore, even though not required by the standards, the numerical seismic evaluation of NS walls is important.

Fig: Damage to NS walls in past earthquakes

Specimen Description

Specimen name	NSW3	NSW4	NSW5	NSW6
Thickness (mm)	120			200
Length (mm)	1050			900
Height (mm)	2100			1800
Vertical rebar	D10@250			D10@200 double
Vertical rebar at end region	2-D13		4-D13	
Horizontal rebar	D10@125 single		D10@60 single	D10@100 double
Concrete strength (MPa)	24.2		22.2	
Shear span ratio	1.0	2.0	1.0	1.0
Axial load ratio	0.15			

Numerical Model Descripton

Since the shear span ratio of NS walls is typically not very high, there exists an interaction between shear and flexural response. Shear-Flexure Interaction-Multiple Vertical Line Element Model (SFI MVLEM) is used in this research. It uses RC panel in a two-dimensional fiber-based macroscopic model to couple the axial and shear response providing systematic prediction of the response of RC walls under reversed lateral loading.

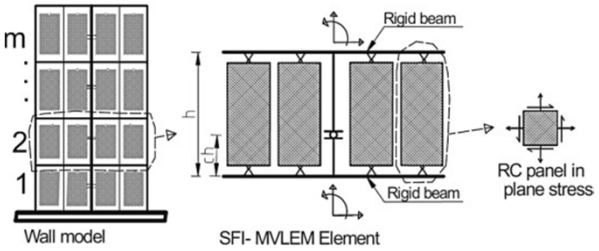

Fig.: Representation of SFI MVLEM model

Conclusions

- The model predicts the global response reasonably with wall strength within a ±10% range of experimentally measured values.
- It lacks the ability to replicate stiffness degradation due to buckling of reinforcement

Social Impact

- Although the SFI MVLEM can not capture buckling-related degradation, it can still be used for damage analysis in less severe damage scenarios if the local responses are also reasonably predicted, aiding in building functionality assessment.

Numerical Results