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NEUTRAL AXIS LENGTH VARIATION OF SELF-CENTERED RC SHEAR WALL UNDER LATERAL NONLINEAR STATIC LOAD

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Collapse prevention of structures is one of the main aims in common seismic designs. Though, experiences exhibit that most of structures in severe earthquakes receive damages and residual displacements. The presence of residual drift due to inelastic deformations may inhibit building occupancy or operation after major earthquakes, and may increase associated repair costs significantly.

During last two decades, researchers have developed seismic resisting systems that can minimize and potentially eliminate residual drift due to earthquakes. Proposed structural systems utilize the so-called "self-centring" systems that can improve the seismic behaviour, provide higher resiliency and overcome the significant residual drift of conventional systems. Self-centering systems are based on the use of post-tensioning (PT) elements along with a gap opening joint that opens and closes during seismic loading. The PT elements should remain elastic during loading and their function is to enforce closing the gap opening in the structure. The use of an energy dissipating fuse provides the desired behaviour of the system by dissipating energy and localizing the damage to replaceable fuse elements.

Reinforced concrete shear wall system with PT tendon comprising mild steel reinforcement for the energy dissipation is a self-centring system. The mild steel reinforcement is located between the concrete panel and the wall foundation.

By applying lateral load, the concrete at the reversible tip (toe) of the wall is under considerable compressive forces. In order to improve the overall behaviour of the wall, the concrete at these locations must be confined. In this paper, the variation of neutral axis length (i.e., contact length) under lateral monotonic loading is studied utilizing numerical finite element analysis. A variation of neutral axis length is monitored for four states on the capacity curve of the wall. These states are corresponded to the commencement of gap opening at the heel of the wall, yielding of the wall, maximum strength and lastly at collapse prevention (where the capacity curve begins to drop down). To verify the accuracy of the nonlinear numerical analysis, tested self-centred walls were modelled numerically using finite element software (ABAQUS). Material nonlinearity for concrete, reinforcement and prestressing cables are considered. Figure 1 illustrates the excellent comparison of the numerical and experimental result.

The results indicate that when concrete at the toe of the wall begins to reach its maximum strength (start of crushing, drift= 1.1%, base shear=109 kN), the neutral axis shifts back (towards the wall centeroidal axis) while the lateral load is increasing.

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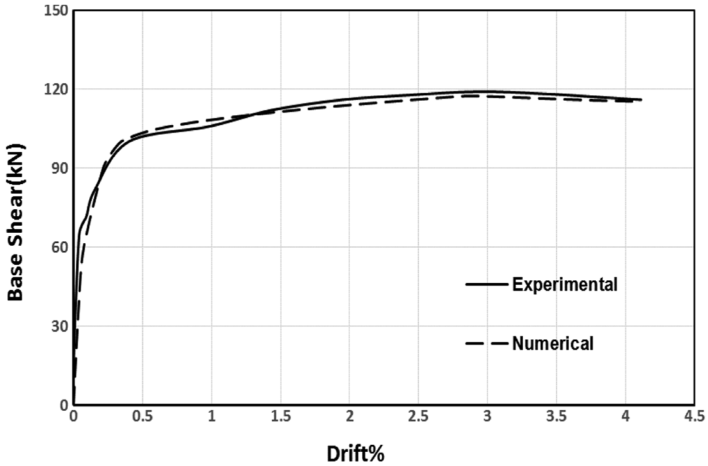

Figure 1. Comparison of numerical and experimental capacity curve.

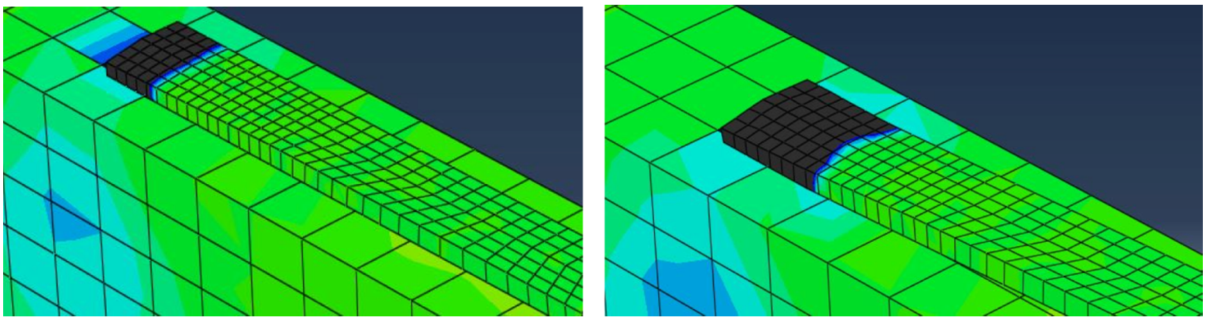

Figure 2. The neutral axis shifts back.