Seismically deficient reinforced concrete structures are widely present in many regions of the world. Structural deficiencies commonly found in old reinforced concrete structures are poor confinement, poor detailing and the presence of non ductile details (lap splices) at the plastic hinge region. The adverse effects of these deficiencies often translate to poor seismic performance due to poor energy dissipation capabilities, poor ductility behaviour, and the association of these effects with brittle failure mechanisms.

The Seismic response of old deficient shear wall structures built in the 1960’s and 1970’s is investigated. The wall specimens investigated contain poor confinement, insufficient shear reinforcement, and lap splices of the longitudinal reinforcement located at the plastic hinge region. As a result of these deficiencies, the wall specimens have non-ductile response behaviour and require retrofit to enhance their seismic performance. Nine shear wall specimens with aspect ratio ranging from 0.65 to 1.20 subjected to quasi-static reverse cyclic loading are investigated as part of a comprehensive research program. Analytical simulations utilizing the finite element method are conducted to predict the response of the wall specimens. The use of carbon fibre reinforced polymers (CFRP) tow sheets in both the transverse and longitudinal directions to mitigate the structural deficiencies of the wall specimens is evaluated. Analytical results show that the fibre reinforced polymer material is effective in eliminating the brittle shear failure mode in walls with insufficient shear reinforcement.

Lap spliced reinforcing steel bars are used in older construction practises, and are present at potential plastic hinge regions of structural members in many old reinforced concrete structures in the world. The behaviour of these non ductile details is complex and is known to lead to poor seismic performance. There has been many experimental tests but relatively few analytical studies have been concerned with the modelling of lap splice behaviour in reinforced concrete structures. While most of the existing research in structures with lap spliced reinforcing steel bars has focused on beams and columns, relatively less attention has been placed in investigating structural shear wall elements. In this paper an analytical finite element model that can capture the behaviour of lap spliced reinforcing steel bars in seismically deficient reinforced concrete shear wall structures is presented. In the proposed analytical model, bond stress-slip models are used to model the bond behaviour between concrete and steel in reinforced concrete structural elements. The proposed models are correlated with experimental beam and shear wall test data obtained from the literature. Numerical results obtained from the analytical models show a good correlation with experimental data of both the load-displacement responses and observed overall failure behaviour.