A NUMERICAL STUDY ON THE DAMAGED RC SHEAR WALLS WITH OPENINGS RETROFITTED BY FRP SHEETS

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Reinforced concrete shear wall is a resistance system against lateral load induced by earthquake and wind in high rise buildings.The functional requirements such as architectural and even mechanical requirements entail openings to be installed in structural walls. These openings may significantly influence its behaviors, such as changing its force transfer mechanism, deducting its strength and stiffness, and decreasing its ductility level. Therefore, repair and retrofit of the shear walls with openings is both necessary and important.

In recent years, fibre reinforced polymers (FRP) have been greatly used in strengthening and retrofitting of structural elements because of their high strength-to-weight ratios, corrosion resistance, ease of application, and tolerability.

This paper presents the effect of retrofitting shear wall with openings that were initially subjected to lateral loading and damaged in lateral loading and subsequently repaired with FRP sheets and re-loaded.

A review on the previous studies showed that very limited analytical and experimental studies have been conducted on the FRP retrofitting of RC shear wall with openings under monotonic loading.

In this study, nonlinear finite element analysis was utilized to study the effects of fiber reinforced plastic (FRP) on the ultimate load capacity of concrete shear walls with openings that were initially subjected to lateral loading and damaged using the finite element software ABAQUS. Nonlinear finite element analysis of reinforced concrete shear wall was performed using damage plasticity model and tension stiffening effect. The finite element software was calibrated and verified using available experimental data. For this reason, the shear wall that tested by Cruz-Noguezwas simulated by damage plasticity model and the results were compared with experimental results (Figure 1).

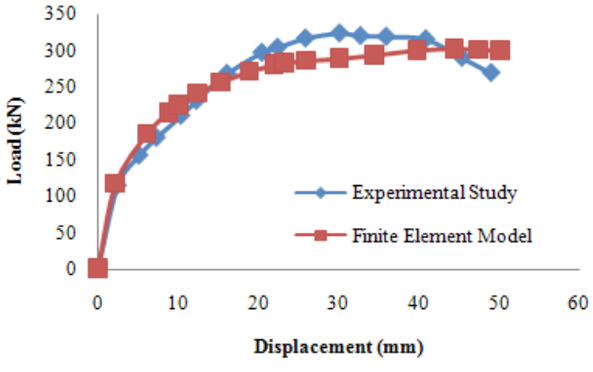
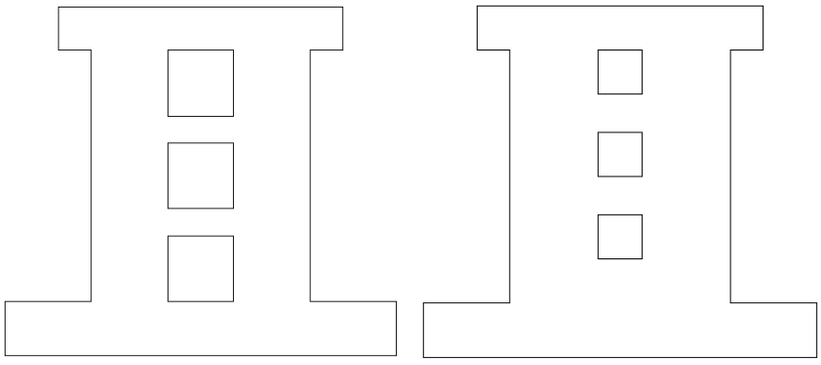


Figure 1. Comparison of the FE model and experimental load–displacement curves

In this study, two RC shear walls with different sizes of openings were designed by strut and tie model, dimensions and shapes of these walls are shown in Table 1 and Figure 2, respectively. These walls were initially subjected to lateral loading and subsequently repaired with different shapes of FRP sheets. Different part of shear wall, especially around the openings, were repaired by FRP sheets.



(a) (b)

Figure 2. RC shear walls with various sizes of openings: (a) w1, (b) w2

Table 1. Dimensions of the walls with openings

Model	Length (mm)	Height (mm)	Size of Opening(mm)
w1	2000	2300	600*600
w2	2000	2300	400*400

After repairing, shear walls were subjected to lateral loading. The performance of the repaired walls was observed to be better than the original walls before repairing in terms of the flexural behavior, shear strength, ductility capacities and ultimate lateral load resistance. Therefore it could be concluded that application of FRP sheets is proper way to retrofit shear wall with openings.

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