# Behaviour of High-Strength Concrete Squat Shear Walls Subjected to Reversed Cyclic Loading – An Experimental Study

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**Abstract**

Six high-strength concrete squat shear walls were tested under in-plane axial load and reversed cyclic displacements. The test parameters included longitudinal reinforcement ratio, transverse reinforcement ratio and axial load. Lateral loads and lateral displacements were measured. The test results showed the axially loaded wall specimens exhibited a brittle behaviour regardless of reinforcement ratio whereas the specimen with no axial load had a lower strength but higher ductility. It was also found that an increase in the longitudinal reinforcement ratio gave an increase in the failure load while an increase in the transverse reinforcement ratio had no significant effect on the strength but influenced the failure mode.

**Keywords: High-Strength Concrete, Reversed Cyclic Loading, Shear Walls.**

## 1. INTRODUCTION

Reinforced concrete (RC) shear walls are frequently used in multistorey buildings to resist the lateral loads due to wind forces and seismic effects on buildings and the vertical loads due to dead and live loads transmitted by floors. Squat shear walls are walls with a ratio of height to length less than 2 and are usually found in low-rise buildings or in the lower storeys of medium to high-rise buildings. The response of such walls is often strongly governed by the shear effects leading to shear induced brittle failure and tensile cracks. The high-strength concrete (HSC) exhibits superior performance allowing shear walls (eg. lift core walls) to be thinner. Nevertheless, the brittle nature of HSC being considerably greater than that of normal strength concrete (NSC), poses many difficulties for designers, particularly in obtaining ductile response from shear walls constructed using HSC.

Fintel [1] documented the superiority of shear walls, over other load resisting systems, to resist lateral forces resulting from earthquake events. This investigation as well as an extensive number of other publications as listed by Paulay and Priestley [2] shows that the ductility of shear walls is of paramount importance. To design a RC shear wall to behave in a ductile manner two issues are critical [1]. First, the wall as well as joints and other members in the building must be appropriately detailed. Second, since a shear failure is significantly less ductile compared with flexural failure and, where possible, shear failure should not be permitted to occur. To achieve this, the shear capacity of a wall must be known and be larger than the shear corresponding to its moment capacity. However, the lack of a similar level of confidence for the shear design of walls as is available for the flexural design leads one to recognise a need for developing an analytical and experimental understanding of shear response of shear walls. Since HSC is more brittle than the NSC, it is important that designers can calculate the difference in the safety between walls designed in the NSC and the HSC alternatives. However, there is a lack of the experimental data and proper models necessary for this to be accomplished. More importantly, the current models and design codes developed for the design of NSC shear walls are empirical and cannot be directly transferred to the design of HSC shear walls.

To ensure that analytical models predict the behaviour of shear walls accurately, experimental data is required. Experimental data can also provide useful information for better understanding the cyclic response of shear walls. While a large number of NSC shear walls tested under monotonic and cyclic loading have been reported in the literature [3-8], only a limited number of research programs on HSC shear walls subjected to monotonic loading [9-11] and cyclic loading [9,12] have been carried out and many important parameters affecting the cyclic behaviour of HSC walls remain unclear. Hence, further experiments regarding the behaviour of HSC shear walls, especially under cyclic condition, are required. This paper presents experimental results of research on HSC squat shear walls tested under reversed cyclic loading. The main aim of the study was to provide the analytical models and baseline experimental data needed to safely design shear walls with high strength concrete under seismic loads.