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A Review on Behaviour of Masonry Wall Panels in Precast Frames against Lateral Loads

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Abstract
Masonry wall construction is one of the oldest construction practices that are still used in the structure industry. A precast framed structure is a grid of beams and columns joined up to form the skeleton framework of the building. The structural frame conveys the entire load of the building and transfers it to the foundation. The plane frame was made with fibre reinforced concrete (FRC) it imparts more strength. Vibrations caused by lateral load develop additional shear stresses which cause damage to structural elements. Applying lateral loads, three forms of failure mechanism occur in the masonry structures, namely, sliding shear failure, the diagonal shear failure and rocking flexural failure. This paper-intensive on the seismic performance of different types of masonry infill and their loading patterns and addition of fibres.

Keywords — *Masonry infill, FRC, Precast frame, Seismic behaviour, Lateral load, Recron fibre.*

I. INTRODUCTION

This document is a template. Masonry structures are the structures which are built by the conventional bricks and bonded with cement mortar. Masonry construction is one of the oldest construction techniques and a highly durable form of construction that is still used in the construction industry. It is mostly used for the walls of the buildings. Bricks and the concrete blocks are the most common types of masonry units. The bond in brick masonry, which adheres bricks together by placing bricks in mortar in a systematic manner to construct solid mass that withstands exerted loads. Special attention shall be practised while the mortar is mixed and placed since it greatly affects the performance and durability of a masonry structure. They generally provide great compressive strength and are best suited to structures with light transverse loading when the cores remain unfilled.

Precast concrete has been commonly accepted as a practical means of constructing safe, durable, reliable, high quality, and cost-effective structural systems.

A precast framed structure is a grid of beams and columns joined up to form the skeleton framework of the building. The structural frame conveys the entire load of the building and transfers it to the foundation. Vibrations caused by earthquakes generate additional loading. Shear stresses develop, which cause damage to structural elements. Since masonry, which can be stressed relatively high in compression, is weak in resisting bending and shear, collapse is often the result. The different failures modes of masonry are sliding shear failure, the diagonal shear failure and rocking flexural failure. The capacity of the frame specimens was increased due to the presence of brick infill in the precast frame specimens.

II. LITERATURE REVIEW

A detailed review of literature has been done to assess and evaluate the earlier works done on the behaviour of various types of masonry building blocks against lateral loads. Literature-based on the seismic performance of masonry infill and their loading patterns. From the detailed literature review, the inference is studied.

CVR Murty et al. (2000) have evaluated the beneficial influence of masonry infill walls on seismic performance of RC frame buildings. Masonry infills in RC buildings cause several undesirable effects under seismic loading such as short-column effect, soft-storey effect, torsion, and out-of-plane collapse. Still, earthquake-resistant buildings were not designed for several moderate earthquake forces, but it shows excellent performance. The experimental results on cyclic tests of RC frames with masonry infills. It is understood that the masonry infills contribute significant lateral stiffness, strength, overall ductility and energy dissipation capacity. It helps in drastically reducing the deformation and ductility demand on RC frame members.

Devisree et al. (2016) has investigated the behaviour of RC frame Infilled with Mud Concrete Blocks. The performances of infill frames with and without openings were compared in terms of strength, peak to peak stiffness, cumulative energy dissipation and crack distribution. The specimens were tested under repeated lateral load. The ultimate load-carrying capacity of Frame with MCB infill is higher than Bare frame. The ultimate load-carrying capacity of Frame with MCB infill with the opening is less than a frame with MCB infill. The cumulative energy dissipation capacity of the RC frame was increased by 15 times with the incorporation of the infill wall.

K. Ramadevi et al. (2014) have studied the Behaviour of Hybrid Fibre-Reinforced Concrete Frames with Infills against Lateral Reversed Loads. It remains understood that the masonry infills contribute significant lateral stiffness, strength, overall ductility and energy dissipation capacity during moderate earthquakes. By providing hybrid fibres in the critical zones, it is conceivable to improve the performance of the frames against lateral loading. The percentages of fibres use dare 0, 0.75, 1.5 and 2%. The load-carrying capacity of the infilled RC frame with hybrid fibre strengthening is more than that of infilled RC frames without fibre reinforcement. The number of cycles to failure increases with an increase in hybrid fibre percentage.

Jaswanth Reddy et al. (2017) have examined the lateral load behaviour of interlocking block masonry wall. Conventional masonry walls are bonded with cement mortar whereas interlocking masonry walls are bonded by self-locking patterns. This masonry wall was analyzed by assigning in-plane lateral load with varying magnitudes and compared the results with a conventional brick masonry wall. These models are analyzed in Ansys 15.0 workbench module. Total deformation, equivalent stress, equivalent elastic strain and strain energy was observed, and hence stress-strain graphs and load-deformation graphs had been plotted. From the analytical study, the values obtained from the interlocking masonry walls are lesser compared with conventional masonry walls. Concerning contact analysis, the parameters such as penetration, gap, frictional stress, and sliding distance values of interlocking masonry wall show improved performance compared with conventional masonry walls.

Sigmund et al. (2012) have assessed the Experimental Study of Masonry Infilled R/C Frames with Opening. The authors have examined the effect of different types and positions of opening in masonry infill, with and without tie-columns surrounding them, on the seismic response of R/C frames. It is tested under constant vertical and a sequence of lateral load reversals till the infill failure. The consequences showed that strength and stiffness properties were only slightly affected by opening position and type. Adding of the tie-columns prevented unexpected and out of the plane failure of the infill piers. Adding the tie-columns around opening did not impact the overall stiffness and capacity of the "framed-masonry" specimens. Tie columns affected the mechanism of failure and ductility and equalized the behaviour of the infill.

Campione et al. (2000) have studied the seismic behaviour of fibre-reinforced concrete frames. In this paper, the performance of framed structures realized by using high strength fibre reinforced concrete and exposed to lateral forces, including P-δ analysis. To estimate the effectiveness of the combined use of reinforcing fibres and steel transverse reinforcement, nonlinear analysis of framed structures under controlled lateral displacements is performed; the analysis is based on a finite element method. The nonlinear analysis for framed structures has stressed that similar ductile behaviour can be obtained by using in the critical regions less volume of transverse reinforcement but integrating the concrete with reinforcing fibres. The result shows that the translation ductility of the frames improved due to the presence of fibres.

Bansal et al. (2017) have studied the behaviour of masonry walls at corners under lateral loads. The behaviour of corners in dry stack masonry was studied up to failure in Abaqus, finite element environment using explicit solver. Various models of masonry structures with loadbearing and non-loadbearing walls were subjected to dynamic loading along the corner. Based on the failure pattern observed under the simultaneous action of in-plane and out plane forces, simplified corner failure mechanisms were proposed for the limiting equilibrium condition, and corresponding values of peak acceleration were obtained. This model was found to be effective in determining the propagation of crack though the masonry as well as the value of acceleration at which a portion of corner walls detaches from the surrounding masonry. This study not only helped in understanding the failure pattern of corner masonry walls but also provided an approach to estimate the limit strength in terms of peak acceleration.

Mulgund et al. (2011) have analyzed the seismic assessment of RC frame buildings with brick masonry infills. The behaviour of RC frames with a different arrangement of infill subjected to dynamic earthquake loading. The result of a bare frame and infill frame effect are compared, and conclusion are made because of is -1893(2002) code. The design of earthquake forces by treating RC frames as ordinary frames without regards to infill leads to an underestimation of base shear. The performance of masonry panels with entire infill frame was significantly superior to that of the bare frame and soft storey frames. The present study also demonstrates the use of nonlinear displacement-based analysis methods for predicting performance-based seismic evaluation.

Nagashree et al. (2017) have studied on Seismic Performance of RC Wall Structures. The shear wall has been used to resist large horizontal load and support gravity load because of its high in-plane stiffness and strength. Using ETABS software, the response spectrum method is performed with 5% damping according to IS 1893:2002. The development analyzed the seismic performance of base shear, bending moment, displacement and period values. The results obtained in terms of base shear and displacement, which showed the capacity of the building and gave the real behaviour of structures.

Bahram Safi Zadeh et al. (2015) have studied on Performance Evaluation of Unreinforced Masonry Walls under Lateral Loading. During earthquakes, masonry buildings are not tough against earthquake due to high weight and low ductility and requirement of seismic rehabilitation. The study was focused on retrofitting of concrete and steel buildings while masonry buildings suffered from damages when an earthquake took place. Behaviour of models by using limited components method and Abaqus software for two models. The masonry walls of 3- and 4-meters length and height to length rates (H/L) of 0.55, 0.7, 0.85, 1, 1.15, and 1.3. Obtained results showed that by the increase of H/L ratio amount of movement of lateral wall increases and one should avoid from using masonry walls with the ratio of H/L≥1.Implementation of such a wall, and one should use needed requirements for limiting more deformations.

I. Movila et al. (2012) have assessed on Modelling of the Lateral Load behaviour of Unreinforced Masonry Walls using the software Atena 2D.It is not economical to design shear wall buildings to remain elastic during the occurrence of strong ground motions. Thus, inelastic deformations are essential as a mean of reducing the seismic demand. The study regarding the lateral load behaviour of unreinforced masonry (URM) walls using ATENA 2D nonlinear finite element software, and the results were compared with experimental data. Some new numerical studies are performed to simplify the Modelling of the behaviour of the masonry. From this study, better results are obtained using for the micro-elements the properties of the bricks instead of those of the masonry. Lastly, the paper suggests an equivalent "macro brick" model that requires less computation time is easier to implement.

Korrapati Anil Kumar et al. (2017) Study on Properties of Concrete using Recron 3s Fibres. The investigation of workability, strength properties of the plane concrete frame was made of fibre reinforced concrete (FRC) using Recron 3s fibre in proportions of 0%, 0.2%, 0.3% and 0.4% were considered for different grade concrete cubes, cylinders and prisms. The present study is to investigate the workability parameters of M25 and M40 grades of concrete using the slump cone test, compaction factor test, and Vee-bee time test. Intended for strength limits, each grade of concrete for each proportion, cubes, cylinders, prisms were cast for 7days, 28days, 56days and 91 days strength. The compressive strength test, flexural strength test, split Tensile strength of M25 concrete at 28 days increased with the addition of Recron fibre up to 0.3% level when compared to that of plain concrete.

III. CONCLUSIONS

From the detailed literature review, the points inferred are as under,

- Masonry buildings belong to the most vulnerable class of structures which have experienced heavy damage or even total collapse in earthquakes.
- The load-carrying capacity of the frame is increased due to the addition of fibres.
- It is understood that the masonry infills contribute significant lateral stiffness, strength, overall ductility and energy dissipation capacity.

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