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Review on Failure Modes of Masonry Infill Frames

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Abstract:

The main aim of this paper is to present a general classification for the failure modes of infill frames without opening. This classification will help in further studies understanding failure modes in a better way. This paper mainly deals with the literature review of past few decades. It is seen that during earthquake the structure suffers from many degradation in lateral strength and stiffness which further leads to failure of structure. In this paper no of different crack patterns are identifies in various regions. Such a classification of failure modes improves substantially the understanding of the earthquake resistant performance of in-filled frames which further leads to better methodological approaches regarding their modelling, analysis and design.

Keywords — **Crack patterns, Earthquake, Infill frames, RC frames.**

I. INTRODUCTION

It has been observed that RC frame structures are widely accepted all over the world. The brick wall is designed as material with brittle behaviour. Infill walls have low resistance to seismic actions. Whereas it is seen that, RC frame behaves more flexible than infill panel. Thus, by adding infill walls to RC frame changed performance of the structures is observed.

From several past studies properties of RC frames is also investigated and it is noted that material used in RC frame and infill panels contributes to the strength of infill walls. Compressive strength and tensile strength of the structure are considered to be the two most important properties of the structure. It has been observed from past researches that added infill panels to the structure contribute to stiffness of the structure. This added stiffness helps in preventing the structure during earthquake, but during severe ground motions structure undergoes various failure mechanism. This paper basically deals with the failure mechanism of the structure.

II. LITERATURE REVIEW

Vintzileou and Tassios, (1989); Paulay and Priestley, et al., (1992), conclude several different failure modes of infill frames. They focused on changed behaviour of the infill panel under cyclic loading. They mentioned that under seismic action the structure undergoes different failure modes and various crack patterns have been observed in the structure Asteris, P. G., Kakaletsis, D. J., & Chrysostomou, C. et al., (2011) presented a general classification scheme of the failure modes of in-filled frames, both with and without openings. Mosalam, 1996; Mosalam et al., 1997 noted from previous study that the failure modes were depicted only for frames without openings and after that he raised question that will these results meet requirement of infill panel with openings subjected to earthquake loading. On the basis of experimental and analytical results (Thomas, 1953; Wood, 1958, 1978; Mainstone, 1962; Liauw and Kwan, 1983; Vintzileou and Tassios, (1989); Paulay and Priestley, (1992); Mehrabi and Shing, 1997, Al-Chaar 2002; El-Dakhakhni, 2002, 2003 et al.,) proposed different failure modes of infill frames.

III. BEHAVIOUR OF INFILL FRAME

Wood 1978; Ghosh and Amde, (2002) et al., proposed different failure modes and classified them as given below:

A. Corner Crushing Mode

In this crushing mode at least one of the loaded corners under goes crushing. This failure generally occurs in those in-filled frames which consist of weak masonry infill panel. In this mode of failure the panel is usually surrounded by a frame with weak joints and strong members. This failure mode is represented in figure1 below.

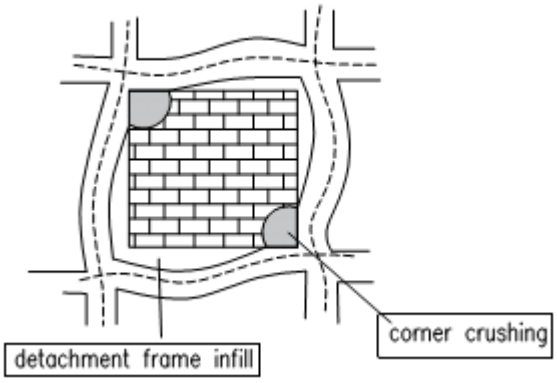

Fig. 1 Corner crushing

B. Diagonal Compression mode

In this mode of failure central region of the infill frame undergoes crushing. This failure results in OOP buckling. This failure mode is represented in figure 2 below.

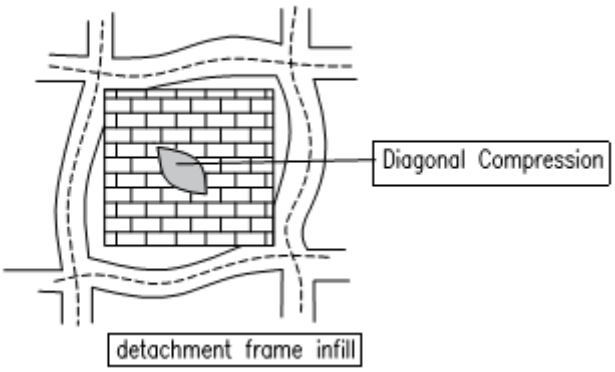

Fig. 2 Diagonal Compression

C. Sliding Shear Mode

In this mode horizontal sliding through bed joints occurs. This mode is associated with infill of weak mortar joints and a string frame. This failure mode is represented in figure 3 below.

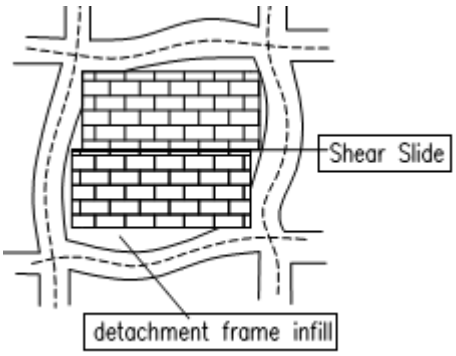

Fig. 3 Sliding Shear Failure

D. Diagonal Cracking Mode

This is seen in the form of a crack across the compressed diagonal of the infill panel and often takes place with simultaneous initiation of sliding shear mode. This mode generally occurs in a weak frame or a frame with weak joints and strong members in-filled with a rather strong in-fill. This failure mode is represented in figure 4 below.

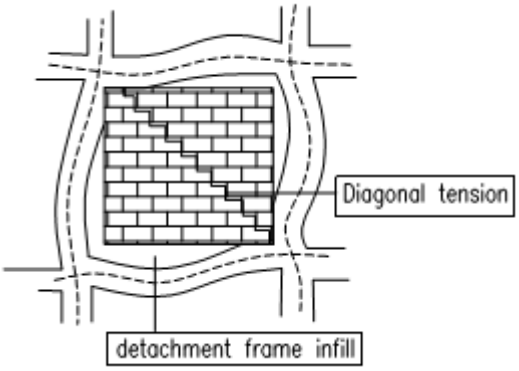

Fig. 4 Diagonal Cracking

E. Frame Failure Mode

When plastic hinges develop in the columns or the beam-column connections frame failure occurs. This generally occurs in case of weak frames. This failure mode is represented in figure 5 below.

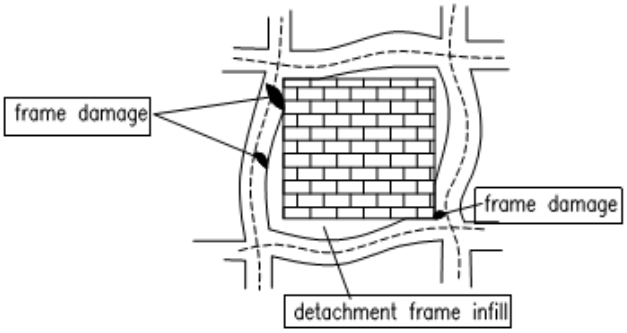

Fig. 5 Frame Failure

IV. CONCLUSIONS

Hence the analytical results indicate that the failure modes of the in-filled frames can be classified into distinct modes. Such a classification of the failure modes considerably enhances the understanding of the earthquake resistant performance of in-filled frames which further leads to improved comprehension study in modelling and analysis.

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