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Non-Linear Static Analysis of Concrete Structure using Brick Infill Material: A Review

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Abstract: The properties of masonary and its constitutive materials were reviewed, giving special emphasis to those aspects which contribute to a better understanding of the strength mechanism. Computer based procedures were developed for the rational evaluation of the strength of masonry subjected to compressive and shear stresses. The effect of pinching of the hysteresis loops in the response of infilled frames subjected to earthquakes was investigated. This paper was prepared to study various research work related to the Seismic analysis of reinforced concrete structures using brick as an infill material.
Keywords: Computer, structure building, earthquakes, construction, infill material etc.

I. INTRODUCTION

Earthquakes are by far the most unpredictable and highly destructive of all the natural disasters. Earthquakes that are of tectonic origin have proved to be the most devastating and their influence is also quite large. These earthquakes result from a series of earth movements brought about by a sudden release of energy during the tectonic activities in the earth’s crust.

The Indian plate is moving at a speed of one centimeter per year towards the north and north- eastern direction and this movement of plates is being constantly obstructed by the Eurasian plate from the north. Because of this both the plates are said to be locked with each other resulting in accumulation of energy at different points of time. Excessive accumulation of energy results in building up of stress, which ultimately leads to the breaking up of the rock and the sudden release of energy causing earthquakes.

Geographical statistics of India show that almost 54% of the land is vulnerable to earthquakes. A World Bank and United Nations report shows estimates that around 200 million city dwellers in India will be exposed to storms and earthquakes by 2050. The latest version of seismic zoning map of India given in the earthquake resistant design code of India [IS 1893 (Part 1) 2002] assigns four levels of seismicity for India in terms of zone factors. In other words, the earthquake zoning map of India divides India into four zones namely Zone II, III, IV and V, with zone V being most vulnerable to earthquakes. Much of India lies in zone III. New Delhi the capital city of India lies in zone IV where as big cities like Mumbai and Chennai are in zone III. Some of the most vulnerable states are Jammu and Kashmir, Himachal Pradesh, Uttaranchal, Sikkim, and the Darjeeling and subdivision of West Bengal and all the Seven States of North-east. Apart from these regions, the Central-Western parts of India, particularly Gujarat and Maharashtra have also experienced some severe earthquake.

It is not possible to prevent the occurrence of an earthquake; hence the next best option is to emphasis on disaster preparedness and mitigation rather than curative measure such as. Modifying the house type, building-design and plan in the vulnerable areas and making it mandatory to adopt earthquake resistant designs and use light materials such as GFRG panel, AAC block etc. in major construction activities in the vulnerable areas.

The damage of buildings during earthquake is mostly due to failure of infill, or failure of columns or beams, spalling of concrete in columns, cracking or buckling due to excessive bending combined with dead load may damage the column. The buckling of columns is significant when the columns are slender and the spacing of stirrup in the column is large. Severe crack occurs near rigid joints of frame due to shearing action, which may lead to complete collapse. The differential settlement also causes excessive moments in the frame and may lead to failure. Design of frame should be such that the plastic hinge is confined to beam only, because beam failure is less damaging than the common failure.

Now a day’s large number of building are constructed using brick masonry, Easy to construct, light in weight, high thermal insulation, high fire protection, high sound insulation, lower water absorption, eco friendly.

Therefore, it is essential to analysis the brick infill building subjected to earthquake using SAP 2000 (ver. 20.0) and compares the response of structure in terms of base shear and displacement.

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Damages During Past Earthquakes In Hilly Region

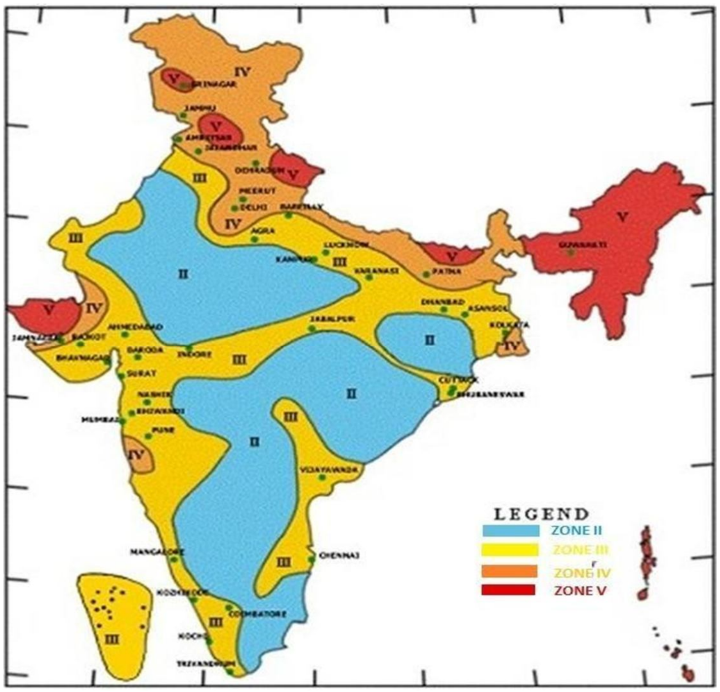

Figure 1.1 Seismic zone map of India as per IS: 1893 (Part1)-2002

Figure 1.1 represents a map of India in which the different zones are created as per the intensity of earthquake and as per IS: 1893 (Part1)-2002. Some of important earthquakes occurred in India are discussed in the following sub sections.

II. PROBLEM DESCRIPTION

The concept and use of the brick infill masonry panel building presents challenges that must be accounted for in its design and use. These challenges arise because in modern present/future time many of the building are constructed with different type of infill in regular and irregular pattern resting on plan or sloping ground. Large irregularities in vertical and horizontal configurations, ground conditions or using different type of infill material can create serious problems of displacement, torsion and stress concentration that will result in distortions and drifts beyond those that the building can accommodate. Scrutiny of these conditions is necessary at an early design stage to ensure that the structure is not faced with conditions that may be almost impossible to make safe.

III. INTEREST OF RESEARCH

The interest of this research is to investigate various seismic responses of brick infill step back and step back-set back building using vertical irregularity in different story of building. The comparison between various seismic parameters would allow us to propose the best suitable infill building on the existing conditions.

More specifically, the salient objectives of this research are:

1) To understand interaction of brick infill structures with the shaky ground.
2) To foresee the consequences of possible earthquakes.
3) To design, construct and maintain brick infill structures to perform at earthquake exposure up to the expectations and in compliance with building codes.
4) Comparison between step back and step back-set back brick infill building on the basis of base shear and displacement subjected to nonlinear static loading.
5) To propose the best suitable building infill on the existing condition.

This work is naturally considered as a fresh and contributively activity in terms of the development of knowledge due to evaluation and validation by available recommendations to analysis brick infill building with the help of advanced computer based software.

IV. RESEARCH AREA

The primary aim of this research is to contribute the knowledge and influence of the performance of brick infill building subjected to seismic load. The research contributes to the development of a 20 story 3-D model of brick infill step- back and step-back set-back building that provides a realistic representation of behavior of building constructed under static nonlinear seismic loading condition. A comprehensive literature review on brick infill step-back and step-back- set back building problems subjected to seismic load was undertaken to review the concept of the brick infill building, establish the benefits of using brick infill panel, identify the issues surrounding, establish current practice in brick infill design and construction and establish research undertaken and the knowledge gaps. The present research work includes the analysis of 3D numerical model of 20 stories brick infill step-back and step-back-set back building using SAP 2000 software (ver. 16) that simulate the behavior and performance of brick infill building under nonlinear static seismic loading and comparison of result in term of displacement and base shear.

V. LITRATURE REVIEW

A brief review of previous studies on the application of structural composition to brick-filled masonry. This literature review also includes previous research on various applications of brick-filled masonry. This literature review of recent contributions was related to seismic analysis of infill brick building structures.

Naraine and Sinha (1992) Interaction curves of brick masonry under cyclic and biaxial pressure. Peak Stresses were determined from a number of interaction curves and corresponding curves Strain was determined using an empirical relationship involving peak strain Envelope voltage and mains voltage ratio. The calculated curve is it compares well with empirical curves obtained using experimental data.

Totoev and Nichols (1997) studied the dynamic modulus of elasticity. Of bricks and masonry using the longitudinal vibration test method Measured by the ultrasonic pulse method and compared with each Young's value Elastic modulus obtained by quasi-static loading. A similar test was conducted for mortar dice. Derivation of elastic modulus and peak stress ratio for bricks, prisms and mortar.

Niruba S (2015) Studies in many references show that infill alters the behavior of truss structures under lateral loads. Of Panel contributions are commonly ignored in general structural analyses. The structural effect of brick filling is it is generally not considered when designing RC frame structure supports and other components. Brick walls have considerable in- plane stiffness that contributes to the stiffness of the frame against lateral loads. Or the lateral deflection is significantly reduced in the filled frame compared to the deflection in the unfilled frame. This It can be seen that the frame with infill flexes much less than the frame without infill. Result Reflects the importance of filling to increase overall system strength, stiffness and frequency Position and amount of padding. We found that the lower the filling volume, the higher the stiffness of the system.

Fabio Di Trapani (2015) in his research the issue of the influence of masonry infill's within RC frames structures has been widely investigated in the last decades by several researchers. The large interest addressed to this topic depends on the actual observation that when in presence of seismic events, the response of framed structures is strongly conditioned by the interaction with the infill walls, which however are considered as non-structural elements and not included in the models. The influence of masonry infill's role in structural response is so much relevant to affect not only the overall strength and the stiffness but it may also radically change the possible collapse mechanisms of the overall structural complex under the effect of strong ground motions. Infill panels may have a beneficial effect on the structural response, being able in some cases to supply the lack of resistance of structures to lateral actions, or an adverse contribution inducing unexpected and dangerous non-ductile collapse mechanisms. However, the studies carried out on this topic have demonstrated that, independently from the beneficial or adverse contribution of masonry infill's on structural response, their presence cannot be neglected in structural modeling both in design and verification phases. This article provides a comprehensive literature review of modeling methods developed over the last decades. This includes sophisticated nonlinear FE micro model approaches to simplified equivalent single- or multi- strut macro models with various technical code statements.

VI. CONCLUSIONS

Infill walls that are too weak seduce the structural drift but decrease strength and stiffness are found in RC-style buildings. Additionally, the presence of infills reduces the strength of the structure while reducing the ductility of the embryos. When the contribution of infills is taken into account in the building design, it is discovered that the sole of the plinth beam is crucial. When present in a structural context, infill walls typically reduce the damage sustained by the same members of the RC during an easterly tremor. The lower stories' columns, beams, and infill walls are more susceptible to deterioration than those in the upper stories.

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