A SURVEY ON SEISMIC EVALUATION OF EXISTING RC BUILDING

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Abstract - *In India we come across many old buildings needing measures repairs or go earlier in to a state of dilapidation conditions to make them unfit for occupation. Regardless of improvements in construction materials and advance techniques, several concrete structure steel fails prematurely, leading to costly and time consuming repairs. More than 50% of Europe's and other developed countries annual budget is spent on repairs of deteriorated structures including rehabilitation and refurbishing of existing structures .in additions, it is well known that numerous existing concrete structures do not meet today's safety standards any more, in turn it become necessary to evaluate the service life of such structures against the today's unpredictable seismic activities so as to plan the repairs as total replacement of the structures which would not be economically feasible. Seismic evaluation of structures also plays an important role in buy/sale of properties, renting, insurance purposes, stability assessment of structures and deciding methodology for repairs. The seismic assessment of any structures requires obtaining first hand information regarding the current condition of the structure through condition survey. Such condition survey involves non-destructive and semi-destructive tests to obtain the strength and other properties of concrete and condition of reinforcement. Material properties and state of degradation can be known through assessment. Seismic evaluation of structures includes the scientific calculation of factors relating to strength, serviceability and durability by engineering methods.*

Key Words: **Seismic Evaluation, Reinforced Concrete, Pushover Analysis, Capacity Curve, Lateral Force, Base Shear.**

1.INTRODUCTION

Amongst the natural hazards, earthquakes have the potential for causing the greatest damages to engineered structures. Since earthquake forces are random in nature & unpredictable, the engineering tools needs to be sharpened for analyzing structures under the action of these forces. India has a number of the world's greatest earthquakes in the last century. In fact, more than fifty percent area in the country is considered prone to damaging earthquakes. The northeastern region of the country as well as the entire himalayan belt is susceptible to great earthquakes of magnitude more than 8.0.

During the last century, 4 great earthquakes struck different parts of the country: (1) Great Assam Earthquake (1897), (2) Kangra Earthquake (1905), (3) Bihar Nepal Earthquake (1934) And (4) Assam Earthquake (1950). In Recent Times, Damaging Earthquakes Experienced In Our Country Include

(1) Bihar Nepal Earthquake (1988), (2) Uttarkashi Earthquake (1991), (3) Killari Earthquake (1993), (4) Jabalpur Earthquake (1997), (5) Chamoli Earthquake (1999) And (6) Bhuj Earthquake (2001) And Recently Occurred (7) West Bengal Earthquake (2011). In all of these earthquakes there is huge loss of life and very large destruction of existing reinforced concrete (rc) buildings. Most recent constructions in the urban areas consist of poorly designed and constructed buildings. The older buildings, even if constructed in compliance with prevailing standards, may not comply with the more stringent specifications of the latest standards of is 1893(part 1):2002, is 4326:1993 and is 13920: 1993. The existing buildings can become seismically deficient since design code requirements are constantly upgraded due to advancement in engineering knowledge.

Investigations of past and recent earthquake damage have illustrated that the building structures are vulnerable to severe damage and/or collapse during moderate to strong ground motion. An earthquake with a moderate magnitude is capable of causing severe damages of engineered buildings, bridges, industrial and port facilities as well as giving rise to great economic losses.

After the Bhuj earthquake (2001) considerable interest in this country has been directed towards the damaging effect of earthquakes and has increased the awareness of the threat of seismic events. Most of the mega cities in India are in seismically active zones and are designed for gravity loads only. The magnitudes of the design seismic forces have been considerably enhanced in general, and the seismic zonation of some regions has also been upgraded. Thus a large number of existing buildings in India needs seismic evaluation due to various above mentioned reasons. Hence evaluation of existing RC buildings in India is a growing concern.

1.1Need For Seismic Evaluation

It is known that damaging earthquakes are very often followed by a series of aftershocks and sometimes by other main shocks. Past earthquakes have shown that when urban areas are hit by damaging earthquakes, a significant percentage of structures attain light to moderate damage. Moreover, it is known that structures that sustained some damages prior to seismic event may collapse during a succeeding event. Such unfortunate events have claimed many lives. Therefore, these structures impose a potential risk to human life, economic assets and the environment. Thus, making decisions regarding the post-earthquake functionality and repair of the damaged structures is a critical part of the post-earthquake recovery process. Also, from the effects of significant earthquakes that has struck the different parts of country, it is concluded that the seismic risks in urban areas are increasing and are far from socio-economically acceptable levels. Therefore there is an urgent need to reverse this situation and it is believed that one of the most effective ways of doing this is through

(1) The seismic evaluation of existing stuck off structures.

(2) The development of more reliable seismic standards and codal provisions than those currently available with their stringent implementation for the complete engineering of new engineering facilities.

Therefore, an accurate estimation of the performance of structure during an earthquake is crucial for estimating the actual effects of that earthquake on the existing rc structures.

The vulnerability of the structure can be assessed with a higher accuracy and better informed decisions can be made on the possible improvement of the seismic resistance of existing rc structures. For example, the critical components of the structure that are likely to sustain significant damages during future earthquake ground motions may be identified. Accordingly, the required immediate structural interventions may be designed to reduce the deformation demands on these components. Subsequently, the overall behavior of the structure may be improved to achieve a satisfactory overall seismic performance during a future earthquake.

2.LITERATURE REVIEW

Introduction

The literature survey is oriented around the seismic evaluation of reinforced concrete structures, assessment of deteriorating structures and their non-destructive testings.

Key literature review

Following paragraphs give the out come of review of literature.

Shamsad Ahmad (2003) carried out a review of service life prediction of concrete structures in which the mechanism reinforcement corrosion, techniques utilized to monitor reinforcement corrosion and methodologies that are utilized for predictions of remaining service life of structures presented. The basic fundamental information is reported to update the viewers.

Ha-Won Song Et Al.,(2009) have carried out the formulation for service life predictions under chloride environment based on mechanism of chloride ion diffusion. The author has described the mechanism using the partial differential equation (pde) of the fick's second law. Based on a crank-nicolson scheme within the finite difference method, aproper formulation profiles are obtained and the service life of repaired concrete structures under chloride environment is predicted.

Marchand Et Al.,(2009) have tried to analyze the models describing the concrete deterioration due to chloride ingress based on simplified equation. The author shows that using fick's law of diffusion to analyse chloride ingress in concrete structure is inappropriate. Major limitations of these models being neglection of behaviour of cementitious materials and environment exposures.

Gang Lin Et Al.,(2010) authors have presented a systematic and robust model for predicting service life of RC structures in which it takes environmental humidity and temperature fluctuations, chloride binding, diffusions and convection, as well as the decay of the structural performance into account. The governing equations of heat, moisture and chloride transport non saturated concrete are described particularly and solved numerically by finite element analysis in space and time domains. Comparisions of numerical results with analytical solution and experimental observations are conducted to establish the validity of the proposed numerical model.

Seung Jun Kwon Et Al.,(2009) indicated that the probability of durability failures of the structures, p(durability), becomes greatly larger with increasing cracks width and service life of the structures rapidly decreases accordingly. For the parametric study of service life predictions in crack concrete, the cover depth and time exponent parameter are considered as design factors with varying values.

Woubishet Zewdu Et Al.,(2013) reviewed the performance of repaired concrete structures and the current status in the development of service life predictions models for repaired concrete structures specially exposed to exposure XD (chlorides excluding seawater). Future research and development of service life prediction model for repaired concrete structures is discussed based on today's research and practice on the area.

B. Bhattachearjee.,(2012)has discussed the complexities and issue related to service life of concrete structures. At the moment, modelling of most of the deterioration processes is not well understood and hence most of the available deterioration models are inaccurate. The difficulty and calibration and validation of the deterioration models against real life behaviour is also a major issue. The current state of degradation models specially based on carbonation and chloride ingress has been stated. In the end, the author has stated the need to revise the exposure conditions mentioned given in is 456-2000. The exposure conditions should be more elaborate and India specific.

Summary

After carrying out limited literature survey, it is observed there are numerous model available for predicting service life of structures which are mostly based on degradation mechanism associated with corrosions, chloride ingress, sulphate attack and carbonation. Modelling of most of the deterioration process is not well understood and hence most of the available deterioration models are inaccurate. These models have been applied to individual elements and not to the structure as a whole. However, negligence of serviceability assessment is seen. Hence, further studies is invited to arrive at a conclusive predictions of service life.

3.SCOPE OF THE PRESENT STUDY

The present study covers the following,

a) Review of literature, Seismic evaluation of reinforced concrete structures, their comparision and suitability.
b) Application of various non-destructive techniques/tests to concrete member, interpretation of results and assessment of quality of member with reference to strength and serviceability.
c) Case study of existing building and Seismic evaluation.

3.1Methodology And Test Details

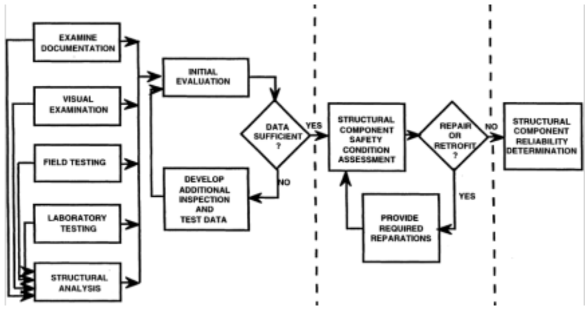

FIG. Methodology for Seismic evaluation of reinforced concrete structures

Methodology as per ACI 365

4.CONCLUSION

The building is capable of taking lateral force upto 6% of it's seismic weight. The performance point lies between the zone of immediate occupancy and life safety. Hence, when a lateral force equal to around 1087 KN is acted upon the building, there will be light to moderate damage. Cracking may be observed with permanent drift the gravity elements will function with no collapse of structures, however, the building may go beyond economical repairs.

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