International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 05 | May 2024 www.irjet.net p-ISSN: 2395-0072

A Review on Existing R.C.C. Framed Building Condition Assessment and Evaluation of Seismic Activity With Etabs

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Abstract - Throughout a building's life, the process of building condition assessment, is essential to controlling and preserving the structure's value, safety, and integrity. This paper provides an in-depth analysis of the importance of condition assessment and earthquake evaluation outlining the various methodologies employed and the areas of focus during an assessment. It includes an evaluation of structural stability, mechanical systems, and seismic condition of the building. In earthquake-prone areas, evaluating a building's seismic resistance is essential to ensuring its safety. This study explores the procedures and significance of comprehensive building seismic evaluation, emphasizing the use of digital modeling tools like SAP, E-tabs , etc. in addition to manual computations. This paper includes insightful information about the difficulties and complexities of R.C. Framed structures, as well as the necessity of approaching their assessment and evaluation in a methodical and thorough manner.

***Key Words*: R.C. Framed Structure, Safety, Earthquake , E-tabs, Condition Assessment.**

1. INTRODUCTION

Building structure evaluation and its ability to withstand seismic events has been a major area of research for many years. Seismic evaluation of existing reinforced concrete (R.C.C.) framed structures is one of the critical topics on which researchers and practitioners have concentrated a great deal of attention.

Structures provide houses, places to live and work, and the infrastructure required for communication, transportation, and other essentials, which is why structures form the foundation of modern civilization. However, as these structures age, they become more susceptible to deterioration and harm from various earthquakes as well as other man-made and natural pressures. This poses a significant danger to the general safety of the town, the safety of its citizens, and the financial and social costs associated with potential injury and fatalities. Therefore, in order to ensure the functioning, security, robustness, and safety of existing buildings, routine condition assessments and seismic assessments are required.

Building owners, property managers, and the general public have serious concerns about preserving the integrity, safety, and long-term worth of structures. Seismic evaluation and building condition assessment are two essential parts of this work.

Figure-1 Old Damaged Building

Condition assessment is a methodical procedure that entails analyzing and assessing different building components. It is intended to detect any current or possible problems, ranging from slight deterioration to significant structural difficulties. The findings of a condition evaluation can assist direct planning for upkeep, support property appraisal, and guarantee respect to building codes.

The goal of earthquake evaluation, on the other hand, is to ascertain how resilient a structure is to seismic forces. This assessment is essential in earthquake-prone locations to prevent structure collapses that might have disastrous effects. A range of methods are employed for doing seismic assessments, from manual computations to sophisticated software modelling tools like as ETABS.

Earthquake evaluation and condition assessment work together to provide essential data that can extend a building's lifespan, improve its functioning, and increase safety. The objective of this study is to examine the significance, approaches, and consequences of building seismic evaluation and condition assessment, emphasizing their complementary functions within the larger framework of preservation and administration.

Objective

- The main objective is to locate any structural flaws, degradation, or damage to building elements.
- To assess the building's vulnerability to seismic forces.
- To examine the building's position in respect to seismic zones, the state of the soil, and the region's past seismic activity when determining the seismic risk.
- To find out how long the various construction systems and components will last under use.
- To make solutions for enhancing the building's ability to withstand earthquakes.

2. Literature Review

[1] Sameh A. El-Betar described that reinforced concrete framed structures are the most prevalent form of existing buildings in Egypt. Many of these structures were merely intended to withstand gravity stresses. The October 1992 earthquake in Egypt severely destroyed educational buildings with gravity load designs in the areas close to the epicenter. Here are some examples of the usual damage found in a few reinforced concrete school buildings in Fayoum, Egypt.

Sameh A. El-Betar has conducted a seismic evaluation of Egypt's contemporary reinforced structures. He carried out two case studies were used. The second building that was chosen was likewise a school, built after 1990, while the first was an old school that was planned and built in the vicinity of 1962.

Figure-2 Damaged elements

In contrast to the second building, which had a framed structure—a frame that could withstand a moment—the first building was merely intended for gravity loads. None of the buildings in this research had any planar or vertical irregularities. First, a FEMA P-154 form and score modifier were utilized for a rapid evaluation of these structures. instance 1 underwent a thorough review since the overall score for the second instance was higher than 2 and lower than 2 for the first. Axial and shear stresses in columns have been measured utilizing Tier 1 screening on Case Study 1. Using the traditional model of an old school building, all objects in Tier 1 of the method pass.

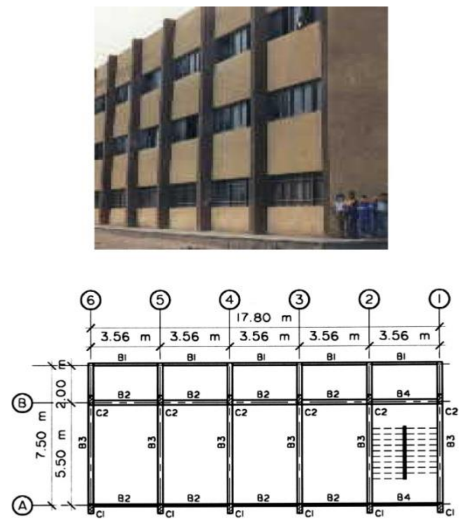

Figure-3 School Building

It does not meet the life safety performance target in all areas, however. It has been established that the model has several shortcomings. These are the short route's drawbacks: it has no redundancy and just one bay moment frame (less than two). The second drawback is that the height to thickness ratio of the corridor perimeters is excessively high (more than 2.5). The design expert can either share defects and provide fixes, or they can take part in Tier 2, the second level. For Tier 2, the examination of shortcomings has to be done using the assessment standards listed in Tier 1. In this case, the as-built measurements, the soil report, the reinforcing requirements for each structural part, and core tests to determine the strength of the concrete are required for the building study. However, same defects are absent from school buildings constructed.

The pushover analysis is used to determine the case studies' capacity curve when they are exposed to lateral forces. Graphs that show the fluctuation of base shear vs top displacement are used to depict the findings of pushover investigations. Pushover analysis was carried out using the IDARC version 6 application. Buildings with gravity load designs are more susceptible to large earthquake loads, according to the study's findings.

[2] Tarek M. Alguhane, Ayman H. Khalil, M. N. Fayed, carried out an case study and research work , in this study aims to analyze the seismic performance of a five-story existing R.C.C. building in Madinah City that was built thirty years ago. With SAP2000, a building model was created. Four model systems have been taken into consideration: model I (no infill), model IIA (update from field test strut infill), model IIB (strut infill – ASCE/SEI 41), and model IIC (soft storey strut infill – ASCE/SEI 41). Inelastic material behavior for concrete, steel, and infill walls has been included into three-dimensional (3D) pushover analysis.

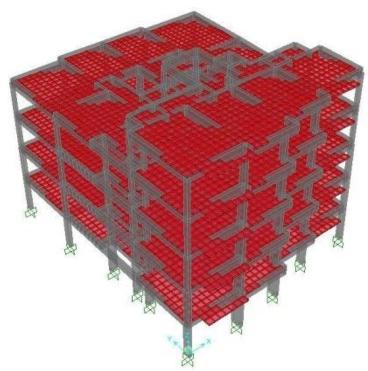

Figure-4 Model without infill

According to ASCE/SEI 41, the infill wall has been modeled as an analogous compression strut with the ability to form an axial hinge in order to compute strengths and effective stiffness.

On four models, displacement-controlled pushover studies were carried out. Buildings can be classified into two intermediate structural performance ranges and three distinct levels based on their structural performance. The three separate structural performance categories are structural stability (CP), collapse prevention (CP), and immediate occupancy (IO)/life safety (LS). There are two levels of intermediate structural performance: the restricted safety range and the damage control range.

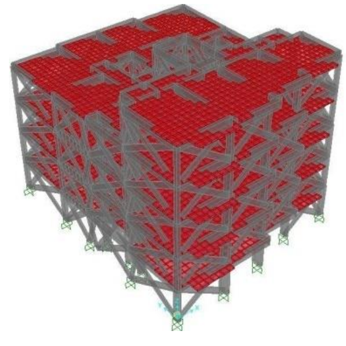

Figure-5 model with infill

Software findings were used to determine the maximum base shear (Vb) and target displacement (δt) values for each of the four models, which were then compared.

The ground soft storey's presence lessens the building's stiffness and results in a lower Response reduction factor value. This demonstrates how crucial infill walls are to the ground floor's improved seismic assessment of the structure.

[3] S Prasanth, Goutam Ghosh, and Ashwani Kulshrestha, describes in India, the most popular building construction method is filled walls with unreinforced masonry (URM) and reinforced cement concrete (R.C.C.). Because Indian regulations do not have codal requirements for the modeling of infills, the influence of infills is often disregarded. Infill modeling techniques are offered by certain international codes, such ASCE 41-06 and FEMA. Because of the infill-frame interaction, URM infills significantly alter the building's mode of failure. By acting in concert to absorb lateral pressures, infills contribute to the building's increased stiffness. Increased stiffness causes the time period to decrease, which has a major impact on the building's seismic behavior.

The authors concentrates on the seismic susceptibility of structures made of reinforced cement concrete (RCC) and infill walls made of unreinforced masonry (URM). The authors point out that URM infill panels' interaction with the frame greatly affects a building's susceptibility; yet, because Indian standards lack of codes provisions for modeling in-fills, this effect is frequently overlooked in practice.

The study uses fragility curves to examine the seismic susceptibility of structures with and without infill panels. The seismic reactions of the buildings are ascertained by non-linear static pushover analysis and non-linear time history analysis. According to the research findings, URM in-fills greatly enhance the building's seismic susceptibility and have an undesired influence on its reaction. Consequently, the authors recommend that design rules take the impact of URM in-fills into account.

They said that the fragility curves for each case were created utilizing the HAZUS approach. The likelihood of damage for different building models in various damage stages is shown by these curves in relation to spectral displacement (Sd). When comparing the fragility curves of infilled frame buildings with those of bare frames, the curves for each damage condition are flatter in the case of bare frames, according to fragility curves for different building types. For a given value of spectrum displacement (Sd), the fragility curves' flatter trajectories indicate that there is a greater likelihood of damage in the case of infilled frame construction models than bare frame models and some other results and curves are prepared

In brief, the research highlights the need of taking into account the interplay between RCC frames and URM infill panels when evaluating a building's seismic susceptibility. The study's conclusions highlight how URM in-fills negatively impact a building's ability to withstand earthquakes and advise that when designing RCC frame structures with URM in-fills, infill-frame interaction should be properly considered.

[4] H. AlWashali, Y. Suzuki observed that , many practicing engineers view brick infill walls as nonstructural since it might be challenging to evaluate their failure modes and interactions with the surrounding frame. They highlight the challenges in precisely determining the masonry infill's

failure mechanism, shear strength, and deformation capacity, particularly in light of the wide range of material qualities and the quantity of structures already in place.

Figure-6 Damage of RC building with masonry infill

Based on earlier research and tests carried out by different scholars, the study aims to provide more straight forward and feasible techniques for assessing the strength and deformation capacity of unreinforced masonry infill in reinforced concrete frames. The authors want to offer suggestions on how to include the impact of masonry infill in the Japanese seismic assessment.

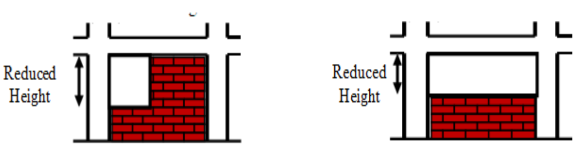

Figure-7 Partial infill masonry walls

They explained that it is important to remember that partial infill panels, like the ones above, are not regarded as openings in the research and that their positive effects should be disregarded when calculating the strength index.

The authors of this study also provided a comparison of current approaches with earlier experimental findings. It is also investigated how apertures affect the lateral strength of masonry infill walls. Based on earlier experimental results, the ductility of a R.C. frame with brick infill is examined. The F-index for masonry infill requires more investigation, and the information currently known about the factors influencing the deformation of masonry infill is deemed insufficient.

[5] Terala Srikanth, Ramancharla Pradeep Kumar conducted a case study and described that adequate building methods and inadequate seismic knowledge have led to a substantial number of deaths during Indian earthquakes, and these issues were the focus of the research. The safety of pre-code revision structures must be taken into consideration. . Representing a significant portion of the stock of vulnerable buildings

Although massive quakes are rare in India, each one is marked by high exposure, and it is impossible to ignore the consequences they have on society and the economy. For instance, the Indian Government estimates that the Jan. 26, 2001, earthquake in Bhuj, Gujarat, impacted 50% of the state's population either directly or indirectly.

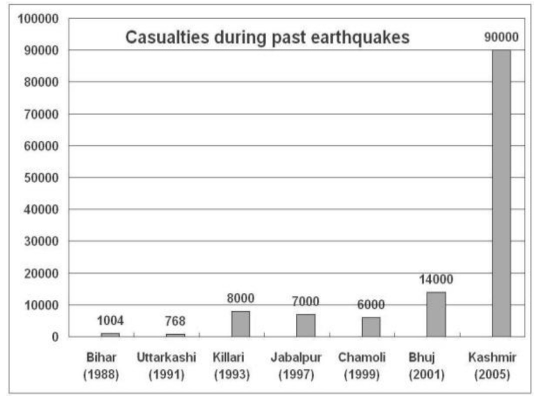

Figure-8 Casualties during past earthquake

The authors examined a number of fast visual screening techniques that are employed in other nations, including New Zealand-RVS, Turkey-RVS, Greece-RVS, Canada-RVS, Japan-RVS, and FEMA-RVS. They implemented the RVS forms that Sudhir K. Jain et al. suggested be used in the Indian context.

For assessing the vulnerability, three tier approach described below is adopted. Rapid Visual Screening (RVS) of building stock, Preliminary seismic evaluation of selected buildings and Detailed seismic evaluation of few buildings

A total of 16,000 structures were surveyed for the case study of the cities of Gandhidham and Adipur. After the buildings were categorized according to their construction characteristics, it was found that a sizable portion of them were made of masonry. A review of the buildings' apparent quality revealed that many of them were of inadequate condition, necessitating more analysis and reinforcement.

The authors also explained that, in comparison to buildings with inadequate performance scores, those with higher performance scores function better. However, there are a lot of buildings that fall into the medium performance rating range, making it challenging to make important decisions because there are no standard findings for Indian settings.

Conducting an initial evaluation of certain structures is suggested as a solution to the abovementioned challenge. For this reason, about 200 structures that lie within the mean plus or minus standard deviation are chosen. Furthermore, a maximum of fifty buildings that had scores that were less than the mean minus two standard deviation and larger than the mean plus two standard deviation were chosen. In order to standardize the RVS score, a subsequent in-depth examination was necessary for a limited number of structures.

The study shows the significance of carrying out thorough seismic risk assessments and offers insights into the seismic susceptibility of structures in the cities of Gandhidham and Adipur. In comparable high-seismic zones, the findings can aid in the development of measures for reducing the danger of earthquakes and enhancing building safety.

3. CONCLUSIONS

To sum up, building condition assessment is essential to preserving a structure's worth, usefulness, and safety over the course of its lifetime. The significance of building condition assessment has been emphasized in this review study, which also provides a critical analysis of the many approaches, strategies, and instruments employed in the procedure.

- The capacity curve is generated by the pushover analysis when case studies are subjected to lateral loads. The results of pushover studies are displayed using graphs that illustrate how base shear changes with top displacement. The study concludes that large earthquake loads are more likely to affect structures with gravity load systems.

- The building's stiffness will increase, and the response modifying factor and over-strength factor values will rise, fulfilling code requirements, according to the ASCE/SEI 41, a revised model based on field measurements and the analysis that incorporates the infill wall. The presence of ground soft storey reduces the building's stiffness and Response reduction factor.

- It is also observed that because of building is more rigid against lateral stresses due to the installation of infill panels, there is a larger chance of damage from seismic forces.

- The assessment and evaluation methods are complex and time consuming.

- It is also investigated how apertures affect the lateral strength of masonry infill walls.

- After a survey, buildings apparent quality revealed that many of them were of low quality, indicating the need for more analysis and strengthening.

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