IJMRSETM

e-ISSN: 2395 - 7639

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING, TECHNOLOGY AND MANAGEMENT

Volume 9, Issue 4, April 2022

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.580

+91 99405 72462 +9163819 07438 ijmrsetm@gmail.com www.ijmrsetm.com

| ISSN: 2395-7639 | www.ijmrsetm.com | Impact Factor: 7.580|

| Volume 9, Issue 4, April 2022 |

| DOI: 10.15680/IJMRSETM.2022.0904018 |

A Review on Seismic analysis and design of hospital building using E-Tab

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ABSTRACT: These motions may be felt everywhere on the planet. The structure vibrates as a result of the ground movements, which causes inertial pressures to be exerted on it. Consequently, buildings situated in Seismic zones are built and specified to assure acceptable levels of safety while maintaining acceptable levels of strength, serviceability, and stability in the face of seismic pressures. A significant number of buildings are undergoing seismic-resistant construction at the moment. This is evident from the fact that the performance of a significant number of reinforced concrete buildings that were subjected to strong earthquakes in different regions of the globe was good. Additionally, these codes have outlined the types of earthquakes that can occur. During the course of this investigation, the blueprint for the G+5 Hospital was created using the Auto CAD tool, and the structure was designed with the E-TAB programme. In order to calculate the dead load, the living load, and the seismic load, the formulae IS: 456-2000 and IS 1893: 2002 are used. In order to fulfil the standards given in IS: 1786-1985, we make use of concrete of grade M25 and HYSD bars of type Fe415. At the beginning of the planning process for the project, the seismic load requirements of IS456:2000 were not taken into account at all. After that, the structure is designed while taking into mind the earthquake loads and IS1893: 2002. The detailing has been finished using both of these methods in line with their specifications. The Indian Standard guidelines will be followed by the planned hospital, and these guidelines will be utilised in the research and design of the structure. There are many different sorts of analysis procedures, and each of these processes is dictated by the external stresses, the structural materials, and the structural model.

KEYWORDS: Seismic analysis, hospital building, E-Tab

I. INTRODUCTION

Seismic waves are created when the earth's crust suddenly releases energy, which is what causes earthquakes. It's possible that seismic vibrations can go a long way. Studying the effects of earthquakes on building performance requires an understanding of peak ground acceleration (PGA) and peak ground velocity (PGV), peak ground displacement (PGD) and frequency content and duration. In the business world, structural analysis is sometimes referred to as the "backbone" of the industry. Over the course of the last few years, there has been an increasing emphasis placed on doing research on the structures via the use of computer-aided software and hardware. But it isn't always necessary to do such in-depth studies; sometimes, merely an approximation of an analysis will be adequate to suit our objectives, Skyscrapers and other sorts of constructions that have a great number of bays and a number of floors are becoming more common in urban areas these days. The research of the frameworks of multi-story buildings proves to be rather tedious since such frameworks contain an excessive number of joints that are free to wiggle. This makes the analysis of the frameworks of multi-story structures quite hard. Even if the method of distributing moments that is used the vast majority of the time is applied to each and every one of the joints, the quantity of labour that must be performed will nonetheless be quite extensive. However, in order to conduct a preliminary study of the structures, it is necessary to make a number of assumptions and use several replacement analysis approaches. The whole new section of the hospital was constructed with Delhi in mind. The structure that houses the hospital has a total built-up area of 315 square metres and is composed of six storeys (the ground floor plus five more). An orthopaedic ward, The building is currently under construction in Delhi. Because hospitals are such important facilities and must continue to function normally after an earthquake, their exteriors have to be constructed in compliance with the principles that govern earthquake design. The present investigation is centred on the seismic analysis of RC buildings that are (G+6) storeys tall. For this purpose, the structural analysis and design software known as STAAD Pro is being used. The floor design of the hospital has a totally regular arrangement of rooms. Every level is exactly the same height as the one that came before it, giving it a total story height of H = 3 metres. The structure that houses the hospital has a total of seven floors, the lowest of which is the basement. Above ground, it consists of six storeys. Due to the fact that the length of the Hospital building is 21 metres and its width is 15 metres, the area is 315 metres squared.

| ISSN: 2395-7639 | www.ijmrsetm.com | Impact Factor: 7.580|

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Every story uses the same amount of space for its column. The width of the beam remains the same from one level to the next. It is essential to ensure that the structure housing the hospital is capable of withstanding an earthquake. This is due to the fact that the hospital is the most vital location during a catastrophe in which to provide humanitarian relief and medical care. The purpose of this research is to provide comparisons between the study and the design of a hospital building that has G+6 stories. The structure is likely to be subjected to many instances of seismic loads all at once.

It is an essential piece of equipment for quake-prone regions, such as Japan, the north-east of India, Nepal, the Philippines, and many other countries. This type of analysis is especially crucial for the design of components of RCC structures such as beams, columns, and slabs that are developed in compliance to the standard IS 13920:2016. The seismic forces have a dynamic quality, and in order to assess their mass, mass carrying capacity, ductility, wetness, and stiffness, they are subjected to testing. When doing seismic research on multi-storeyed buildings, IS 1893:2016 is the code that is used.

The structural reaction to powerful earthquakes is dynamic, nonlinear, and unpredictable, hence the issue is difficult in theory to solve because of these characteristics. linear, and predictable (or at the very least, can be well approximated as such), all three traits are very uncommon. As a consequence of this, seismic design requires a specific set of abilities and data, neither of which are necessarily possessed by the typical designer. Seismic codes offer a variety of methods for seismic analysis that are geared toward applications in the real world. (It is important to note that the word "code" is used in a wide sense throughout this work, and encompasses not just codes but also standards, recommendations, and particular requirements.) According to Albert Einstein, the procedures that are employed in codes should be "as basic as feasible, but not simpler."

In contrast to this, research that is geared toward the acquisition of new information need to make use of the most cutting-edge analytical, numerical, and experimental techniques available. It is essential to keep in mind that it is not possible to anticipate the particulars of the ground motion that will take place during future earthquakes. On the other hand, the particulars of the dynamic structure reaction, particularly in the inelastic region, are riddled with high levels of uncertainty. According to Aristotle, "the mark of an educated mind is to rest satisfied with the degree of precision which the nature of the subject admits and not to seek exactness where only an approximation is possible. (The sign of an educated mind is) "it is the sign of an educated mind to rest content with the degree of accuracy which the nature of the topic permits and it is the sign of an educated mind to rest satisfied with the degree of precision which the nature of the subject admits and it is"

II. LITERATURE REVIEW

Shaik, K., &Ajitha, B. (2022), During the Bhuj earthquake that occurred in 2001, a significant number of hospitals sustained damage, which resulted in a significant disruption in the delivery of wounded patients. It should go without saying that after a significant earthquake, hospitals must continue to operate normally. At the very least, some essential medical requirements were made available to the wounded, which is something that will be very much appreciated. In the aftermath of the earthquake, we will be able to continue to provide urgent medical treatment if we implement seismic protection in the form of floor isolation. Isolation of important medical facilities in hospital buildings using seismic floor systems is an excellent and cost-effective approach for providing protection. Only the floor that houses the operating theatre is separated from the rest of the hospital by means of floor isolators, and time history analysis is carried out on that level using SAP2000 software. This is all part of the case study that is being carried out on the hospital's three-story facility.

Rojas, P. P., Retamales, R., Miranda, E., Caballero, M., Barros, J., &García, L. (2022), The Solca Hospital in Guayaquil is situated roughly 260 kilometres (nearly 160 miles) from the epicentre of the magnitude 7.8 Pedernales earthquake that occurred on April 16, 2016. The hospital is made up of many frame structures that are built out of moment-resistant reinforced concrete. Some of these buildings were completed around the beginning of the 1980s. The primary focus of the Solca Hospital's medical care is on the diagnosis and treatment of patients suffering from cancer. Numerous of the buildings sustained damage of varying degrees as a result of the shaking, which resulted in the closure of several different areas of the hospital. Following the earthquake, many of the hospital's buildings went through a methodical procedure that consisted of post-seismic inspections, structural assessments, and structural repair. This article contains the analyses that were carried out by the authors in order to restore these structures in terms of seismic activity. To begin, a broad overview of the structures is provided for your perusal. Second, a report is made on the seismic damage that was seen in each building. The field and the analytical investigations that were conducted are then described in this section of the report in order to establish the source of the damages. A discussion of the seismic restoration solutions that have been offered for each structure rounds out the contents of the article.

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Kober, D., Semrau, P., & Weber, F. (2022), A hospital building with an irregular layout, consisting of one basement floor and five overground floors, has been investigated. The structure is of the frame type and was constructed as part of a hospital ensemble in Bucharest, which is located in an area with a high corner period seismicity. An investigation of the effectiveness of base isolation is being done for these difficult seismic circumstances. There are two potential approaches to the design: isolating the base, and reinforcing it. Both of these potential solutions have their positive and negative aspects mentioned below.

M. Chalabi, H. Naderpour, and M. Mirrashid all contributed to the research (2022), Aneuro-fuzzy model for predicting the difficulty level of steel and concrete moment frames in school buildings is the goal of this study. There are a lot of factors that have been considered in order to achieve this aim, such as the ratio of total height to width, period, spectral acceleration, peak ground velocity, and distance from fault. For the building of the nervously model, the results of the nonlinear analysis of the frame were included into the database. A strategy to predicting resilience was developed and presented on the basis of the analytical data presented here. In addition, the suggested neuro-fuzzy model was validated using an actual school building, and the results were compared. According to the findings, the calculation of the robustness index of the moment frames was carried out with a high degree of precision. To assess resilience using the approaches that are now available, it is required to carry out a huge number of laborious and time-consuming investigations, as well as sophisticated computations. On the other hand, the resilience index might be calculated without resorting to such analysis if one used the model that was provided.

Kassem, M. M., Nazri, F. M., Farsangi, E. N., &Ozturk, B. (2022), The methodology used to determine the seismic vulnerability index has been modernised and forms the basis of the framework (SVI). Three rounds of validation are conducted on two reference buildings that were damaged by the seismic event that took place in Ranau, Malaysia, in 2015. This is done in order to validate the framework that has already been built. At the beginning of the process, on-site inspections of the affected facilities, such as hospitals and schools, are carried out in order to locate any structural problems. After that, a comprehensive diagnostic of the many elements of the physical injury is carried out by field visual inspection. An improved seismic risk index is obtained in the second phase by the use of finite element modelling.

Mayer and Boston, M. Mayer and M. Boston (2022), It is anticipated that key infrastructure systems, including hospitals, would continue to operate normally in the immediate aftermath of an earthquake. There is a need for a functionality dashboard that can quickly spot reductions in functional performance. The dashboard has to take into account both actual and potential disruptions, and it should also include data from previously occurring disruptive events. Putting up a functionality database using data from previous earthquakes will offer the information required to construct a representative event tree of the functioning of the hospital. Fault trees, which are produced on the basis of the information obtained in the functionality database, are responsible for the governance of drops in functionality. These technologies offer the engine for a hospital functioning dashboard, which can be used to estimate how well a hospital will respond to certain scenario occurrences. Utilization of the dashboard will assist in determining crucial relationships between hospital components that have an influence on functioning and will offer information that is necessary for enhancing the architecture of the facility.

Garcia-Troncoso et al. (2022), The current study makes it possible to evaluate the behaviour of a structure in the city of Guayaquil that was constructed on a soft soil type E, taking into consideration the seismic performance in light of the most recent earthquake that struck Ecuador and caused irreparable damage. Because of this, the structure was modelled for further analysis using software designed specifically for structural analysis called ETABS. The goal of this modelling was to evaluate and compare the values collected from the measurement in the accelerographs of Guayaquil and Manta, and to acquire a reference and knowledge regarding the damage, displacements, and deformations that were observed. These are the goals of this work: to demonstrate the behaviour of the structure by analysing the static level of the infrastructure when it is placed in pseudo-dynamic and dynamic time-history mode; to investigate the possibility of redesigning the structure while taking into account the existing regulations concerning stability, drifts, and shear forces; and to demonstrate that this work is complete. The work provides and expands the data on the factors that increase the seismic hazard, which in the future can be contrasted with similar studies within the city of Guayaquil, in order to analyse the possible variants of how to improve future constructions. The work also provides and expands the data on the factors that increase the seismic hazard.

Masatkar, V., & Grover, R. K. (2022), The primary purpose of this project is to conduct an investigation into the performance of a R.C.C-framed structure in a variety of seismic zones and investigate the variation in the percentage of

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steel and concrete materials. A major earthquake and the horrific aftereffects it causes are two of the most terrifying and devastating natural events that may occur. It is very unlikely that a person could stop an earthquake from happening, but the level of damage that it does to structures may be mitigated via careful planning and attention to detail. Because of this, it is essential that buildings be subjected to seismic analysis and designed to resist collapse. Because earthquakes are such uncommon occurrences, designing a building in such a manner that it would sustain less damage during one is a waste of time and money because there is no guarantee that an earthquake will ever happen during the building's lifetime. The current version of IS code 1893:2002 does not provide any information on the variations in concrete and the percentage of steel that may be found in each zone.

Pérez Jiménez, F. J., &Morillas, L. (2022), In order to investigate the impact that the significance factor has on seismic performance, this study compares four prototype health facilities that are situated in an area of Europe that has a medium risk of earthquakes. The frame constructions of the buildings are made of reinforced concrete (RC), and they were designed with significance factors of 1.0, 1.2, 1.4, and 1.5 respectively. The technique outlined in FEMA P-58-1 is used as the foundation for performance evaluation. The results of this investigation show that the seismic performance of the prototypes that were studied is inadequate in terms of the amount of damage, the loss of functioning, and the repair costs.

Seismic assessment is an essential method for validating the ability of structures to withstand earthquake loads. Abass, H. A., and Jarallah, H. K. (2021). Regarding their significance, buildings are capable of having major and secondary components. Main elements comprise the structural components; subsidiary elements contain the non-structural components. ATC-40, FEMA-356, and FEMA-440 were studied for their similarities and differences. Study of the Baghdad, Iraq, ThalassemiaCenter Medical Building as a case study was offered in this examination. The Iraqi Seismic Code's response spectrum was used in the research (ISC-2017). Capacity curves and performance levels were used as comparison measures when comparing the results of the different assessment codes The results of the comparison revealed a number of important points. According to ATC-40, the results of FEMA-440's improved equivalent linearization methodology differed from that of the CSM method. This is due to the fact that the corresponding linearization technique relied on new formulas to compute the effective period and the effective damping, respectively. It was found that the ISC-2017-compliant spectral response acceleration values were enough and appropriate for use in seismic analysis and design as a result of these improved results There's a good chance that the results using ATC40 are overestimated compared to those obtained using the capacity spectrum method (CSM), which uses FEMA440 as its foundation.

III. CONCLUSION AND FUTURE SCOPE

During an earthquake, horizontal and vertical ground motions radiate from the epicentre. These movements are global. Ground motions cause the structure to shake, causing inertial pressures. In seismic zones, buildings are developed and specified to provide appropriate levels of safety, strength, serviceability, and stability. Several structures are now being made earthquake-resistant. Several reinforced concrete structures that were exposed to large earthquakes across the world performed well, proving this. The Indian standard codes IS: 1893-1984 and IS: 13920-1993 provide earthquake-resistant design standards, earthquake probability, structural and foundation features, and permissible damage. These codes also include earthquake kinds. During this inquiry, the G+5 Hospital was developed utilising Auto CAD and E-TAB (including the beams, columns, footings, and seismic load analysis by applying the equivalent static approach). IS: 456-2000 and IS 1893: 2002 are used to determine dead, living, and seismic loads. We employ M25 concrete and Fe415 HYSD bars to meet IS: 1786-1985 specifications. At the start of project planning, IS456:2000 seismic load criteria were ignored. The structure is then developed using IS1893: 2002 and seismic loading. Both approaches were used to complete the details as specified. The projected hospital would follow Indian Standard criteria for research and design. External stresses, structural materials, and the structural model determine each analytical approach. This category includes linear static, linear dynamic, nonlinear static, and nonlinear dynamic analyses.

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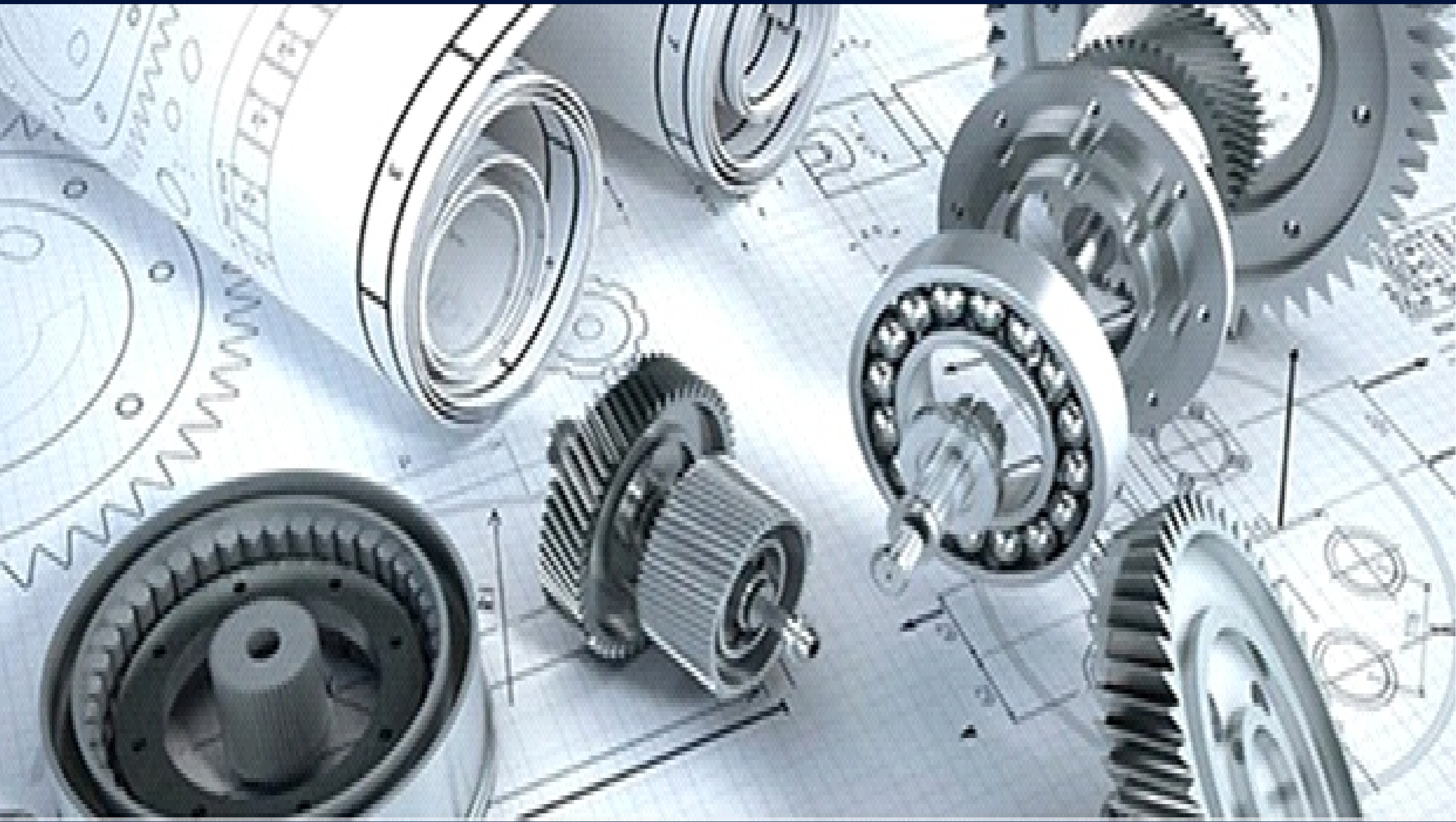

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