Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 8, No.2, August : 2024

RESEARCH ON INNOVATION IN EARTHQUAKE PROOF STRUCTURE

Harendra singh bhati, Assistant Professor, Dept. Of Civil Engineering, IIMT College of Engineering Greater Noida harrybhati1993@gmail.com
Munesh rajput, Student, Dept. Of Civil Engineering, IIMT College of Engineering Greater Noida
Hrishabh Sharma, Student, Dept. Of Civil Engineering, IIMT College of Engineering Greater Noida
Abhishek chauhan, Student, Dept. Of Civil Engineering, IIMT College of Engineering Greater Noida
Sidhant singh Student, Dept. Of Civil Engineering, IIMT College of Engineering Greater Noida

ABSTRACT
Earthquakes constitute one of the greatest hazards of life and property on the earth. Due to suddenness of their occurrence, they are least understood and most dreaded. The earthquake resistant construction is considered to be very important to mitigate their effects Earthquakes may create various kinds of causalities like loss of life and damage of property depending upon its magnitude; causalities could range from small property damage to landslides and a long range of liquefaction. Secondary effects like fire; blockage on services such as water supply, electricity, and transportation; and communication disruption are even more disastrous. Man-made infrastructures are however the major contributor of casualties during earthquake devastations. These structures therefore should be carefully designed and constructed. It is very important to develop new technologies to minimize these losses. Thus, we started to do research regarding these new techniques and to improve our knowledge and become aware of these recent methods and their usage in our daily life to optimize earthquake effects on our structures. We cannot make fully earthquake-proof structures but we will reduce its damage and make structures earthquake resistant. In this research paper, we will discuss modern technologies that make our structure earthquake resistant.

KEYWORDS-
Advanced Techniques, Earthquake, Effective Designs Process, Ideal Resistant Ratio, Structure failure

INTRODUCTION
Earthquake is one of the natural disasters that frequently occurred some areas in India. Based on geographical location, it is known that most of region in India bypassed by the ring of fire and that is caused highly risk of danger. A fundamental approach to preventing damage has been the creation of a 'damage-free' building, achieved by preventing the structure from reaching the limit state where it would be deemed unsafe for occupation. An earthquake is the sudden shaking of the surface of the earth caused by the passage of seismic waves through the earth's crust. During the earthquake, vibrations occur in all directions radiating from the epicenter. The sudden release of energy cause structure to vibrate and inertia forces are acting on them. Most of the earthquakes are result from tectonic events, primarily movements on the faults, and remaining related to the man made. The lack of earthquake knowledge and its incorporation in the building design and execution leads to the failure of structures.
There are 9 severe earthquakes has witnessed by India in the last 3 decades between 1990 to 2020 and reports claim the number of causalities approx. 30500. Although, certain parts of the country are more prone to earthquakes (seismic zone V of IS 1893(Part 1)- 2016) than the others [4]. No region can be considered free from earthquakes. In the Indian scenario,minor earthquakes are reported near the seduction zone (Himalayan belt) on a daily basis, whereas in the interpolate region (Deccan plateau) few major earthquakes have been observed over the years. The performance of the built

environment during the past earthquakes has shown its brittle nature and has created an itch among the engineers and architects to move towards seismically efficient buildings. Analysis of earthquake resistant Design structures against natural earthquakes he said that buildings can effectively protect against earthquake using multiple design options[3].Load factors of earthquake designing structures where a number of options, details for earthquake types can be found[9]. About 60 % of the Indian landmass, is susceptible to moderate to very severe earthquakes. A great earthquake in an unoccupied area may produce minimum damage when compared to a moderate earthquake in a densely populated area. All the field survey studies conducted after a major earthquake suggested that the maximum casualties reported were caused by structure collapse.The seismic performance of a building during an earthquake depends on its shape, size, geometry, and the nature of the load path. The aim of seismic design philosophy is to ensure the safety of structural components and human life. Design philosophies state that the load-bearing structural elements must suffer no damage in the case of a minor shaking, sustain repairable damage in the case of moderate shaking and sustain severe damage without collapse under strong shaking.

RESEARCH OBJECTIVE

The main aim of a structural engineer is to prevent the structural damages that are caused due to earthquakes. So, the main objective of this paper is to fulfil the following.

1. To increase the stability of structures against inertial forces using modern techniques.
2. To know about new and advanced methods for earthquake-resistant structures.
3. To prevent deflection of structure which causes failure by using new and advanced methods.

NECESSITY FOR EARTHQUAKE RESISTANT CONSTRUCTION

As per census 2011 India, there are more than 330 million dwelling units in the country, two-thirds out of which are rural households. According to India's geological survey, the country has been classified into four seismic zones having different seismic capabilities.The Last seismic experience shows that modern residential buildings lack seismic designs. Further, the importance of incorporating seismic principles in the structural design of the building to function as a single unit during the earthquake has become clear. Empowering rural communities to ensure seismic safety of building stock by generating awareness about earthquakes and the significance of earthquake-resistant buildings. The environment built in urban areas should be planned and has to be carefully prepared in the initial stages so that the constructing layout is suited for seismic performance.

BUILDING TYPOLOGIES

The classification of the building is based on the material used in the building such as Type of mortar used,Concrete used in the structure, Reinforcement and Wooden structures.

1. Classification of masonry units –

Stonemasonry - doing stonework ,Wooden masonry - doing wooden work ,Reinforcement masonry - doing steelwork , Brick masonry - doing brickwork

2. Classification of load- bearing units in structures- Reinforced walls - the walls can be made load bearable Trusses- H shaped girders made of steel Braces- made of steel Columns - vertical reinforced concrete bars Beams - horizontal reinforced concrete.

TECHNIQUES TO MAKE BUILDING EARTHQUAKE PROOF STRUCTURES

A. shape alloy memory.
B. base isolation

C. steel plate shear wall
D. seismic dampers, etc.

RECOMMENDATION

After discussing several ways and alternatives forearthquake structure design, we recommend all designersand architectures to use these methods for constructingearthquake-resistant structures for saving the lives ofpeople and assets.Some of the alternatives are economicaland the methods with better efficiency are a lit bit moreexpensive. For example, the performance of shear plateshear walls is better but it is a little bit more expensive.Dampers and base insulation both provide betterresistance and better adequate safety.New technologiesare yet to come as the arena of knowledge is exceedingday by day.So, it is important to be up to date.

Seismic Design Principles and Codes

Seismic design principles form the fundamental framework for developing earthquake-resistant design strategies for tall structures. Understanding the behaviour of structures under seismic forces and the characteristics of earthquakes is essential in ensuring their safety and resilience. Seismic design principles relevant to tall structures encompass a range of considerations .These include the analysis of dynamic loads, determination of design ground motions, evaluation of structural response, and implementation of appropriate structural systems. The behaviour of tall buildings under seismic forces is influenced by factors such as lateral stiffness, strength, ductility, and damping. Therefore, it is crucial to incorporate these principles into the design process to enhance the seismic performance of tall structures. Compliance with building codes and standards is a critical aspect of seismic design. Building codes provide guidelines, regulations, and requirements for designing structures to withstand seismic forces. These codes are typically developed based on extensive research, lessons learned from past earthquakes, and the collective expertise of professionals in the field. The codes address various aspects of seismic design, including structural analysis and design methodologies, material specifications, and construction practices. Applicable building codes and standards vary across different regions and countries, reflecting the specific seismic hazards and local practices.

DESPITE ADVANCEMENTS, CHALLENGES PERSIST

1. **Urbanization**: Rapid urban growth leads to poorly designed structures that lack earthquake resilience.
2. **Awareness and Implementation**: Educating builders, architects, and the public about earthquake-resistant techniques remains crucial.
3. **Cost Constraints:** challenge to provide Implementing advanced technologies can be expensive, especially for low-cost housing.
4. **Enforcement of Codes**: Strict enforcement of building codes and regulations is essential.

CHALLENGES AND LIMITATIONS

While earthquake-resistant design approaches for tall structures have significantly evolved and improved over the years, several challenges and limitations persist. It is important to acknowledge and address these challenges to further enhance the seismic performance of tall buildings. Here are some of the common challenges and limitation;

1.Uncertianity seismic hazard assessment
2. local site condition 3.
economic constraints 4.
complex structural system 5.
public precipitation and awards

Addressing these challenges and limitations requires ongoing research, innovation, collaboration among experts, and continuous improvement in design practices. By acknowledging these factors,

engineers and designers can work towards developing more robust and efficient solutions for earthquake-resistant tall structure.

CONCLUSION

In conclusion, earthquake-resistant design for tall structures is a critical field of study that aims to ensure the safety and resilience of buildings in seismic-prone regions. This review article has provided an overview of seismic design principles, building codes, design strategies, case studies, and a comparative analysis of design approaches employed indifferent regions or countries. The seismic design principles and codes discussed highlight the significance of incorporating factors such as structural strength, ductility, lateral stiffness, and foundation design to withstand seismic forces effectively. By adhering to building codes and standards specific to seismic design, engineers can ensure that tall structures are built to with stand the potential hazards associated with earthquakes. Through case studies, we have examined notable projects and experiences from around the world, showcasing successful design implementations, innovative techniques, and lessons learned. These examples underscore the importance of understanding local seismic hazards, site-specific conditions, and the integration of advanced design strategies and technologies. By the use of locally available materials, researchers from all over the world are attempting to produce cost-effective and efficient construction technology. The researchers in Peru, have made traditional adobe structures by reinforcing walls with plastic mesh and they are much stronger. There are many examples such as in India, the engineers have successfully used bamboo to strengthen concrete and In Indonesia, some homes now stand in bearings which are very easy to make fashioned from old tires filled with sand and stones.

Reference

[1]. Abarkane, C., Galé-Lamuela, D., Benavent, A., Suárez, E., Gallego, A. (2017). Ultrasonic Pulse-Echo Signal Analysis for Damage Evaluation of Metallic Slit-Plate Hysteretic Dampers. Ammor Books, New York.
[2]. BMTPC (2006). Vulnerability Atlas of India. Building materials and technology promotion council, Ministry of Urban Development, Government of India, New Delhi.
[3]. Duggal, S. (2007). Earthquake Resistant design of Structures. Oxford University Press, USA.
[4] IS 1893 (part 1) : 2016. Criteria For Earthquake Resistant Design of Structure.Bureau of Indian Standards, New Delhi.
[5]. Jain, S. K., Brzev, S., Bhargava, L. K., Basu, D., Ghosh, I., Rai, D. C., & Ghaisas, K. V. (2015). Confined masonry for residential construction, campus on theSabarmati monograph. Indian Institute of Technology, Gandhinagar.
[6]. Make India Statistics. (2015). makeindia.com/sector/construction.
[7]. MacGREGOR, J., Wight, J.K. (2009). Reinforced Concrete: Mechanics and Design, Pearson Publisher, 5th Edition, New York.
[8]. Abhilash Thakur and Ravi Kumar (2017) An experimental study on the behavior of self compacting concrete and hybrid fiber reinforced self compacting concrete. International Journal of Engineering Researches and Management Studies. Vol 4(2):37-42.
[9]. Segui, W. (2013). Steel Design. Cengage Learning, 5th Ed, LA.
[10]. Sinha, R., Goyal, A. (2004).A national policy for seismic vulnerability assessment of buildings and procedure for rapid visual screening of buildings for potential seismic vulnerability. Report to Disaster Management Division, Ministry of Home Affairs, Government of India
[11]. State Disaster Management Action Plan of Uttar Pradesh.
[12]. Rao, K.S. and Satyam, D.N., 2007 Liquefaction Studies for seismic microzonation of Delhi region. current Science.
[13]. Abhilash Thakur; abhi30111992@gmail.com 2022 ,earthquake resistant structure and its innovation and its construction.