A Study on Seismic Design Based on Earthquake Resistant Construction Techniques

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Abstract— Disasters are biggest enemy of human beings which affects not only human life but the damage and destruction of their constructions which they have constructed, which causes heavy losses of life as well as their wealth and property. These natural disaster such as earth quake is unpredictable, that practically impossible to predict their time of occurrence, their location, intensities and other characteristics related to it. Various attempts have been made and still alterations and modification in construction techniques are going on so as to reduce the damage of structures and which can able to survive to those natural attacks without any loss of life or say major structural damages. Since earthquakes are still unpreventable and unpredictable, the option left is to develop the construction techniques which help in the construction of earthquake resistant structures. Accordingly to that, various scientific researches are going on, in different parts of the world, so that they incorporate these techniques to fulfill the needs required for the practically feasibly construction of earthquake resistant structures.

Key words: Earthquake Resistant Construction Techniques, Seismic Design, P-Waves, Damping

I. INTRODUCTION

Earthquakes are catastrophic events that occur mostly at the boundaries of portions of the earth's crust called tectonic plates. When movement occurs in these regions, along faults, waves are generated at the earth's surface that can produce very destructive effects.

Earthquake waves are seismic waves that created when energy build up in rocks and the fractures. The earthquake waves are basically of two types, namely body waves and surface waves.

Body waves are generated due to release of energy at the focus and move in all directions travelling through the body of the earth. The body waves interact with the surface rocks and generate new set of waves called surface waves. There are two types of body waves namely primary waves (p-waves) and secondary waves (s-waves). Primary waves are waves of short wavelength and high frequency. They are longitudinal waves and can travel through solid liquid and gases, whereas secondary waves are waves of short wavelength and high frequency which are transverse in nature which travel through all solid particles.

Terminology related to earthquake

1) Focus: - the point of propagation of seismic waves, within earth where actual seismic energy is released.

2) Epicenter: - when the point of focus is traded on the earth surface perpendicularly, that point on the earth surface is called epicenter.

It is to be noted that, epicenter is the point on the earth surface and it is the zone where the intensity of earthquake is maximum and intensities variably depreciate as its propogates to its direction. Also the intensity of earthquake is maximum when focal depth value is minimum.

In multistory buildings with floors of equal weight, the loading is further simplified as a group of loads, each being applied at a floor line, and each being greater than the one below in a triangular distribution. Seismically resistant structures are designed to resist these lateral forces through inelastic action and must, therefore, be detailed accordingly. These loads are often expressed in terms of a percent of gravity weight of the building and can vary from a few percent to near 50% of gravity weight. Increased compression may exceed the axial compressive capacity of columns while decreased compression may reduce the bending strength of columns.
II. FACTORS AFFECTING ANALYSIS AND DESIGN OF STRUCTURE DUE TO VARIOUS BEHAVIOR OF STRUCTURES UNDER SEISMIC FORCES

A. Building Behavior

The building is subjected to various types of forces, mostly due to vibration caused on account of earthquake forces. The foundation of structure or structural members are not damaged due to impact forces or external pressure due to winds, but due to action of inertial forces caused by various vibrations and shaking of structure of the building. The increased weight of structure has adverse effects on design of building against seismic forces. It increases the inertial forces on the structure as mass of structure get increased and secondly it results in buckling and crushing of structural members such as walls and columns when the earthquake forces tends to bend the structural members or moved out the members from its initial position.

B. Influence of Soil

Due to vibration of structure, which is associated with the ground motions, the amplification of acceleration and its frequency of vibration coincides with the vibrations transferred to soil. This phenomena of coinciding of frequency is called resonance. Thus it is possible for the building and the ground which it rest on it have same fundamental time period and frequency of vibrations which wake the situation more adverse during occurrence of such conditions. Thus, it is concluded from the fact that, to avoid such conditions the structure must ensures that it has different frequency and time period of vibrations to that of ground on which it rest upon.

C. Damping

When the vibrational characteristics of structure coincides with the vibrational characteristics of seismic waves, results in resonance which is responsible for heavy destruction of structure. but, considering the fact that resonance in building is not same as in ideal cases which we have studied, rather they are damped resononating in nature. Their damping behavior depends on the constructional material, connection type and other influence due to presence nonstructural members, which are only used to serve for architectural purposes and thus have no stiffness characteristics on the building. Damping of structure is measured with reference to critical damping in some percentage.
D. Building Motions and Separations
Earthquake-induced motions, even when they are more violent than those induced by wind, evoke a totally different human response—first, because earthquakes occur much less frequently than windstorms, and second, because the duration of motion caused by an earthquake is generally short. People who experience earthquakes are grateful that they have survived the trauma and are less inclined to be critical of the building motion. Earthquake-induced motions are, therefore, a safety rather than a human discomfort issue. Lateral deflections that occur during earthquakes should be limited to prevent distress in structural members and architectural components. Non load-bearing in-fills, external wall panels, and window glazing should be designed with sufficient clearance or with flexible supports to accommodate the anticipated movements.

III. ROLE AND RESPONSIBILITIES OF STRUCTURAL ENGINEER
Earthquake is been occurring from time to time, but it becomes very dangerous to modern world as compared to the to the old days due to the fact that, earthquake in its own is not the direct enemy to the human beings, its the big vulnerable structures which are more prone to go under severe damage under the action of disaster due to earthquake. So this is the central concept which directly increases the role and responsibility of structural engineer towards the construction of earthquake resistant structures. Thus a capable structural engineer should be one who understands the factors which causes failure of structural elements and he is capable to resist them by incorporating various modern earthquake resisting techniques which are effectively used in the modern world. Now, if the structures are made earthquake resistant, it’s a most effective way to minimize the heavy damages in humans life as well as structural property, as we cannot stop occurring of earthquakes but a this role and responsibility of structural engineer should help in creating a new effectively safe surroundings of human beings.

IV. GUIDELINES OF EARTHQUAKE RESISTANT CONSTRUCTION
Bureau of Indian standard has recommended the guidelines, design of earthquake resistant structures in IS CODE-1893, whereas BIS has published other complementary design codes for the design of masonry structures in IS CODE-13828 1993. According to the above mentioned codes, following points should be strictly incorporated in construction techniques:
- All provisions should be followed, to provide the vertical as well as horizontal reinforcements at critical positions such as internal and external wall junctions, corners etc. as per the design codes mentioned above.
- In vertical as well as horizontal configurations of the structure, irregular shapes where detailing of reinforcement is difficult should be avoided.
- Horizontal reinforcement should be provided at plinth level, roof level and plinth, where necessary as per the design codes.
- Grade of concrete, grade of mortar, clear cover for all structural elements, should be done according to the level of severeness and exposure as per the different earthquake zone.

V. CONCLUSION
In a modern world various technology is developed to avoid the heavy losses due to natural disaster like earthquake. Every country have their own set of guidelines to design earthquake resistant structures. But at the end, it all depends upon, how the available technology is incorporated in design techniques, effectively, precisely with proper care so as to achieve the theoretical targeted design values as closer as possible. Thus there should be no place for carelessness or violation in strict guidelines prescribed in design codes should result in sufferings caused by earthquake disasters. This increases extra role and responsibility of structural engineer to fulfill those needs which an earthquake resistant structure demands, so that it can effectively able to restrict the structural damages on account of earthquake and can withstand safely against those unconditional disasters.

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