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EARTHQUAKE RESISTANT STRUCTURE BUILDING

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Abstract - Building failures during earthquakes often are due to poor construction methods or inadequate materials. In less-developed countries, concrete often is not properly mixed, consolidated, or cured to achieve its intended compressive strength, so buildings are thus extremely susceptible to failure under seismic loading. This problem is often made worse by a lack of local building codes or an absence of inspection and quality control. Earthquake-resistant construction requires that the building be properly grounded and connected through its foundation to the earth. Building on loose sands or clays is to be avoided, since those surfaces can cause excessive movement and nonuniform stresses to develop during an earthquake. Furthermore, if the foundation is too shallow, it will deteriorate, and the structure will be less able to withstand shaking. The foundation should therefore be constructed on firm soil to maintain a structure that settles uniformly under vertical loading.

***Key Words*: Non-engineered construction, Building codes, Seismic strengthening, Earthquake weakening**

1. INTRODUCTION:

Earthquakes are natural hazards under which disasters are mainly caused by damage or to collapse of buildings and other man-made structures. Earthquake damage depends on many parameters such as, intensity, vibration period and frequency of ground motion, geologic and soil condition, quality of construction etc. Non-engineered buildings are frequently affected by earthquakes and need special attention. Earthquake is a likely major disaster to a building and has caused a lot of destructions in many areas of the world. Therefore buildings should be firmly built to reduce the rate of human death, injuries and structural damages. Moreover the masons should carefully apply the construction techniques, like building codes and arts where methods and principles used for the strategy and construction of building structures exposed to earthquakes should be considered, and their causes to the building should be noted to reduce the rate of destructions as explained.

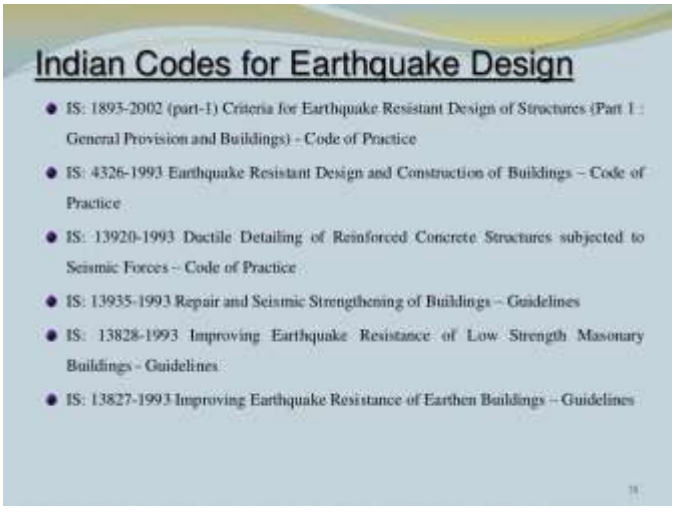
1.1 Non-Engineered construction

The destruction of the building structures was seen to have a reasonable cause, and some of these causes of destructions include; building construction material like brick. Some materials are very weak to withstand the shake of the earthquake. Other materials are firm, and thus they overcome the vibrations of the ground, and these materials include stone masonry, mud mortar, RCC frame, wooden frame. Again a building can also be affected by the earthquake due to non-engineered construction in this case a building can be constructed under poor engineering skills and thus can easily collapse (Taranath, 2016).

BUILDING STANDARDS

Additionally low quality of construction highly leads to the destruction of a structure in case the quality of the building does not meet the standards. Likewise when there is no use of existing design codes the structure is highly affected by the vibration of the earthquake if these codes are not fully meet. Furthermore, the use of sand taken from river-side or streams is highly affected by the earthquakes since it's not the structure is not firm to resist the earthquake, also use of mud taken from mountain slopes and farms cannot withstand the vibration since its particles are not firm (Kappos, & Penelis, 2016). Besides construction of a building by untrained masons are exceedingly affected by the earthquake since the rules and regulations of the building construction is not fully considered during the construction.

INDIAN STANDARDS ON EARTHQUAKE ENGINEERING



Earthquake resistant building design guidelines are provided by set of Indian Standard codes (IS Codes). After observing Indian earthquakes for several years Bureau of Indian Standard has divi.ded the country into five zones depending upon the severity of earthquake. IS 1893-1984 shows the various zones.

TOPOGRAPHY

Finally, the topography of land fully describes the action of the earthquake to the building for example construction of buildings in a sloppy ground without will likely be affected by the earthquake since it will not be in a stable state. Flat ground supports the stability of the building and thus rarely affected by the vibrations (Ortega, J., Vasconcelos, G., Rodrigues, H., Correia, M., & Lourenço, P. B., 2017).

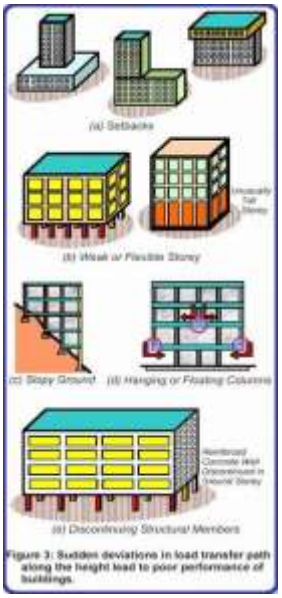


Figure 3: Sudden deviations in load transfer path along the height lead to poor performance of buildings.

As it is clear from figure 3 that any building on the sloped surface will tend to be more prone to earthquake damage Preventive measures.

At present, earthquake prediction is insufficiently precise to provide the public with sufficient advance warning. For this reason, adequate preparedness and assistance in catastrophes is extremely important in areas affected by earthquakes. Measures of this nature enable numbers of human lives to be saved. But we can also take adequate care while keeping in mind the following factors. Most structures fail laterally by an earthquake, meaning the walls may fall down, or movement of the walls may cause displacement of the roofs, and result in the collapse of the structure. Therefore, to ensure safety of human life and property, earthquake resistant techniques should be used, including the utilization of proper design and materials.

SOIL CONDITION

The condition of soil at construction site is an important factor, since the state of soil can significantly alter the motions of an earthquake. The condition of the soil should be thoroughly evaluated. Soils that consist of loose sand and gravel possess poor earthquake-resistant characteristics, and should be reinforced. Seismic waves are amplified in soils that are saturated with water, and change the form of soil from a solid to a liquid upon the occurrence of earthquakes. Such soils acquire the characteristics of quicksand and make the ground incapable of supporting a foundation due to cracks and weakening. Deep and firm soils are good since they allow only minor vibrations to be transferred from the foundation to the construction above.

LOCATION AND BUILDING CODES

The constructors and designers should strictly follow the building codes. The building that follows the building codes is guaranteed of survivability during the serious damage of the earthquake (Subramani, & Vasanthi R. 2016) Building codes and building structures are meant to defend the structure from disintegrating and to withstand the earthquake which may occur in the area of the construction. The designers should provide the building with proper toughness, alignment and should be meant to last long. Furthermore, the constructors and designers should identify the location of the construction, and they should, therefore, choose the flat, stable ground to overcome the earthquake and this succeeds after implementation of building codes.

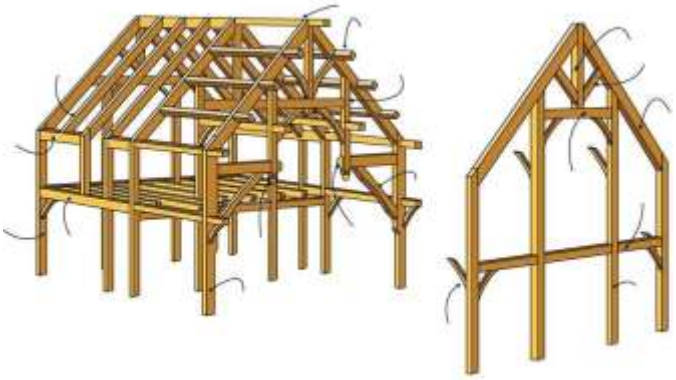
BASE ISOLATION

Base isolation techniques are the recent developments in the structural design of buildings and bridges in highly seismic regions. They function on the principles of oscillation and damping. Rubber isolation bearings are used that minimize the earthquake damage to the buildings by decoupling the building from the horizontal component of the ground movement. This is achieved by making the bearings rigid in the vertical direction and elastic in the horizontal direction. The earthquake energy is not absorbed by the base isolation techniques but is deflected due to the system. Rubber bearings can be manufactured easily, do not have any moving parts, and are not affected by time or the environment.

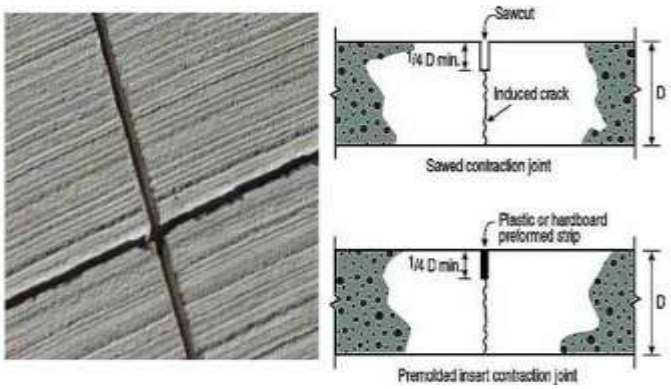
WEAKINING OF EARHTQUAKES

Earthquake in the building can be weakened in two ways, and these are direct which deals with the ground shaking, and it includes both horizontal and vertical modules and the second way to destabilize the earthquake is an indirect way which includes the mudslides, rockslides and soil liquefaction due to the earthquake (Moehle, 2015). The performance of the building should be improved from mud bricks which are very vulnerable to strong earthquakes which are mostly used by most of the people especially in Pakhtunkhwa. The performance of these building to weaken the earthquake effects on them can be improved quality of construction, seismic strengthening, and the box-type compact draft.

More so timber frame structures if they are well engineered it gives long survivability and other structural advantages that help in the weakening of the earthquake effects to the structure (Mishra et al. 2015) this is mostly found in the areas where there is forest since there are a lot of trees.



Also, in some earthquake areas there can be the existence of some of the concrete structures and these structures can be affected by the earthquake and therefore the concrete frame should have elastic joints, and steel aids bars should be used to give forte to the structure, (Hoult, R., Goldsworthy, H., & Lumantarna, E. 2018).In a sloppy area which has tough topography in the construction of the erections, stones are used as the best materials to construct the structures. To make these structures less vulnerable to earthquake, fewer and nimble stonework is required. This can also be referred to seismic resilience.



CONCLUSION

Earthquake is of serious concern in the construction field. There are some very complex design procedures which are very important. These are used not only in the foundation as a base isolation but also in the whole structure with protective elements of earthquake. In the coming years, the field of Earthquake Resistant Designing of structures is most likely to witness the most reliable structure which could withstand the effect of earthquake. The designers should strictly follow the building codes which are meant to provide the building strategies to reduce the effects of the earthquake to the building. Well trained engineers should be recommended for best structures. More so, best and firm materials should be selected for durability of the structures. Earthquake propagation is controlled by both the applied stresses and the dynamic frictional strength of fault rocks. Dynamic friction of rocks is characterized by strong weakening driven by shear heating and power dissipation

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