Recognizing the Earthquake Resistant Home

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Abstract

Past Few decades have witnessed that India has seen a spurt in the infrastructural development particularly in vertical development in buildings. These buildings are in every range i.e from tiny to big. When an earthquake arrived on earth, the biggest thing strikes the our house building is safely designed to resist earthquake or may fail due to its impact. As per the Researchers earthquake itself is not threatening, but causes due to improper construction of building without taking consideration of earthquake resistant design. Ductility can never be ignored while constructing the home or any other civil engineering structure. The best way to construct an earthquake resistant building or structure is to possess the adequate amount of knowledge about earthquake resistance construction. One's can interoperate the earth's crust can be as a thin shell, mostly made of rocks material that overlies a molten core. This shell has numerous cracks in it. Hence one can successfully divides the crust into a serial of large plates termed as tectonic plates. Due to high impact of gravitational force, great transmission of forces occur in the earth's core and that results introduction of large forces originate due to rotation of earth, the above tectonic plates are repeatedly pushed against each other. The stress and strain energy begins to introduce as a development within each tectonic plates and also to the extremities between the plates. Even after a century , the generated stresses conglomerate to a point where they can be higher to the strength of the rock crust itself. This phenomenon causes a differential movement of earth's crust which sequentially liberates the strain energy that stored over the years in the form of kinetic energy itself. This is the accurate cause of generating the seismic waves from earth's crust propagate to surface soil result in not only the earth shake but also the seismic effects.

Introduction:-

The occurrence of an earthquake is really unpredictable, precisely. The earthquake may occur anytime, anywhere. As per the collection of historical data it can be predicated that most earthquakes occur at faults, at the point of weak section of earth's crust`. Due to change in geological and tectonic activities over a century the earth's crust also changes, in the consequence the generated stresses also cause change of pattern. As a result of that faults may repeatedly changing its zones over different geologic areas. This Phenomenon can only be monitored by continuous research on it. The measures of an earthquake is its magnitude and intensity factors. The earthquake size can be measured by its magnitude. That impersonate the amount of energy liberates due to occurrence of earthquake.

The amplitude of seismic waves decreases due to an earthquake and radiate it out ,as a ripple form around the place where a object falls in to the lake.

At the source the earthquake are found more catastrophic. Otherwise some particular location the intensity of earthquake are found to be very intensive due to its

topography, location and also condition of soil that can be measured as intensity of earthquake.

Largely the magnitude of the earthquakes are found to be small in magnitude and intensity even though millenarian shake occur throughout the world in a year. Although big earthquakes generates large amount of energy which was heap together over a century. These earth shakes are generally exhibit high magnitude and intensity.

Reason for Failure of any Civil Engineering Structure like Building& Bridge etc:-

Primarily when the earthquake induced in a building consequently changes occur in the structure due to shaking of ground. As a matter of course the footing of the structure vibrates in congruence with the vibrating earth. The super structure generally collapsed due to its inelastic behaviour. All building constructions posses a mass and consequently they also possess inertia as well as exhibits *a* resilient innersole to a certain level. While accordance with the vibration , the superstructure of the building get lag behind. In a nut shell the superstructure proceed for lateral as well as vertical movement with the elevated flows respectively. Due to corresponding displacement the forces produces in the structure and become a cause of supplementary distortion of the building.

We all accepting the power of earth's impetuosity, still we can minimise the damage of a structure with construction technique in accordance to the risk factor of earthquake in account while designing these structure carefully.

An earthquake resistant structure is to be design and build focusing on the criteria that soil of earth must be more firm and heavy than the foundations of structure; foundation may possess more power comparative to the columns and beams of the building. Simply the more earthquake resistance power of building possesses greater ductility to the building. Primarily the steel bars of the building provided during construction plays overcritical role and causes the enhance in the ductility of the building. As we are remembering before the earthquake in Latur region of Maharashtra the tensile steel bars of the RCC structure are supposed to be reason of complete power of the building and also provides the resistance during an earth shake. Generally the steel bars made of high carbon content during that period, in an effort to enhance the strength of the structure. Mainly the destructive potential of an disaster like earthquake was considerably multiplied due to the brittleness of steel bars. Like a shot the Latur earthquake, the researchers give more concentrations on the study of the earthquake resistance capability of the buildings. Researchers focused the aim of their researches on resisting severe earthquakes. The following point may be very prominent while constructing the earthquake resistant building

A) The earthquake resistance design of the building is must before constructing a building.

B) The construction of a building can only be done in accordance with most contemporary earthquake resistant techniques of constructions.

C) The material of the construction must be more ductile in nature i.e. causes of earthquake resistant structure.

Absence of joint effort between expert authority:

Practically planning of building is done by Architect and designed by an structural engineering expert. May be some time the engineering expert has to do undeniable

negotiations on the design of the building. So it seems that joint effort of both an architect and structural engineer expert is very much required since the initial stage of planning of the building. The proper direction must be exhibits for contractor from both an architect and structural engineer expert for constructing an earthquake resistant building.

Excessively or unjustifiably confident by executing some parameter but ignorance of basic parameters of earthquake resistant constructions.

As a matter of fact, no essential parameter or factor for earthquake resistant design must be left or ignored. Sincere and severity parameters of design and materials which make the building seismic resistant must be focused otherwise the require result of earthquake resistant building could be achieved. Some recent news are reporting regarding the contractor or suppliers of home that they are cheating their customers who want to buy their residence in high rise buildings by selling the houses to them with false commitment of earthquake resistant homes. The Indian market of fraudulent home makers are increasing these days and they are cheating the buyers with selling their unethically constructed building as commitment of earthquake resistant building. They are using unconscionable tactics of selling like confirming to the byers that their constructed houses are earthquake resistant because of using the steel bars in the construction of the building.

Enormous customers are buying **EQR certification** steel or logo stamped steel to construct their own house as a building material. No matters the manufactures are not claiming the EQR certification of their steel but they are giving wrong impression to the customers by catchy advertisements and promotions. The customers are buying theses highly advertised steels brand from the market for construction of their homes in the impression that they are using best EQR certified steel.

Bureau of Indian Standards. The National Standards Body of India describes in its **IS 1786** code distinctly the list of numerous grades of steel used in India are as,

A)	Fe415,	Fe415D,	Fe415S
B)	Fe500,	Fe500D,	Fe500S

Nothing about EQR grade is describe in the above Indian standards codes of practices. Hence it is quite clear that EQR certification is not required for the quality steel but on a marketing gimmick created by some unauthorised and dishonest steel manufacturers who are cheating the customers by selling off their products at higher rate.

After studying this code of practice, the points come into the notice of an individual that it is quite clear that the grades of the Steel bars should be marked with 'Fe' as prefix followed by a number. Here 'Fe' indicates the iron and number say '150' or '415' are the indicatives of their tensile strength. This combination is read as grade of steel. Further the other way of defrauding was also noticed in the Indian market. Numerous suppliers of steel are labelling their local with the brand names followed by a number. It is really surprising that Indian market is full of such knavish suppliers of steel who are accepting numerous unethical approaches to sell their steel . By doing so they not only cheating the costumers but also they are doing this life threatening act. In the other hand they are also cheating the BIS, as they are pretending to have justified quoted number. Take for example i.e 'XYZ 55O R' that artfully creates an impression to the buyers that 'XYZ' brand is having minimum 550 N/mm^2 of yield strength and is also possess more ductility. But reasonably found to be

wrong to have even 415 N/mm^2 strength.

Significance for Seismic Resistant Design of any civil engineering structure:-

History of civil engineering construction revolves around in zonal wise collected data of seismic activities which educate us the real sustainability of infrastructure around us. In specially our country specific local investigations are require to develop the local design response spectrum. Obviously, it has also been noticed for some cases the local ground motion parameters and structure response are of different substantially from the value obtained with design response spectrum of that zone. Liquification factor of Sandy or muddy soils must be checked as far as possible because a huge amount of soil will behave like a liquid during an earthquake Foundation of structure and must be designed to keep all the effective parameters of earthquake design with in elastic range. Importantly, the critical path of compressive, shear and tensile forces may be transferred from plastic zones of building walls through the slab to extension walls and ultimately to the raft foundation of the building.

It is very much needed for the earthquake resistant building designer that the stair case slabs of that building are integrally connected to the frame of the building to prevent any collapse because staircase is the only escape route in the maximum buildings during an earthquake otherwise building got failed. In earthquake resistant building design there is a strong core shear wall usually needed to be designed in the elevator area. It is noticed during an earthquake that these shear walls provide necessary stiffness to the buildings, and also keeps away the particular building from excessive sway. Taking offsets and asymmetrical bracings must be avoided while designing the earthquake resistant buildings as these are the prime factors for resulting the weak building during the seismic resistance and ductility. Hence, the provisions or seismic resistant design made by BIS must be strictly accompanied. It is to be mention here that in the country like India 57% of total area are in seismic zones. The seismic zones or earthquake risk area of our country are understandably described in Indian panel code IS 1893:2002. It can be very much understandable that the zone II, III, IV and V described in IS code of practice are based on the risk of earthquake occurrence. In addition to Indian panel code IS 1893:2002 there is another code which is governed by BIS code IS 4326:1993 in which guidelines are provided for the selection of construction material can be used in earthquake resistant constructions activity. The greater significance are given in this code to the parameters as lightness, continuity of construction in avoidance of suspended and projected members etc. But primarily the importance during the building construction is focus on the ductility of the building, as per the code. Hence, BIS code IS 13920:1993 is the principal code to be practised in the construction of earthquake resistant building. In subjected to occurrence of different seismic forces this code provides the standard guideline to be followed during construction and also the ductile detailing of reinforced concrete structures, which are liable to seismic force. On studying this code it is sufficiently understand that the steel bars of grade Fe ‘415’ or less is importantly require for constructing the earthquake resistant buildings.

The bracing of RCC masonry wall with other reinforced members is require to be considered during earthquake resistant design and that will improve lateral load resizing capacity of building on occurrence of an earth shake. The lateral stiffness and ductility of the building masonry walls can be improved by reinforcing the steel bars in longitudinal direction. This is the basic and most important concept of design and construction of a structure.

Engineers must take care of the above BIS standards and provisions, during the activity of earthquake resistant construction of a structure.

Advanced seismic resistant construction techniques of building : -

It is to be understand the in normal construction of any civil engineering structure we assume that strengthening of building is crucial activity for earthquake resistance. But in some structures it has been found practically by the researchers that softening of the structure practically more beneficial. The better alternative is to avoid catastrophic failure in local bearing structures, is by generate a disconnect between the substructure and superstructure of the building. In the current scenario of earthquake resistant building construction the base isolating techniques are widely used in Japan and USA.

American technology of construction *:*

In studying the American technology it is very much clear that use of isolating the structure from the foundation using an air compression fill in between is widely used for earthquake resistance.

Japanese technology of construction:

It is quite evident that Japan is the country, which is at the forefront of earthquake resistant technology. During the construction of middle height or skyscrapers, strong building codes are executed in Japan with specific rules. Generally the buildings in Japan which are Medium or taller rest on huge rubber, fluid filled shock absorbers, which could stick side to side dissipating lateral motion which causes the generation of heat energy. Moderately small size of building structures are rest in Teflon coated pegs embedded in the foundation. The entire weight of the building structure anchors the building on the pegs, but when the ground shifts the entire building slides over the smooth surfaces.

The great attention is required while constructing the Beam – column joint area of earthquake resistant building, to avoid the diagonal cracking and crushing of concrete. For achieving the quite resistance to shear force in joints of the building closely spaced closed loops of steel are required around column bars to hold the concrete together.

Anchoring of longitudinal beam bars in the exterior joints where beams terminate at columns will ensure proper gripping of concrete.

It is evident of developing TMT technology and high strength steel bars during the construction of an earthquake resistant building due to continuous and advanced research in this field. Mostly numerous grades of TMT steel are available in the market named as Fe 415, Fe500, and Fe550 etc. These high strength steel bars are having their own characteristics that makes them suitable for specific applications of the building construction in making it earthquake resistant. All the above grades of steel described are manufactured using same TMT process but with little tweaking. During the TMT process, all the steel bars are quenched rapidly in a short interval of time under controlled conditions. This gives results in better development of a tempered martensite outer core and a ductile ferrite-pearlite inner core. If the steel is quenched more, the outer martensite layer will become thicker at the expense in respect to the soft inner core. It is better understand that the outer core gives tensile strength and inner core endows the bar with ductility (ability to deform without breaking), when an earthquake occurs in a building a slight reduction in ductility has grave consequences for the safety of the buildings. It can also be witnessed that Fe415 is the default option and

commonly used grade while other grades are for special use.
In the Indian market of building material the shops contains variety of steel rebars and mostly he will find a different range offerings, including standards Fe415 and other specific grades of high strength steel. It is quite understandable that all these grades of steel deliver high strength and ductility for the buildings. The most commonly used steel Fe415 and all other grades of steel are used for special applications where it is essential. In these cases, BIS has taken steps to nullify the decrease in ductility of the material and hence the origin of 'D' (Ductile) and 'S' (seismic) versions take place. In short, it is very clear that the advantages of not using Fe415 is particularly decreased by usage of ductile and seismic versions of steel like (Fe 415 and Fe500).
As earlier mentioned that a lot of fraud grades of steel was available in the Indian market like EQR (Earthquake resistant) steel which we described in the initially. Structure designers and construction engineers must use the TMT bars in construction only after proper testing and verification of the same irrespective of the name of the brand / manufacturer. It is also an important aspect to ask for a test certificate and a computerized plotted stress strain graph from suppliers that will help us to identify the ductility part of the steel purchased and also its tensile strength. As per the suggestion of IS code 13920:1993, that the grade Fe415 is the TMT grade of steel you purchase for earthquake resistant buildings.
Rib formation in the TMT steel bars is another factor that is accountable while buying of earthquake resistant TMT steel bars from suppliers because the TMT steel bars causes properly ground rib formation that bonds the steel bars with the concrete coherently.
The buckling of compressed longitudinal bars in RCC beams can be prevented by using stirrups made out of TMT steel bars and these stirrups also resist vertical shear cracks. It is to be verify that both the end of vertical stirrups must be bent into a 1350 hook. The ends need to be sufficiently beyond the hook to avoid opening up of stirrup during a seismic activity.

Prime cause of brittle failure during an earthquake in buildings :-

Varies researchers explain the prime cause of failure of building during an earthquake is using steel with higher UTS. It is also evident that after amendment of BIS code IS1786 that the values of mechanical properties to be shown by different grade of TMT are having high impact to make an structure earthquake resistant. We can understand that commonly used Fe415 grade must give minimum 415 N/mm^2 yield strength and not less than 485 N/mm^2 ultimate tensile strength and the recommendation of the code that Fe 415S (Seismic variant) must give minimum 415 N/mm^2 yield strength and maximum ultimate tensile strength value must be 540 N/mm^2.

The amount of loading where the steel starts deform plastically is the Yield strength of a material and the amount of loading when the steel break up in to two entirely separate pieces is known as ultimate tensile strength of the material. Once the steel intersect its UTS, the amount of load it can transmit drops immediately to zero.
Ductile failure is the main cause of failure oof a building during an earthquake. As When load applied to the structure due to an earthquake exceeds UTS, the entire building may collapse. Numerous causalities may occur when a structure fails due to occurrence of an earthquake with no warning, that it is overloaded. The visualisation of structural components and hearing sound of starting to yield can give occupants a warning alarm. This is the proper time by which the occupants of the building can save their lives. It is very much understandable that if we use higher level of UTS in building

construction that may results in sudden failure of structure without much warning or alarming and may cause most of the causality or deaths.
The researchers also concludes that during the failure of one part of building in earthquake the other part of the building also effected due to transmission of shock and impact loads. Hence ,when a load exceeds the UTS, these single components failures can cascade into a serious damage. This impact energy can be absorbed in the building component itself if and only if the material of that particular building could yield and deform significantly before failing. Thus it could prevent it from transmitting elsewhere that may cause failure. About the case of automobiles there will be a crumple zone for safety of passengers. The crumple zones absorb the impact of head on collision in automobiles are located in front part of the vehicle.
Similarly yielding for a while than having higher UTS is practically a better consideration of earthquake resistant buildings.

Conclusion

It is evidently concluded that micro alloying is the best method to achieve desired strength for specific TMT grades without losing its ductility character particularly in earthquake resistance of the building. The impurities of the steel bars can be minimised by restricting the impurities like sulphur and phosphorous and by controlling the carbon content compliment to this. The drawback is that this technology is still to be come up in India. Now a day in most of the countries , all the steel producers make use of TMT process for manufacturing high strength steel bars with superior ductility. The condition can only be changed on using the micro alloying process. So in this regard Fe '415' grade of steel bar is the best option of TMT which offer adequate amount earthquake resistance.

This is also advisable all authorities like BIS that they must periodically check whether compliance to the seismic resistant codes is done or not by the contractors or engineers during construction of a particular building.These authorities must ensure about Providing safe structure certificates to building under construction and that will be the another method to ensure earthquake resistant building construction.

No one can fully guaranteed upon that your home is complete resistance to earthquake, but our residential buildings can be protected from the damage due to occurrence of this disaster like an earthquake up to an extent by implementing the above points in the construction of your homes.

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