DESIGN OF EARTH-QUAKE RESISTANTMULTI-STORIED RCC BUILDING

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Abstract

Earthquake is one of the largest disasters of nature. Millions of lives have gone because of this disaster. Though it cannot be stopped but through various measures, lives and resources can be saved. Especially through following certain preventive measures as per scientific standards, its effects can be minimized or prevented. Buildings are on great risks because of the earthquakes. When a multi-storied building falls down, it takes many lives with it. In addition, removing the rubbles will cost a lot. Rather, constructing a building which can endure these earthquakes is the most ideal step to take. There are many scientific guidelines as per which a strong multi storied building can be constructed.

This project involves the analysis of simple 2-D frames of varying floor heights and varying number of bays using a very popular software tool Etabs. Using the analysis results reaction, displacement, shear in column and beam is obtained. In addition to that the detailed study of seismology was undertaken and the feasibility of the software tool to be used was also checked. Till date many such projects have been undertaken on this very topic but the analysis were generally done for the static loads i.e. dead load, live load etc. But the earthquake analysis or seismic analysis is to be incorporated. The structure would be analysed and designed for seismic load and for all possible load combinations pertaining to IS 456, IS 1893 and IS 13920 manually.

This project includes examining basic 2-D panels with different floor heights and different lengths using a common Etabs software tool. Reaction, shift, shear in the column, and beam are obtained by evaluating effects. The comprehensive seismology analysis was carried out as well as testing the viability of the technical method used. To date, various such experiments were carried out on this subject, but typically for static loads such as dead load, live load, etc., research was carried out. But it is important to add an earthquake analysis or a seismic analysis. The structure had to be evaluated and designed manually for the seismic load and for everything possible IS 456, IS 1893, and IS 13920 load variations.

Keywords: Earthquake, seismic load, shear wall, building, structure.

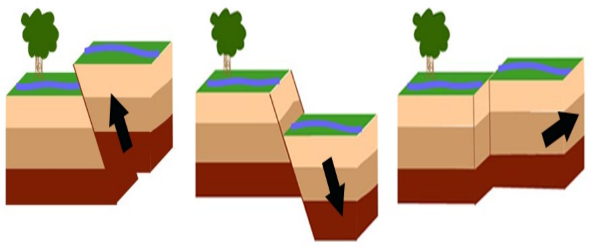
INTRODUCTION

Earthquake is the term for the trembling of the earth's surface. Earth's surface tremble can happen suddenly. Unfortunately, earthquakes are an awful natural tragedy. Earthquakes can destroy life and property tremendously. Some earthquakes would possibly pass unnoticed as they are small in nature in comparison to some horrible and violent earthquakes. In nature, most of the big earthquakes are disastrous. Most importantly, it is very unpredictable that when and where an earthquake will occur. That's how risky they are. The plates are piled at the ends, but the rest of the plates moves, so the stones on the ends (what we call 'strain') are skewed. As the acceleration continues, the tension rises to the extent at which the rock can no longer resist bending. The rock splits with a lick and pushes both sides. The trembling from the ruptured rock is the Earthquake. Estimation is made that about 500000 earthquakes takes place per annum and can be identified with existing instruments. Of these, about 100,000 can be noticed. At some locations almost regularly, small earthquakes occur around the world. From about 350 in 1931, the overall seismic stations have hiked to several thousands. Consequently, there are far more cases of earthquakes has been recorded in comparison to the past, but since instrumentation has been enhanced greatly. Maximum number of earthquakes (i.e. 90% of the total and 81% of the biggest quakes) occurs of approximately 40000 kms long and in a zone which is shaped as horse-shoe, known as "circum-pacific seismic belt". It is called as "pacific ring of fire" and it bounds the "pacific plate". Substantial earthquakes exist in other flat limits, as in the Himalayas. The 1556 Shaanxi earthquake, which took place in Shaanxi province, China, on 23 January 1556, was the most destructive Earthquake in the world. There have been more than 830,000 deaths.

Types of Earthquake

Tectonic Earthquake: the crust of the Earth contains a rock plate of uneven forms. This rock layer is a tectonic base. In addition, electricity is stored here. This energy contributes to keep tectonic panels moving away from one another. The energy and the movement between two panels rise with the passage of time.

This tremendous pressure thus contributes to the forming of the fault line. The focus of the Earthquake is also the origin of this disruption. The waves of energy then travel from concentration to the surface. This triggers the soil to shake.



Volcanic Earthquake: the magnitude of the volcanic activity of this type Earthquake is weak in common. There are two forms of earthquakes. The first type is an earthquake of volcanic tectonics. Tremors here emerge as a result of Magma injection or elimination. The second form is an earthquake in the long term. It is an earthquake due to the variations in friction between the layers of the Earth. Magma movement under the Earth's crust and the motion contributes to pressure changes where there has been tension on the rock surrounding the magma. At any point, the rock will crack or shift due to this tension. Scientists track volcanoes with this seismic activity. Earthquakes can also occur as earthquakes or as dike interference. Tectonic, volcanic seismicity is an important way of forecasting volcanic eruptions. As a counterpart to most major eruptions, seismic activity is present. We can forecast eruptions of extinct volcanoes by using tectonic events.

Collapse Earthquake: In the caves and mines, these earthquakes occur. In addition, the intensity of these earthquakes is small. Underground explosions are likely to cause mines to crumble. Overall, seismic waves are caused by this mining failure. These earthquakes are the result of seismic waves.

Explosive Earthquake: these generally occur because of nuclear weapons tests. A massive explosion happens when a test is made for a nuclear weapon. This contributes to a significant volume of energy being released. This is likely to lead to earthquakes. An explosion is a fast rise in volume and energy consumption, typically when high temperatures are produced, and gas is emitted. High explosives are known to cause supersonic explosions, detonations, and the propagation of supersonic shock waves.

Effects of Earthquakes

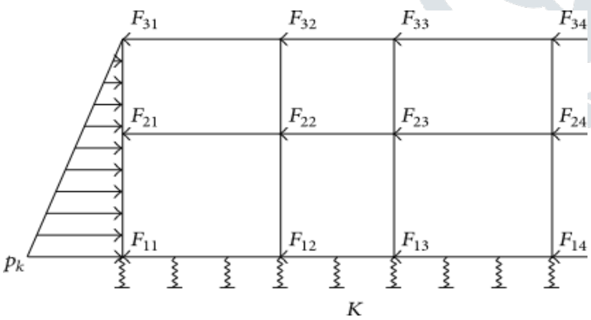
First of all, trembling generated from earthquake is the most visible sign for it. In addition to trembling happens, the earth ruptures. The infrastructure services have been badly damaged. Earthquake magnitude depends on the scale and distance from the epicentre. In order to assess the magnitude, local geographical conditions play a part. Land rupture leads to the Earth's observable breakup. Landslides are another critical consequence of the Earthquake. Landslides are caused by weakness of the slope. The Earthquake triggers this slope instability. Soil liquefaction can be caused by earthquakes. This occurs when a granular water-saturated substance lacks its strength. It then transitions from solid to liquid. Thus solid systems sink into the layers of liquefied matter. The consequence could be earthquakes. The Earthquake destroys electricity and gas lines. Over everything, once a fire starts, it becomes incredibly hard to stop. The notorious Tsunamis may also be caused by earthquakes. Tsunamis are sea waves of long wavelength. The rapid or unexpected acceleration of vast amounts of water is responsible for these sea waves. This is attributable to the ocean's Earthquake. In fact, Tsunamis can fly at speeds between 600 and 800 km / h. This tsunami will lead to major damage by reaching the sea. In short, an Earthquake is a horrific occurrence in the world. In conclusion, it reflects man's fragility toward nature. This is a big happening which definitely surprises everyone. The Earthquake only lasts a few seconds but may lead to damages which are beyond imaginations. An earthquake is capable of causing injuries, loss of lives, bridge and road damage, damage to property, and destabilization or/and collapse of buildings (which will likely result in potential collapse). The effects will lead to sickness, lack of vital needs, behavioural impacts, like panic attacks, victim stress, and increased insurance's rates. If dams are impaired, flooding could be a secondary result of earthquakes. Earthquakes can contribute to Dam Rivers collapsing and flooding.

Tajikistan's landscape below Lake Sarez is in danger of disastrous floods, if during a possible earthquake, the landing dam built under the name Usoi Dam failed. The flood may affect approximately five million people according to the experts' estimate.

Effect of earthquake on structure

Inertia Forces in Structures

Seismic effects which impact the structures are the production of inertia forces in it. When there is an earthquake, the building's foundation will shake, but the roof will relax. However, the roof is pulled against the basis of the house while the walls and columns are secured to it. Inertia is called the inclination of the roof framework to continue at its original position. The forces of inertia can cause structural shear, which may focus stresses on the weak walls or joints of the structural system that result in failure or even a complete collapse. More density means more inertia, and thus lighter structures are better able to support the Earthquake. At several concentration forces, simplifications of inertia forces can be made and it can function over the component-connected node, as exhibited in Figure 1. Fij is the equal horizontal seismic inert force operating on node "ij" that can be determined by the formula (1). The simplification of inertia force can be done at many forces of concentrations and function on a component-linked node. Pk is the maximal value of the horizontal triangle resistance, and K is the "coefficient" of sub grade reaction that could be determined by the equilibrium seismic lowering of the horizontal load.



Take the2-span & 3-leveled station for consideration, make it the equivalent inertial force at the junction "ij" on the subway station member I is the transverse member layers "i= 1~3";j is the numbers of vertical component columns, j=1~4). The value is the product of the correction factor and half the sum of the mass of the member's mass around the nodes. The formula is shown below:

$$Fij=K*mij$$

mi is half the sum of the member's mass around the nodes; kis equivalent inertial force coefficient.

Effect of Deformations in Structures

If there is an earthquake which trembles the base of the building, the action of the roof will, however, depart from the structure's foundation. In columns that appear to transform the column around to its original location, this difference in motion generates internal forces. These inner forces are called the forces of rigidity. The power is higher as the columns' size grows. The frequency of a column's stiffness is column stiffness times its relative displacement.

Horizontal and Vertical Shaking

Earthquakes cause the soil to shake in all three dimensions, X, Y, and Z, and the soil will shake spontaneously in each dimension. Structures are typically designed to accommodate vertical loads such that vertical shocking due to earthquakes can be addressed by protection considerations utilized within the architecture for accommodating vertical load (either adding or subtracting vertical load). Horizontal trembling in the direction of X & Y is, nevertheless, vital to the success of the structure, as it produces lateral displacement and inertia forces and hence provides a sufficient load transfer trajectory to avoid the structural detriment.

Flow of Inertia Forces to Foundations

Horizontal forces of inertia are produced at the mass levels of the structure (usually on the floor levels) throughout horizontal shaking of the earth. These lateral forces of inertia are then transmitted to the foundations and the underlying soil structure by the floor plate onto the walls or columns (Figures 4). There must also be a secure transference of inertia forces between any of these structural components (foundations, walls, pillars, and bases), as well as between them.

Literature Reviews

[1] In India, people live in villages and small homes and in India; so earthquake damages are much more vulnerable than earthquake resistance, but they are very costly and not used by Everyone people, so here some useful low-cost techniques to resist earthquake effects. The goal of the paper is to save lives by using low-cost architecture, strong seismic awareness, and low-cost earthquake-resistant building strategies to the low construction cost.

[2] Standardized response systems are unique resistant earthquake frames, where members of identical groupings such as pillars, columns, and braces, regardless of their place in the group, share the equal ratio of the demand capacity. The underlying concept because of which this presentation has been presented is that the seismic structural reaction primarily relies, rather than study, on design and construction. Both strength and rigidity are both caused and not studied. Mechanisms of collapse and conditions of equilibrium are not tested but applied. During large earthquakes, systems with uniform reactions are supposed to undergo comparatively strong inelastic moves. A basic strategy for monitoring and resolving the progressive deterioration of these systems because of the partial/local uncertainties and plastic hinge was proposed. The degree and shape of the lateral force distribution impact the distributions of the story rigidity in quantity to the story's moment in the frameworks of a uniform response, thus influencing the system's dynamic behaviour. Conveniently closed-form formulas defining the non-linear actions of uniform reaction moment frames were suggested. While this approach is restricted to the time parameters, the approach introduced may effectively be used over all forms of earthquakes forbearing structures.

[3] The shear wall is usually covered on single side with the plate boards or "orientated strand board (OSB)", and "gypsum" is a crucial part of the "seismic load-resistant framework" of a building which is wood-framed. The "sheer capacity" of "gypsum shear walls" in zones of higher seismic is usually ignored due to the vulnerability to damage incurred by earthquakes by traditional screw connexions. A revolutionary viscoelastic (VE) gypsum shear wall with earthquake resistance is tested and contrasted with traditional non-structural and structural walls. "8 ft by 8 ft" (ten) wood framed wall protocol samples in three sets were exposed to a cyclic research protocol (OSB-Nailed, Gypsum-VE, and Polymer-Gypsum). The energy dissipation of all shear walls, their rigidity, and their damage characteristics are noted. The findings of the test show that the walls of VE-gypsum will spill more power than the "structural panels of OSB" & 500 percent of extra energy than traditional sheathed "gypsum walls" & contains a continuous energy supply which cannot be observed in the non-structural and structural walls. The OSB wall's wall rigidity is much more pronounced than its VE gypsum wall and declines below the VE wall stiffness with constant cycling. In comparison to the traditional wall styles, when exposed to shear displacements up to 1, there was no noticeable or auditory evidence of disruption on the VE wall.

[4] In a multi-storied building, earthquakes demonstrate that if the buildings are not properly constructed, developed, and adequately strengthy, they contribute to the maximum collapse of the buildings. Therefore, the seismic analysis must be explored in the construction of earthquake resistance systems in order to ensure protection from seismic forces in multi-story buildings. In the seismic analysis, both the ordinary instant resistant frame and the special moment resistant frame were known to minimize responses for two situations. The key motive of this work is to study the seismic system examination in a regular resistant system and a particular momentary system for static and dynamic analysis. The approaches used in the "structural seismic" examination are equal static examination and spectrum examination of reaction. For seismic analysis, we considered the G+ 15-storied residential block, which is situated in zone II. Computers using STAAD.PRO tools have studied the overall structure. For static and dynamic analysis, we observed reaction reduction of cases of ordinary frame resistance to moment and special frame resistance to moment with deflection diagrams. The unique resistance to structured frames is strong when seismic loads are resisted.

[5] The presence of walls in frames influences the construction's lateral load behaviour. The inflexibility of the infill wall to evaluate the framed building is, however, common business practice. Engineers assume that the study contributes to conservative architecture without taking into account infill rigidity. This cannot be precise always, particularly for those buildings which are irregular from vertical view with irregular walls of infill. In the seismic study of framed structures, the modelling of infill walls is also imperious. "Indian Standard IS 1893: 2002" permits a study of exposed surface floor constructions with a multiplication factor of 2.5 without recognizing infill rigidity in compensation for rigidity. According to the coding, open floor columns and beams have to be constructed 2.5 times the shears of the story and the time measured for the seismic load of bare frames (i.e., without respect to infill rigidity). However, the multiplication ratio of 2.5 is unrealistic for low-lying structures, as skilled through the engineers at construction offices. The code suggested for low rise open ground floor buildings that must be assessed and updated. Motive of this paper is, therefore, to determine the

applicability and the effects on seismic analysis for the low-level open-air building, the multiplication factor 2.5, and to investigate strengths as well as stiffness. 2 separate instances in this building are analyzed: a) the infill masses stigma & b) the infill masses but without taking into account infill rigidity. This building is analyzed. Using commercial software SAP2000, two different models were produced. Infill weights are modelled by using static dead weights and related masses for dynamic studies considered from this dead weight. The steadiness of infill was modelled using an approach to diagonal strut. The effect of multiplication factors on support conditions is studied in two separate "support conditions", namely the "fixed end support conditions" and "pinned end support conditions". The model was conducted in linear and non-linear analyses and the outcomes contrasted.

[6] The Aim of present study "Earth quake resistant design of multi-storey building'' by "ETABS" is to define technique for stability of structure by taken regular Geometry. The frames were founded as sufficiently designed for the seismic load in "Zone IV". The building is designed as per IS 1893(Part 1):2016. The main objectives of the paper are to compare the variation of steel percentage, maximum shear force, maximum bending moment, and maximum deflection in seismic zone IV.

[7] In Japan, a planned offshore building structures earthquake-resistant construction framework is launched. Offshore constructions structures are classified as offshore structures of the form fixed that are used for that purpose constantly: living, facility, job, functioning, collecting, sightseeing, leisure, etc. In the first section, fundamental concepts are developed for designing offshore building systems that address the safety of human life, maintenance, and the conservation of building functions. The second segment evaluates seismicity in and around Japan with the use of past seismic data and current seismic investigations and revises a seismic map in Japan. The third component suggests an earthquake-resistant construction framework based on the fundamental concepts of construction and seismicity in Japan. The framework comprises three types of earthquake-resistant construction processes in compliance with a basic natural structural period: seismic coefficient construction, modified seismic coefficient design, and dynamic analysis. The builder of the structure is responsible for selecting these approaches.

[8] the author presented a review on some experimental and analytical activities conducted by the authors, on a balsa wood scale structures that was designed for a Seismic Design Competition (SDC) organized by Earthquake Engineering Research Institute from USA. Highlights are presented in the paper focusing on experimental researches including the design, the analytical approach, and the laboratory tests executed on shaking table facility and equipment available at the Technical University of Cluj-Napoca.

[9] Larger than shorter structures are the tall buildings, and the seismic excitation is vulnerable to a different frequency spectrum. Studies that add average earthquake properties and standard properties of high buildings affirm the earthquake achievements of big buildings, and no particular earthquake threats occur merely because of their height. This paper addresses various methods of study, base isolation, and the relationship between soil structures. For a wide range of high builds, which include plates, beams, columns, base stones, walls, etc..., the research technique is used. Base separation means the collection of concrete components that greatly distinguish a superstructure from its substructure, and lies on a shaking floor, and preserves the stability of construction or non-building structures. It is one of the most effective earthquake engineering equipment using technology for passive structural vibration control. The relationship with the soil structure is the technique in which soil reaction affects the structural motions, and soil responses are affected by the movement of the structure. The key aim of the study of the soil structure is to measure the seismic response of structure bases based on the free field seismic response.

[10] The need for seismic evaluation of buildings over the last few years has stimulated the production of simpler non-linear static studies on maintaining heavy motions. Several protocols for determining the conduct of airframe systems or of designed; standard-structured structures suitable for engineering are today available. Instead, abnormal systems have fewer detailed procedures available. This thesis introduces the use of ability domains and polar spectra as new methods to test the seismic efficiency of abnormal structures. Capacity domains, which are plotted in relation to simple node and shear regulation and attained by non-linear analysis, static, contribute in particular to an estimation of the position of the "least seismic capacity" of the studied system. Instead, "the polar spectrum" allows the path and position influence of seismic activity to be considered. The "spectral seismic"

response tested for multiple in-plan directions is the polar spectrum in particular.

PROJECT DETAILS

Layout plan

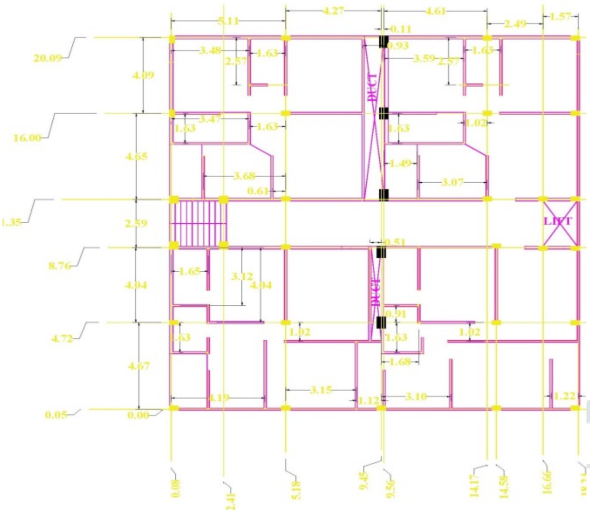


FIG 3

Image above FIG 3 is a architectural drawing which is to be design for G+4 story height.Which is 20.17m in length, 18.29m in breadth and 32.5m is the height of building. In Order to design building, architectural drawing which is in autocad is to be Imported from autocad to etabs which is done by grid option available in etabsOnce the modeling of frame is done. Material property is defined, building which is 5 story height or above the concrete grade should be M25 and the main reinforcement should be TMT500.If lesser grade is provided then structural failure May take place. After the application of material property section property is applied in which different sections which are basically size of beam and columnare defined ,which is then assign to grid frame section .After the application of Section properties .Slab is defined which is also called shell or membrane.Afterassigning section properties on a frame section various load are applied on the Framesection which is Live load LL, Dead load DL, Seismic Load. After the Assignment of load the frame section is then analyzed and designed. And if the Column or beam is falling the software indicate the falling beam or column changing the color from green which indicate that the frame section is safe and if the frame section is falling it indicate red color. Generally the falling section in Etabs is overstressed (OS#2),(OS#45) which is failing in shear and failing in Reinforcement. To pass the column for (OS#2) torsion property is changed and to pass (OS#45) beam and column size is increased. Once all the member passed detailing is done which is done in autocad.

1.1 Etabs Frame structure of layout

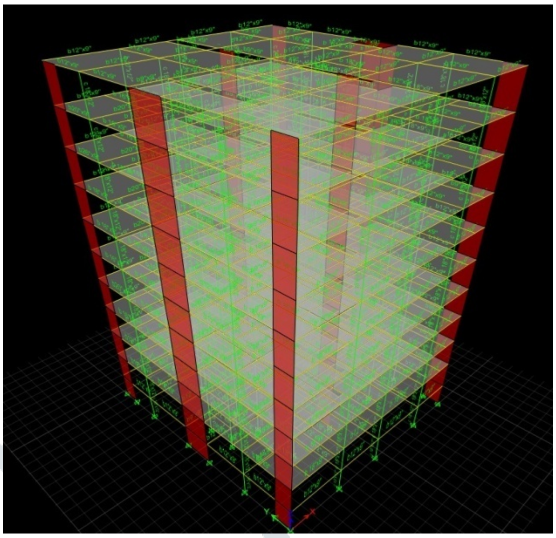


FIG 4

Above image FIG 4 is the 3D view of the model in Etabs.

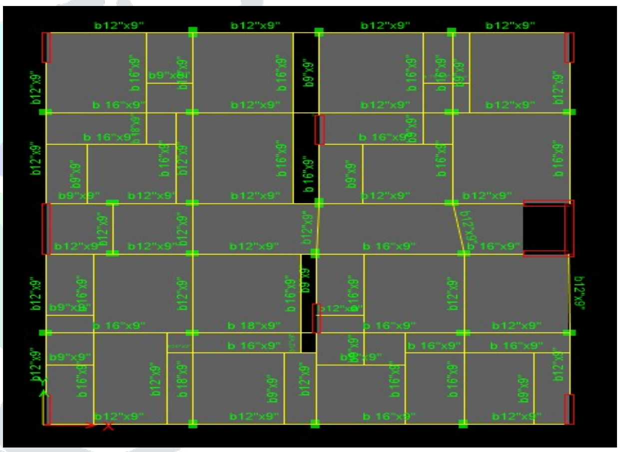


FIG 5

Above image FIG 5 is the top view of the model which is imported from autocad which can be changed story wise.

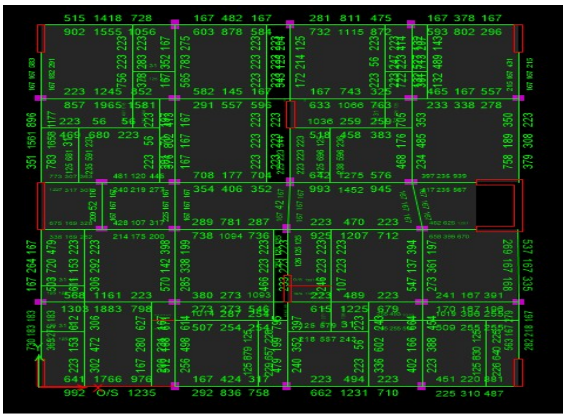


FIG 6

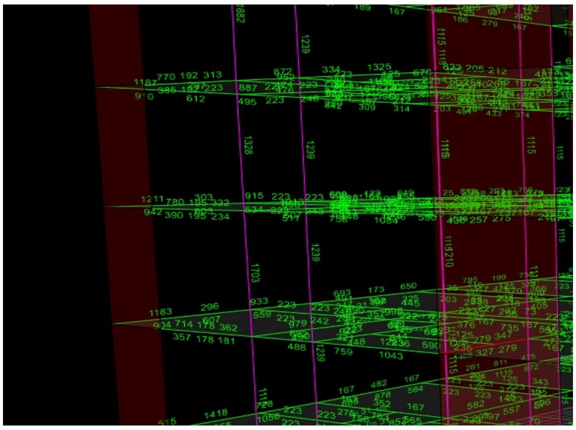


FIG 7

Above two images FIG 6 and FIG 7 shows area of steel (ast) which was shown by Etabsafter Analysis and design. The overall cost estimate is determined by amount of astEtabs Calculated. According to ast final size of the column is determined as well as beam and after the finalization of size detailing is done in autocad which is field ready for layout and construction.

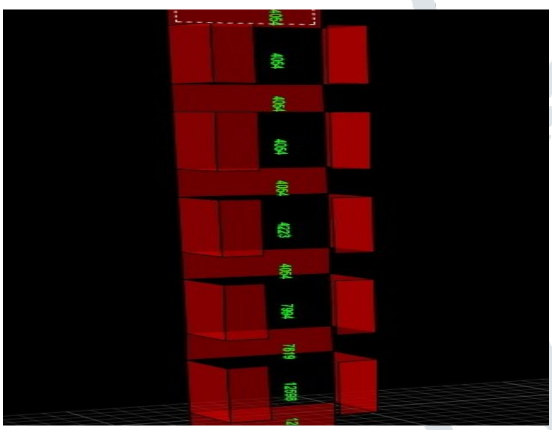


FIG 8

Red blocks which is shown in the above image is shear wall which is provided for lift. And the numbers which are written in the green are ast for shear wall as shown in the image, ast decreases as we move upwards. And the numbers which are written in the green are ast for shear wall as shown in the image, ast decreases as we move upwards.

RESULT OBTAINED AFTER ANALYSIS

1.2 IS1893 2002 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern eqx according to IS1893 2002, as calculated by ETABS.

Direction and Eccentricity

Direction = X

Structural Period

Period Calculation Method = User Specified

User Period $T = 0.36$ sec

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 2] $Z = 0.1$

Response Reduction Factor, R [IS Table 7] $R = 5$

Importance Factor, I [IS Table 6] $I = 1$

Site Type [IS Table 1] = II

Seismic Response

Spectral Acceleration Coefficient, S_a /g [IS 6.4.5] $\frac{S_a}{g} = \frac{1.36}{T}$ $\frac{S_a}{g} = 1.36$

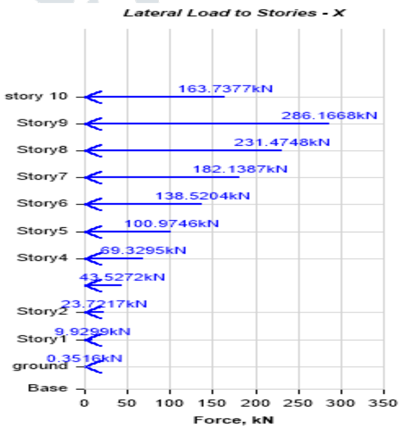
Equivalent Lateral Forces

Seismic Coefficient, A_h [IS 6.4.2] $A_h = \frac{ZI\frac{S_a}{g}}{2R}$

Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
X	0.36	49994.9161	1249.8729

Applied Story Forces



Story	Elevation m	X-Dir kN	Y-Dir kN
story 10	32.5	163.7377	0
Story9	29.5	286.1668	0
Story8	26.5	231.4748	0
Story7	23.5	182.1387	0
Story6	20.5	138.5204	0
Story5	17.5	100.9746	0
Story4	14.5	69.3295	0
Story3	11.5	43.5272	0
Story2	8.5	23.7217	0
Story1	5.5	9.9299	0
ground	2.5	0.3516	0
Base	0	0	0

This calculation presents the automatically generated lateral seismic loads for load pattern eqy according to IS1893 2002, as calculated by ETABS.

Direction and Eccentricity

Direction = Y

Structural Period

Period Calculation Method = User Specified

User Period $T = 0.35$ sec

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 2] $Z = 0.1$

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Y	0.35	49994.9161	1249.8729

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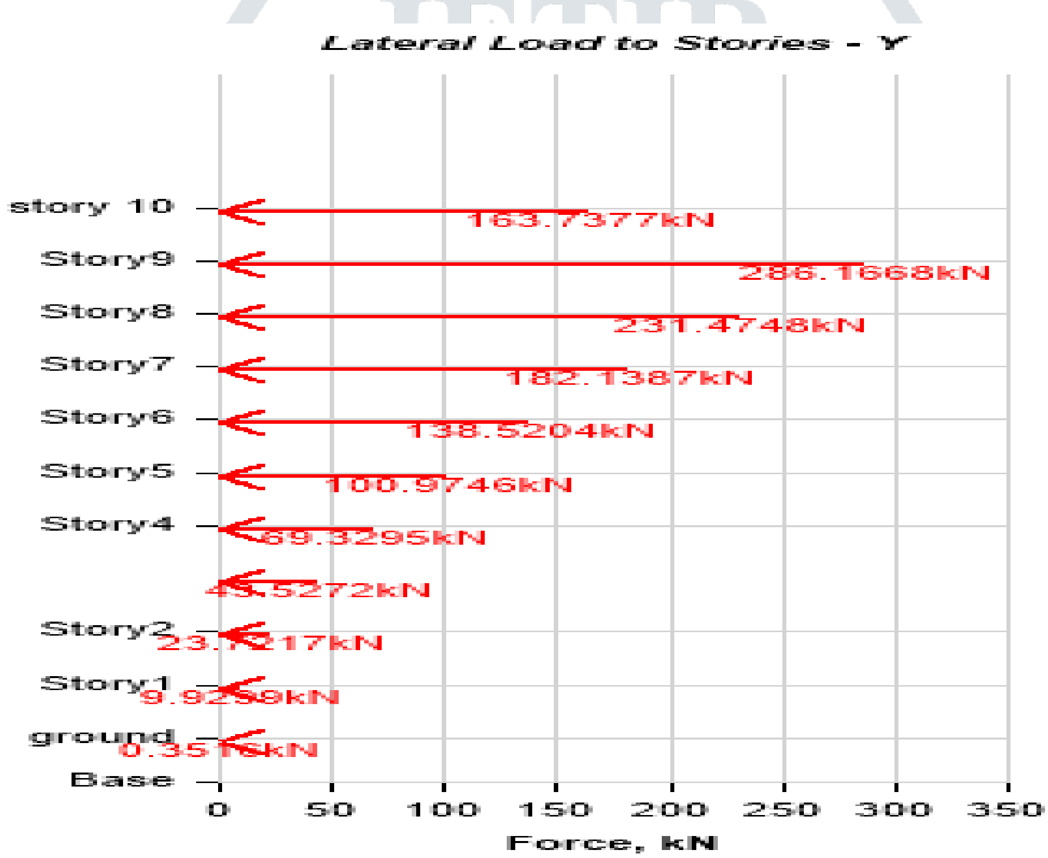

Story	Elevation	X-Dir	Y-Dir
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Story3	11.5	0	43.5272
Story2	8.5	0	23.7217
Story1	5.5	0	9.9299
ground	2.5	0	0.3516
Base	0	0	0

Base Reactions

Load Case/Combo	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m	X m	Y m	Z m
Dead	0	0	23577.1652	234520.6724	-219294	-0.3174	0	0	0
Live	0	9.357E-07	6208.5461	67621.6925	-55332.0029	-0.1657	0	0	0
ff	0	5.848E-07	3382.6909	37251.0009	-29886.5313	-0.1077	0	0	0
stair	0	0	181.041	1820.1631	-225.5206	-0.0047	0	0	0
wall	0	2.19E-06	21562.4708	208067.8501	-188953	-0.8896	0	0	0
eqx	-1249.8729	-8.966E-06	0	0.6577	-32883.2779	12409.2402	0	0	0
eqy	0	-1249.8729	0	31944.2226	-0.3955	-11234.4289	0	0	0
wind x	0	-272.9438	0	4174.0943	-0.1372	-2498.4865	0	0	0
wind y	0	-272.9438	0	4174.0943	-0.1372	-2498.4865	0	0	0
specx Max	1200.6223	58.4043	0	1334.0153	24694.984	12842.0827	0	0	0
specy Max	61.4855	1262.0603	0	24934.144	1285.3289	14575.4005	0	0	0

TABLE 10

Max story displacement at y direction for SPECY with shear wall.

FIG 21

Max story displacement at y direction for SPECY without shear wall.

FIG 22

Because of column axial deformations and the diagonal and girder deformations, the distortion in the building frames is a product of pattern contributions from bending and shears. The changes of the shear mode are the most critical in low-level braced systems, deciding the lateral rigidity of the system largely. The higher axial strengths and deformations within the columns and aggregation of their impact on a higher altitude make the bending portion of the displacement dominant in medium to large structures. The value for maximum story displacement for y with the shear wall is 54.97 mm, and maximum story displacement without a shear wall is 94.20 mm and for X direction with a shear wall is 31mm and without a shear wall is 55mm.

Inter story drift for direction Y for specy (dynamic analysis) with shear wall

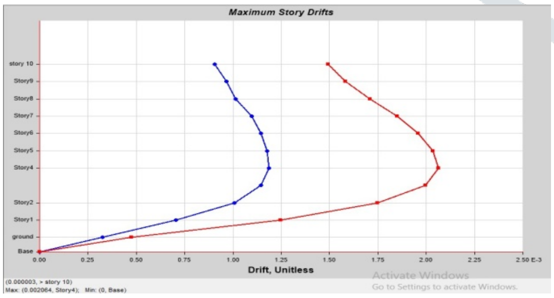

FIG 23

Inter story drift for direction Y for specy (dynamic analysis) without shear wall

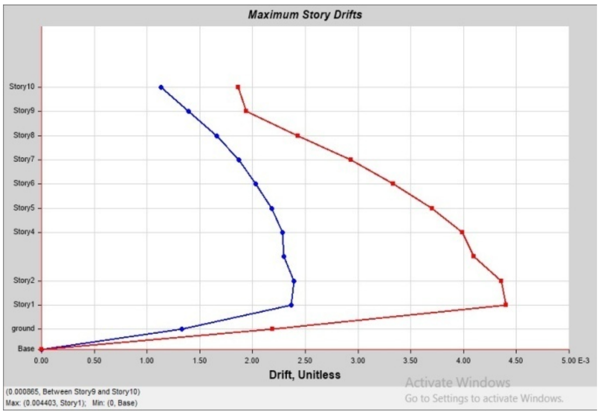

FIG 24

The earthquake was a major problem in the structure design. Although the earthquake powers are appropriately taken, the house and the lives of people may be destroyed. The forces of the earthquake must be taken carefully. Tale drift plays an important role in earthquake architecture. The structure G+9 is modeled with Etabs software in this analysis. For each story, the story drift was calculated. The loadings and the specification are carried out according to the required IS codes (1893:2000). For y-direction drifting with a shear wall, the inter-story value is greater than two, and without a value of 4 stories, drift is smaller.

Center of mass displacement for direction y for specy (dynamic analysis) with shear wall

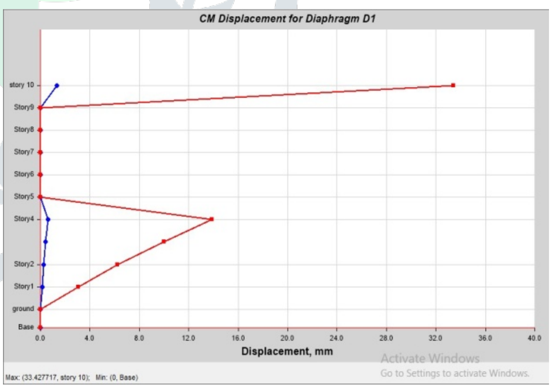

FIG 25

Center of mass displacement for direction y for specy (dynamic analysis) without shear wall

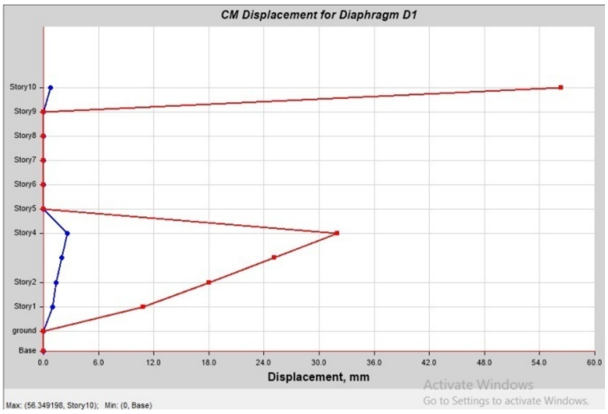

FIG 26

The center of the mass is the average location of any element of the structure, weighted by mass. The mass distribution is balanced by the center of mass, and its coordinates are defined by the weighted direction of the mass. At each floor level, acceleration-induced inertia forces are produced and operate at a point where the mass of the whole story is expected to be concentrated. The positions of the centers of floor masses do not vary from floor to floor when a building has a symmetrical mass distribution. Inconsistent mass spread over a building's elevation, though, can lead to differences in mass centers at different heights. Shear wall CM 14 mm and 33 mm without scroll displacement.

Conclusion

They were using ETABS Software, a typical multi-storey (G+10). The efficient placement of shear walls has been selected. Both analyses have been rendered in compliance with the Indian Standard codebooks. The research is carried out in a ten-story model and is built with a scissor wall on the sides of either side of the exterior, in the middle of the house.This structure is designed using dynamic analysis (IS code 1893:2000) under which response spectrum method is adopted there are other method which is time history method but response spectrum is widely used method for accurately obtaining peak result in a graph of acceleration and period the formula used to obtain value for different mode of structure is SRSS and CQC method. All the members are passed after application of various load .All the sizes of beam and column is obtained after analysis of model through area of steel (AST) which also determine the overall cost of structure. This model is made for zone 2 where earthquake rarely occurs hence size of beam and column and AST according to this zone is less .Final conclusion is after the calculated of the load of structure which determines, type and size of foundation and once the foundation is decided layout is done and then excavation after that construction of building is done the value for maximum story displacement for y with shear wall is 54.97 mm and maximum story displacement without shear wall is 94.20 mm and for X - direction with shear wall is 31mm and without shear wall is 55mm.The value for inter story drift for y direction with shear wall is above 2and without is above 4 inter story drift value is unless.CM displacement with shear wall 14mm and without 33mm

It is clear from the above two graphs that structure with shear wall displaced less as compared to with no shear wall, lesser the displacement lesser will be the chances of structure failure in event of earthquake. The red line in graph indicates the displacement in Y direction because the shear wall is provided in Y direction. For both structure value of displacement is less for X direction because shear wall is provided in Y direction hence all the lateral forces acting on the structure in y direction is resisted by shear wall.

REFERENCES

[1]. https://theconstructor.org/structural-engg/shear-walls-structural-forms-positioning/6235/

[2]. http://www.sginstitute.in/activities/Civil/Day_6_2.pdf

[3]. https://shodhganga.inflibnet.ac.in/bitstream/10603/60130/7/07_chapter%202.pdf

[4]. http://www.ijste.org/articles/IJSTEV2I1059.pdf

[5]. https://www.iitk.ac.in/nicee/EQTips/EQTip23.pdf

[6]. https://www.irjet.net/archives/V5/i3/IRJET-V5I3186.pdf

[7]. https://www.scribd.com/doc/241872571/Scope-for-Future-shear-wall

[8]. http://www.ijmetmr.com/oloctober2015/BRamamohanaReddy-MVisweswaraRao-59.pdf

[9]. https://www.comsol.co.in/multiphysics/response-spectrum-analysis

[10]. http://www.ijirset.com/upload/2018/may/75_DETERMINATION.pdf

[11]. https://www.ijert.org/research/assessment-of-location-of-centre-of-mass-and-centre-of-rigidity-for-different-setback-buildings-JERTV6IS050488.pdf

[1] S. Bhargava and V. S. Parihar, “A Study on the Earthquake Resistant Low Cost,” *Int. J. Res. Appl. Sci. Eng. Technol.*, vol. 5, no. Iv, pp. 28–31, 2017.

[2] M. Grigorian and C. E. Grigorian, “An introduction to the methodology of earthquake resistant structures of uniform response,” *Buildings*, vol. 2, no. 2, pp. 107–125, 2012, doi: 10.3390/buildings2020107.

[3] D. W. Dinehart and A. S. Blasetti, “Comparison of energy dissipation, stiffness, and damage of structural oriented strand board (OSB), conventional gypsum, and viscoelastic gypsum shearwalls subjected to cyclic loads,” *Buildings*, vol. 2, no. 3, pp. 173–202, 2012, doi: 10.3390/buildings2030173.

[4] E. P. Kumar and et al, “Earthquake Analysis of Multi Storied Residential Building,” *Int. J. Eng. Res. Appl.*, vol. 4, no. 11, pp. 59–64, 2014.

[5] S. Patel, “Earthquake resistant design of low-rise open ground storey framed building,” no. May, 2012.

[6] M. E. Uz and M. N. S. Hadi, “Earthquake Resistant Design of Buildings,” *Earthq. Resist. Des. Build.*, no. May, pp. 5769–5776, 2017, doi: 10.1201/9781351200875.

[7] T. Rossetto and P. Duffour, “Earthquake resistant design,” *Encycl. Earth Sci. Ser.*, no. 4, pp. 231–240, 2013, doi: 10.1007/978-1-4020-4399-4_107.

[8] C. V. Miculaș, M. Moldovan, and A. Ciocan, “Earthquake Resistant Multi Storey Structures,” *Proc. C60 Int. Conf. ”Tradition Innov. - 60 Years Constr. Transilv.*, no. November 2013, pp. 29–30, 2013.

[9] . N. T., “Earthquake Resistant Techniques and Analysis of Tall Buildings,” *Int. J. Res. Eng. Technol.*, vol. 04, no. 25, pp. 99–104, 2015, doi: 10.15623/ijret.2015.0425016.

[10] L. Petti and I. Marino, “Innovative procedures to assess seismic behaviour of existing structures by means of non linear static analysis: Polar spectrum and capacity domains,” *Buildings*, vol. 2, no. 3, pp. 271–282, 2012, doi: 10.3390/buildings2030271.

[11] R. R. Bhandarkar, U. M. Ratanpara, and M. Qureshi, “Seismic Analysis & Design of Multistory Building Using Etabs,” vol. 5, no. 2, pp. 78–90, 2017.

[12] M. Betti and L. Galano, “Seismic analysis of historic masonry buildings: The Vicarious Palace in Pescia (Italy),” *Buildings*, vol. 2, no. 2, pp. 63–82, 2012, doi: 10.3390/buildings2020063.

[13] K. Sathishkumar, “Study of Earthquake Resistant RCC Buildings with Increased Strength and Stability,” pp. 4664–4674, 2015, doi: 10.15680/IJIRSET.2015.0406283.

[14] I. Arora, “To study the earthquake resistant design of structure,” *Int. Res. J. Eng. Technol.*, vol. 4, no. 7, pp. 957–959, 2017.

[15] F. Parisi and N. Augenti, “Uncertainty in seismic capacity of masonry buildings,” *Buildings*, vol. 2, no. 3, pp. 218–230, 2012, doi: 10.3390/buildings2030218.

[16] M. A. Dar, A. R. Dar, A. Qureshi, and J. Raju, “A Study on Earthquake Resistant Construction Techniques,” *Am. J. Eng. Res.*, no. 12, pp. 258–264, 2013.

[17] . S. Z. A., “Seismic Response of Rc Frame Structure With Soft Storey,” *Int. J. Res. Eng. Technol.*, vol. 03, no. 09, pp. 180–186, 2014, doi: 10.15623/ijret.2014.0309027.

[18] C. M. R. Kumar, M. B. Sreenivasa, A. Kumar, and M. V. Sekhar, “Seismic Vulnerability Assessment Of Rc Buildings With Shear Wall,” vol. 3, no. 3, pp. 646–652, 2013.

[19] A. K. & A. K. G. Poonam, “Study of Response of Structurally Irregular Building Frames to Seismic Excitations,” *Int. J. Civil, Struct. Environ. Infrastruct. Eng. Res. Dev.*, vol. 2, no. 2, pp. 25–31, 2012.

[20] B. Bagheri, E. S. Firoozabad, and M. Yahyaei, “Comparative study of the static and dynamic analysis of multi-storey irregular building,” *Int. J. Civ. Environ. Eng.*, vol. 6, no. 11, pp. 1847–1851, 2012.

[21] P. Malaviya, “Comparitive Study of Effect of Floating Columns on the Cost,” vol. 5, no. 5, pp. 22–34, 2014.

[22] M. S. H. G.S Hiremath, “Effect of Change in Shear Wall Location with Uniform and Varying Thickness in High Rise Building,” *Int. J. Sci. Res.*, vol. 3, no. 10, p. —, 2014.

[23] P. . Kabade and D. . Shinde, “Effect of Column Discontinuity at Top Floor Level on Structure,” *Int. J. Curr. Eng. Technol.*, vol. 4, no. 4, pp. 2784–2787, 2014.

[24] I. Journal, “Inter-Relationship between Moment Values of Columns in a Building with Different Architectural Complexities and Different Seismic Zones,” vol. 5, no. 2, pp. 55–59, 2012.

[25] S. P. Khokale, “Progressive Collapse of High Rise R . C . C . Structure under Accidental Load,” vol. 3, no. 4, pp. 262–270, 2014.

[26] B. Kvgd, “Recommendations For The Seismic Design of Multistoried Building Recommendations For The Seismic Analysis of Multistoried Building With Floating Column,” no. November, p. 116, 2015.