STUDY OF REGULAR AND IRREGULAR BUILDING WITH BRACING AND SHEAR WALL

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Abstract: Modern residential structure are going higher and higher these days. The impact of lateral loads in the form of wind/Earthquakes affects the performance of these structures dramatically. It is often a common practice among structural engineers to use shear walls in place of columns. In the present study the comparison of seismic behaviour of G+15 storey buildings having horizontal irregularity with the regular building of similar properties with bracing and shear wall by using ETAB software was done. For this purpose four multi-storey building plans are considered that are symmetric plan, L shape, T shape. For the comparison, parameters taken are lateral displacement, storey drift and model period. All the four buildings were analyzed for zone IV. Modal Period with different configuration of building, Storey Displacement of structure with different configuration of building, Storey Drift with different configuration of building were studied and their comparison was done.

Keywords: Regular and Irregular Buildings, Shear wall, ETABs Software, Seismic and wind forces, Storey Displacement, Storey drift and Time period.

I. Introduction

In India most of the structures are low rise buildings. Now a days due to greater migration towards cities, results in increase in the population in most of the major cities. In order to fulfill the requirement of this increased population in limited land the height of building becomes medium to have high rise buildings. The improper design and construction of building may cause great destruction of structures all over the world.

A regular building can be defined as symmetrical in plan and elevation of the building about the axis and providing a continuous path of load for gravity such as dead and live load and lateral loads such as wind and earthquake load.

An irregular building can be defined as the lack of symmetry of the building and it has discontinuity in the geometry, mass or load resisting elements.

Table 1: Buildings Specifications

Details	Regular Building	Irregular Building
Plan Dimensions	22m X 22m	20m X 16m
Slab Thickness	180 mm	180 mm
Thickness Of Wall	230 mm	230 mm
Thickness of Shear Wall	150	150
Height Of Floor	3m	3m
Grade OF Concrete	M25	M25

Grade Of Steel	HYSD 415	HYSD 415
Density Of Concrete	25 KN/m^3	25 KN/m^3
Live Load	1 kN/m^2	1 KN/m^2
Seismic Zone	Zone IV	Zone IV
Zone Factor	0.24	0.24
Importance Factor	1	1
Poisson's ratio	0.4	0.4
Modulus of elasticity	2 x 10^5 N/mm^2	2 x 10^5 N/mm^2

Table 2: Column Sizes

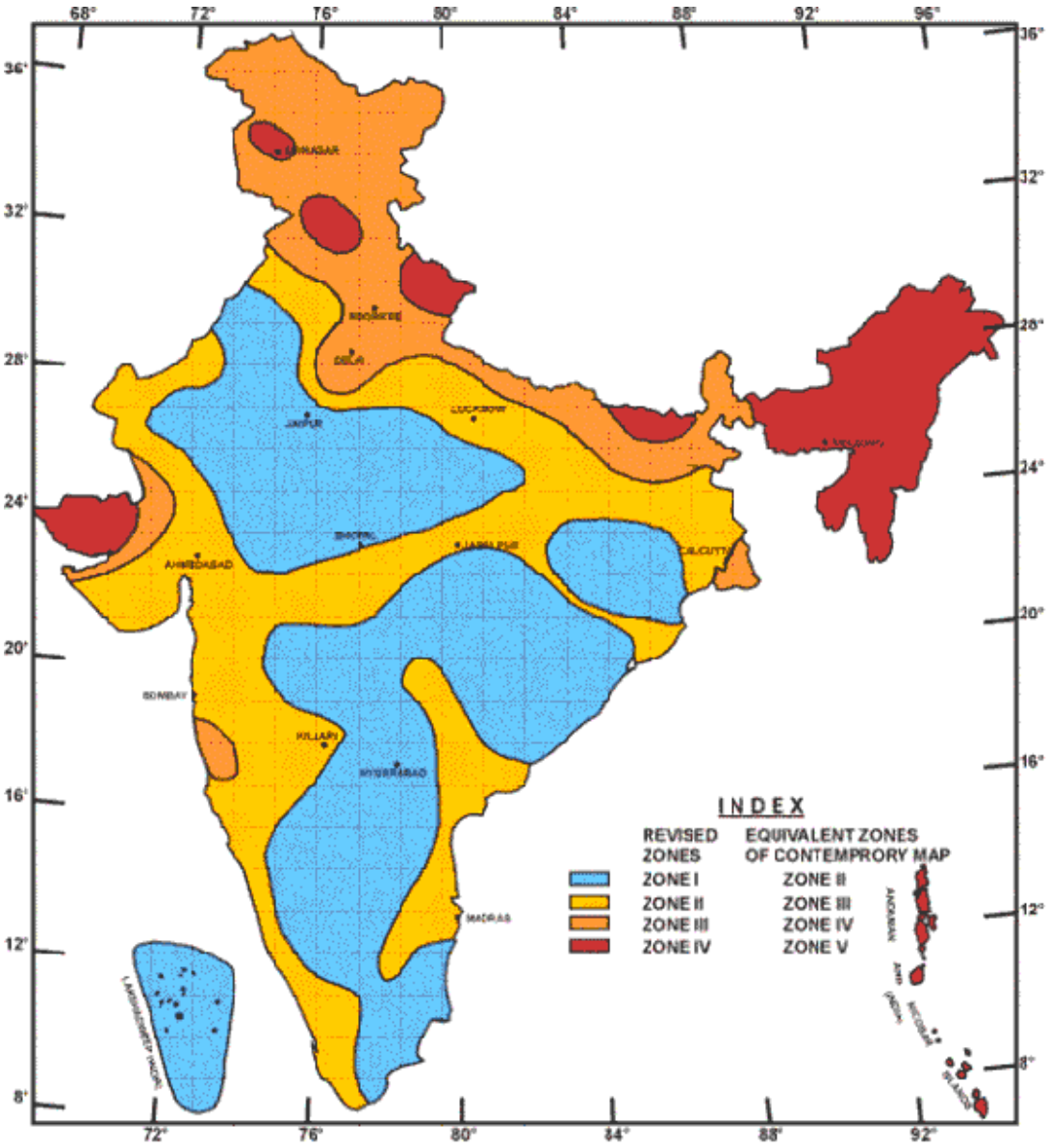
Column	Size	Column	Size
C1	770 X 900	C11	550 X 670
C2	740 X 870	C12	530 X 640
C3	720 X 850	C13	510 X 600
C4	700 X 830	C14	490 X 580
C5	680 X 800	C15	470 X 560
C6	660 X 780	C16	450 X 540
C7	640 X 760	C17	430 X 520
C8	620 X 740	C18	400 X 490
C9	600 X 720	C19	370 X 470
C10	570 X 690	C20	350 X 450

Table: Beam Sizes

Beam	Sizes
B1	350 X 500
B2	230 X 450
B3	230 X 400
B4	230 X 350

II. Earthquake

An earthquake (also known as a quake, tremor or temblor) is the shaking of the surface of the Earth, resulting from the sudden release of energy in the Earth's lithosphere that creates seismic waves. Earthquakes can range in size from those that are so weak that they cannot be felt to those violent enough to toss people around and destroy whole cities. The seismicity, or seismic activity, of an area is the frequency, type and size of earthquakes experienced over a period of time.



Zone 1

Since the current division of India into earthquake hazard zones does not use Zone 1, no area of India is classed as Zone 1.

Future changes in the classification system may or may not return this zone to use.

Zone 2

This region is liable to MSK VI or less and is classified as the Low Damage Risk Zone. The IS code assigns zone factor of 0.10 (maximum horizontal acceleration that can be experienced by a structure in this zone is 10% of gravitational acceleration) for Zone 2.

Zone 3

This zone is classified as Moderate Damage Risk Zone which is liable to MSK VII. and also 7.8 The IS code assigns zone factor of 0.16 for Zone 3.

Zone 4

This zone is called the High Damage Risk Zone and covers areas liable to MSK VIII. The IS code assigns zone factor of 0.24 for Zone 4 Jammu and Kashmir, Himachal Pradesh,Uttarakhand, Sikkim, the parts of Indo-Gangetic plains (North Punjab, Chandigarh, Western Uttar Pradesh, Terai, North Bengal, Sundarbans) and the capital of the country Delhifall in Zone 4. In Maharashtra, the Patan area (Koynanagar) is also in zone no-4. In Bihar the northern part of the state like Raxaul, Near the border of India and Nepal, is also i

Zone 5

Zone 5 covers the areas with the highest risks zone that suffers earthquakes of intensity MSK IX or greater. The IS code assigns zone factor of 0.36 for Zone 5. Structural designers use this factor for earthquake resistant design of structures in Zone 5. The zone factor of 0.36 is indicative of effective (zero period) level earthquake in this zone. It is referred to as the Very High Damage Risk Zone. The region of Kashmir, the Western and Central Himalayas, North and Middle Bihar, the North-East Indian region, the Rann of Kutch and the Andaman and Nicobar group of islands fall in this zone.

Generally, the areas having trap rock or basaltic rock are prone to earthquakes.

III. Types of Earthquake

Tectonic earthquake: is one that occurs when the earth's crust breaks due to geological forces on rocks and adjoining plates that cause physical and chemical changes.

Volcanic earthquake: is any earthquake that results from tectonic forces which occur in conjunction with volcanic activity.

Collapse earthquake: are small earthquakes in underground caverns and mines that are caused by Seismic waves produced from the explosion of rock on the surface.

Explosion earthquake: is an earthquake that is the result of the detonation of a nuclear and/or chemical device.

IV. Methods Of Analysis

Time history analysis:

In this analysis dynamic response of the building will be calculated at each time intervals. This analysis can be carried out by taking recorded ground motion data from past earthquake database. This analysis overcomes all disadvantages of response spectrum analysis if there is no involvement of nonlinear behaviour. Hence this method requires greater efforts in calculating response of buildings in discrete time intervals.

Response spectrum method:

The representation of maximum response of idealized single degree freedom system having certain period and damping, during earthquake ground motions. This analysis is carried out according to the code IS 1893-2002 (part1). Here type of soil, seismic zone factor should be entered from IS 1893-2002(part1). The standard response spectra for type of soil considered is applied to building for the analysis in ETABS 2017 software.

Advantages of building:

Regular buildings are more stable under applications of lateral loads.

Irregular buildings with shear wall and bracing deflect under permissible limits.

Shear wall and bracings are important for stability of structure.

Disadvantage of Earthquake:

Loss of habitat for humans and animals

Deaths and injury of humans and animals

Cause landslides

Can cause the destruction of buildings

Tsunamis are caused by earthquakes

The people might experience poverty due to the destruction

Shear wall

Shear wall is vertical plate like RC wall in building. Shear wall is generally started at the foundation level and are continuous right the way through the stature of the building. The thickness of the shear wall is at minimum thickness as 150 mm or as maximum at 400 mm .shear wall are usually provided along both longitudinal and transverse direction. Shear wall is provided for large stiffness and strength of the building in the way of their point of references which considerably reduce the lateral sway of the building and also reduce the damage of the structure and its contents.

Bracings

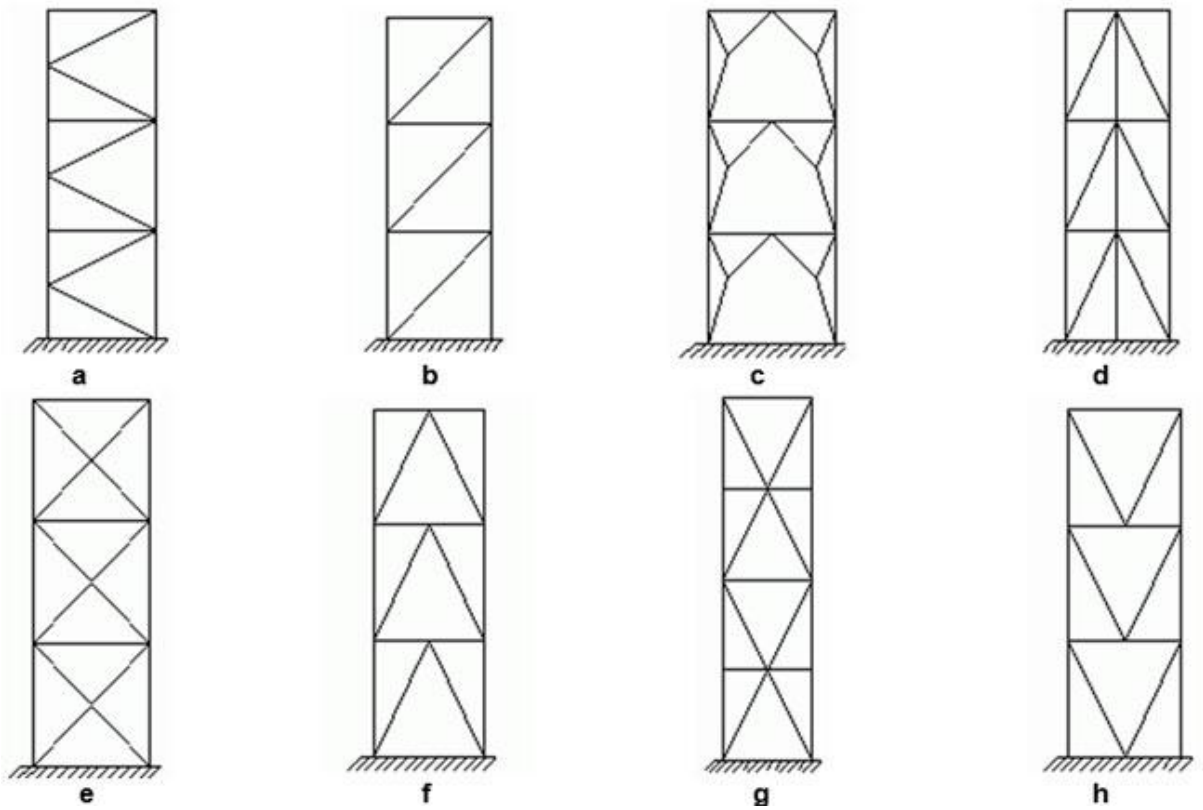
Bracing, which provides stability and resists lateral loads, may be from diagonal steel members or, from a concrete 'core'. In braced construction, beams and columns are designed under vertical load only, assuming the bracing system carries all lateral loads.

Types of bracings

Vertical bracing system: Vertical bracing are diagonal bracings installed between two lines of columns. Not only does it transfer horizontal loads to the foundations (create load path for horizontal forces) but also it withstands overall sway of the structure.

Horizontal bracing system**:** Horizontal bracing systems purpose is the transfer of horizontal loads from columns at the perimeter of the structure to the planes of vertical bracing.

Bracings:



V. LITERATURE REVIEW

Niveditha M P, Sunil R (JULY 2018)-discussed about the behaviour of regular and irregular building with and without shear wall under seismic motion. In this paper two varieties of G+8 building geometry of are considered one is regular building with and without shear wall and another one is irregular building with and without shear wall. They did this project in software ETABS-2016. Various parameters are considered such as lateral displacement, stiffness, and storey drift. Seismic analysis is done as per IS: 1893-2002(Part-1) code of practice. Seismic zone V and type of soil II (medium) strata are taken for all of instances. Analysis of buildings is done by equivalent static method and response spectrum method. The results from the analysis are obtained and the results are compared. By this project they found that stiffness was more at bottom storey and less at top storey. Stiffness was higher in buildings with shear wall as compared to buildings without shear wall. Storey drift was more in buildings without shear wall. The lateral displacement is less in response spectrum method as compare to the equivalent static method.

Arvindreddy, R.J. Fernandes (AUGUST 2015) - In this paper an analytical study was made to find response of different regular and irregular structures located in severe zone V. Analysis has been made by taking 15 storey building by static and dynamic methods using ETABS 2013 and IS code 1893-2002 (part1).They used Linear Equivalent Static analysis for regular buildings up to 90m height in zone I and II, Dynamic Analysis for regular and irregular buildings for zone IV and V. Also time history analysis was carried out by taking BHUJ earthquake of magnitude of 7.7 with ground acceleration of 0.106g. The results obtained from static analysis method showed lesser storey displacement value as compared to response spectrum analysis. Storey displacement and storey drift was less in irregular structures in both the methods.

MindalaRohini, T. Venkat Das (APRIL 2019) - . In this study, the analysis is carried out for seismic response of (G+15) residential building for zone-III and Zone-V regions through response spectrum method and time history method in ETABS. The parameters likes storey displacement, storey drift and storey shear are observed for specified zones. They found that storey displacement was greater in zone 5 than in zone 3. The storey shear in both the methods is greater at ground. It is high for zone 5

Suruchi Mishra[1*], Rizwanullah[2] - In the present study the comparison of seismic behaviour of G+10 storey buildings having horizontal irregularity with the regular building of similar properties with and without shear wall by using ETAB software was done. For this purpose four multi-storey building plans are considered that are symmetric plan, L shape, T shape, and + shape. For the comparison, parameters taken are lateral displacement, storey drift and model period. All the four buildings were analyzed for zone IV. Modal Period with different configuration of building, Storey Displacement of structure with different configuration of building, Storey Drift with different configuration of building were studied and their comparison was done.

VI. Objective

To increase the stability of RCC structural members against earthquake.

To calculate base shear, moment, time period, displacement and storey shear.

Foresee the potential consequences of strong earthquake on urban areas and civil infrastructure

Design the structure to perform at earthquake exposure up to expectation and in compliance with building codes

A structure which is properly designed to withstand the seismic effect while sustaining an acceptable level of damage

VII. Problem statement

To analyse and study about behaviour of regular and irregular RC framed structure with bracing and shear wall in zone 4 under seismic loads and to finding out the results.

VIII. Methodology

The basic procedure is to design the building and then analysis accordingly for various result.

AutoCAD and ETABS 2017 are used.

Design of buildings and loading patterns are done as per specification.

The result will be interpret and graphs will be plotted accordingly.