iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** X **Month of publication:** October 2021

DOI: https://doi.org/10.22214/ijraset.2021.38491

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue X Oct 2021- Available at www.ijraset.com

Comparative Analysis and Designing of Flat and Grid Slab System with Conventional Slab System by ETABS

Mohammed Naser[1], G. Srinath[2]
[1, 2]*Vidya Jyothi Institute of technology, Dept of Civil Engineering*

Abstract: Structural Engineering is a branch of Civil Engineering in which the look at is done to recognize how the structure behave whilst building is constructed at real environment and to perceive the numerous forces like axial force and shear force, bending moment and displacement and many others.When the analysis come to complicated structure or multistory structure the guide calculation will be hard to carry out and subsequently there is diverse software available to carry out those calculations.In this examine, slab machine layout and evaluation for G+10 building for seismic zone III and having medium soil situation by the usage of ETABS V9.7.Four and those slab gadget analyzed for one of a kind plan location or grid length/ spacing of the column.
Keywords: Structure Design and Analysis of slab system, Flat Slab System, Grid Slab System, Conventional Slab System, ETABS.

I. INTRODUCTION

A. General

Building production is the engineering offers with the construction of building consisting of residential houses. In a simple constructing can be define as an enclose space by walls with roof, meals, fabric and the primary needs of humans. In the early ancient times people lived in caves, over trees or underneath trees, to defend themselves from wild animals, rain, solar, and many others. As the times exceeded as people being started out dwelling in huts made of wooden branches. The shelters of these vintage have been developed nowadays into beautiful homes. Rich humans stay in state-of-the-art circumstance houses.

B. Grid Slab

Interconnected grid structures are being typically used or supporting constructing floors bridge decks and overhead water tanks slabs. A grid is a planar structural system composed of continuous members that either intersect or cross each other. Grids are used to cover massive column loose regions and had been constructed in number of regions in India and overseas. Is subjected to masses applied usually to its plane, the structure is referred as Grid. It is composed of non-stop member that either intersect or move every different. Grids further to their aesthetically beautiful look provide a number of advantages over the opposite varieties of roofing structures.

Fig 1 : Grid slab

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue X Oct 2021- Available at www.ijraset.com

C. Flat Slab

Flat slab is a bolstered concrete slab supported at once by concrete columns without the use of beams. It is described as one sided or -sided support gadget with sheer load of the slab being concentrated on the helping columns and a square slab known as 'drop panels'. They play a big function here as they increase the overall capacity and durability of the floors device beneath the vertical hundreds thereby boosting cost effectiveness of the construction. Usually the peak of drop panels is ready two times the height of slab. If feasible, try and remove drop panels as a good deal as viable and attempt to make the nice use of thickness of flat slabs. The purpose is to allow the advantages of flat soffits for the floor surface to be maintained, make sure drop panels are solid as part of the column.

Fig 2 : Flat slab

D. Objectives Of The Study

From this study the following objectives are made

1) To calculate the design lateral forces on Grid slab and Flat slab using response spectrum analysis and to compare the results of general slab.
2) To study three irregularities in structures namely mass, stiffness and vertical geometry irregularities.
3) To calculate the response of buildings subjected to various types of ground motions namely low, intermediate and high frequency ground motion using Response spectrum analysis and to compare the results.
4) To carry out ductility-based earthquake-resistant design as per IS 13920 corresponding to equivalent static analysis and time history analysis and to compare the difference in design

II. MODELLING OF SHEAR WALL

A. Response Spectrum Method

The representation of most reaction of idealized unmarried diploma freedom gadget having sure duration and damping, for the duration of earthquake ground motions. This evaluation is done according to the code IS 1893-2002 (part1). Here form of soil, seismic region thing should be entered from IS 1893-2002 (part1). The preferred reaction spectra for form of soil considered is applied to building for the evaluation in ETABS 2013 software. Following diagram suggests the same old reaction spectrum for medium soil kind and that may be given in the shape of time period as opposed to spectral acceleration coefficient (Sa/g).

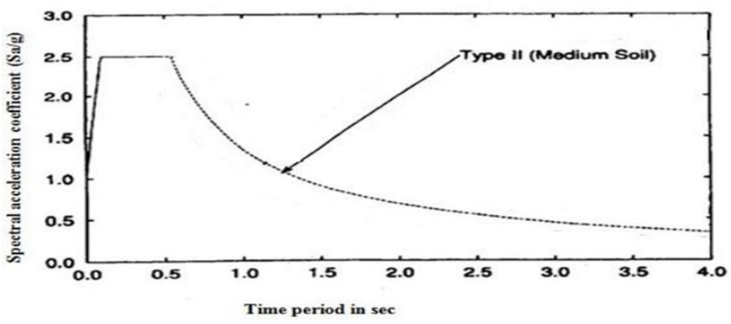


Fig 3 : Response spectrum for medium soil type for 5% damping

This approach lets in the more than one modes of reaction of a constructing to be taken in to account (in the frequency area). This is required in lots of constructing codes for all except very simple or very complex systems. The reaction of a shape can be described as a mixture of many special shapes (modes) that in a vibrating string correspond to the “harmonic” laptop analysis may be used to decide those modes for a shape. For every mode, a reaction is examine from the layout spectrum, based at the modal frequency and the modal mass, and they're then combined to provide an estimate of the full reaction of the structure.

B. Designing Of Flat Slab

The term flat slab manner a bolstered concrete slab with or without drops, supported typically with out beams, by using columns with or without flared column heads. A flat slab can be solid slab or may additionally have recesses formed on the soffit so that the sof healthy contains a chain of ribs in two directions. The recesses may be fashioned by means of detachable or everlasting filler blocks.

Components of flat slab design:

1) Column strip : Column strip means a layout strip having a width of zero.25 I,, however not extra than 0.25 1, on each aspect of the column centre-line, in which I, is the span within the route moments are being determined, measured centre to centre of supports and 1, is the -span transverse to 1,, measured centre to centre of helps.
2) Middle strip: Middle strip manner a layout strip bounded on each of its opposite sides by way of the column strip.
3) Panel: Panel means that a part of a slab bounded on-each of its four facets by means of the centre -line of a Column or centre-lines of adjoining-spans. Division into column and middle strip alongside.

Longer span	Shorter span
L_1=6.6 m , L_2=5.6 m (i) column strip = 0.25 L_2 = 1.4 m But not greater than 0.25 L_1 = 1.65 m (ii) Middle strip = 5.6 – (1.4+1.4) = 2.8 m	L_1=5.6 m , L_2=6.6 m (i) column strip = 0.25 L_2 = 1.65 m But not greater than 0.25 L_1 = 1.4 m (ii) Middle strip = 6.6 – (1.4+1.4) = 3.8 m

Table 2. 1 : centre -line of a Column or centre-lines of adjacent-spans.

C. Grid Slab Design

The slab this is resting at the beams strolling in guidelines is referred to as grid slab. In the ones types of slab, a mesh or grid of beams walking in each the suggestions is the principle shape, and the slab is of nominal thickness. It is used to cowl a big area with out obstruction of internal columns. They are generally hired for architectural reasons for huge rooms consisting of auditoriums, vestibules, theatre halls, display rooms of shops in which column unfastened area is often the primary requirement.

Notations used

1) L = Length of Hall (Longer side of hall)
2) B = Width of Hall (Shorter side of hall)
3) l = Spacing of grid beams in the direction of the length of the hall
4) b = Spacing of grid beams in the direction of the width of the hall
5) Mx= Bending moment in the beams running in x-direction
6) My= Bending moment in the beams running in y-direction
7) Qx= Shear force in the beams running in x-direction
8) Qy= Shear force in the beams running in y-direction

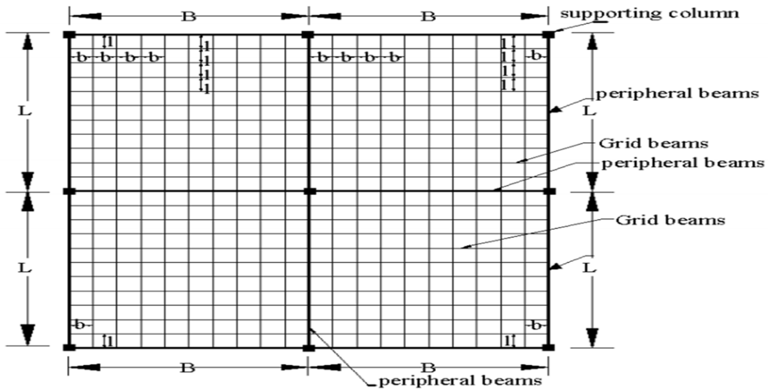


Fig 4 : Plan of grid system

D. Loads Acting On The Structure

The varieties of loads appearing on structures for homes and other systems can be widely classified as vertical hundreds, horizontal masses and longitudinal hundreds. The vertical masses include dead masses, stay load and effect load. The horizontal masses comprises of wind load and earthquake load. The longitudinal hundreds i.E. Tractive and braking forces are taken into consideration in special case of layout of bridges, gantry girders and so on.

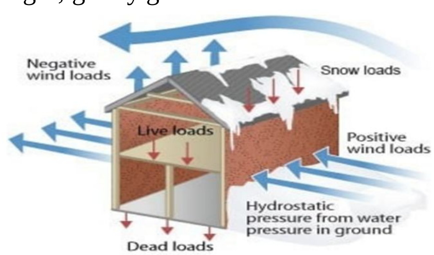


Fig: 5 Loads acting on a building

1) *Dead Loads (DL):* The estimation of dead heaps of each structure are figured by the volume of each area and duplicated with the unit weight. Unit weights of a portion of the regular materials are exhibited in table beneath.
2) Imposed Loads or Live Loads (IL or LL): The second vertical load that is considered in outline of a structure is forced loads or live loads. Live loads are either portable or moving burdens with no increasing speed or effect. These heaps are thought to be created by the planned utilize or inhabitance of the building including weights of versatile allotments or furniture and so forth. Live load continues changing now and again. These heaps are to be appropriately accepted by the planner. The base estimations of live loads to be expected are given in IS 875 (section 2) – 1987. It relies on the proposed utilization of the building.
3) *Wind Loads:* Wind stack is essentially even load caused by the development of air in respect to earth. Wind stack is required to be considered in basic outline particularly when the heath of the building surpasses two times the measurements transverse to the uncovered breeze surface. Finish points of interest of ascertaining wind stack on structures are given beneath (by the IS-875 (Part 3) - 1987).

To get the design wind velocity V_z the following expression shall be used:

$$\mathbf{V_z = k_1.k_2.k_3.V_b}$$

Where k_1 = risk coefficient
k_2 = coefficient based on terrain, height and structure size.
k_3 = topography factor

The design wind pressure is given by

$$p_z = 0.6\ V^2{}_z$$

Where p_z is in N/m^2 at height Z and V_z is in m/sec. up to a height of 30m, the wind pressure is considered to act uniformly. Above 30 m height, the wind pressure increases.

4) *Snow Loads:* Snow loads constitute to the vertical loads in the building. However, these sorts of burdens are viewed as just in the snow fall places. The IS 875 (section 4) – 1987 manages snow stacks on tops of building. The base snow stack on a rooftop territory or some other region over the ground which is subjected to snow aggregation gotten by the articulation

$$S = \mu S_o$$

Where S = configuration snow stack on plan zone of rooftop
μ =shape coefficient and
S_o = ground snow stack

5) *Quake loads (EL) or Seismic Load:* Tremor powers constitute to both vertical and level powers on the building. The aggregate vibration caused by seismic tremor might be settled in to three commonly opposite headings, typically taken as vertical and two flat bearings. The developments vertical way don't make powers in superstructure any noteworthy degree. Be that as it may, the even development of the working at the season of tremor is to be considered while outlining.

E. Basic Aspects Of Seismic Design

1) The mass of the constructing being designed controls seismic design further to the building stiffness, due to the fact earthquake induces inertia forces that are proportional to the building mass.
2) Designing buildings to behave elastically at some point of earthquakes with out damage may additionally render the assignment economically unviable. As a effect, it is able to be necessary for the structure to undergo damage and thereby expend the energy enter to it for the duration of the earthquake. Therefore, the conventional earthquake-resistant layout philosophy requires that ordinary homes need to be able to face up to
3) (a) Minor (and common) shaking and not using a harm to structural and non-structural factors;(b) Moderate shaking with minor damage to structural elements, and a few damage to non-structural elements; and
4) (c) Severe (and rare) shaking with damage to structural factors, however with NO crumble (to store existence and belongings inner/adjacent the constructing).

III. DESIGN CONSIDERATIONS AND MODELING OF BUILDING

In the present study, analysis of G+ 30 stories building in Zone IV and Zone V seismic zones is carried out in ETABS.

Basic parameters considered for the analysis are

1) Grade of concrete : M40
2) Grade of Reinforcing steel : HYSD Fe500
3) Dimensions of beam : 230mmX350mm
4) Dimensions of column : 600mmX600mm
5) Thickness of slab : 120 mm
6) Drop panel Size : 1300mm
7) Drop : 300mm
8) Reinforcement details
   Bar size : 25d
   Corner bar size : 20d
   Number of bars on column : 10no's
9) Height of bottom story : 4m
10) Height of Remaining story : 3m
11) Live load : 3 KN/m^2
12) Dead load : 2 KN/m^2
13) Density of concrete : 25 KN/m^3
14) Seismic Zones : Zone 3
15) Site type : II
16) Importance factor : 1.5

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue X Oct 2021- Available at www.ijraset.com

17) Response reduction factor : 5
18) Damping Ratio : 5%
19) Structure class : C
20) Basic wind speed : 39m/s
21) Risk coefficient (K1) : 1.08
22) Terrain size coefficient (K2) : 1.14
23) Topography factor (K3) : 1.36
24) Wind design code : IS 875: 1987 (Part 3)
25) RCC design code : IS 456:2000
26) Steel design code : IS 800: 2007
27) Earth quake design code : IS 1893 : 2002 (Part 1)

IV. RESULTS AND ANALYSIS

A. *Storey Drift in X*

Table 1- Comparing drifts in X axis

Story	DriftX in Grid Slab	DriftX in Flat Slab
STORY11	0.000976	0.006285
STORY10	0.001247	0.006348
STORY9	0.00157	0.006418
STORY8	0.001896	0.006458
STORY7	0.002212	0.006435
STORY6	0.002506	0.006302
STORY5	0.002742	0.005989
STORY4	0.002851	0.005413
STORY3	0.002725	0.004479
STORY2	0.002192	0.003094
STORY1	0.000969	0.001148

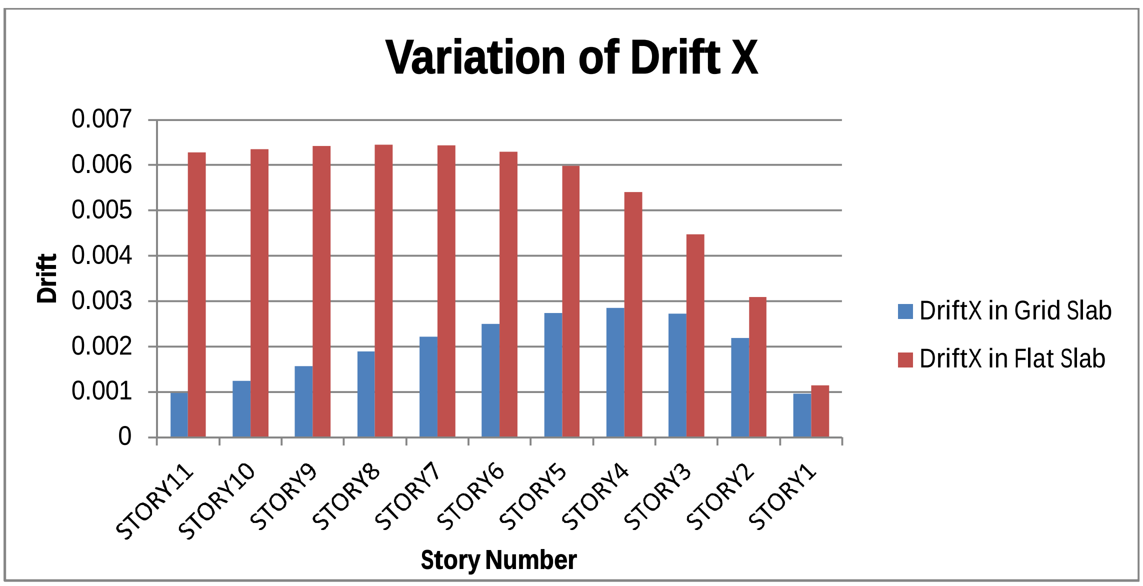


Fig.6 Graphical representation of drifts in X axis

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue X Oct 2021- Available at www.ijraset.com

B. Drift Y

Table 2- Comparing drifts in Y axis

Story	DriftY in Grid Slab	DriftY in Flat Slab
STORY11	0.001177	0.007131
STORY10	0.001504	0.007218
STORY9	0.001893	0.007326
STORY8	0.002289	0.007411
STORY7	0.002676	0.007431
STORY6	0.003037	0.007324
STORY5	0.003329	0.007003
STORY4	0.003466	0.006363
STORY3	0.003314	0.00529
STORY2	0.002667	0.003669
STORY1	0.001179	0.00137

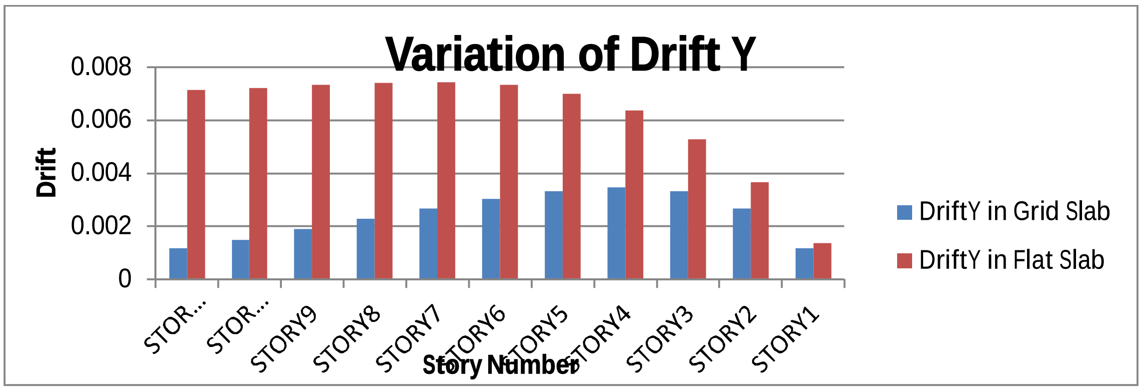


Fig 7 Graphical representation of drifts in Y axis

C. Shear Force (Vx)

Table 3- Comparing Shear Force (Vx)

Story	Shear force (VX) Grid Slab	Shear force (VX) Flat Slab
STORY11	145.93	93.25
STORY10	301.05	167.68
STORY9	417.08	192.99
STORY8	497.68	183.29
STORY7	555.47	167.25
STORY6	607.61	183.41
STORY5	665.67	237.52
STORY4	727.89	301.52
STORY3	782.19	352.92
STORY2	816.5	382.26
STORY1	827.94	391.15

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue X Oct 2021- Available at www.ijraset.com

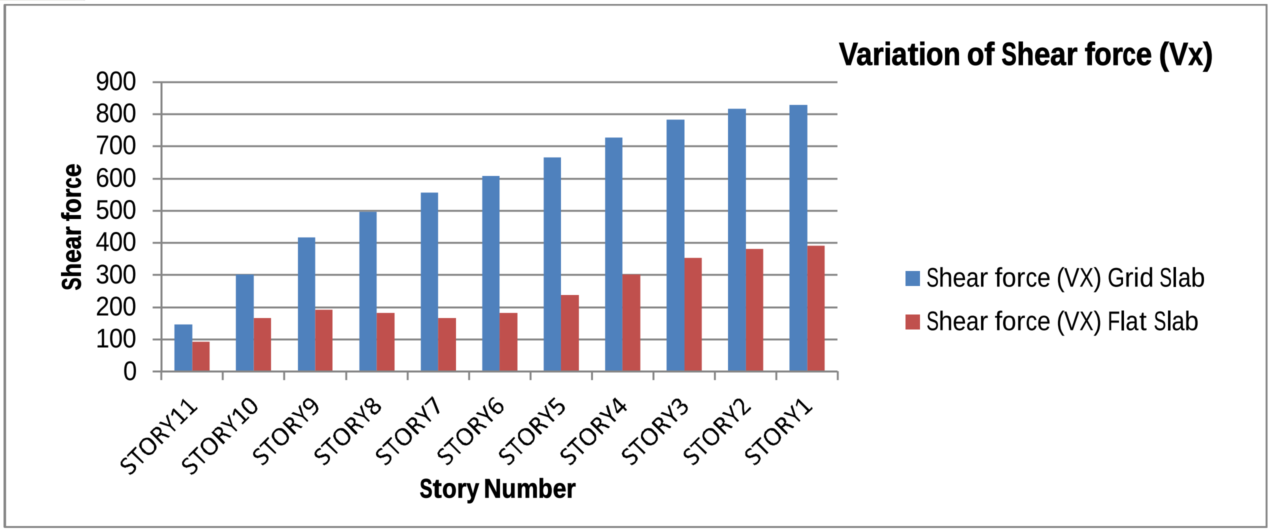


Fig 8 Graphical representation of Shear Force (Vx)

D. Shear Force (Vy)

Table 4- Comparing Shear Force (Vy)

Story	Shear force (VY) without Shear wall	Shear force (VY) with 15% Shear wall	Shear force (VY) with 28% Shear wall	Shear force (VY) with 38% Shear wall
STORY15	58.76	59.41	69.21	82.06
STORY14	121.46	123.88	142.82	168.41
STORY13	176.75	181	206.48	241.58
STORY12	223.61	229.64	259.98	302.21
STORY11	262.14	269.83	304.14	352
STORY10	293.6	302.78	340.86	393.62
STORY9	320.14	330.62	372.68	430.09
STORY8	344.23	355.82	402.12	464.05
STORY7	367.88	380.45	430.84	497.01
STORY6	391.95	405.37	459.14	528.97
STORY5	415.88	430.04	485.9	558.61
STORY4	437.91	452.71	509.17	583.92
STORY3	455.8	471.09	526.9	603
STORY2	467.5	483.12	537.8	614.79
STORY1	472.12	487.86	541.96	619.48

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue X Oct 2021- Available at www.ijraset.com

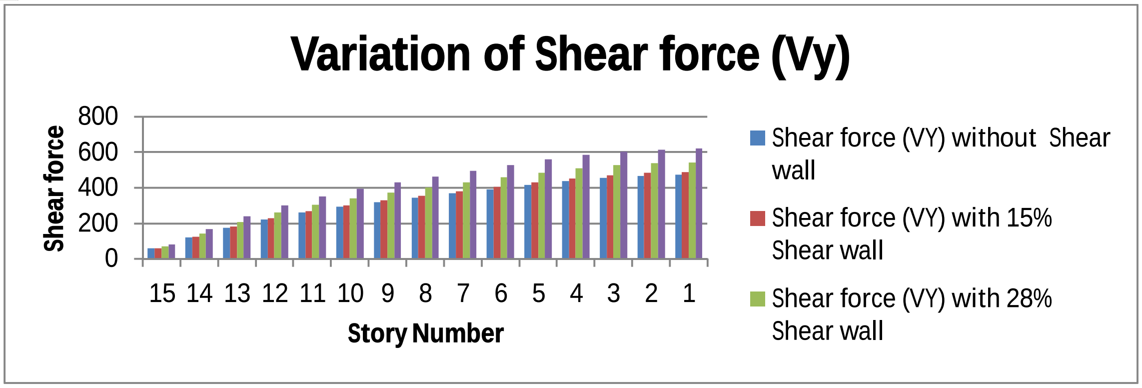


Fig 9 Graphical representation of Shear Force (Vy)

E. *Building Torsion (T)*

Table 5- Comparing Torsion (T)

Story	Building Torsion (T) in Grid Slab	Building Torsion (T) in Flat Slab
STORY11	6426.2	3250.371
STORY10	13254.65	6066.37
STORY9	18479.44	7230.945
STORY8	22599.55	8040.483
STORY7	26529.63	9341.387
STORY6	30840.23	11565.42
STORY5	35481.75	14490.17
STORY4	39933.91	17329.4
STORY3	43493.69	19473.55
STORY2	45636.89	20670.36
STORY1	46340.25	21030.99

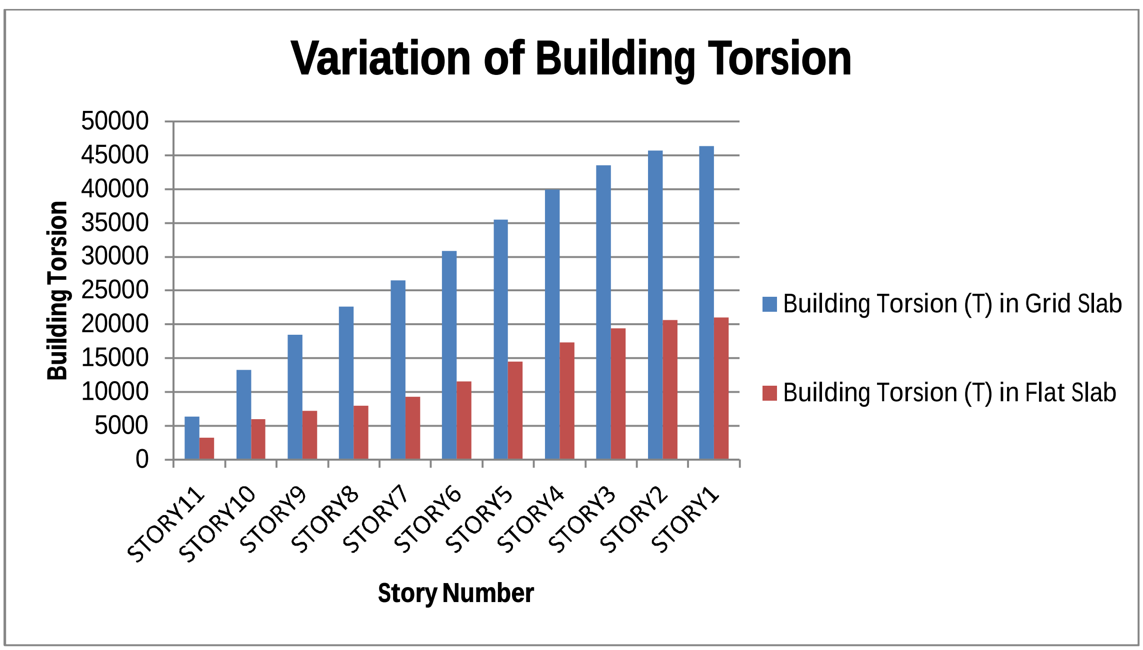


Fig 10 Graphical representation of Torsion (T)

F. Bending Moment (Mx)

Table 6- Comparing Bending moment (Mx)

Story	Bending moment (MX) in Grid slab	Bending moment (MX) in Flat slab
STORY11	437.009	279.749
STORY10	1335.226	782.073
STORY9	2571.893	1356.125
STORY8	4028.947	1882.523
STORY7	5616.403	2294.433
STORY6	7289.764	2598.094
STORY5	9050.243	2880.502
STORY4	10924.18	3275.128
STORY3	12931.71	3875.786
STORY2	15064.5	4678.46
STORY1	17287.66	5616.557

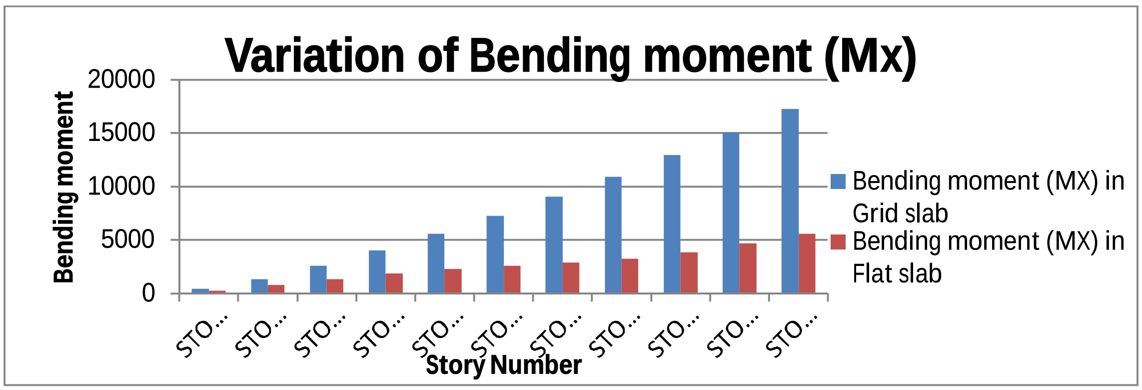


Fig 11 Graphical representation of Bending moment (Mx)

G. Bending Moment (My)

Table 7- Comparing Bending moment (My)

Story	Bending moment (MY) in Grid slab	Bending moment (MY) in Flat slab
STORY11	437.802	279.745
STORY10	1339.927	782.067
STORY9	2585.309	1356.121
STORY8	4056.969	1882.524
STORY7	5665.252	2294.436
STORY6	7365.082	2598.097
STORY5	9156.233	2880.502
STORY4	11063.11	3275.128
STORY3	13104.09	3875.787
STORY2	15269.72	4678.461
STORY1	17524.67	5616.554

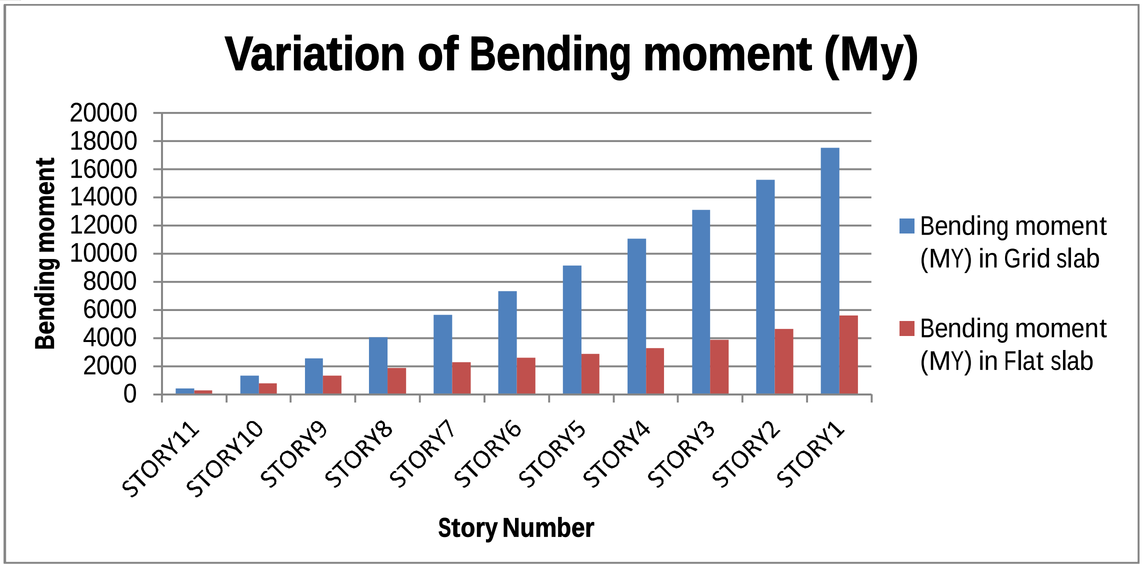


Fig 12 Graphical representation of Bending moment (My)

V. CONCLUSIONS

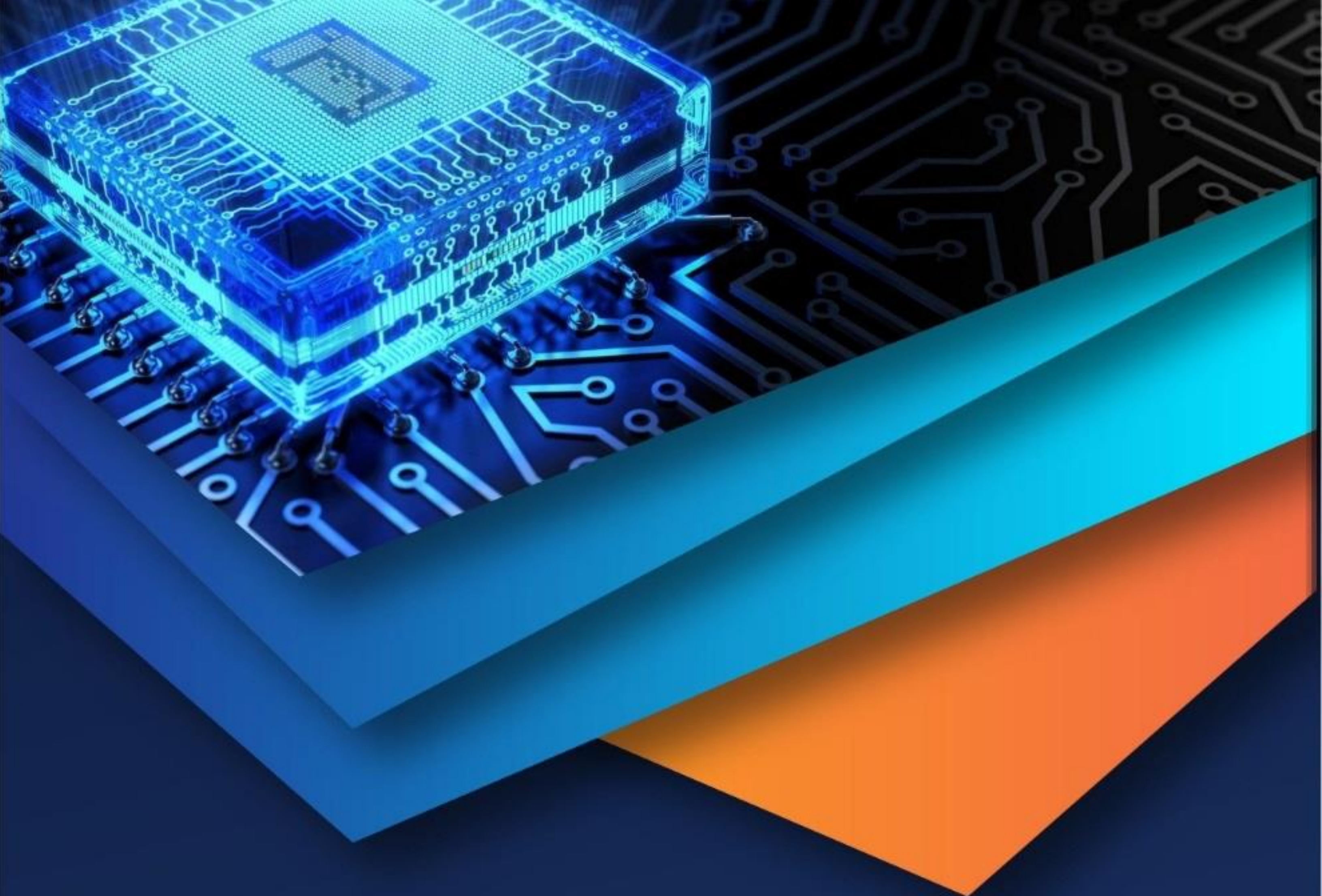
From this study the following conclusions were made

A. The amount of concrete required for grid slab multi tale building is maximum and for the flat slab multi tale constructing is minimal for the identical span/ grid length. But whilst we speak about the traditional slab gadget the amount of concrete required more than the flab slab multi story constructing
B. For Grid slab and irregular building systems the values of drift in both X and Y direction are less for building using Grid slab system than building with Flat slab system. As per displacement point of view the Grid slab will have less displacement than Flat slab systems.
C. The values of Shear force in both X and Y-Direction found lower value for building with Flat slab system than Grid slab system buildings. And the value of shear force increases from top story to bottom story.
D. The values of Building Torsion (T) found lower value for building with Flat slab system than Grid slab system buildings. And the value of Building Torsion increases from top story to bottom story.
E. The values of Bending moment in both X and Y-Direction found lower value for building with Flat slab system than Grid slab system buildings. And the value of Bending moment increases from top story to bottom story.
F. The total quantity of concrete of Flat slab is maximum because the thickness of Flat slab is greater than Grid slab, the steel quantity is also greater than other combinations.
G. Total top of Flat slab is smaller than general peak of the Grid slabs
H. The cost of shape for flat slab multi story constructing is determined to be least for all span / grid size of the shape and for the gird or coffered slab multi tale constructing is determined to be most for all span/ gird size of the structure.
I. The cost per meter square for all taken into consideration slab machine is observed to be adjustments with span/ grid length of the structure. In this situation also cost according to meter square is determined to be least for flat slab gadget and maximum for grid slab system.

REFERENCES

[1] IS:875-1987.'Indian Standard Code of Practice for Design Loads (other than Earthquakes) for Buildings and Structures, (2nd revision).' Bureau of Indian Standard, New Delhi.
[2] IS: 456-2000.'Indian Standard Code of Practice for Design of reinforced concrete", Bureau of Indian Standard, New Delhi.
[3] Design of Reinforced concrete structures by S. Ramamrutham and R.Narayanan, 17th edition Dhanpat Rai Publishing Company.
[4] User manual for E tabs.
[5] A Sathawane R.S Deotale 'Analysis and design of flat and grid slab and their comparision, international journal of engineering Research and their applications vol 1.Issue.3.PP 837-848.
[6] Baishali Das Static and dynamic analysis of grid beams, project report of Bachelor of technology, Deportment of civil engineering ,National institute of technology Rourkila 21010.

[7] N. krishnaraju, Advanced reinforced concrete design(IS 456-2000)(CBS publications and distributors, CBS plaza, New delhi).
[8] Ibrahim vepari, Dr.H.S Patrl,study one conamical aspects of long span slabs,13-14 may2000.
[9] Bhavikatti S.S, "Advance R.C.C .Design" ,New Age International(p) Limited, Publishers, New Delhi, India.
[10] P.C Varghese a book of advanced reinforced concrete design
[11] N KRISHNA RAJU Book of advanced reinforced concrete design".
[12] Techi Tata, Volume 03 Issue 09, Sep-2016 Study of Behaviors of Building with Flat Slab, International Research Journal of Engineering and Technology (IRJET), pp.1333-1339.
[13] Mohana H.S,Volume02 Issue 03,June-2015Comparative Study of Flat Slab and Conventional Slab Structure Using ETABS for Different Earthquake Zones of India, International Research Journal Of Engineering and Technology (IRJET).pp.1931 – 1936.



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY