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"SEISMIC ANALYSIS OF MULTI-STOREY RCC STRUCTURE HAVING VERTICAL IRREGULARITY IN DIFFERENT LOCATIONS"

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Abstract - The effect of seismic forces on buildings with different vertical geometry arrangements have been analysed by utilizing ETABS software. ETABS is an engineering software product which is utilized for analysis and design of structures. Analysis and design are done as per IS 456-2000. M30 grade of concrete and Fe-500 steel is adopted. Load combinations are taken as per IS: 875-part 5 (2015). Live loads are taken as per IS 875-part 1. There are several concerns which affect the performance of structure from which storey shear and storey displacement play a crucial role in finding the behavior of structure against the seismic loads. Results are conveyed in form of tables, bar charts. Storey displacement increased with storey height.
Keywords: Irregularity, Behavior, Storey Displacement, Storey Shear

1. Introduction

Building is most important part of structure in our growing world. There are many kinds of building design are construct in well developed society like residential, commercial, institutional, and business building. Mostly the regular (rectangular) geometric shape are consider in building design. But sometimes due to space restriction or aesthetic purpose the demand of irregular or different shape of building are increase. There are many types of irregularities in building like vertical irregularities, geometric irregularities and plan irregularities etc.

2. Literature Survey

Rakesh Sakale (2014) has object of the current work is to look at the seismic conduct of customary structure with evenly sporadic structures. For this reason four multi-story structures are thought of and furnished with and without shear dividers. Building 1 is standard arrangement, building 2 is of L shape, building 3 is of T shape and building 3 is of C shape in arrangement. To concentrate on the conduct the reaction boundaries chose are horizontal relocation and story drift. Every one of the structures are thought to be situated in zone II, zone III, zone IV and zone V. this work gives a decent wellspring of data on the boundaries parallel dislodging also story drift. For every one of the casings considered, drift esteems follow a comparable way along story stature with most extreme worth lying some place close the second to 10th storey.

Ashvin G. Soni (2015) examines the presentation assessment of RC (Reinforced Concrete) Structures with inconsistency. Primary anomalies are significant elements which decline the seismic execution of the constructions. The review overall tries to assess the impact of vertical inconsistency on RC structures, as far as powerful qualities and the affecting boundaries which can manage the impact on Story Displacement, Drifts of contiguous stories, Excessive Torsion, Base Shear, and so on. In this paper, different casings with various irregularities, however with same aspects have been investigated to concentrate on their conduct when exposed to parallel burdens. Every one of the edges were investigated with something very similar strategy as expressed in IS 1893 (section I):2002. The base casing (regular) grows least story floats while the working with weighty stacking on fourth and seventh stories shows most extreme story floats on the story levels.

Consequently, this is the most defenseless against harms under this sort of stacking. The structures with irregularities likewise showed inadmissible outcomes somewhat.

Pathan Irfan Khan (2016) have done a significant number of the investigations have shown seismic examination of the RCC structures with various irregularities like mass irregularity, firmness and vertical math irregularity. At whatever point a construction having distinctive irregularity, it is important to dissect the working in different seismic tremor zones. From numerous past examinations plainly impact of tremor on construction can be limit by giving shear divider, base detachment and so forth The parallel relocation of the structure is decreased as the level of irregularity increment. As the level of vertical irregularity expands, the story float lessens and continue inside reasonable cutoff as proviso no. 7.11.1 of IS 1893-2002 (Part I). It was observed that mass irregular structure outlines experience bigger base shear than comparative regular structure outlines.

Pragya Singhal (2016) does relative review between 3D topsy-turvy frames(in two bearings) with 3D uneven (In one course) outline keeping floor region steady in all structures . All edges are of 9*9 narrows and 9 stories. Reaction range strategy is utilized for seismic examination of structures. Reactions of building outline are gotten utilizing STAAD. Pro V8i. Reactions like Horizontal Displacement, Torsion and Drift of structures are looked at by and large. It is presumed that exhibition of designs expansions in balanced structure then hilter kilter structures. It is presumed that each floor of top storey assembling (topsy-turvy in more than one course) is exposed to higher flat dislodging in correlation of each floor of building having unevenness in only one bearing.

Shivkumar Hallale (2016) studied about the 5 bayous X 5 narrows, 10 storeyed structure with arrangement of lift center dividers and every story tallness 3.2 m, having no irregularity in arrangement and height, is considered as the essential three dimensional construction with which the seismic conduct of three distinctive arrangement irregularity structures are looked at of the three irregular structures which have the very region as that of the regular structure, two are balanced with regards to X hub ('C' molded structures in plan) and one has no hub of balance ('L' molded structure in arrangement). Both regular and irregular structures are accepted to be situated in zone III.

Akhil R (2017) work is near investigation of the firmness of the construction by thinking about the three models in Regular Structure and three models in Plan irregular design with various Vertical irregular design. All models are analyzed with dynamic seismic tremor stacking for the Zones V. Result found from the reaction range investigation that in irregular formed structure removals are more than that of regular molded structure. All structure outlines are modeled & analyzed in programming Staad Pro V8i. Different seismic reactions like base shear, recurrence, hub dislodging, and so forth are acquired. The general exhibition of regular structure is observed better compared to irregular building. The seismic execution of multistory regular not set in stone by Response Spectrum investigation in STAAD Pro. Programming.

3. Methodology

The behavior of building is studied using dynamic analysis in which vertical geometrical irregularity is considered. The models been analyzed using ETABS software. The co-relation of conventional and trial cases is done based on responses such storey shear, storey displacement.

3.1 Structural Details

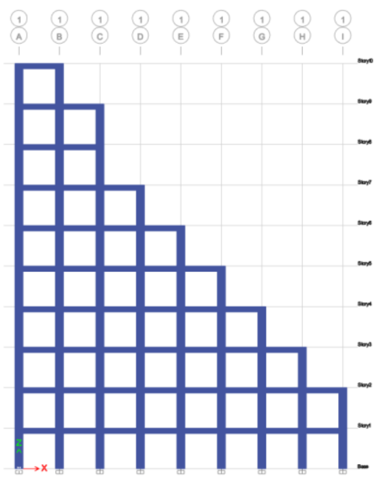
The building configuration used in the research work is based on review study done in previous chapter. The plan size is 24 m X 18 m. The load detail is discussed below after modelling of the cases. The configuration discussed is suitable for all the trial cases. The description of trial cases proposed for the investigation is given below-

Table 1 Trail Models details for the study

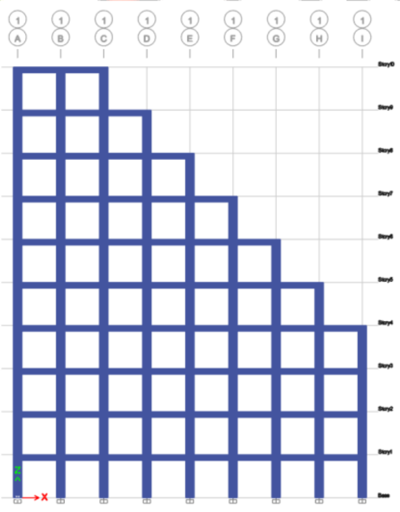
Description	Case ID
Model with 2nd storey irregularity	Case 1
Model with 4th storey irregularity	Case 2
Model with 6th storey irregularity	Case 3

Table 2 Structural Configurations

PARTICULARS	PROPERTIES
Total Built-Up Area	24 X 18 m
Storey Arrangement	G + 9
Height	3.0 meter
Dimension of Vertical Member	0.6 X 0.55 m
Dimension of Beam	23 X 40 cm
Thickness of Slab	15 cm



(A)



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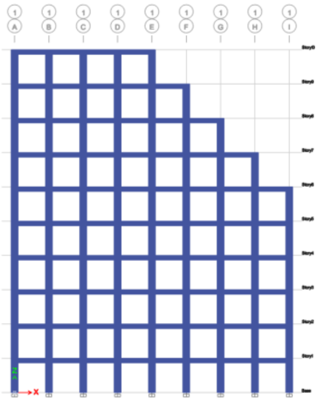


(C)

Figure 1 Model trail Cases Elevation View (A) Case 1 (B) Case 2(C) Case 3

3.2 Material Specifications Considered for Design & Analysis of Cases

These building frames models are made up of two basic materials i.e., concrete and reinforced steel. The table given below shows the properties of materials considered for design and analysis of all RCC frame buildings.

Table 3 Material Properties used in all Frames

Particular	Details
Grade of Concrete	M30
Grade of Main Steel	Fe500
Grade of Secondary Steel	Fe500
Beam & column cover	25 mm & 40 mm
Density of Reinforced Concrete	25 KN/m^3
Density of Brick walls, Plaster	18 KN/m^3
Young's modulus of steel	2 X 10^5 N/mm^2

4. Loading Specification & Calculations Common for All Frames Used in Software

The loads which are to be studied in the project is discussed under following clauses below in which their calculation detail is also been discussed such as Primary load, Seismic Load & their load combination etc.

4.1 Primary Loads Applied for Analysis

In Software, the loads are taken in the form of load cases i.e., primary load cases and the load combination of primary load cases also which are used same for all frame buildings. Firstly, here are the primary load cases which have been used in ETABS software analysis are given below in table 3.4 with their load type & numbers-

Table 4 Primary Load Cases

Load Case Number	Load Type	Name
1	Dead Load	DL
2	Live Load	LL
3	Seismic Dynamic Load	DQX
4	Seismic Dynamic Load	DQY

4.2 Load Calculations Used for All Frame Cases

The calculated load acting on the structures of dead load, floor live load, roof live load is given below-

4.2.1 Dead Load (D.L)

In this analysis, dead load includes dead load of the slab, dead load of beam & column, dead load of external walls and dead of internal walls. DEAD LOAD is designated as D.L in ETABS.

Self-Weight of Slab/Plate = 25 X 0.15 = 3.75 KN/m^2

Self-Weight of Column (0.6x0.55) = (25 X 0.6X 0.55) = 8.25 KN/m (per meter height)

Self-Weight of Beam in all floors = 25 X 0.40 X 0.23 = 2.3 KN/m

4.2.2 Live Load (L.L)

In this research, live load includes live load for all the floors as it is considered from the commercial building category given in IS 875 Part -1 and live load for roof is also considered from same above code. LIVE LOAD is designated as L.L. and ROOF LIVE LOAD is designated as R.L.L in ETABS. Here we consider-

Live load for all the floors = 5 KN/m^2

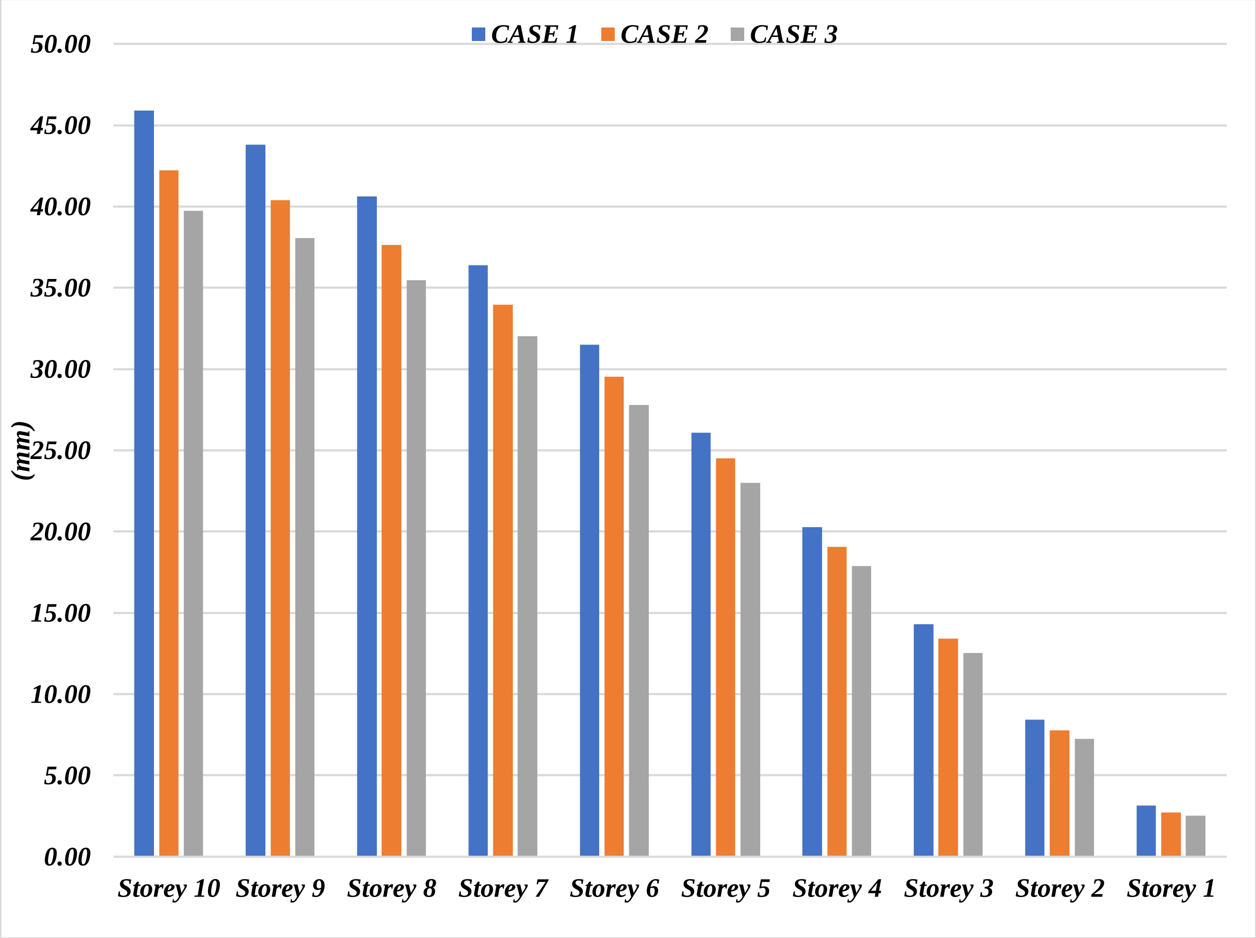
4.2.3 Earthquake or Seismic Load (EQX & EQZ) -

Earthquake load or seismic load calculation involves the full dead load plus the percentage of live or imposed load as per IS 1893:2016 considerations and importantly for calculating earthquake or seismic load. Also, as per IS 1893 Seismic weight of each floor is its full dead load plus approximate amount of live or imposed load. In this study, the approximate amount of live or imposed load considered is 50% of the total live load as per IS 1893 (Table 8) and all the rest calculation is done with the help of ETABS Software. SEISMIC OR EARTHQUAKE LOAD is designated as DQX & DQY where "DQ" stands for Dynamic Earthquake load whereas X & Y represents their respective lateral direction.

5. Result & Discussions

5.1 Comparison of Displacement

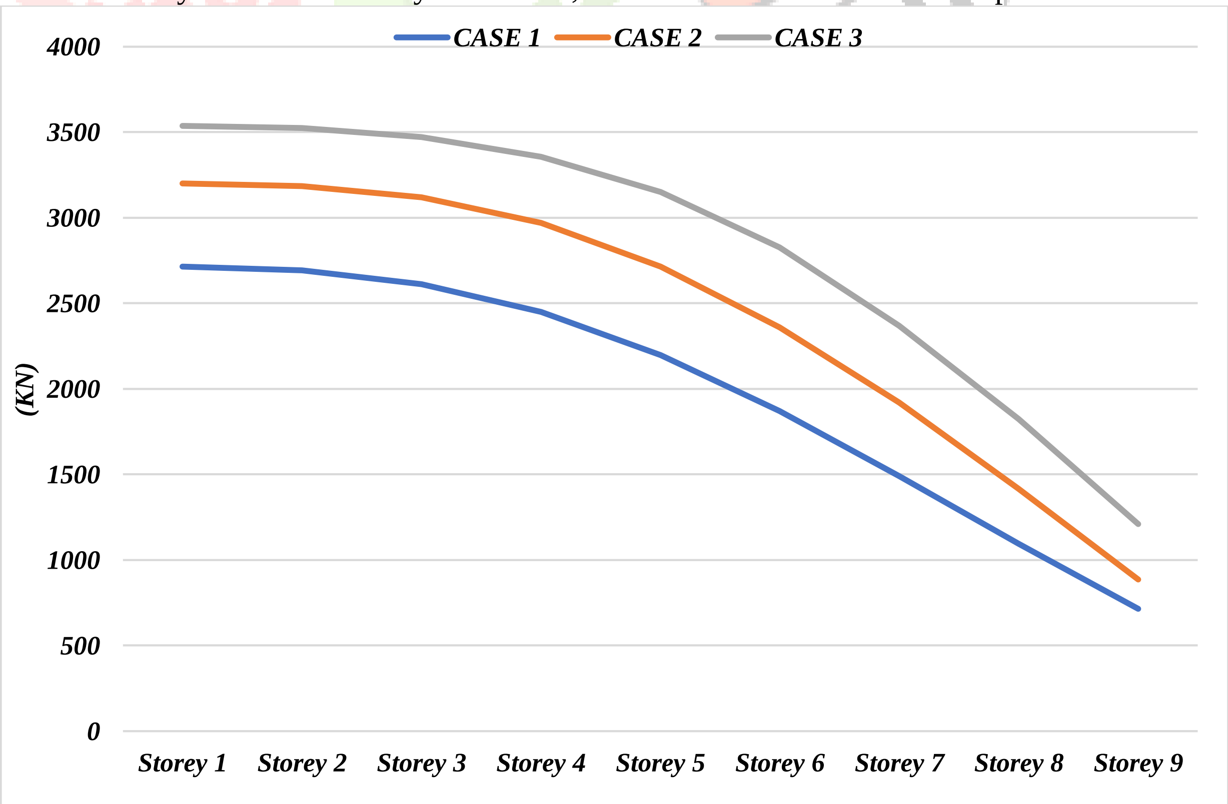
The maximum displacement is shown by Case 1 i.e., 45.9 mm. The least value of displacement is for Case 3.



Graph 1 Comparison of Displacement

5.2 Comparison of Storey Shear

The maximum storey shear is shown by Case 3 i.e., 3523 KN. The least value of displacement is for Case 1.



Graph 2 Comparison of Storey Shear

6. Conclusions

- It has been seen that the displacement value of Case 1 building is about 13.4 % higher than Case 3. The displacement decreases as the vertical irregularity increases.
- It has been seen that the storey shear value of Case 3 building is about 23.21 % higher than Case 1.

References

1) Sakale R, Arora R and Chouhan J (2014) " Seismic Behavior Of Buildings Having Horizontal Irregularities" International jornal of structural and civil engineering research ISSN 2319 – 6009 www.ijscer.com Vol. 3, No. 4
2) Soni A., Agrawal D. And Pande A. (2015) " Effect of Irregularities in Buildings and their Consequences" International Journal of Modern Trends in Engineering and Research (IJMTER) Volume 02, Issue 04, ISSN 2349–9745
3) Khan P. and Dhamge N.R. (2016) " " Review Paper On Seismic Analysis Of Multistoried Rcc Building Due To Mass Irregularity ". International Journal of Scientific Development and Research (IJSDR) ISSN: 2455-2631 Volume 1 Issue 6.
4) Hallale S. and H Sharada (2016) " Seismic Behavior of Buildings with Plan Irregularity with and Without Structural Infill Action " Researchgate International Journal of Recent Advances in Engineering & Technology (IJRAET) ISSN 2347 - 2812, Volume-4, Issue -4.
5) Akhil R and Kumar S (2017) " Seismic Analysis Of Regular And Irregular Buildings With Vertical Irregularity Using Staad.Pro" International Research Journal of Engineering and Technology (IRJET) ISSN: 2395 -0056 Volume: 04 Issue: 06
6) Adapa N (2017) " Static Analysis and Design of Multi- Storied (G+4) Residential Building Using Staad-Pro 2007" International Journal of Advanced Technology and Innovative Research Volume. 09, IssueNo.03.
7) T. Jayakrishna, K. Murali, Powar S and J Seetunya (2018) " Seismic Analysis Of Regular And Irregular Multi-Storey Buildings By Using Staad-Pro" International Journal of Civil Engineering and Technology (IJCIET) Volume 9, Issue 1
8) Kumar K and U. Dhiyaanesh (2018) " Comparative analysis of wind load on different non-circular shaped buildings" International Journal of Pure and Applied Mathematics Volume 119 No. 16 2018, 4809-4815.
9) Pritam C, P. Saklecha, and Milind R(2018) Comparison and analysis of regular and irregular configuration of multistory building in various seismic zones and various type of soil" International Advanced Research Journal in Science, Engineering and Technology ISO 3297:2007 Certified Vol. 5, Issue 6.
10) Raj R, Sharma A and Chohan S (2018) " Response of Square and Plus Shaped Buildings on Varying Wind Loads Urbanization Challenges in Emerging Economies.
11) A .Rajendra, Naidu D and Venkateswarlu D. (2018) " Comparative Analysis Of A, E Shaped Buildings Using Staad.Pro" International Journal of Research and Analytical Reviews (IJRAR) Volume 5, Issue 4.
12) V raman and V cheeranjivi (2018) " Comparative Study On Design Results Of A Multi-Storied Building Using Staad Pro And Etabs For Regular And Irregular Plan Configuration" International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 05 Issue: 01.
13) Dobule S (2018) " Seismic Analysis And Design Of Vertically Irregular R.C. Building Frames" International journal of advance research in science and engineering volume 7.
14) Raw A and Verma A (2019) " Seismic Analysis and Design of Vertically Irregular Mutistoried RC Concrete Building using Staad Pro V8i" International Journal of Trend in Scientific Research and Development (IJTSRD) Volume 4 Issue 1.
15) Yogita K. Kalambe and Sanjay Denge (2019) " Seismic Analysis of R.C.C. Building With Plan Irregularities" www.ijsart.com Volume 5 Issue 6.
16) Khare B and Gholgate K (2020) " Analysis of Different Shape of High Rise Building with Alternative RCC Shear Walls Using STAAD Pro" International Journal of Progressive Research in Science and Engineering Volume-1, Issue-3.
17) Zabihullah, Priyanka Singh and Mohammad Zamir Aryan (2020) " Effect of (Vertical & Horizontal) Geometric Irregularities on the Seismic Response of RC Structures" International Journal on Emerging Technologies 11(3): 965-974
Rashmi Agashe, Marshal Baghele, Vaishanvi Deshmukh, Sharad Khomane and Gaurav Patle (2020) To Study Analysis and Design of Multi-Storey building using STAAD-pro. and Comparing with Manual Calculations" International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 07 Issue: 04.
18) Pavani S and Rao M (2020) " Seismic Evalution Of Irregular Structure Using Staad Pro" International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 07 Issue: 07.
19) Smita and Juhi (2020) " Study of irregular multi-storey RC frame subjected to seismic condition analysis with STAAD Pro V8i software" International Journal of Advance Research, Ideas and Innovations in Technology.
20) Md Ali Akber (2021) " Impact Of Regular And Irregular Reinforced Concrete Structure Under Seismic Conditions" ResearchGate.
21) Mohamed Hamud Mohamed, Hanad Muse Ali and Abdikadir Hassan (2021) " A Review On Design And Analysis Of MultiStorey Building By Staad.Pro" Journal of Emerging Technologies and Innovative Research (JETIR) ISSN-2349-5162. [24] K venketash (2021) " Design and Analysis of Irregular Building Using STAAD Pro Without Earthquake Load" International Journal of Recent Advances in Multidisciplinary Topics Volume 2, Issue 11
22) Singhal P. (2016) " Study Of Response Of Vertically Irregular Buildings To Seismic Excitations Keeping Floor Area Constant " International conference on recent trends in engineering and science and management

23) IS 875(Part 1) -1987, “Code of Practice For Design Loads (Other Than Earthquake)For Buildings And Structures, Part 1: Dead Loads - Unit Weights of Building Material And Stored Materials, Second Revision , September 2003.
24) IS: 875 (Part 2) – 1987, “Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structures”, Part 2 Imposed Loads, Second Revision and June 1998.
25) IS 1893 (Part 1):2002/2016, “Criteria for Earthquake Resistant Design of Structures”, Part 1 General Provisions and Buildings.
26) IS 456:2000, “Plain and Reinforced Concrete - Code of Practice”, Fourth Revision, 2000.