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Analysis And Design Of G+10 Multi Storey Building Using Etabs

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Abstract **–** Most buildings with horizontal beams and vertical columns have straight forward geometry. Although it is possible to configure any building in 2009 with ETABS, in most cases a simple grid system described by horizontal and vertical column lines will achieve a minimal effort for the geometry of the building. Most buildings have a similar floor level. This function can be used to reduce modelling and design times drastically. The present work deals with the study, design and use of the most economical column beam approach to a multi-story residential building (G+10). Dead load & living loads have been applied and E-TABS' concept for beams, columns, base has exceeded its predecessors by its data sharing. With its current characteristics.The main principal purpose is to construct a multi-storey building that is secure and cost efficient against conditions of gravity loading and to serve the role for which the structures were planned. The dead load and live load are taken into account in the design of the structure. The structure analysis and design is performed using the ETABS software kit. We have followed a state-limited method of analysis in this multi-story project. IS 456-2000 verified the build.The results of analysis are used to check the fitness of structure for use. Computer software for the determination of force, timing of bending, tension, strain & distortion or distortion for a complex structural structure is often used. The principal aim of this project is to comparison ETABS 2009 with manual calculations of the design and analysis of a multi-story building (G+10).

Keywords **:**Gravity load, Hostel, building Etabs, Design.

Introduction

Since our country is the world's fast-growing country, there is no need for shelter for densely populated cities where land costs are high and more widespread horizontal expansion due to the lack of space, so vertical expansion is the only solution. The key element of civil engineering is structural design. The most important structural foundations are the construction of basic fundamental components and building members, such as plates, beams, columns and foundations. It is necessary to get the plan for the

specific building first to design them. The arrangement of the beams and the location of the columns are therefore fixed depending on the appropriate plan. The vertical loads of the deadload and the living load are then measured.

The area available is small and expenditure for any building project is increased, which leads to extensive development of multi-level, residential and commercial high-rise superstructures. Because of its various advantages over other materials like steel, wood etc., reinforced concrete designs have been generally accepted and applied. RECC structures that are properly designed and designed can provide adequate ductility to structures and strength and are easier to cast at higher altitudes than steel. Different software programmes such as STAAD Pro and ETABS are being developed to minimise the capital amount along with the required safety standards.

The key benefit and incentive of using this programme for design and analysis is to make building not only economical but also simpler and less time-consuming. The programme effectively manages almost all kinds of loads and geometric configurations. It is very tough to perform 3-dimensional frame analyses manually with precision both STAAD and ETABS. In this plates are meshed and analysed in order to produce the most reliable performance. Both applications support Finite Element Meshing. Manual calculations is almost negligible since both the programme contains all the latest Indians and other codes that result in material specifications being streamlined, while retaining the requisite safety standards.

In this article, ETABS was used to evaluate a typical G+10 residential house. The study aimed at modelling a structure, applying the vertical and horizontal loading to be obtained from the programme, in compliance with the Indian Codes (IS- 456, Is-875 {Part 1 , 2 , 3}). The paper was also enlarged on studying the reaction and base shear generated by horizontal loadings at the base of the shear wall and identifying the most effective shear wall position in the design of the structure.

Table 1: Basic data for analysis

Parameter	Values
Density of concrete	25 kN/m^3
Density of steel	7.85 kg/m^3
Grade of concrete	M30
Grade of steel	Fe415
Poisson ratio	0.17
Damping factor	0.05
Basic wind speed	50 m/s
Seismic zone	III
Importance factor	I

Soil type	Medium (type II)
Total number of story	G+10

Aim of Current Study

The goal of this project is to evaluate and design multi-story constructions with E-tabs. ETABS is currently the leading software on the market for design and modelling. Our structure is analysed with ETABS. By analysis on ETABS we studied various forces and factors affecting on the structure. The goal of structural design is to achieve an reasonable likelihood that the structure being built will serve its purpose and will avoid the impact that will impact the structure over its entire useful life.

Objective of Current Study

All expected loads should be carried without fail by the structure. Conduct a thorough study and design of the major construction elements of the building with multi-story slabs, columns, bars, etc. Getting acquainted with the structural software (E-TABS) the goal is to provide a structural analysis of multistored RCC construction using software (ETABS) by appropriate methods of structural analysis before that manual calculation. Beam, column, foundation and slab construction are completed. Further measurements are carried out with MS-Excel

The Main objectives are:

- The aim of this project is to check and design the multi-story building's seismic response through Etabs.
- To track normal and abnormal software construction (ETABS) multi-story behaviour.
- Understanding the precision of the analysis and design tools for irregularity of plan and elevation.
- Another object for a complex structural system is study of strength, bending moment, stress, tension and deflection.
- To resist the seismic impact of the house. os
- To examine the drift of storeys, moves, shear and the stiffness of the storey on the different floors, and frequency.
- Modeling the structure with ETABS V.9.7.4 software
- The application by Indian codal provision of gravity loads and various load combinations.
- study and specification for the worst case load combination of hostel construction.
- To understand basic structural concepts using standard Indian codes.
- To understand beam, columns, laths and other structural elements design parameters.
- To prepare 3D Structure Models for detailed study and design by using E-TABS Software.

Scope of the Study

The research is aimed at producing good structural work to evaluate and design a building for the residential population.

1. Through this project, we will learn some civil engineering related to structural design and analysis such as ETABS.
2. By using ETABS tools, we learn how to test the materials in our project structure

Methodology and Material Properties

The properties of materials like concrete and steel should be described in order to perform the work in ETABS software. Likewise, loads such as live load, super dead loads should be described.

Table 2: Material specifications

Material specifications	
Grade of concrete M30	f_{ck}=30N/mm^2
Grade of steel	f_y=415N/mm^3
Density of concrete	Γ_c=25KN/m^3
Density of brick walls concrete	Γ_{brick}=20KN/m^3

This step takes into account the final step. After the study has been completed, a concrete structural design according to IS 456: 2000 has now been carried out (Indian code). Select design variations for this purpose from the Design Menu. Following this, ETABS will again design a concrete frame design menu, and start design with a structure check, so that each structural element will be built.

Extended Three-Dimensional Building Systems Analysis is ETABS. ETABS has been used to develop the Burj Khalifa Mathematical Model developed by Chicago, Skidmore, Owings and Merrill LLP (SOM) based in Illinois. Skyscrapers, car park garages, steel & cement buildings, low-level buildings, portal structures and high-rise buildings are also used to evaluate the ETABS. The techniques of ETABS are developed specifically for the use of the special physical and numerical features connected to building type structures input , output, and numerical solution. A full range of Windows graphical tools and utilities, including modeller and postprocessor, are included in the base kit for showing all results including force diagrams and deflected types.

Table 3: Preliminary Data

Number of storeys	10
Size of beam	30cmx60cm
Size of column	50cmx50cm
Slab thickness	15cm
Support condition	fixed
Thickness External wall	20cm

Table 4: Details of Code

Steel frame preferences	IS 800 - 2007
Concrete frame preferences	IS 456 - 2000
Shear wall preferences	IS 456 - 2000
Composite beam preferences	AISC 360 -10
Composite column preferences	AISC 360 -10

Table 5: Story Data

Name	Height m	Elevation m	Master Story	Similar To
Story 10	3	31	Yes	None
Story 9	3	28	No	Story 10
Story 8	3	25	No	Story 10
Story 7	3	22	Yes	None
Story 6	3	19	No	Story 7
Story 5	3	16	No	Story 7
Story 4	3	13	No	Story 7
Story 3	3	10	No	Story 7
Story 2	3	7	No	Story 7
Story 1	4	4	No	Story 7
Base	0	0	No	None

Table 6: Frame sections-summary

Name	Material	shape
Beam 30*60	Concrete	Concrete rectangular
Column50*50	concrete	Concrete rectangular

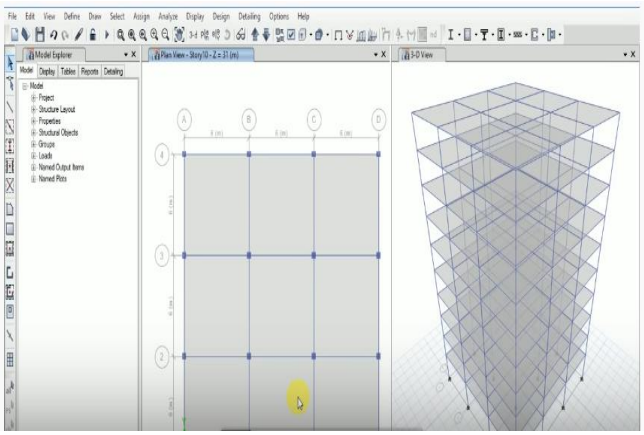


Figure 1: 2D & 3D view of a building

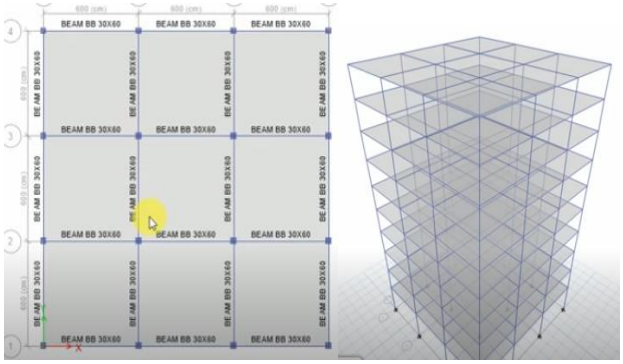


Figure 2: Assign the beams

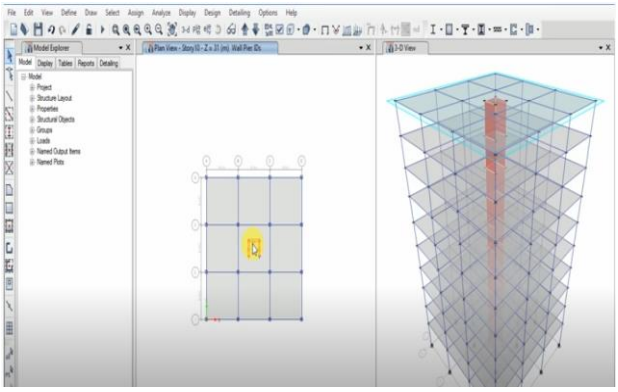


Figure 3: Shell Assignment

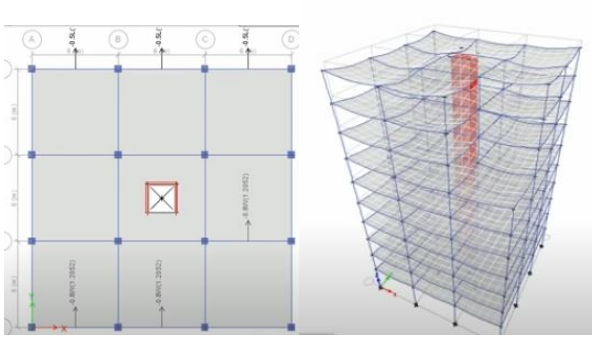


Figure 4: Deformation of a building (or) deflection details of a building

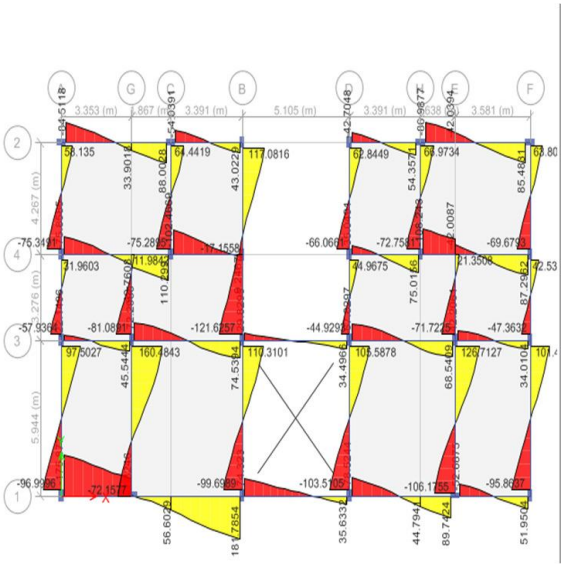


Figure 5: Shear force details

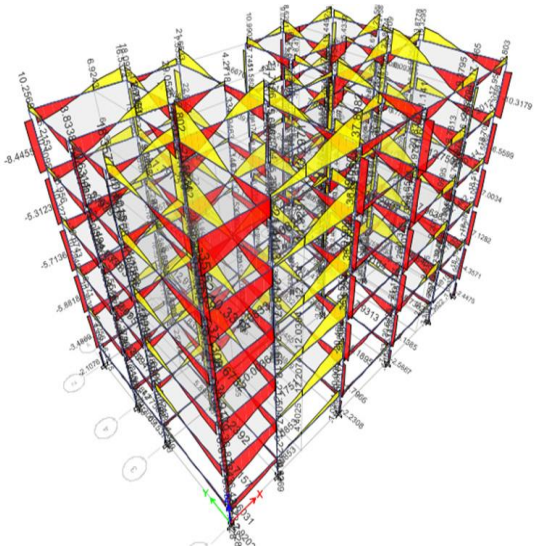


Figure 6: Shear force details in 3Dview

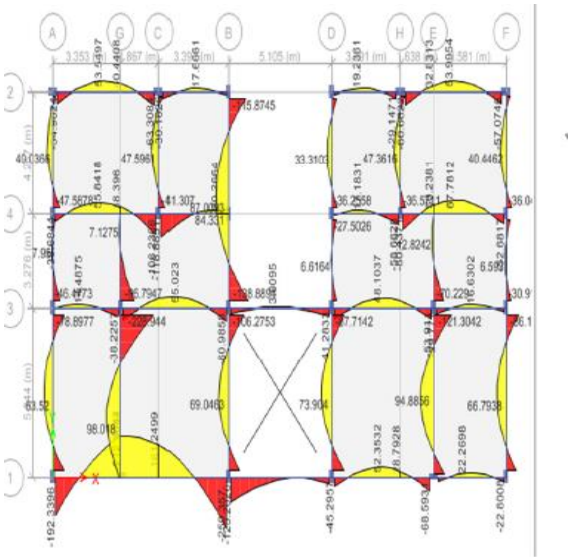


Figure 7: Bending moment details

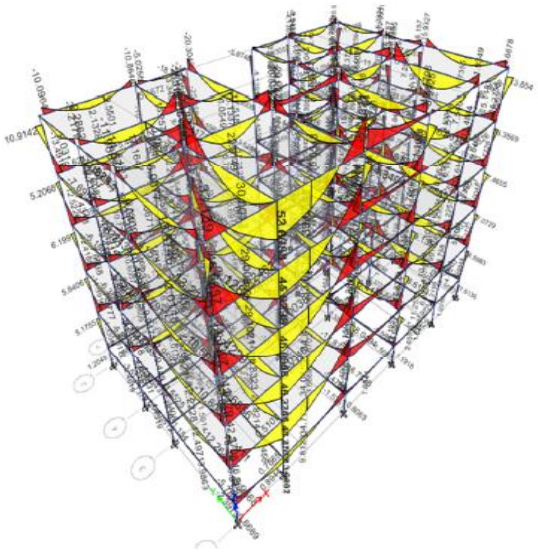


Figure 8: Bending moment in 3D view

Results and Discussions

Apartment building with G+10 floors is evaluated and planned. The analysis is conducted via the ETABS V15.2 programme, which has proven to be the premium in analysing and designing different components. Structural features are also included such as RCC frame, shear wall and retaining walls. The soil research report offers an isolated basis. ETABS are used to design RCC frames such as beams and columns. According to standard criteria, research and design were carried out as far as possible. Even the different difficulties in the design process and different limitations in the design of the architectural drawing that the structural engineer has faced were realised.

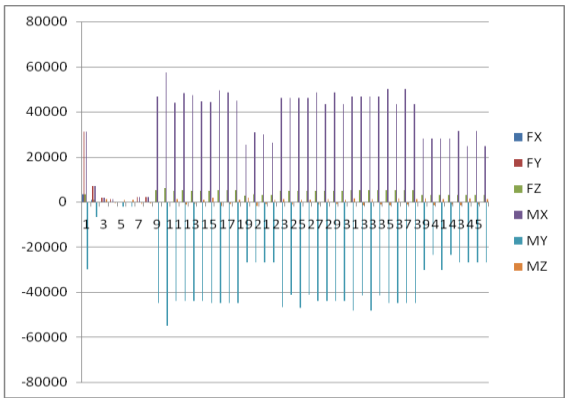
Two types of support reactions are like Shear strength and moments of curvature. Shear force is displayed in FX, FY and FZ for help reactions. And in MX, MY and MZ, the bending moment help reactions are represented.

Story	Point	Load	FX	FY	FZ	MX	MY	MZ
BASE	1	Dead	3392.0004	31192.9967	3392.0004	31192.9967	-29874.1549	0
BASE	2	Live	773	7119	773	7119	-6795	0
BASE	3	WINDX	-137.7701	1765.3167	-137.7701	1765.3167	-7.1655	1121.0991
BASE	4	WINDY	0	1247.0968	0	1247.0968	0	-680.4533
BASE	5	EQXA	0	0	0	0	-2238.838	1012.2531
BASE	6	EQXB	0	0	0	0	-2238.838	834.8752

BASE	7	EQXA	0	2238.838	0	2238.838	0	-939.7654
BASE	8	EQXB	0	2238.838	0	2238.838	0	-762.3875
BASE	1	Dead	0	0	5088.0006	46789.495	-44811.2324	0
BASE	2	Live	0	0	6247.5006	57467.995	-55003.7324	0
BASE	3	WINDX	-90.7271	40.675	4832.6763	43856.0159	-44011.5845	1345.3189
BASE	4	WINDY	90.7271	-40.675	5163.3247	48092.7761	-43994.3873	-1345.3189
BASE	5	EQXA	0	-90.7271	4998.0005	47470.9122	-44002.9859	-816.544
BASE	6	EQXB	0	90.7271	4998.0005	44477.8798	-44002.9859	816.544
BASE	7	EQXA	-113.4089	50.8437	4881.3454	44141.5199	-44821.9806	1681.6487
BASE	8	EQXB	113.4089	-50.8437	5294.6558	49437.4701	-44800.4841	-1681.6487
BASE	1	Dead	0	-113.4089	5088.0006	48660.1403	-44811.2324	-1020.68
BASE	2	Live	0	113.4089	5088.0006	44918.8497	-44811.2324	1020.68
BASE	3	WINDX	-113.4089	50.8437	2846.1451	25425.7219	-26897.4877	1681.6487
BASE	4	WINDY	113.4089	-50.8437	3259.4556	30721.6721	-26875.9912	-1681.6487
BASE	5	EQXA	0	-113.4089	3052.8004	29944.3423	-26886.7394	-1020.68
BASE	6	EQXB	0	113.4089	3052.8004	26203.0517	-26886.7394	1020.68
BASE	7	EQXA	-118.2519	0	4998.0005	45974.396	-46689.5915	1214.7038
BASE	8	EQXB	118.2519	0	4998.0005	45974.396	-41316.3803	-1214.7038
BASE	1	Dead	-118.2519	0	4998.0005	45974.395	-46883.5915	1001.8503
BASE	2	Live	118.2519	0	4998.0005	45974.396	-41316.3803	1001.8503
BASE	3	WINDX	0	-118.2519	4998.0005	48661.0016	-44002.9859	-1127.7185
BASE	4	WINDY	0	118.2519	4998.0005	43287.7904	-44002.9859	1127.7185
BASE	5	EQXA	0	-118.2519	4998.0005	48661.0016	-44002.9859	-914.65
BASE	6	EQXB	0	118.2519	4998.0005	43287.7904	-44002.9859	914.865
BASE	7	EQXA	-147.8149	0	5088.0006	46789.495	-48169.4894	1518.3797
BASE	8	EQXB	147.8149	0	5088.0006	46789.495	-41452.9754	-1518.3797
BASE	1	Dead	-147.8149	0	5088.0006	46789.495	-48169.4894	1252.3129
BASE	2	Live	147.8149	0	5088.0006	46789.495	-41452.9754	-1252.3129
BASE	3	WINDX	0	-147.8149	5088.0006	50147.752	-44811.2324	-1409.6481

BASE	4	WINDY	0	147.8149	5088.0006	43431.238	-44811.2324	1409.6481
BASE	5	EQXA	0	-147.8149	5088.0006	50147.752	-44811.2324	-1143.5812
BASE	6	EQXB	0	147.8149	5088.0006	43431.238	-44811.2324	1143.5812
BASE	7	EQXA	-147.8149	0	3052.8004	28073.697	-30244.9964	1518.3797
BASE	8	EQXB	147.8149	0	3052.8004	28073.697	-23528.4824	-1518.3797
BASE	1	Dead	-147.8149	0	3052.8004	28073.697	-30244.9964	1252.3129
BASE	2	Live	147.8149	0	3052.8004	28073.697	-23528.4824	-1252.3129
BASE	3	WINDX	0	-147.8149	3052.8004	31431.954	-26886.7394	-1409.6481
BASE	4	WINDY	0	147.8149	3052.8004	24715.44	-26886.7394	1409.6481
BASE	5	EQXA	0	-147.8149	3052.8004	31431.954	-26886.7394	-1143.5812
BASE	6	EQXB	0	147.8149	3052.8004	24715.44	-26886.7394	1143.5812

Table 7: Support Reactions



Graph 1: support reaction

The Graph is clear that the shear force values are in FX, FY and Fz. The bending moment values in MX, MY and MZ.

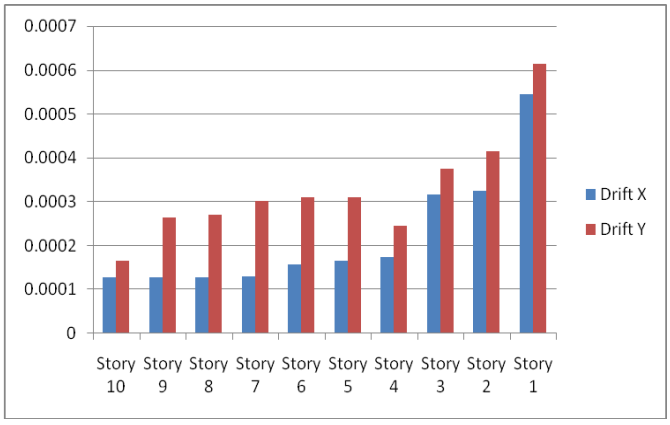
STOREY SHEAR

The seismic force at the bottom is referred to as base shear. The side forces at various levels are known as shelf shears because of an earthquake. Its value at the lower level is highest and at the top level the lowest. It is known as the lateral force which acts horizontally in each storey during the earthquake, and at the base of a building called the base shear, maximum lateral shear should always be used.

Shear for ESA in X & Y axis full past
For the combination of seismic load (1,2DL+1,2LL+1,2EqX) and the Y direction for the combination of seismic load (1,2DL+1,2LL+1,2EQY) is obtained the shelf shear in a building along X direction.

Story	Drift X	Drift Y
Story 10	0.000127	0.000166
Story 9	0.000127	0.000265
Story 8	0.000127	0.000270
Story 7	0.000130	0.000301
Story 6	0.000157	0.000310
Story 5	0.000166	0.000311
Story 4	0.000173	0.000245
Story 3	0.000317	0.000375
Story 2	0.000325	0.000415
Story 1	0.000545	0.000615

Table 8: Storey Shear



Graph 2: Storey Shear

From the above story shear graph it is clear that, the story shear of structure increases as we go to higher seismic stories. The story shear of the building for each floor in Drift X is 0.000545, 0.000325, 0.000317, 0.000173, 0.000166, 0.000157, 0.000130, 0.000127, 0.000127 and 0.000127.

The story shear of the building for each floor in Drift Y is 0.000615, 0.000415, 0.000375, 0.000245, 0.000311, 0.000310, 0.000301, 0.000270, 0.000265 and 0.000166.

Conclusions:

The following results are taken from the study and construction of a multi-story building:

- Apartment building with G+10 floors is evaluated and planned. The test is carried out using the ETABS V15.2 programme,
- In particular for sunlight and wind direction the architecture and design of the building must obey the nature. These concepts were vastly clarified only at the start of the project.
- IS875 has been used for all forces and loads in design IS456. Using low weight concrete and light weight materials can minimise the dead framework load and then minimise the column height, the foundation and other load-bearing components by the builder.
- Design was carried out with ETABS software and manually reviewed in compliance with IS 456-2000.
- Analysis and design can be carried out within the specified timeframe with the use of ETABS. Compared with manual calculations and design, the analysis and design results obtained from software are secure.
- The value of dead, living and floor finishing loads obtained by the software ETABS are identical to those obtained by hand. In response to design earthquake loads, the results of the analysis of the structural integrity of the building were done and were assessed as safe.

Future Scope of Study:

This experimental work was performed on a 10-story building with frame and shear walls to achieve an efficient design only. Four different models can be explored to ensure that the potential work is optimised with pre-cast elements (frame + shear walls) (frame + shear core), (frame + shear walls + shear core).

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- ETABS can also be used to perform complex analyses.
- Secure may be used to design slabs and footings.
- Various slab forms can be drawn up in ETABS 2016 V16.2.
- Even traditional or STAAD-PRO approaches may be used to construct the parts of ETABS.
- Analyzed and formed in ETABS can also be the abnormal structures subjected to various load cases.

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