Design And Analysis Of Prefabricated Structure Using E TAB

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Abstract: ***Precast concrete is well known technology in which some standardized units which are manufactured in factories are used for fast construction. Though the technology is developed many years ago but the implementation is not up the mark in our country. In this study we have carried out detailed study of various concepts of precast, go through number of literature & found the facts associated with it. Existing reinforced concrete structures stock is wide and also includes buildings with precast elements, being largely used since Fifties primarily to satisfy needs of the manufacture and tertiary purposes. Their diffusion has been supported by flexibility of structural net dimensions and by the economy and efficiency of the constructional process. For this purpose a reference project at Chennai location is taken and modelled in ETABS software to analyze the structure and design.***

Keywords: Design, Analysis, Prefabricated Structure, E TAB

1. INTRODUCTION

Seismology is the scientific study of earthquakes elastic waves Earth earthquake environmental effects tsunamis seismic sources geology paleo seismology. A recording of earth motion as a function of time is called a seismogram. A seismologist is a scientist who does research in seismology and the propagation of through the or through other planet-like bodies. The field also includes studies of such as well as diverse such as volcanic, tectonic, oceanic, atmospheric, and artificial processes such as explosions.Generally concrete is good in compression and weak in tension. So in order to overcome the weakness in the tensile strength reinforcement is placed in the concrete so it is known as reinforced concrete. Now a days in order to complete work fast precast structures are used. Precast structures are easy to cast and easy to construction in site. The time taken for the construction is also very less when compared with the normal construction. The structural components are standardizedand produced in plants in a location away from the building site.

- Then transported to the site for assembly.
- The components are manufactured by industrial methods based on mass production in order to build a large number of buildings in a short time at low cost.

Precast concrete construction is not a new construction technique it's as old as traditional construction itself. But it was not extensively used and its application was only limited to industrial structures and long span elements like bridge girder, tunnel lining, retaining wall etc. Precast concrete construction was not used in large scale in commercial and residential projects due to many problems the major drawbacks were,

- Lack of standard guidelines by building authorities,
- Complicated analysis design procedures, which was not possible without advancement of computer application in analysis and design.

But in present days precast concrete construction used in phase of industrialization of construction Industry. This technique is gaining importance in present days supported by Advancement in automations on production of precast elements. Introduction of heavy lifting equipment and transportation vehicle. Improvement in concrete technology also required strength and mechanical properties can be achieved easily in concrete now a day.

Advancement in connection technique to assemble precast component like post stressing, dowel connection, steel anchor connections etc. The cons of these technique are Improved quality control can be maintained in industrial production. Better indoor working condition to cast precast components. The shortage of onsite skilled workers is solved by precast construction. The precast components are cast in precise steel moulds hence onsite formwork is not required. Cost effective production due to cost reduction from formwork, scaffolding. Time saving is achieved hence it is erected easily without huge time gap for curing, formwork, reinforcement fabrication on site. Slender members like T-section and I-section can be produced to meet the architectural demand and material saving. Transportation cost is reduced when the project site is in economical reach. But the major difficulty faced by structural engineers in implementing this technique in large scale project because its seismic performance was not satisfactory which majorly depend on connection type used to connect one member with other and lack of stiffening elements for horizontal stiffness of structure with shear wall and core walls.

1.1 Features

- The division and specialization of the human workforce.
- The use of tools, machinery, and other equipment, usually automated, in the
- Production of standard, interchangeable part sand products.
- Compared to site-cast concrete, precast concrete erection is faster and less affected by adverse weather conditions.
- Plant casting allows increased efficiency, high quality control and greater control on finishes.

1.2 Comparison

1.2.1 Site-Cast

- No transportation
- The size limitation is depending on the elevation capacity only
- Lower quality because directly affected by weather
- Proper, large free space required.

1.2.2 Precast At Plant

- Transportation and elevation capacity limits the size.
- Higher, industrialized quality – less affected by weather.
- No space requirement on the site for fabrication.
- Unlimited opportunities of architectural appearance
- Option of standardized components.

1.3 Description Of Building

The building is a G+6 stories apartment including car parks, swimming pool and security. A typical floor of the building measures around 2284.6 Sq.m& having 4 m building grids in both directions is shown in Figure. The design floor-to-floor height is 4.0 m. Staircases, lift cores and other building services such as toilets etc. are included & the cast in-situ construction is provided wherever necessary.

1.3.1 Loading Consideration

Loads acting on the structure are dead load (DL), Live Load (IL) and Earthquake Load (EL)

- DL: Self weight of the structure, Floor load and Wall loads
- LL: Live load 3KN/m^2 is considered
- SeismicZone: III
- Zone Factor: 0.16
- Soil type: II
- Response reduction factor: R=5
- Importance factor: 1
- Damping: 5%
- Time period: 0.427 sec (calculated as per IS 1893: 2002)

2. METHODOLOGY

Figure 1 shows the methodology of the study

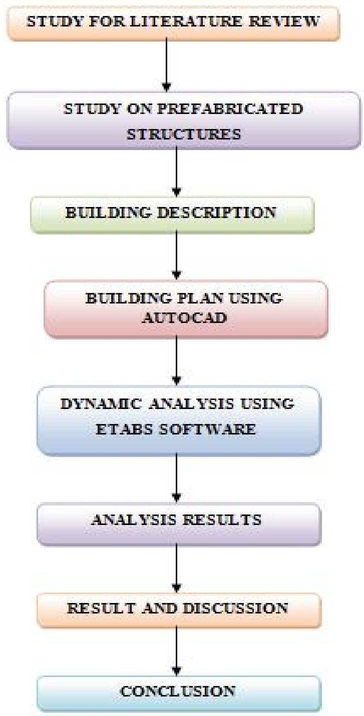

Figure 1: Methodology

3. PREFABRICATED STRUCTURES

3.1 Prefabrication

Prefabrication is the practice of assembling components of a structure in a factory or other manufacturing site and transporting complete assembles to the construction site where the structure is to be located. Prefabricated building is the completely assembled and erected building of which the structural parts consist of prefabricated individual units or assemblies using ordinary or controlled materials.
Prefabricated construction is a new technique and is desirable for large scale housing programmes.

3.1.2 Principles

- To effect economy in cost
- To improve in quality as the components can be manufactured under controlled conditions.
- To speed up construction since no curing is necessary.
- To use locally available materials with required characteristics.
- To use the materials which possess their innate characteristics like light weight, easy workability, thermal insulation and combustibility etc.

3.1.3 Need For Prefabrication

- Prefabricated structures are used for sites which are not suitable for normal construction method such as hilly region and also when normal construction materials are not easily available.
- PFS facilities can also be created at near a site as is done to make concrete blocks used in plane of conventional knick.
- Structures which are used repeatedly and can be standardized such as mass housing storage sheds, godowns, shelter, bus stand security cabins, site offices, fool over bridges road bridges. Tubular structures, concrete building blocks etc. are prefabricated structures.

3.1.4 Process Of Prefabrication

- An example from house building illustrates the process of prefabrication.
- The conventional method of building a house is to transport bricks, timber, cement, sand, steel and construction aggregate etc. to the site and to construct the house on site from these materials.
- In prefabricated construction only the foundations are constructed in this way. While sections of walls floors and roof are prefabricated structures with windows and doorframe included and transported to the site lifted in to place by a crane and boiled together.

3.2 Design Considerations

- Final position and loads
- Transportation requirements – self load and position during transportation
- Storing requirements – self-load and position during storing – (avoid or store in the same position as it transported / built in)
- Lifting loads – distribution of lifting points – optimal way of lifting (selection of lifting and rigging tools)
- Vulnerable points (e.g. edges) – reduction of risk (e.g. rounded edges)

3.3 Uses Of Prefabrication

- The most widely used form of prefabrication building and civil engineering is the use of prefabrication concrete & prefabricated steel sections in structures where a particular part or form is repeated many times.
- Pouring concrete sections in a factory brings the advantages of being able to re-use moulds and the concrete can be mixed on the spot without having to be transported to and pumped wet on a congested construction site.
- Prefabricating steel sections reduces on-site cutting and welding costs as well as the associated hazards.
- Prefabrication techniques are used in the construction of apartment blocks and housing developments with repeated housing units.
- The technique is also used in office blocks, warehouses and factory buildings.
- Prefabricated steel and glass section are widely used for the exterior of large buildings.
- Prefabricated bridge elements and systems offer bridge designers & contractors significant advantages in terms of construction time safety environmental impact constructability and cost.
- Prefabrication can also help minimize the impact on transfer from bridge building.
- Radio towers for mobile phone and other services often consist of multiple prefabricated sections.
- Prefabricated has become widely used in the assembly of aircraft and space craft with component such as wings and fuselage sections often being manufactured in different countries or states from the final assembly site.

3.4 Materials Used

Prefabricated building materials are used for buildings that are manufactured offsite and shipped later to assemble at the final location some of the commonly used prefabricated building. The materials used in the prefabricated components are many. The modern trend is to use concrete steel, treated wood, aluminium cellular concrete, light weight concrete, ceramic products etc. While choosing the materials for prefabrication the following special characteristics are to be considered.

- Light weight for easy handling and transport and to economic an sections and sizes of foundations.
- Thermal insulation property
- Easy workability
- Durability in all weather conditions
- Non combustibility
- Economy in cost
- Sound insulation

3.5 Types Of Pre Cast System

- Large-panel systems
- Frame systems
- Slab-column systems with walls
- Mixed systems

3.5.1 Large-Panel Systems

- Box-like structure.
- Both vertical and horizontal elements areload-bearing.
- One-story high wall panels (cross-wall system / longitudinal wall system / two way system).
- One-way or two way slabs.

3.3.2 Frame Systems

- Components are usually linear elements.
- The beams are seated on corbels of the pillars usually with hinged joints(rigid connection is also an option).
- Joints are filled with concrete at the site.

3.3.3Slab-Column Systems With Walls

- Partially precast (pillars) / partially precast onsite (slabs).
- One or more storey high pillars (max 5).up to 30 storey high constructions.
- Special designed joints and temporary joints.
- Slabs are casted on the ground (one on top of the other) – then lifted with crane or special elevators.

3.6 Advantage Of Prefabrication

- Self supporting readymade components are used so the need for form work shuttering and scaffolding is greatly reduced.
- Construction time is reduced and buildings are completed sooner allowing on earlier return of the capital invested. On-site construction and congestion is minimized.
- Quality control can be easier in a factory assembly line setting than a construction site setting.
- Prefabrication can be located where skilled labour, power materials space and overheads are lower.
- Time spent in bad weather or hazardous environments at the construction site is minimized
- Availability of precise structure and expect workmanship. Work time is reduced.
- Fewer expansion joints are required.
- Interruptions in connecting can be omitted.
- Work is done with a better technology.
- Less workers are needed.
- Members can be used again.

3.7 Prefabricated Construction Systems

The system of prefabricated construction depends on the extent of the use of prefabricated components, their material, sizes and the technique adopted for their manufacture and use in building. The various prefabrication systems are outlined below.

- Small prefabrication
- Medium prefabrication
- Large prefabrication
- Open prefabrication system
- Partial prefabrication open system
- Full prefabrication open system
- Large panel prefabrication system
- Wall system
- Cross wall system
- Longitudinal wall system
- Floor system
- Stair case system
- Box type system

3.7.1 Small Prefabrication

The first 3 types are mainly classified according to their degree of precast elements using in that construction. foreg:- brick is a small unit precasted and used in buildings. This is called as small prefabrication. That the degree of precast element is very low.

3.7.2 Medium Prefabrication

Suppose the roofing systems and horizontal member are provided with precast elements. These constructions are known as medium prefabricated construction. Here the degree of precast elements are moderate.

3.7.3 Large Prefabrication

In large prefabrication most of the members like wall panels, roofing/flooring systems, beams and columns are prefabricated. Here degree of precast elements are high.

4. ABOUT SOFTWARE

4.1 ETABS

Computers and Structures, Inc. (CSI) is a structural and earthquake engineering software company founded in 1975 and based in Walnut Creek, California with additional office location in New York. The structural analysis and design software CSI produce include SAP2000, CSI Bridge, ETABS, SAFE, PERFORM-3D, and CSiCOL.One of Computer and Structure, Inc.'s software, ETABS, was used to create the mathematical model of the BurjKhalifa, currently the world's tallest building, designed by Chicago, Illinois-based Skidmore, Owings & Merrill LLP (SOM). In the Structural analysis section of their December 2009 Structural Engineer magazine article entitled Design and construction of the world's tallest building:

In the last 30 years TABS and ETABS have set the international standards in structural analysis and design. They first took into consideration the characteristic properties of a building's mathematical model, thereby allowing the graphical creation of a building's model in the same sequence that the it will actually be constructed (slab by slab, floor by floor). Worldwide, ETABS is considered the most popular analysis and design software. The "Top Seismic Product of the 20th Century" (2006) and "Honor Award in Engineering Software" (2002) awards, establish it as the innovator in structural analysis and design and the reference point for the entire market. The latest version of ETABS continues in that tradition, incorporating structural element terminology that is used on a daily basis (Columns, Beams, Bracings, Shear Walls etc.), contrary to the common civil engineering programs that use terms such as nodes, members etc. Additionally, it offers many automatic functions for the formation, analysis and design of the structural system in an efficient, fast and easy way. The user can easily create a model, apply any kind of load to it and then take advantage of the superior capabilities of ETABS to perform a state-of-the-art analysis and design. ETABS is the solution, whether you are designing a simple 2D frame or performing a dynamic analysis of a complex high-rise that utilizes non-linear dampers for inter-story drift control.

4.2 Areas Of Application

Analysis and design of building structures with a structural system consisting of beams, slabs, columns, shear walls and bracings. Different materials can be assigned to the structural elements within the same model such as steel, RC, composite or any other user-defined material. Easy and automatic generation of gravity and lateral loads (seismic and wind loads) when compared with other FE general analysis programs.

4.3 Advantages

- Graphic input and editing for easy and fast model generation
- 3D generation of the model through plan views and elevations Fast model generation using the concept of Similar stories
- Easy editing through the Move, Merge, Mirror and Copy commands
- Accuracy in dimensions by using Snaps (end, perpendicular, middle etc.)
- Fast object creation with one click of the mouse
- Multiple viewing windows.
- 3D view with zoom and pan capability
- 3D axonometric view of the model, plan view, elevation view, elevation development view, custom view defined by the user.
- Graphic input of cross sections of any geometry and material (Section Designer)
- Copy and Paste of the geometry of a model to and from spreadsheets

4.4 ETABS Nonlinear Further Expands The Potential Of Plus With The Following

- Static non linear analysis
- Construction sequence analysis
- Plastic hinge element
- Static pushover analysis according to FEMA 273, 356 and ATC-40
- Non linear dynamic analysis
- Gap/Hook elements that act only in tension or compression with an initial void or not
- Damp element
- Elasto-plastic element
- Seismic base isolator element with hysteretic behavior (LRB)
- Friction Pendulum System (FPS) seismic base isolator element

5. E-TABS RESULTS

5.1 Structure Data

This chapter provides model geometry information, including items such as story levels, point coordinates, and element connectivity.

5.1.1 Story Data

Table 1 shows the storey data of ETABS

Table 1: Storey Data

Name	Height mm	Elevation mm	Master Story	Similar To	Splice Story
Story6	1500	18000	Yes	None	No
Story5	3000	16500	No	Story6	No
Story4	3000	13500	No	Story6	No
Story3	3000	10500	No	Story6	No
Story2	3500	7500	No	Story6	No
Story1	4000	4000	No	Story6	No
Base	0	0	No	None	No

5.2 Loads

This chapter provides loading information as applied to the model.

5.2.1 Load Patterns

Table 3 shows the load patterns

Table 2: Load patterns

Name	Type	Self Weight Multiplier	Auto Load
Dead	Dead	1	
Live	Live	0	
SEISMIC	Seismic	1	IS1893 2002
SEISMIC 1	Seismic	1	User Loads

5.3 Functions

Figure 2 shows the rendered view

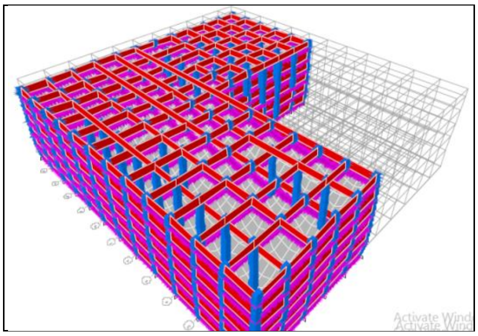

Figure 2 Rendered view

Figure 3 shows the building storey

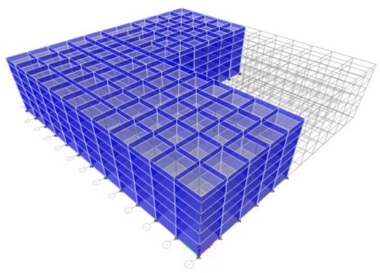

Figure 3 Buliding storey

5.3.1 Response Spectrum Functions

Table 3 Shows the Response Spectrum function

Table 3 Response Spectrum Function - IS 1893:2002

Name	Period sec	Acceleration	Damping	Z	Soil Type
Func2	0	0.36	5	0.36	II
Func2	0.1	0.9			
Func2	0.55	0.9			
Func2	0.8	0.612			
Func2	1	0.4896			
Func2	1.2	0.408			
Func2	1.4	0.349714			
Func2	1.6	0.306			
Func2	1.8	0.272			
Func2	2	0.2448			
Func2	2.5	0.19584			
Func2	3	0.1632			
Func2	3.5	0.139886			
Func2	4	0.1224			
Func2	4.5	0.1224			

5.3.2 Load Cases

Table 4 shows Load Cases – Summary

Table 4 Load Cases - Summary

Name	Type
Dead	Linear Static
Live	Linear Static
SEISMIC	Linear Static
SEISMIC 1	Linear Static
RES	Response Spectrum
TIME	Nonlinear Modal History (FNA)
BUCK	Buckling

5.4 Analysis Results

This chapter provides analysis results.

5.4.1 Structure Results

Table 5 shows Base Reactions and Table 6 shows Response Spectrum Modal Information

Table 5 Base Reactions

Load Case/Combo	FX KN	FY KN	FZ KN	MX KN-m	MY KN-m	MZ KN-m
Dead	0	0	260459.5565	9300699	-5672550	0
Live	0	0	0	0	0	0
SEISMIC 1	-60489.103	0	260459.5565	9300699	-6226515	1665430
SEISMIC 2	0	-60489.103	260459.5565	9852664	-5672550	-882285
SEISMIC 3	-60489.103	0	260459.5565	9300699	-6226515	1665430
SEISMIC 4	0	-60489.103	260459.5565	9852664	-5672550	-882285
SEISMIC 5	-60489.103	0	260459.5565	9300699	-6226515	1665430
SEISMIC 6	0	-60489.103	260459.5565	9852664	-5672550	-882285
SEISMIC 1	0	0	260459.5565	9300699	-5672550	0
RES Max	83709.7669	64580.7966	0	766074.9712	996281.703	3230604
TIME Max	11.6653	0.4725	0	6.2065	120.9026	383.268
TIME Min	-10.5363	-0.5199	0	-5.6362	-115.205	-396.3479
BUCK 1	-0.0591	0.0091	3.836E-05	-0.3862	-0.9439	1.9503
BUCK 2	-0.095	0.0035	-0.0006	-0.1261	-1.5437	2.7225
BUCK 3	-1.1632	0.0412	-0.0001	-0.4908	-3.5089	33.5641
BUCK 4	0.0056	-0.002	0.0005	0.0603	0.256	0.1063
BUCK 5	0.0077	0.0026	0.0013	-0.0476	-0.066	-0.0596
BUCK 6	0.0267	-0.0033	0.0001	-0.0079	0.103	-0.5934
1	0	0	8334706	2976223361	-1815216805	0
2	0	0	4167353	1488111181	-907608403	0
3	0	0	2083676	744055590	-453804401	0
4	0	0	1041838	372027795	-226902201	0
5	0	0	520919.1129	186013898	-113451100	0
6	0	0	260459.5565	93006899	-56725550	0
Comb1 Max	929987.5941	76223.661	651129.1851	16651986	10202589	3539036
Comb1 Min	-929987.5941	-76223.661	-651129	-16651986	-10202589	-3539036

Table 6 Response Spectrum Modal Information

Response Spectrum Case	Modal case	Mode	Period sec	Damping Ratio	U1 Acceleration mm/sec²	U2 Acceleration mm/sec²	U3 Acceleration mm/sec²	U1 Amplitude mm	U2 Amplitude mm	U3 Amplitude mm
RES	Modal	1	0.073	0.05	7392.9	0	7392.9	86.8	0	0
RES	Modal	2	0.069	0.05	7173.2	0	7173.2	-46.1	0	0
RES	Modal	3	0.066	0.05	7031.42	0	7031.42	-70.6	0	0
RES	Modal	4	0.062	0.05	6839.56	0	6839.56	-24.2	0	0
RES	Modal	5	0.049	0.05	6147.77	0	6147.77	1.7	0	0
RES	Modal	6	0.047	0.05	6030.82	0	6030.82	-0.3	0	0
RES	Modal	7	0.043	0.05	5781.23	0	5781.23	-0.9	0	0
RES	Modal	8	0.04	0.05	5624.69	0	5624.69	0.9	0	0
RES	Modal	9	0.036	0.05	5429.6	0	5429.6	-0.02215	0	0
RES	Modal	10	0.034	0.05	5323.02	0	5323.02	-0.1	0	0
RES	Modal	11	0.032	0.05	5239.97	0	5239.97	-0.2	0	0
RES	Modal	12	0.03	0.05	5140.1	0	5140.1	0.0494	0	0

5.5 Story Results

Table 7 shows Story Drifts

Table 7 Story Drifts

Story	Load Case/Combo	Label	Item	Drift	X m	Y m	Z m
Story6	Dead	23	Max Drift X	9E-06	0	50	18
Story6	Dead	115	Max Drift Y	1.3E-05	30	60	18
Story6	Live	86	Max Drift X	0	30	55	18
Story6	Live	86	Max Drift Y	0	30	55	18
Story6	SEISMIC 1	13	Max Drift X	2.4E-05	0	0	18
Story6	SEISMIC 1	115	Max Drift Y	1.6E-05	30	60	18
Story6	SEISMIC 2	68	Max Drift X	1.1E-05	25	35	18
Story6	SEISMIC 2	85	Max Drift Y	3.8E-05	30	50	18
Story6	SEISMIC 3	13	Max Drift X	2.4E-05	0	0	18
Story6	SEISMIC 3	115	Max Drift Y	1.6E-05	30	60	18
Story6	SEISMIC 4	68	Max Drift X	1.1E-05	25	35	18
Story6	SEISMIC 4	85	Max Drift Y	3.8E-05	30	50	18
Story6	SEISMIC 5	13	Max Drift X	2.4E-05	0	0	18
Story6	SEISMIC 5	115	Max Drift Y	1.6E-05	30	60	18
Story6	SEISMIC 6	68	Max Drift X	1.1E-05	25	35	18
Story6	SEISMIC 6	85	Max Drift Y	3.8E-05	30	50	18
Story6	SEISMIC 1	23	Max Drift X	9E-06	0	50	18
Story6	SEISMIC 1	115	Max Drift Y	1.3E-05	30	60	18
Story6	RES Max	13	Max Drift X	5.4E-05	0	0	18
Story6	RES Max	86	Max Drift Y	4.8E-05	30	55	18
Story6	TIME Max	10	Max Drift X	0	25	0	18
Story6	TIME Max	114	Max Drift Y	0	25	60	18
Story6	TIME Min	10	Max Drift X	0	25	0	18
Story6	TIME Min	114	Max Drift Y	0	25	60	18
Story6	BUCK 1	114	Max Drift X	5.052E-08	25	60	18
Story6	BUCK 1	115	Max Drift Y	2.044E-07	30	60	18
Story6	BUCK 2	4	Max Drift X	6.444E-08	15	0	18
Story6	BUCK 2	1	Max Drift Y	1.254E-07	10	0	18

5.6 Modal Results

Table 8 shows Modal Periods and Frequencies and Table 9 shows Modal Participating Mass Ratios (Part 1 of 2) and Table 10 shows Modal Participating Mass Ratios (Part 2 of 2)

Table 8 Modal Periods and Frequencies

Case	Mode	Period sec	Frequency cyc/sec	Circular Frequency rad/sec	Eigenvalue rad^2/sec^2
Modal	1	0.073	13.71	86.1441	7420.8087
Modal	2	0.069	14.537	91.3393	8342.8748
Modal	3	0.066	15.126	95.0385	9032.3105
Modal	4	0.062	16.003	100.5484	10109.9895
Modal	5	0.049	20.232	127.1243	16160.59
Modal	6	0.047	21.179	133.0701	17707.6447
Modal	7	0.043	23.527	147.8261	21852.56
Modal	8	0.04	25.286	158.8749	25241.2402
Modal	9	0.036	27.883	175.1952	30693.3748
Modal	10	0.034	29.541	185.6116	34451.6488
Modal	11	0.032	30.976	194.6279	37880.0143
Modal	12	0.03	32.898	206.7029	42726.0786

Table 9 Modal Participating Mass Ratios (Part 1 of 2)

Case	Mode	Period sec	UX	UY	UZ	Sum UX	Sum UY	Sum UZ
Modal	1	0.073	0.3222	0.0086	0	0.3222	0.0086	0
Modal	2	0.069	0.122	0.5634	0	0.4442	0.572	0
Modal	3	0.066	0.3491	0.2109	0	0.7932	0.7829	0
Modal	4	0.062	0.0542	0.0677	0	0.8474	0.8506	0
Modal	5	0.049	0.0009	0.0001	0	0.8483	0.8507	0
Modal	6	0.047	3.563E-05	0.0026	0	0.8483	0.8533	0
Modal	7	0.043	0.0005	0.0001	0	0.8488	0.8534	0
Modal	8	0.04	0.0007	0.0001	0	0.8495	0.8535	0
Modal	9	0.036	6.647E-07	0.0002	0	0.8495	0.8537	0
Modal	10	0.034	3.109E-05	5.284E-06	0	0.8496	0.8537	0
Modal	11	0.032	0.0001	6.368E-06	0	0.8496	0.8537	0
Modal	12	0.03	7.151E-06	7.368E-06	0	0.8496	0.8537	0

Table 10 Modal Participating Mass Ratios (Part 2 of 2)

Case	Mode	RX	RY	RZ	Sum RX	Sum RY	Sum RZ
Modal	1	0.0035	0.1335	0.3885	0.0035	0.1335	0.3885
Modal	2	0.2241	0.0477	0.1116	0.2276	0.1813	0.5001
Modal	3	0.0799	0.1335	0.2745	0.3075	0.3148	0.7746
Modal	4	0.0231	0.0212	0.0797	0.3306	0.336	0.8543
Modal	5	4.781E-05	0.0005	0.0002	0.3306	0.3365	0.8546
Modal	6	0.0009	1.574E-05	0.0004	0.3315	0.3365	0.855
Modal	7	0.0001	0.0002	0.0001	0.3316	0.3367	0.8551
Modal	8	5.827E-07	0.0002	0.0003	0.3316	0.3369	0.8554
Modal	9	1.605E-05	1.32E-06	0.0013	0.3316	0.3369	0.8567
Modal	10	5.081E-06	0.0001	0.0011	0.3316	0.337	0.8578
Modal	11	4.459E-06	1.278E-05	0.0003	0.3316	0.337	0.8581
Modal	12	0.0001	0.0006	0.0002	0.3317	0.3376	0.8583

Table 11 Modal Load Participation Ratios and Table 12 Modal Direction Factors

Table 11 Modal Load Participation Ratios

Case	Item Type	Item	Static %	Dynamic %
Modal	Acceleration	UX	98.52	84.96
Modal	Acceleration	UY	98.57	85.37
Modal	Acceleration	UZ	0	0

Table 12 Modal Direction Factors

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Case	Mode	Period sec	UX	UY	UZ	RZ
Modal	1	0.073	0.483	0.013	0	0.504
Modal	2	0.069	0.171	0.79	0	0.039
Modal	3	0.066	0.449	0.271	0	0.28
Modal	4	0.062	0.417	0.515	0	0.068
Modal	5	0.049	0.002	0	0	0.998
Modal	6	0.047	0	0.007	0	0.992
Modal	7	0.043	0.027	0.007	0	0.966
Modal	8	0.04	0.002	0.001	0	0.997
Modal	9	0.036	0	0.001	0	0.999
Modal	10	0.034	0.02	0.036	0	0.945
Modal	11	0.032	0.004	0.008	0	0.988
Modal	12	0.03	0.099	0.016	0	0.885

5.7 Response Spectrum Analysis Results

Figure 4. shows Period vs spectral velocity Figure 5. shows Period vs acceleration Figure 6. shows Period vs spectral displacement Figure 7.shows Time history functions

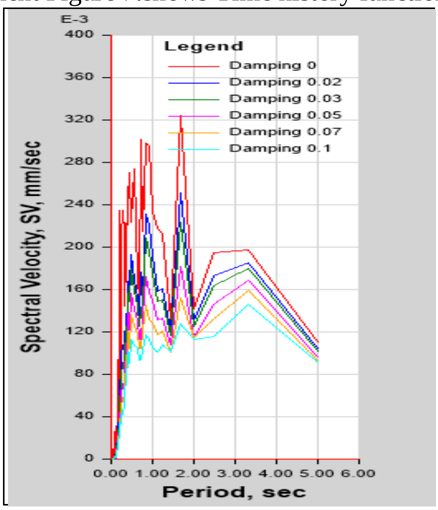

Figure 4 Period vs spectral velocity

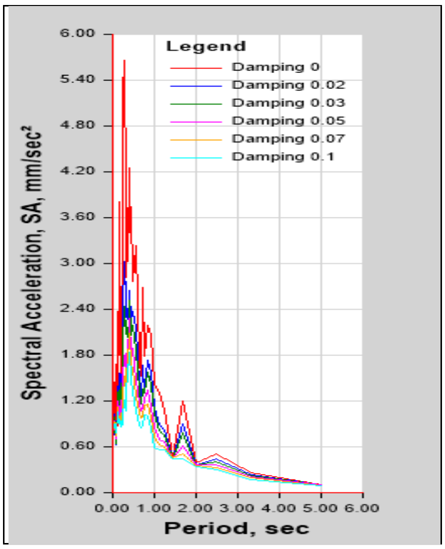

Figure 5 Period vs acceleration

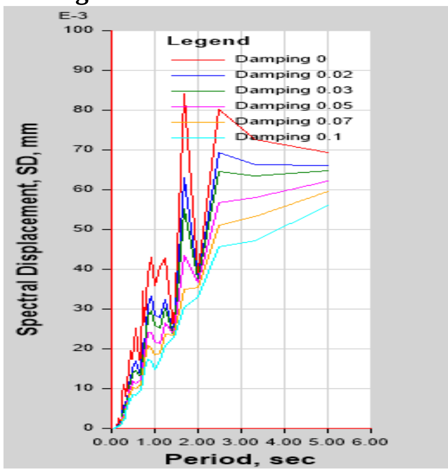

Figure 6 Period vs spectral displacement

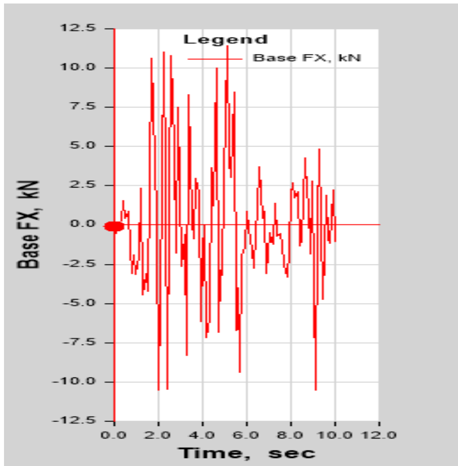

Figure 7 Time history functions

5.8 STORY RESPONSE PLOTS

Figure. 8 shows Story displacement, Figure 9 shows Story drift, Figure 10 shows Story shear, Figure 11 shows Story overturning moments

Figure. 8 Story displacement

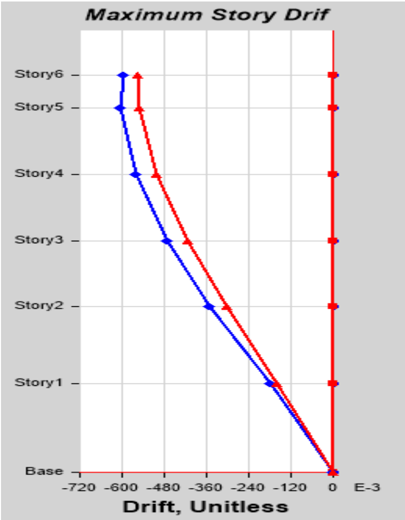

Figure 9 Story drift

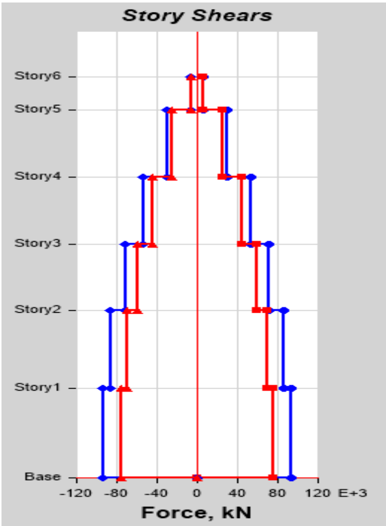

Figure 10 Story shear

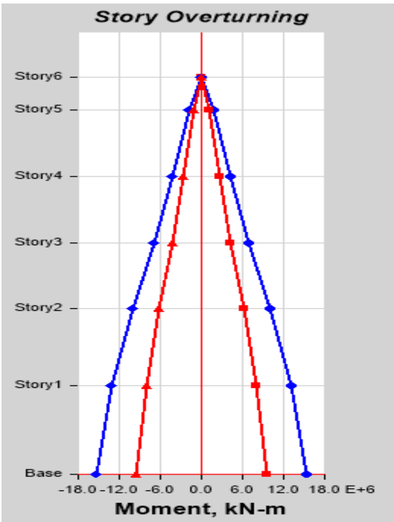

Figure 11 Story overturning moments

6. CONCLUSION

By considering the results that has been concluded, that the deflection and the storey drift occurred in the precast structure is more when compared with the RCC structure. The base shear values are also different when compared with the RCC structure.

- The use of prefabrication and preassembly is estimated to have almost doubled in the last 15 years, increasing by 86%.
- The use of precast concrete construction can significantly reduce the amount of construction waste generated on construction sites.
- Reduce adverse environmental impact on sites.
- Enhance quality control of concreting work.
- Reduce the amount of site labour.
- Increase worker safety.
- Other impediments to prefabrication and preassembly are increased transportation difficulties, greater inflexibility, and more advanced procurement requirements.

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