COMPARATIVE STUDY OF PRECAST AND CAST-IN-SITU BUILDING

[1]Dhrumal C. Kanpariya, [2]Nihil Sorathia
[1]P.G. Student [2]Assitstant Professor, Faculty of Engineering and Technology
[1]Structural Engineering,
[1] Faculty of Engineering and Technology, Parul University, Vadodara, India.

Abstract:* The analysis of a Precast and cast-in-situ building. It's structural system to determine the deformations and forces induced by applied lateral loads. The precast building system includes precast hollow core slab, precast beam and columns. The cast-in-situ building system includes precast slab, beam and columns. Different configuration of precast and cast-in-situ slab, beam and columns are studied. A regular building with G+12 story height is considered. In Precast and cast-in-situ building is considering dead load, live load, seismic forces there is a range of methods from a linear analysis to a sophisticated nonlinear analysis depending on the purpose of the analysis in the design process. In this paper a residential G+12 RC frame building is analyzed by the linear analysis approaches of Equivalent Static Lateral Force and Seismic coefficient methods using ETABS Ultimate 2016 software as per the IS- 1893-2002-Part-1. These analysis are carried out by considering different seismic zones, medium soil type for all zones and for zone III using OMRF frame type and for those of the rest zones using OMRF frame. Different parameter like base shear and displacements are plotted in order to compare the results of the static analysis

***Index Terms* – Cast-in-situ building, Precast building, Seismic Analysis, Base shear, Maximum story displacement**

I. Introduction

Prefabricated and cast-in-situ building systems are widely adopted in public buildings as well as in private building projects. The standardization and mechanization has brought a substantial change in the development of the construction industry worldwide over last few decades. Recently in India use of cast-in-situ and prefabrication in building construction is increasing. With the adoption of more mechanization, computer aided manufacturing, and intelligent management systems, the extensive use of prefabrication contributed to sustainable development by using cleaner and more resources saving production process.

The cast-in-situ building system includes precast slab, beam and columns. Different configuration of precast and cast-in-situ slab, beam and columns are studied. A regular building with G+12 story height is considered. In Precast and cast-in-situ building is considering dead load, live load, seismic forces, combinations as per IS code. When earthquakes occur, a buildings undergoes dynamic motion. This is because the building is subjected to inertia forces that act in opposite direction to the acceleration of earthquake excitations. These inertia forces, called seismic loads, are usually dealt with by assuming forces external to the building. So apart from gravity loads, the structure will experience dominant lateral forces of considerable magnitude during earthquake shaking. It is essential to estimate and specify these lateral forces on the structure in order to design the structure to resist an earthquake. The ductility of a structure is the most important factors.

II. Problem Description

Analysis of the Pre-cast and cast-in-situ frame and load Combinations is carried out by applying IS-456:2000. Considering preliminary sizing of all precast and cast-in-situ members and given specific properties. Design of Precast and cast-in-situ Structural members has been carried out by Code for flexure, shear, Torsion and Axial Loads based on respective clauses, concrete is designed on the basis of Ultimate loading. This is often referred to as Strength design. These factored loads are used to determine maximum factored moments, shears and other effects which are then compared to the strength of the member. Gravity load and Lateral Load Analysis Below table shows the Dimensional data of both building

Table 1: Dimensional detail of residential building from live structure (All dimensions are in mm.)

No. of Story	G+12
Column size (Base to 3rd)	300 × 675
Column size (4th to 6th)	230 × 675
Column size (7th to 9th)	230 × 600
Column size (10th to 12th)	230 × 525
Beam size	230 × 450
Thickness of slab	115
Stair case slab thickness	150

The height of Building is 39 m, Typical floor height 3 m, Parapet wall 1 m height, grade of concrete M25, Yield Strength of steel 415Mpa Earthquake data are taken for Surat city in Gujarat, which are, R=4, Soil type is medium, Important factor is 1, zone is III and damping is 5% taken. The applied loads are Dead load, Self-weight and live load, LL= 2 kN/m^2, FF= 1 kN/m^2

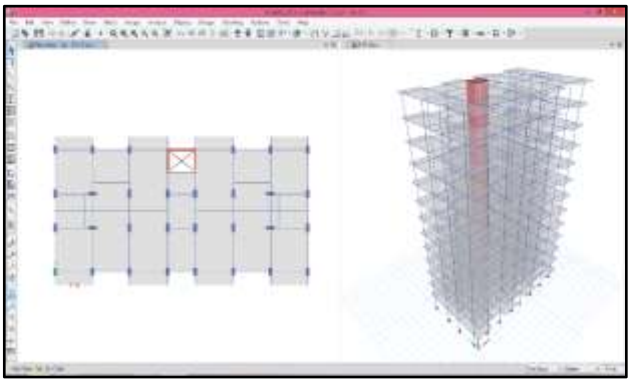


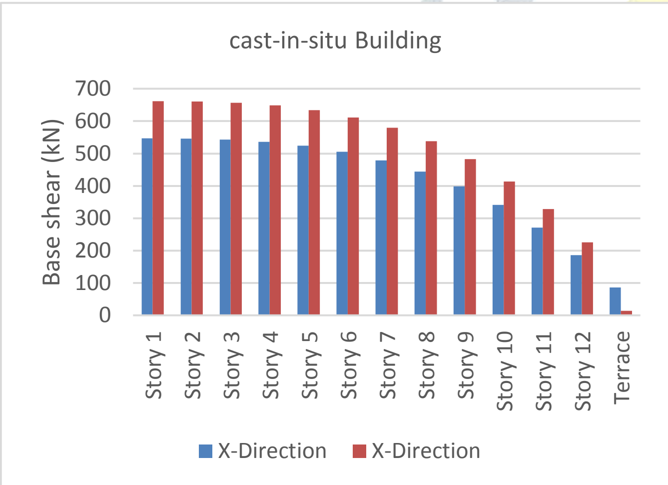
Figure 1: Plan & 3D view of Building

III. RESULTS:

Base shear for multi-story buildings obtained by Seismic Co-efficient Method and it is seen that the maximum base shear in X and Y direction is observed at Surat site for G+12 story building.

Table 2: Comparison of base shear (all value are in kN)

Floor level	Cast-in-situ Building		Pre-cat Building	
	X-Direction	Y-Direction	X-Direction	Y-Direction
Terrace	81.77	96.05	86.31	14.42
Story 12	176.80	207.70	186.62	225.79
Story 11	257.27	302.23	271.55	328.56
Story 10	323.77	380.36	341.75	413.50
Story 9	377.93	443.99	398.92	482.68
Story 8	421.05	494.65	444.45	537.75
Story 7	454.07	533.44	479.29	579.92
Story 6	478.93	562.64	505.53	611.66
Story 5	496.66	583.47	524.24	634.31
Story 4	508.01	596.80	536.23	648.81
Story 3	514.45	604.36	543.01	657.02
Story 2	517.33	607.75	546.06	660.71
Story 1	518.05	608.59	546.83	661.63



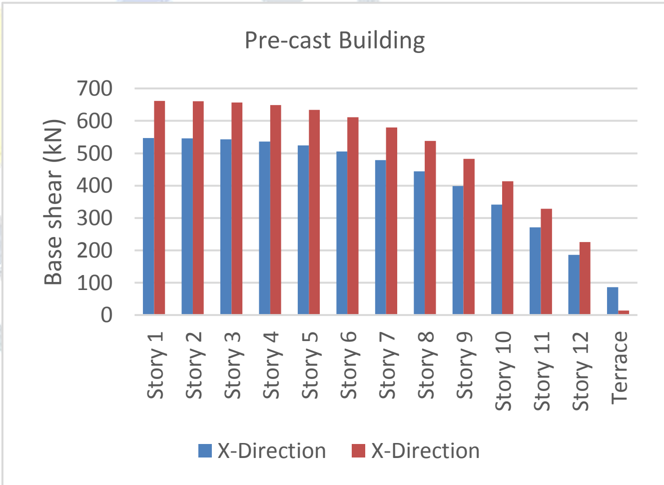
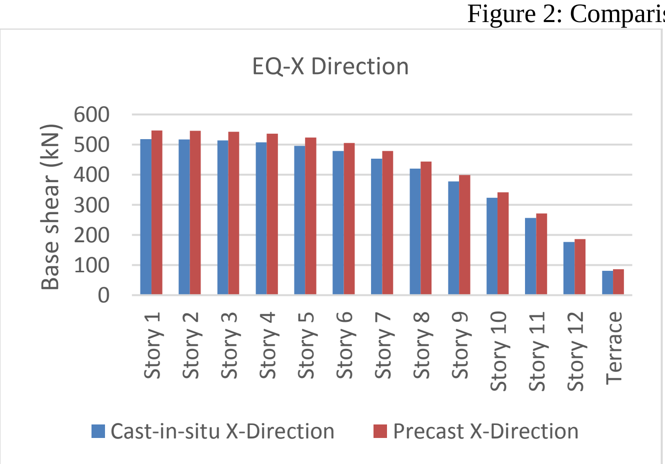


Figure 2: Comparison of base shear in X and Y Direction



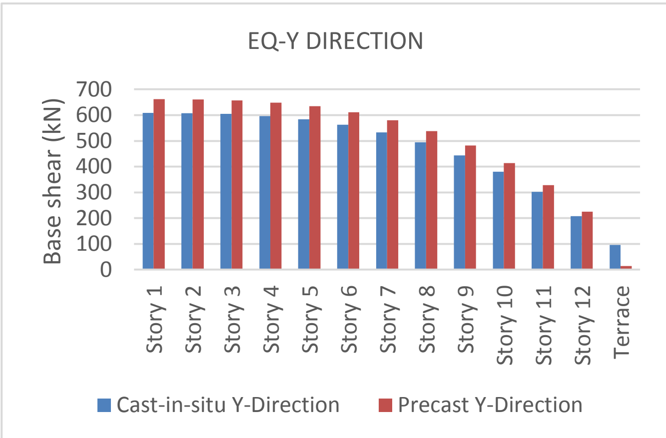


Figure 3: Comparison of base shear in X-X and Y-Y Direction for both building

Performance of a structure an earthquake typically is gauged by whether it posed a significant life safety threat and if it did not by how it will be cost and how long it will be taken to return it to service because these parameter generally related to specific level of damage, a damage indicator is a critical component of performance based design damage in a yielding structure usually can be related more directly tension. It maximum story displacement during earthquake its earthquake behavior on both direction so generate maximum story displacement in X and Y direction. The maximum story displacement in X and Y direction is observed at Surat site for G+12 story building. Comparison of maximum story displacement of Cast-in-situ and Precast Building at different story

Table 3: Maximum Story Displacement in EQX-Direction (all value are in mm)

Floor level	**Cast-in-situ Building**		**Pre-cat Building**	
	X-Direction	**Y-Direction**	**X-Direction**	**Y-Direction**
Terrace	50.062	6.547	46.326	6.969
Story 12	47.471	7.185	44.062	7.511
Story 11	44.264	7.446	41.195	7.688
Story 10	40.406	7.327	37.677	7.49
Story 9	35.989	6.891	33.6	6.98
Story 8	31.273	6.302	29.231	6.33
Story 7	26.298	5.539	24.595	5.512
Story 6	21.292	4.711	19.925	4.644
Story 5	16.827	4.129	15.819	4.061
Story 4	12.531	3.476	11.859	3.419
Story 3	8.305	2.551	7.912	2.509
Story 2	4.532	1.543	4.363	1.525
Story 1	1.481	0.541	1.45	0.54

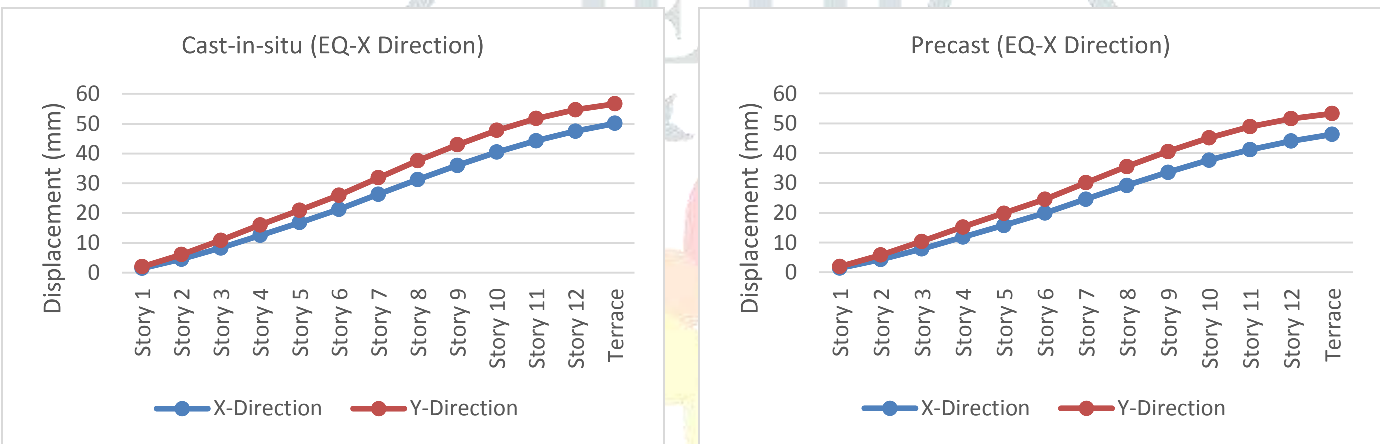


Figure 4: Displacement in X and Y Direction during EQ-X

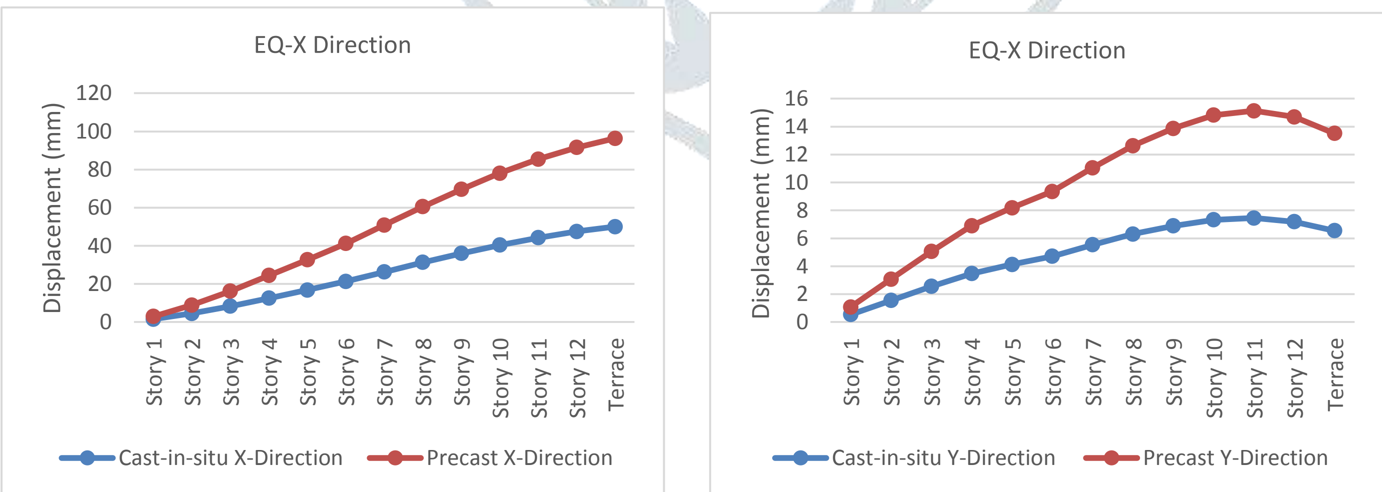


Figure 5: Displacement in X-X and Y-Y Direction for both building during EQ-X

The maximum story displacement in X and Y direction is observed at Surat site for G+12 story building during earthquake in Y direction. Comparison of maximum story displacement of Cast-in-situ and Precast Building at different story It maximum story displacement during earthquake its earthquake behavior on both direction so generate maximum story displacement in X and Y direction.

Table 4: Maximum Story Displacement in EQY-Direction (all value are in mm)

Floor level	Cast-in-situ Building		Pre-cat Building	
	X-Direction	Y-Direction	X-Direction	Y-Direction
Terrace	5.88	51.38	5.92	47.96
Story 12	5.77	48.73	5.80	45.47
Story 11	5.53	45.62	5.56	42.54
Story 10	5.16	41.93	5.18	39.05
Story 9	4.68	37.67	4.69	35.06
Story 8	4.15	33.03	4.15	30.73
Story 7	3.57	28.07	3.56	26.11
Story 6	2.95	22.93	2.94	21.36
Story 5	2.42	17.95	2.40	16.76
Story 4	1.86	13.07	1.85	12.27
Story 3	1.25	8.377	1.25	7.92
Story 2	0.69	4.336	0.71	4.14
Story 1	0.23	1.305	0.23	1.26

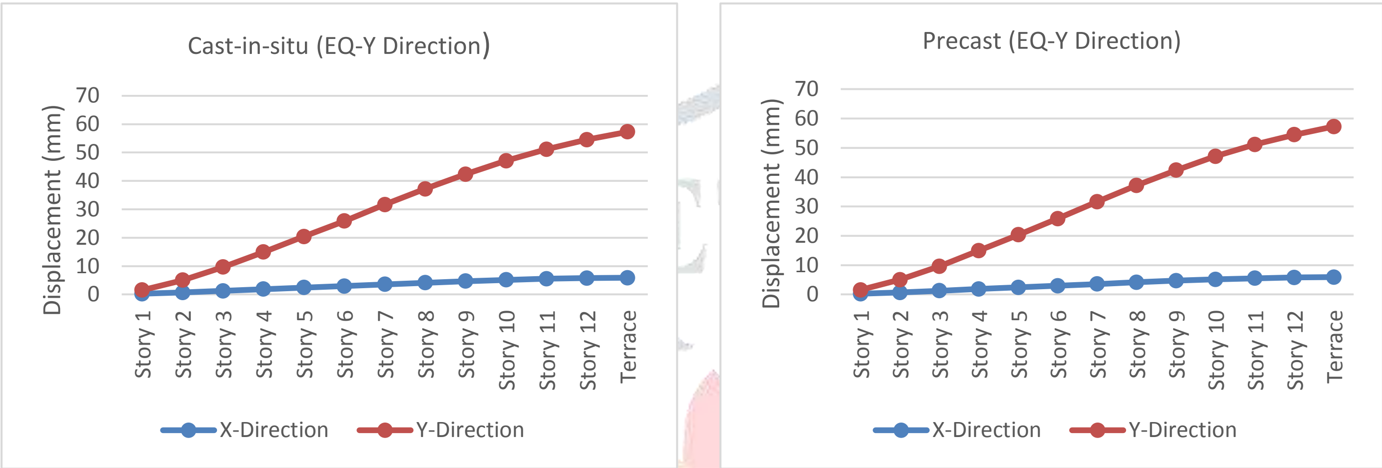


Figure 6: Displacement in X and Y Direction during EQ-Y

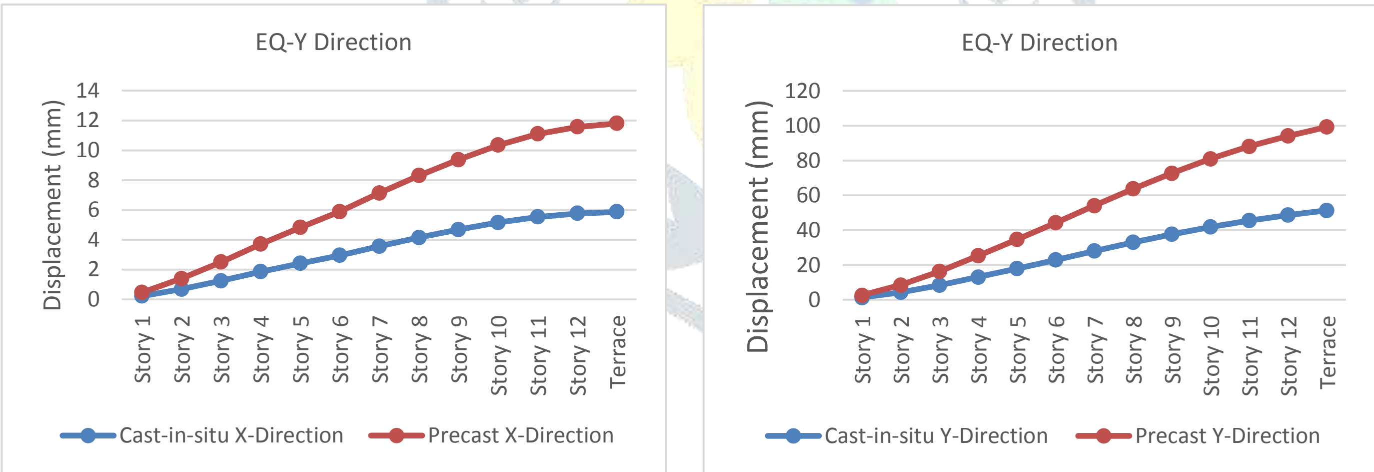


Figure 7: Displacement in X-X and Y-Y Direction for both building during EQ-Y

IV. CONCLUSIONS:

i) In parametric study of storey displacement X and Y direction during earthquake forces for cast-in-situ building and precast building

ii) Base shear is more in Y-direction for both building and precast building have more base shear compare to the cast-in-situ building using seismic coefficient

iii) Maximum story displacement is higher in cast-in-situ building compare to the precast building during earthquake forces in X direction

iv) Maximum story displacement is higher in cast-in-situ building compare to the precast building during earthquake forces in Y direction

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REFERENCES

[1]. K. R. Thagaragunta, M. H. Santhi, "Analysis and Design of a G+7 storeyed Precast Building"*Civil Engineering Systems and Sustainable Innovations* 139-148

[2]. N. Dineshkumar, P. Kathirvel "Comparative Study on Prefabrication Construction with Cast In-Situ Construction of Residential Buildings" *International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 4*, (2015)

[3]. B. L. pez-Mesa, A. Pitarch, A. Tomas, T. Gallego "Comparison of environmental impacts of building structures with in situ cast floors and with precast concrete floors" *Science direct@ Building and Environment* (2009), 699–712

[4]. S.K Duggal, "Earthquake resistance design of Structure"

[5]. R.P Rethaliya, "Earthquake Engineering"

[6]. IS 10297 (1982) "Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab unit" 1982

[7]. IS 456-2000 "Code of Practice Plain Reinforce Concrete" Fourth revision, 2000

[8]. IS 875-1987(Part-5) "Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structures", Part-5 Loads Combination, 1987.

[9]. IS 1893:2016 (Part 1), "Criteria of earthquake resistant design of structures, General Provisions and Buildings", BIS,2016.