COMPARATIVE STUDIES BETWEEN PRECAST AND CONVENTIONAL CAST-IN-SITU STRUCTURAL SYSTEMS

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ABSTRACT. In India, greatest constructional exercises are finished utilizing the old convectional cast in situ strategies since seemingly forever. As the nation is creating at a high speed, the necessity for lodging is heightening and in this way development ventures are additionally blossoming quickly henceforth requesting quicker and better development techniques. This expanded interest can be coordinated by utilizing one of the cutting-edge innovations, pre-projected substantial strategy. Investigation of writing shows various priority of precast constructional strategy over different techniques for development. Appropriately, this investigation presents the examination and plan of g+5 floor precast concrete structure and traditional cast-in-situ structure. The designs were demonstrated and investigated utilizing Etabs programming for dead, forced, and seismic loads and for load combinations. The fundamental intention was to consider the conduct of both the sorts of structures under the previously mentioned loads and load mixes. Examination was directed dependent on different components like external loads, greatest deflections, most extreme story drifts, mode shapes, time-frames, frequencies and base shears.

Key words: Conventional Cast in Situ Method, Etabs, Pre-Cast Concrete Method, Seismic Analysis.

1. INTRODUCTION

In the creating time, the constitution of the greater part of the mechanical, private and business developments depends on the precast built-up concrete (RC). Precast reinforced concrete technique has various powers over other; improved thermal properties, less labor, higher toughness, improved norm of cast units, quicker development speed, shows social and ecological advantages, straightforward, deal with and apply. In India, precast substantial technique is applied in exceptionally specific building destinations because of the misguided judgments and absence of information on the candidates. Likewise, this technique needs firm accepts and trust which is the explanation it is as yet not utilized in seismic districts. This brings our consideration towards the need of illuminating the development businesses with legitimate information and benefits of precast strategy and the relations among the precast individuals. Studies should be done in the field of precast structures and strategies. Survey of a few related writing is talked about in the forthcoming subtleties with the center reason for creating mindfulness and inspiring the utilization of precast in the coming ages of development. And furthermore, conduct of both the structure is seen under different loads and burden blends.

1.1 Precast structure

Precast cement is a development item. The creation of precast cement is finished utilizing mechanical techniques by settling the substantial in reusable shape and structures under controlled conditions, then, at that point is moved to locales and lifted into places. It is referenced in different investigations [1-5] that precast constructions are being given
inclinations over solid substantial designs across the globe in view of its improved and wanted characteristics precast edges can be produced by utilizing either straight segments or spatial shaft section associated. Precast bar section associations have the advantage that the interfacing faces between the associations can be put away from the urgent edge regions; notwithstanding, straight components are by and large utilized on the grounds that they confronting troubles with shaping, taking care of, and raisingspatial components.

1.2 Conventional structure
Cast-in-situ concrete is projected into structures on the structure site. It offers limitless conceivable outcomes to the architect for any shape arrangement with a boundless choice of surface surfaces. In this sort of structures everyone of the components like, section, piece and so on are casted on location in the open climate and consequently it is hard to control blend, situation and restoring. Truth be told, less joints are available in underlying framework and components in these structures are not to be intended for any such burdens or loads.

2. OBJECTIVE
The primary target of this undertaking is to discover an ideal development strategy which has a negligible expense and gives a base term of time by doing a relative report among precast and conventional development.
- To analyze and design a precast structure for different loads and load combinations.
- To study the conduct of the designed precast construction in examination with regular cast-in-situ structure.
- To lead a near investigation of pros and cons of precast structures over ordinary cast-in-situ structures.

3. MODELING
Modelling of the two different kinds of structural system buildings is made in Etabs software. Structural elements like columns, slab, and beams are only considered and if any balcony exists their loads are considered in the frame analysis. In this present study ground+5 stories for framed structure as precast concrete building and conventional concrete building were considered around 625sqm of carpet area per floor and all joints are rigid. Since precast structures have minimum m80 grade concrete, hence all the material properties are assigned as per m80 for precast concrete type structure and for conventional cast-in-situ type structure m30 grade concrete is taken under consideration and materials are assigned as per that and material properties are given in table-1&2. Section’s properties are assigned same to both the type of structures and are presented in table-3. Slabs are considered as shell-thin elements for conventional concrete building and for precast building it considered as membrane element in Etabs; that transfer load via one-way slab action.

| Table 1. | Material properties for conventional building |
|----------|------------------------------------------------|
| Material name | Concrete       |
| Grade of material | M30             |
| Directional symmetry type | Isotropic     |
| Weight per unit volume | 25 KN/m³        |
| Mass per unit volume  | 2550 kg/m³     |
| Modulus of elasticity, e | 27386.13 MPa  |
| Poisson’s ratio, u   | 0.2             |
| Shear modulus       | 11410.89 MPa   |
Table 2. Material properties for precast building

| Material name       | Concrete          |
|---------------------|-------------------|
| Grade of material   | M80               |
| Directional symmetry type | Isotropic        |
| Weight per unit volume | 25 KN/m³         |
| Mass per unit volume  | 2550 kg/m³        |
| Modulus of elasticity, $e$ | 42244.238 MPa    |
| Poisson’s ratio, $u$  | 0.2               |
| Shear modulus       | 17601.77 MPa      |

The sectional properties of components considered in both the kind of structures i.e., precast concrete structure and conventional cast-in-situ structure are recorded in table-3.

Table 3. Sectional element properties for both structures

| Members   | Cross-sectional dimension |
|-----------|---------------------------|
| Column-1  | 0.70mx0.70m               |
| Column-2  | 0.65mx0.65m               |
| Beam      | 0.60mx0.60m               |
| Slab      | 150mm or 0.15m thick      |

Plan for both the kinds of outlined design being precast concrete construction and conventional cast-in-situ structure is taken same for the displaying and is introduced in figure 1. Expulsion perspective on both the structures are appeared in figure 2&3.

Figure 1. Plan view for both the structures
**Figure 2.** Extrusion view for conventional structures

**Figure 3.** Extrusion view for precast structures
Different assumptions were taken while displaying and analyzing both the kinds of structures. Thesuscipions were,

- The areas of the underlying component of the structure (like section 0.5mx0.5m, pillar 0.35mx0.40m and chunk 0.15m thick) were viewed as same for every one of the floors all through the structure.
- Building is appropriately situated in Srinagar; along these lines, different boundaries that essentially impact and ought to be thought of (like wind speed, seismic zone factor) for horizontal burden examination and geotechnical viewpoints are kept identified with it.

4. LOADS AND LOAD COMBINATIONS

All of the loads and load combination are viewed as following the statements referenced in the Indian standard codes like dead load has been considered according to is 875(part-i):1987. Live load is taken 4kn/m2 on the floors and 1.5kn/m2 on the rooftop according to is 875 (part 2):1987. Also, seismic and wind loads are considered according to is 1893:2016 and is 875(part-3):1987 individually. Seismic and wind loads required certain boundaries to be relegated in Etabs for the sidelong load examination. Windco-effective boundaries and seismic boundaries are given in table -4.

Table 4. Wind parameters

| Wind parameters as per is 875 (part-3):1987 |
|-------------------------------------------|
| Wind speed (vs) 39m/s                     |
| Terrain category 1                        |
| Structure class B                         |
| Risk co-efficient factor, k1 1            |
| Topography factor, k2 1                   |
| Windward co-efficient 0.8                 |

| Seismic parameters as per is 1893:2016    |
|------------------------------------------|
| Seismic zone factor(z) 0.36              |
| Soil type 1                             |
| Important factor (i) 1                  |
| Response reduction factor (r) 5         |
| Eccentricity ratio 0.05                  |

Load combinations as per is 456:2000; here we consider both limit state of collapse and limit states of serviceability.

The load combinations included the following:

Table 5. Load Combinations

| Limit State of Collapse | Limit State of Serviceability |
|-------------------------|-------------------------------|
| 1.5(d.l.+w.l.)          | 1.0(d.l+l.l)                  |
| 1.5(d. L+w.l)           | 1.0(d.l+w.l)                  |
| 0.9d.l+1.5w.l           | 1.0d.l+0.8l.1+0.8w.l          |
| 1.2(d.l+1.l+w.l)        | 1.0(d,l+e,l)                  |
| 1.5(d.1+e.l)            | 1.0 d.1+0.8l.1+0.8w.l         |
| 0.9d.l+1.5e.l           |                               |
| 1.2(d.1+1.l+e.e.l)      |                               |
5. RESULT AND DISCUSSION

Outlined constructions one being precast concrete design and other being traditional cast-in-situ structure having g+5 stories is analyzed for gravity and different lateral loads for seismic and wind zone in Srinagar. The demonstrating and examination is done in Etabs programming and its planning is likewise checked to protect that whether the areas gave can really bear the stacking or it comes up short. After the investigation work esteems are ready for various levels and introduced as appeared.

5.1 Storey displacement

As the structure is totally even in both x and y course, hence there is exact moment contrast in the upsides of displacement. Along these lines, graphical portrayal against displacement versus story height shows the joined qualities got in x and y directions. The greatest story displacement happened because of earthquake power in x and y directions are plotted and introduced in the charts in figure 4. The most extreme displacement acquired in x and y heading for precast structure was 0.040338m at the rooftop level and for conventional structure the greatest displacement noticed was 0.03620m at the rooftop level. The distinction in greatest uprooting noticed for precast and traditional designs was almost practically 3mm because of seismic power acting in x and y heading. The uprooting noticed for singular story is introduced in table-6.

Table 6. Displacement at individual storey levels

| Storey | Elevation | Conventional building | Precast concrete building |
|--------|-----------|------------------------|---------------------------|
|        |           | X- dir. | Y-dir. | X- dir. | Y-dir. |
| Storey 6 | 18        | 36.202  | 36.202 | 40.338  | 40.338 |
| Storey 5 | 15        | 32.328  | 32.328 | 35.547  | 35.547 |
| Storey 4 | 12        | 26.538  | 26.538 | 28.827  | 28.827 |
| Storey 3 | 9         | 19.282  | 19.282 | 20.607  | 20.607 |
| Storey 2 | 6         | 11.345  | 11.345 | 11.811  | 11.811 |
| Storey 1 | 3         | 3.959   | 3.959  | 3.936   | 3.936  |
| Base    | 0         | 0       | 0      | 0       | 0      |

![Figure 4. Maximum displacement at individual storey levels](image)
5.2 Storey drift

The most extreme story drift happened because of quake power in x and y direction are plotted and introduced in the diagrams in figure 5. The greatest drift acquired in x and y heading for precast structure was 0.00292mm at the third-floor level and for traditional concrete structure the most extreme drift noticed was 0.00264mm at the third-floor level. The distinction in greatest uprooting noticed for precast and customary constructions was almost practically 0.003mm because of seismic power acting in x and y course. The drift was seen to be inside as far as possible i.e., story drift in any story ought not surpass 0.004 occasions that of the story height. The drift noticed for singular story is introduced in table-6. As the structure is totally even in both x and y bearing, in this manner there is exact moment distinction in the upsidess of dislodging. Thus, graphical portrayal against story float versus story tallness shows the consolidated qualities acquired in x and y bearing.

| Storey | Elevation | Conventional building | Precast concrete building |
|--------|-----------|-----------------------|--------------------------|
|        |           | X-dir. | Y-dir. | X-dir. | Y-dir. |
| Storey 6 | 18        | 0.001293 | 0.001293 | 0.001597 | 0.001597 |
| Storey 5 | 15        | 0.00193 | 0.00193 | 0.00224 | 0.00224 |
| Storey 4 | 12        | 0.002419 | 0.002419 | 0.00274 | 0.00274 |
| Storey 3 | 9         | 0.002646 | 0.002646 | 0.002932 | 0.002932 |
| Storey 2 | 6         | 0.002465 | 0.002465 | 0.002625 | 0.002625 |
| Storey 1 | 3         | 0.00132 | 0.00132 | 0.001312 | 0.001312 |
| Base    | 0         | 0      | 0      | 0      | 0      |

**Table 7. Storey drift at individual storey levels**

**Figure 5.** Maximum storey drift at individual storey levels
5.3 Storey shear
As the structure is even in both x and y heading, hence there is by all account’s exact moment distinction in the qualities acquired. In this way, graphical portrayal against story shear versus story height shows the joined qualities acquired in x and y heading. The acceleration spectrum esteem was 0.0801 for outlined design as ordinary concrete structure and 0.1000 for precast concrete construction, i.e., the story shear was multiple of acceleration spectrum esteem and theseismic load of the structures. The seismic load of the construction contains dead load and a piece of live load according to is1893(part 1): 2002. The shear saw at singular floor level is introduced in a plain structure in table-7 and graphical portrayal can be found in figure-6.

| Storey | Elevation (in meter) | Conventional building | Precast concrete building |
|--------|----------------------|-----------------------|--------------------------|
|        |                      | X-dir. | Y-dir. | X-dir. | Y-dir. | X-dir. | Y-dir. |
| Storey 6 | 18                  | -696.790 | -696.790 | -843.562 | -843.562 |
| Storey 5 | 15                  | -1197.609 | -1197.609 | -1444.854 | -1444.854 |
| Storey 4 | 12                  | -1518.132 | -1518.132 | -1829.680 | -1829.680 |
| Storey 3 | 9                   | -1698.428 | -1698.428 | -2046.145 | -2046.145 |
| Storey 2 | 6                   | -1778.558 | -1778.558 | -2142.352 | -2142.352 |
| Storey 1 | 3                   | -1798.590 | -1798.590 | -2166.404 | -2166.404 |
| Base    | 0                   | 0       | 0       | 0       | 0       |

Figure 6. Storey shear at individual storey levels

5.4 Mass participation factor and time period
Time span of building is the time taken by it to go through one complete pattern of oscillation. It is an intrinsic property of a structure constrained by its mass and firmness. According to the different impacts common time of a structure increments when the solidness of building increments. For the inflexible structure time-frame ought to be less as could be expected. Henceforth diagram shows precast structure has higher time span as contrast with normal design. The mass cooperation factors (%) and time-frame for both the structures for initial six predominant modes are introduced in figure 7.
6. CONCLUSION

A comparative study is accomplished for both precast construction and ordinary construction. In this investigation different boundaries were viewed as like story displacement, story drift and story shear for relative examination between both the kinds of outlined constructions being precast and conventional structure having g+5 story building. The outlined construction of g+5 story by thinking about gravity, lateral, seismic and wind loads has been investigated and demonstrated in Etabs programming. For this reason, different writings are explored and the assessment and planning are accomplished for both the traditional and precast construction. In this examination, just individuals are planned and joints are not planned as of now. Execution of the two structures was discovered to be fulfilling. It is seen that the precast construction has given the better outcomes when analyzed inside two designs.

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