Analysis of Precast Building System

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Abstract. Prefabricated building systems is widely adopted in public buildings as well as in private building projects. Prefabrication together with the standardization and mechanization has brought a substantial change in the development of the construction industry worldwide over last few decades. Analysis of Precast building. All precast elements are designed considering forces during handling in addition to forces due to gravity load and lateral loading. For design of various precast elements EXCEL sheets are used. Comparison of Precast building in terms of cost and time with in-situ construction is also presented. Cost of precast building including material, construction cost and handling is presented in the report.

Keywords: Precast Building, Analysis Design, STAAD Pro.

1 Introduction

Precast concrete is defined as concrete which is cast at location other than its final position in the finished structure. Precast concrete elements are reinforced either with steel or with prestressing strands [1]. When prestressing is employed for the production of precast concrete members, the method generally used is pretensioning, in which the strands are tensioned prior to pouring the concrete in long lines in the precasting operation.

Precast concrete is produced under rigid quality control conditions in a precasting plant. The concrete strengths used range from M30 to M45 grade, with the higher strengths being preferred to ensure durability and high cycle production rates in the plant [8]. The forms used are of better quality than those normally used for cast-in- place concrete. Hence better shapes and finishes are obtained [10]. Cast-in-place concrete requires more formwork, and form can be reused only up to 10 times. For precast concrete, finished wood and fiberglass forms may be used up to 50 times with minor rework [2].

The concept of precast construction include those buildings, where the majority of structural components are standardized and produced in plants in a location away from the building, and then transported to the site for assembly[3,4]. These 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. (Figure 1) shows typical arrangement of precast building [7].

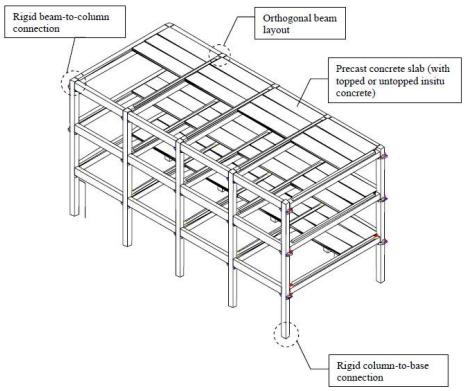

Fig. 1: Precast building systems

1.1 The main advantages of precast construction are as follows:

1. Increased speed of construction.
2. Improved quality owing to factory production done in controlled environment.
3. Enhanced long term durability.
4. Improved life cycle costs in view of reduced maintenance.
5. Repetition of standard elements will lead to cost reduction.
6. Precast element production can continue in any weather condition with better health and safety standard at building site.
7. Simple and fast erection with excellent finishing.
8. Thin precast panels increase the carpet area.
9. No plastering required since precast panels have smooth surface finishing.
10. The use of tools, machinery, and other equipment, can be automated, in the production of standard, interchangeable parts and products.

1.2 Types of precast system

Depending on the load-bearing structure, precast systems can be divided into the following categories [5,6].

1. Large-panel systems
2. Frame systems
3. Slab-column systems with walls
4. Mixed systems.

2 METHODOLOGY

Analysis and Design of Precast building include the 5 story frame system, assumed basic data and analyze by applying Gravity and lateral load using

STAAD/Pro software. Calculating member forces and Design of Precast Members using ACI 318-08(M) code. Compare total cost of the precast structure with conventional building.

2.1 Structural Data of Building

- Location of The building = Surat
- Grade of Concrete = M35 MPa
- Yield strength of steel =415 MPa
- Length of Building (X-Dir) =24 m
- Width of Building (Y-Dir) = 15 m
- Typical Floor Height = 3 m
- No of Bay in (X Dir) = 4 m
- No of Bay in (Y Dir) = 3 m
- Spacing of Bay in X Dir = 6 m

Pracast Building plan shown in the (Figure 2). Analysis of the precast frame is carried out by applying ACI 318:08 load Combinations using STAAD/Pro software[11]. Considering preliminary sizing of all precast members and given specific properties [9]. Figure 3 shows 3D view of STAAD modelling of precast structure. Design of Precast Structural members has been carried out using ACI-318:08 Code for flexure, shear, Torsion and Axial Loads based on respective clauses. Similar to the LRFD method in steel, 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.

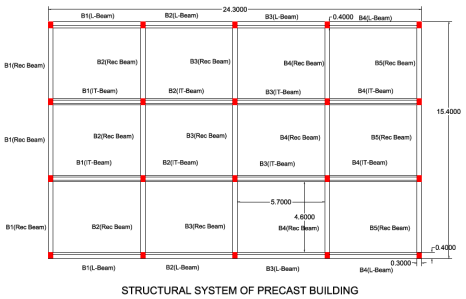

Fig. 2: Precast building plan

3 RESULTS AND DISCUSSION

Analysis results have been taken from the STAAD output for 5 storey precast building for the effective Load combination of shown in Table 1 are typical for ground floor.

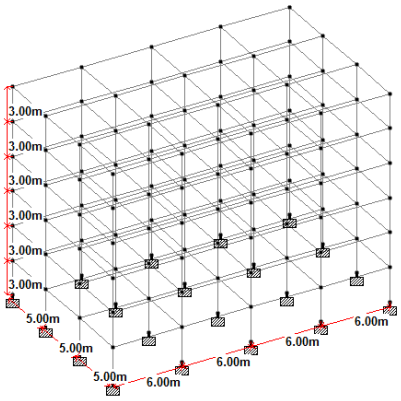

Fig. 3: STAAD/Pro Modelling of Precast Structure

Ground Floor: Load Case: 19 = 1.2(DL) - 1.0(EQY) + 1.0(LL).

The STAAD.Pro result is given in Table 2. Analysis and design of 5 storey Precast building system is carried out for gravity and lateral load. In analysis and design procedure the concept and methodology of precast building system is different compared to cast-in-place building.

Table 1: Member Details for Ground Level

Sr.No.	Member No.	Type
1	32,36,47,51	Corner Column
2	37,41,42,46	Peripheral Column Z-dir.
3	33,34,35,48,49,50	Peripheral Column X-dir.
4	38,39,40,43,44,45	Internal column
5	52,53,54,55,79,80,81,82	Ledger Beam
6	61,62,63,64,70,71,72,73	Inverted Tee Beam
7	56,57,58,59,60,65,66,67,68,69,74,75,76,77,78.	Rectangular Beam

4 CONCLUSION

- The Analysis and design methodology of precast building is different in comparison of cast in place building systems.
- The Analysis results shows that the X-direction frame consisting of L beam, Inverted T beam carries more load compared to Y-direction frames.
- L beams on periphery are subjected to horizontal moment in addition to shear and bending moment while rectangular and inverted T beams are subjected to shear force and bending moment only.

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