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Precast Element's Erection & Installation at Site – A Case Study

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ABSTRACT:The prefabricated building technology is a dry construction process that provides a fast, safer and greener way to build. The aim of this research work is to study joints primarily considering precast concrete elements which are used in buildings which may be referred to for handling, jointing and erection where appropriate that can allow year round construction, could lead to less wastage of materials than in site construction. It can also ensure higher worker safety and comfort level in site built construction.

A live case study for HIG & MIG residential project by Shirke Group for MAHADA pimple wagre.. The data collected based on jointing, quality management and errection was obtained through questionnaire and check list prepared as per my literature studies and book case studies and individual site visit and interaction with PMC engineer. Based on the data collection conclusion were drawn.

There is a great need to study the joint details by Architects along with precast engineers as it will make them understand the designing of the elements well before they produce the elements. The study will also help in easy installation of these elements and casting / grouting / splicing the joints in order to fulfil the design criteria and in overall make the building functional as designed.

Keywords

Precast Construction, less wastage of materials, high rise mass housing, the correct supporting systems, lifting arrangements, personnel safety measures and meticulous planning.

1. INTRODUCTION

The purpose of this practice is to provide practical guidance and set minimum standards for the safe handling, erection and jointing of precast concrete elements. This paper applies to all places of work at which an employee has to handle, erect and jointing of precast concrete components in housing developments with repeated housing units.

The terms used here in these paper are brace, **anchor, tower crane , Leveling shim, Lifting beam** and **Prop** for jointing its errection and installation.

1.1 Area of study

This study is conducted in Pimpri Chinchwad Municipal area, **HIG & MIG** residential project by **Shirke Group** for **MAHADA** pimple wagare.

1.2 Aim

- To speed up construction with use of materials which possess their innate characteristics like light weight, easy workability, thermal insulation and combustibility etc.
- To allow the year round construction, to allow less wastage of materials than in site- built construction.
- To ensure higher worker safety and comfort level than in site- built construction.
- To study the joint details.
- Need for studying handling, errection and jointing of precast elements is that a Well detailed and constructed joint plays a vital part in maintaining the integrity of the external envelope of the building, ensuring it weatherproof.
- Meeting other requirements such as fire- resistance and acoustic performance.
- The right locations, correct levels and alignments with necessary grouting at all intersection of the precast members play the key role to fulfil the function of the building desired by the Architect.

1.3 Categories of precast joints

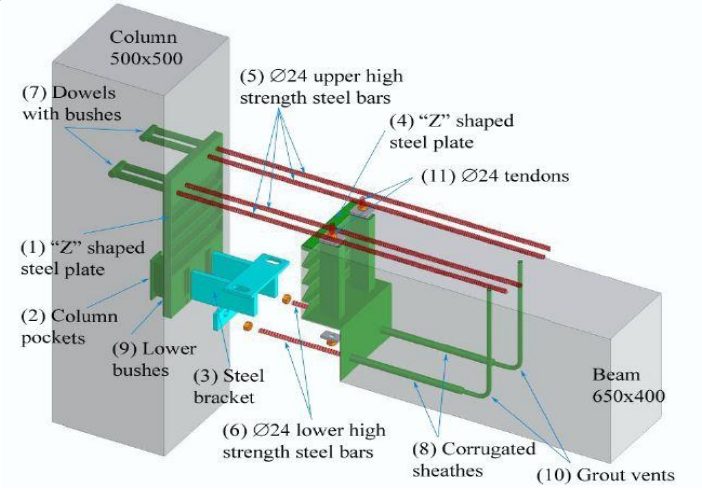

Fig: 1.3 Typical precast beam-column dry joint

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Based on the construction method, joints can be classified as wet and dry.

Wet joints- are constructed with cast-in-place concrete poured between the precast panels.

Dry joints- are constructed by bolting or welding together steel plates or other steel inserts cast into the corner ends of the precast panels for this purpose.

1.4 Typical joints with compressive forces

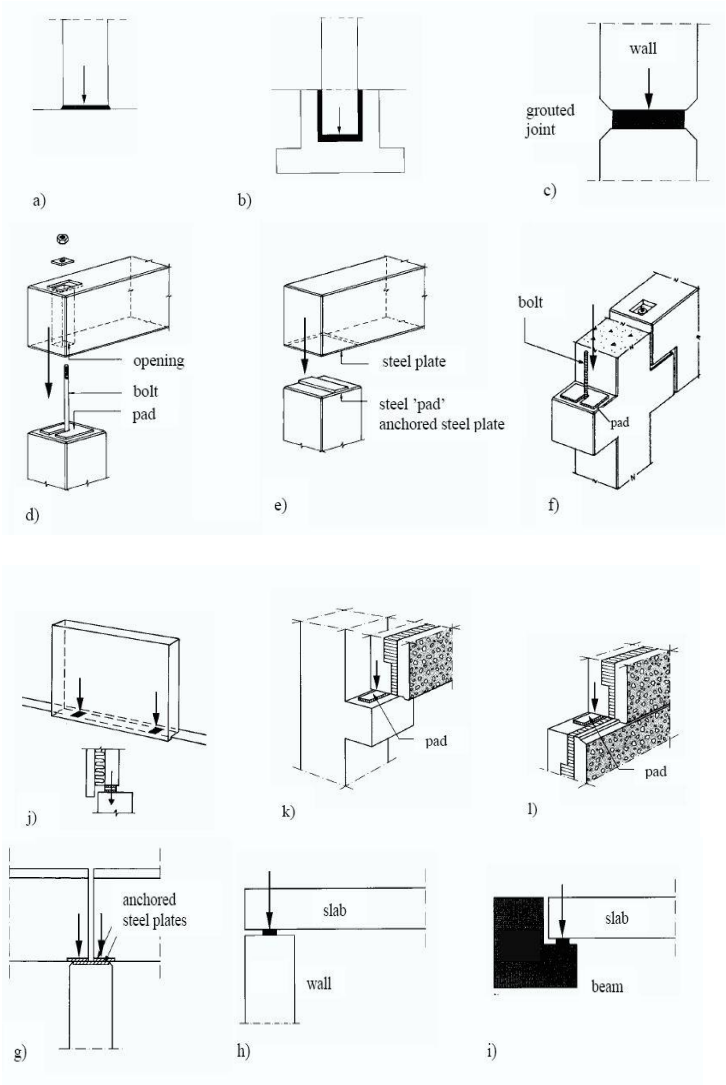

Fig: 1.4 a) column-foundation (grout), b) column foundation(grout), c) wall (column)-wall (column) (grout), d) beam-column (pad), e) beam-column (steel), f) beam-corbel (pad), g) double tee-wall (steel), h) slab-wall (strip), i) slab-beam (strip), j) wall foundation (steel), k) wall-corbel (plastic), l) wall-wall (plastic)

2. Findings - Errection and Installation Analysis at Site.

HIG & MIG residential project by Shrike Group for MAHADA Pimple Wagre.

The project details are as follows

plot area	30816 sqm.
Open space	3102sqm
Internal road	647.95
FSI	2.5
Permissible floor area	77041 sqm
Residential built up area	73691sqm
Total HIG 4 build	(s+22)
Total MIG 7 build	(s+22)
Parking structure	G+4
Shopping complex	LB + 2

Prefab erection work comprises of following activities- It includes Stacking of prefab members on site. Lifting of prefab members, Placing of prefab members& Grouting of prefab members**.**

Placing of prefab members includes following activities- It includes placing of column, placing of wall, placing of beam, placing of slab& placing of staircase.

Grouting of precast member include following activities- Half Grout, Full Grout &Grouting of joints.

Stacking of precast members -. Ground surface on which stacking to be done should be properly leveled. Sleepers are placed that helps in avoiding dirtiness of members. Checking of members which are damaged or not during transportation. Internal cores of column should be checked for any foreign material present inside it or not and are immediately removed for better bonding of concrete.

Fig. 2.1.1 Result of Wrong Stacking Work.

Fig. 2.1 Wrong Method of Stacking

Lifting of prefab members- It includes precast member should be lifted only with the cradle, lifted properly. Lifting of two or more members is risky and this may leads to accidents.

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Placing of column- Before placing if level of concrete is not proper padding is done with GP2 as per recommendation of drawing and concrete surface coordinates should be marked on leveled surface. These coordinates should be cross checked then column can be placed at their position. Their nomenclature checked with their notches position and verified for any cracks in column or not.

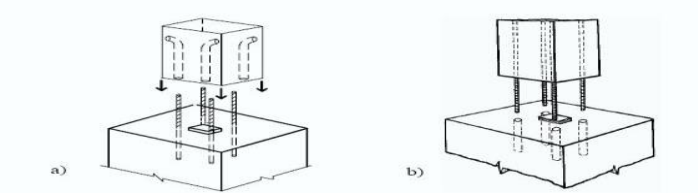

Fig. 2.2 Column base connections with projecting reinforcement bars in grouted sleeves, a) bars projecting from the base, b) bars projecting from the column

Water Tightness:.The grouted joints helped to achieve water tightness taking into consideration the local tropical climate with heavy monsoons. Backer rods placed at the exterior exposed face to prevent water entry. Waterproofing sealant applied at these joints as an additional line of defence.

Fig.2.2.1 Erection of column

Fig.2.2.2 Supports provided to the column

Placing of wall- If concrete is not leveled padding with GP2 as per recommendation of drawing are made. Coordinates are marked on leveled surface and structural damages are checked. It should be anchored properly with fastener and push-pull jack. Verticality of wall should be checked properly by checking two perpendicular walls,

Fig. 2.3 Placing Of Wall and Their Supporting

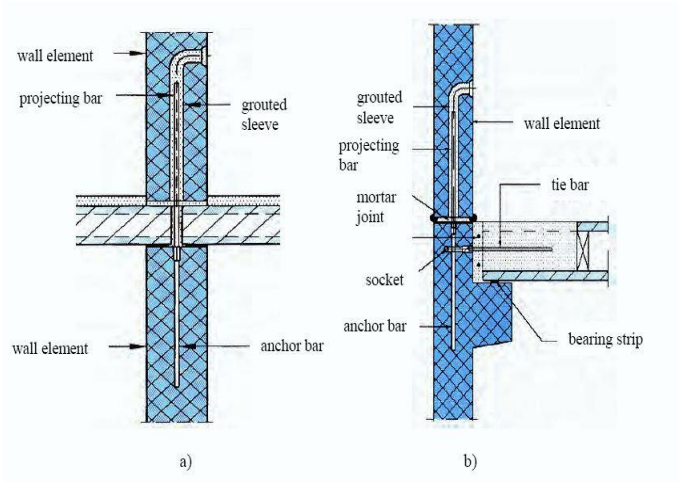

Fig. 2.3.1 wall to wall connections with projecting bars in grouted sleeves, a) interior connection, b) exterior connection

Placing of beam- primary beam has already placed during placing of column to restraint the column. secondary beam is placed after half grout done . Their nomenclature, orientation and structural damages should be checked. Line of beam should be maintained to avoid uneven offset formed visible after block masonry. Supports needed to those whose length is larger than 3m and at primary secondary junction.

Fig. 2.4 Placing of beams with better supporting system

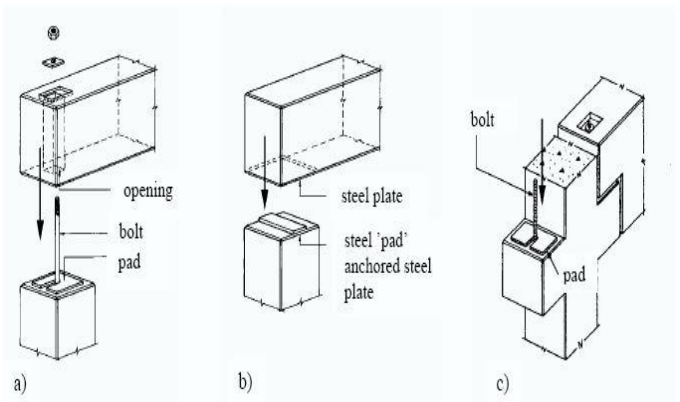

Fig. 2.4.1 a) beam-column with elastomeric pad, bolt, b) beam-column with cast in place plates, steel plate 'pad', welding, c) beam-corbel with plain elastomeric pad, bolt

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Placing of slab- Burr should be removed from flange on which slab rested. Orientation, nomenclature and structural damages should be checked after placing of slab. It should be free from dirt and leveled. Supports should be provided at joints with the help of wooden chabi and props.

Fig 2.5 Placing of slabs

Fig 2.5.1 Electrical layout done before slab installation

Fig.2.5.2 cement slurry applied in sunken portion to avoid leakages.

Fig. 2.5.3 Brooming of slab

Placing of staircase- Nomenclature of raker should be checked before it is placed. Joints and leveled. Beam on which raker is placed should be supported before placing of raker because this beam get twisted and after twisting it can't be corrected due to heavy loads.

Fig. 2.6 Placing of staircase with hooks to lift and place.

Fig. 2.6.1 Problem arises if supports are not provided to the beam prior to placing of staircase.

Half grout- Column should be drilled for perfect level of half grout which will help in avoiding of water clogging inside the core. Drilling hole should be smaller it should be washed to remove dust which helps to maintain proper bonding of core with column. Beam (primary) should be fixed in notches at least from two directions to avoid twisting of column. Verticality of column (plumb) and their internal distances should be checked.

Full grout- All pre-cast main beam & secondary beam should be checked as per GFC Drawings with curing period. All type of beam sizes with length should be checked as per drawing with required bearing, top portion shear link & main beam + secondary beam with column junction portion. All beams, PC Slabs & Siporex slab should be cleaned / washed before resting on column.

3. Conclusions

a. **Jointing**- Great care should be taken while stacking as maximum damage can occur if placed wrongly. The level should be checked using plumb as it can lead to severe damage. Only one component should be raised and placed accurately at a time. Proper clearing should be done for removing dirt and burr so that jointing is done in well way and quality or strength is achieved. Well skilled and trained person is required for all allotted works of errection at site**.**

The minimum use of tower crane should at least lift 25- 30 components/day. Curing time for jointing is 14 days but can be fasten by using ant solve (sika make) used in dry areas as it is water based curing compound. Columns available in precast are 1 core, 2 cores and 3 cores. Half grouting is done after errection. Dimensions are checked diagonally with next column.

Column is placed over steam column casted at site just above foundation or footing. Cement slurry in sunken portion applied to avoid leakages. For staircase- Beam on which raker is placed -should be supported before placing of raker which can get twisted further and can't be corrected due to heavy loads. Supports provided to those beams whose length is larger than 3m and at primary secondary junction.

b. Erection

Erection platform- The erection platform (floor slab, footing, suspended slab or surrounding ground) can support the construction and erection loads and provide verification to the crane operator prior to the commencement of the work. A temporary propping system may be required.

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Erection preparation- Prior to commencing the handling and/or erection of precast concrete elements. Check crane access to the site and erection platform to prevent cranes or trucks damaging the concrete floor during access. A compacted hard-fill ramp at a suitable gradient should be provided to a level slightly above the concrete floor which can support the erection loads. Ensure the dowels and leveling shims are correctly located. Sufficient space available for precast propping or panel bracing. The lifting inserts are in their correct location.

Erection crew

The erection crew for handling and erection of precast elements should consist of: A competent crane operator, , a dodger who holds a national certificate, or one who is competent in the work that is to be performed; and an additional competent labor as required to assist with erection or placement of elements.

Note: A person with dual qualifications may function as both a rigger and dodger.

Erection of tilt-up panels

The crane operator should be competent in the scope of the work to be undertaken.. Whenever possible, panels should be lifted with the rigging equipment in view of the crane operator. At no time should any worker position themselves underneath a precast element or on the underside of a tilt-up panel during erection. No attempt should be made to lift and erect panels in strong winds where control of the panel may be lost. Braces at both ends should be connected before releasing the lifting equipment, unless designed otherwise.

4. Recommendations

If incorrectly located, faulty or missing lifting inserts are identified, immediate contact should be made with the designer who will rectify the problem and/or provide an appropriate solution. Check that the strong backs, if required, are available and correctly installed. we need to understand the sequence of construction and create a schedule / program for erection works

Quality Management- After all precast concrete panels have been installed; the Contractor and the Engineer shall conduct a final inspection to locate any damage or deficiencies. All visible damage or deficiencies shall be repaired by the Contractor to the satisfaction of the Engineer and acceptable to the Department before final approval is granted.

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