

Joints and Connections in Precast Concrete Buildings

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Abstract: As the overall stability of a precast structure majorly depends on its connections and joints between elements, it is important to consider the role of these connections and joints in transferring the loads between its elements and to stabilize the foundation. The connections and joints should be designed so that it has to satisfy all the requirements of the building so that it can achieve shorter construction time. This literature will highlight some of the important features of such connection and joints used in Precast residential structures.

Keywords: Connections, Design, Joints, Precast, Residential building

1. Introduction

Precast construction technology is the practice of casting components of a structure in a factory or other manufacturing site, and transporting complete components and parts of the structure to the construction site where the structure is to be erected. The components of the structure are joined together in a mechanical way, for example using bolts, welds, reinforcing steel, and grout and concrete in the joints, a However, connecting the elements together is not just a question of fixing the elements to each other, but it is to ensure the structural integrity of the whole structure.

1.1 Need for Precast construction technology

- Structural efficiency
- Cost effective
- Optimum use of materials
- Rapid construction
- Quality maintenance
- Adaptability
- Eco-friendly

In the complete precast structure or building the structural connections between the components will form an essential part of the structural system. The structural response of the building will depend on the behavior and the characteristics of the connections.

To achieve a satisfactory design the designer should understand how the connections influence the transfer of forces through a structure under vertical and horizontal loads. The main purpose of the structural connections is therefore to transfer forces between the precast elements in order to enable the required structural interaction when the structural system is subjected to load.

The another most important and difficult problems to be solved in both designing and execution of precast concrete structure/ building is joints between the members

A Well detailed and constructed joint play an important role in maintaining the integrity of the external part of the building, ensuring it is weatherproof and meeting other requirements.

When solving the problems of joints the properties of reinforced concrete must be taken into consideration. In other words the design of the construction of the joint should stabilize with materials to be used.

Several load transmitting joints comes under a single connection so it is important to study the difference between a 'joint' and 'connection'.

2. What are joints and connections in Precast concrete buildings

2.1 Joints

A joint is an designedly gap between adjoining elements or between an element and some other portion of the structure where the action of forces takes place (e.g. Compression, Tension and Shear etc).

Joints may be horizontal, vertical or inclined.

The function of a joint between precast elements is to provide physical separation between the components of the structure.

2.2 Connections

A connection is an assembly consisting of one or more interfaces and parts of the adjoining components, designed to resist the action of forces or moments.

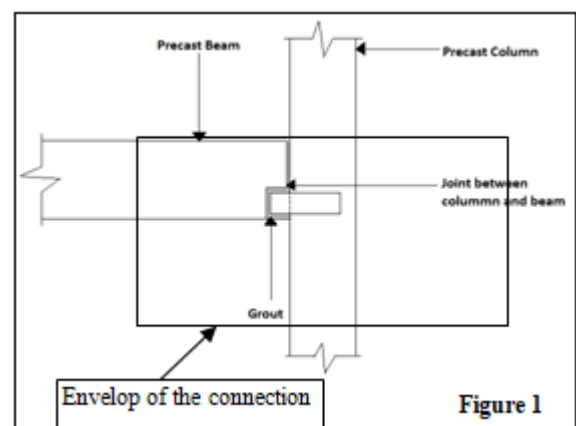


Figure 1: Shows the detailed envelop of connection

3. Purpose and importance of joints and connections in Precast concrete buildings

The Design & Construction of Joints & Connections is the most important consideration in Precast Concrete Structures/Buildings

The purpose of Connection and Joint is:

- 1) To transmit forces between structural components
- 2) To provide overall stability
- 3) To provide strength to the structure
- 4) To prevent from external leakages

In addition to this the joint is to be designed to resist unpredictable loads due to

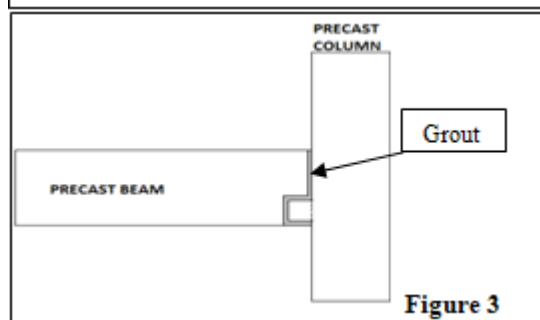
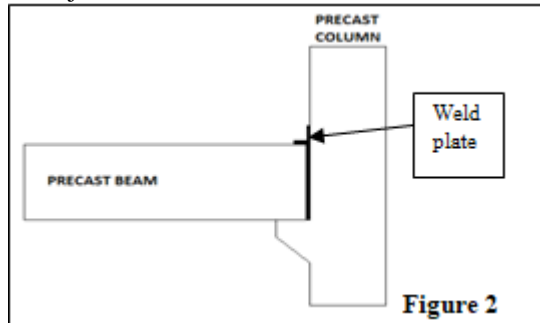
- 1) Fire
- 2) Impact
- 3) Explosion

*Failure of one joint should not affect the stability of the structure, there must be always alternate path must be available for transfer of loads.

4. Different types of joints and connections

Two kinds of joints can be distinguished

- a) **Dry Joints:** Joint accomplished by simple placing of two members by means of welding or fastening, figure. 2 shows the dry joint
- b) **Wet Joints:** Joint requires not only casting with cement but also concreting and grouting material, figure. 3 shows the wet joint.



Different types of connection between the precast components of a structure

- Column to foundation
- Wall to foundation
- Wall to wall
- Wall to column
- Wall to beam
- Column to column

- Beam to column
- Beam to slab
- Wall to slab
- Stairs to wall

5. Failure of joints and connections

As the stability and strength of precast concrete building depends on connections and joints between the components. So it is necessary to study the reasons causing the failure of connections and joints.

Here are the few reasons due to which connections and joints fails:

- Improper Detailing of reinforcement in elements
- Inadequate Design of Precast element
- Type of concrete use and its mix design
- Low quality of material used at the time of production
- Lack of concrete continuity
- Low quality connecting loops provided
- Low quality of grouting material
- Usage of weather sensitive connections
- Inappropriate lapping of steel (locker Bars) in connection
- Inappropriate water to powder ratio of grouting material
- Unprofessional workmanship at the time of execution
- Ignorance in supervision

6. Issues with Joints and Connections

- Adequate number of joints should be provided to transfer the forces.
- The joints and connection between core structure and components should be strong enough to transfer the different kinds of loads.
- Joints must have adequate strength to transfer gravity and lateral load between the precast elements.
- If joints and connection are not well finished and accomplish its results in leakage.

7. Conclusions

- 1) The connection and joint are two different concepts and generally a connection comprises of one or more load transmitting joints (compression/shear/tension joints)
- 2) The connections and joints are responsible for stability as well as strength of the precast structures
- 3) The main purpose of joints and connections is to transfer the load between the components
- 4) There should be adequate designing of joints in order to transfer the subjected load on the structure
- 5) The alternate load path should be always available in case of failure of joints
- 6) The type material used in joint between two components also plays an important role in strength of joint

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