4.1 TYPES OF JOINTS BASED ON ACTION OF FORCES

4.1.1 Compression Joints

Compressive forces can be transmitted between adjacent precast components by a direct bearing or through an intermediate medium such as in-situ mortar, fine concrete, bearing pads or other bearing elements. Direct contact between the elements should be used when a great degree of accuracy in manufacturing and erection needs to be achieved and when the bearing stresses are small. Cementitious materials such as in-situ mortar, fine concrete or grouting are often used in the joints between load-bearing elements in columns and walls as well as for beam and floor elements. The nominal thickness is about 10 to 30 mm for mortar and grout and 30 to 50 mm for fine concrete. The bedding is usually without any reinforcing bars. The mode of failure is predicated by the crushing of the mortar or splitting of the precast components in contact with it. Although the mortar, grout or fine concrete is in a highly confined state under predominantly plane stress conditions and should achieve a compressive strength higher than f_{cu}, a low design strength is normally used because the edges of the bedding tend to spall off. This will lead to a non-uniform stress distribution. The situation can be exacerbated by poor workmanship, unintentional eccentricity, spurious bending moments, and shear forces. Another fact which leads to a reduction of the joint strength is when there is a great difference in the elastic response between the bedded material and the precast concrete, which may result in localized contraction, lateral tensile stress, and splitting forces. This effect may become important when the joints thickness is greater than 50 mm.

The position of the support reaction must be accounted for eccentricities due to rotation and tolerances. The rules for this are given in Eurocode 2 (STN EN 1992-1-1, 2015). The basic dimensions of the bearing should be determined such that the stress under the bearing is limited to that of the strength of the bearing material and that of the concrete in the connected components.

Advantages

- Simple and quick to install.

- Panel edges can be plain or simple profiles.
- Economical.

Disadvantages

- Cannot be fully weatherproof, so limited to low-rise industrial buildings.
- Joint width is critical.
- Maintaining compression on the seal at the intersection of horizontal and vertical joints is difficult.
- Difficult to maintain and/or replace.
- Time-consuming while erecting.

4.1.2 Tensile Joints

The connections with the tensile capacity are often part of the overall tying system that should provide structural integrity and prevent progressive collapse. Such a connection should be designed and detailed to have a ductile behavior. Premature brittle failures must be avoided and it should be possible to obtain a rupture of the ductile components of the connections (fib Bulletin, 2008). Tensile forces are transferred between the concrete by means of various types of steel connectors that are anchored to each side of the elements at the joint with a continuity achieved by the overlapping of steel bars, dowel action, bolting or welding. The tensile capacity of the connection can be determined by either the strength of the steel elements or by the anchorage capacity.

4.1.3 Shear Joints

Shear forces can be transferred between concrete elements by adhesion or friction at a joint interface, a shear-key effect at indented joint faces, the dowel action of transverse steel bars, pins and bolts, etc. Shear keys are generally formed by providing the precast members with indented joint faces. The shear keys work as mechanical locks, thereby preventing any significant slip along the joint. Shear keys must fulfill certain minimum requirements concerning the length, depth and inclination of the tooth. Such minimum requirements are given in code and design rules (fib Bulletin, 2008).

A shear transfer by bond between precast and in-situ elements is possible, when the shear stress is low. It is not necessary to deliberately roughen the surface texture of precast units beyond the as-cast finish, which may be of a slip-forming, extrusion or tamped finish. Shear transfer by shear friction requires the presence of a permanent normal compressive force. The force may arise from permanent gravity loads, by prestressing or be artificially induced by reinforcement bars placed across the joints. Shear keys for the transfer of shear forces between elements are obtained by cast in-situ concrete or grout in joints between the elements which surface castellations. Under the action of a shear load, the shear keys act as mechanical locks that prevent significant slips at the interface.