UNIT IV

JOINTS IN STRUCTURAL MEMBERS

One of the most intricate and most difficult problems to be solved in both design of construction of structures assembled of prefabrication members is the joining.

It is highly important that the construction of the joints should be easy that unavoidable smaller inaccuracies and deviations within dimensional tolerances should neither influence the designed stresses in a detrimental manner nor cause is admissible changes in the stress distribution of the structures.

The forming and construction of joints requires owing to their intricacy, great increased control joints which cannot be inspected should be omitted.

When solving the problem of joints the properties of reinforced concrete must be taken into consideration. This means in other words, that the design of the construction of the joint should harmonize with the materials to be used. The properties of steel of timber are quite different from those of concrete and reinforced concrete. Therefore joints similarly to those used in timber and steel construction are generally not appropriate for the purpose.

Joints of reinforced concrete structures which should be omitted are shown

These joints have to be seen. This is a solution resembling a butt joint with splayed table as used in timber construction. This doesn’t comply with the nature of the material of so is not good for this purpose. The imitating a joint used in steel construction, is not appropriate either. The steel structure like joint as seen in which the component structural parts are welded to the reinforcement is also not sufficient adequate. The two halves of the steel structure forming the main constituents of the joints have to be concrete into the ends of the jointed. The slightest rotational displacement is sufficient to hinder the teeth to one another and the placing of the pins.

The joints can be rigid hinge-like or shed rigid joints are adequate in addition to the bearing the tensile, compressive of shear forces for resistance.

Design of class based an efficiency of the material used:

The plastic concrete can be used for the subsequent concrete of joints of the fluid cement mortar cast or pressed into the gaps less part of their water during the setting time of shrink, after setting the shrinkage of the in-site concrete of mortar continue.
With respect to two phase of shrinkage same codes on reinforced concrete construction permit only reduced stresses for a subsequent in-site concrete of a mortar casting. There are generally determined as a function of width of the joint on the gap to be concrete as cast.

Joints must be designed so that compensation for the allowed dimensional tolerances is ensured. A relative displacement of the joined member should be impossible even as a result of a blow or of any other unfavourable force effect. The length of the section determined for the transmission of forces should be as short as possible but should excluded any excess of the permissible stress.

The joints can be rigid hinge like or shed. Rigid joints are adequate in addition to the bearing of tensile, compressive of shear forces for resisting to bending moments too. These joints make relative displacement and relative relation impossible. Hinge like joints can transmit forces passing through the hinge itself and also allow a certain motion and rotation.

Rigid joints are generally used for the junction of column to footings, but they can also be applied for joining of individual groups with one another. The joints generally used in the construction with precast members are usually hinge like. Their execution is simpler and requires less working lime than rigid joints “shed joints” are only exceptionally used in industrial construction of are justified for a long span only. These joints are chiefly used in bridge construction for long span bridges depending on the necessity of in-site concreting; two kinds of joints can be distinguished.

a) Dry joints = joint accomplished by simple placing of two members on each other of fasting.

b) Wet joints = joint require not only casting with cement mortar but also subsequent concreting.

**Joints for different structural connections:**

- Jointing of column to footing
- Jointing of column to beam on top of column.
- Jointing of column to beam at an intermediate functions.
- Lengthening of columns.
- Jointing of beams.
- Forming of joints of arched structure.
- Joining of joints f post tensioned structures.
• Joining of precast to monolithic reinforced concrete structures.

(a) JOINING COLUMNS TO FOOTING:
This joint is usually rigid but also can be hinge. A rigid joint can be made by placing the column into a calyx of the footing or by using a welded joint. The figure shows the three variations of this method.
• Can be used for smaller.
The depth of the calyx is dimensioned according to the long or side length of the column. The depth of the calyx should be equal to 12.5% of the length of the column. The opening of the calyx is 6-10 cm greater in all direction than the class of the column. This is enabling the vibrator to be operated while concreting at the bottom of the calyx of checked by levelling before concreting. A similar steel plate is also put on the lower end of the column when positioning the column. These two steel plates must be on each other. The dimensions of these steel plates are frame 100x100x10 to 150x150x10 mm a chord into the concrete after the column is put in placed properly plumbed two advantages of the calyx joint should be mentioned.

1. The placing plumbing and fixing of the column as well as the subsequent filling of the calyx with concrete is for simpler and requires less time than in the case of a welded joint.

2. The method is least sensitive to inaccuracies occurring during the construction.

The disadvantages of the calyx joint are more suitable for small columns. In the case of large columns requiring a calyx depth of which is greater than 1 m.
(b) JOINING OF COLUMN TO BEAM AT AN INTERMEDIATE JUNCTION:

One method of forming a hinge like joint consists either or placing to beam on to a small cantilever protruding from the column or of putting it on the bottom of an adequately shaped opening left out of the column shaft. The beam rests temporarily on a tongue like extension on a steel plate placed in this opening on the supporting surface the tongue is also furnished with a steel plate anchored into the concrete. The other parts of the tongue are supported after the placing has been finished with concrete cast through an opening left for this purpose.
Hinge like joining of girder to column:

1. Opening for casting.
2. Subsequent concreting.
3. Steel plate.

(c) **LENGTHNING OF COLUMNS:**

Columns are usually lengthened at floor levels. An intermediate lengthening should be avoided if possible.

The lengthening of columns can be executed similarly to the joining with footing, accordingly the upper columns rests on the lower ones by a tongue like extension. The steel bars of the main reinforcement are joined by overlapping looped steel bars a welding. There after the stirrups have to be placed of finally the joint must be concreted.
(d) JOINING OF BEAMS:

The functions of beams can be affected either by overlapping the protracting steel bars or by welding them together.

Fig. shows the hinge like joint of purlins. In this method the whole shear must be borne by both cantilevers (i.e.) by two separate structures therefore it is expedient to form this joint at least for large girders.
The method illustrated in the fig presents a dry joint of beams which is called a bolted front. The advantages of this joint are immediate bearing capacity.

(e) **FORMING OF FUNCTIONS OF ARCHED STRUCTURES:**

Precast arches are usually produced and assembled in the form of three hinged structures. When the constant load has already been applied the centre joint is frequently eliminated. The omission of the centre joint increases the rigidity of the structures. Naturally arched structures can also be precast in a piece i.e. in the form of two hinged ones.

Hinges of arched structures can be made by using either steel shors are more expensive, but the centre transmission of forces is enhanced by their use of forming of joints on an arched structure.

The arrangement of the Centre junction and the end hinge of an arched structure. This method was used in the construction of the hall for the middle rolling train in D.O.Sgyor. The structure was precast of assembled in the form of a three-hinged arched transformed lates into a two-hinged one.

(f) **DESIGN OF JOINTS FOR POST TENSIONED STRUCTURES:**

Post tensioned structure can generally be joined for more simply then the usual reinforced concrete structures, by using post tensioning it can be ensured that in the entire structure. The joints included only compressive can develop consequently the problem of joining can be solved in a very easy manner namely by placing plane surfaces side by side and then filling the gaps with cement mortar by so doing longer beams can also be produced from shorter precast member. Thus is post tensioned structures the forming of joints does not cause difficulties.

Sketches on solution of principles relating to the joining of post tensioned structure are to be illustrated in the fig. all these joints are of course rigid and moment bearing. It is not permissible for the mortar which is to be poured into the ducts of the stressing cables to avoid this cable ducts are joined by placing a shore piece of tube or rubber ring into the duct itself.

A rigid point of these kind established between a column two girders supported by the former after the casting of the gaps and hardening of the mortar, the short inserted cables and stressed and so rigid joint is established.
(g) JOINING OF PRECAST TO MONOLITHIC REINFORCED CONCRETE STRUCTURES:

It frequently occurs that a monolithic beam has to be joined to a precast column. In this case the function can be established in the same way as already been described in the previous paragraph an joining namely by placing the end of the beam either on to a cantilever protruding from the column or into an opening formed into the columns shaft.

When making the joint, first of all a 2.5 cm deep cavity is chiselled out of the siole of the precast column. The bottom of this cavity should be roughened so as to attain a belter band between the concrete of the monolithic beam and the precast column.

EXPANSION JOINT
An Expansion joint is an assembly designed to safely absorb the heat –induced expansion and contraction of various construction material to absorb vibration or to allow movement due to ground settlement or earthquakes they are commonly found between sections of sidewalks, bridges, railway tracks, piping systems, and other structures.

EXPANSION JOINT DESIGN
A design specification shall be prepared for each expansion joint application. Prior to writing the expansion joint design specification it is imperative that the system designer complicity review the structural system layout and other items which may affect the performance of a expansion joint particular attention shall be given to the following items the system should be reviewed to determined the local and type of expansion joint which is most suitable for the application. Both the EJMA standards and most reliable expansion joint manufacturers. catalogs provide numerals examples to assist the user in this effort. The availability of supporting structures of anchoring and guiding of the
system and the direction and magnitude of thermal moments to be absorbed must be
consider when selecting the type and location of the expansion joint.

CONVENTIONAL RUBBER EXPANSION JOINT

Expansion joints are designed to provide stress relief in piping system that are loaded by
thermal movements and mechanical vibration. To deal with the various forces on the
joint they require fiber reinforcement which guarantees both flexibility and strength.

Conventional expansion joints are reinforced using prefabricated fiber pipes, the use of
these fiber pipes makes it impossible to control the orientation of the fiber on complex
shape such as the below of the expansion joint. In both case the inability to use the fiber
in the optimal way leads to the following disadvantages.

High material cost

- More fiber needed then necessary
- More rubber needed then necessary
- Additional parts such as material reinforcement rings necessary with multiple
  bellows

Lower Performance

High rubber wall thickness and fiber pack make product less flexible

Undesired radial and axial expansion under pressure.