

### 4.3 DESIGN OF EXPANSION JOINT

#### Joint Techniques:

The joint technique is a vital role for prefabricated structures. The joint mechanism is implemented to prefabricated elements. In case of dry joint the joint is under the category of bolting and welding. The bolted or welded connection should be designed properly with economical consideration. In case of wet joint the joint is in situ concrete. The in situ concrete should be in rich mortar.

#### Design of expansion joint

1. The expansion joint are provided to accommodate movements of thermal expansion
2. To avoid the cracks expansion joints should be provided
3. The thermal are formed due to summer seasons and the precast member will expand behind the original dimension. This cause the cracks will be developed in the prefabricated structures
4. Hence to avoid the formation of cracks expansion joint should be provided in the prefabricated structures

#### Spacing's of Expansion joints

S.NO	TYPE OF WALL	MAX SPACING IN METRE
1	Large Block	35
2	Curtain Wall	80
3	Large panel (homogeneous)	45
4	Large panel (non-homogeneous)	60

5. AS per NBC the structures which are more than 20m the expansion joint must be provided the material are used for expansion joints bitumen with mineral , filler and cork strip. The expansion joint is protected by a sealing compound at the top against intrusion. The building is commonly separated the structure. The welded joints between the panels which permits the rotation.

The exposed roof elements are higher expansion produced the materials are also expanded. The common building material, linear co-efficient of thermal expansion are given below

SI.NO	MATERIALS	CO-EFFICIENT $\alpha$ , $10^{-4}$ PER $^{\circ}$ C
1	Gravel	13
2	Brick	5
3	Concrete	8
4	Clinker	6
5	Blast furnace slag	11
6	Expanded clay	10
7	Lime stone	10
8	Expanded shale	10
9	Prelate	11
10	Vermiculite	14

### Design procedure for expansion joint

Expansion joint must be sized to accommodate the movements of several primary phenomena imposed upon the bridge following installation of its expansion joint devices. Concrete shrinkage, thermal variation, and long term creep are the three most common primary sources of movement.

Calculation of movements associated with each of these phenomena must include the effects to super structure type, tributary length , fixity condition between super structure, sub structure and piers flexibilities.

#### a) Shrinkage effects

Accurate calculation of shrinkage as a function of time requires that average ambient humidity, volume to surface ratios and curing methods to be taken in consideration as summarized, because expansion joint devices are generally installed in their respective block at least 30 to 60 days following concrete deck placement, they must accommodate only the shrinkage that occurs from that time onwards. For most situations, that shrinkage strain can be assumed to be 0.0002. For normal weight concrete is an unrestrained condition .This value must be corrected for restrained condition imposed by various super structure types

$$\Delta \text{shrink} = \beta \cdot \mu \cdot L_t$$

Where

$L_t$  = Tributary length of the structure subjected to shrinkage

$\beta$  = ultimate shrinkage strain after expansion joint installation estimated as 0.0002 of more refined calculations

$\mu$  = restrained factor accounting for the restraining effect imposed by superstructure element installed before the concrete slab is cast = 0.1 for steel girders, 0.5 for precast prestressed concrete girders, 0.8 for concrete box girders and T beam, 1.0 for flat slabs.

### b) Thermal effects:

Bridges are subjected to all modes of heat transfer, radiation, convection and conduction. Each mode affects the thermal gradients generated in a bridge superstructure differentially. Climate influences vary geographically resulting in different seasonal and average properties.

Example:

A massive concrete box girder bridge will be much slower to respond to an imposed thermal situation, particularly diurnal variation than steel plate Girder Bridge composed of many relatively thin steel elements.

Variation in superstructure average temperature produces elongation and shortening. Therefore thermal movement ranges calculated using a maximum and minimum anticipated bridge. Super structure average temperature anticipated during the structures life time. The consideration in the proceeding have led to the following temperature guide lines

Concrete bridges	0° F to 100° F
Steel bridges	30° F to 120° F

Total thermal movement range is calculated as

$$\Delta \text{temp} = \alpha \cdot L_t \cdot \partial T$$

Where

$L_t$  = Tributary length of the structure subjected to thermal variation

$\alpha$  = Co-efficient of thermal expansion 0.000006 in / $^{\circ}$  F for concrete and 0.0000065 in / $^{\circ}$  F

$\partial_T$  = Bridge superstructure average temperature ranges as a function on bridge type and location Generally these settings are specified for temperature of 40 $^{\circ}$  F , 64 $^{\circ}$  F and 80 $^{\circ}$  F

