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9 JOINTS AND SEALANTS (WHEREVER APPLICABLE)

9.1 SCOPE OF WORK


- i) The work under this Chapter include all labour, materials and equipment required for the supply, fabrication (if any), storage, handling, placing and splicing of waterstops and other components to be incorporated in the movement joints in concrete structures as shown on the Construction Drawings, or as required by Project Manager.
- ii) The work shall include all the necessary supports and ties required for placing waterstops and other materials.

9.2 STANDARDS

- i) The concrete materials, production, methods, testing and admixtures shall conform to the latest revisions of the following Indian Standards or, where not covered by these standards, to the equivalent International Standards:

IS: 412	Expanded metal steel sheets for general purposes.
IS: 432	Mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.
IS: 1580	Bituminous compounds for waterproofing and caulking purposes.
IS: 1834	Hot-applied sealing compounds for joints in concrete.
IS: 1838	Preformed fillers for expansion joint in concrete paving and structures (non-extruding and resilient type).
IS: 1972	Copper plate, sheet and strip for industrial purposes.
IS: 3400	Methods of test for vulcanised rubbers.
IS 4461	Code of practice for joints in surface hydroelectric power stations
IS: 11433	One part grade polysulphide based joint sealant.
IS: 12200	Code of practice for provision of waterstops at transverse contraction joints in masonry and concrete dams.

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- ii) In cases of conflict between the above standards and the specifications given herein, the decision of Project Manager should prevail.

9.3 SUBMITTALS

At least 56 days prior to procuring or dispatch to the Site of the particular item of work to which the submittal relates, the Contractor shall submit to the Project Manager the details covering the properties and performance, including the certified copies of reports of all tests made by the manufacturers, along with material samples of the products, of:


- a) Waterstops (PVC and Z type copper strip),
- b) Joint fillers,
- c) Joint sealing compounds.
- d) Bituminous coating

9.4 JOINTS

9.4.1 CONSTRUCTION JOINTS IN CONCRETE STRUCTURE-

- i) A concrete surface, which becomes so rigid, by reason of limitations in the rate of placing of concrete imposed by these specifications or by reason or delays in construction progress, that in the opinion of the Project Manager, the new concrete cannot be integrally incorporated with the previously placed, shall be defined as requiring a construction joint.
- ii) Construction joints shall be located in the positions shown on the drawings or as directed by the Project Manager and the Contractor shall not be permitted to make any additional joints or deviate from the joints indicated on the drawings without the written authorisation of the Project Manager.
- iii) Joints at exposed surfaces of concrete shall be straight and continuous, as shown on the drawings or otherwise directed.
- iv) The concrete of the earlier pour shall be chipped to produce a rough surface or green cut with an air-water jet or by sand blasting after the concrete has hardened sufficiently as directed by the Project Manager. Before placing new concrete, the surface shall be restored to the condition existing

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immediately after chipping or green cutting by means of another washing with air-water jet, vigorous brushing, sand blasting etc.

v) All the joints shall be cleaned by the Contractor to the satisfaction of the Project Manager. All intersections of construction joints with concrete faces, which will be exposed to view, shall be made straight, level and in plumb.

vi) All exposed construction joints shall conform to the requirements of aesthetics and their pattern shall be subject to the approval of the Project Manager. Surfaces of the construction joints that have been permitted to dry by reason of a succeeding layer not placed within the specified plastic period (which occurs before final set), shall be kept moist until the placing of the additional layer.

If the additional layer is placed more than 28 days after the previous layer has been placed, it is possible that curing has stopped and that the surface is no longer moist, in this case the previous surface shall be kept moist for at least 72 hours prior to placing the succeeding layers.

vii) Horizontal construction joints shall be arranged wherever possible to coincide with joints in the formwork.


viii) To prevent feather edges, the construction joints at the tops of horizontal lifts near sloping exposed concrete surfaces shall be inclined near the exposed surface so that the angle between such inclined surface and the exposed concrete surface shall not be less than 50 degrees.

ix) When the work has to be resumed on a surface that has hardened, such surfaces shall be roughened and new concrete placed after taking all measures mentioned at paragraph (iv) above. After cleaning but just before placing a new concrete layer, a 10 mm cement rich mortar paste; which is made from the same mix of concrete but without coarse aggregate; shall be applied on the previous surface.

x) The use of a retarder shall not relieve the Contractor of the responsibility of producing surfaces at construction joints as specified and to the satisfaction of the Project Manager.

xi) Disturbance of surface concrete at the joints shall be avoided during the early hardening period. Before placing the succeeding layer, the surface of

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the construction joint shall be thoroughly cleaned and loose, defective or fractured concrete shall be removed satisfactorily.

9.5 MOVEMENT JOINTS


- i) The term movement-joints comprise both, the expansion and the contraction joints in concrete structures. Movement joints shall be constructed at such locations and to such dimensions as shown on the Construction Drawings or as directed by the Project Manager.
- ii) The Contractor shall supply and install the various joint components as specified herein, as shown on the Construction Drawings and in accordance with the manufacturers recommendations.
- iii) No fixed metal/reinforcement embedded in the concrete shall be continuous through a movement joint except where expressly shown on the Construction Drawing.
- iv) Expansion joints may be comprised of the following elements:
 - a) Flexible PVC waterstop,
 - b) Concrete shear keys,
 - c) Joint filler,
 - d) Joint sealing compounds,
 - e) Bituminous coating.
- v) Contraction joints may be comprised of the following elements:
 - a) Flexible PVC waterstop,
 - b) Z type copper strip
 - c) Bituminous coating, or other approved bond breaker.

9.6 MATERIAL

9.6.1 PVC WATERSTOPS


- i) Waterstops shall be made of extruded polyvinyl chloride (PVC) conforming to IS: 12200 or IS: 4461. Material for waterstops shall be clean, homogeneous and free from porosity and other imperfections of fabrication:

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- ii) Waterstops will have minimum width of 230 mm for joints in general and 300 mm for concrete cut-off trench of the dam. Minimum wall thickness of this waterstop shall be 8 mm.
- iii) The properties of waterstops shall meet the following requirements:
 - a) Specific Density: Not less than 1.3 g/cm³,
 - b) Tensile Strength: Not less than 120 kg/cm²,
 - c) Tear Resistance: Not less than 50 kg/cm²
 - d) Ultimate Elongation: Not less than 33%,
 - e) Stiffness in Flexure: Not less than 28 kg/cm²,
 - f) Cold bend: No crack when bent at 180° after being exposed for two hours to a temperature of 5° C,
 - g) Resistance to alkalis: Testing on alkalis shall result after 7 days in a variation in weight within the limits of -0.1% to +0.25%; after 28 days the variation in weight shall be within the limits of -0.30% to +0.40%.
- iv) The wings of the PVC waterstop shall be provided with corrugations or bulbs to achieve good bond. PVC waterstops in expansion joints shall be provided with hollow centre bulb.
- v) Waterstops must have been tested by the manufacturer as follows:
 - a) Tensile strength and ultimate elongation shall be tested in accordance with IS: 412, specimens being cut by means of Die "C". Conformity shall be determined on the average of results from test on five specimens,
 - b) Modulus of elasticity shall be tested by clamping the specimen on the testing machine in such a manner to form a cantilever beam with the 25 mm dimension as the beam width. The specimen shall be held between the centre line and nearest width on one side of the piece so as to result, with the load applied at the farthest rib from the clamp, in a nominal span of 4 cm in length. Load shall be applied across the full width of the specimen by a rigid, blade type, loading head of 1 mm contact edge radius. With load value being

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that obtained for a deflection rate of 5 mm/min., the modulus of the material shall be calculated from the formula $E = PL^3/3DI$, in which:

- E = modulus elasticity (N/mm²)
- P = applied load (N)
- L = span length (mm)
- D = deflection under applied load (mm)
- I = moment of inertia of the specimen section (mm⁴)

c) The average thickness of specimen may be used for calculation of moment of inertia. Conformity shall be determined on the average of results from tests on three specimens. Each specimen shall be 25 mm in length and of the full cross section of the finished waterstop,

d) Cold bend test: Each specimen shall be 25 mm wide and approximately 150 mm long. The specimen shall be cooled to 5°C, then immediately bent through 180° around a 6 mm diameter mandrel. Any cracking shall constitute failure. Conformity shall be determined from the test conducted on three samples of flat pieces in the shape of a sheet with a thickness similar to that used as a waterstop,


e) Effect of alkali:

- Either a single sample cut from the finished waterstop, weighing between 75 and 125 gm,
- Six strips from a sheet of PVC compound, each being 150 mm long and approximately 20 mm wide.

f) For the test on the single sample, the sample shall be weighed to the nearest milligram. For tests on the 6 strips, the strips shall be weighed together, not singly, also to the nearest milligram. The hardness shall be measured in accordance with IS: 3400 (Part 2),

g) The specimen shall be totally immersed in a solution consisting of 5.0 gm C.P. sodium hydroxide and 5.0 gm C.P. potassium hydroxide dissolved in 1 litre of distilled water. The solution shall be maintained at 20°C to 25°C and shall be replaced every 7 days with

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a fresh solution at the same temperature. At 7 and 28 days, the specimen shall be removed, rinsed, surface dried, air-dried for 10 minutes and then checked for changes in weight. At 7 days it shall also be checked for any change in hardness. Weight changes shall be recorded as a percentage of the original weight and hardness change in durometer units.

- vi) Storage of material prior to placement shall be made in such a way as not to alter the properties of the material during storage. Water stops shall be stored so as to permit free circulation of air around them. All materials shall be protected from contact with oil and grease. Waterstops shall be stored in a place protected from the direct rays of Sun or to any other heat source.
- vii) Waterstops shall be joined and fixed in place in accordance with manufacturer's recommendations to form a continuous watertight barrier. All crosspieces, T-pieces and corner-pieces shall be factory produced. All joints shall be welded with approved, thermostatically controlled electric heat equipment. The temperature at which the splices are made shall be sufficient to melt but not char the plastic material. All splices shall be neat with the ends of the joined waterstops in true alignment. A mitre-box guide and portable knife shall be provided for cutting the ends to be joined to insure good contact between joined surfaces.


9.6.2 Z TYPE COPPER STRIP

Z type copper strip shall be as per IS: 12200.

9.6.3 STEEL DOWELS

Steel dowels shall be about 700 mm long plain steel bars conforming to IS: 432 (Part 1), and of 25 mm diameter. Prior to placing the subsequent pour, each bar shall be wrapped or coated to half the length with bituminous materials approved by the Project Manager. As an alternative to such coating a PVC cap may be used.

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9.6.4 JOINT FILLER

Bituminous fibre sheet shall be 12 mm thick and shall conform to IS: 1838.

9.6.5 JOINT SEALING COMPOUND

Joint sealing compounds shall be as per IS: 1834.

9.6.6 BITUMINOUS COATING


Bituminous coating shall consist of two (2) layers of coating as per IS: 1580.

9.7 EXECUTION

9.7.1 MOVEMENT JOINTS IN GENERAL CONCRETE STRUCTURES

- i) Where grouting is not required, the movement joint surfaces shall be formed with F1 finish. If grouting is required, joint surfaces shall be formed with F2 finish.
- ii) The Contractor shall supply all necessary supports and ties required for placing the waterstop and shall position it so that its central axis coincides with the joint centre. Care shall be taken that waterstop does not bend or deflect during concreting. Concrete adjacent to the waterstop shall be thoroughly worked to ensure full compaction and full contact with the waterstop but without damaging it. PVC materials shall be protected from sunlight until installation is completed.
- iii) For structures founded below the ground water table, waterstops shall be placed in the construction joints of the slabs, and at the interface between the slab and the perimeter wall, as shown on the drawings. Prior to commencement of concrete placing, the waterstops placed shall be inspected by the Project Manager.
- iv) Before casting the second part of a movement joint, the whole surface will be covered with bituminous coating, bituminous fibre sheet joint filler, or other approved bond breaker as shown on the Construction Drawings.
- v) Before applying a joint sealant, the joint shall be raked out to a depth corresponding to about 40% of the aggregate size, which value does not

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include the necessary removal of laitance, or as specified. All laitance, dirt, oil and foreign matter shall be removed from the joint by sandblasting, compressed air, grinding discs, chipping or other effective means, and the concrete surfaces coated with an approved suitable primer. Joint sealant shall be placed after the concrete curing period in accordance with manufacturer's instructions. The concrete surface temperature shall not be higher than 30°C at the time of placing, and the concrete face shall be moist for at least 4 hours, whereby any free water on the surface shall be removed prior to applying the joint sealant. After placing, the sealant shall be protected from the effects of water for a period of 10 hours.

- vi) The Contractor shall replace sealant that becomes unbonded from the concrete, or has cracks, or shows any other defects before final acceptance of the work.

9.8 MEASUREMENT AND PAYMENT

- i) Measurement for payment will be made for the following items in the units stated:
- PVC waterstop and Z type Copper strip per linear metre placed
 - Joint filler per square meter
 - Bituminous coating per square meter
 - Joint sealant (including primer) per linear metre placed
 - Steel dowels complete with half-length bitumen coated per kg
- ii) Payment will be made at the appropriate Unit Price entered in the Bill of Quantities, which shall include the entire cost of all materials, plant and labour for furnishing and construction of movement joints as specified, any testing required, and all temporary protection of the joints from damage.
- iii) Payment will only be made for movement joints shown on the Construction Drawings or directed by the Project Manager. Additional joints for Contractor's own convenience may be approved by the Project Manager, but no payment will be made for materials used in such joints.
- iv) No separate payment shall be made for construction joints.

End of Chapter

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