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12 JOINTS

12.1 GENERAL

12.1.1 Scope

- 1 This part deals with movement and construction joints, slip bearings, waterstops and associated sealants and filler materials.
- 2 Related Sections and Parts are as follows:

This Section

Part 1 General

Part 10, Curing

Part 15, Hot Weather Concreting

Part 16, Miscellaneous

12.1.2 References

ASTM D638..... Standard Test Method for Tensile Properties of Plastics

ASTM D1751..... Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

ASTM D2240..... Standard Test Method for Rubber Property—Durometer Hardness

ASTM D3575..... Standard Test Methods for Flexible Cellular Materials Made From Olefin Polymers

BS 903 Physical testing of rubber

BS 2571 General purpose flexible PVC compounds for moulding and extrusion

BS 2782, Methods of testing plastics

BS 6093, Design of joints and joining in building construction

BS 6920 Suitability of non-metallic materials and products for use in contact with water intended for human consumption with regard to their effect on the quality of the water

BS 7164, Chemical tests for raw and vulcanized rubber

EN 1992-3 Eurocode 2. Design of concrete structures. Liquid retaining and containing structures

ISO 7214 Cellular plastics. Polyethylene. Methods of test

ISO 9001 Quality management systems. Requirements

CRD-C572..... Corps of Engineers Specifications for Polyvinylchloride Waterstop

12.1.3 Submittals

- 1 The Contractor shall submit for approval by the Engineer as soon as practicable after acceptance of his Tender and not less than three weeks before commencement of concreting, drawings showing his proposals for the position of construction joints having due regard to any that may be shown on the Contract Drawings.
- 2 For slide bearings the Contractor shall provide at least three samples of the proposed material, together with the manufacturer's technical specifications and recommendations in respect of application and performance.
- 3 For slip joints the Contractor shall provide at least three samples of materials proposed, together with manufacturer's technical specifications and recommendations in respect of application and performance.
- 4 For waterstops the Contractor shall provide at least three samples of proposed types, including prefabricated joints and junctions, if applicable. If joints are to be made up on site, provide worked samples, including samples for each make of waterstop, where samples from different manufacturers are provided.
- 5 The Contractor must supply a certificate of compliance for the joint sealant, stating that it meets the requirements of the specification. The Contractor shall also supply the Manufacturer's technical and installation data for the proposed material. The Contractor shall provide details of previous installations of the product, with the client name, structure name, type of joint and value of contract.
- 6 The Contractor shall prepare shop drawings that show the layout of the waterstops, specials and joints.

12.1.4 Quality Assurance

- 1 The joint sealant, including primers and debonding materials shall be compatible with each other and shall be supplied from a manufacturer operating the ISO 9001 or 9002 Quality Assurance Scheme.

12.1.5 Definitions

- 1 Construction Joint: The surface where two successive placements of concrete meet, across which it is desirable to develop and maintain bond between the two concrete placements, and through which any reinforcement which may be present is not interrupted.
- 2 Contraction Joint: Formed, sawed, or tooled groove in a concrete structure to create a weakened plane and regulate the location of cracking resulting from the dimensional change of different parts of the structure. (See also Isolation Joint.)
- 3 Expansion Joint: A separation between adjoining parts of a concrete structure which is provided to allow small relative movements such as those caused by thermal changes to occur independently.
- 4 Isolation Joint: A separation between adjoining parts of a concrete structure provided to isolate an element and thus allow independent movement.

- 5 Joints Fillers: Materials that are used to fill space within movement joints during construction. They may provide support to a sealant applied subsequently.

12.2 CONSTRUCTION JOINTS

12.2.1 General

- 1 Where construction joints are required in slabs or beams (designed by Direct Design Method DDM) they shall be located within the middle third of their spans, and at one-third to one-quarter of span in slabs and beams subject to a maximum spacing of approximately 9 metres. Where slabs are supported by beams then the beams and slabs shall be constructed in one operation.
- 2 In all cases vertical stop boards of a form to be approved by the Engineer shall be provided by at the end of each section of work which is to be concreted in one operation and the concrete shall be thoroughly compacted against these stop boards.
- 3 Where slabs, beams and walls incorporate construction joints, panels shall generally be constructed consecutively. Where this is not possible a gap not exceeding one metre shall be formed between adjacent panels. This gap shall not be concreted until a minimum interval of 7 d has expired since the casting of the most recent panel.
- 4 The size of bays for reinforced floors, walls and roofs shall be as shown on the drawings but in no event shall they exceed 7.5 m in either direction and 6 m when unreinforced or with nominal reinforcement.
- 5 Horizontal construction joints in walls will only be permitted when the wall is continuous with the floor slab. Walls shall be keyed on cast kickers 150 mm high or on the tops of walls meeting the soffits of suspended members.
- 6 Construction joints in monolithic structures shall be aligned with each other whenever practicable.
- 7 Before placing new concrete against concrete which has already set the latter shall be treated to expose the aggregate over the full section and leave a sound irregular surface. This shall be done while the concrete is still fresh by means of water spray and light brushing or other means approved by the Engineer.
- 8 Immediately before the new concrete is placed all foreign matter shall be cleaned away and the surface moistened.
- 9 If during the course of the Contract it should become apparent that the Contractor's methods of forming construction joints are not proving effective the Engineer may order the Contractor to execute at the Contractor's expense such preventative measures as the Engineer may consider necessary to ensure the watertightness of the construction joints in further work.

12.2.2 Construction Joints in Water Retaining Structures

- 1 The floor may be designed as fully restrained against shrinkage and thermal contraction and should be cast directly onto the blinding concrete.

- 2 In large structures, the floor shall be designed as a series of continuous strips with transverse induced contraction joints provided to ensure that cracking occurs in predetermined positions. Longitudinal joints between the strips should form contraction joints.
- 3 Waterstops shall be incorporated into construction joints, crack induced joints, contraction joints and expansion joints in water retaining structures. The Contractor shall ensure that all such joints are watertight and any joints which may leak or weep shall be rectified by the Contractor to the Engineer's satisfaction.
- 4 The spacing of construction joints, crack induced joints, contraction joints and expansion joints in water retaining structures shall be shown on the design drawings.
- 5 Where the positions or type of joints are not indicated on the drawings, the spacing of construction joints or crack induced joints in water retaining structures shall not exceed 5 m.
- 6 Where the positions or type of joints are not indicated on the drawings in the ground floor slab, construction joints, crack induced joints, contraction joints and expansion joints shall be incorporated into the works as appropriate. for slabs on grade, construction joints or crack induced joints should be provided at areas where differences in subgrade and slab support may cause cracks. The slab shall be cast in strips not more than 15 metres wide across the width of the building. Within each strip for both directions, crack induced joints shall be provided at areas where cracks are expected and not more than 5.0 metre spacing, and construction or contraction joints shall be provided at not more than 15.0m spacing.
- 7 Construction or contraction joints shall be provided between adjacent strips.
- 8 Waterstops of a type acceptable to the Engineer shall be embedded in the concrete. The waterstop should be made of a high quality material, which must retain its resilience through the service life of the structure for the double function of movement and sealing. The surface of waterstops should be carefully rounded to ensure tightness of the joint even under heavy water pressure. To ensure a good tightness with or without movement of the joints, the waterstop should be provided with anchor parts. The cross-section of the waterstops should be determined in accordance with the presumed maximum water pressure and joint movements. The complete works of fixed and welded connections must be carried out strictly in accordance with the manufacturer's instructions.
- 9 Engineer's acceptance shall be obtained by the Contractor, prior to start of work, on the casting sequence and the layout of joints.

12.3 MOVEMENT JOINTS

12.3.1 General

- 1 Movement joints for expansion and contraction shall be constructed in accordance with the details and to the dimension shown on the Drawings or where otherwise ordered by the Engineer and shall be formed of the elements specified.

- 2 Movement Joints in Water Retaining Structures shall be in accordance with the details and to the dimension shown on the Drawings and EN 1992-3.
- 3 The Contractor shall pay particular attention to the effects of climatic extremes on any material which he may desire to use on any movement joint and shall submit for approval by the Engineer his proposals for the proper storage, handling and use of the said materials having due regard for any recommendations made by the manufacturer in this connection.

12.3.2 Joint Filler

- 1 Joint fillers shall conform to the requirements of BS 6093 or ASTM D1751 or equivalent if they are bituminous type or to the requirements of ASTM D3575 or ISO 7214 or equivalent if they are polymer foam type.
- 2 The joint filler shall be fixed to the required dimensions of the joint cross-section and shall provide a firm base for the joint sealer.
- 3 When required between two concrete surfaces as a resilient movement joint, the filler shall be an approved granulated cork bound with insoluble synthetic resin.
- 4 When required between blockwork and concrete as a low density movement joint filler or for building details it shall be an approved bitumen impregnated fibreboard or preformed closed cell polyethylene.

12.3.3 Joint Sealants

- 1 All joints to be sealed shall be formed and the groove grit blasted to remove all traces of deleterious materials such as form oil or curing compounds and also to remove any surface laitance from the sides of the joint. The joint shall be dry prior the application of priming. Where the use of grit blasting is not possible the Contractor may propose alternative methods subject to the approval of the Engineer.
- 2 The back of the joint shall receive a debonding tape or polyethylene foam backer cord in order to provide the correct depth to width ratio and prevent three sided adhesion.
- 3 The areas adjacent to the joint shall be protected using masking tape.
- 4 The sides of the joint shall be primed with the relevant primer as recommended by the sealant manufacturer and the sealant material applied in accordance with the manufacturers instructions.
- 5 The sealant material shall be a non-biodegradable multicomponent polyurethane elastomeric joint sealant, carefully selected as appropriate for the specific climatic and environmental exposure conditions expected. Alternative types of sealant will be considered, including epoxy-polyurethane, rubber bitumen, polyurethane, polysulphide and acrylic, subject to the requirements of the specification and the approval of the Engineer.
- 6 Where the joint sealant is to be in contact with a protective coating the Contractor shall satisfy the Engineer that the sealant and protective coating are compatible
- 7 Sealants shall exhibit the following properties:

- (a) Movement accommodation factor 25 %
- (b) Shore 'A' hardness 20 - 25
- (c) Solids content 100 %
- (d) Service temperature range 0 °C to 90 °C (-20 °C to 90 °C for cold store)
- (e) Chemical resistance to Sewage, Sabkha, Mineral acids and Alkalies
- (f) Width to depth ratio 2:1

- 8 Where shown on the Drawings sealants shall also be suitable for use with potable water.
- 9 All surface preparation, priming, mixing and application shall be carried out in strict accordance with the manufacturer's instructions.
- 10 The sealant shall have a proven track record of no less than ten years under similar local conditions.

12.4 SLIP BEARINGS

12.4.1 General

- 1 Slip bearings shall be preformed low friction bearing strips to form a thin sliding joint.
- 2 They shall be extruded from specially formulated polyethylene to form a durable lamina resistant to sewage, mineral acids and alkalis, solvents and weathering.
- 3 Slip bearings shall be applied in two layers with the bottom layer bonded to the substrate with a high quality solvent borne adhesive based on polychloroprene rubber. The substrate shall be clean and free from deleterious materials such as form oil or curing compounds and surface laitance. The surface shall be level and even along the full length of the joint
- 4 The applied loads for slip bearings shall not exceed 0.7 MPa.
- 5 Operating temperatures shall be up to 80 °C
- 6 The coefficient of friction shall not exceed 0.15

12.5 WATERSTOPS

12.5.1 General

- 1 Waterstops and associated materials shall be by a manufacturer with a minimum of ten years experience in the field of engineering waterproof products.
- 2 PVC waterstops shall be suitable for storage, handling, installation and service within a range of 15 °C to 65 °C.

12.5.2 Waterstops

- 1 The waterstop shall be a high performance system forming a continuous network as shown on the Drawings.
- 2 Site jointing is to be limited to butt joints and shall be performed strictly in accordance with the manufacturer's instructions.

- 3 Centrally placed waterstops shall employ centre bulbs/shutter stop with ribs on the web sections.
- 4 Externally placed waterstops shall have ribs on either side of the centre of the waterstop. The water bar used at the location of expansion joints shall have a bulb in the centre to accommodate the movements.
- 5 Waterstops shall have a minimum thickness of 3 mm.
- 6 The minimum test performance data for PVC waterstops shall be as follows:

Tensile strength	>12 MPa
Elongation at break	300 %
Hardness Shore	'A' 80 to 90

- 7 The materials shall be tested in accordance with BS 2571 or BS 2782 or CRD-C572 or ASTM D2240, BS 6920 for Toxicity, and ASTM D638 for tensile & Elongation ..

12.5.3 Butyl Rubber Waterstops

- 1 Butyl rubber waterstops shall have the properties stated in Table 12.1 when tested in accordance with BS 903.

Table 12.1
Properties Requirements of Butyl Rubber Waterstops

BS 903	Property	Requirements
Part A1	Density	1100 kg/m ³ ($\pm 5\%$)
Part A26	Hardness	60-70 IRHD
Part A2	Tensile Strength	Not less than 17.5 N/mm ²
Part A2	Elongation at break point	Not less than 450 %
Part A/6	Water Absorption (48 hours immersion)	Not exceeding 5 %

- 2 Butyl rubber waterstops shall be suitable for storage, handling, installation and service within a temperature of 0 °C to 40 °C

12.5.4 Water Swelling Gaskets

- 1 Where active sealing is required for critical areas, waterstops shall be hydrophilic polymer modified chloroprene rubber strips. The rubber strips shall conform to the following properties as applicable:

- (a) Water pressure resistance : 5 Bar (50 m)
- (b) Expansion in contact with fresh water : 2 x original size
- (c) : Reversible
- (d) Application Temperatures : - 30 to + 70 °C

- 2 The selected rubber strips shall be available for three exposures:

- (a) Fresh Water

- (b) Seawater
- (c) Chemicals (if the condition demands or upon the Engineer's request)

The supplier shall furnish references upon request of the Engineer.

END OF PART

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