



# **DS 152: DESIGN OF NEW REINFORCED CONCRETE (RC) STRUCTURES**

## **Purpose**

To state WW requirements and provide a standardised approach to the design of new reinforced concrete structures.

## **Scope**

New reinforced concrete structures and modifications to existing. This DS does not cover the design of unreinforced concrete structures.

## **Inherently Safer Design**

This Design Standard should be read in conjunction with [DS102 – Inherently Safer Design](#). The ethos and principles of DS102 must be applied at all stages of the project design process.

## **Status**

Compliance with Design Standards is mandatory unless a deviation has been formally approved.

Deviations shall be agreed in advance with the Technical Manager and then either approved via the Delivery Challenge Register or recorded in the deviations section of the approval paper when the project is submitted for authorisation.

Everyone involved in delivery projects using design standards is encouraged to challenge and suggest changes to all design standards to help Wessex Water deliver its required outcomes.

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## Abbreviations

|       |   |  |
|-------|---|--|
| CESWI | - | Civil Engineering Specification for the Water Industry     |
| CIRIA | - | Construction Industry Research and Information Association |
| DS    | - | Design Standard  |
| EC    | - | Structural Eurocode  |
| NA    | - | National Annex   |
| NCCI  | - | Non-Contradictory Complimentary Information                |
| PCC   | - | Precast Concrete   |
| RC    | - | Reinforced Concrete  |
| WIMES | - | Water Industry Mechanical and Electrical Specification     |
| WW    | - | Wessex Water   |

## COMPANY REQUIREMENTS

### 1. General

- The following requirements apply to the design of RC structures.

#### 1.1 Design Codes

- Unless noted otherwise in this DS all parts of the following design codes, in conjunction with the relevant UK National Annexes and referenced Non-Contradictory Complementary Information (NCCI) where applicable, shall be used in the design of RC structures as a minimum. The latest version of these codes shall be used.
  - BS EN 1990: Eurocode: Basis of structural design (EC0)
  - BS EN 1991: Eurocode 1: Actions on structures (EC1)
  - BS EN 1992: Eurocode 2: Design of concrete structures (EC2)
  - BS 8500: Concrete – Complementary British Standard to BS EN 206

#### 1.2 Design Life

- The design life of RC structures shall be as specified in DS100.

### 1.3 Concrete Mixes

- Unless the RC structure is outside the scope of application of DS151, the concrete mixes tabulated in DS151 shall be specified for insitu RC construction. Concrete mixes for PCC construction shall be determined by the supplier.

### 1.4 Nominal Cover

- The nominal cover to reinforcement in in-situ concrete shall be as follows, unless required otherwise for durability purposes:

|                                    |      |
|------------------------------------|------|
| Concrete cast against blinding     | 50mm |
| Concrete cast against soil         | 75mm |
| Walls supporting motorised wheels* | 50mm |
| All other locations                | 40mm |

\*Note that WW apply de-icing salts to the tops of walls which support motorised wheels.

The nominal cover to reinforcement in specialist PCC construction shall be determined by the supplier.

### 1.5 Solar Thermal Effects

- Unless agreed otherwise with WW, where roofs of tanks are susceptible to solar thermal effects:
  - the wall to roof joint shall be continuous (monolithic) for small structures (say, a maximum of 5m on plan in any one direction) and
  - for all other structures the tops of walls shall be designed as free and detailed with a horizontal proprietary slip membrane. The whole detail shall have a design life equal to the design life of the structure. Where a roof is supported by columns it shall be designed for thermal stresses in accordance with the requirements of the Eurocodes.

### 1.6 Type of Construction

- Unless agreed otherwise with WW, all RC structures shall be of continuous construction.
- Semi-continuous or full jointed construction shall only be used where economically advantageous and the required design life can be achieved. In such circumstances all joint details shall be provided on the construction drawings.

### 1.7 Finishes and Tolerances

- Finishes and tolerances shall generally be in accordance with CESWI. Where project specific finishes and/or tolerances are required these shall be specified on the construction drawings.

### 1.8 Protection Against hydrogen Sulphide (H<sub>2</sub>S) Attack

- Where H<sub>2</sub>S exists, the preference is for internal concrete surfaces to be protected by providing an appropriate level of additional concrete cover. Proprietary products can be specified, subject to agreement with WW.

### 1.9 RC Detailing

- Prior to commencement of the design and RC detailing the following shall be agreed with WW, as a minimum:
  - If reinforcement bar sizes need to be such that temporary stability propping isn't required prior to pouring. Where reinforcement bars aren't sized to remove the need for temporary propping this shall be clearly stated on the RC drawing.
  - Construction joint locations
  - A concrete pour sequence that reduces the risk of cracking due to restraint and hence reduces the reinforcement quantity (refer to C766: Control of cracking caused by restrained deformation in concrete, Section 6.1)
  - The maximum length and weight of reinforcement bars for delivery and handling
  - Preferences for the use of prefabricated reinforcement boxes
  - If reinforcement starter-bars need to be detailed to obviate the risk of impalement (i.e. u-bars or hooks)
  - The location sumps slabs to simplify RC detailing

- Preferences for staggered lap percentages
- Preferences for pipe penetrations (i.e. cast-in with puddle flanges, couplings or Link-Seal)
- Requirements for reinforcement sterile zones to facilitate ease of post drilling
- The general preference is for smaller diameter bars at close centres to be used rather than larger diameter bars at wider centres.
- All RC detailing shall be undertaken in accordance with the latest edition of the IStructE Standard Method of Detailing Structural Concrete – A Manual for Best Practice.

### **1.10 Fixings into Concrete**

- Fixings into concrete shall comply with the requirements of WIMES 8.03 – Mechanical Installations (+ WW Amendments).

### **1.11 Specific Requirements for Supplier Design RC and PCC Structures**

- Where the design of RC or PCC structures is being undertaken by a Supplier, this DS along with the requirements of Standard Specification for Supplier Designed In-Situ and Precast Concrete Structures shall be complied with.

## **2. WATER RETAINING STRUCTURES**

### **2.1 General**

- Water retaining structures that form part of a water treatment process shall comply with the following requirements. Basements to buildings shall be protected against water ingress in accordance with the latest edition of BS 8102.

### **2.2 Design Requirements**

- Water retaining structures shall be designed in accordance with of BS EN 1992-3 – Liquid retaining and containment structures and the associated UK National Annex.
- Tightness Class 1 shall apply unless requested otherwise by WW.
- Construction joints in large water retaining structures (reservoirs, balance tanks, contact tanks, storm tanks, settlement tanks etc) shall be specified with centrally located hydrophilic strips. These shall be DWI Regulation 31 Approved where the retaining liquid is part of a potable water system.
- In the application of BS EN 1992-3 and the associated UK National Annex, the following amendment applies:

#### **NA to BS EN 1992-3 NA.4**

**Replace:** CIRIA Report C660: Early-age thermal crack control in concrete

**with:** CIRIA Report C766: Control of cracking caused by restrained deformation in concrete (+ all published errata amendments)

### **2.3 Application of CIRIA C766**

- All recommendations and complimentary expressions contained in C766 can be adopted to determine the reinforcement required to control cracking due to restraint, with the exception of the following:

#### **Allowable crack width**

For publicly visible water towers the allowable crack widths should not exceed 0.1mm for aesthetic purposes.

#### **Cover to reinforcement**

All crack width calculations should be conducted based on  $C_{nom}$ , not  $C_{min}$ .

## 2.4 Testing

- Drawings shall clearly indicate which structures are to be water tested in accordance with the requirements of the latest version of CESWI (+ WW amendments).

## Revision History

| Issue | Revision Description  | Prepared by               | Approved by  | Approval date |
|-------|---|---------------------------|--------------|---------------|
| 1     | First Issue Standardised approach to the design of RC structures. Adoption of CIRIA C766. | Brad James                | Silas Warren | June 2020     |
|       | Reformatted, no technical changes   | George Hinchcliffe Morgan | Silas Warren | May 2024      |
| 2     | Content reviewed – no changes required  | Lewis Brett-Iveson        | Silas Warren | April 2025    |