Structures

Master Specification

ST-SC-S5 Heat Accelerated Curing

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Contents

ST-SC-S5 Heat Accelerated Curing

1 General

1.1 This Part specifies the requirements where heat accelerated (hot water) curing of precast concrete is to be used for components manufactured in accordance with ST-SC-S3 “Precast Concrete Units” and ST-SC-C2 "Post Tensioned Concrete".

1.2 The following definitions apply:

Term	Definition
Concrete Mass	The concrete product, member or part of a structure, or the concrete in the products on a pre-tensioning bed or in a group of similar products made within the one casting period, to which steam curing is applied.
Initial Maturity °C.h	The product of temperature of the concrete in °C and time in hours (h). Temperature is that of the concrete mass at the completion of placement. The time is measured from the time of completion of placement of the concrete mass to the first introduction of steam.
Recording Thermometer	An instrument capable of continuously recording and printing a permanent record of temperature vs time. The report shall be accurate to within 2°C.
Steam Covers	Flexible or rigid barriers that retains heat and moisture around the concrete mass and test specimens during steam curing.
Temperature Probe	A probe with thermometer which can be inserted under the steam covers to check the steam temperature. The thermometer shall be accurate to within 1°C.
Test Specimen	Any compression, flexural or other test specimen which is to be tested for the purpose of determining a property of the concrete mass following steam curing.

1.3 Unless specified otherwise, all design and / or documentation must comply with the most recent revisions (including published amendments) of the following design standards and / or specifications:

a) AS 1379 The Specification and Supply of Concrete.

2 Quality Requirements

2.1 Further to the requirements of PC-QA1 "Quality Management Requirements", the Contractor shall prepare and implement a Quality Plan that at a minimum includes detailed procedures and documentation for:

a) curing of precast units by the controlled circulation of hot water.

2.2 If not provided beforehand, the procedures shall be submitted at least 28 days prior to the commencement of the work subject to this Part.

2.3 Provision of the procedures listed in this Clause shall constitute a **Hold Point**.

3 Heat Delivery

3.1 Heat Accelerated curing shall involve heating of precast units, after an initial maturing period, by the controlled circulation of hot water through a series of steel conduits attached externally to the steel mould. A purpose built tank used for the curing of concrete test cylinders shall be connected to the hot water system. Hot water curing shall be continuously applied until the concrete has attained the required compressive strength.

3.2 The hot water system shall be controlled by a thermostat so that the temperature difference between ingoing and outgoing water in the Water jacket is not more than 10°C. The Contractor shall provide evidence that this requirement is met.

3.3 The maximum temperature (refer Clause 6.5 “Curing Time”) of the water system shall not be exceeded to ensure that there is no localised overheating of the concrete mass.

3.4 Unformed exposed concrete surfaces shall be covered immediately following the concrete finishing operations to minimise evaporation from the surface of the concrete mass. Curing covers shall be heat insulated to prevent surface heat loss during hot water curing.

4 Hot Water Curing Cycle

4.1 Concrete shall have an initial maturity of not less than 40°C.h and the duration of pre-setting period shall not be less than 2 hours nor longer than 5 hours, unless wet curing is applied in the interim period prior to heat application

4.2 Where necessary a small amount of hot water heat application may be used to maintain the concrete at the temperature at which it was placed. During this period the temperature at the surface of the concrete mass shall not exceed 30°C.

4.3 The maximum rate at which water temperature rises / falls shall not exceed 24°C/h.

4.4 The target inlet water temperature shall be 70°C with a tolerance of ± 5°C.

5 Temperature Record

5.1 A sufficient number of temperature proves and recording thermometers shall be used to ensure that any temperature difference between any 2 points in the hot water jacket is detected. Where the hot water jacket consists of more than one section, temperature recording shall be undertaken for each section.

5.2 Recording thermometers shall be capable of continuously recording and printing a permanent record of water temperature versus time. The report shall be accurate to within 2°C.

5.3 Temperature Probes shall be probes with a thermometer, which can be inserted into water-filled temperature stations to check the water temperature. The thermometer shall be accurate to within 1°C.

5.4 The recording thermometers shall be set in operation immediately upon completion of casting and screeding, the temperature sensitive part of each thermometer being installed in position at the same time.

5.5 A printed continuous record of temperature variation with time shall be obtained.

5.6 The Contractor shall record the following information:

a) description of concrete mass (e.g. pile, girder, etc., with identifying element number);

b) time of completion of concrete placement;

c) temperature of the concrete at completion of placement;

d) temperature of the concrete at time of commencement of heating;

e) time of commencement of heating;

f) temperature difference between ingoing and outgoing water for each section of the hot water jacket;

g) water temperature in the curing tank;

h) time of shutting off heat;

i) time of removing covers;

j) ambient air temperature at the time of removal of curing covers; and

k) name of Contractor and date of operation.

6 Hot Water Cured Test Specimens

General

6.1 The sampling and testing of specimens for hot water cured concrete shall conform to the requirements of AS 1379, as applied to non-hot water cured concrete.

6.2 Test specimens shall be subjected to the same curing procedure adopted for the elements they represent, including any subsequent moist curing. They shall be located in a purpose built tank that is filled with water maintained at a temperature within 10°C but not exceeding the maximum temperature of the water in the jacket.

6.3 The Contractor shall ensure that sufficient cylinders are provided to enable the required testing to be undertaken (a minimum of 2 cylinders to be tested from the last batch of concrete, the average representing the “Transfer” strength).

Testing for Transfer and / or Handling

6.4 If, on testing at the end of the curing cycle, compressive strength test specimens made for the purpose of determination of time of transfer of prestressing force and / or handling do not achieve the required strength, further curing shall be carried out until the required strength is achieved.

Curing Time

6.5 If 75% of the target 28 day compressive strength has not been achieved at the end of the curing cycle, curing by either moist or hot water methods shall continue until that strength is reached.

7 Removal of Curing Covers

7.1 Curing covers shall not be removed until the surface temperature of the concrete has fallen to within 30°C of the ambient air temperature outside of the curing covers. Curing covers shall remain in place longer if the concrete product shows signs of damage due to thermal shock or differential cooling.

8 Additional Moist Curing

8.1 Additional moist curing, if required, shall not be applied until the concrete mass has cooled to the ambient air temperature, not shall it be delayed beyond this time.

9 Hold Points

9.1 The following is a summary of hold Points referenced in this Part:

Document Ref.	Hold Point	Response Time
2.3	Submission of Procedures	7 days

10 Verification Requirements and Records

10.1 The Contractor shall supply written verification that the following requirements have been complied with and supply the verification with the lot package.

Table ST-SC-S5 10-1 Verification Records

Document Ref.	Subject	Record to be Provided
3.2	Thermostatically Controlled Hot Water System	Evidence of thermostat meeting temperature requirements
5	Water Temperature	Information specified in Clause 5