AMENDMENTS TO OPSS 910 (NOV 88) – CONSTRUCTION SPECIFICATION FOR PRESTRESSED CONCRETE CAST-IN-PLACE [1]

OPSS 910.02 is amended by the addition of the following:

Canadian Standards Association Standards:

CSA-A23.2-1B	Viscosity, Bleeding, Expansion and Compressive Strength of Flowable Grout
CSA-A23.5-M86	Supplementary Cementing Materials

American Society for Testing and Materials:

ASTM-D-962-81	Standard Specification for Aluminum Pigments, Powder and Paste for Paints

OPSS 910.03 is amended by the deletion of the definition for "Grout", and the addition of the following:

Cementing Materials: means Type 10 Portland cement and silica fume.

Grout: means an initially fluid mixture of Type 10 Portland cement, silica fume, water and approved admixtures.

OPSS 910.05.08 is deleted and replaced by the following:

910.05.08 Grout

The grout shall consist of Type 10 Portland cement, silica fume (6% replacement by mass of cement), superplasticizer in powdered form (1.5% by mass of cementing materials), aluminum powder and water. The maximum ratio of water to cementing materials shall be 0.33, or as recommended by the manufacturer of the packaged grout.

1. All references to OPS specifications that have been amended (as noted in LIST T1) are superseded by references to the replacement City of Toronto specifications (as given in LIST T1).

The dry ingredients of the grout shall be mixed and shall be supplied in bagged form, with a maximum bag size of 30 kg. The bag shall be made of 3-ply paper with a 13 μm thick polyethylene lining. The name of the supplier of the packaged grout and the date when the grout is packaged shall be printed on the bag. The packaged grout shall be supplied on skids covered with polyethylene sheeting.

The packaged grout shall be stored in a dry condition up to the time of its use, and shall be used within one month of packaging.

The packaged grout shall be from suppliers approved by the Owner, such as King Package Material Company, Paris, Ontario, Grout Mix No. 3011.

OPSS 910.05.10 is deleted.

OPSS 910.06.02 is amended by the deletion of the 2nd paragraph and is replaced with the following:

The mixer shall be a high speed (1200 to 2000 rpm) mechanical mixer. The mixer shall be equipped with a calibrated measuring device for determining the quantity of mixing water. The device shall measure the total quantity of water used in each batch of the grout to an accuracy of ± 2%. The mixer shall be equipped with a visible timing device suitable for controlling the mixing time.

OPSS 910.06 is amended by the addition of the following subsection:

910.06.03 Grout Testing

Equipment required for the flow time, bleeding, and expansion measurements, stainless steel moulds for preparing cubes for compressive strength tests, and thermometers for measuring air and grout temperature shall be provided by the Contractor. The equipment shall conform to CSA-A23.2-1B.

OPSS 910.07.01 is amended by the addition of the following:

Flow time, bleeding and expansion measurements, and preparation of cubes for compressive strength tests shall be carried out on a level, vibration-free surface.

OPSS 910.07.04 is superseded by:

910.07.04 Grouting

910.07.04.01 Preparation for Grouting

After stressing of tendons, all openings and vents along the ducts shall be temporarily plugged or sealed until the grouting is performed.

A check shall be performed to ensure the ducts, vents, inlets, and outlets are capable of accepting injection of the grout. This shall be conducted by blowing dry, oil-free compressed air through each duct and testing each vent in turn.

All ducts shall be clean and free of all deleterious matter that would impair bonding of the grout to the ducts and tendons. If required, the ducts shall be thoroughly flushed out with water and blown out with dry, oil free compressed air. Steam shall not be used for cleaning.

All grout vents of each duct shall be open when grouting starts. The elevation of the end of the ejection vent at the free end shall be higher than the high point vents along the duct.

910.07.04.02 Grout Mixing

A standard batch size shall be established prior to commencing grouting and maintained throughout the grouting operation.

The mixing procedure for the grout shall be as follows:

(a) The required amount of water shall be added by means of the calibrated measuring device attached to the mixer.

(b) Packaged dry ingredients shall be added to the mixer; and

(c) The grout shall be mixed for a minimum of 1 minute after all the dry ingredients are added and until the grout is mixed thoroughly and uniformly.

The time between the addition of the dry ingredients and pumping the grout shall not exceed 15 minutes. No water shall be added to the grout after initial mixing.

The holding tank shall be kept at least partially full at all times during the pumping operation to prevent air from being drawn into the duct.

910.07.04.03 Temperature

The temperature of the grout at the time of injection shall not be less than 15°C nor more than 25°C and shall be measured hourly.

910.07.04.04 Quality of Grout Mixture

Any grout mixture showing evidence of dampness, lumps, hardened pieces, or contamination shall not be incorporated in the work.

Prior to the grouting operation, in the presence of the Commissioner, a test batch shall be mixed and the grout tested for bleeding, expansion, and flow times to ensure that the grout meets the requirements, before the grouting is allowed to proceed. The test batch shall not be used in the actual grouting operation.

Bleeding, expansion, and flow time measurements shall be performed on the grout at any time during the grouting operation, at least once per day, or as requested by the Commissioner. For testing, the Contractor shall employ staff from a testing company certified by the Canadian Standards Association. (Reference CSA A283 - Certification for Category O) and who demonstrates to the Owner that they are competent in testing the grout and preparing the cube specimens in accordance with CSA-A23.2-1B.

Bleeding, expansion and flow time test results shall be submitted to the Commissioner. Any test result which indicates the grout is not meeting specifications must be reported immediately to the Commissioner and the grouting operation halted until the cause of the problem is identified and corrected.

910.07.04.05 Bleeding and Expansion Requirements

The grout shall not bleed or segregate when allowed to stand for 1 hour.

The grout shall exhibit an expansion of 6 ± 2% of its original volume at 1 hour.

The bleeding and expansion shall be tested in accordance with CSA-A23.2-1B.

910.07.04.06 Flow Time Requirements

The flow time of the grout shall be between 11 and 25 s when the measurements are performed immediately after the grout is removed from the mixer and shall remain between 11 and 25 s, 30 minutes after mixing.

The grout used for the first set of flow time measurements shall be discarded after testing and shall not be used for the 30 minute measurement. The grout used for the 30 minute measurement shall be left undisturbed in a clean container covered with a lid until the measurement is performed.

The flow times shall be measured in accordance with CSA-A23.2-1B.

910.07.04.07 Strength Requirements

The grout shall have an average compressive strength of not less than 30 MPa at 7 d and 60 MPa at 28 d. The grout specimens shall be prepared and tested in conformance with CSA-A23.2-1B. The Contractor shall satisfy himself and the Commissioner by casting test cubes, that the prepackaged grout will meet these requirements.

Cubes shall be prepared on site from the grout to be pumped into the ducts. A minimum of three cubes shall be made for 7-day strength tests, and six cubes for 28-day strength tests, once per day, as directed by the Commissioner. These cubes shall be taken at the mixer. Three additional cubes shall be taken at the anchorage outlet to be tested at 28 days.

The grout specimens shall be stored at a temperature between 15°C and 25°C and shall not be moved prior to demoulding. The grout specimens shall be demoulded and transported to the laboratory designated by the Owner within 24 ± 4 hours. The grout samples shall be transported in a sealed white opaque plastic bag containing at least 250 ml of water and maintained at a temperature between 15°C and 25°C.

910.07.04.08 Grouting Procedures

Once permission to grout has been received in writing from the Commissioner, grouting shall be carried out as soon as possible, but in no case shall any prestressing steel be left ungrouted for more than 7 days after receipt of permission to grout or more than 14 days after completion of tensioning. If the temperature of the concrete or the duct drops below 5°C, it shall be raised to at least 5°C to complete the grouting and maintained at that level or higher for at least 72 hours after completion of grouting.

Grouting shall commence as soon as possible after mixing and shall be carried out in one operation without interruption. A continuous, one-way flow of grout shall be maintained. The pumping pressure at the injection vent shall not exceed 1 MPa. The grout shall be pumped from the lowest grout inlet.

As grout of original consistency without slugs of water or air emerges from the vents, the vents shall be successively closed as the filling of the ducts progresses. When grout of original consistency without slugs of water or air emerges from the ejection vent at the free end, the vent shall be closed. While pumping continues, the high point vents along the duct shall be re-opened, one at a time, starting with the vent closest to the injection vent. Vents shall not be resealed until grout of original consistency without entrapped air or residual water emerges. The injection tubes shall be sealed off under pressure when the duct is completely filled with grout. A pressure of approximately 500 kPa shall be maintained for at least 1 minute after sealing.

The grout tubes shall be topped up with grout if a wastage or subsidence of grout occurs when disconnecting the pump or pressure apparatus so that grout completely fills the ducts and openings. After the grout has hardened, the grout tubes shall be cut off flush with the surface of the deck and any tubes not completely full of grout shall be topped up flush with the surface of the concrete.

After grouting is completed, any residue of grout remaining on concrete surfaces adjacent to the vents shall be removed.

Loads shall not be applied to or removed from the structure until the grout has reached a compressive strength of 20 MPa.

OPSS 910.08.01 is deleted and replaced by the following:

Representative samples of the packaged material shall be submitted to the Commissioner when requested.