CONSTRUCTION SPECIFICATION FOR PRESTRESSED CONCRETE - PRECAST GIRDERS

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909.01 SCOPE

This specification covers the construction requirements for installation of precast prestressed concrete girders.

909.02 REFERENCES

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 905 Steel Reinforcement for Concrete

Ontario Provincial Standard Specifications, Material

OPSS 1355 Precast Concrete - Materials and Production

Ontario Ministry of Transportation Publications

Structural Manual

MTO Forms:
PH-CC-701 Request to Proceed
PH-CC-702 Notice to Proceed

CSA Standards

A23.4-16 (R2021) Precast Concrete Material and Construction
CSA S6:25 Canadian Highway Bridge Design Code

National Cooperative Highway Research Program

Project 12-98, Appx. C Proposed Guidelines for Prefabricated Bridge Elements and Systems Tolerances

Precast/Prestressed Concrete Institute (PCI)

MNL-135-00 Tolerance Manual for Precast and Prestressed Concrete Construction, 1st Edition

909.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Design Proposal means a submission of proposed changes, when engineering design is required.

Girders means precast prestressed concrete girders.

Girder Type means a girder differentiated by its cross-sectional shape such as box girder type (solid or voided), I-girder type (such as Nebraska University [NU] and Canadian Precast Prestressed Concrete Institute [CPCI]), or T-girder type.

Post-Tensioning means a method of prestressing in which tendons are tensioned after the concrete has reached a predetermined strength.

Precaster means the party who produces the girders.

Prestressed Concrete means reinforced concrete in which internal stresses have been initially introduced so that subsequent stresses resulting from dead load and superimposed loads are counteracted to a desired degree. This may be accomplished by pretensioning or post-tensioning.

Pretensioning means a method of prestressing in which strands are tensioned before the concrete is placed.

Strand means as defined in OPSS 905.

Sweep means the lateral deviation from straightness of a girder with respect to its design centre line.

Tendon means a high-strength steel element consisting of one or more wires, strands, or bars; used to impart prestress to the concrete.

909.04 DESIGN AND SUBMISSION REQUIREMENTS

909.04.01 Design Requirements

909.04.01.01 General

The design shall be according to CSA S6, the Structural Manual Division 1 and as specified in the Contract Documents.

The jacking force shall be calculated to achieve the theoretical prestressing force in the strand, immediately prior to transfer, as specified on the Contract Documents.

In determining the jacking force, losses due to chuck slip, bed shortening and bulkhead rotation, including abutment tilt, temperature variation, deflected strand friction, sequential strand stressing, and initial relaxation of strand prior to transfer shall be included. Deflected strand friction may be taken as nil where pin rollers are used at the bulkheads (hold-ups) and swivel pin roller devices are used at hold-down locations. Relaxation loss shall not be taken as greater than 15 MPa. During jacking, each strand may be stressed up to 0.80 fpu.

909.04.01.02 Permissible Changes from the Contract Drawings

909.04.01.02.01 General

Changes from the Contract Drawings are permitted and may be implemented by the precaster, without prior approval from the Owner, provided they meet the requirements of this specification.

909.04.01.02.02 Prestressing of Girders

The prestressing strand pattern may be adjusted to suit production requirements provided all changes meet the original design strength without adversely affecting other components of the structure. If the centre of gravity of the strands at the interior hold down closest to mid-span is within ± 10 mm of the original design, then one or more of the following adjustments shall be permitted provided that both the serviceability and ultimate limit states capacities are not adversely affected:

a) Use additional strands with a lower jacking stress provided the total prestress force is within ± 2% of the original design.

b) Use of imperial strand spacing in lieu of metric, where 25 mm = 1” and 50 mm = 2”.

c) Addition of one hold-down per end is added towards the girder end at the same spacing as the original design.

d) One less hold-down per end when the hold-down closest to mid-span is deleted.

e) Increase or decrease the number of strands in each hold-down group.

f) Increase of vertical strand spacing between hold-down points from 25 mm up to 50 mm.

909.04.01.02.03 Reinforcing of Girders

The stirrup projection may be adjusted from that specified on the original design, based on details such as the predicted camber, provided it meets the deck embedment range indicated elsewhere in the Contract Documents.

Spacing of stirrups around blockouts for diaphragms may be adjusted, provided the minimum spacing requirements of CSA S6 are satisfied, and up to two stirrups may be added in order to maintain the total reinforcement requirements.

909.04.01.02.04 Other Design Details

Details limited to those below may be adjusted to suit production requirements, provided all changes meet the original design without adversely affecting other components of the structure:

a) Dowel holes and inserts may be adjusted vertically within ± 75 mm from the location specified on the original design to avoid any conflict with strands.

b) Undercut dimensions may be adjusted to accommodate the predicted camber.

c) Additional pockets and hardware for temporary bracing may be added.

d) Additional temporary post-tensioning or pre-tensioning for shipping and handling may be added provided they do not adversely affect the girders at any stage.

The production length of the girder may be adjusted to account for elastic shortening.

909.04.01.03 Temporary Bracing

Temporary bracing shall be installed at the time of I-girder installation.

Temporary bracing for girders shall be designed according to CSA S6 and the Contract Documents. If the girders are not to be permanently connected within the same construction season, the bracing for girders shall be designed for multi-year construction using a return period of 25 years.

In no case shall temporary bracing be less than the minimum requirements specified in the Contract Documents.

909.04.02 Submission Requirements

909.04.02.01 Working Drawings

One electronic copy in PDF format of the Working Drawings, including supporting documentation shall be submitted to the Contract Administrator at least 7 Days prior to commencement of fabrication of the girders, for information purposes only. Prior to making a submission, the design Engineer and the design-checking Engineer shall affix their seals and signatures on the Working Drawings verifying that the drawings are as specified in the Contract Documents.

When other authorities are involved in the approval of the design or construction of a highway structure, the fabrication Working Drawings submission shall be at least 5 weeks prior to commencement of the work and one additional copy of the submission shall be provided for each authority. The requirements of each authority and the requirements of the Owner specified in the Contract Documents shall be satisfied prior to commencement of the work.

The Working Drawings shall include the following information:

a) Girder details.

b) Prestressing reinforcing steel size, grade, location, and jacking force as required by the design.

c) Hold-down locations and forces.

d) Reinforcing steel schedules.

e) Lifting point locations.

f) Details and location of all temporary supports.

g) Temporary bracing details.

h) Strand release sequence.

i) Stripping strength for formwork removal.

j) Any changes to the Contract Drawings made as specified in the Permissible Changes from the Contract Drawings clause.

k) All other applicable details.

The supporting documents shall include the following information:

a) A letter signed and sealed by an Engineer listing all permitted changes made along with supporting calculations. The letter shall state that the changes have not adversely affected the girder capacities.

b) Handling and installation procedures, including calculations and lifting point locations.

c) Details of bracing installed to provide adequate support and stability to the girders during construction.

d) Design calculations for temporary bracing for girders that are not permanently connected to the deck within the same construction season.

909.04.02.02 Design Change Proposals

When a change to the design is proposed, one electronic copy, in PDF format, shall be submitted to the Contract Administrator for acceptance. The design proposal shall bear the seal and signature of the design Engineer and the design checking Engineer. The Contractor shall not proceed with the proposed changes until the design proposal has been accepted by the Contract Administrator.

The Contract Administrator shall provide a response within 10 Business Days of receiving the proposal.

909.05 MATERIALS

909.05.01 Precast Concrete Girders

Precast concrete girders shall be according to OPSS 1355.

909.07 CONSTRUCTION

909.07.01 Inspection of Girders Prior to Installation

Prior to commencing installation, the Contractor shall inspect all the girders on site for any defects or deficiencies. The Contract Administrator shall be notified immediately in writing if any of the girders contain defects or deficiencies.

A MTO form PH-CC-701, Request to Proceed shall be submitted to the Contract Administrator prior to installation. The girders shall be inspected on site by the Contract Administrator for any defects and deficiencies prior to installation. The Contract Administrator will notify the Contractor immediately in writing if any of the girders contain defects or deficiencies.

Any defects or deficiencies identified shall be addressed prior to installation according to the Defects and Deficiencies subsection of OPSS 1355, as applicable.

Installation of girders shall not proceed until a MTO form PH-CC-702, Notice to Proceed has been received from the Contract Administrator.

909.07.02 Installation of Girders

The Contract Administrator shall be notified in writing of the installation date at least 3 Business Days prior to the commencement of field installation operations.

Installation shall be as specified in the Working Drawings, and as specified in the Contract Documents.

The work shall consist of installation and stabilization of the girders during construction. Girders shall be lifted and placed in a manner to ensure they are not overstressed, unstable, or unsafe at any time.

I-girders and other girders that may experience stability problems during construction shall be braced individually by attaching each end to the substructure, as a minimum, immediately upon installation, according to the Working Drawings.

For box girders placed side-by-side, the accumulated tolerance differences shall be distributed equally along the width of the structure.

The forces resulting from the lifting devices acting on the girders shall not be inclined to the vertical at an angle greater than 30 degrees. All lifting devices for girders shall be removed or cut off to maintain the specified cover prior to placement of concrete in the deck.

A copy of the Working Drawings shall be kept on the site during installation of the girders.

Repairs to erected girders, according to OPSS 1355, shall only be carried out after the Contract Administrator has accepted the repair proposal.

909.07.03 Installation Tolerances

Girders shall meet the installation tolerances specified in Table 1 and the Contract Documents. Installation tolerances are a combination of the fabrication tolerances, erection tolerances and interfacing tolerances. Unless specified otherwise, the installation tolerances shall be according to NCHRP Project 12-98 Appendix C, CSA A23.4, and MNL-135-00.

909.07.04 Inspection after Installation of Girders

A MTO form PH-CC-701, Request to Proceed shall be submitted to the Contract Administrator after the installation of girders for each structure within a construction stage and prior to the cutting or removal of any temporary lifting, setting, or levelling devices, or casting of concrete or grouted joints.

The next operation shall not proceed until a MTO form PH-CC-702, Notice to Proceed has been received from the Contract Administrator.

909.07.05 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

909.08 QUALITY ASSURANCE

909.08.01 General

The acceptance requirements of girders shall be as specified in this specification and the Contract Documents.

909.08.02 Acceptance of Installation Tolerances

The Contract Administrator shall be notified in writing when the girders are ready for the verification measurements.

The Contract Administrator will carry out measurements on the installed girder to confirm the installation tolerances meet the requirements specified in Table 1 and the Contract Documents. Girders that do not meet the installation tolerances specified in Table 1 shall be deemed rejectable.

909.08.03 Field Inspection

The Contract Administrator will inspect the installed girders to determine if the completed work contains any defects and deficiencies.

For precast concrete, any defects and deficiencies identified shall be addressed according to the Defects and Deficiencies subsection of OPSS 1355, as applicable.

909.10 BASIS OF PAYMENT

909.10.01 Prestressed Concrete Girders (Type) Fabrication - Item
Prestressed Concrete Girders Containing Silica Fume (Type) Fabrication - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work, subject to payment adjustments according to OPSS 1355.

Rejected girders shall be replaced at no additional cost to the Owner.

Girders that require no further fabrication and that are stored at the fabricator's premises in Ontario or some other location in Ontario away from the Working Area shall be eligible to be paid for when the Contractor obtains a lease from the property owner that names the Owner as the tenant. The Owner shall provide the form of lease for this purpose that specifies payment of $1.00 for the term of the lease. The Contractor shall retain full responsibility for the Work.

909.10.02 Prestressed Concrete Girders (Type) Delivery - Item
Prestressed Concrete Girders Containing Silica Fume (Type) Delivery - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

909.10.03 Prestressed Concrete Girders (Type) Installation - Item
Prestressed Concrete Girders Containing Silica Fume (Type) Installation - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

TABLE 1
Installation Tolerances

Item	Tolerances
Camber Difference: Between adjacent girders spaced apart Between adjacent girders placed side-by-side	 25 mm 15 mm
Joint width	± 13 mm (visually non-critical) ± 19 mm (hidden)
Maximum accumulated tolerance for side-by-side box girders	± 70 mm
Maximum jog in alignment of matching edges (straight line measurement taken horizontally from adjacent girders)	13 mm (visually non-critical) 6 mm (architectural)
Plan location at bearing (Straight-line measurement taken horizontally from the plan datum at bearing locations)	± 25 mm in both the longitudinal and transverse directions
Side-By-Side Box Girders: Maximum accumulated increase or decrease in total width of the girders	 70 mm maximum with 35 mm maximum on either side
Squareness and Plumbness	1 in 200 maximum
Sweep: I-girders, spaced box girders, and spaced hollow slab girders Abutting box and hollow slab girders	 1 mm/m length of girder ± 10 mm
Top surface elevation from nominal top surface elevation (straight-line measurement taken vertically from the elevation datum)	13 mm maximum low 7 mm maximum high