CONSTRUCTION SPECIFICATION FOR TEMPORARY PROTECTION SYSTEMS

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539.01 SCOPE

This specification covers the requirements for the design, construction, maintenance, monitoring, and removal of a temporary protection system made necessary by excavation, embankment construction, dewatering, or other work.

539.02 REFERENCES

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

Ontario Provincial Standard Specifications, Construction

OPSS 903 Deep Foundations
OPSS 904 Concrete Structures
OPSS 906 Structural Steel for Bridges
OPSS 942 Prestressed Soil and Rock Anchors

Ontario Provincial Standard Specifications, Material

OPSS 1350 Concrete - Materials and Production
OPSS 1601 Wood Material, Preservative Treatment, and Shop Fabrication

Ontario Ministry of Transportation Publications

Structural Manual

CSA Standards

S6-06 Canadian Highway Bridge Design Code

Ontario Ministry of Labour

Occupational Health and Safety Act, R.S.O. 1990, c.O.1, as amended

American Association of State Highways Transportation Officials (AASHTO)

AASHTO Guide Design Specification for Bridge Temporary Works, 1st Edition with Interim Revisions

International Organization for Standardization/International Electrotechnical Commission (ISO/IEC)

17025 General Requirements for the Competence of the Testing and Calibration Laboratories

539.03 DEFINITIONS

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

Anchor means:

a) A system consisting of prestressed tendons or non-prestressed rods installed in predrilled holes and encapsulated in grout or concrete. A system that derives its load carrying capacity in bond between the grout and concrete body and the surrounding soil or rock; or

b) A tie back to a deadman.

Bracing means the system of walers, struts, anchorages, and like members that connect frames, shores, or panels of a sheathing system to resist external pressures and to provide stability against lateral movement.

Cofferdam means a watertight enclosure.

Dredge Line means the exposed lower limit of the protection system.

Erector means a supervisory person that undertakes the construction of a protection system.

Protection System means the construction necessary to mechanically support existing or proposed work so that its function shall not be affected or construction necessary to support work such as open excavations during actual construction operations for safety and convenience.

Raker means a structural member inclined to the front of the shoring wall providing lateral support.

Shoring Wall means a structural wall consisting of wood, steel, or concrete or any combination of these materials that supports earth or rock and any structure, materials, Utilities, or other facility contained in or on the supported earth or rock mass.

Top of Shoring Wall means the upper limit of the protection system.

539.04 DESIGN AND SUBMISSION REQUIREMENTS

539.04.01 Design Requirements

539.04.01.01 General

The protection system shall be designed for the performance level as specified in the Contract Documents.

Except for Owner designed protection systems, the Contractor shall be responsible for the complete detailed design of the protection system required to carry out the work as specified in the Contract Documents.

Protection systems that are not as specified in the Contract Documents shall be assigned an appropriate performance level for design by the design Engineer. The Contract Administrator shall review the performance level selected at the time of submission of the specified Working Drawings.

The geotechnical and foundation portions of the design shall be based on a method published in AASHTO Guide Design Specification for Bridge Temporary Works and in general conformance with CAN/CSA-S6. The design shall be appropriate for the specific site conditions. Design methods not meeting the AASHTO and CSA design specifications may only be used on this Contract, if approved by the Owner.

A protection system shall be designed to provide protection for excavations at the locations as specified in the Contract Documents and at any other location where the stability, safety, or function of an existing structure or Utility may be impaired by construction work.

The temporary slope geometry used to determine requirements of the protection system shall be according to the Occupational Health and Safety Act.

Performance levels for protection systems are as follows:

Performance Level	Maximum Angular Distortion	Maximum Horizontal Displacement
1a	1:1000	5 mm
1b	1:1000	10 mm
2	1:200	25 mm
3	1:100	50 mm

Where:

Angular Distortion = $\pm \Delta/H$

Δ = Horizontal displacement in mm at height H

H = Height in mm above dredge line to point of measurement or height above the nearest system restraining support.

When performance level 1a is specified, the bracing system shall be preloaded.

Where the bracing systems are preloaded, the effects of the preload shall not cause damage to adjacent facilities.

Protection systems with a face within a horizontal distance of 1/3H of any part of a structure foundation shall be designed for performance level 1a.

539.04.01.02 Designer Qualifications

The design Engineer and design-checking Engineer shall have demonstrated expertise for the work. As well, the design Engineer and design-checking Engineer shall have a minimum of 5 years experience in designing protection systems of similar nature and scope to the required work.

One person shall not perform both the design Engineer and design-checking Engineer roles for a protection system.

539.04.01.03 Design Assumptions

The design assumptions shall accurately represent the subsurface conditions prevalent at the site and shall be specific to the type of protection system used. The design shall address the subsurface conditions at the project site as specified in the Contract Documents.

539.04.01.04 Vertical and Horizontal Loadings

Vertical and horizontal design loadings used shall represent existing conditions and accepted design practice. Future loadings that are known and may affect the protection system during its useful life shall be considered.

539.04.02 Submissions

539.04.02.01 Working Drawings

The Contractor shall submit 3 sets of Working Drawings to the Contract Administrator at least 7 Days prior to commencement of the protection system installation, for information purposes only. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

Where multi-discipline engineering work is depicted on the same Working Drawing and the design or design-checking Engineer or both are unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be sealed and signed by as many additional design and design-checking Engineers as necessary.

Prestressed anchor submissions shall be according to OPSS 942.

When other authorities are involved, 1 set of Working Drawings shall be submitted for each authority at least 5 weeks prior to the commencement of falsework construction. The requirements of each authority shall be satisfied prior to commencement of the protection system installation.

The Contractor shall have a copy of the Working Drawings at the site during protection system installation.

For protection systems that are not specified in the Contract Documents, the Contractor shall submit the Working Drawings for these systems to the Contract Administrator at least 3 weeks prior to the commencement of any construction.

The following information and details shall be shown on the Working Drawings:

a) Plans, Elevations, and Details

   i. Location of protection system and station limits.
   ii. Plan and elevation of shoring showing the extent of the protection system.
   iii. Details of the shoring system, including cross-sections.
   iv. Details of internal bracing.

b) Design Criteria

i. Pressure diagrams including values of horizontal and vertical loads, dead load, and live load surcharge.
ii. Design assumptions and parameters.
iii. Anchor bond stresses.
iv. Pile design.
v. Anchor system stressing schedule specifying working loads, stressing loads, and lock in loads.
vi. Details of preload, when required.
vii. For protection systems not specified in the Contract Document, the performance level shall be designated.

c) Materials

i. Grade of structural steel and grade and species of structural wood.
ii. Concrete strengths.
iii. Grout strengths.
iv. Details of protection from rain and frost action.
v. Wood lagging and size.
vi. Mill certificates or test reports from an independent organization certified by the Standards Council of Canada certifying that the steel meets the requirements of the grade, where specified.
vii. Details of patented accessories, including load test data.

d) Installation Procedure

i. Installation sequence and procedure, including to the installation of piling, lagging, anchor systems, and rakers.

e) Monitoring Method

i. The proposed method of monitoring the performance of the protection system during installation and use. The method of monitoring shall be consistent with the requirements specified in the Quality Control subsection.

f) Removal of Protection System

i. The details of the procedures associated with the removal of the protection system indicating: method, sequence of work, and removal limits, except when the protection system is specified in the Contract Documents to be left in place.

539.04.02.02 Amendments to Protection Systems

Work shall not proceed on amendments to the protection system until the Contractor has received sealed and signed approval to proceed from the design Engineer and design-checking Engineer and has submitted a copy of the approval to the Contract Administrator.

Amendments to the protection system shall be submitted to the Contract Administrator on revised Working Drawings bearing the seal and signature of the design Engineer and design-checking Engineer.

539.04.02.03 Preconstruction Survey

Prior to commencing the work, the Contractor shall submit to the Contract Administrator, a condition survey of property and structures that may be affected by the work. The survey shall include the locations and conditions of adjacent properties; buildings; underground structures; Utility services; and structures, such as walls abutting the site within a horizontal distance of $2H_w$ from the face of the protection system, where H_w is the height of the wall from the ground surface to the dredge line.

539.04.02.04 Materials

539.04.02.04.01 Structural Steel

539.04.02.04.01.01 Mill Certificates

The Contractor shall submit to the Contract Administrator at the time of delivery 1 copy of the mill certificates, indicating that the steel meets the requirements for the appropriate standards for H-piles, tube piles, casings, and sheet piles.

Where mill test certificates originate from a mill outside Canada or the United States of America the Contractor shall have the information on the mill certificates verified by testing by a Canadian laboratory. The laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian testing laboratory and appropriate wording stating that the material conforms to the specified material requirements. The stamp shall include the appropriate material specification number, the date (i.e., yyyy-mm-dd), and the signature of an authorized officer of the Canadian testing laboratory.

For Contractor designed protection systems using previously used structural steel that a mill test certificate is not available and coupons have not been tested to verify the steel's material properties, a mill test certificate is not required when the yield strength specified on the Working Drawings does not exceed 250 MPa. If the yield strength specified exceeds 250 MPa, the Contract Administrator may request that the material be tested to confirm the material properties indicated on the Working Drawings. The costs of this testing shall be at the expense of the Owner if the test results indicate that the material is according to the Working Drawings, and at the expense of the Contractor if the test results indicate that the material is not according to Working Drawings.

539.05 MATERIALS

539.05.01 Wood

Wood shall be according to OPSS 1601.

Wood shall be of the size, grade, and species shown on the Working Drawings and shall be in sound condition, free from defects that may impair its strength. Wood lagging does not have to be grade-stamped.

539.05.02 Proprietary Shoring and Patented Accessories

Where proprietary shoring or patented accessories are to be used, the Contractor shall follow the manufacturers' recommendations for load carrying capacity. The recommended load carrying capacities shall be supported by test results from an accredited testing laboratory approved by the Owner.

539.05.03 Concrete

Concrete shall be according to OPSS 1350.

539.05.04 Other Materials

The design Engineer may consider other suitable materials when sufficient information is available to quantify the allowable design loads or when the manufacturer's recommendations regarding load carrying capacities are supported by test results from an independent organization accredited by the Standards Council of Canada.

539.07 CONSTRUCTION

539.07.01 General

The Contractor shall be responsible for the design, materials, construction, maintenance, monitoring, and removal of a temporary protection system.

The erector shall be experienced in the method of construction of protection systems. Such experience shall have been obtained within the preceding 5 years on projects of similar nature and scope to the required work.

Protection systems shall be built according to the specifications and the Working Drawings.
Piling shall be according to OPSS 903 and the Working Drawings.

Concrete construction shall be according to OPSS 904. Concrete shall be placed in the dry. Where cofferdams are used, they shall be sealed sufficiently to permit concrete to be placed in the dry.

The Contractor shall carry out dewatering, as required, to facilitate the installation of the protection system.

Tremie concrete shall be placed according to the requirements of OPSS 904.

Structural steel shall be according to OPSS 906 and the Working Drawings.

Prestressed anchors shall be supplied, installed, and stressed according to OPSS 942.

The protection system shall be protected from the detrimental effects of rain and frost action.

Material used in the protection system shall remain the property of the Contractor.

Loss of soil from behind the shoring shall be prevented during and following the installation of the lagging.

539.07.02 Removal of Protection Systems

Protection systems may be left in place, unless otherwise specified.

Where protection systems are left in place, the top shall be removed to at least 1.2 m below the finished grade or ground level or at least 0.6 m below the streambed.

Where protection systems are specified for removal or the Contractor elects to remove, the method and sequence of removal shall be so that there shall be no damage to the new work, existing work, and facility being protected.

All disturbed areas shall be restored to an equivalent or better condition than existed prior to the commencement of construction.

539.07.03 Quality Control

539.07.03.01 General

In addition to the quality control measures instituted by the Contractor, the Contractor shall complete a preconstruction condition survey and monitor the protection system installation as specified herein, and as shown on the Working Drawings.

539.07.03.02 Inspection of Welds

The Contractor shall be responsible for visual inspection of all welds. Any required testing of welds shall be as specified by the design Engineer of the protection system.

539.07.03.03 Monitoring

539.07.03.03.01 General

Monitoring shall be conducted by a Registered Ontario Land Surveyor or an Engineer according to the program submitted with the Working Drawings.

The minimum requirements for monitoring shall include the survey measurements of scaled targets attached to the shoring wall at the elevations specified. The scaled targets shall be placed at a maximum spacing of 6 m with targets placed at the extreme ends and the targets distributed between the outer limits. The survey targets shall be monitored for horizontal displacement from the vertical at the frequency specified.

All test results, observations, and records, including the preconstruction survey, taken during construction and operation of the protection system shall be available on the site for review by the Contract Administrator.

If movement of the protection system is more rapid than is expected, or if movement approaches the allowable limit, the Contract Administrator shall be notified immediately and suitable measures shall be taken to ensure stability of the protection system and to ensure movement does not exceed the performance level specified in the Contract Documents.

539.07.03.03.02 Excavation Depths Less Than or Equal to Three Metres

The protection systems shall be monitored during construction. Readings shall be taken during installation of the protection system at the top of the protection system at each construction stage during the installation. After installation, the above readings shall be taken every two weeks.

The Contractor's Engineer shall inspect the following Work:

a) Installation of the protection system, including excavation to dredge line.

b) Removal of the protection system.

539.07.03.03.03 Excavation Depths Exceeding Three Metres

The protection systems shall be monitored during construction. Readings shall be taken during installation of the protection system at the top, at each restraint point, at the dredge line, and halfway between the restraint points at each construction stage during the installation of the protection system. After installation, the above readings shall be taken weekly.

The Contractor's Engineer shall inspect the following Work:

a) Layout and extent of protection system.

b) Piling.

c) Installation of protection system, including excavation to dredge line.

d) Removal of protection system.

539.07.03.04 Certificates of Conformance

539.07.03.04.01 Excavation Depths Less Than or Equal to Three Metres

For protection systems to facilitate excavation depths less than or equal to 3 m and provided that surcharge loading due to vehicular traffic, construction equipment and materials, or other is beyond a horizontal distance defined by a 1H : 2V line projected from the dredge line at the face of the protection system to the roadway

surface, the Contractor's Engineer shall inspect and verify that the that the protection system was installed, monitored, and subsequently removed according to the Contract Documents.

A Certificate of Conformance shall be submitted to the Contractor Administrator upon completion of the installation of the protection system.

A Certificate of Conformance shall be submitted to the Contractor Administrator upon completion of the removal of the protection system.

Should the traffic be within a horizontal distance defined by a 1H: 2V line projected from the dredge line at the face of the protection system to the roadway surface, the Certificate of Conformance requirements as specified in the Excavation Depths Exceeding Three Metres clause shall apply.

539.07.03.04.02 Excavation Depths Exceeding Three Metres

For protection systems to facilitate excavation depths that exceed 3 m or should traffic, construction equipment and materials, or other be within a horizontal distance defined by a 1H:1V line projected from the dredge line at the face of the protection system to the roadway surface.

The Contractor's Engineer shall inspect and verify that the materials have been supplied and installed according to the Contract Documents. A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the installation of the materials.

The Contractor's Engineer shall inspect and verify and that the protection system was installed, monitored, and subsequently removed according to the Contract Documents. A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the removal of the protection system.

539.07.04 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

539.10 BASIS OF PAYMENT

539.10.01 Protection System - 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.

When the Contract does not contain a separate item for protection systems, the Contract price for the items directly associated with the protection system shall include full compensation for all labour, Equipment, and Material to do the work described in this specification.