OPSS 539, November 2003, Construction Specification for Protection Systems is deleted in its entirety and replaced with the following:

CONSTRUCTION SPECIFICATION FOR PROTECTION SYSTEMS

539.01 SCOPE

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

539.02 REFERENCES

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

Ontario Provincial Standard Specifications, Construction:

OPSS 180 Management and Disposal of Excess Material
OPSS 903 Piling
OPSS 904 Concrete Structures
OPSS 906 Structural Steel

Ontario Provincial Standard Specifications, Material:

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

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:


Canadian Standards Association

CAN/CSA-S6-00, Canadian Highway Bridge Design Code

539.03 DEFINITIONS

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

Anchorage System: means a system consisting of tendons installed in predrilled holes in soil or rock and encapsulated in grout or concrete that derives its load carrying capacity in bond between the grout/concrete body and the surrounding soil or rock; or tie back to deadmen.
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 water-tight enclosure.

Design Engineer: means the Engineer retained by the Contractor who produces the original design and working drawings.

Design Checking Engineer: means the Engineer retained by the Contractor who checks the original design and working drawings.

Dredge Line: means the exposed lower limit of the Protection System.

Erector: means a person that undertakes the construction of a Protection System.

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

Quality Verification Engineer: means the Engineer, retained by the Contractor, qualified to determine that the work is in general conformance with the Contract Documents and issue Certificate(s) of Conformance.

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, concrete or 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.

Stamped: means drawings or details that have been reviewed and stamped "In General Conformance with Contract Documents". The stamp shall include the date and signature of the Quality Verification Engineer.

Top of Shoring Wall: means the upper limit of the Protection System.

539.04 SUBMISSION AND DESIGN REQUIREMENTS

539.04.01 Submissions

539.04.01.01 Working Drawings

Three (3) copies of stamped working drawings shall be submitted to the Contract Administrator for information purposes at least one(1) week before commencement of construction of the protection system.

All submissions shall bear the seal and signature of the Design Engineer and Design Checking Engineer.

For contracts where another authority, such as a railway or navigable waters, is affected the Contractor shall submit working drawings to each authority (number of sets of drawings to be determined by the authority). The requirements of each authority shall be satisfied before commencement of protection system installation.

The Contractor shall have a copy of the stamped working drawings at the site during protection system construction.
For protection systems that are not specified in the Contract Documents, the Contractor shall submit to the Owner working drawings of these systems at least three weeks prior to the commencement of any construction.

539.04.01.02 Working Drawings/Details Requirements

539.04.01.02.01 Information To Be Shown on Working Drawings/Details

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 where required.
   vii. For protection systems not specified in the Contract, 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 specified.
   vii. Details of patented accessories, including load test data.

d) Installation Procedure
   i. Installation sequence and procedure including but not limited 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 Section 539.07 of this special provision.

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.
539.04.01.03  Qualifications

Design Engineer: The Design Engineer shall have demonstrated expertise for the work. The Design Engineer shall have a minimum of five (5) years experience in designing protection systems of similar nature and scope to the required work. One person cannot perform both the Design Engineer and Design Checking Engineer roles for a protection system.

Design Checking Engineer: The Design Checking Engineer shall have demonstrated expertise for the work. The Design Checking Engineer shall have a minimum of five (5) years experience in designing protection systems of similar nature and scope to the required work.

Erector: All supervisory personnel involved in the work performed under this specification shall be experienced in the method of construction of protection systems. Such experience shall have been obtained within the preceding five years on projects of similar nature and scope to the required work.

Quality Verification Engineer: The Quality Verification Engineer shall have a minimum of five(5) years experience in the design of comparable protection systems, or alternatively with demonstrated expertise through providing satisfactory quality verification services for a minimum of two (2) projects in which the work was of similar scope to that in the Contract. The Quality Verification Engineer shall be retained by the Contractor to determine if the work is in general conformance with the Contract Documents and to issue Certificate(s) of Conformance.

539.04.01.04  Certificates of Conformance

539.04.01.04.01  Excavation Depths Less Than or Equal to Three (3) metres

For protection systems to facilitate excavation depths less than or equal to three (3) metres 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 shall submit, to the Contract Administrator, a Certificate of Conformance sealed and signed by the Quality Verification Engineer following the installation of Protection System to the Dredge Line.

Should 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 clause 539.04.01.04.02 shall apply

Upon completion of the operation of the protection system and removal of the protection system, the Contractor shall submit to the Contract Administrator a final Certificate of Conformance sealed and signed by the Quality Verification Engineer. The Certificate of Conformance shall state that the protection system was monitored and subsequently removed, and it performed in general conformance with the stamped working drawings and contract documents.

539.04.01.04.02  Excavation Depths Exceeding Three (3) metres

For protection systems to facilitate excavation depths that exceed three (3) metres, the Contractor shall submit to the Contract Administrator a Certificate of Conformance sealed and signed by the Quality Verification Engineer upon completion of each of the following operations, prior to commencement of each subsequent operation:
a) Layout and Extent of Protection System
b) Piling
c) Installation of Protection System including excavation to Dredge Line
d) Removal and management (in accordance with OPSS 180 and as specified in the Contract).

The Certificates of Conformance shall state that the materials and work have been supplied and installed in general conformance with the working drawings.

Upon completion of the operation of the protection system and removal of the system, the Contractor shall submit to the Contract Administrator a final Certificate of Conformance sealed and signed by the Quality Verification Engineer. The Certificate shall state that the protection system was monitored and removed, and it performed in general conformance with the stamped working drawings and contract documents.

539.04.01.05 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 original 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/Details bearing the seal and signature of the original Design Engineer and Design Checking Engineer.

539.04.01.06 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, but not be limited to, 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 Design

539.04.02.01 General

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

Protection systems that are not 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 Contractor shall be responsible for the complete detailed design of the protection system needed to fulfill the requirements specified in the contract drawings.

The geotechnical/foundation portion of the design shall be based on a method published in AASHTO Guide Design Specification for Bridge Temporary Works and in general conformance with the CAN/CSA-S6-00 Canadian Highway Bridge Design Code (CHBDC). Design methods not meeting this design specification may be used on a particular contract only if prequalified by the Owner.
A protection system shall be designed to provide protection for excavations as required by the Occupational Health and Safety Act, at the locations specified in the Contract, and at any other location where the stability, safety or function of an existing structure and/or utility may be impaired by construction work.

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

Performance levels for protection systems are as follows:

<table>
<thead>
<tr>
<th>Performance Level</th>
<th>Maximum Angular Distortion</th>
<th>Maximum Horizontal Displacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>1:1000</td>
<td>5 mm</td>
</tr>
<tr>
<td>1b</td>
<td>1:1000</td>
<td>10 mm</td>
</tr>
<tr>
<td>2</td>
<td>1:200</td>
<td>25 mm</td>
</tr>
<tr>
<td>3</td>
<td>1:100</td>
<td>50 mm</td>
</tr>
</tbody>
</table>

Where:

\[
\text{Angular Distortion} = \pm \Delta / H
\]

\[
\Delta = \text{Horizontal displacement (mm) at height } H
\]

\[
H = \text{Height (mm) above dredge line to point of measurement or height above the nearest system restraining support.}
\]

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 1/3 H of any part of a structure foundation shall be designed for performance level 1a.

539.04.02.02 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 reported in the Foundation Investigation Report described in the Contract Documents.

539.04.02.03 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.

539.05 MATERIALS

539.05.01 Wood

Wood shall be according to OPSS 1601, shall be of the size, grade and species shown on the working drawings and shall be in sound condition, free from defects which will impair its strength. Wood lagging does not have to be grade-stamped.
539.05.02  Structural Steel

539.05.02.01  Mill Certificates

The Contractor shall submit to the Contract Administrator at the time of delivery one copy of the mill certificate, 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 certificate verified by testing by a Canadian laboratory. The laboratory shall be accredited by a Canadian National Accreditation Body to comply with the requirements of ISO/IEC Guide 25 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 and the signature of an authorized officer of the Canadian testing laboratory.

539.05.03  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.

539.05.04  Concrete

Concrete shall be according to OPSS 1350.

539.05.05  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 as to 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.

Protection systems shall be built according to the specifications and the stamped working drawings.

Concrete construction shall be according to OPSS 904.

Structural steel shall be according to OPSS 906.

Piling shall be according to OPSS 903.

Prestressed anchors shall be supplied, installed and stressed according to the Contract Documents.
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 unless otherwise specified.

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

The Contractor shall carry out dewatering as required to facilitate the installation of the protection system. Concrete shall be placed in the dry unless otherwise specified in the Contract. Where cofferdams are used they shall be sealed sufficiently to permit concrete to be placed in the dry. When concrete cannot be placed in the dry, tremie techniques shall be employed according to OPSS 904.

539.07.02 Removal of Protection Systems

Protection systems shall be removed from the right-of-way unless otherwise specified in the Contract that the protection system may be left in place.

The Contractor shall obtain approval from the Ministry of the Environment and other approving Authorities when all or any portion of the protection system is to be left in place.

Where piles 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.

The method and sequence of removal shall be such that there will be no damage to new work, existing work and the facility being protected.

Unless otherwise specified, the area remaining disturbed after removal of the protection system shall be restored to as close to its original condition as possible.

539.07.03 Quality Control

539.07.03.01 General

The Contractor shall complete a preconstruction condition survey and monitor the protection system installation as specified herein, or 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 construction drawings/details.

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 metres 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 construction 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.

539.07.03.02 Excavation Depths Less Than or Equal to Three (3) 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 of the protection system. After installation the above readings shall be taken bi-weekly.

539.07.03.03 Excavation Depths Exceeding Three (3) 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.

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.

For protection systems not specified in the Contract Documents, the cost shall be included in the protection system tender item, if available, and shall be full compensation for all labour, equipment and material required to carry out the work, including subsequent removal of the protection system and any necessary restoration work.

If the protection system tender item is not included in the Contract Documents, the cost shall be included in the item or items directly associated with the protection system, and shall be full compensation for all labour, equipment and material required to carry out the work, including subsequent removal of the protection system and any necessary restoration work.