CONSTRUCTION SPECIFICATION FOR
STEEL REINFORCEMENT FOR CONCRETE

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905.01 SCOPE

This specification covers the requirements for the placing of steel reinforcement and mechanical connections for concrete structures.

905.01.01 Significance and Use of Appendices

Appendices are not a mandatory part of this specification unless invoked by the Owner.

Appendix 905-A is a commentary appendix to provide designers with information on the use of this specification in a Contract.
905.02 REFERENCES

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

**Ontario Provincial Standard Specifications, Material**

- OPSS 1440 Steel Reinforcement for Concrete
- OPSS 1442 Epoxy Coated Steel Reinforcement for Concrete
- OPSS 1443 Organic Coatings for Steel Reinforcement

**Ministry of Transportation Publications**

- Structural Manual
- Laboratory Testing Manual:
  - LS-434 Method of Test for Mechanical Connectors Used to Splice Steel Reinforcement

**Canadian Standards Association**

- G30.18-M92 (R2002) Billet Steel Bars for Concrete Reinforcement
- S6-00 (R2005) Canadian Highway Bridge Design Code
- W186-M1990 (R2002) Welding of Reinforcing Bars in Reinforced Concrete Construction

**ASTM International**

- A 955/A 955M-05a Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement

**ISO International Organization for Standardization/International Electrotechnical Commission**

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

**Others**

- Concrete Reinforcing Steel Institute:
  - Voluntary Certification Program for Fusion-Bonded Epoxy Coating Applicator Plants

905.03 DEFINITIONS

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

**Coated Reinforcing Steel Bar** means reinforcing steel bars coated with epoxy.

**Engineer** means a professional engineer licensed by the Professional Engineers of Ontario to practice in the Province of Ontario.

**Mechanical Connection** means a joining of two steel reinforcement bars by means of a mechanical connector.

**Mechanical Connector** means a mechanical device used to splice steel reinforcement bars.

**Proposal** means a Contractor’s submission of changes, when engineering design is required, affecting the original design.

**Reinforcing Stainless Steel Bars** means as defined in OPSS 1440.
Reinforcing Steel Bars means as defined in OPSS 1440.

Slip means the axial displacement of the reinforcing bars measured relative to the mechanical connector. Displacement is measured at a rebar stress of 5% of specified yield, after the mechanical connection has been loaded to a rebar stress of 50% of specified yield, then unloaded to a bar stress of 5% of specified yield.

Splice means a connection of one steel reinforcement bar or splice bar to another by lapping, welding, mechanical connections, or other means or the lap between sheets or rolls of welded wire fabric.

Splice Bar means as defined in OPSS 1440.

Steel Reinforcement means a general term for deformed steel bars, which includes reinforcing steel bars, splice bars, coated reinforcing steel bars, reinforcing stainless steel bars, and welded steel wire fabric.

Steel Wire Fabric means a wire mesh fabricated by means of welding the crossing joints, available in rolls or flat sheets.

Tensile Strength means the stress at which a steel reinforcement bar fails under tensile testing.

Yield Strength means the maximum tensile stress, which a material is capable of sustaining.

905.04 SUBMISSION AND DESIGN REQUIREMENTS

905.04.01 Submission Requirements

905.04.01.01 Certification of Manufacturer

At least 3 weeks prior to fabrication, a statement shall be submitted to the Contract Administrator from the manufacturer certifying that their plant meets the minimum quality criteria set forth in the Voluntary Certification Program for Fusion-Bonded Epoxy Coating Applicator Plants document.

905.04.01.02 Working Drawings

When Working Drawings are not included in the Contract Documents by the Owner, the Contractor shall prepare and submit to the Contract Administrator five complete sets of Working Drawings consisting of steel reinforcement placing drawings and steel reinforcement schedules, at least 3 weeks before the commencement of the installation of the reinforcement. The Working Drawings shall include the following information:

a) Quantity of steel reinforcement.

b) Size of steel reinforcement bars.

c) Grade of steel.

d) Identification mark and number, including coating designation.

e) Location and spacing for all steel reinforcement.

f) Type of steel reinforcement.
Where the Working Drawings have been prepared by the Contractor according to the Contract Documents an Engineer's stamp is not required; however, the Working Drawings shall be accompanied by a letter bearing the seal and signature of an Engineer attesting to this conformity. All other design work requires the seals and signatures of both the design and the checking Engineers.

When other authorities are involved in the approval of the design or construction of a highway structure, the submission shall be made at least 5 weeks prior to commencement of work. The submission shall include one additional set for each authority.

Work shall not commence until written notice to proceed has been given by the Contract Administrator.

When a metric to imperial bar size substitution is made, the Working Drawings shall include a), b), and c) as noted above, as well as the location and spacing of both the metric and the substitute imperial steel reinforcement bars.

When bar marks are shown on the Working Drawings, they shall be used in the schedule.

Reinforcing steel shall be detailed according to CAN/CSA S6 and the Structural Manual.

**905.04.01.03 Welding Details**

Five copies of all welding details shall be submitted to the Contract Administrator, at least 3 weeks before commencement of the welding of steel reinforcement. All welding details shall bear the seal and signature of an Engineer. The welding details shall include the following information:

a) Materials.
b) Procedures.
c) Bars to be welded.
d) Location and type of weld.
e) Tack welds.

Details shall be designed to prevent notching effects in the bars.

**905.04.01.04 Mechanical Connections**

Five copies of all details for the mechanical connections shall be submitted to the Contract Administrator at least 3 weeks prior to commencement of the work and shall contain the following information:

a) The type or series identification of the connector.
b) The grade and size of the reinforcement to be joined by the connector.
c) A copy of the manufacturer's catalogue giving complete data on the connector material and installation procedures.
d) Location of splices, including type of splice.

**905.04.01.05 Mill Test Certificates**

One copy of mill test certificates for each material to be used in the fabrication shall be available for review at the fabricating plant during fabrication. The mill test certificates shall show that the material is according to the Contract Documents.
If the material cannot be identified by mill test certificates, coupons shall be taken and tested and these coupon test certificates shall be made available.

Two copies of the mill or coupon test certificates shall be submitted to the Contract Administrator, when the material is shipped from the fabrication plant.

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 test certificate verified by testing by a Canadian laboratory. This 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 laboratory and appropriate wording stating that the material is in conformance with the requirements specified in the Contract Documents. The stamp shall include the appropriate material designation, testing date, and signature of an authorized officer of the Canadian laboratory.

905.04.01.06 Return of Submissions

Two copies of each submission to be returned shall be marked as one of the following:

a) Stamped with the wording that allows for permission to construct.

In this case, work can commence upon receipt of the Working Drawing by the Contractor. A copy of these Working Drawings shall be available at the site prior to and during construction.

b) Stamped with the wording that allows for permission to construct as noted.

In this case, work can start upon receipt of the Working Drawings by the Contractor. The Working Drawings shall be updated as noted and shall have a stamp affixed that is signed by an Engineer stating the Working Drawings have been revised according to the noted comments. A copy of the stamped updated Working Drawings shall be available at the site prior to and during construction.

c) Showing only required changes.

In this case, the Working Drawings shall be updated as required and the submission process repeated.

905.05 MATERIALS

905.05.01 Steel Reinforcement

Steel reinforcement shall be according to OPSS 1440.

Reinforcement steel shall be produced by a manufacturer approved by the Owner.

The imperial and soft-converted metric bar size substitutions for metric bar sizes shown in Table 2 will be permitted on a one-for-one basis without adjustment.

Other imperial and soft-converted metric reinforcing stainless steel bar sizes may be substituted for metric bar sizes, subject to the following:

a) The area of substituted steel reinforcement for the concrete component per linear metre or per gross cross-section area, as applicable, shall not be less than that shown for the concrete component on the Contract Documents.
b) The spacing of substituted steel reinforcement for the concrete component shall be according to CAN/CSA-S6 and the Structural Manual.

Nominal cross-sectional areas of metric and imperial bar sizes used for determining substitutions shall be according to ASTM A 955M and CAN/CSA G30.18, respectively.

Reinforcing stainless steel bars, stainless steel spirals, and stainless steel spiral spacers shall be of a stainless steel type specified in Table 1.

905.05.02 Mechanical Connections

The mechanical connectors shall be by a manufacturer acceptable to the Owner.

Mechanical connections for steel reinforcement shall develop, in tension or compression as required, at least 120% of the specified yield strength of the bars, but not less than 110% of the mean yield strength, representative of the bars to be used, in the test of the mechanical connection. For the purpose of qualifying mechanical connectors the actual yield strength obtained from the mill test certificate may be used in lieu of testing for the mean yield of the bars.

The total slip of the steel reinforcement shall not exceed the following measured displacements between gauge points straddling the mechanical connector as follows:

a) For bar sizes up to and including 45M 0.25 mm
b) For 55M bars 0.75 mm

Splice bars shall be supplied by the manufacturer of the mechanical connector.

Mechanical connectors and splice bars for stainless steel reinforcing bars shall be of the stainless steel type specified in Table 1.

Mechanical connectors shall be of an approved type and design and may be the form saver type, the filled sleeve type, the sleeve swaged coupler type, the threaded coupler type, the hot rolled thread bar coupler type or the forged bar coupler type or as specified in the Contract Documents.

905.05.03 Associated Hardware

Hardware, including spacers and support devices, approved by the Owner shall be used with steel reinforcement. Supports or support systems shall be capable of withstanding the loads to be placed on them. Embedded hardware, except for tie wire, within 50 mm of exposed faces shall be coated with an acceptable material or be of an acceptable non-metallic material.

The tie wire shall be annealed ferrous wire 2.6 mm in diameter and shall be coated when used with coated reinforcing steel bar.

Tie wire used to tie reinforcing stainless steel bars to reinforcing stainless steel bars, reinforcing steel bars, and shear studs shall be Type 316 LN or Type 316 L stainless steel wire, 1.2 or 1.6 mm in diameter. Tie wire used to tie reinforcing stainless steel bars to coated reinforcing steel bars shall be coated wire.

Concrete chairs shall be a minimum compressive strength of 20 MPa and may only be used in footings.

905.05.04 Patching Material for Coated Reinforcing Steel Bars

Patching material for coated reinforcing steel bars and mechanical connectors shall be according to OPSS 1443.
905.05.05  Polyethylene Sheeting

Polyethylene sheeting used for protection purposes shall be opaque and have a minimum thickness of 150 μm.

905.07  CONSTRUCTION

905.07.01  General

All reinforcement and associated hardware shall be kept clean of all mud, oil, and other deleterious materials that adversely affect bonding strength and stored clear of ground contact on timbers or other suitable protective cribbing spaced to prevent sags in the bundles.

Stacked bundles of straight bars shall have adequate blocking to prevent contact between the layers of bundles.

Reinforcing steel bars with rust, mill scale, or a combination of both will be acceptable provided the minimum physical properties, including height of deformations and mass, of a wire brushed test specimen are not less than the applicable specification requirements. Loose scale shall be removed.

Reinforcing stainless steel bars shall be free of deposits of iron and non-stainless steels.

905.07.02  Reinforcing Steel Bars, Coated Reinforcing Steel Bars, Reinforcing Stainless Steel Bars, Splice Bars, Coated Splice Bars, and Stainless Steel Splice Bars

905.07.02.01  Storage and Protection of Coated Reinforcing Steel Bars

Unprotected on-site storage shall not exceed 30 Days and total on-site storage time shall not exceed 120 Days.

When protection is required, bars shall be covered with opaque polyethylene sheeting or other equivalent protective material. For stacked bundles, the protective covering shall be draped over the sides of the bundles around the perimeter of the stack. The covering shall be adequately secured with provisions for adequate air circulation around the bars to prevent condensation under the protective covering.

Exposed bars installed in the structure, including bars partially embedded in concrete, shall be protected from the elements by covering with opaque polyethylene sheeting or equivalent protective material when the exposure time exceeds 30 Days. The protection shall be adequately supported and secured in place.

This protection shall be maintained until removal is required for concrete placement.

905.07.02.02  Storage and Protection of Reinforcing Stainless Steel Bars

Reinforcing stainless steel bars shall be stored separately from other steel reinforcement with the bar tags maintained and clearly visible until placing operations commences.

905.07.02.03  Placing

Steel reinforcement shall be placed in the positions shown in the Working Drawings and held in this location during the operations of placing and consolidating concrete.
Bars shall be tied at least at every fourth intersection. The maximum untied length of any bar shall be 1 m.

For slab-on-girder type decks, the top layer of deck reinforcement shall be tied to the shear studs or shear stirrups on each girder at approximately 1.5 m centres.

Spacers for spirals shall be spaced equally around the spiral and shall be such that the pitch of the spiral, as specified in the Contract Documents, is maintained.

Steel reinforcement shall be placed according to the tolerances specified in Table 3.

905.07.02.04 Cutting

The cutting of steel reinforcement and splice bars, except for coated reinforcing steel bars and coated splice bars, by oxyacetylene torch may be carried out only where permitted in writing by the Contract Administrator. The cutting of coated reinforcing steel bars by oxyacetylene torch is prohibited. Coated bars shall be cut only when specified in the Contract Documents or approved by the Contract Administrator. Repairs to epoxy coatings shall be according to the Repairs to Damaged Epoxy Coating clause.

905.07.02.05 Bending

Steel reinforcement shall not be re-bent in the field except when specified in the Contract Documents or approved by the Contract Administrator.

When epoxy coated reinforcing steel bars are re-bent or straightened in the field, the area of the bend shall be inspected and damaged areas repaired.

905.07.02.06 Welding

Steel reinforcement shall not be welded, including tack welds, except as shown in the Contract Documents or as shown on the welding details submitted to the Contract Administrator.

When welding of the steel reinforcement is specified in the Contract Documents, the welding shall be according to CSA W186 and performed by companies certified by the Canadian Welding Bureau according to CSA W186.

Welding of splices for coated reinforcing steel bar spirals shall be of the direct butt-splice type with no more than one splice per 15 metres of bar. Splice welds shall be ground flush with the bar deformations and cleaned of deleterious material prior to application of the patching material. Patching of epoxy coating shall be according to the Repairs to Damaged Epoxy Coating clause.

Except for splicing of stainless steel spirals, stainless steel reinforcing bars shall not be welded.

905.07.02.07 Splicing

Welded splices shall develop 100% of the tensile strength of the bar.

Splices for steel reinforcement other than spirals shall be made as specified in the Working Drawings.

End anchorage of column spiral reinforcement shall be provided either by one and one half extra turns of spiral bar at each end of the spiral, one end embedded in the footing and the other end in the component supported above, or by a 90-degree bend around a longitudinal reinforcing bar plus an extension of at least 24 bar diameters into the core of the column.
Splicing of spiral reinforcing bars by means of a non-welded splice shall be as specified in the Working Drawings. Non-welded splices shall be by a mechanical connection or anchoring the ends of the spiral bars by means of a 90-degree bend around a longitudinal reinforcing bar with extensions of at least 24 bar diameters into the core of the column.

905.07.02.08 Repairs to Damaged Epoxy Coating

905.07.02.08.01 General

Coated reinforcing steel bars and associated hardware with epoxy coating damage greater than 1% of the surface area in any one metre length of bar shall be rejected.

Coated reinforcing steel bars and associated hardware with epoxy coating damage to 1% or less of their surface area shall have all damaged areas of the coating repaired.

Repairs to damaged epoxy coating shall be according to OPSS 1442.

Repairs shall not be done when the temperature of the steel bar or ambient air is 5 °C or less, or when moisture is present on the bar.

905.07.02.08.02 Pre-Installation

Prior to installation, the Contract Administrator shall have access to inspect the coated reinforcing steel bars to identify bars to be rejected or repaired.

All bars and accessories with damaged portions of coating, including bare portions of bar, shall be repaired.

905.07.02.08.03 Post-Installation

After the coated reinforcing steel bars have been placed in the work, the Contract Administrator shall have access to inspect the coated reinforcement steel for visible signs of damage and to determine if steel with epoxy coating damage shall be replaced or repaired.

Repairs to the epoxy coating shall be completed at least 12 hours before permission to place concrete is given. Repairs should be performed immediately after the damage occurs, and shall be done before rusting begins. Rust that is present shall be completely removed before the patching material is applied.

905.07.03 Mechanical Connections

905.07.03.01 General

Locations of mechanical connections shall be as specified in the Working Drawings.

When a mechanical connector type is specified in the Contract Documents, only the specified mechanical connector type shall be used for that application.

The form saver type of mechanical connector shall only be used at construction joints.

The mechanical connections shall be qualified by tests made on sample splices according to the clause for Job Control Tests.

All procedures and equipment for mechanical connections shall be according to the mechanical connector manufacturer's recommendations.

Ends of reinforcing bars to be joined shall be cut nominally square.
Mechanical connector sleeves shall have the clear concrete cover as specified in the Contract Documents for the steel reinforcement in that location.

Stirrups, ties, and other reinforcement shall be adjusted or relocated, if necessary, to provide the required clear concrete cover to the reinforcement.

Threads cut on the ends of the steel reinforcement shall match the internal threads in the mechanical connector.

Joints between the coated reinforcing steel bars, coated splice bars, and coated mechanical connectors shall be sealed with the application of epoxy coating according to OPSS 1443. Epoxy coating shall be applied according to the manufacturer’s recommendations.

905.07.03.02 Job Control Tests

When mechanical connectors are used, the Contractor shall perform job control testing on a lot by lot basis prior to installation of the connectors. A lot shall comprise of all connectors of one size and type from one supplier. The lot will be divided into sublots of 300 connectors or any fraction thereof. The job control test shall consist of testing for slip and strength according to LS-434. Testing shall be carried out on three sample connections for each sublot of mechanical connector types used in the Work. The samples shall be made at the Working Area in the presence of the Contract Administrator, and the test shall be performed on each bar size connected.

Each test sample shall be tagged with a weatherproof marking, which clearly identifies the following:

a) Contract number.

b) Sublot number.

c) Connector bar size.

d) Number of connectors within the sublot.

e) Date of supply to the Working Area.

f) Name of manufacturer.

The reinforcing bars from which the test samples are fabricated shall be selected on a random basis. The length of each bar to be joined shall be at least 500 mm. The same materials, position, location, equipment, and procedures as are being used to make connections in the steel reinforcement in the work shall be used when making the sample connections.

The Contractor shall make sample connections and arrange testing by an independent test laboratory. The results shall be submitted to the Contract Administrator for his review and stamping.

When one of the three test samples for a sublot fails the slip test or the strength test, two new sample connections shall be prepared from the same sublot and tested along with the remaining connectors. In this case a total of four samples are necessary to qualify the sublot of 300. Qualification of this sublot requires all four connectors to pass. If these further requirements are not met, the sublot shall be rejected.

The above procedure shall be repeated for the next sublot. If an additional sublot fails, then the remainder of the lot shall be rejected and the Contractor shall submit a proposal for replacing this lot to the Contract Administrator for approval.

Only qualifying sublots will be used in the work.
Rejected mechanical connections shall be stored at a secure site for inspection by the Contract Administrator until completion of the Work. After completion of the Work, the Contractor shall remove the rejected material.

A copy of all job control test reports bearing the seal and signature of an Engineer shall be submitted to the Contract Administrator.

905.07.03.03 Testing Laboratory Requirements

The testing of mechanical connectors shall be carried out by an independent laboratory, accredited by the Standards Council of Canada or ISO 17025 registered, for testing according to ASTM E8M.

905.07.04 Management Of Excess Material

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

905.08 QUALITY ASSURANCE

905.08.01 Sampling

905.08.01.01 Steel Reinforcement

The sampling of steel reinforcement shall be on a random basis.

905.08.01.02 Reinforcing Stainless Steel Bar

Three 1.5 m long randomly selected samples of reinforcing stainless steel bars for each bar size from each supplier of reinforcing stainless steel bars shall be submitted to the Contract Administrator with the mill test certificates for that Contract.

905.08.02 Testing

905.08.02.01 Steel Reinforcement

The testing of steel reinforcement shall be according to CSA G30.18.

905.08.03 Mechanical Connections

The torque will be checked on 5% of the splices. Formwork that will limit access to connectors for testing purposes shall not be placed until testing has been completed.

905.09 MEASUREMENT FOR PAYMENT

905.09.01 Actual Measurement

905.09.01.01 Reinforcing Steel Bar

Coated Reinforcing Steel Bar

Reinforcing Stainless Steel Bar

Measurement of steel reinforcement shall be by mass for the steel reinforcement placed. Alternatively, steel reinforcement may be a lump sum item.
905.09.01.02 Mechanical Connections and Coated Mechanical Connections

For measurement purposes, a count shall be made of the number of mechanical connections or coated mechanical connections installed.

905.09.01.03 Stainless Steel Mechanical Connections

For measurement purposes, a count shall be made of the number of stainless steel mechanical connections installed.

905.09.02.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

905.10 BASIS OF PAYMENT

905.10.01 Reinforcing Steel Bar - Item
Coated Reinforcing Steel Bar - Item
Reinforcing Stainless Steel Bar - Item

Payment at the Contract price shall be full compensation for all labour, Equipment, and Material to do the Work.

Payment for the supply of steel reinforcement to the Working Area shall be made according to the Contract Documents.

When the Contract does not contain separate tender items for steel reinforcement, the Contract price for the concrete items into which the steel reinforcement is incorporated shall be full compensation for labour, Equipment, and Material to do the work.

905.10.02 Mechanical Connections - Item
Coated Mechanical Connections - Item
Stainless Steel Mechanical Connections - Item

Payment at the Contract price shall be full compensation for labour, Equipment, and Material required to do the Work.

Costs associated with any required removal and replacement of rejected mechanical connectors shall be the Contractor’s responsibility at no cost to the Owner.
### TABLE 1
Type of Stainless Steel

<table>
<thead>
<tr>
<th>Common or Trade Name</th>
<th>UNS Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 316 LN</td>
<td>S31653</td>
</tr>
<tr>
<td>Type 2205 Duplex</td>
<td>S31803</td>
</tr>
</tbody>
</table>

Note:

A. Condition/Finish: reinforcing stainless steel bars and shapes shall be hot rolled and pickled or hot rolled and descaled to the required mechanical properties and dimensions.

### TABLE 2
Metric to Imperial Steel Reinforcement Bar Size Conversion

<table>
<thead>
<tr>
<th>Metric Bar Size</th>
<th>Imperial Bar Size</th>
<th>Bar Designation No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>15M</td>
<td>#5</td>
<td>15</td>
</tr>
<tr>
<td>25M</td>
<td>#8</td>
<td>25</td>
</tr>
<tr>
<td>35M</td>
<td>#11</td>
<td>35</td>
</tr>
</tbody>
</table>
### TABLE 3
Tolerances for Cover and Placing Accuracy

<table>
<thead>
<tr>
<th>Steel Reinforcement</th>
<th>Tolerance mm</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cast-In-Place Concrete</td>
</tr>
<tr>
<td>Principal Reinforcing Steel</td>
<td>± 20</td>
<td>± 10</td>
</tr>
<tr>
<td>Concrete Cast Against and Permanently Exposed to Earth</td>
<td>± 25</td>
<td></td>
</tr>
<tr>
<td>Stirrups in Webs</td>
<td>± 5, - 3</td>
<td></td>
</tr>
<tr>
<td>Stirrups, Ties, Spirals</td>
<td>± 20</td>
<td>± 10</td>
</tr>
</tbody>
</table>

#### Cover to Surface of Concrete (Note 1)

#### Placing Accuracy

<table>
<thead>
<tr>
<th></th>
<th>Tolerance mm</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin Deck Slab</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top</td>
<td>± 20</td>
<td>± 15</td>
</tr>
<tr>
<td>Bottom</td>
<td>± 10</td>
<td>± 10</td>
</tr>
<tr>
<td>(Notes 2, 3, and 4)</td>
<td></td>
<td>(Notes 2, 3, and 4)</td>
</tr>
<tr>
<td>Remainder</td>
<td>± 30</td>
<td>± 30</td>
</tr>
<tr>
<td>(Notes 2, 3, and 4)</td>
<td></td>
<td>(Notes 2, 3, and 4)</td>
</tr>
<tr>
<td>Lateral spacing in thick slabs, footings and walls</td>
<td>± 30</td>
<td>± 30</td>
</tr>
<tr>
<td>(Notes 3 and 4)</td>
<td></td>
<td>(Notes 3 and 4)</td>
</tr>
<tr>
<td>Longitudinal location of bends and ends of bar in continuous member</td>
<td>± 50</td>
<td>± 50</td>
</tr>
<tr>
<td>Longitudinal location of bends and ends of bar at discontinuous end</td>
<td>± 20</td>
<td>± 20</td>
</tr>
</tbody>
</table>

Notes:

1. The cover to the concrete surface shall not be reduced by more than one-third of the specified cover.
2. The clear distance between bars shall not be less than one and one-half times the nominal diameter of the bar, one and one-half times the nominal size of the coarse aggregate, or 40 mm.
3. In two or more layers, the rebar shall be directly above one another and the clear distance between layers shall not be less than 25 mm.
4. The size, number, and spacing of bars shall be as specified in the Working Drawings.
Appendix 905-A, Commentary for OPSS 905, April 2007

Note: This appendix does not form part of the standard specification. It is intended to provide information to the designer on the use of this specification in a Contract.

Designer Action/Considerations

The following should be specified in the Contract Documents:

- Pitch of spiral steel reinforcement. (905.07.02.03)
- Concrete cover to steel reinforcement connections. (905.07.03.01)
- Payment for supply of steel reinforcement to working area. (905.10.01)

The designer should determine if any of the following are required and, if so, specify them in the Contract Documents.

- Whether the Owner is supplying the Working Drawings. (905.04.01.02)
- Whether the need for a specific type of mechanical connector. (905.05.04)
- Whether cutting of coated bars is allowed. (905.07.02.04)
- Whether field re-bending of bars is allowed. (905.07.02.05)
- Whether welding of steel reinforcement is allowed. (905.07.02.06)

The designer should ensure that the Ontario Provincial Standards General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

- OP SD 804.030 Concrete Headwall For Pipe Less Than 900mm Diameter
- OP SD 804.040 Concrete Headwall For Sewer Or Culvert Pipe Outlet
- OP SD 812.010 Cut Off Wall For Structural Plate Pipe Arch Or Circular CSP
- OP SD 3329.100 Deck, Reinforcement Supports For Reinforcing Steel For Slab Depths Less Than 300 mm
- OP SD 3329.101 Deck, Reinforcement Supports For Reinforcing Steel For Slab Depths Greater Than 300 mm
- OP SD 3339.100 Deck, Voids Access Hatch For Concrete Bridges Installation