Certificate of Compliance. Records for all other checks shall be submitted as a Type 1 Working Drawing.

Girders with vertical deflections not meeting the limit shown in the Plans for the shipment check (item 2 above) shall require an analysis of girder lateral stability and stresses in accordance with Section 6-02.3(25)L1. The Contractor shall perform this analysis and submit it as a Type 2E Working Drawing prior to shipment.

The "D" dimensions shown in the Plans are computed upper and lower bounds of girder vertical deflections at midspan based on a time lapse of 40 and 120 days after release of the prestressing strands. Any temporary top strands are assumed to be cut 30 days prior to these elapsed times (10 and 90 days after release of the prestressing strands). Any diaphragms are assumed to be placed. The "D" dimensions are intended to advise the Contractor of the expected range of girder vertical deflection at the time of deck placement. A positive (+) "D" dimension indicates upward deflection.

If the girder vertical deflection measured for the erection check (item 3 above) is not between the lower "D" dimension bound shown in the Plans and the upper "D" dimension bound shown in the Plans plus ¾ inches, the Engineer may require corrective action. The Contractor shall submit a Type 2 Working Drawing for any required corrective action.

6-02.3(25)L Handling and Storage

During handling and storage, each prestressed concrete girder shall always be kept plumb and upright. It shall be lifted only by the lifting embedments (strand lift loops or high-strength threaded steel bars) at either end.

For strand lift loops, only ½-inch diameter or 0.6-inch diameter strand conforming to Section 9-07.10 shall be used, and a minimum 2-inch diameter straight pin of a shackle shall be used through the loops. Multiple loops shall be held level in the girder during casting in a manner that allows each loop to carry its share of the load during lifting. The minimum distance from the end of the girder to the centroid of the strand lift loops shall be 3 feet. The loops for all prestressed concrete girders, with the exception of prestressed concrete slab girders, shall project a minimum of 1′-6″ from the top of the girder. The loops for prestressed concrete slab girders shall project a minimum of 4 inches. Loops shall extend to within 3 inches clear of the bottom of the girder, terminating with a 9-inch long 90-degree hook. Loads on individual loops shall be limited to 12 kips, and all girders shall be picked up at a minimum angle of 60 degrees from the top of the girder.

For high-strength threaded steel bars, a minimum of two 1⅜-inch diameter bars conforming to Section 9-07.11 shall be used at each end of the girder. The lifting hardware that connects to the bars shall be designed, detailed, and furnished by the Contractor. The minimum distance from the end of the girder to the centroid of the lifting bars shall be 3 feet. Lifting bars shall extend to within 3 inches clear of the bottom of the girder and shall be anchored in the bottom flange with steel plates and nuts. The minimum size of embedded plates for lifting bars shall be ½ inch thick by 3 inches square. Lifting forces on the lifting bars shall not exceed 58 kips on an individual bar, and shall be within 10 degrees of perpendicular to the top of the girder.

4. Small adjustments in girder length to account for elastic shortening, creep and shrinkage
5. Strand adjustments, as long as the center of gravity of the strands remains at the location shown in the plans and concrete cover is not reduced.
6. Diaphragm web hole vertical adjustments to avoid harped strands.
7. Substitution of welded wire reinforcement for conventional reinforcing steel.

Shop drawings shall show the size and location of all inserts and penetrations. Penetrations for deck formwork and falsework shall match the deck formwork Working Drawings. Field-drilled holes in prestressed concrete girders are not allowed.

Deformed welded wire reinforcement conforming to Sections 9-07.7 and 9-07.8 may be substituted for the mild steel reinforcement shown in the plans. The substitution shall be submitted as a Type 2E Working Drawing. The AASHTO LRFD Bridge Design Specification requirements (latest edition including interims) shall be satisfied, including at a minimum the following Articles:

5.8.2.6 Types of Transverse Reinforcement

5.8.2.8 Design and Detailing Requirements

5.10.3 Spacing of Reinforcement

5.10.6.3 Ties

5.10.7 Transverse Reinforcement for Flexural Members

5.10.8 Shrinkage and Temperature Reinforcement

5.10.10 Pretensioned Anchorage Zones

5.11.2.5 Welded Wire Fabric

5.11.2.6.3 Anchorage of Wire Fabric Reinforcement

5.11.6 Splices of Welded Wire Fabric

Yield strengths in excess of 75.0 ksi shall not be used for welded wire reinforcement.

The spacing of vertical welded wire reinforcement within slabs and girder webs shall not exceed 18 inches or the height of the member minus 3 inches, whichever is less. Longitudinal wires and welds are permitted in girder flanges but shall be excluded from girder webs. For vertical welded wire reinforcement in prestressed concrete slab girders, no welded joints other than those required for anchorage shall be permitted. Epoxy-coated wire and welded wire reinforcement shall conform to Section 9-07.3 with the exception that ASTM A884 Class A Type I shall be used instead of ASTM A775.

Shop drawings for spliced prestressed concrete girders shall also conform to Section 6-02.3(26)A. The Working Drawings for spliced prestressed concrete girders shall include all details related to the post-tensioning operations in the field, including details of hardware required, tendon geometry, blockout details, and details of additional or modified steel reinforcing bars required in cast-in-place closures.

6-02.3(25)L2 Lateral Stability and Stress Analysis

Analysis for girder lateral stability and concrete stresses during lifting, storage, shipping and erection shall be in accordance with the PCI *Recommended Practice for Lateral Stability of Precast, Prestressed Concrete Bridge Girders*, First Edition, Publication CB-02-16-E and the AASHTO *LRFD Bridge Design Specifications* edition identified in the Contract documents. The following design criteria shall be met:

1. Factor of Safety against cracking shall be at least 1.0
2. Factor of Safety against failure shall be at least 1.5
3. Factor of Safety against rollover shall be at least 1.5
4. Allowable concrete stresses shall be as specified in Section 6-02.3(25)L3

The analysis shall address any effects on girder vertical deflection (camber), "A" dimensions at centerline of bearings and deck screed cambers (C).

Shipping and handling details provided in the Contract documents have been determined using the following analysis assumptions:

1. Girder dimensions, strand locations and lifting embedment locations are within the tolerances specified in Section 6-02.3(25)I
2. Girder horizontal alignment (sweep) is within the tolerance specified in Section 6-02.3(25)J
3. Girder vertical deflection (camber) at midspan is less than or equal to the value shown in the Plans for shipping
4. Minimum concrete compressive strength at release (f'ci) has been reached before initial lifting from casting bed. Minimum concrete compressive strength at 28 days (f'c) has been reached before shipping.
5. Height of girder bottom above roadway at shipping supports is less than or equal to 72 inches
6. Height of shipping support roll center above roadway is 24 inches, ± 2 inches
7. Shipping support longitudinal placement (L_1 and L_2) tolerance is ± 6 inches
8. Shipping support lateral placement tolerance is ±1 inches
9. Shipping supports provide the minimum shipping support rotational spring constant (K_θ) and minimum shipping support center-to-center wheel spacings (W_{cc}) shown in the Plans
10. For shipping at highway speeds a ±20 percent dynamic load allowance (impact) is included with a typical roadway superelevation of 2 percent
11. For turning at slow speeds, no dynamic load allowance (impact) is included with a maximum roadway superelevation of 6 percent
12. Wind, centrifugal and seismic forces are not considered

6-02.3(25)L3 Allowable Stresses

Prestressed concrete girder stresses shall be limited to the following values at all stages of construction and in service:

Condition	Stress	Location	Allowable Stress (ksi)
Temporary Stress at Transfer and Lifting from Casting Bed	Tensile	In areas without bonded reinforcement sufficient to resist the tensile force in the concrete	$0.0948\lambda\sqrt{f'_{ci}} \leq 0.2$
		In areas with bonded reinforcement sufficient to resist the tensile force in the concrete	$0.24\lambda\sqrt{f'_{ci}}$
	Compressive	All locations	$0.65f'_{ci}$
Temporary Stress at Shipping and Erection	Tensile	In areas without bonded reinforcement sufficient to resist the tensile force in the concrete	$0.0948\lambda\sqrt{f'_c} \leq 0.2$
		In areas with bonded reinforcement sufficient to resist the tensile force in the concrete	$0.19\lambda\sqrt{f'_c}$
		In areas with bonded reinforcement sufficient to resist the tensile force in the concrete when shipping at 6% superelevation, without impact	$0.24\lambda\sqrt{f'_c}$
	Compressive	All locations	$0.65f'_c$
Final Stresses at Service Load	Tensile	Precompressed tensile zone	0.0
	Compressive	Effective prestress and permanent loads	$0.45f'_c$
		Effective prestress, permanent loads and transient (live) loads	$0.60f'_c$
Final Stresses at Fatigue Load	Compressive	Fatigue I Load Combination plus one-half effective prestress and permanent loads	$0.40f'_c$

Variables are as defined in the AASHTO *LRFD Bridge Design Specifications*.

6-02.3(25)M Shipping

After the girder has reached its 28-day design strength, the girder and a completed Certification of Compliance, signed by a Precast/Prestressed Concrete Institute Certified Technician or a Professional Engineer, shall be submitted to the Engineer for inspection. If the Engineer finds the certification and the girder to be acceptable, the Engineer will stamp the girder “Approved for Shipment”.

No prestressed concrete slab girder shall be shipped for at least 3 days after concrete placement. No prestressed concrete wide flange deck, deck bulb tee or tub girder shall be shipped for at least 7 days after concrete placement, except that they may be shipped 3 days after concrete placement when L/(bd) is less than or equal to 5.0, where L equals the shipping length of the girder, b equals the girder top flange width (for prestressed concrete wide flange deck and deck bulb tee girders) or the bottom flange width (for prestressed concrete tub girders), and d equals the girder depth, all in feet. No other girder shall be shipped for at least 10 days after concrete placement.

Girder support locations during shipping shall be no closer than the girder depth to the ends of the girder at the girder centerline.

Girder lateral stability and stresses during shipping shall be in accordance with Section 6-02.3(25)L1.

If the Contractor elects to assemble spliced prestressed concrete girders into shipping configurations not shown in the Contract documents, the Contractor shall submit a Type 2E Working Drawing analyzing girder lateral stability and concrete stresses in accordance with Section 6-02.3(25)L2 before shipping.

6-02.3(25)N Prestressed Concrete Girder Erection

Before erecting any prestressed concrete girders, the Contractor shall submit an erection plan as a Type 2E Working Drawing. The erection plan shall conform Section 6-02.3(25) L1. The erection plan shall provide complete details of the erection process including at a minimum:

1. Temporary falsework support, bracing, guys, deadmen, and attachments to other Structure components or objects;
2. Procedure and sequence of operation;
3. Girder stresses during progressive stages of erection;
4. Girder weights, lift points, lifting embedments and devices, spreaders, and angle of lifting cables in accordance with Section 6-02.3(25)L, etc.;
5. Crane(s) make and model, mass, geometry, lift capacity, outrigger size, and reactions;
6. Girder launcher or trolley details and capacity (if intended for use); and
7. Locations of cranes, barges, trucks delivering girders, and the location of cranes and outriggers relative to other Structures, including retaining walls and wing walls.

The erection plan shall include drawings, notes, catalog cuts, and calculations clearly showing the above listed details, assumptions, and dimensions. Material properties and Specifications, structural analysis, and any other data used shall also be included.

The concrete in piers and crossbeams shall reach at least 80 percent of design strength before girders are placed on them.

The Contractor shall hoist girders only by the lifting embedments at the ends, always keeping the girders plumb and upright. When the girders are to receive a cast-in-place concrete deck, lifting embedments shall be removed after erection to provide a minimum 2½-inch clearance to the top of the deck. When the girders are not to receive a cast-in-place concrete deck, lifting embedments shall be removed 1-inch below the girder surface and grouted with an epoxy grout conforming to Section 9-26.3(1)A.

The girders shall be braced in accordance with Sections 6-02.3(17)F4 and 6-02.3(17)F5. **When temporary strands in the top flange are used, they shall be cut after the girders are braced and before girder deflections are equalized and the intermediate diaphragms are cast.**

Instead of the oak block wedges shown in the Plans, the Contractor may use Douglas fir blocks if the grain is vertical. The height of oak block wedges at the girder centerline shall not exceed the width.

The Contractor shall fill all block-out holes with a mortar or grout acceptable to the Engineer.

Stop plates and dowel bars for prestressed concrete girders shall be set with either epoxy grout conforming to Section 9-26.3 or type IV epoxy bonding agent conforming to Section 9-26.1.

6-02.3(25)O Girder to Girder Connections

When differential camber between adjacent girders in a span exceeds the tolerance in Section 6-02.3(25)I, the Contractor shall submit a method of equalizing deflections as a Type 1 Working Drawing. Any temporary strands in the top flange shall be cut in accordance with Section 6-02.3(25)N prior to equalizing girder deflections.

Prestressed concrete girders shall be constructed in the following sequence:

1. If required, deflections shall be equalized in accordance with the Contractor's equalization plan.
2. Any intermediate diaphragms shall be placed and any weld ties shall be welded in accordance with Section 6-03.3(25). Welding ground shall be attached directly to the steel plates being welded when welding the weld-ties.
3. Any keyways between adjacent girders shown in the Plans to receive grout shall be filled flush with the surrounding surfaces using a grout conforming to Section 9-20.3(2).
4. Equalization equipment shall not be removed and other construction equipment shall not be placed on the structure until intermediate diaphragms and keyway grout have attained a minimum compressive strength of 2,500 psi.

6-02.3(26) Cast-In-Place Prestressed Concrete

Unless otherwise shown in the Plans, concrete for cast-in-place prestressed bridge members shall be Class 4000D in the bridge deck, and Class 4000 at all other locations. Air entrainment shall conform to Sections 6-02.3(2)A and 6-02.3(3).

The Contractor shall construct supporting falsework in a way that leaves the Superstructure free to contract and lift off the falsework during post-tensioning. Forms that will remain inside box girders to support the bridge deck shall, by design, resist girder contraction as little as possible.

Standard Specifications

for Road, Bridge, and Municipal Construction

2020

M 41-10

Washington State
Department of Transportation

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