



Purpose

Notify WSDOT staff of updated Standard Specifications clarifying use of tolerances and adding tolerances for cast-in-place concrete structures.

Guidance

WSDOT staff involved in design and construction of projects, particularly for cast-in-place concrete structures, are encouraged to review changes to Standard Specifications 1-05.5, 6-02.3(7), 6-02.3(24)C, 6-13.3(4), 6-19.3(1)A and 6-19.3(5)C.

These revisions include:

- Introduced Standard Specifications Section 1-05.5 that generally defines and clarifies use of tolerances for all work on projects
- Introduced Standard Specifications Section 6-02.3(7) to define construction tolerances for cast-in-place concrete structures
- Updated reinforcement placement tolerances in sections 6-02.3(24)C and 6-19.3(1)A
- Corrected minor errors discovered with tolerances in sections 6-13.3(4) and 6-19.3(5)C

Background

Construction tolerances are included in Standard Specifications, Special Provisions and other Contract Documents for many components. However, the previous specifications lack general requirements for all tolerances, as well as tolerances for many cast-in-place concrete structures.

These changes were reviewed by the Headquarters Construction Office, Headquarters Design Office, Headquarters Bridge & Structures Office, Headquarters Real Estate Services Office, Region Construction Engineers, the AGC/WSDOT Structures Team and the ADSC/WSDOT Team.

Resources

Cast-in-place concrete structure tolerances are based on those in ACI 117 "Specification for Tolerances for Concrete Construction and Materials".

Implementation Plan

Changes to Standard Specifications 1-05.5, 6-02.3(7), 6-02.3(24)C, 6-13.3(4), 6-19.3(1)A and 6-19.3(5)C, were to be published in the August 2018 Standard Specification Amendments.



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1-05.5 Tolerances

Geometrical tolerances shall be measured from the points, lines, and surfaces defined in Contract documents.

A plus (+) tolerance increases the amount or dimension to which it applies, or raises a deviation from level. A minus (–) tolerance decreases the amount or dimension to which it applies, or lowers a deviation from level. Where only one signed tolerance is specified (+ or –), there is no specified tolerance in the opposing direction.

Tolerances shall not be cumulative. The most restrictive tolerance shall control.

Tolerances shall not extend the Work beyond the Right of Way or other legal boundaries identified in the Contract documents. If application of tolerances causes the extension of the Work beyond the Right of Way or legal boundaries, the tolerance shall be reduced for that specific instance.

Tolerances shall not violate other Contract requirements. If application of tolerances causes the Work to violate other Contract requirements, the tolerance shall be reduced for that specific instance. If application of tolerances causes conflicts with other components or aspects of the Work, the tolerance shall be reduced for that specific instance.

6-02.3(7) Tolerances

Unless noted otherwise, concrete construction tolerances shall be in accordance with this section.

Tolerances in this section do not apply to cement concrete pavement.

Horizontal deviation of roadway crown points, cross-slope break points, and curb, barrier or railing edges from alignment or work line: ± 1.0 inch

Deviation from plane: ± 0.5 inch in 10 feet

Deviation from plane for roadway surfaces: ± 0.25 inch in 10 feet

Deviation from plumb or specified batter: ± 0.5 inch in 10 feet, but not to exceed a total of ± 1.5 inches

Vertical deviation from profile grade for roadway surfaces: ± 1 inch

Vertical deviation of top surfaces (except roadway surfaces): ± 0.75 inch

Thickness of bridge decks and other structural slabs not at grade: ± 0.25 inch

Length, width and thickness of elements such as columns, beams, crossbeams, diaphragms, corbels, piers, abutments and walls, including dimensions to construction joints in initial placements: $+0.5$ inch, -0.25 inch

Length, width and thickness of spread footing foundations: $+2$ inches, -0.5 inch

Horizontal location of the as-placed edge of spread footing foundations: The greater of $\pm 2\%$ of the horizontal dimension of the foundation perpendicular to the edge and ± 0.5 inch. However, the tolerance shall not exceed ± 2 inches.

Location of opening, insert or embedded item at concrete surface: ± 0.5 inch

Cross-sectional dimensions of opening: ± 0.5 inch

Bridge deck, bridge approach slab, and bridge traffic barrier expansion joint gaps with a specified temperature range, measured at a stable temperature: ± 0.25 inch

Horizontal deviation of centerline of bearing pad, oak block or other bearing assembly: ± 0.125 inch

Horizontal deviation of centerline of supported element from centerline of bearing pad, oak block or other bearing assembly ± 0.25 inch

Vertical deviation of top of bearing pad, oak block or other bearing assembly: ± 0.125 inch

6-02.3(24)C Placing and Fastening

The Contractor shall position reinforcing steel as the Plans require and shall ensure that the steel ~~does not move as the concrete is placed~~ is set within specified tolerances. Adjustments to reinforcing details outside of specified tolerances to avoid interferences and for other purposes are acceptable when approved by the Engineer.

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~~If a bar will interfere with a bridge drain, it shall be bent in the field to bypass the drain.~~

Unless noted otherwise, the ~~Clearances~~ minimum concrete cover for ~~main~~ reinforcing bars shall be at least:

~~4 inches between: Bars and the surface of any concrete masonry exposed to the action of salt or alkaline water.~~

~~3 inches between: Bars and to the a concrete surface of any concrete deposited against earth without intervening forms.~~

~~2½ inches between: Adjacent bars in a layer. to the top surface of a concrete Bbridge deck and or bridge approach slab. bars and the top of the slab.~~

~~-2 inches between: Adjacent layers. Bars and the surface of concrete exposed to earth. Reinforcing bars and the faces of forms for exposed aggregate finish. Bars and to the a concrete surface of concrete when not specified otherwise in this section or in the Plansthe Contract documents.~~

~~1½ inches between: to a concrete barrier or curb surface. Barrier and curb bars and the surface of concrete.~~

~~1 inch between: Bridge deck bars and the bottom of the bridge deck. Slab bars and the top surface of the bottom slab of a cast in place concrete box girder.~~

Except for top cover in bridge decks and bridge approach slabs, **minimum concrete** cover to ties and stirrups may be **reduced by ½ inch** ~~less than the values specified for main bars~~ but shall not be less than 1 inch. Minimum concrete cover ~~and clearances to mechanical splices and headed steel reinforcing bars~~ shall also be provided to the outermost part of ~~the mechanical splices and headed steel reinforcing bars of the bar.~~

Reinforcing steel bars **location, concrete cover and clearance** shall not vary more than the following tolerances from ~~their position what is shown~~ specified in the ~~Plans~~ **Contract documents**:

Reinforcing bar location for M ~~members 10-12 inches or less in thickness: $\pm\frac{1}{4}$ ± 0.25 inch.~~

Reinforcing bar location for M ~~members more greater than 10-12 inches in thickness: $\pm\frac{3}{8}$ ± 0.375 inch.~~

Reinforcing bar location for bars placed at equal spacing within a plane: the greater of either ± 1 inch or ± 1 bar diameter within the plane. The total number of bars shall not be fewer than that specified.

~~Clearance between reinforcement or between reinforcement and embedments shall be within $\pm 25\%$ of the specified distance, not to exceed ± 1 inch.~~

The ~~distance~~ clearance between reinforcement shall not be less than the greater of the bar diameter or 1 inch for unbundled bars. For bundled bars, the ~~distance~~ clearance between bundles shall not be less than the greater of 1 inch or a bar diameter derived from the equivalent total area of all bars in the bundle.

~~Drilled Shafts top of rebar cage elevation $+6$ in./ 3 in.~~

~~Except:~~

~~The clearance to the top surface of the bridge decks and bridge approach slabs $+1/4$ in./ $0''$~~

Longitudinal ~~spacing~~ location of bends and ends of bars: ± 1 inch.

~~Length of bar laps $-1\frac{1}{2}$ in.~~

Embedded length of bars and length of bar lap splices:

No. 3 through No. 11: **-1 inch.**

No. 14 through No. 18: **-2 inches.**

~~When reinforcing steel bars are to be placed at equal spacing within a plane:~~

Concrete cover measured perpendicular to concrete surface (except for the top surface of bridge decks, ~~and~~ bridge approach slabs and other roadway surfaces): ± 0.25 inch

Concrete cover measured perpendicular to concrete surface for the top surface of bridge decks, ~~and~~ bridge approach slabs and other roadway surfaces: $+0.25$ inch, -0 inch

~~Stirrups and ties ± 1 in.~~

~~All other reinforcement ± 1 bar dia.~~

Before placing any concrete, the Contractor shall:

1. Clean all mortar from reinforcement, and
2. Obtain the Engineer's permission to place concrete after the Engineer has inspected the placement of the reinforcing steel. (Any concrete placed without the Engineer's permission shall be rejected and removed.)

6-13.3(4) Precast Concrete Facing Panel and Concrete Block Fabrication

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All concrete blocks shall be manufactured within the following tolerances:

1. Vertical dimensions shall be $\pm 1/16$ inch of the Plan dimension, and the rear height shall not exceed the front height.
2. The dimensions of the grooves in the top and bottom faces of the concrete blocks shall be formed within the tolerances specified by the proprietary wall manufacturer, for the fit required for the block connectors.
3. All other dimensions shall be $\pm 1/4$ inch of the Plan dimension.

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6-19.3(1)A Shaft Construction Tolerances

Shafts shall be constructed so that the center at the top of the shaft is within the following horizontal tolerances:

Shaft Diameter (feet)	Tolerance (inches)
Less than or equal to 2	3
Greater than 2 and less than 5	4
5 or larger	6

Shafts shall be within 1.5 percent of plumb. For rock excavation, allowable tolerance can be increased to 2 percent maximum.

During drilling or excavation of the shaft, the Contractor shall make frequent checks on the plumbness, alignment, and dimensions of the shaft. Any deviation exceeding the allowable tolerances shall be corrected with a procedure approved by the Engineer.

Shaft steel reinforcing bar placement tolerances shall conform to Section 6-02.3(24)C. **The elevation of the top of the reinforcing cage for drilled shafts shall be within +6 inches and -3 inches from the elevation shown in the Plans.**

Add a “-“ in front of the concrete cover tolerance in the top row of the table in 6-19.3(5)C:

6-19.3(5)C Concrete Cover Over Steel Reinforcing Bars

Steel reinforcing bars shall be placed as shown in the Plans with minimum concrete cover as shown below:

Shaft Diameter (feet)	Minimum Concrete Cover, <u>and</u> <u>Concrete Cover Tolerance</u> , Except at Permanent Slip Casing (inches)	Minimum Concrete Cover at Permanent Slip Casing (inches)
Less than or equal to 3	3, <u>1½</u>	1½
Greater than 3 and less than 4	4, <u>-2</u>	1½
Greater than or equal to 4 and less than 5	4, <u>-2</u>	2
5 or larger	6, <u>-3</u>	3

The concrete cover tolerances specified above apply to the concrete cover specified in the Plans, even if it exceeds the minimum concrete cover.