Setting Screed Rails for Bridge Deck Paving

Learn how to set screed rails to meet deck grade tolerances

By Bruce A. Suprenant

Bridge deck paving machines are set on top of and travel forward along screed rails during concrete placement. Where and how workers set the screed rails determine the final deck profile. To meet typical deck grade tolerances of ±1 inch, contractors require knowledge and skill in screed-rail placement. They must also consider how the movement of a loaded screed rail affects form deflection and bridge girder movement.

Finished Deck Grade

Check the plans for the required final bridge deck elevation. The engineer sets final deck grades that account for dead-load deflection and the desired residual camber. For bridge deck widening, the new deck surface must match each edge of the existing deck as well as the desired grade at the outside edges of the widened deck. Determine the existing deck profiles to check for dips or humps caused by super-elevation transitions, alignment tapers, or concrete finishing operations.

Edge deck profiles are sometimes included in the contract plans. Verify these grade profiles to determine if remedial work is necessary. Identify grade problems early and present solutions to the engineer.

Screed rail used to set deck slab grade for paving machines can be set on the exterior overhang form or on the exterior girder. Placing the screed rail on the girder requires hand placing and finishing of side strips.

Construction Grade Control

Most state highway departments provide contractors with elevation points along the beams and on the formed exterior overhangs. Existing girder elevations are established at 8 or 10 equally spaced points along the bridge girders and are recorded on the beams. Use these measured elevations, along with the engineer's calculated dead-load deflections and desired residual camber requirements, to set deck forms and screed rails (Figure 1).

Generally, the thickness of the concrete directly above the girders but below the bottom of the deck slab is varied to account for girder placement and beam fabrication tolerances. This method maintains a constant deck thickness. Some state highway departments, however, require the deck slab to vary in thickness to accommodate girder placement and beam fabrication tolerances.

Some problems that arise during grade control include top flanges of steel girders embedded in the concrete deck due to girder placement and beam fabrication tolerances, and prestressed beams that creep upward during construction. When these problems arise, check with the engineer since the top-of-deck grades can sometimes be raised. Also, always keep the field notes

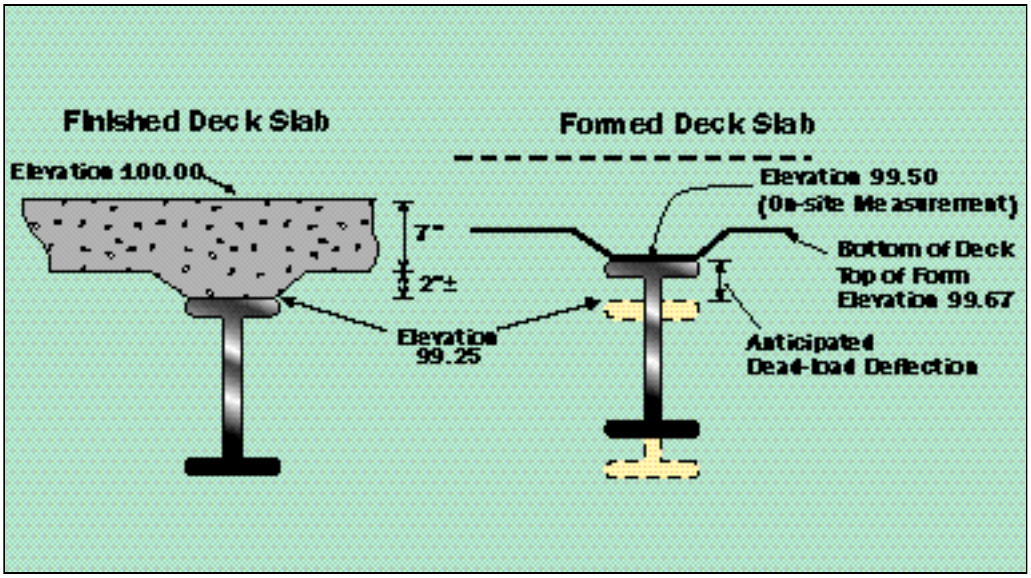

Figure 1. **Engineers mark the elevation of the as-built girders at 8 to 10 equally spaced points along the beam. These elevations vary due to beam fabrication and placement tolerances. Using the girder elevations and information from the plans, workers can set the top of the forms to account for dead-load deflection. If the beam elevations vary, a constant slab thickness is maintained by adjusting the height of concrete above the girder.**

and a level on hand during the deck pour to solve any grade problems that might occur.

Elevation control should be set when ambient temperatures are the same as those anticipated at the time of concrete placement. It's best to determine elevation controls early in the morning when temperature variation is minimal and the girder temperature is constant or stable. Elevations taken in the afternoon won't match early morning or late afternoon elevations due to temperature differences between the top and bottom of the girders.

Placing Screed Rails

Set screed rails parallel to the girders. The rails can be placed directly on the exterior girders or on the formed deck overhang. Use the engineer's elevation measurements to set the desired rail elevation at two points, then use a stringline to set correct grade between the measured elevations. Raise or lower rails where necessary to meet grade.

Screed rails should run the full length of the concrete placement and extend beyond both ends a sufficient distance, usually 20 feet, to permit the finishing equipment to clear the placement area. Set screed elevation beyond the limits of the concrete placement to assure proper grade at the bulkheads (Figure 2).

Screed rails placed on the exterior of the deck's formed overhang can also be used for traveling work bridges. Screed rails placed on the girders are removed during the concrete placement but can be relocated outside the placement for work-bridge use.

Screed rails on exterior girders. Placing the screed rails on the exterior girders is easier and quicker than placing them on the formed overhang. However, if the rails are placed on the girders they must be removed to complete the concrete deck placement. Concrete placed on the overhang must be placed, vibrated, screeded, and straight edged by hand.

Screed rails placed on exterior girders are normally located with the bottom of the rail 2 to 3 inches above finished deck grade. Rail segments are typically no more than 10 feet long so the finishers can remove the short rail sections as the paver moves forward. This allows workers to hand finish the overhang areas, matching the grade of the paver and the finished grade on the exterior form.

Screed rails on formed overhangs. Many contractors prefer to place the screed rail on the formed

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Figure 2. **Extend the screed rail beyond the limits of the concrete placement to ensure grade at end bulkheads and to operate the paving rollers, screed pan, and drag to the end of the concrete placement. On this job, the contractor provided temporary blocking to support the screed rail beyond the concrete placement.**

exterior overhang since the paving machine can finish 95% of the deck. Separate labor-intensive overhang placements aren't necessary when the screed rail is located outside the concrete placement. Even though the screed rail is outside the pour, hand finishing of a 1-foot-wide strip along each adjoining side edge form or rebar cage is still required.

When placing screed rail on the exterior overhang, contractors must consider the effect the loaded screed rail has on form deflection and bridge girder movement. If wood formwork is used, deflection will also include natural compression of the forms during loading, or form "take-up." Some contractors dry-run the machine over the screed rails to eliminate most form take-up. Further form take-up during concrete placement may require adjustment to the screed rail. One contractor uses a rule of thumb of ⅛ inch take-up for any two adjoining wood surfaces supporting the deck plywood. To minimize form deflection with overhang brackets, follow the manufacturer's recommendations for spacing, using a maximum spacing of 4 feet.

For short-span bridges, girder deflection and rotation aren't usually a problem. They are more often a problem with long-span steel girders. To minimize this problem, block the bottom flange of the exterior girder to the bottom flange of the adjacent interior girder. Use 4x4-inch blocking at 6- to 10-foot spacings along the bottom flange. For very deep, thin-web steel girders, some contractors weld rebar across the exterior girder's top flange to the top flange of interior girders. Get the engineer's permission before welding temporary or permanent construction supports.

Screed rails placed outside the concrete placement are typically located 1 to 2 feet above the deck on a stud wall. One contractor recommends using a 2x4 stud wall having a top and bottom plate with studs spaced 16 inches on-center.

Figure 3. **Use a 2x4 stud wall to support screed rails on the exterior formed overhang. Brace the wall every 2 to 3 feet and drill holes every 24 to 32 inches to insert threaded rod for screed chairs.**

Avoid spaces between the top plate and studs since this will result in nonuniform form settlement. Drill holes (1¼ inch in diameter) in the top plate to insert the threaded rods for the screed chairs. Use 2x4s to brace the top of the stud wall to the deck form at a 2- to 3-foot spacing (Figure 3).

Most contractors rough grade overhang forms to approximately ½ inch below the planned grade. When the engineer sets final grade, it's usually easier and quicker to jack or wedge the overhang up instead of trying to lower it. Use the overhang grades provided by the engineer to position the screed rail with a rod and level.

Some contractors use a "story pole" to set rail grade. A story pole is constructed by subtracting the difference between final screed-rail grade from the overhang grade at each grade location and marking these elevation differences on the pole. Set the story pole at each grade location and adjust the screed chairs until the screed rail is at the desired elevation.

Screed Rails and Chairs

Bridge deck paving machines typically have flanged wheels that sit on top of the screed rails. Choose screed rails that are strong enough to support the paving machine without excessive deflection or stress. Also, minimize rail deflection and stress by placing screed chairs at an appropriate spacing. Besides supporting the rail, screed chairs can be adjusted up or down for elevation control. Screed chairs are set on the overhanging deck forms or the exterior girders.

Screed-rail sections are usually 2-inch-diameter schedule 80 pipe, 10 to 20 feet in length. Only use rail sections that can be connected or spliced together. Connected sections form a continuous rail, minimizing high deflections that result from a loaded rail supported as a cantilever. Most contractors use screed rails connected with an easy-to-assemble male-to-female sleeve that provides the required continuous support.

Most contractors space screed chairs 24 to 32 inches on-center. When using a high-strength rail, the supporting screed chairs can be placed farther apart. The table shows the maximum deflection and stress for a 2-inch-diameter, schedule 80 pipe screed rail with a maximum wheel load of 1,600 pounds. Closely spaced screed chairs reduce rail deflection and stress.

Bridge deck paver manufactur-

Pipe Screed Rail Deflection and Stress
1,600-pound Wheel Load on a 2-inch Schedule 80 Pipe

Screed Chair Spacing inches	Deflection inch	Stress psi	Safety Factor*
24	1/64	13,135	2.44
30	1/32	16,420	1.95
36	1/16	19,700	1.62
42	3/32	22,990	1.39
48	9/64	26,270	1.22

* Based on 32,000 psi yield strength
(Source: Bid-Well, Div. of CMI Corp.)

ers sell both screed rails and screed chairs. However, contractors often build their own screed chairs. A typical screed chair consists of a U-shaped saddle welded to a 1-inch-diameter, 8-inch-long threaded rod that includes a nut and washer. Don't forget the washer. Threaded rods without washers experience more settlement due to local crushing when the nut bears on wood forms.

The threaded rod can be welded to a steel base (usually 6 inches square) to make a free-standing platform, inserted into a pipe sleeve that's welded onto a steel beam or cast into a concrete girder, or dropped into a hole drilled in supporting formwork. Turning the nut raises or lowers the saddle supporting the rail. It's best to use a screed chair that allows at least 2 inches, preferably more, of elevation control.

Many engineers and state highway departments don't allow the screed chair rod sleeve to be welded in the negative moment region (tension side) of the beam. Therefore, a combination of welded sleeves and platform bases is usually used when placing screed rail along a bridge girder. Regardless of how the threaded rod is attached to the beam, most specifications require the contractor to tie-wire the rail to the chair.

Put the deck paving equipment through a dry run to make final adjustments to the forms and screed rails. Set up the paver according to the manufacturer's recommendations, then run the paver along the complete length of the deck. Some contractors stop the paver at 10-foot intervals to measure elevations and, if necessary, adjust the screed rails to grade. As the paver travels along the screed rails, check rebar clearances, bulkhead elevations, deck thickness, and screed-rail deflection.

Crown Adjustment

Screed rails also are used as a signal guide to the paver operator. When a hydraulic crown adjuster is used, mark the beginning and end of the crown on the screed rails. Also, mark locations every 3 to 5 feet along the rail to notify the operator how much to turn the crank to raise or lower the machine. Using the marked screed rails as guides, the paver operator should be able to obtain a smooth transition from zero to maximum crown then back to zero.

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