"CONSTRUCTION PRACTICES FOR BRIDGE DECKS"

AUSTIN GRIFFITH
Bridge Construction Engineer
Kentucky Department of Highways


This paper on the "Construction Practices for Bridge Decks" will discuss the conditions that cause roughness. Other ideas for correcting this condition will be the subject of discussion at end of this session.

The principal reasons found for roughness of bridge decks and suggested measures to reduce roughness of bridge decks are grouped under the following principal topics:

1. Poor hand finishing
2. Settlement of falsework
3. Transverse joints
4. Camber for steel structures
5. Sag due to shrinkage, creep, plastic flow or camber for concrete structures
6. Shortage of experienced inspection personnel
7. Bituminous wearing courses on bridge decks
8. Machine finishing—Film by Stow Manufacturing Company—4 minutes of Projects listed

(1) Poor hand finishing

Contractors find it difficult to find experienced bridge deck finishers. Sometimes craft unions require that finishers be rotated so that a contractor is unable to keep good finishers more than a few weeks or a season at the longest. Poor finishers fail to properly use straight edges and floats and are inclined to overedge the joints creating a small bump just behind the edger. Generally the area for working space is limited. It is suggested that portable bridge over the deck be used to remove screed bars as transverse screeds are required by the present specifications. The removal of screed bars (Transverse) has a tendency to leave a high or low place when removed unless properly filled and straight edged before floating and belting.

The use of set retarding agents is suggested in some cases to allow more time for finishing and checking by the inspector. The amount of retarding agent can be reduced as the pour advances so the entire pour of bridge deck may set at about the same time. The use of "Protex" and "Plastiment" retarding agents or
others is agreeable to the Department of Highways for use under supervision of Materials Section.

The uniformity of slump, or consistency of concrete going into the deck is consider important since areas placed with dried concrete will finish a little higher than those placed with wetter concrete.

(2) Settlement of falsework

Some highway engineers feel the effect of falsework settlement is more unsightly due to length of sag rather than contributing to a rough riding surface. However, where falsework is found to result in adequate and even support credit is generally given to observing the following measures:

a. contractor is required to submit a detailed plan of intended falsework for approval by the Bridge Construction Engineer.

b. allowances are made at each joint in falsework for crush and take up.

c. care is exercised to place sills on stable ground or piling.

Settlement may be measured as the pour progresses by hanging tell-tales from top of falsework down to fixed reference points or a piano wire stretched the span length. Adjustments may then be made either in the falsework by wedging. Manufactured falsework system and form ties are generally found to overcome much of the falsework difficulty as screw jack system will permit adjustment to maintain proper deck grade. Many manufacturers furnish a service which includes adequate form designs.

(3) Transverse Joints

Joints between spans are a cause of roughness. Failure to set steel expansion dam devices to grade and roadway slope may result in sharp bump at the dam and might be avoided by careful inspection during steel erection. Steel beams in composite structures and continuous steel girders should be erected and connected before the dams are field drilled and set to match the abutment dam steel of the parapet wall or parapets may be poured later to match the bridge deck.

Extrusion of fillers, occasional spalling and the tendency to work small bumps behind the edger when finishing are additional causes of roughness.

(4) Camber for steel structures

It is reported that steel elevations vary considerably on steel beams and steel continuous girders, but using Dim “X” for setting templates based on difference of elevation of steel in place with no forming to finished grade which includes camber due to concrete deck load will give a smooth concrete deck that will straight edge easily.

(5) Sag due to shrinkage, creep and plastic flow

Concrete is found to shrink a maximum of about .006 of its length to drying, most of which takes place in a period of approximately 6 or 8 months, following the curing period. The amount of shrinkage and resulting sag in concrete spans is a variable which is reduced with a reduction of mixing water. Therefore, it is important to use a relatively consolidation. Creep and plastic flow is the tendency for loaded concrete to deform with lapse of time. This process is found to continue after most of the initial shrinkage has taken place, at a decreasing rate for a period of four or five years. These factors have caused sag on some concrete structures which were cambered for dead load only. The problem is more serious where the spans are comparatively long, also a roller coaster effect to riding is given until structure regains normal grade in four or five years when full cambered. Camber is usually provided to compensate for sag which may be expected as a result of dead load deflection, shrinkage and creep or plastic flow. Among rules offered to determine the amount of camber provided are:

1. Allow one-eighth of inch for every ten feet of deck span in addition to
dead load deflection. Dead load deflection based on deflection = \frac{M_{mdx}}{E I}

E = \frac{29,000,000}{8} \text{ for dead load deflection.}

2. Compute dead load deflection and then multiply this by approximately four. Another practice is to assume the value of modulus of elasticity of concrete as one thirtieth that of steel for computing ultimate deflection due to combined creep and dead load of slabs and beams. This is also the recommendation of AASHO, Std. Spec. for Highway Bridges. (Note: (1) This preceding material regarding camber is applicable to conventional reinforced concrete structures and does not apply to prestressed concrete, (2) The use of certain mixtures such as retarders that permit a reduction in mix water may reduce the ultimate deflections making adjustments in camber desirable.

(6) Shortage of Experienced Inspection Personnel

In general, it is felt that a shortage of experienced personnel has caused some sacrifice in quality of inspection. More field training of inexperienced resident engineers and inspectors is recommended. It will be the practice in the future of assigning a roving bridge engineer to be present when important pours are to be made and the Resident Engineer through the Area will be advised of this procedure.

(7) Bituminous wearing course on bridge decks

This does away with exacting finish requirements necessary for concrete surfaces and at the same time gives a smoother riding surface. The deck area to be paved with asphaltic material is dropped below the finish grade by the thickness of asphaltic material to be used so that the resulting surface comes flush with the concrete gutter. To date this has been used on prestressed bridge and maintenance bridge replacements giving a smooth riding surface for this type of bridge.

(8) Machine Finishing

Most engineers feel that the use of machines for finishing bridge decks should be encouraged, except where it is found impractical due to shortness of span. Some states are attacking the problem by specifying machine-finishing for bridge decks on interstate projects—(steel deck bridges). The specification should be purposely broad in order to encourage experimentation and development of equipment on the part of contractor and the manufacturers. In the main, it set up results rather than methods. In stressing end results rather than the means and precise operating procedure, it is important to maintain close construction control. The Kentucky Department of Highways has set up a Special Provision for finishing concrete bridge floors by means of a vibrating screed as an alternate method as to what specified under Art. 5.4.3.C-8-6 of 1956 Specifications. This special provision shall be applicable only when indicated on plans or in the proposal or by change order and can be modified for use of screed with finisher on experimental basis.

A film was presented by Stow Manufacturing Company, Binghamton, New York, on the use of vibrating screed in the following areas:

1. 24' span underslung Stow Screed used by Bayer and Mingola on bridge deck on Massachusetts Turnpike—Note now rollers can be flipped up to 11 ft. and screed up off the surface. Slump was 1 to 2 inches.

2. 14' span underslung screed used by Brunalli Construction Company on the Chicopee River Bridge over the Massachusetts Turnpike. 2 inch slump concrete was pour from buggy’s and vibrated as it was placed which made it easier to screed. They made two passes and then bull floated.
(3) 38' underslung screed used by the Ferrer Construction Company on a monolithic slab using 3 inch slump concrete on the North South Expressway north of Montreal. Two power paks were used on this unit, since two of these bridge beds are being poured side by side at the same time two 38 foot underslung screeds were used.

(4) 28' screed with Adjustable Crown Assembly—Note that crown can be adjusted with this assembly from 0 inches to 3 inches. This screed has two power paks and was used in South Bend, Indiana on project.

In conclusion it is brought out by this paper and discussion that the problem is compared to “The Largest Room in the World is the Room for Improvement.”