

forms. Materials or methods used in oiling the forms shall not result in the discoloration of the concrete.

In lieu of the conventional stationary forms, concrete parapet rail may be constructed by using an extrusion machine or other equipment specifically designed for constructing cast-in-place concrete parapet rail, provided the finished barrier is true to line and grade and the concrete is properly consolidated.

(b) Permanent Steel Deck Forms. An approved type of galvanized steel form, complying with the requirements shown on the plans and these specifications, may be used as an alternate to conventional removable forms for forming the bridge deck between the exterior beams or girders. These forms shall be designed to provide not less than the minimum concrete cover shown on the plans for all reinforcing bars in the bottom of the slabs. The effective design depth of slab shall be maintained over the entire area of the deck. Provision shall be made to provide encasement of top flanges of beams or girders in compression except where shear connectors are provided.

Detailed plans of proposed permanent steel deck forms shall be submitted to and approved by the Engineer before work of forming the bridge deck is started. The approval of the Contractor's plans shall not be considered as relieving the Contractor of any responsibility for the results obtained by the use of these approved plans. Construction shall be according to the approved plans.

All material and elements of the permanent steel deck form units shall be fabricated from steel conforming to ASTM A653/A653M, Structural Steel (SS), Grades 33,37,40,50 Class 1 or 2, or 80, having a coating class of G165 [Structural Steel(SS), Grades 230, 255, 275, 340 Class 1 or 2, or 550, having a coating class of Z350]. Thickness and grade of form sheets and form supports shall be as designated on the shop drawings. In no case shall thicknesses be less than 22 gage for sheets and 16 gage for form supports. The Contractor shall provide a manufacturer's certification indicating compliance with the above requirements and Section 106.

Permanent steel forms shall be designed on the basis of the dead load of the form, reinforcement, and the plastic concrete, plus 50 psf (245 kg/sq m) for construction loads. Unit working stresses shall be according to the standard specifications for construction loads and the unit stress in the steel sheet shall be not more than 0.725 of the

specified minimum yield strength of the material furnished, but not to exceed 36,000 psi (250 MPa). Maximum deflection shall be calculated using the weight of plastic concrete, reinforcement, and forms, or 120 psf (585 kg/sq m), whichever is greater. Maximum deflection shall not exceed 1/180 of the form span or 1/2" (12 mm), whichever is less. The form span for design and deflection shall be the clear distance between supports plus 2" (50 mm), but not less than the clear distance between the flanges of the supporting beams less 4" (100 mm) measured parallel to the form flutes.

Physical design properties shall be computed according to requirements of the latest edition of *AISI Specifications for the Design of Cold-Formed Steel Structural Members*.

All reinforcement shall have a minimum concrete cover of 1" (25 mm). Bars in the bottom layer of the main reinforcement shall be approximately centered over the valleys of the forms when necessary to achieve the minimum 1" (25 mm) concrete cover. The distance from the top of the slab to the bottom layer of main slab reinforcement shall be not less than that shown on the plans.

Permanent steel forms used in panels where longitudinal slab construction joints are located between stringers must provide adequate structural capacity without excessive deflections. Adequate external support of forms at the joint must be provided to assure that the forms do not separate from the hardened concrete.

All forms shall be installed according to detailed fabrication plans submitted to the Engineer for approval. The fabrication plans shall clearly indicate locations and methods of attachment where the forms are supported by steel beam flanges subject to tensile stresses and without shear connectors.

Form sheets shall not be permitted to rest directly on the top of the stringer or floor beam flanges. Sheets shall be securely fastened to form supports and shall have a minimum bearing length of 1" (25 mm) at each end. Form supports shall be placed in direct contact with the flange of stringer or floor beam. All attachments shall be made by welds, bolts, clips, or other approved means. However, welding of form supports to flanges of steels other than AASHTO M 270, Grades 36 (250), 50 (345), or 50W (345W) of a weldable grade, and to those portions of a flange subject to tensile stresses will not be permitted except as provided for in the plans. Welding shall be accomplished by certified welders and according

to Subsection 807.26 except that 1/8" (3 mm) fillet welds will be permitted.

Provisions shall be made to keep the panels at an acceptable temperature before placement of concrete.

Calcium Chloride or any other admixture containing chloride salts shall not be used in the concrete placed on permanent steel deck forms.

After the deck concrete has been placed for a minimum of 2 days, the following inspection procedure shall be followed:

The forms shall be tested for soundness of the concrete and bonding of the forms to the concrete by striking the form a sharp blow with a geologist hammer. As a minimum, the forms shall be struck at 10' (3 m) intervals parallel to and 6" (150 mm) from the edge of the steel beam, and at 10' (3 m) intervals along the centerline of each bay between the beams in an X pattern with those along the beams, and at random points on a semicircle or circle, as applicable, with approximately 2' (0.5 m) radius from the above points. They shall be struck in other places as directed by the Engineer to define any suspicious or defective area. Areas where efflorescence is evident shall be thoroughly investigated.

The Contractor shall furnish all facilities such as ladders, scaffolding, etc., that will provide for a thorough inspection of the forms.

The striking of the forms shall be accomplished in such a manner and at a time that the sound is clearly audible. Properly bonded sheets attached to sound concrete will emit a clear ring when struck a sharp blow with a hammer. Honeycomb concrete and/or unbonded areas will give a different sound such as a thud or clatter. The forms shall be removed full width between beams wherever the Engineer suspects that honeycomb or unbonded areas exist so that the Engineer may make a visual examination of the concrete surface. Any defective concrete shall be repaired to match the adjacent concrete to the satisfaction of the Engineer.

The amount of sounding and form removal may be reduced, at the Engineer's discretion, after a substantial amount of slab has been constructed and inspected, if the Contractor's methods of construction and the results of the inspections as outlined above indicate that sound concrete is being obtained throughout.

If the Contractor varies his procedures significantly, the initial inspection procedure shall be used to verify that the new conditions are yielding desirable results.

Any forms that must be removed because of unsatisfactory test results shall be removed by a metal saw or air-carbon-arc gouging with minimum damage to the concrete. The cut in forms parallel to the corrugations shall be located in a non-horizontal lap section of the corrugation. The cuts parallel to the beam shall be through the supporting angles taking care not to damage the structural steel beams.

All concrete that is found defective or is damaged in removing a section of the form for inspection shall be repaired to match the adjacent concrete in section and color. All repair work shall be completed to the satisfaction of the Engineer.

Payment for forms will be made and fully covered under the unit price bid for superstructure concrete. No direct or additional payment of any kind will be made because of the use of these forms. Payment will be made for Class S(AE) Concrete in place in the bridge decks on the basis of the thickness specified on the plans, not including any excess thickness used and not including any concrete in portions of haunches that may be omitted because of the use of these forms.

802.15 Removal of Falsework and Forms. In the determination of the time for the removal of falsework and forms and the discontinuance of heating, consideration shall be given to the location and character of the structure, the weather and other conditions influencing the setting of the concrete, and the materials used in the mix.

Removal of falsework and forms shall be according to the following schedule:

Item	Minimum Time	Strength Requirement
Bottom Forms for Deck Slabs, Beams, and Caps	7 Days	Min. Spec.
Top Slabs of RC Box Culverts	7 Days	80% Spec.
Forms for Columns and Vertical Walls	24 Hours	N/A
Side Forms for Footings, Beams, and Caps	12 Hours	N/A
Side Forms for Parapets, Median Barriers, and Curb Faces	6 Hours	N/A