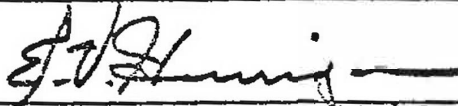


<b>TO:</b> <b>MODIFIED BY EI 85-030</b> <b>EFFECTIVE 5/7/85</b>  <b>SUPERSEDED BY EB 97-020</b> <b>EFFECTIVE 4/4/97</b>	<h1>ENGINEERING INSTRUCTION</h1> <p>NEW YORK STATE DEPARTMENT OF TRANSPORTATION</p>
<b>Distribution:</b> <input checked="" type="checkbox"/> Main Office <input checked="" type="checkbox"/> Regions <input checked="" type="checkbox"/> Special	<b>SUBJECT:</b> BRIDGE DECK FORM SYSTEMS  <b>Subject Code:</b> 7.35-8, Technical Policy And Procedures Manual
<b>APPROVED:</b>  <hr/> E. V. Hourigan, Deputy Chief Engineer (Structures)	<b>Code:</b> EI 82-22 <b>Date:</b> 4/6/82 <b>Supersedes:</b>

This Engineering Instruction deals with the preparation of that portion of the Contract Documents relating to deck forming systems for bridges.

### I. BACKGROUND

For the past several years, the deck forming system of a bridge was selected at the time the superstructure was being designed. Generally, the choice was between removable wooden forms and permanent corrugated metal forms. The choice was made by the Designer because of the need when designing the superstructure to provide for the extra dead load contributed by the permanent corrugated metal forms and the concrete in the corrugations of these forms.

This procedure is considered undesirable because the Designer is required to make the deck forming decision without knowledge of the relative economy of the options, while the Contractor, who is in a better position to know which is least costly, is prevented from making that decision. This deficiency can be overcome by allowing an optional form system provided that two superstructures are designed, one for forming systems which do not increase dead load and one for those that do. Two superstructure designs are generally only required for steel stringer superstructures, because only this type of superstructure is sensitive to the two dead load conditions.

When concrete stringers are used as the superstructure support, the dead load of the stringer is so great that the dead load of the forming system has no significant affect to the design.

In addition to removable and permanent corrugated metal forms, a third type of deck forming system has been developed for use. It is a prestressed concrete slab which acts as a form and also functions as the lower part of the structural deck, resulting in no increase in dead load.

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## II. ACTION

The Contract Documents shall be prepared so as to allow the Contractor the choice of three deck forming systems. This will be accomplished by designing and detailing two steel stringer superstructures for each location. One superstructure will be designed using conventional slab dead loads, and will be used by the Contractor when removable or prestressed concrete forms are elected. The second superstructure will be designed using the additional dead load of the metal forms and the concrete in their corrugations (16 PSF) and be used when a permanent corrugated metal form system is elected.

Because of the benefits which accrue with the use of an optional form specification, the optional form concept will be used in rehabilitation work if at all possible. Each bridge to be rehabilitated shall be evaluated to determine the suitability of a two-way or three-way option, considering whether or not stage construction is to be used, and the effect of added dead load on the structure. Should the use of permanent corrugated metal forms result in overstress of the superstructure, permanent metal forms may be used only if concrete is prevented from filling the corrugations, or the superstructure is strengthened to compensate for the extra load. Generally, strengthening to allow optional forms will not be economical, and should only be considered when strengthening is also required to improve the capacity of the bridge for live load.

The depth of stringer for both designs shall be the same, and only the flange widths may vary. On rare occasions, a change in web thickness may be necessary because of differences in design loads. All other details (bearings, stiffeners, etc.) shall be based on the heavier stringer design. The tables for camber, moments, and shears are to be shown for the heavier stringer design only. Top flange widths for stringers shall not be less than 12 inches in order to accommodate prestressed concrete forms.

If the forming system is to span less than 5'-0", or more than 10'-9", the prestressed concrete forms shall not be used.

Figure #1 gives an example of the general fashion in which built-up stringers should be detailed where optional form systems are allowed. In particular, note how the two designs for each stringer are shown. This example is intended as a guide, but may be used as shown. Obviously, modifications are necessary for continuous and/or curved stringers, but the concept should remain the same.

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- II. Decks shall be detailed for removable forms with typical (standard) details inserted in the plans for the other forming options. The details now used when permanent corrugated metal forms are specified shall be placed on the plans when permanent corrugated metal forms are included as an option. Bridge Design Data (BDD) Sheets containing typical details to be used when prestressed forms are allowed are attached to this Engineering Instruction.

The following instructions pertain to the use of Prestressed Form BDD Sheets:

1. There are five BDD Sheets pertaining to Prestressed Concrete Form Units, as follows:
  - BDD 82-95A, "Prestressed Concrete Form Units, Straight Girder Layout, (For Skews 30° & Under)."
  - BDD 82-95B, "Prestressed Concrete Form Units, Curved Girder Layout, (For Skews 30° & Under)."
  - BDD 82-95C, "Prestressed Concrete Form Units, Straight Girder Layout, (For Skews Over 30°)."
  - BDD 82-95D, "Prestressed Concrete Form Units, Curved Girder Layout, (For Skews Over 30°)."
  - BDD 82-95E, "Prestressed Concrete Form Units, Typical Details."
2. The plans for each structure containing prestressed concrete forms as an option will require at least two of the five sheets; one of the first four layout sheets and the last sheet, showing the typical form details. On occasion, because of the configuration of the bridge, it may be necessary to use all four "Layout" sheets.
3. The four "Layout" sheets will require the following additions prior to insertion into the Contract Plans:
  - a. The reinforcing bars marked A through F shall be identified with the bar marks for the specific bridge.
  - b. The note on the plans referring to Bars A through F shall be removed.
  - c. Cross reference drawing numbers shall be added, where needed.
  - d. The project title and number shall be added.

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II. Bridge deck forms shall be specified by use of Item No. 15555.04 - Structural Slab Concrete (Optional Forming Systems). This specification must be accompanied by Item No. 718.05 - Prestressed Concrete Form Units. These items will be stocked as Main Office inserts. Copies of each specification are attached. It should be noted that Item No. 15555.04 allows the Contractor to use any one of the three form systems. If the Designer wishes to limit the types of form systems to be allowed, it must be done via a note in the General Notes on the Contract Plans.

The following details should be noted regarding Item No. 15555.04:

1. Item No. 15555.04 includes the payment for bar reinforcement as part of the structural slab. Bar reinforcement for the structural slab, therefore, will not appear in the Estimate Of Quantities.
2. Item No. 15555.04 is referenced to the following Standard Specification Items: 555, 556, and 557.
3. Item No. 15555.04 contains certain restrictions with regard to areas of a span which must be formed with removable forms. Designers should familiarize themselves with those restrictions.
4. Subsection 718-05 is related to, and referenced to, Subsection 718-01.

Effective with the receipt of this instruction, projects to be let on August 5, 1982, (P.S. & E. - May 13, 1982), or later, shall not use the following standard pay items for structural slab work, unless a waiver of Item No. 15555.04 has been obtained from the Deputy Chief Engineer (Structures):

1. Item No. 555.0401 - Concrete For Structures, Class E (Structural Slab With Integral Wearing Surface - Bottom Formwork Required).
2. Item No. 555.0403 - Concrete For Structures, Class E (Structural Slab - Separate Wearing Surface).

If the Designer believes that the three-form system option is inappropriate for a given bridge, a request for a waiver of this policy shall be made to the Deputy Chief Engineer (Structures).

The structural steel estimate for a bridge with optional forms specified shall be based on the use of removable forms. There should be very few projects where the structural steel is bid on a per pound basis. The material transmitted with this issuance has been prepared assuming structural steel will be bid as a lump sum. If it is to be bid on a per pound basis, contact the Special Design Unit for special notes needed in the plans.

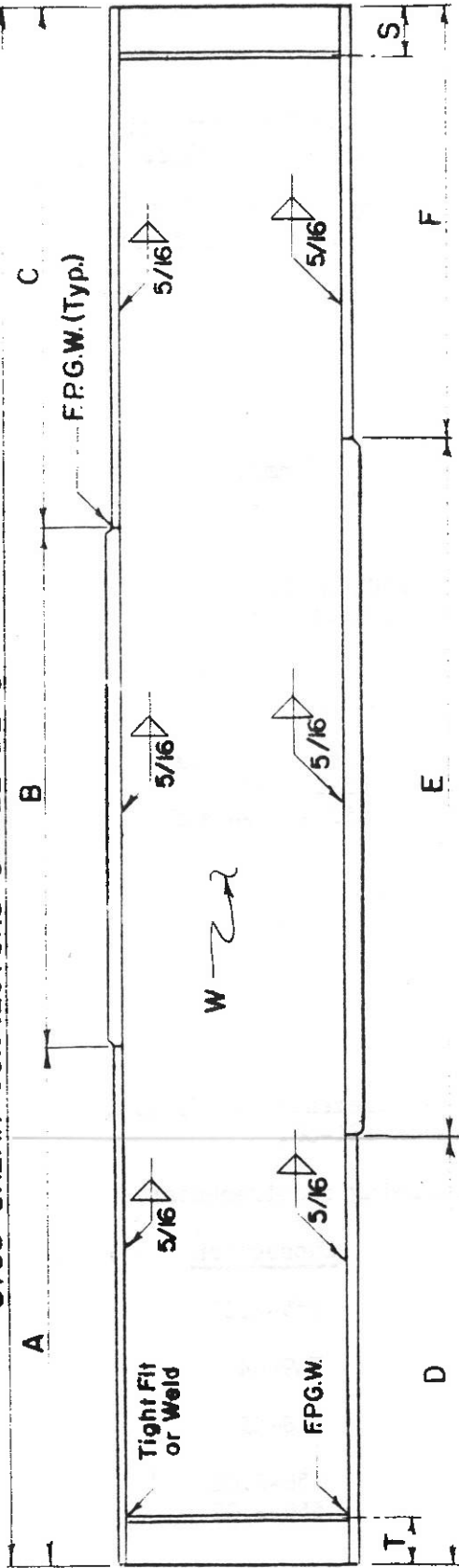
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II. Persons responsible for checking fabrication drawings for structural steel must determine the type of form system being used by the Contractor in order to check the drawings.

The use of optional deck forming systems shall start with the Letting of August 5, 1982. If you have any questions regarding this policy, contact the Special Design Unit of the Structures Division at 518-457-2459.

Attachments

STUD SHEAR CONNECTORS SHALL BE SPACED ON 'X' CTRS



STRINGER ELEVATION

NOTE: SEE FRAMING PLAN FOR LOCATION OF CONNECTION PLATES AND INTERMEDIATE STIFFENERS.

Span	Str. Mark	Deck Form Type	TOP FLANGE			BOTTOM FLANGE			WEB W	X (in)	TOTAL NO OF STUDS	SIZE INTER STIFF.	SIZE CONN. PLATES	SIZE BEAR'G STIFF.
			A	B	C	D	E	F						
1	G1	1	12 $\frac{3}{4}$ x 25-6	13-1 x 40-0	12 $\frac{3}{4}$ x 25-6	15-1 x 20-0	15-1 x 51-0	15-1 x 20-0	42 x $\frac{3}{8}$	4 $\frac{1}{2}$	490	5 x $\frac{3}{8}$	7 x $\frac{1}{2}$	7 x $\frac{1}{8}$
1	G1	2	13 $\frac{3}{4}$ x 25-6	15-1 x 40-0	13 $\frac{3}{4}$ x 25-6	16-1 x 20-0	16-1 x 51-0	16-1 x 20-0	42 x $\frac{3}{8}$	4 $\frac{1}{2}$	490	5 x $\frac{3}{8}$	7 x $\frac{1}{2}$	7 x $\frac{1}{8}$
2	G2	1	14-1 x 40-0	16 $\frac{3}{4}$ x 55-0	14-1 x 40-0	17-1 x 39-0	17-1 x 57-0	17-1 x 39-0	42 x $\frac{7}{16}$	4 $\frac{5}{8}$	658	6 x $\frac{7}{16}$	7 x $\frac{1}{2}$	7 x $\frac{1}{8}$
2	G2	2	15-1 x 40-0	17 $\frac{1}{4}$ x 55-0	15-1 x 40-0	18-1 x 39-0	18-1 x 57-0	18-1 x 39-0	42 x $\frac{7}{16}$	4 $\frac{5}{8}$	658	6 x $\frac{7}{16}$	7 x $\frac{1}{2}$	7 x $\frac{1}{8}$
2	G3	1												
2	G3	2												

\*- TYPE 1 forms are removable or integral prestressed concrete.  
 TYPE 2 forms are permanent corrugated metal.

FIGURE #1

ITEM 15555.04 - STRUCTURAL SLAB CONCRETE  
(OPTIONAL FORMING SYSTEMS)

DESCRIPTION. The work shall consist of furnishing and placing portland cement concrete and reinforcing steel to construct a structural slab.

Unless otherwise noted on the plans, the contractor may use any of the following forming systems to form the underside of the structural slab:

1. Removable forms
2. Permanent corrugated metal forms
3. Prestressed concrete form units.

The following restrictions shall apply:

- A. Fascia overhangs shall be formed with removable forms. The forms used shall leave the resulting concrete flat surfaced.
- B. A bay, constructed in stages such that a longitudinal joint is required, shall be formed with removable forms.
- C. A beam which rests upon an end diaphragm shall be formed with removable, or permanent corrugated metal, forms.
- D. Prestressed concrete form units shall not be used where the design span is less than 5'-0" nor greater than 10'-0". The design span is equal to the beam spacing minus one-half the top flange width.
- E. Prestressed concrete form units may be restricted at the ends of some narrow spans. Refer to the plans for detail.

The brushing and oiling of reinforcing steel will be part of this work.

1. Concrete. This shall meet the material requirements for Class E (or allowable class options) as set forth in 501-00.
2. Other Materials. These shall meet the following requirements:

<u>Material</u>	<u>Subsection</u>
All material listed under subsection 555-2.01	555-2.01
Epoxy coated bar reinforcement	709-04
Prestressed concrete form units	718-05
Chairs, tie wires, and other devices used to position reinforcing steel	556-2.01 556-2.02

CONSTRUCTION DETAILS

1. Concrete Manufacturing and Transportation.

The requirements of subsection 555-3.01 shall apply.

2. Falsework. The requirements of subsection 555-3.02 shall apply.

3. Forms.

- a. Removable Forms: The requirements of 555-3.03A and 555-3.03B shall apply.
- b. Permanent Corrugated Metal Forms: The requirements of 555-303A and 555-303C shall apply.
- c. Prestressed Concrete Form Units: The requirements of 555-3.03A; 557-3.01; 557-3.02; 557-3.03A and 557.3.03B shall apply.

Form supports shall be placed in direct contact with the flange of the stringer. All attachments shall be made by permissible welds, bolts, or other means approved by the Engineer. The welding of form supports to steel not considered weldable, or to portions of flanges subject to tensile stresses will not be permitted. Welds and welding shall be in accordance with those portions of the New York State Steel Construction Manual concerned with fillet weld design, fillet weld details; general workmanship and technique, except that 1/8 inch fillet welds will be permitted. All welding shall be performed by a New York State Department of Transportation Certified Welder whose qualifications permit him to do the work.

4. Placing and Fastening Reinforcing Steel.

- a. Removable Forms and Permanent Corrugated Metal Forms. The requirements of subsection 556-3.01 and 556-3.02 shall apply.
- b. Prestressed Concrete Form Units. The requirements of subsections 556-3.01 and 556-3.02 shall apply, except that the second paragraph of 556-3.02E which begins with "The structural..." and ends with "...of concrete." shall not apply. The following shall apply instead: "The top reinforcing steel mat shall be securely connected to the forms and the stud shear connectors. Connections shall be placed no farther apart than 4'-0" on centers. Connections to the forms may be made to the form lifting devices, reinforcing steel projecting from the forms, or devices in the form supplied for this purpose. Hold down devices shot into the form will not be permitted. Connections shall neither deflect the reinforcing steel, nor interfere with the smooth flow of concrete.

5. Handling and Placing Structural Slab Concrete. The requirements of 555-3.04 shall apply.

6. Provisions for Concreting in Cold Weather. The requirements of 555-3.06A and 555-3.06B shall apply.

7. Cold Joints. "Cold Jointing", that is, the bonding of fresh concrete to set concrete, will be allowed only where indicated on the plans, or where approved by the DCES. For the purpose of this specification, the plane formed between prestressed concrete form units, and subsequent portland cement concrete placements, is not considered a cold joint.

When cold jointing, the concrete in place shall have its surface cut over with a suitable tool to remove all loose and foreign materials. This surface shall be scrubbed with wire brooms and kept clean. Immediately before placing the new concrete, the forms shall be drawn tightly against the concrete in place. The existing concrete surface shall be coated thoroughly with a thin coating of 1:1 mortar, or neat cement paste, thoroughly brushed into the surface.

The mortar shall be worked into the prepared surface by means of stiff brushes, or other methods acceptable to the Engineer. Mortar shall not be allowed to begin to dry. If drying does begin to occur, as evidenced by a light grey color, prior to concrete placement, the Engineer shall order the mortar to be completely removed and new mortar placed at no additional cost to the State.

8. Finishing Integral Wearing Surfaces: The requirements of subsection 555-3.08D shall apply.

9. Finishing Surfaces to be Overlaid with Portland Cement, or Asphalt, Concrete: Finishing of these surfaces shall be done by mechanical means except in areas which are inaccessible to a mechanical screeding operation. The equipment shall be approved by the Engineer prior to use.

Surfaces shall be screeded to a surface tolerance of 3/8 of an inch in ten (10) feet. The surface tolerance shall be verified by the Engineer with an approved straight edge not less than ten (10) feet long. The straight edge shall be furnished by the Contractor who shall maintain it in good condition at the paving site at all times.

Hand screeding when required, shall be performed in such a manner as to produce the same surface quality and uniformity as that produced by mechanical screeding. Finishing screeds shall be 10 inches or more in width and the contacting surfaces shall be steel. Hand-operated equipment shall be used in such a manner as to duplicate the action of a mechanical screed. Hand-screeding shall be performed in the same sequence and manner as mechanical screeding unless otherwise directed by the Engineer.

10. Curing: The requirements and allowances of subsection 555-3.09 shall apply.

11. Damaged or Defective Concrete: Damaged, or defective, concrete shall be defined by, and repaired in accordance with, the requirements of Section 502, Portland Cement Concrete Pavement, and subsection 502-3.15, Defective or Damaged Concrete. Epoxy mortar made from Item 721-05, Epoxy Repair Paste, shall be used for patching vertical or overhead surfaces.

METHOD OF MEASUREMENT:

The requirements of subsection 555-4.02 shall apply.

BASIS OF PAYMENT

The terms of subsection 555-5.03 shall apply with the following modifications:

1. The cost of furnishing and placing bar reinforcement will be paid for under this item.
2. Partial payment, in accordance with the terms of subsection 109-04, may be made for bar reinforcement in the cast-in-place concrete portion of the structural slab. Partial payment may be made for Precast concrete form units, provided they have received the Inspector's stamp of approval, as required under "Basis of Acceptance" under subsection 718-01.
3. Progress payments will be made on a per-span basis as follows:
  - a. Forty(40) percent of the estimated square footage (less the cost of partial payments made for materials) will be paid for after all reinforcing is properly placed, to the satisfaction of the Engineer.
  - b. An additional fifty(50) percent of the estimated square footage (less the cost of partial payments made for materials) will be paid for after the concrete has been placed and curing applications have been instituted. Both placement and curing operations shall meet with the approval of the Engineer prior to payment authorization.
  - c. The remainder will be paid for after completion of all curing, and necessary corrective work.

## ITEM 718-05 - PRESTRESSED CONCRETE FORM UNITS

### SCOPE:

This specification contains the requirements for prestressed concrete form units.

These units are used to form the lower portion of a structural slab. They act compositely with the cast-in-place portion of the slab and become an integral part of the structural slab.

### GENERAL:

Materials specification 718-01, Prestressed Concrete Units (Structural) shall apply with the following modifications:

Under REINFORCEMENT AND PRESTRESSING STEEL, Page 7-149, add the following as the last paragraph:

"Devices which will be used as hold-down points for outside reinforcing steel shall be placed prior to concrete placement in the forms. Devices used to lift the units are acceptable for this purpose. The maximum spacing between hold-down devices shall be 4'-0" center-to-center of device."

Under FINISHING, Page 7-150, first paragraph, fourth line: The words "...the tops" of units shall be magnesium float finished..." shall not apply.

### Under CONCRETE STRENGTH REQUIREMENTS:

1. Test Cylinders, subsection "A", second paragraph, Page 7-151. Add the following as the last sentence: "All cylinders used to test for concrete strength shall be cured in the same manner as the units they represent unless otherwise indicated on the Working Drawings."

2. Testing For Concrete Strength, Delete this section in its entirety and substitute the following:

The strength requirements for each day's production shall be certified by the Contractor before that day's production is accepted for strength. Certification shall be done in accordance with the terms of this subsection. All cylinders cast shall be cast in sets of three. One set shall be cast from the first concrete placement of the day. One set shall be cast from the last concrete placement of the day. In addition to those, there shall be a set cast for each ten cubic yards of concrete, or major fraction thereof, placed in any one day.

A. Transfer Strength: Three cylinders from each day's production shall be tested in immediate succession to verify prestress transfer strength. One cylinder shall be taken from the first set cast; one cylinder shall be taken from the last set cast. The strength of each cylinder shall be at least 95 percent of the required prestress transfer strength. The average strength of the three cylinders shall be equal to, or greater than, the required prestress transfer strength.

Item 718-05 - Prestressed Concrete Form Units (Continued)

- B. 28-Day Strength: Three (3) cylinders representing each day's production shall be tested in immediate succession at twenty-eight (28) days of age to verify the required 28-day strength. The strength of each cylinder shall be at least ninety-five (95) percent of the required 28-day strength. The average strength of the three cylinders shall be equal to, or greater than, the required 28-day strength. If these requirements are not met, any remaining cylinders representing the day's production shall also be tested at 28 days of age. The average strength of all cylinders representing the 28-day strength of any one day's production shall be equal to, or greater than, the required 28-day strength.
- C. Option: The Contractor may test three (3) cylinders, representing each day's production in immediate succession, prior to the 28-day age limit. Each cylinder shall have a strength of at least ninety-five (95) percent of the required 28-day strength. The average strength of the three cylinders shall be equal to, or greater than, the required 28-day strength. If these requirements are met, the cylinder test at 28 days of age shall be waived. If this option is exercised, sufficient cylinders shall be made to ensure that at least 3 cylinders are available for the 28-day test.

Under REJECTION OF UNITS, Page 7-151: This subsection which begins with the words, "Any unit not fabricated..." and ends with the words "... of an inch in width." shall not apply.

The following shall apply:

REJECTION OF UNITS: Any unit not fabricated in accordance with the Contract Documents, or displaying any of the following defects, shall be subject to rejection:

1. Strength Requirements: Any unit represented by cylinders not meeting the required strengths, as specified in Concrete Strength Requirements, of this specification.
2. Exposed Prestressing Steel: Any unit which exhibits one or more exposed prestressing strand(s) on a top or bottom surface.
3. Honeycombing: Honeycombing of the unit to such an extent that chipping away from the honeycombed concrete results in the exposure of one, or more, prestressing strands on a top, or bottom, surface.

All honeycombed areas shall be chipped until sound concrete is reached. Sound concrete is defined as that point at which chipping causes fracture of the aggregates. If chipping of the honeycombed portion results in a hole more than one-half the thickness of the unit, the unit will be rejected.

Item 718-05 - Prestressed Concrete Form Units (Continued)

4. Cracks: Any unit which exhibits a crack that is greater than one-half inch (1/2") in depth, and twenty-five ten thousandths of an inch (.0025") in width.

Under DAMAGED UNITS, Page 7-152: The subparagraph titled "Repair" shall not apply.

The following shall apply:

Repair: Repair, if allowed by the DCES, shall be made with Epoxy Repair Paste (721-05). Epoxy repair paste shall be mixed and placed in strict accordance with the manufacturer's instructions.

Form Supports: Form supports for installation of the units shall be supplied as part of this work. They shall conform to the latest specification for ASTM A446, Grades A through E. Fabrication shall be in conformance with ASTM A525, Coating Class G165.

The Contractor shall supply the Engineer with certification that the form supports meet the foregoing requirements.

Under TOLERANCES, Page 7-153. The requirements of this subsection shall not apply.

The following shall apply:

Tolerances: All units shall be checked for compliance with the tolerances listed below, after the units have completed the FINAL CURING PHASE and within three (3) days prior to shipping. The Inspector shall document to the DCES any unit with dimensions out of tolerance. Any unit which fails to meet these tolerances shall be rejected with the concurrence of the DCES.

Finished Dimensions

\*Width  $\pm$  1/4 inch  
Length  $\pm$  1/2 inch  
Depth  $\pm$  1/4 inch

Position of Strands

Vertical  $\pm$  1/4 inch  
Horizontal  $\pm$  1/2 inch

\*Width is defined as the dimension measured parallel to the prestressing strands.