



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

ROADWAY DESIGN UNIT RECEIVED FILE		
JUL 11 2005		
<input checked="" type="checkbox"/> DESIGN	<input checked="" type="checkbox"/> DRAWING	<input checked="" type="checkbox"/> CHECK
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MICHAEL F. EASLEY
GOVERNOR

cc

MEMORANDUM TO: Project Engineers
Project Design Engineers

FROM: G. R. Perfetti, P. E.
State Bridge Design Engineer *A.R. Perfetti GM.*

DATE: July 11, 2005

SUBJECT: BOX BEAM GUIDELINES

General

The Structure Design Unit shall consider the use of box beam girder bridges for locations where they are more economical than any other structure type. This policy memorandum presents the design and detailing guidelines for box beam bridges.

Box beams shall be detailed to the dimensions and section properties shown in Figure 6-127, and are to be designed for prestressing with straight strands. For approximate span length limits see Design Manual Figure 11-3. Specify high strength concrete only in spans where required by design. Box beams shall be constructed in a side-by-side layout, similar to the current practice with cored slab bridges.

Box beams may be used for skews between 60° and 120°, and on grades up to 4%. Box beams may be set on caps with a slope of 2% or less. When box beams are used on vertical curves, the 2'-8" (813mm) minimum dimension from the top of the wearing surface to the top of the barrier rail must be maintained.

The attached standards were developed for the use of a concrete overlay. For projects requiring an asphalt overlay, the standards will have to be slightly modified.

Design

For those projects requiring top-down construction or for projects with span arrangements that permit top-down construction, design the box beam units for top-down construction loads. For box beam bridges where none of the span lengths exceed 55'-0" (16.76m) the top-down

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The use of level, unreinforced pads is preferred. The pads shall be designed in accordance with the AASHTO Standard or LRFD Specifications. In general, use 6" (150 mm) by 5/8 inch (16 mm) pads as a minimum and provide 1 1/4" (32 mm) ϕ holes in fixed end bearing pads and 2 1/2" (64 mm) ϕ holes in expansion end bearing pads for #8 (#25) dowels. Dowels shall be 2'-3" (685 mm) long set 1'-0" (300 mm) into the concrete cap. Do not apply epoxy protective coating to the bent caps of prestressed concrete box beam structures.

Detailing

The expansion joints shall be evazote joints with elastomeric concrete. If the thickness of the overlay at the rail is 4 1/2" or more, detail a minimum concrete overlay thickness of 2 1/4" below a 2 1/2" X 5 1/2" blockout. If the thickness of the overlay at the rail is less than 4 1/2", detail a full-depth blockout.

The barrier rail shall be placed such that there is a 1" offset from the edge of the exterior unit to the exterior face of the barrier rail. The barrier rail shall be attached to the exterior units by casting reinforcing steel into the exterior units and pouring the barrier rail after the units are post-tensioned, but prior to placement of the concrete overlay.

When required, a minimum sidewalk width of 5'-0" (1500mm) or 5'-6" (1650mm) shall be used unless otherwise recommended. Place the sidewalk and parapet so the offset from the edge of the exterior unit to the exterior face of the parapet is 1" (25mm). See the attached Figure 6-128. If the overall width is not in an even 3'-0" increment, increase the sidewalk width as necessary and inform the Roadway Project Engineer of any adjustment so the guardrail location, where necessary, can be adjusted accordingly.

Eight standard drawings are available and should be used in plan development.

- PCBB1 - 3'-0" x __'-__" Prestressed Concrete Box Beam Unit
- PCBB2 - 3'-0" x 2'-3" Prestressed Concrete Box Beam Unit
- PCBB3 - 3'-0" x 2'-3" Prestressed Concrete Box Beam Unit
- PCBB4 - 3'-0" x 2'-9" Prestressed Concrete Box Beam Unit
- PCBB5 - 3'-0" x 2'-9" Prestressed Concrete Box Beam Unit
- PCBB6 - 3'-0" x 3'-3" Prestressed Concrete Box Beam Unit
- PCBB7 - 3'-0" x 3'-3" Prestressed Concrete Box Beam Unit
- PCBB8 - 3'-0" x __'-__" Prestressed Concrete Box Beam Unit

See Figure 6-129. A pair of 2" (50 mm) ϕ holes, for the post-tensioning strands, shall be formed through the diaphragm and shall be located symmetrically about the mid-height of the box beam section. The post-tensioning strand shall be seven wire, high strength Grade 270, 0.6" (15.24 mm) ϕ , low-relaxation strands. The anchorage recess for the post-tensioning assembly shall be grouted as shown on the Standard Drawings.

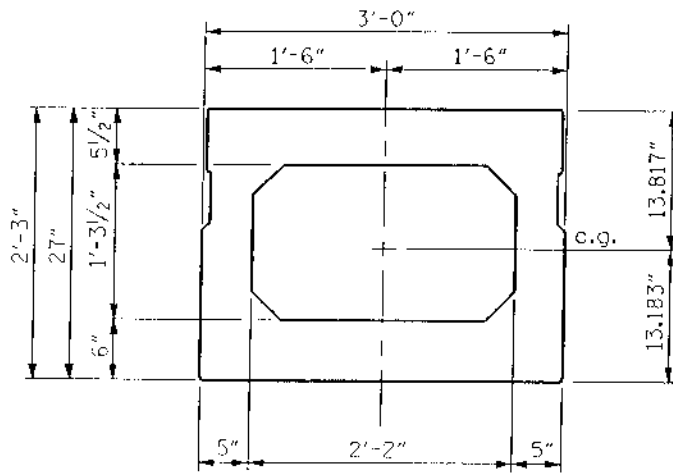
This policy is effective with the October 2005 letting. The Standard Drawings are available via the network drive. The Design Manual will be revised at a later date.

Attachments

Standard Drawings PCBB1-8 (SM)
Design Manual Figures 6-127, 6-128, 6-129, and 6-130

GRP/GM/snj

cc: R. V. Keith, P. E., with attachments
R. A. Raynor, P. E., with attachments
T. S. Drda, P.E., FHWA, with attachments
E. C. Powell, Jr., P. E., Attn: R. Hancock, P. E., with attachments
J. Emerson, P. E., with attachments
D. R. Henderson, P. E., with attachments
J. A. Bennett, P. E., with attachments



27" BOX BEAM

AREA: 574.2 in.²
3.9875 ft.²

WEIGHT: 3.9875 X 150 = 598 lbs/ft.

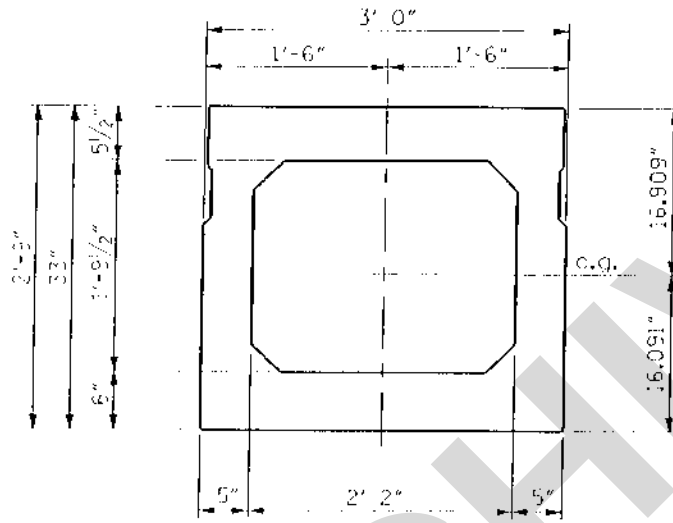
I = 51019 in.⁴

C_T = 13.817 in.

C_B = 13.183 in.

S_T = 3692 in.³

S_B = 3870 in.³



33" BOX BEAM

AREA: 634.2 in.²
4.4042 ft.²

WEIGHT: 4.4042 X 150 = 661 lbs/ft.

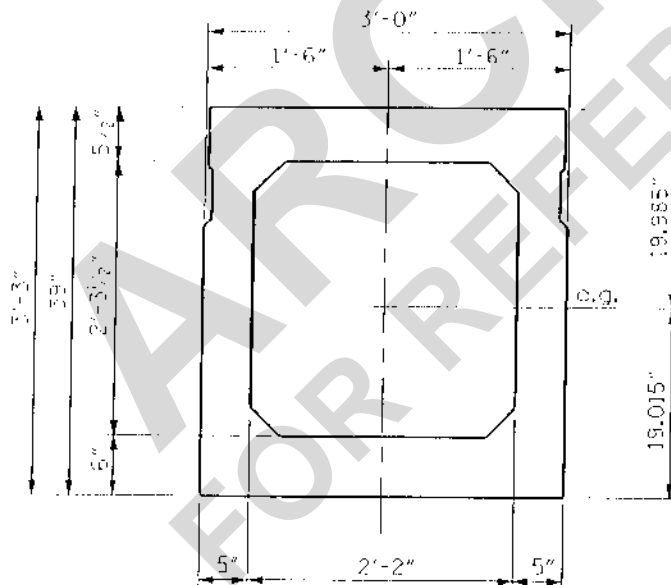
I = 86519 in.⁴

C_T = 16.909 in.

C_B = 16.091 in.

S_T = 5117 in.³

S_B = 5377 in.³



39" BOX BEAM

AREA: 694.2 in.²
4.8208 ft.²

WEIGHT: 4.8208 X 150 = 723 lbs/ft.

I = 133426 in.⁴

C_T = 19.985 in.

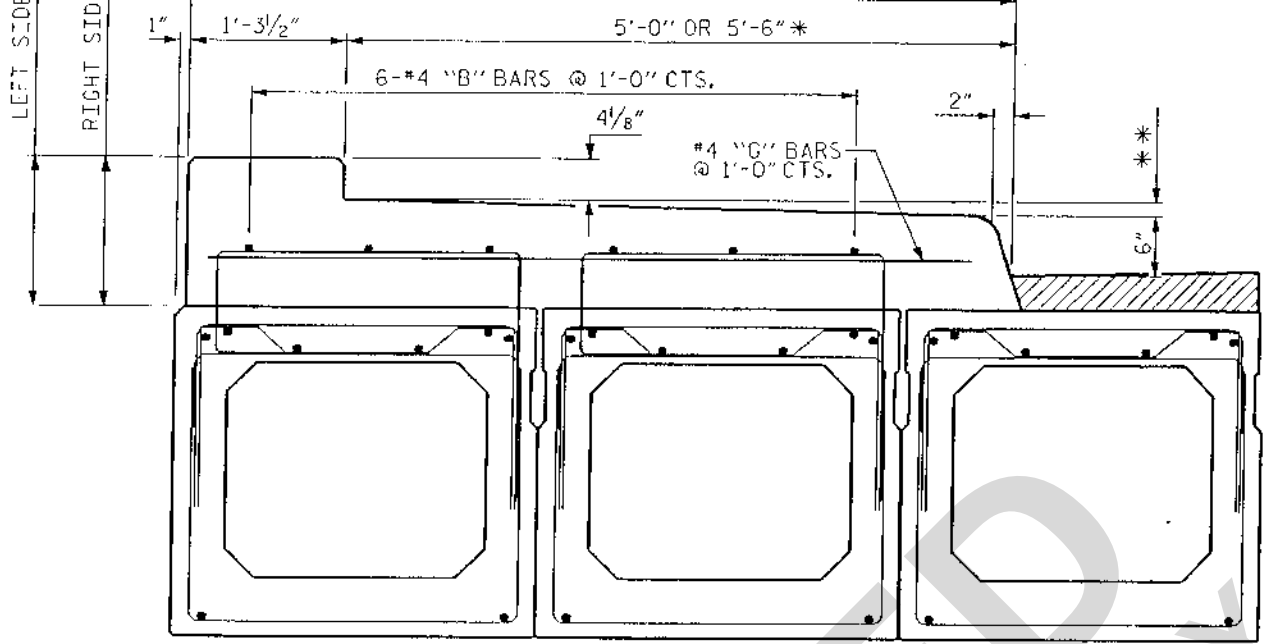
C_B = 19.015 in.

S_T = 6676 in.³

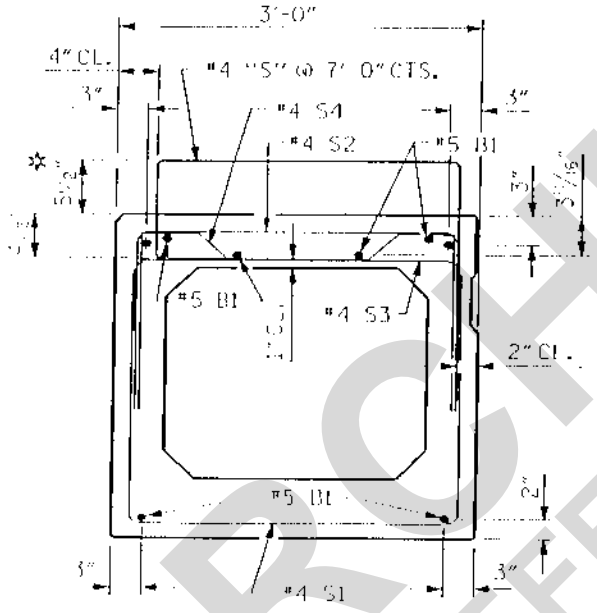
S_B = 7017 in.³

DIMENSIONS, AREA & DESIGN DATA OF
PRESTRESSED CONCRETE BOX BEAMS

FIGURE 6 - 127

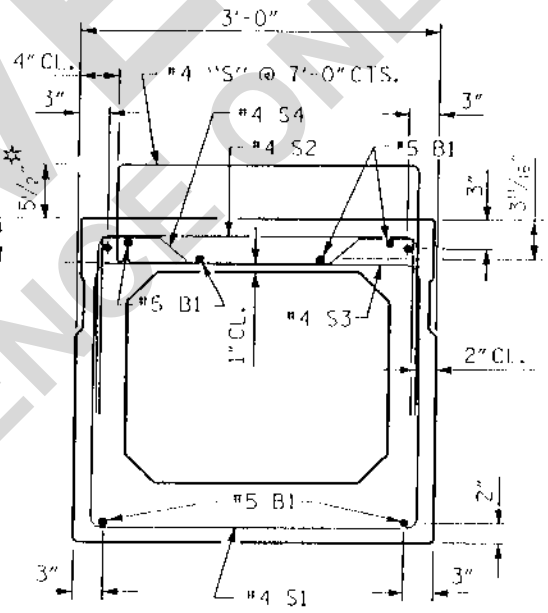


SECTION THROUGH SIDEWALK



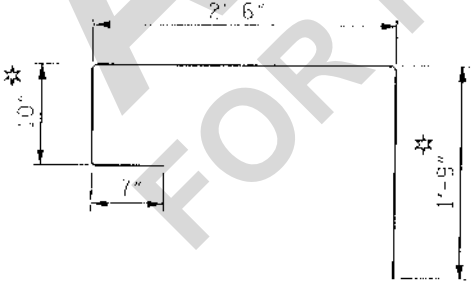
EXTERIOR SLAB SIDEWALK SECTION

STRAND LAYOUT NOT SHOWN
(EXTERIOR SLAB SECTION)



INTERIOR SLAB SIDEWALK SECTION

STRAND LAYOUT NOT SHOWN
(INTERIOR SLAB SECTION ADJACENT
TO EXTERIOR SLAB SECTION)



"S" BAR DETAIL

** 1 1/4" FOR 5'-0" SIDEWALK OR 1 3/8" FOR 5'-6" SIDEWALK.

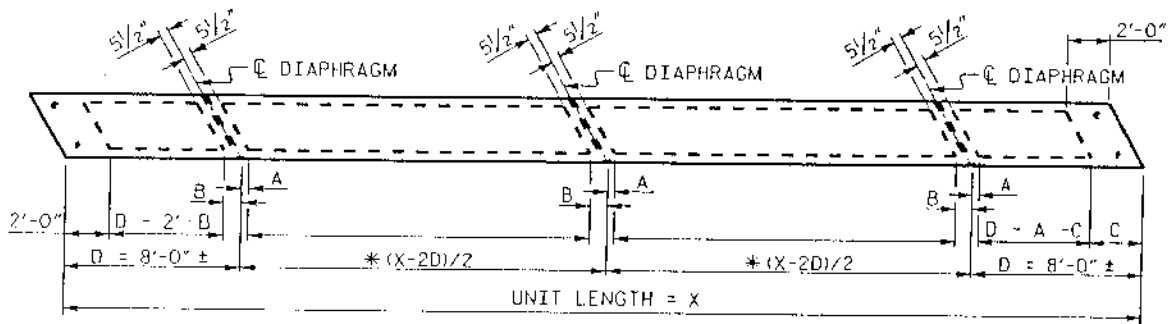
* SIDEWALK WIDTH MAY BE INCREASED AS NECESSARY TO PROVIDE AN OVERALL STRUCTURE WIDTH THAT IS AN EVEN 3 FOOT INCREMENT.

* BASED ON 3/2" WEARING SURFACE. ADJUST ACCORDINGLY.

NOTE ON PLANS:
GROOVED CONTRACTION JOINTS 1/2" IN DEPTH, SHALL BE TOOLED IN ALL EXPOSED FACES OF SIDEWALK IN ACCORDANCE WITH ARTICLE 825-10(B) OF THE STANDARD SPECIFICATIONS. THE CONTRACTION JOINTS SHALL BE LOCATED AT A SPACING OF 8 FEET TO 10 FEET BETWEEN EXPANSION JOINTS. NO CONTRACTION JOINTS WILL BE REQUIRED FOR SEGMENTS LESS THAN 10 FEET IN LENGTH.

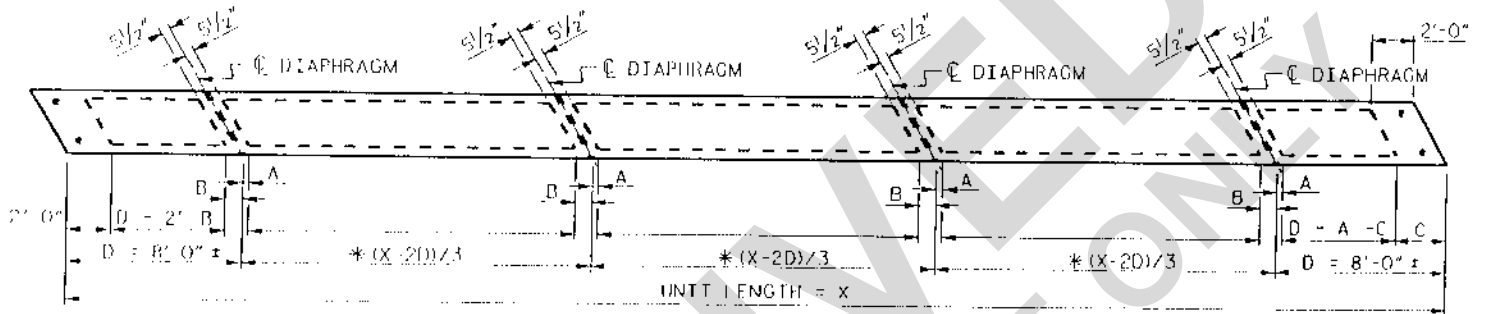
SIDEWALK ON BOX BEAMS

FIGURE 6 - 128



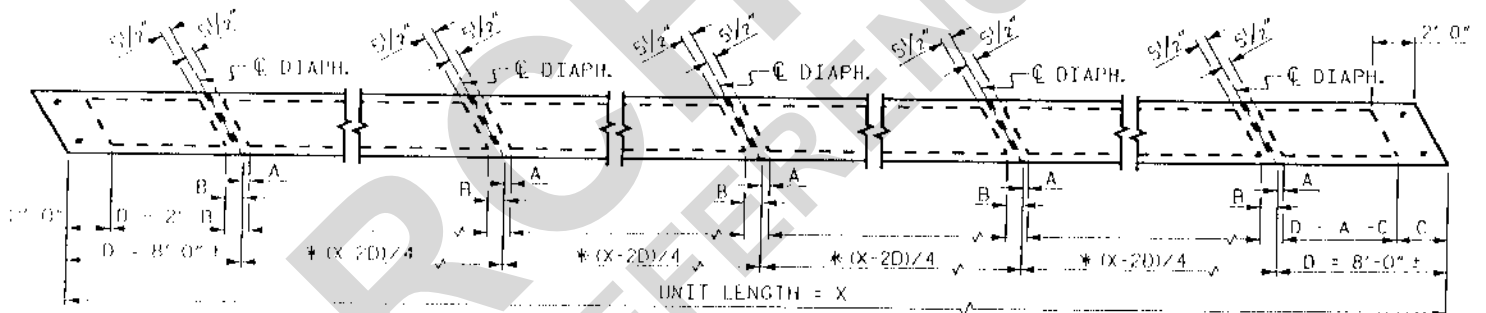
PLAN OF BOX BEAM UNIT - SPAN " "

FOR SPAN LENGTHS $\leq 60'$



PLAN OF BOX BEAM UNIT - SPAN " "

FOR SPAN LENGTHS $> 60'$ AND $\leq 85'$



PLAN OF BOX BEAM UNIT - SPAN " "

FOR SPAN LENGTHS $> 85'$

* ROUND TO THE NEAREST INCH

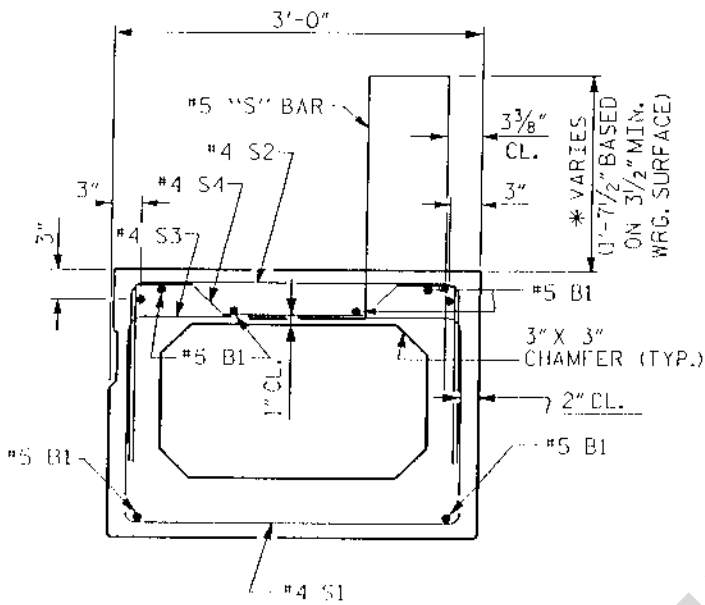
$A = 5\frac{1}{2} / \sin (\text{SKEW}) - 5'' / \text{ABS} [\tan (\text{SKEW})]$ $B = 5\frac{1}{2} / \sin (\text{SKEW}) + 5'' / \text{ABS} [\tan (\text{SKEW})]$ $C = 2' + .8333' / \text{ABS} [\tan (\text{SKEW})]$

ABS = ABSOLUTE VALUE

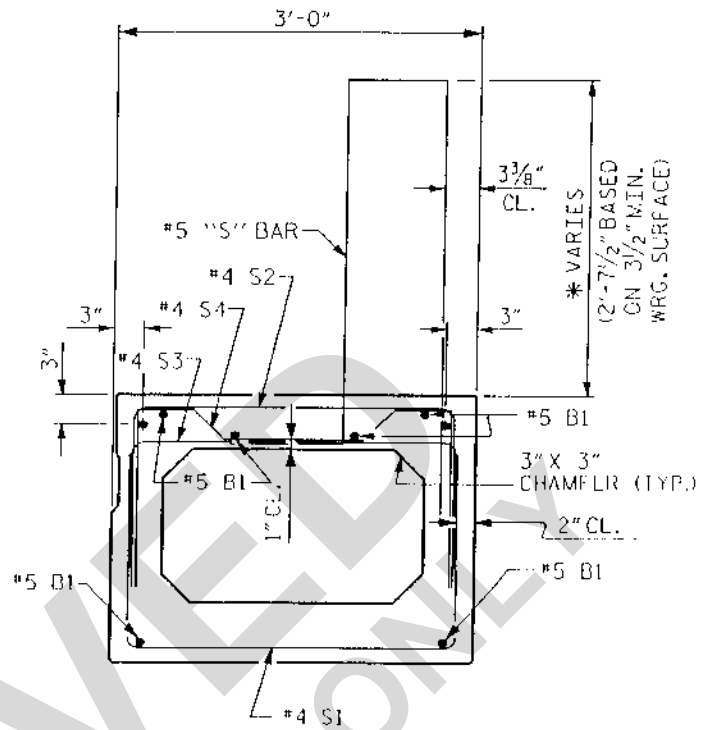
NOTE: DIMENSIONS ARE TO THEORETICAL ACUTE CORNERS AND DO NOT ACCOUNT FOR ANY CHAMFERS THAT MAY BE REQUIRED.

PLAN VIEW OF BOX BEAM SUPERSTRUCTURE UNITS

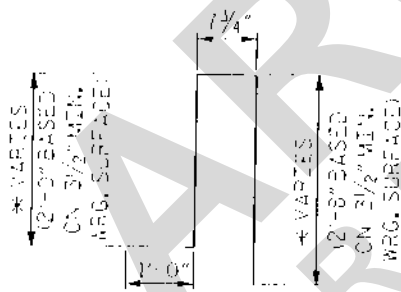
FIGURE 6 - 129



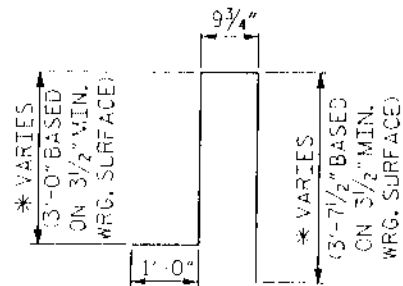
EXTERIOR BOX BEAM SECTION-
ONE BAR METAL RAIL
(STRAND LAYOUT NOT SHOWN)



EXTERIOR BOX BEAM SECTION-
TWO BAR METAL RAIL
(STRAND LAYOUT NOT SHOWN)



'S' BAR DETAIL-
ONE BAR METAL RAIL



'S' BAR DETAIL-
TWO BAR METAL RAIL

ONE AND TWO BAR METAL RAILS ON BOX BEAMS

FIGURE 6 - 130