

**BULB-TEE (BT-72), SINGLE SPAN, COMPOSITE DECK**

9.1a.8.5.4 Stresses from Deck Shrinkage/9.1a.9 Strength Limit State

It is likely, however, that the full calculated force from deck shrinkage will not occur because of the presence of deck cracking and deck reinforcement. **Table 9.1a.8.5.2-1** summarizes the effect of applying 0, 50, or 100% of the calculated deck force on the stresses at load combination Service III.

**Table 9.1a.8.5.4-1**

**Stresses at Midspan for Load Combination Service III Including the Effect of Deck Shrinkage.**

Deck Shrinkage Force, %	Bottom of Beam, ksi Service III
0	+0.127
+50	-0.001
100	-0.128

**9.1a.9 STRENGTH LIMIT STATE**

Total ultimate bending moment for Strength I is:

$$M_u = 1.25(DC) + 1.5(DW) + 1.75(LL + IM)$$

Using the values of unfactored bending moment given in **Tables 9.1a.4-1** and **9.1a.4-2**, the ultimate bending moment at midspan is:

$$M_u = 1.25(1,438.2 + 1,659.6 + 180) + 1.5(360) + 1.75(1,830.3 + 843.3) = 9,316 \text{ ft-kips}$$

Average stress in prestressing strands when  $f_{pe} \geq 0.5 f_{pu}$ :

$$f_{ps} = f_{pu} \left( 1 - k \frac{c}{d_p} \right) \quad \text{[LRFD Eq. 5.7.3.1.1-1]}$$

where

$f_{ps}$  = average stress in prestressing strand, ksi

$f_{pu}$  = specified tensile strength of prestressing strand = 270.0 ksi

$$k = 2 \left( 1.04 - \frac{f_{py}}{f_{pu}} \right) \quad \text{[LRFD Eq. 5.7.3.1.1-2]}$$

= 0.28 for low-relaxation strands [LRFD Table C5.7.3.1.1-1]

$d_p$  = distance from extreme compression fiber to the centroid of the prestressing strands =  $h - y_{bs}$  = 80.00 - 6.92 = 73.08 in.

$c$  = distance from the extreme compression fiber to the neutral axis, in.  
To compute  $c$ , assume rectangular section behavior and check if the depth of the equivalent compression stress block,  $a$ , is less than or equal to  $t_s$ : [LRFD C5.7.3.2.2]

where  $a = \beta_1 c$

$$c = \frac{A_{ps} f_{pu} + A_s f_y - A'_s f'_y}{0.85 f'_c \beta_1 b + k A_{ps} \frac{f_{pu}}{d_p}} \quad \text{[LRFD Eq. 5.7.3.1.1-4]}$$

where

$a$  = depth of the equivalent stress block

$A_{ps}$  = area of prestressing strand = 48(0.153) = 7.344 in.<sup>2</sup>

$A_s$  = area of nonprestressed tension reinforcement = 0 in.<sup>2</sup>

$A'_s$  = area of compression reinforcement = 0 in.<sup>2</sup>

$f'_c$  = specified compressive strength of deck concrete = 4.0 ksi

$f_y$  = specified yield strength of tension reinforcement, ksi

$f'_y$  = specified yield strength of compression reinforcement = 60.0 ksi

$\beta_1$  = stress factor of compression block [LRFD Art. 5.7.2.2]

= 0.85 for  $f'_c \leq 4.0$  ksi

=  $0.85 - 0.05 (f'_c - 4.0) \geq 0.65$  for  $f'_c > 4.0$  ksi

= 0.85

$b$  = effective width of compression flange = 108 in.