Now check the beam for local buckling according to Section F.3.

a) The flange is in uniform compression, so the strength is given in Section B.5.4. Section B.5.4.1 addresses flat elements supported on one edge; from Part VI, Table 2-19

$b/t = (3.50 – 0.19)/[(2)(0.32)] = 5.2 < 6.7 = \lambda_1$ so
$F/\Omega = 21.2$ ksi

b) The web is in flexure so the strength is given by Section B.5.5.1, flat elements in flexure supported on both edges. Since the beam is symmetric about the bending axis, $c_c = - c_o$, and $m = 0.65$.

$b/t = (5.00 – 2(0.32))/0.19 = 22.9 < \lambda_1 = 33.1$, so

$F/\Omega = 31.8$ ksi

For an I 5 × 3.70, with a section modulus $S = 5.58$ in^3, the stress in the flange is

$f = M/S = (92.6 \text{ in-k})/(5.58 \text{ in}^3) = 16.6 \text{ ksi} < 21.2 \text{ ksi}$

so the I 5 × 3.70 is acceptable for local buckling using the limiting element method (Section F.3.3).

Web shear is addressed by Section G.2, flat webs supported on both edges.

$b/t = 22.9 < 35.3 = \lambda_1$, so $F_s/\Omega = 12.7$ ksi, allowable shear stress

From Part VI Beam Formulas Case 43, continuous beam of four equal spans.

$V = 17wL/28 = 17(0.375 \text{ k/in.})(48 \text{ in.})/28 = 10.9$ k, maximum web shear

The required web area is

$A = V/(F_s/\Omega) = (10.9 \text{ k})/(12.7 \text{ k/in}^2) = 0.86 \text{ in}^2$

(The above is an approximate method. See example 26.)

For I 5 × 3.70

$A_w = dt_w = (5.00)\ 0.19$

$= 0.95 \text{ in}^2 > 0.86 \text{ in}^2$

The I 5 × 3.70 is therefore the lightest satisfactory beam.

NOTES: The building code should be checked to see if analysis for other loading conditions (such as alternate span loading) is required in addition to the load addressed above. Generally, the use of the formula $M = \pm wL^2/8$ satisfies all building code requirements for uniformly loaded beams supported on both ends.

If holes will be drilled in the flange at or near points of high tensile stress, it may be necessary to use a larger beam. This may be determined by multiplying the computed flange stress at the section under consideration by the ratio of the gross area of the flange to the net area of the flange and comparing the result with the allowable stress.

Web crippling at supports should be checked; see Example 4.