Steel Frames
Quiz 4
March 6, 2008

SOLUTION

An A992 Grade 50 wide-flange section is to be used as a beam that is part of a structure spanning the Wyrick Industrial Channel. The beam must support a service dead load of 500 lb/ft and a service live load of 1000 lb/ft. The span will be simply-supported and 22' long. Lateral support can only be assumed at the support locations.

Select an economical (lightest section) beam assuming deflections due to live load cannot exceed the span/360 and for total load; span/240.

After making a selection based on deflection control, check the section for moment and shear capacity. Do not select a new section if it fails the strength checks.

$$\Delta_L = \frac{22'(12''/ft)}{360} = 0.73''$$

NOTE LIMITS & LOADS ARE PROPORTIONAL SO ONLY NEED TO USE ONE Δ LIMIT.

$$\Delta = \frac{5(1\,k/ft)\left(\frac{1}{12}\right)(264'')^4}{384(29000\,ksi)(I_x)} = 0.73'' \longrightarrow I_x = 249\ in^4$$

FROM PG 3-21 SELECT W16x26 (BOLD FACE ENTRY > 249 in^4)

STRENGTH CHECKS - $w_u = 1.2(.5) + 1.6(1) = 2.2\,k/ft$

$$M_u = \frac{2.2\,k/ft\,(22')^2}{8} = 133.1\ ft\text{-}k$$

$$V_u = \frac{2.2\,k/ft(22')}{2} = 24.2\,k < \phi V_n = 106\,k \text{ (PG 3-18)}$$

O.K.

$L_p = 3.96'$
$L_r = 11.2'$
$L_b = 22'$

USE $\phi M_n = \phi F_{cr} S_x$ OR TABLE 3-10

PG 3-129
@ $L_b = 12'$
$\phi M_n = 90\ ft\text{-}k$

NO GOOD

SO NO GOOD @ 22'