CRITIQUE

Strengthening of Existing Composite Beams Using LRFD Procedures

Paper by JOHN P. MILLER, P.E.
(2nd Quarter, 1996)

Critique by Sompandh Wanant, P.E.

The detailed procedures and an example presented in John Miller's paper will help structural engineers in designing or modifying composite steel beams or girders. The author addressed every important engineering aspect related to the design including deflections. In determining the deflection, however, the writer would like to offer a more accurate deflection formula which is somewhat simple and practical for manual calculations.

In the case of uniform load, the maximum deflection for beam having smaller moment of inertia at both ends can be expressed, from Figure 1, as follows:

$$\Delta_{MAX} = \frac{5}{384}\frac{wL^4}{EI_1} + \frac{1}{2}\frac{(k-1)w}{EI_1}\left[\frac{Lb^3}{3} - \frac{b^4}{4}\right]$$

where

$k = I_1 / I_2 > 1$
I_1 = Larger moment of inertia at center portion of the beam
I_2 = Smaller moment of inertia at both ends of the beam
b = Distance from support to the point where stiffness changes from I_1 to I_2
w = Uniform load per unit of length
L = Span length
E = Modulus of Elasticity

If a beam or girder subjected to concentrated loads is to be modified, similar deflection formula should be used. Figure 2 and 3 show diagrams and deflection formulae for beam with two and three equal concentrated loads respectively.

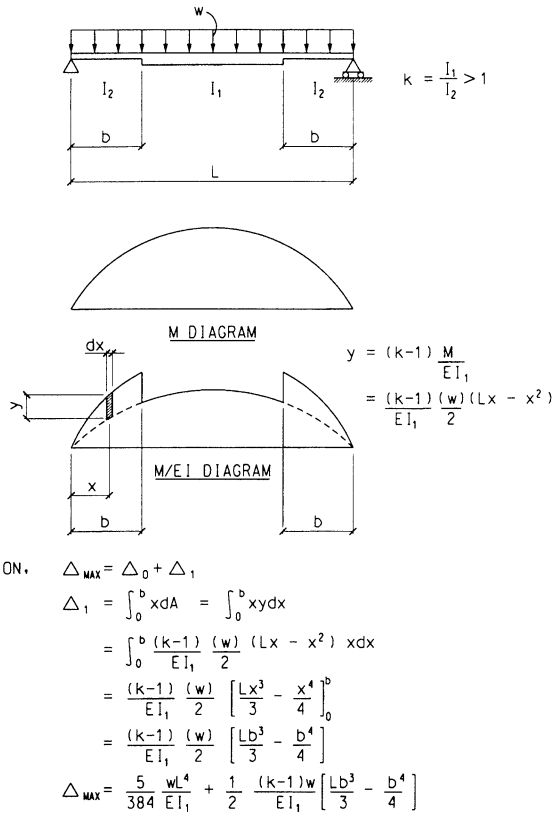

Figure 1.

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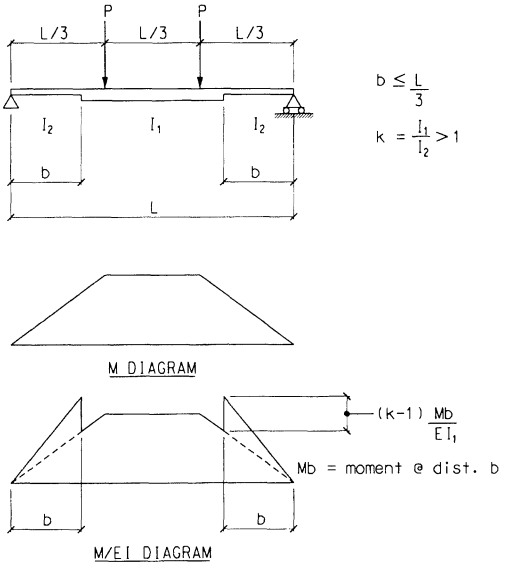


DEFLECTION, $\Delta_{MAX} = \Delta_0 + \Delta_1$

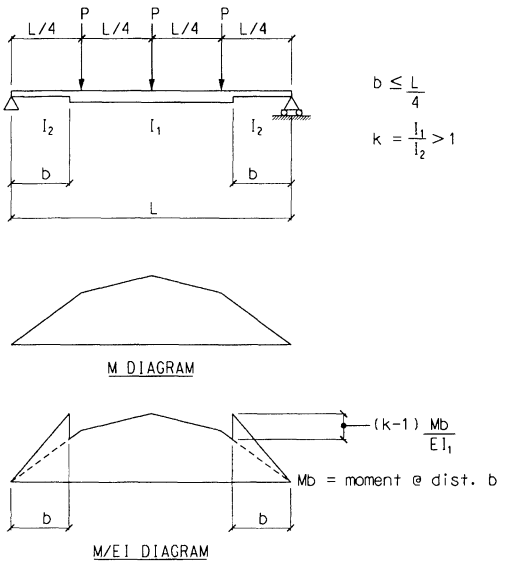
$$\Delta_1 = \frac{(k-1)}{2}\frac{Mb}{EI_1}(b)\left(\frac{2b}{3}\right)$$

$$= \frac{1}{3}\frac{(k-1)}{EI_1}(b)^2(Pb)$$

$$= \frac{1}{3}\frac{(k-1)}{EI_1}Pb^3$$

$$\Delta_{MAX} = \frac{23}{648}\frac{PL^3}{EI_1} + \frac{1}{3}\frac{(k-1)}{EI_1}Pb^3$$

Figure 2.



DEFLECTION, $\Delta_{MAX} = \Delta_0 + \Delta_1$

$$\Delta_1 = \frac{1}{2}(b)(k-1)\frac{Mb}{EI_1}\left(\frac{2b}{3}\right)$$

$$= \frac{1}{2}(b)(k-1)\frac{3}{2}\frac{Pb}{EI_1}\left(\frac{2b}{3}\right)$$

$$= \frac{1}{2}\frac{(k-1)}{EI_1}Pb^3$$

$$\Delta_{MAX} = \frac{19}{384}\frac{PL^3}{EI_1} + \frac{1}{2}\frac{(k-1)}{EI_1}Pb^3$$

Figure 3.