DESIGN OF BEAM

LATERALLY SUPPORTED:

STEP 1: FIND OUT ULTIMATE LOAD ON BEAM.

Factored Ultimate Load (Factored Load) w = 1.5 × Working Load

STEP 2: FIND OUT MAXIMUM BENDING MOMENT (M) AND SHEAR FORCE (V) ON BEAM.

STEP 3: CALCULATE PLASTIC SECTION MODULUS REQURIED FOR TRIAL SECTION.

$$Z_{P(required)} = \frac{M\gamma_0}{f_y}$$

STEP 4: SELECT SUITABLE SECTION BASED ON Z_p FROM IS: 800: 2007, PAGE NO. 138, 139. WRITE DOWN SE TIONAL PROPERTIES.

STEP 5: SECTION CLASSIFICATION.

a. Find out value of b/t_f and d/t_w. (refer Figure. 2, Page no. 19, IS 800: 2007 to find b and d)
t_f = thickness of flange t_w = thickness of web.

b. Refer Table 2, Page no. 18, IS 800: 2007 and classify the section semi-compact, compact, plastic or slender.

STEP 6: CHECK FOR SHEAR. (Clause no. 8.4.1., Page no. 59, IS 800: 2007)

a. Find out design shear strength V_d.

$$V_d = \frac{f_y}{\sqrt{3}\gamma_{mo}} h t_w$$

b. Beam is checked for high / low shear case

$V \le 0.6\ V_d$ low shear case
$V > 0.6\ V_d$ high shear case

STEP 6: CHECK FOR BENDING.

a. For low shear Case (Clause no. 8.2.1.2, Page no. 53, IS 800: 2007)

$M_d > M$
M_d = Design Bending Strength
M = Bending Moment

$$M_d = \beta_b Z_p \frac{f_y}{\gamma_{mo}} \le 1.2 Z_e \frac{f_y}{\gamma_{mo}} \quad (for\ simply\ supported\ beam)$$

$$\le 1.5 Z_e \frac{f_y}{\gamma_{mo}} \quad (for\ cantilever\ beam)$$

β_b = 1 for plastic and compact sections.
= Z_e/Z_p for semi compact sections.
Z_e = Elastic section Modulus
Z_p = Plastic section Modulus

b. For High shear Case (Clause no. 8.2.1.3, Page no. 53, IS 800: 2007)

Refer Clause no. 8.2.1.3, Page no. 53, IS 800: 2007. Generally low shear case is preferred.

STEP 7: CHECK FOR WEB BUCKLING AT SUPPORT (Clause no. 8.7.3.1, Page no. 67, IS 800: 2007)

a. Capacity of section = $A_b f_{cd} > V$

b. $A_b = (b_1 + n_1)\ t_w$ when load is at support

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$A_b = (b_1 + 2n_1)\, t_w$ when load is not at support

Where, b_1= stiff bearing length of load = assume between 0 to 100mm

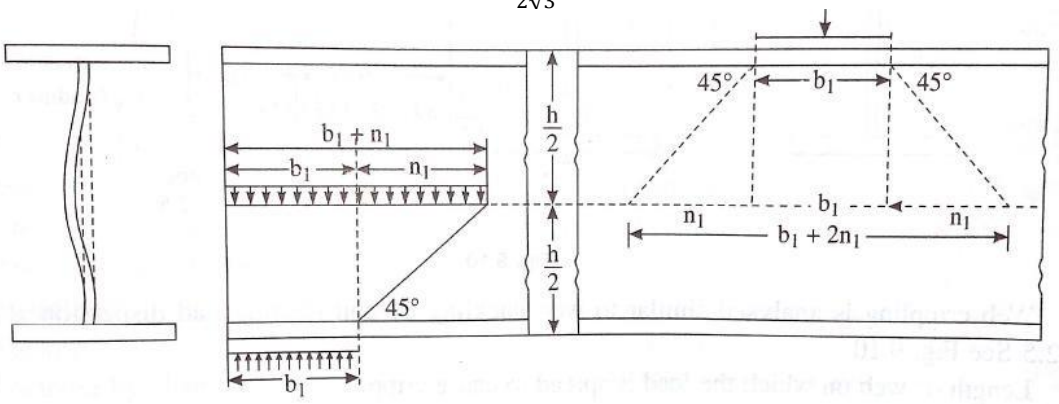
n_1 = for 45˚ dispersion consider h/2

d. Find out F_{cd} = Design Compressive Stress considering class c and f_y = 250 MPa.

Slenderness ratio $= \frac{kl}{r} = \frac{0.7d}{r}$

D = depth of the web between the flanges

r = least radius of gyration of the section = $\frac{t_w}{2\sqrt{3}}$



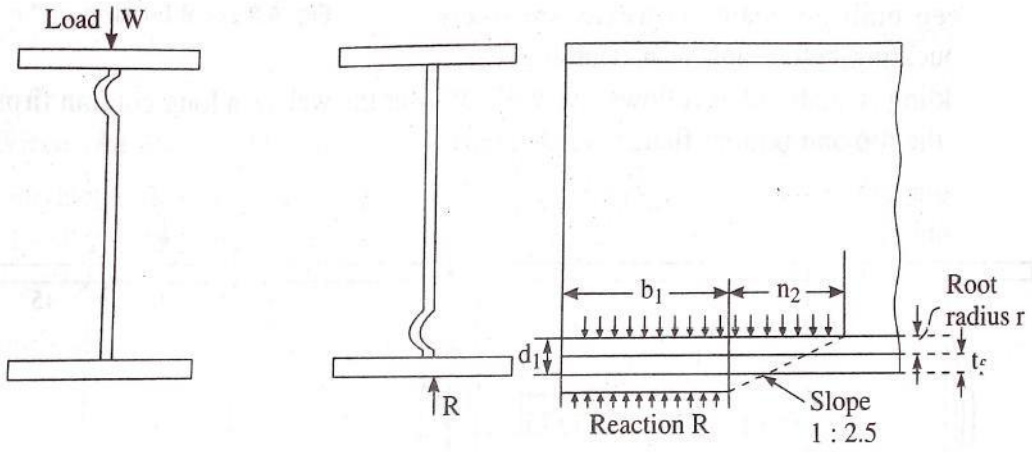
STEP 7: CHECK FOR WEB CRIPPLING (Clause no. 8.7.4, Page no. 67, IS 800: 2007)

Design crippling strength $F_w = \frac{(b_1+n_2)t_w f_{yw}}{\gamma_{mo}} > V$

Where, b_1 = stiff bearing length = 0 to 100 mm

$n_2 = 2.5\ (t_f + r_1)$

f_{yw} = yield stress of web



STEP 8: CHECK FOR DEFLECTION

a. Actual deflection for simply supported

$$\delta_{max} = \frac{5}{384}\frac{wl^2}{EI}$$

b. Permissible deflection = Span/300 (table 6, Page no. 31, IS 800: 2007)