BEAM DESIGN (Cont'd)

WEB FAILURE

GENERAL PRINCIPLES

IN GENERAL, THE DESIGN OF A BEAM INVOLVES ENSURING THAT THE INTERNAL CAPACITY OF THE BEAM IS ALWAYS GREATER THAN THE ACTION OF THE DESIGN LOADS ACTING ON IT.

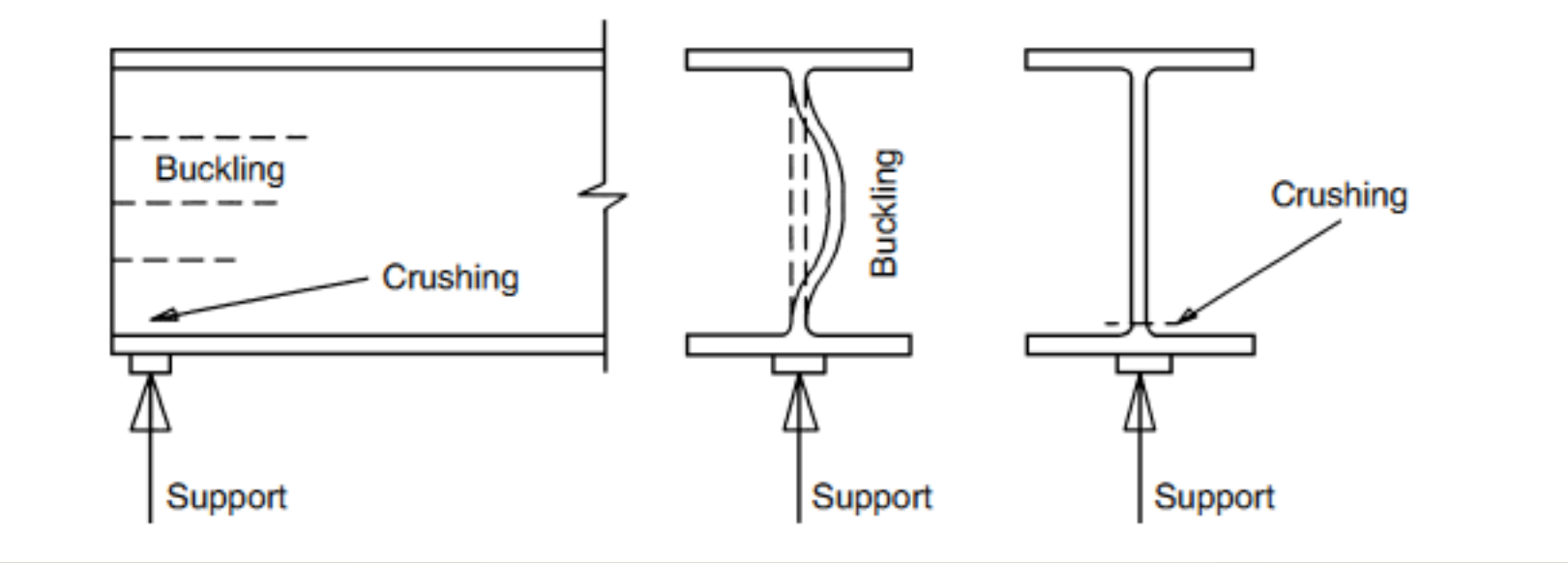
MEMBERS IN BENDING ARE NORMALLY CHECKED AT CRITICAL POINTS FOR THE FOLLOWING:

- **SHEAR**
- **BENDING**
- **DEFLECTION**

IN CERTAIN CASES IT MAY ALSO BE NECESSARY TO CHECK FOR WEB FAILURE

WEB FAILURE

FORCES TRANSMITTED THROUGH A FLANGE TO THE WEB MAY RESULT IN BEARING (SOMETIMES ALSO REFERRED TO CRUSHING OR CRIPPLING) OR BUCKLING FAILURE. THIS IS COVERED IN Cl. 6 OF BS EN 1993-1-5.



DESIGN RESISTANCE OF WEB

THE DESIGN RESISTANCE OF WEBS DUE TO LOCAL BUCKLING, F_{Rd}, IS GIVEN BY

$$F_{\mathrm{Rd}} = \frac{f_{\mathrm{yw}} L_{\mathrm{eff}} t_{\mathrm{w}}}{\gamma_{\mathrm{M1}}}$$

where

f_{yw}	yield strength of web
t_w	thickness of web
γ_{M1}	partial safety factor for resistance = 1.0
L_{eff}	effective length of web which resists transverse forces = $\chi_f l_y$

DESIGN RESISTANCE OF WEB (CONT'D)

in which

$$\chi_F = \frac{0.5}{\bar{\lambda}_F} \leq 1.0$$

where

$$\bar{\lambda}_F = \sqrt{\frac{l_y t_w f_y}{F_{cr}}}$$

in which

$$F_{cr} = \frac{0.9 k_f E t_w^3}{h_w}$$

EFFECTIVE LOADED LENGTH

l_y is the effective loaded length, taken as the minimum of the following three values:

- $l_{y1} = s_s + 2t_f(1 + \sqrt{m_1 + m_2})$
- $l_{y2} = l_e + t_f \sqrt{\frac{m_1}{2} + \left(\frac{l_e}{t_f}\right)^2 + m_2}$
- $l_{y3} = l_e + t_f \sqrt{m_1 + m_2}$

EFFECTIVE LOADED LENGTH (CONT'D)

where

$$l_{\mathrm{e}} = \frac{k_{\mathrm{F}} E t_{\mathrm{w}}^2}{2 f_{\mathrm{yw}} h_{\mathrm{w}}}$$

$$m_1 = \frac{f_{\mathrm{yf}} b_{\mathrm{f}}}{f_{\mathrm{yw}} t_{\mathrm{w}}}$$

$$m_2 = 0.02 \left({}^{h_{\mathrm{w}}}/_{t_{\mathrm{f}}} \right)^2 \qquad \text{if } \bar{\lambda}_{\mathrm{F}} > 0.5$$

$$m_2 = 0 \qquad \text{if } \bar{\lambda}_{\mathrm{F}} \leq 0.5$$

k_f is obtained from Fig. 6.1 in EC3-5 and s_s is the length of the stiff bearing.

EFFECTIVE LOADED LENGTH (CONT'D)

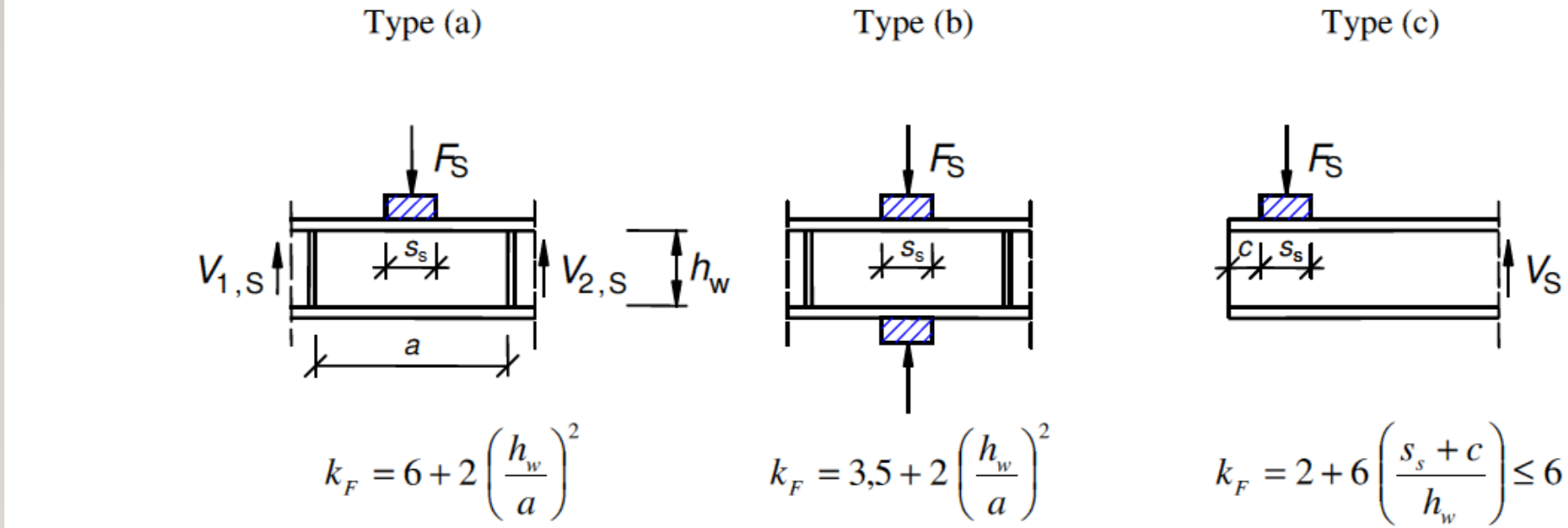


Figure 6.1: Buckling coefficients for different types of load application

EXERCISE

Assuming the beam sits on 100mm bearings at each end check the resistance of the web to transverse forces.