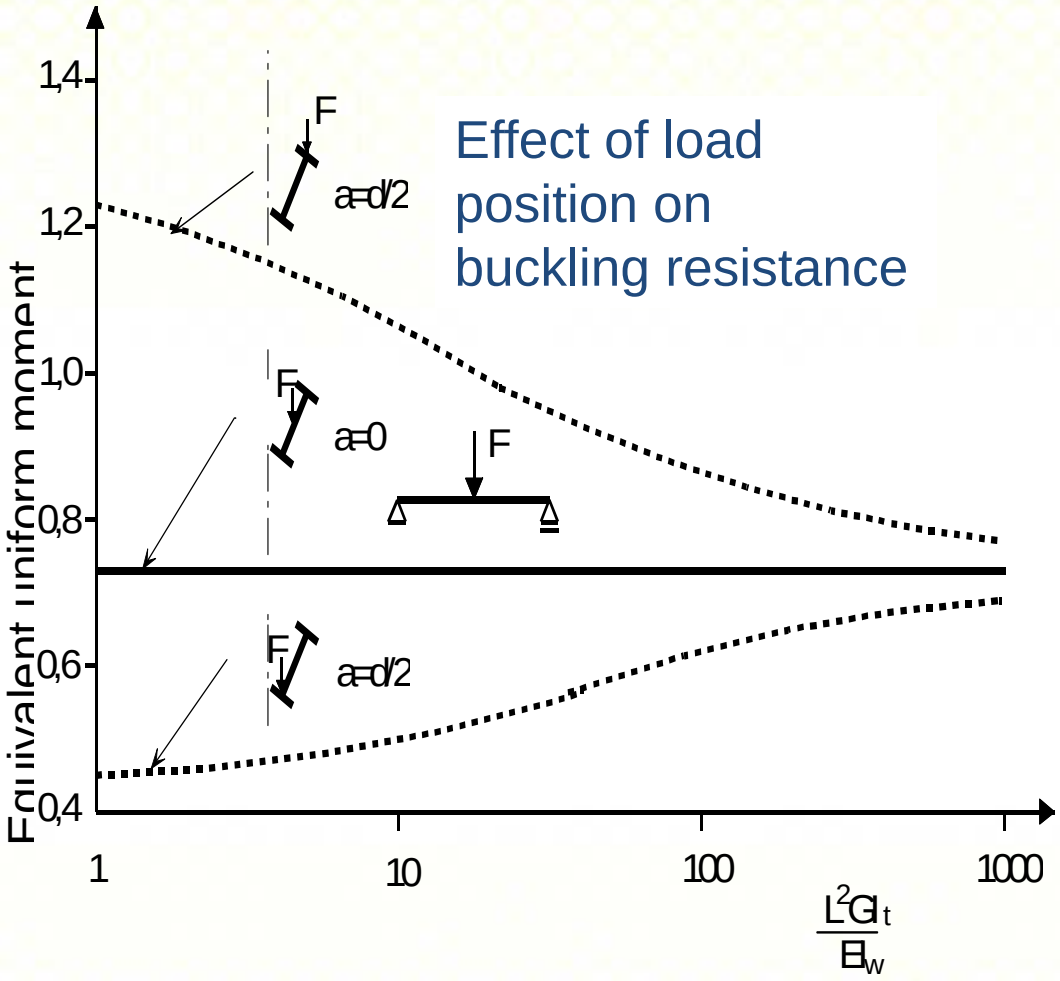
Level of application of load

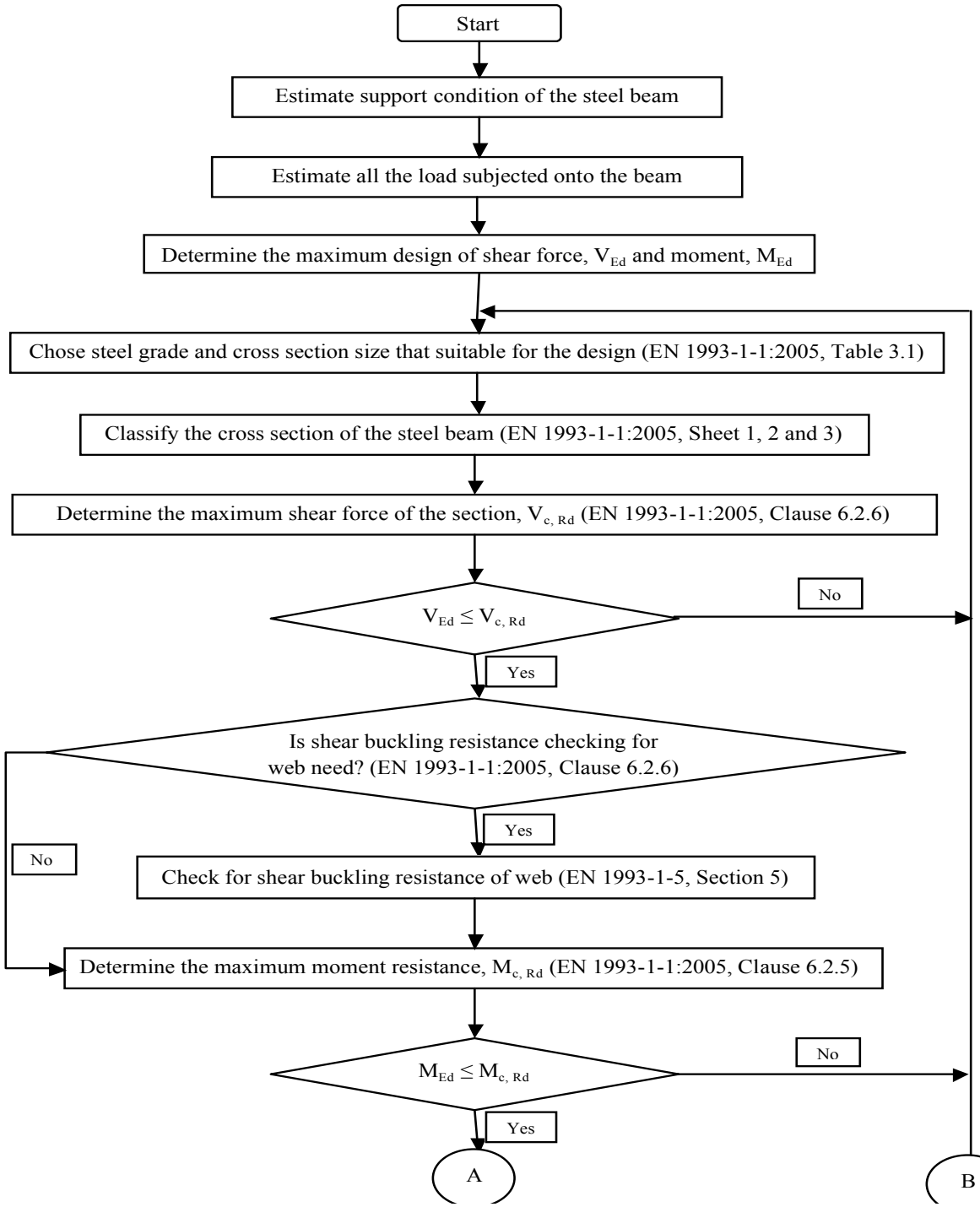


- Loads applied to top flange are destabilising
- Problem increases with depth of section and/or as span reduces
- EC3 introduces C_2 factor into expressions for χ_{LT}

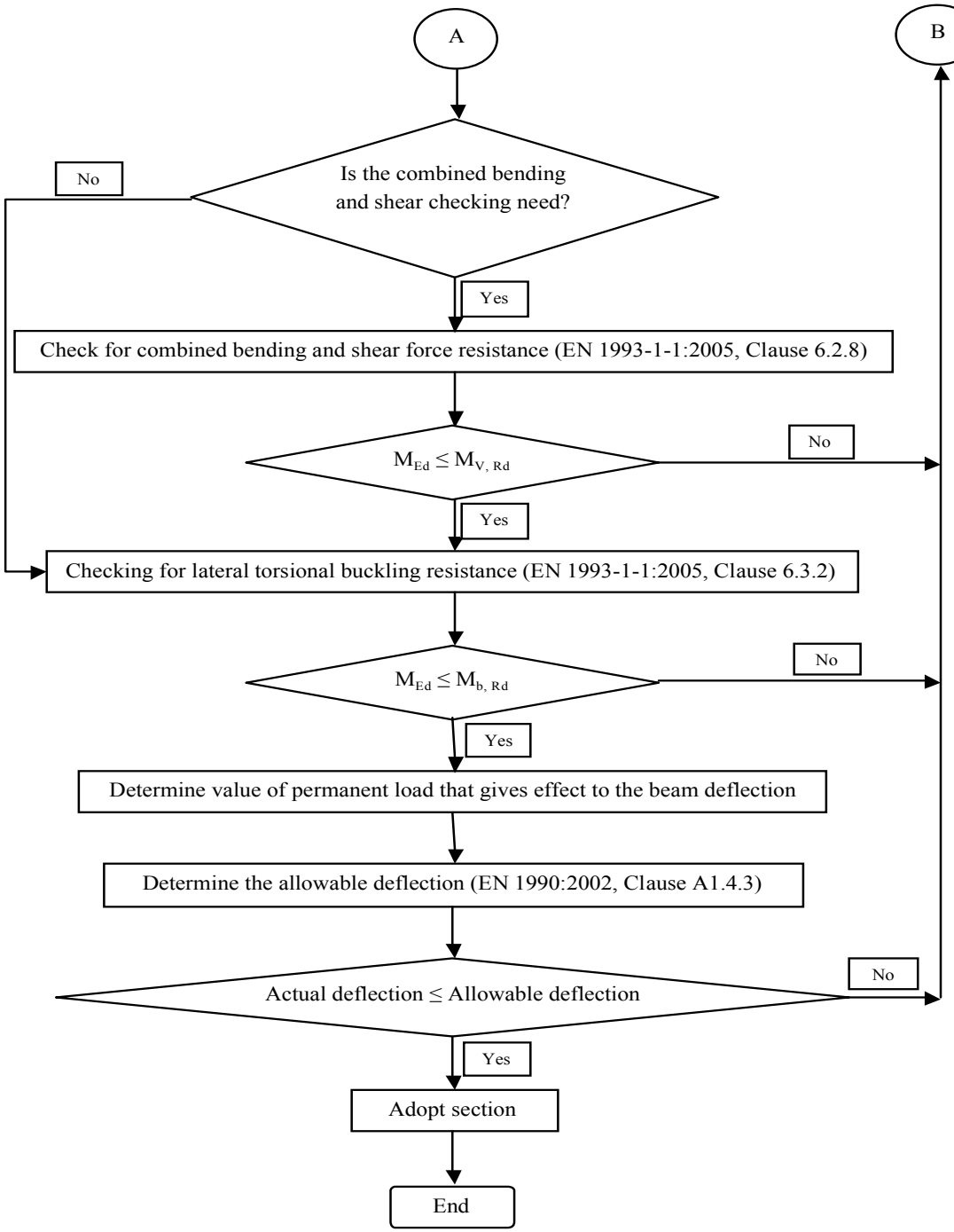
Beams with intermediate lateral support

- If beams have lateral restraints at intervals along the span the segments of the beam between restraints must be treated in isolation
- beam design is based on the most critical segment
- Lengths of beams between restraints should use an effective length factor k of 1.0

Design Procedure :



Design Procedure :



Design Procedure :

$\frac{M_{Ed}}{M_{b,Rd}} \leq 1{,}0$

- M_{Ed} Design Moment
- $M_{b,Rd}$ Design buckling resistance moment
- $M_{b,Rd} = \chi_{LT} W_y \frac{f_y}{\gamma_{MI}}$
  - For class 1 and 2 cross-sections — $w_y = w_{pl,y}$
  - For class 3 cross-sections — $w_y = w_{el,y}$
  - For Class 4 cross-sections — $w_y = w_{eff,y}$

χ_{LT} Reduction Factor

- General — $\chi_{LT} = \frac{1}{\Phi_{LT} + \sqrt{\Phi_{LT}^2 - \bar{\lambda}_{LT}^2}}$ but $\chi_{LT} \leq 1{,}0$
- For rolled section or equivalent welded sections
  - $\chi_{LT} = \frac{1}{\phi_{LT} + \sqrt{\phi_{LT}^2 + \beta \lambda_{LT}^2}}$ but $\begin{cases} \chi_{LT} \leq 1.0 \\ \chi_{LT} \leq \frac{1}{\lambda_{LT}^2} \end{cases}$
  - $\chi_{LT,mod} = \frac{\chi_{Lt}}{f}$ but $\chi_{LT,mod} \leq 1$ — With moment distribution between lateral restraint of members
- Simplified assessment method for beams with restraints

For rolled section or equivalent welded sections

$$\chi_{LT} = \frac{1}{\phi_{LT} + \sqrt{\phi_{LT}^2 + \beta\lambda_{LT}^2}} \text{ but } \begin{cases} \chi_{LT} \le 1.0 \\ \chi_{LT} \le \frac{1}{\lambda_{LT}^2} \end{cases}$$

- $\Phi_{LT} = 0{,}5\left[1 + \alpha_{LT}\left(\bar{\lambda}_{LT} - \bar{\lambda}_{LT,0}\right) + \beta\bar{\lambda}_{LT}^2\right]$
- α_{LT} Imperfection factor
  - Table 6.3
  - Table 6.5
- $\bar{\lambda}_{LT,0} = 0{,}4$ (maximum value)
- $\beta = 0.75$

$$\chi_{LT,mod} = \frac{\chi_{Lt}}{f} \text{ but } \chi_{LT,mod} \le 1$$

With moment distribution between lateral restraint of members

$$\bar{\lambda}_{LT} = \sqrt{\frac{W_y f_y}{M_{cr}}}$$

$$M_{cr} = C_1 \frac{\pi^2 EI_z}{L_{cr}^2}\left(\frac{I_w}{I_z} + \frac{L_{cr}^2 GI_T}{\pi^2 EI_z}\right)^{0.5}$$

- $E = 210\,000 \text{N/mm}^2$
- L_{cr} is the buckling length
- $G = 81\,000 \text{ N/mm}^2$
- C_1
  - $C_1 = 1.88 - 1.40\Psi + 0.52\Psi^2$ but C1 £ 2.70, where Ψ is the ratio of the end moments for restrained ends
  - Alternatively

Table 6.3

Table 6.3: Recommended values for imperfection factors for lateral torsional buckling curves

Buckling curve	a	b	c	d
Imperfection factor α_{LT}	0,21	0,34	0,49	0,76

Table 6.5

Table 6.5: Recommendation for the selection of lateral torsional buckling curve for cross sections using equation (6.57)

Cross-section	Limits	Buckling curve
Rolled I-sections	$h/b \leq 2$ $h/b > 2$	**b** **c**
Welded I-sections	$h/b \leq 2$ $h/b > 2$	**c** **d**

Example 1 : Design of an unrestrained beam

Thank You