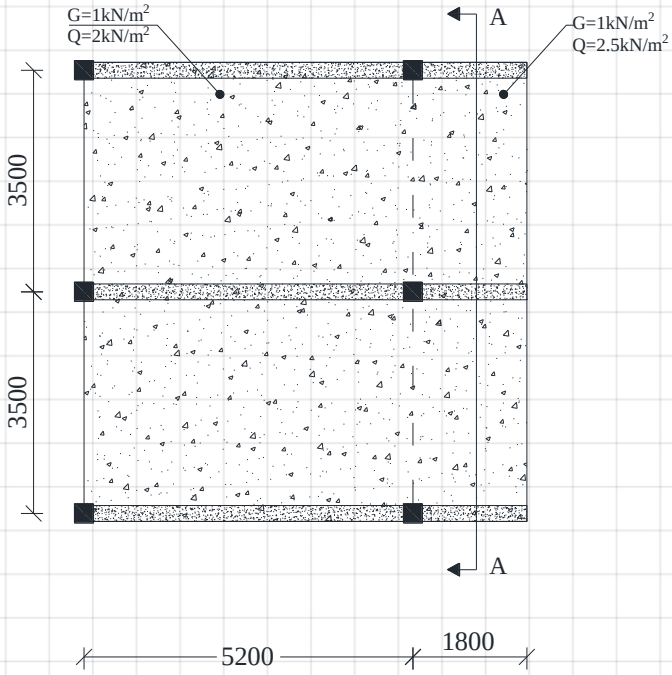
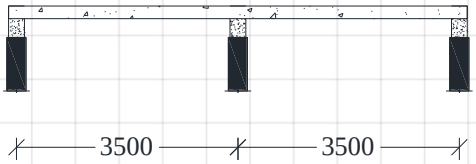
In the previous video, the design bending moment for the middle beam has been determined. For the same beam:

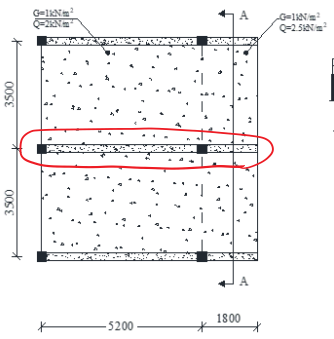
a) Determine the required reinforcement for the positive and negative moment
b) If only a rectangular cross-section is assumed in both positive and negative bending moments.
c) If relevant, the T-Section due to the effect of the slab is considered in the calculation.
d)

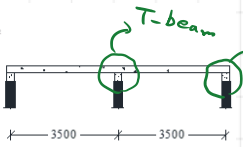
Eurocode 1992-1-1 and the Finnish national annex are applied.
The beam is 250mm in width and 500mm in height. Concrete class C30/37, reinforcement of B500 and take the nominal cover of the beam to be 35mm. T16 for the longitudinal and T10 for the stirrup is suggested to be utilized.





Sec A-A





$M_{Ed}^{+} = 108\ kN \cdot m$

$M_{Ed}^{-} = 64\ kN \cdot m$

$b = 250\ mm$

$h = 500\ mm$

$\phi_s = 16\ mm$

$\phi_{sw} = 10\ mm$

C30/37

$f_{yk} = 500\ MPa$

Width of the beam	$b := 250\ mm$
Height of the beam	$h := 500\ mm$
Nominal cover	$c_{nom} := 35\ mm$
Reinforcement Diameter	$\phi_s := 16\ mm$
Stirrup Diameter	$\phi_{sw} := 10\ mm$
Design Bending Moment	$M_{Ed} := 108\ kN \cdot m$
Concrete Compressive Strength	$f_{ck} := 30\ MPa$

M^{+} → 4 T 16

$Status_1$ = "Compressive Reinforcement is not Required"

	$A_s = 599\ mm^2$
Required Reinforcement (Number)	$n_{s.rqd} = 2.98$
	$n := 4$

Width of the beam	$b := 250\ mm$
Height of the beam	$h := 500\ mm$
Nominal cover	$c_{nom} := 35\ mm$
Reinforcement Diameter	$\phi_s := 16\ mm$
Stirrup Diameter	$\phi_{sw} := 10\ mm$
Design Bending Moment	$M_{Ed} := 64\ kN \cdot m$
Concrete Compressive Strength	$f_{ck} := 30\ MPa$

M^{-} → 2 T 16

$Status_1$ = "Compressive Reinforcement is not Required"

	$A_s = 344\ mm^2$
Required Reinforcement (Number)	$n_{s.rqd} = 1.712$
	$n := 2$

5.3.2 Geometric data

5.3.2.1 Effective width of flanges (all limit states)

(1)P In T beams the effective flange width, over which uniform conditions of stress can be assumed, depends on the web and flange dimensions, the type of loading, the span, the support conditions and the transverse reinforcement.

(2) The effective width of flange should be based on the distance l_0 between points of zero moment, which may be obtained from Figure 5.2.

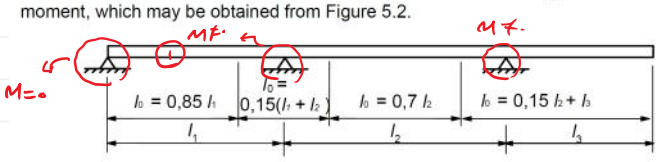
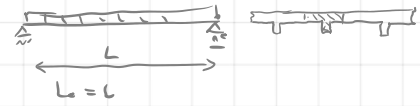
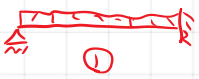
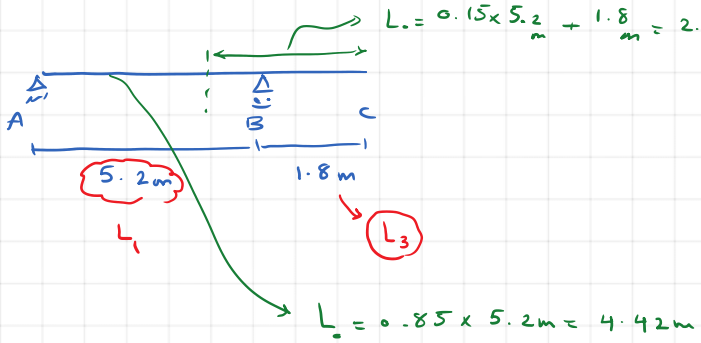


Figure 5.2: Definition of l_0, for calculation of effective flange width

Note: The length of the cantilever, l_3, should be less than half the adjacent span and the ratio of adjacent spans should lie between 2/3 and 1,5.







$L_0 = 0.15 \times 5.2\,m + 1.8\,m = 2.58\,m$

(3) The effective flange width b_{eff} for a T beam or *L* beam may be derived as:

$$b_{eff} = \sum b_{eff,i} + b_w \le b \quad (5.7)$$

where

$$b_{eff,i} = 0{,}2 b_i + 0{,}1 l_0 \le 0{,}2 l_0 \quad (5.7a)$$

and

$$b_{eff,i} \le b_i \quad (5.7b)$$

(for the notations see Figures 5.2 above and 5.3 below).

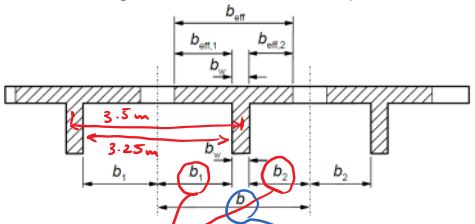
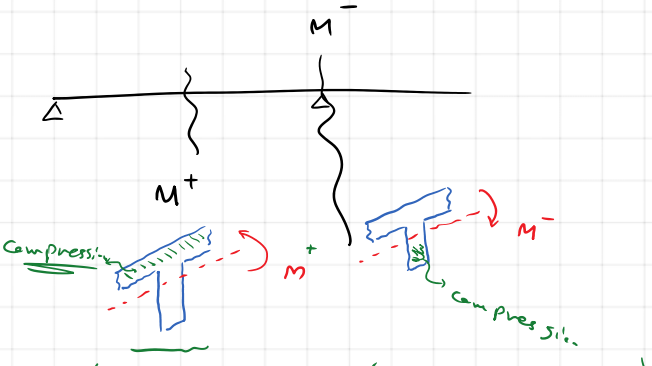


Figure 5.3: Effective flange width parameters

(4) For structural analysis, where a great accuracy is not required, a constant width may be assumed over the whole span. The value applicable to the span section should be adopted.

$b_{eff,left} = \min\{0.2 b_{left} + 0.1 L_0, 0.2 L_0\}$



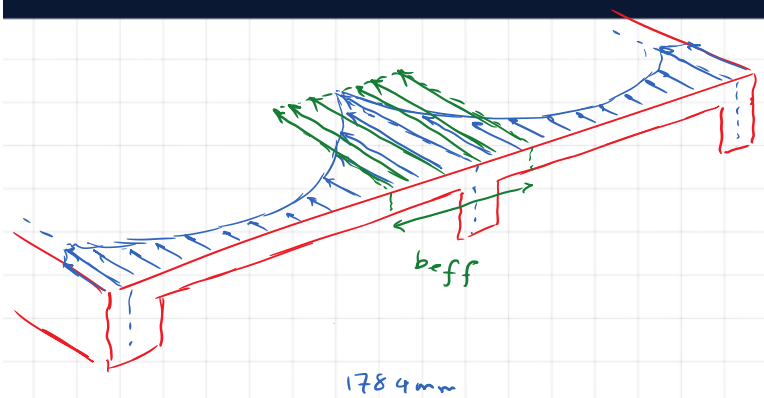
$\frac{3.25\,m}{2} = 1.625\,m$

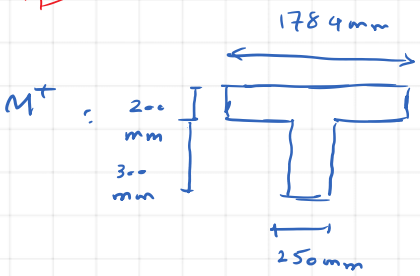
$1.625\,m = 1.625\,m + 0.25\,m = 3.5\,m$

$b_{eff,left} = \min\{0.2 \times 1.625\,m + 0.1 \times 4.42\,m,\ 0.2 \times 4.42\,m\} = 767\,mm = b_{eff,right}$

767mm 1.77m

$b_{eff} = 2 \times 767\,mm + 250\,mm = 1784\,mm \le 3500\,mm \Rightarrow \boxed{b_{eff} = 1784\,mm}$





Width of the web	$b_w := 250\ mm$
Effective Width	$b_{eff} := 1784\ mm$
Height of the beam	$h := 500\ mm$
Height of the flange	$h_f := 200\ mm$
Nominal cover	$c_{nom} := 35\ mm$
Reinforcement Diameter	$\phi_s := 16\ mm$
Stirrup Diameter	$\phi_{sw} := 10\ mm$
Design Bending Moment	$M_{Ed} := 108\ kN \cdot m$
Concrete Compressive Strength	$f_{ck} := 30\ MPa$

$A_s = 563\ mm^2$

Required Reinforcement (Number) $n_{s,rqd} = 2.8$

$n := 3$

3T16