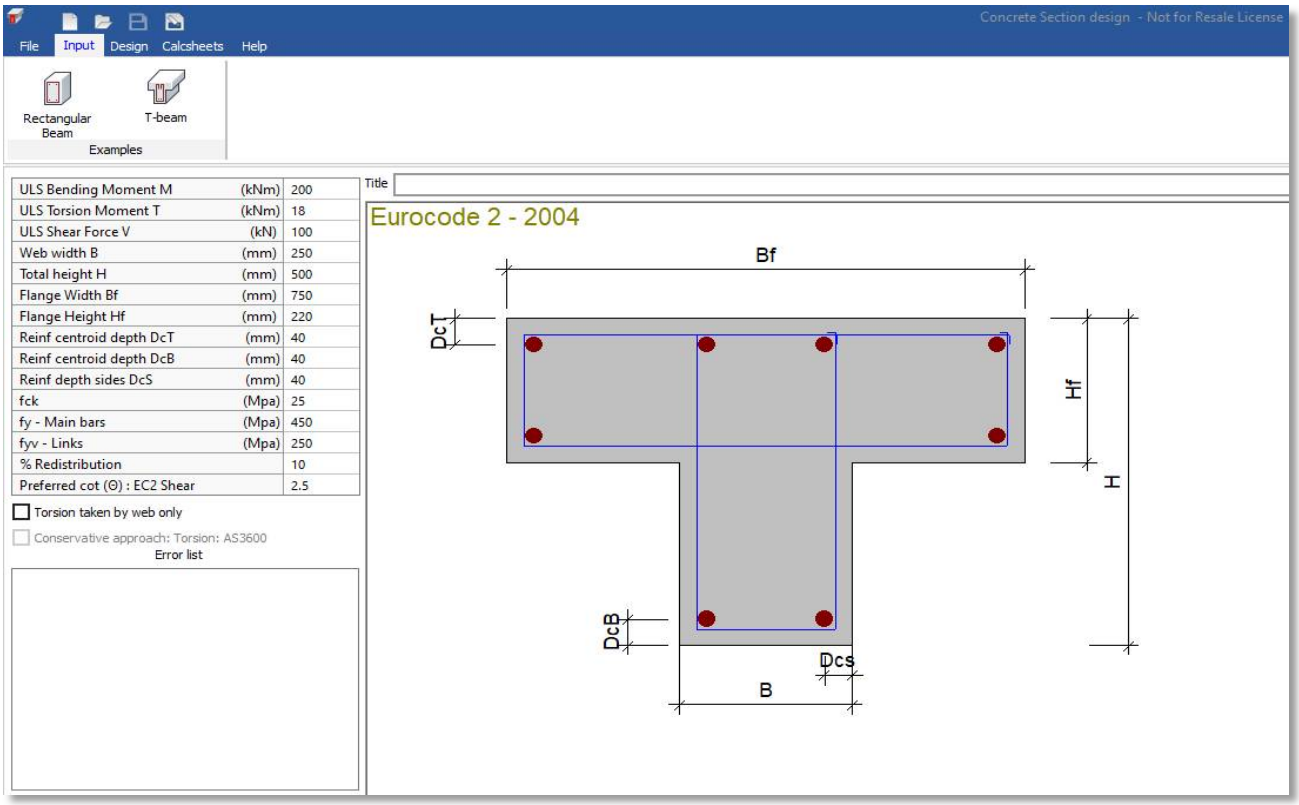
BEAM SECTION

DESIGN OF CONCRETE BEAM SECTIONS

DESIGN | C22

Summary

The **Beam Section** module is a simple utility for designing concrete sections for combined bending, shear, and torsion. The module accommodates rectangular and T-sections. The single input table makes it quick and easy to enter the section geometry and ultimate loading.



What makes this module special?

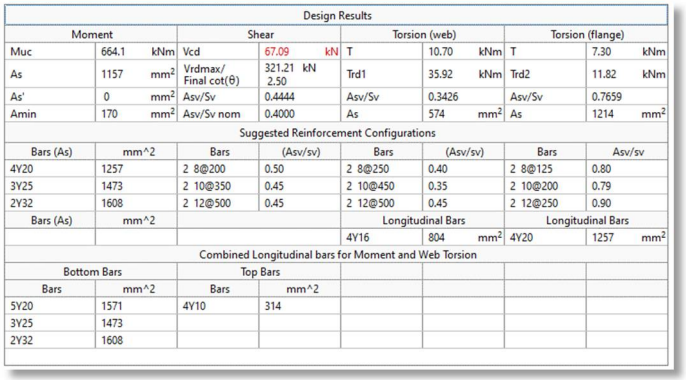
- Simplified input
- Suggested reinforcement output
- Detailed calculations

Detailed Description

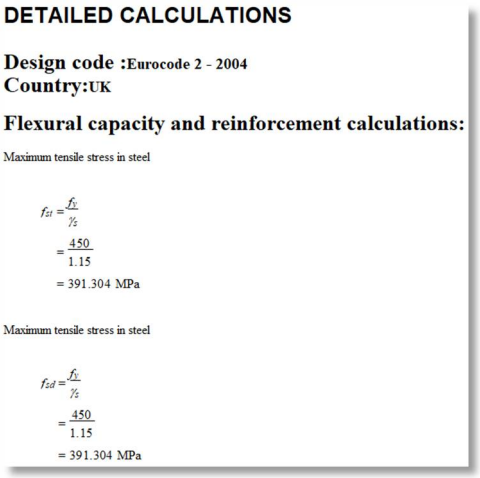
Use the **Beam Section** module to design a concrete section subjected to moment, shear, and torsion forces.

The design calculates moment, shear, and torsional stresses in web and flange, and required reinforcement for each.

Some reinforcement configurations are also suggested in the output as guidelines. The section design output can be grouped on a **Calcsheet** for printing or sending to **Calcpad**. Various settings can be made with regards to the inclusion of design results and pictures.



Design Results							
Moment		Shear		Torsion (web)		Torsion (flange)	
Muc	664.1 kNm	Vcd	67.09 kN	T	10.70 kNm	T	7.30 kNm
As	1157 mm²	Vrdmax/ Final cot(θ)	321.21 kN 2.50	Trd1	35.92 kNm	Trd2	11.82 kNm
As'	0 mm²	Asv/Sv	0.4444	Asv/Sv	0.3426	Asv/Sv	0.7659
Amin	170 mm²	Asv/Sv nom	0.4000	As	574 mm²	As	1214 mm²
Suggested Reinforcement Configurations							
Bars (As)	mm^2	Bars	(Asv/sv)	Bars	(Asv/sv)	Bars	Asv/sv
4Y20	1257	2 8@200	0.50	2 8@250	0.40	2 8@125	0.80
3Y25	1473	2 10@350	0.45	2 10@450	0.35	2 10@200	0.79
2Y32	1608	2 12@500	0.45	2 12@500	0.45	2 12@250	0.90
Bars (As)	mm^2			Longitudinal Bars		Longitudinal Bars	
				4Y16	804 mm²	4Y20	1257 mm²
Combined Longitudinal bars for Moment and Web Torsion							
Bottom Bars		Top Bars					
Bars	mm^2	Bars	mm^2				
5Y20	1571	4Y10	314				
3Y25	1473						
2Y32	1608						



DETAILED CALCULATIONS

Design code :Eurocode 2 - 2004
Country:UK

Flexural capacity and reinforcement calculations:

Maximum tensile stress in steel

$$f_{st} = \frac{f_y}{\gamma_s} = \frac{450}{1.15} = 391.304 \text{ MPa}$$

Maximum tensile stress in steel

$$f_{sd} = \frac{f_y}{\gamma_s} = \frac{450}{1.15} = 391.304 \text{ MPa}$$

Theory used in this module

The normal code formulae apply when calculating flexural reinforcement for rectangular sections and for flanged sections where the neutral axis falls inside the flange. If the neutral axis falls outside the flange, the section is designed as two separate sub sections:

- The first sub section consists of the flange without the central web part of the section and the remaining central portion defines the second sub-section.
- By considering the total section, the moment required to put the flange portion in compression can be calculated using the normal code formulae. This moment is then applied to the flange sub section and the required reinforcement calculated using the effective depth of the total section.
- The same moment is then subtracted from the total applied moment, the resulting moment is applied to the central sub section and the reinforcement is calculated.

The tension reinforcement for the actual section is then taken as the sum of the calculated reinforcement for the two sub sections. If compression reinforcement is required for the central sub section, it is used as the required compression reinforcement for the entire section.

The module assumes that shear is resisted by the web portion of the section only. Shear stress is therefore calculated using the web area and checked not to exceed the ultimate allowable shear stress given in the code. The shear capacity is calculated using the required bending reinforcement and the shear reinforcement calculated using the normal code formulae.

Depending on the option chosen, torsion can be resisted by the section as a whole or by the web portion only. For flanged beams, the torsion is calculated separately for the flange and web along the guidelines given in the code. The torsional shear stresses are checked to not exceed the ultimate allowable shear stress. Reinforcement requirements are also evaluated separately for the flange and web using the normal code formulae. For the Eurocode, the strut-and-tie model is used, and the angle of the struts can be specified within the limits of the code.

Supported Design Codes

Design Codes

- ACI 318 - 1999
- ACI 318 - 2005
- ACI 318 - 2011
- ACI 318 – 2014
- ACI 318 - 2019
- AS 3600 - 2001
- AS 3600 – 2009
- AS 3600 - 2018
- BS 8110 - 1985
- BS 8110 - 1997
- CP 65 - 1999
- CSA A23.3-04 - 2010
- CSA-A23.3:2019
- Eurocode 2 - 2004
- HK Concrete - 2004
- HK Concrete - 2013
- IS:456 - 2000
- NZ 3101 - 2006
- SABS 0100 – 2000
- SP 63.13330.2018