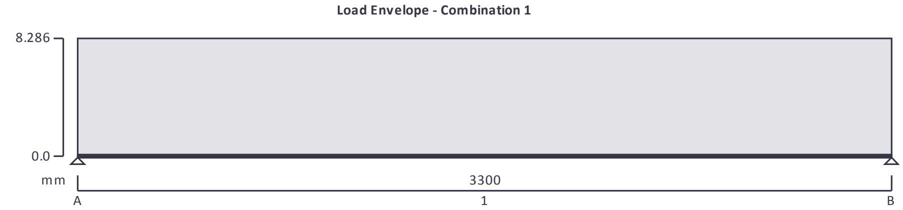
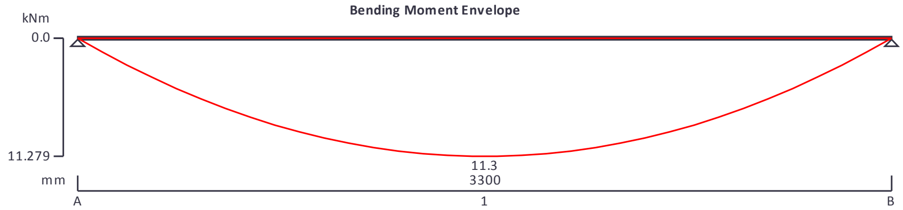
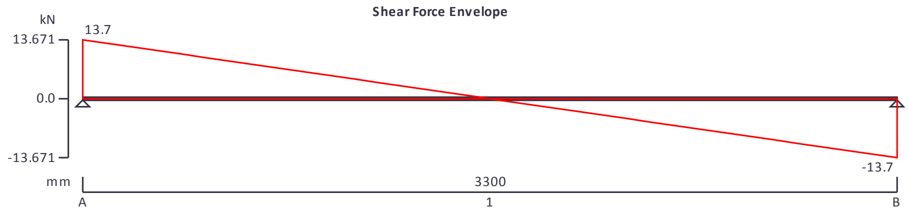
RC BEAM ANALYSIS & DESIGN BS8110

TEDDS calculation version 2.1.12







Support conditions

Support A	Vertically restrained	
	Rotationally free	
Support B	Vertically restrained	
	Rotationally free	

Applied loading

	Dead full UDL 0.6 kN/m	
	Imposed full UDL 1.5 kN/m	
	Dead self weight of beam × 1	

Load combinations

Load combination 1	Support A	Dead × 1.40
		Imposed × 1.60
	Span 1	Dead × 1.40
		Imposed × 1.60
	Support B	Dead × 1.40
		Imposed × 1.60

Analysis results

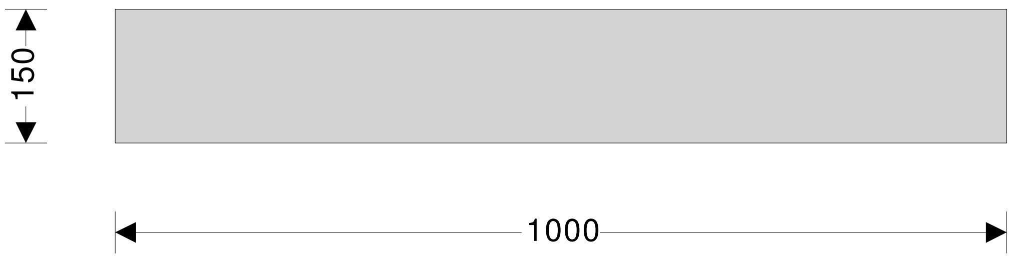
Maximum moment support A	M_{A_max} = **0** kNm	M_{A_red} = **0** kNm

Maximum moment span 1 at 1650 mm	M_{s1_max} = **11** kNm	M_{s1_red} = **11** kNm
Maximum moment support B	M_{B_max} = **0** kNm	M_{B_red} = **0** kNm
Maximum shear support A	V_{A_max} = **14** kN	V_{A_red} = **14** kN
Maximum shear support A span 1 at 100 mm	$V_{A\_s1\_max}$ = **13** kN	$V_{A\_s1\_red}$ = **13** kN
Maximum shear support B	V_{B_max} = **-14** kN	V_{B_red} = **-14** kN
Maximum shear support B span 1 at 3200 mm	$V_{B\_s1\_max}$ = **-13** kN	$V_{B\_s1\_red}$ = **-13** kN
Maximum reaction at support A	R_A = **14** kN	
Unfactored dead load reaction at support A	R_{A_Dead} = **7** kN	
Unfactored imposed load reaction at support A	$R_{A\_Imposed}$ = **2** kN	
Maximum reaction at support B	R_B = **14** kN	
Unfactored dead load reaction at support B	R_{B_Dead} = **7** kN	
Unfactored imposed load reaction at support B	$R_{B\_Imposed}$ = **2** kN	

Rectangular section details

Section width — b = **1000** mm

Section depth — h = **150** mm



Concrete details

Concrete strength class — **C40/50**

Characteristic compressive cube strength — f_{cu} = **50** N/mm²

Modulus of elasticity of concrete — $E_c = 20\text{kN/mm}^2 + 200 \times f_{cu}$ = **30000** N/mm²

Maximum aggregate size — h_{agg} = **20** mm

Reinforcement details

Characteristic yield strength of reinforcement — f_y = **500** N/mm²

Characteristic yield strength of shear reinforcement — f_{yv} = **500** N/mm²

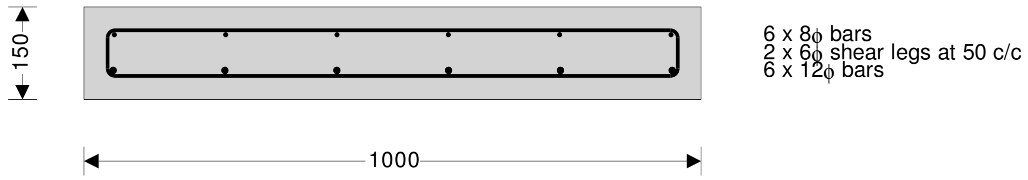
Nominal cover to reinforcement

Nominal cover to top reinforcement — c_{nom_t} = **35** mm

Nominal cover to bottom reinforcement — c_{nom_b} = **35** mm

Nominal cover to side reinforcement — c_{nom_s} = **35** mm

Mid span 1



Design moment resistance of rectangular section (cl. 3.4.4) - Positive moment

Design bending moment — $M = \text{abs}(M_{s1\_red})$ = **11** kNm

Depth to tension reinforcement — $d = h - c_{nom\_b} - \phi_v - \phi_{bot} / 2$ = **103** mm

Redistribution ratio — $\beta_b = \min(1 - m_{rs1}, 1)$ = **1.000**

$K = M / (b \times d^2 \times f_{cu})$ = **0.021**

$K' = 0.156$

K' > K - No compression reinforcement is required

Lever arm — $z = \min(d \times (0.5 + (0.25 - K / 0.9)^{0.5}), 0.95 \times d)$ = **98** mm

Depth of neutral axis — $x = (d - z) / 0.45$ = **11** mm

Area of tension reinforcement required — $A_{s,req} = M / (0.87 \times f_y \times z)$ = **265** mm^2

Tension reinforcement provided — 6 × 12ϕ bars

Area of tension reinforcement provided — $A_{s,prov}$ = **679** mm^2

Minimum area of reinforcement — $A_{s,min} = 0.0013 \times b \times h$ = **195** mm^2

Maximum area of reinforcement — $A_{s,max} = 0.04 \times b \times h$ = **6000** mm^2

PASS - Area of reinforcement provided is greater than area of reinforcement required

Rectangular section in shear

Shear reinforcement provided — 2 × 6ϕ legs at 50 c/c

Area of shear reinforcement provided — $A_{sv,prov}$ = **1131** mm^2/m

Minimum area of shear reinforcement (Table 3.7) — $A_{sv,min} = 0.4N/mm^2 \times b / (0.87 \times f_{yv})$ = **920** mm^2/m

PASS - Area of shear reinforcement provided exceeds minimum required

Maximum longitudinal spacing (cl. 3.4.5.5) — $s_{vl,max} = 0.75 \times d$ = **77** mm

PASS - Longitudinal spacing of shear reinforcement provided is less than maximum

Design concrete shear stress — $v_c = 0.79N/mm^2 \times \min(3,[100 \times A_{s,prov} / (b \times d)]^{1/3}) \times \max(1, (400mm / d)^{1/4}) \times (\min(f_{cu}, 40N/mm^2) / 25N/mm^2)^{1/3} / \gamma_m$ = **0.903** N/mm^2

Design shear resistance provided — $v_{s,prov} = A_{sv,prov} \times 0.87 \times f_{yv} / b$ = **0.492** N/mm^2

Design shear stress provided — $v_{prov} = v_{s,prov} + v_c$ = **1.395** N/mm^2

Design shear resistance — $V_{prov} = v_{prov} \times (b \times d)$ = **143.7** kN

Shear links provided valid between 0 mm and 3300 mm with tension reinforcement of 679 mm²

Spacing of reinforcement (cl 3.12.11)

Actual distance between bars in tension — $s = (b - 2 \times (c_{nom\_s} + \phi_v + \phi_{bot}/2)) /(N_{bot} - 1) - \phi_{bot}$ = **169** mm

Minimum distance between bars in tension (cl 3.12.11.1)

Minimum distance between bars in tension — $s_{min} = h_{agg} + 5$ mm = **25** mm

PASS - Satisfies the minimum spacing criteria

Maximum distance between bars in tension (cl 3.12.11.2)

Design service stress — $f_s = (2 \times f_y \times A_{s,req}) / (3 \times A_{s,prov} \times \beta_b)$ = **130.2** N/mm^2

Maximum distance between bars in tension — $s_{max} = \min(47000 N/mm / f_s, 300 mm)$ = **300** mm

PASS - Satisfies the maximum spacing criteria

Span to depth ratio (cl. 3.4.6)

Basic span to depth ratio (Table 3.9) — $span\_to\_depth_{basic}$ = **20.0**

Design service stress in tension reinforcement — $f_s = (2 \times f_y \times A_{s,req})/ (3 \times A_{s,prov} \times \beta_b)$ = **130.2** N/mm^2

Modification for tension reinforcement

$f_{tens} = \min(2.0, 0.55 + (477N/mm^2 - f_s) / (120 \times (0.9N/mm^2 + (M / (b \times d^2)))))$ = **2.000**

Modification for compression reinforcement

$f_{comp} = \min(1.5, 1 + (100 \times A_{s2,prov} / (b \times d)) / (3 + (100 \times A_{s2,prov} / (b \times d))))$ = **1.089**

Modification for span length — $f_{long} = 1.000$

Allowable span to depth ratio — $span\_to\_depth_{allow} = span\_to\_depth_{basic} \times f_{tens} \times f_{comp}$ = **43.6**

Actual span to depth ratio — $span\_to\_depth_{actual} = L_{s1} / d$ = **32.0**

PASS - Actual span to depth ratio is within the allowable limit