CSS Ref:	P00608
Document:	Structural Calculation Package
Project Address:	53-54 SWANLEY CENTRE, SWANLEY, KENT BR8 7TQ
Date:	May 2025
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1.0 Design Philosophy

The design of the structural elements will be carried out in such a way to limit the impact of the structural works on the existing building construction and that of the neighbouring properties.

This structural design package is carried out in accordance with the relevant British Standards.

This is solely a Permanent Works Structural Design package and does not include any Temporary Works documentation. Temporary works remains the Contractor's responsibility unless a Temporary Works Co-ordinator is appointed.

Note: Calculations are subject to building control approval. Any works carried out prior to approval of calculations by building control are at own risk.

Deflection Limits:

Beams supporting existing masonry	= span/500 Total Load
Beams supporting new structure	= span/360 Live Load
Beams supporting new structure	= span/200 Total Load

Bearing Pressures:

A site specific geotechnical investigation has not been carried out however BGS website has indicated clay soil. Foundation depths for new trench footings have been determined considering NHBC CH4.2. An allowable bearing pressure of 100 kPa will be used in the design of foundations. Local building inspector required to confirm bearing conditions on site prior to pouring new concrete foundations.

Existing Masonry

Existing masonry is to be assessed in accordance with guidance given in CIRIA Report 111 ie, for UNFACTORED LOADS

i) Basic brick compressive strength = 0.42 N/mm2

ii) Enhancement under bearings = 1.5

iii) Therefore padstones to be sized on the basis of a bearing stress of

(0.42 x 1.5 =) 0.63 N/mm2

2.0. Loadings (Service Loads SL)

Pitched Roof

Dead Loads	
Slate and felt	0.30 kN/m^2
Boards and joists	0.25 kN/m^2
Ceiling	0.25 kN/m^2
Services	0.15 kN/m^2
Total Dead Load	**1.00 kN/m^2**
Imposed Load Roof (maintenance)	0.75 kN/m^2
Total Imposed Loading	**0.75 kN/m^2**

Timber Floors

Dead Loads	
Boards and joists	0.30 kN/m^2
Ceiling	0.15 kN/m^2
Services	0.15 kN/m^2
Total Dead Load	**0.50 kN/m^2**
Imposed Load	**1.50 kN/m^2**
Partitions (on plan)	**0.60 kN/m^2**

Walls Loads (on elevation)

Stud Partitions	0.50 kN/m^2
225 Brickwork + Plaster	5.30 kN/m^2

3.0 STRUCTURAL DESIGN CALCULATIONS

EXTERNAL STAIRCASE

Client provided external staircase intent drawing with no input by the staircase supplier. DSK is desging the stair post only.

Assumed selfweight of steel staircase = 3kN/m2
Imposed load = 2.5kN/m2

Design wrost case post

Area of post taking load = 4.3/2 x 1.3/2= 1.4m2
SLS load take down
DL= 3 x 1.4= 4kN , IL= 2.5 x 1.4= 3.5kN

ULS
DL= 4 x 1.35= 5.4kN , IL= 3.5 x 1.5= 5.3kN
T= 5.4+5.3= 10.7kN say 11kN

Column is shorter than above applied load, however design for worse case height = 4.4m

STEEL COLUMN AND BASE PLATE DESIGN (EN1993)

STEEL COLUMN AND BASE PLATE DESIGN (EN1993)

Tedds calculation version 1.0.04

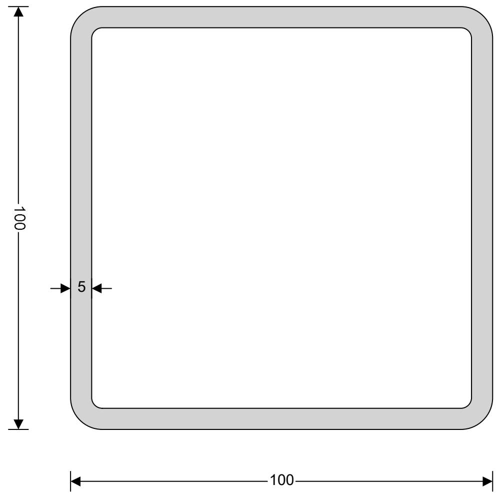
STEEL COLUMN DESIGN (EN1993-1-1:2005)

In accordance with EN1993-1-1:2005 incorporating Corrigenda February 2006 and April 2009 and the UK national annex

Tedds calculation version 1.1.08

Design summary

Description	Unit	Provided	Required	Utilisation	Result
Axial compression	kN	665	11	0.017	PASS
Buckling in compression	kN	250	11	0.044	PASS



SHS 100x100x5.0 (Tata Steel Celsius (Gr355 Gr420 Gr460))
Section depth, h, 100 mm
Section breadth, b, 100 mm
Mass of section, Mass, 14.7 kg/m
Section thickness, t, 5 mm
Area of section, A, 1873 mm^2
Radius of gyration about y-axis, i_y, 38.623 mm
Radius of gyration about z-axis, i_z, 38.623 mm
Elastic section modulus about y-axis, $W_{el.y}$, 55886 mm^3
Elastic section modulus about z-axis, $W_{el.z}$, 55886 mm^3
Plastic section modulus about y-axis, $W_{pl.y}$, 66358 mm^3
Plastic section modulus about z-axis, $W_{pl.z}$, 66358 mm^3
Second moment of area about y-axis, I_y, 2794323 mm^4
Second moment of area about z-axis, I_z, 2794323 mm^4

Column details

Column section **SHS 100x100x5.0** — Steel grade **S355H**
Yield strength f_y = **355** N/mm^2 — Ultimate strength f_u = **470** N/mm^2
Modulus of elasticity E = **210** kN/mm^2 — Shear modulus G = **80.8** kN/mm^2

Column geometry

Major axis buckling length L_y = **4400** mm — Minor axis buckling length L_z = **4400** mm
The column is not part of a sway frame in the direction of the minor axis
The column is not part of a sway frame in the direction of the major axis

Column loading

Axial load N_{Ed} = **11** kN (Compression)
Major axis moment at end 1 $M_{y,Ed1}$ = **0.0** kNm — Major axis moment at end 2 $M_{y,Ed2}$ = **0.0** kNm

Minor axis moment at end 1 $M_{z,Ed1}$ = **0.0** kNm — Minor axis moment at end 2 $M_{z,Ed2}$ = **0.0** kNm

Major axis shear force $V_{y,Ed}$ = **0** kN — Minor axis shear force $V_{z,Ed}$ = **0** kN

Buckling length for flexural buckling - Major axis

End restraint factor K_y = **1.000** — Buckling length L_{cr_y} = **4400** mm

Buckling length for flexural buckling - Minor axis

End restraint factor K_z = **1.000** — Buckling length L_{cr_z} = **4400** mm

Section classification (Table 5.2)

Web classification **1** — Flange classification **1**

The section is class 1

Resistance of cross section (cl. 6.2)

Shear - Minor axis (cl. 6.2.6)

Design shear force $V_{z,Ed}$ = **0.0** kN — Plastic shear resistance $V_{pl,z,Rd}$ = **192.0** kN

PASS - Shear resistance exceeds the design shear force

$V_{z,Ed}$ <= 0.5×$V_{pl,z,Rd}$ - No reduction in f_y required for bending/axial force

Shear - Major axis (cl. 6.2.6)

Design shear force $V_{y,Ed}$ = **0.0** kN — Plastic shear resistance $V_{pl,y,Rd}$ = **192.0** kN

PASS - Shear resistance exceeds the design shear force

$V_{y,Ed}$ <= $0.5 \times V_{pl,y,Rd}$ - No reduction in f_y required for bending/axial force

Compression (cl. 6.2.4)

Design force N_{Ed} = **11** kN   Design resistance $N_{c,Rd}$ = **665** kN

PASS - The compression design resistance exceeds the design force

Combined bending and axial force (cl. 6.2.9)

Buckling resistance (cl. 6.3)

Axial buckling resistance

Flexural buck resist about y $N_{b,y,Rd}$ = **250.2** kN   Flexural buck resist about z $N_{b,z,Rd}$ = **250.2** kN

Min. buckling resistance $N_{b,Rd}$ = **250.2** kN

PASS - The axial load buckling resistance exceeds the design axial load

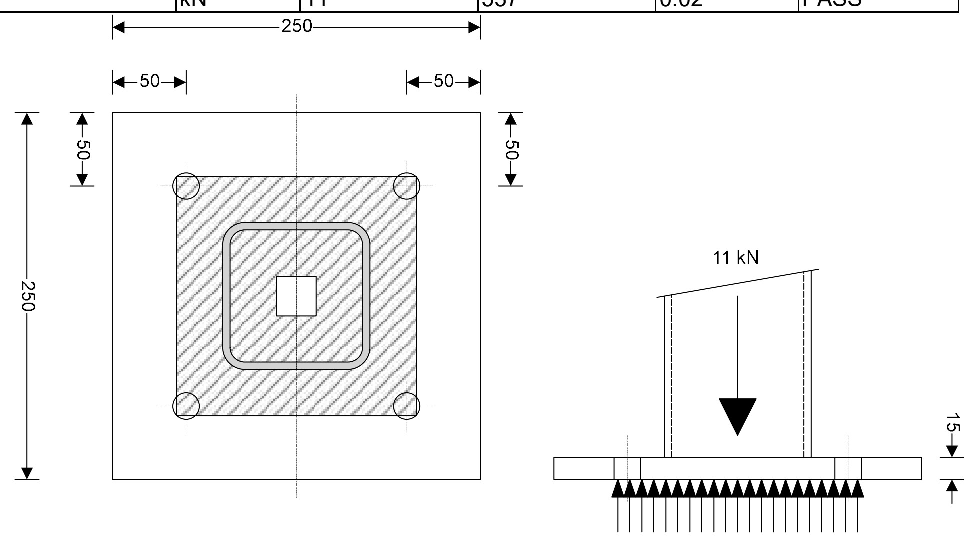
COLUMN BASE PLATE DESIGN

In accordance with EN1993-1-1:2005 incorporating Corrigenda February 2006 and April 2009, and EN1993-1-8:2005 incorporating Corrigenda December 2005, September 2006 and July 2009, and the UK national annex

Tedds calculation version 2.0.13

Design summary

Description	Unit	Design	Resistance	Utilisation	Result
Axial	kN	11	537	0.02	PASS



Design forces

Design axial force N_{Ed} = **11** kN   Design shear force V_{Ed} = **0** kN

Design moment M_{Ed} = **0** kNm

Column Details

Column section **SHS 100x100x5.0**   Depth D = **100** mm

Width B = **100** mm   Thickness t = **5** mm

Base plate details

Length h_p = **250** mm   Width b_p = **250** mm

Thickness t_p = **15** mm   Column eccentricity in x-axis e_{bpx} = **0** mm

Anchor details

Number of anchors LHS n_1 = **2**   Number of anchors RHS n_2 = **2**

Edge distance x-axis e_{x1} = **50** mm Edge distance x-axis e_{x2} = **50** mm

Edge distance y-axis e_{y1} = **50** mm Edge distance y-axis e_{y2} = **50** mm

Anchor diameter $d_{a,b}$ = **16** mm

Foundation details

Foundation depth t_{fnd} = **300** mm

Concrete details

Concrete strength class **C25/30** Char comp cylinder strength f_{ck} = **25** N/mm^2

Partial factor for concrete γ_c = **1.50** Char comp cube strength $f_{ck,cube}$ = **30** N/mm^2

Comp strength coeff α_{cc} = **0.85** Design comp strength f_{cd} = **14.17** N/mm^2

Steel details

Base steel grade **S275** Base nom yield strength f_{yp_plt} = **275** N/mm^2

Base nom ult tensile strength f_{u_plt} = **410** N/mm^2 Column steel grade **User defined**

Column nom yield strength f_{yp_col} = **355** N/mm^2 Column nom ult strength f_{u_col} = **470** N/mm^2

Partial factor cross sections γ_{M0} = **1.00** Partial factor welds γ_{M2} = **1.25**

Foundation bearing strength - EN1992-1-1 Section 6.7

Design bearing strength joint f_{jd} = **20.78** N/mm^2

Base plate compressive resistance

Additional bearing width c = **31.5** mm Effective bearing area A_{eff} = **25845** mm^2

Design resistance $N_{c,Rd}$ = **537** kN

PASS - Design compressive resistance exceeds applied axial load

FOUNDATION SLAB DESIGN FOR STAIRCASE

Allow for 5kN/m2 for surcharge plus point load at for each post

FOUNDATION ANALYSIS & DESIGN (EN1992/EN1997)

FOUNDATION ANALYSIS

In accordance with EN1997-1:2004 + A1:2013 incorporating corrigendum February 2009 and the UK National Annex incorporating corrigendum No.1

Tedds calculation version 3.3.06

Summary table

Description	**Unit**	**Allowable**	**Actual**	**Utilisation**	**Result**
Base pressure	kN/m^2	30	29.2	0.974	Pass
Description	**Unit**	**Provided**	**Required**	**Utilisation**	**Result**
Reinforcement x-dir, top	mm^2	550	507	0.922	Pass
Reinforcement x-direction	mm^2	550	507	0.922	Pass
		Allowable	Actual	Utilisation	
Shear x-axis	kN	174	9	0.051	Pass
Description	**Unit**	**Allowable**	**Actual**	**Utilisation**	**Result**
Punching shear	N/mm^2	0.980	0.035	0.035	Pass

Description	Unit	Allowable	Actual	Utilisation	Result

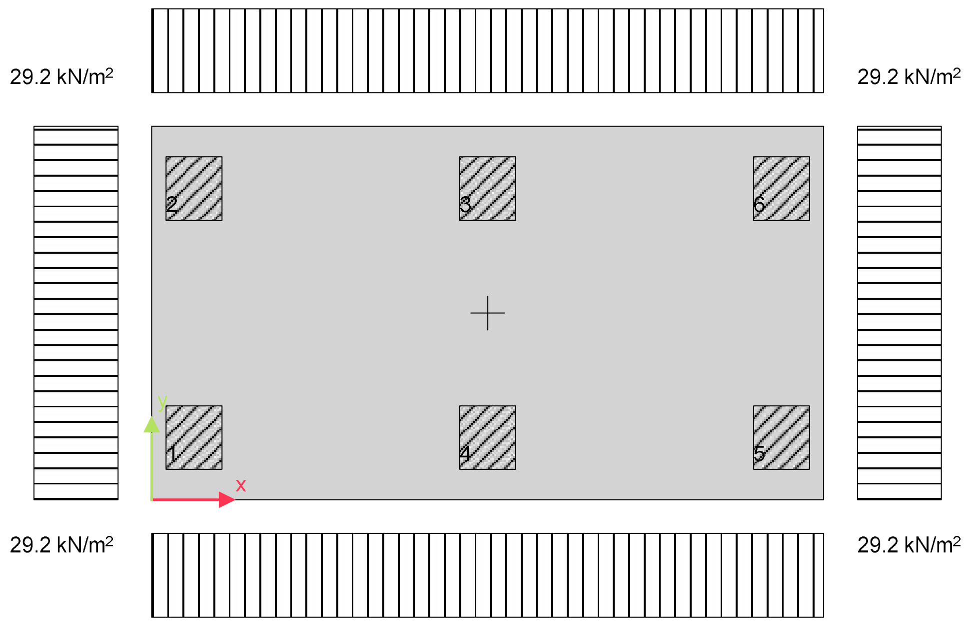
Pad foundation details

Length of foundation L_x = **2700** mm | Width of foundation L_y = **1500** mm

Depth of foundation h = **300** mm | Depth of soil over foundation h_{soil} = **200** mm

Level of water h_{water} = **0** mm | Density of water γ_{water} = **9.8** kN/m^3

Density of concrete γ_{conc} = **25.0** kN/m^3



Column no.1 details

Length of column l_{x1} = **225** mm | Width of column l_{y1} = **255** mm

position in x-direction x_1 = **170** mm | position in y-direction y_1 = **250** mm

Column no.2 details

Length of column l_{x2} = **225** mm | Width of column l_{y2} = **255** mm

position in x-direction x_2 = **170** mm | position in y-direction y_2 = **1250** mm

Column no.3 details

Length of column l_{x3} = **225** mm | Width of column l_{y3} = **255** mm

position in x-direction x_3 = **1350** mm | position in y-direction y_3 = **1250** mm

Column no.4 details

Length of column l_{x4} = **225** mm | Width of column l_{y4} = **255** mm

position in x-direction x_4 = **1350** mm | position in y-direction y_4 = **250** mm

Column no.5 details

Length of column l_{x5} = **225** mm | Width of column l_{y5} = **255** mm

position in x-direction x_5 = **2530** mm | position in y-direction y_5 = **250** mm

Column no.6 details

Length of column l_{x6} = **225** mm | Width of column l_{y6} = **255** mm

position in x-direction x_6 = **2530** mm | position in y-direction y_6 = **1250** mm

Soil properties

Density of soil γ_{soil} = **18.0** kN/m^3 Net ultimate bearing pressure n_f = **30** kN/m^2

Friction angle δ_k = **20** deg

Foundation loads

Permanent surcharge load F_{Gsur} = **2.0** kN/m^2 Variable surcharge load F_{Qsur} = **5.0** kN/m^2

Self weight F_{swt} = **7.5** kN/m^2 Soil weight F_{soil} = **3.6** kN/m^2

Column no.1 loads

Permanent axial load F_{Gz1} = **4.0** kN Variable axial load F_{Qz1} = **3.5** kN

Column no.2 loads

Permanent axial load F_{Gz2} = **4.0** kN Variable axial load F_{Qz2} = **3.5** kN

Column no.3 loads

Permanent axial load F_{Gz3} = **4.0** kN Variable axial load F_{Qz3} = **3.5** kN

Column no.4 loads

Permanent axial load F_{Gz4} = **4.0** kN Variable axial load F_{Qz4} = **3.5** kN

Column no.5 loads

Permanent axial load F_{Gz5} = **4.0** kN Variable axial load F_{Qz5} = **3.5** kN

Column no.6 loads

Permanent axial load F_{Gz6} = **4.0** kN Variable axial load F_{Qz6} = **3.5** kN

Bearing resistance (Section 6.5.2)

Forces on foundation

Force in z-direction F_{dz} = **118.3** kN

Moments on foundation

Moment in x-direction M_{dx} = **159.7** kNm Moment in y-direction M_{dy} = **88.7** kNm

Eccentricity of base reaction

Eccentricity in x-axis e_x = **0** mm Eccentricity in y-axis e_y = **0** mm

Eccentricity of base reaction

Eccentricity in x-axis e_x = **0** mm Eccentricity in y-axis e_y = **0** mm

Pad base pressure

q_1 = **29.2** kN/m^2 q_2= **29.2** kN/m^2 q_3 = **29.2** kN/m^2 q_4 = **29.2** kN/m^2

Minimum base pressure q_{min} = **29.2** kN/m^2 Maximum base pressure q_{max} = **29.2** kN/m^2

Presumed bearing capacity

Presumed bearing capacity $P_{bearing}$ = **30.0** kN/m^2

PASS - Presumed bearing capacity exceeds design base pressure

Design approach 1

Partial factors on actions - Combination1

Partial factor set A1

Permanent action γ_G = **1.35** Variable action γ_Q = **1.50**

Partial factors for spread foundations - Combination1

Resistance factor set R1

Bearing $\gamma_{R.v}$ = **1.00** Sliding $\gamma_{R.h}$ = **1.00**

Forces on foundation

Force in z-direction F_{dz} = **165.9** kN

Moments on foundation

Moment in x-direction M_{dx} = **224.0** kNm | Moment in y-direction M_{dy} = **124.4** kNm

Eccentricity of base reaction

Eccentricity in x-direction e_x = **0** mm | Eccentricity in y-direction e_y = **0** mm

Effective area of base

Effective length L'_x = **2700** mm | Effective width L'_y = **1500** mm

Effective area A' = **4.050** m^2

Pad base pressure

Design base pressure f_{dz} = **41.0** kN/m^2

Design approach 1

Partial factors on actions - Combination2

Partial factor set A2

Permanent action γ_G = **1.00** | Variable action γ_Q = **1.30**

Partial factors for spread foundations - Combination2

Resistance factor set R1

Bearing $\gamma_{R.v}$ = **1.00** | Sliding $\gamma_{R.h}$ = **1.00**

Forces on foundation

Force in z-direction F_{dz} = **130.7** kN

Moments on foundation

Moment in x-direction M_{dx} = **176.4** kNm | Moment in y-direction M_{dy} = **98.0** kNm

Eccentricity of base reaction

Eccentricity in x-direction e_x = **0** mm | Eccentricity in y-direction e_y = **0** mm

Effective area of base

Effective length L'_x = **2700** mm | Effective width L'_y = **1500** mm

Effective area A' = **4.050** m^2

Pad base pressure

Design base pressure f_{dz} = **32.3** kN/m^2

FOUNDATION DESIGN

In accordance with EN1992-1-1:2004 + A1:2014 incorporating corrigenda January 2008, November 2010 and January 2014 and the UK National Annex incorporating National Amendment No.1 and No.2

Tedds calculation version 3.3.06

Concrete details (Table 3.1 - Strength and deformation characteristics for concrete)

Concrete strength class C28/35 | Char.comp.cylinder strength f_{ck} = **28** N/mm^2

Partial factor for concrete γ_C = **1.50** | Maximum aggregate size h_{agg} = **20** mm

Design compressive strength f_{cd} = **17.0** N/mm^2 | Design tensile strength, plain $f_{ctd,pl}$ = **1.1** N/mm^2

Reinforcement details

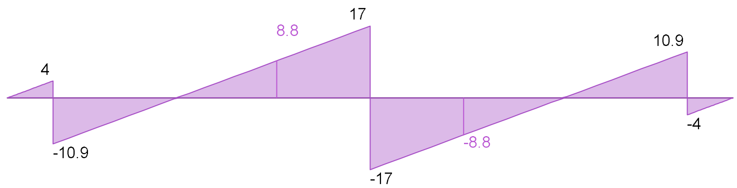
Characteristic yield strength f_{yk} = **500** N/mm^2 | Partial factor for reinforcment γ_S = **1.15**

Design yield strength f_{yd} = **435** N/mm^2 | Nominal cover to top c_{nom_t} = **50** mm

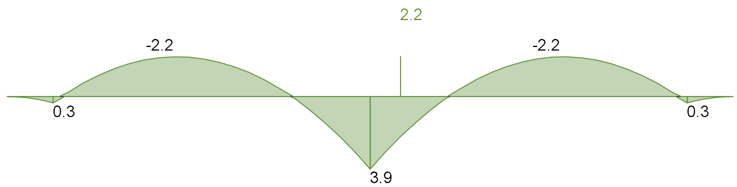
Nominal cover to bottom c_{nom_b} = **50** mm | Nominal cover to side c_{nom_s} = **50** mm

Nominal cover to top reinforcement c_{nom_t} = **50** mm

Shear diagram, x axis (kN)



Moment diagram, x axis (kNm)



Rectangular section in flexure (Section 6.1)

Design bending moment $M_{Ed.x.max}$ = **2.2** kNm K = **0.001** K' = **0.176**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sx.bot.req}$ = **507** mm^2

Tens.reinforcement provided A393 Square mesh (10 ϕ bars @ 200 c/c) $A_{sx.bot.prov}$ = **550** mm^2

Min.area of reinforcement $A_{s.min}$ = **507** mm^2 Max.area of reinforcement $A_{s.max}$ = **14100** mm^2

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

Crack control (Section 7.3)

Limiting crack width w_{max} = **0.3** mm Maximum crack width w_k = **0.015** mm

PASS - Maximum crack width is less than limiting crack width

Rectangular section in flexure (Section 6.1)

Design bending moment abs($M_{Ed.x.min}$) = **2.2** kNm K = **0.001** K' = **0.176**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sx.top.req}$ = **507** mm^2

Tens.reinforcement provided A393 Square mesh (10 ϕ bars @ 200 c/c) $A_{sx.top.prov}$ = **550** mm^2

Min.area of reinforcement $A_{s.min}$ = **507** mm^2 Max.area of reinforcement $A_{s.max}$ = **14100** mm^2

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

Crack control (Section 7.3)

Limiting crack width w_{max} = **0.3** mm Maximum crack width w_k = **0.015** mm

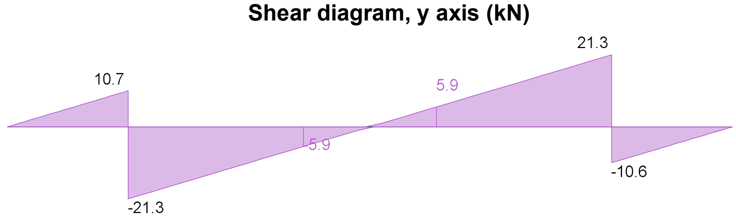
PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear (Section 6.2)

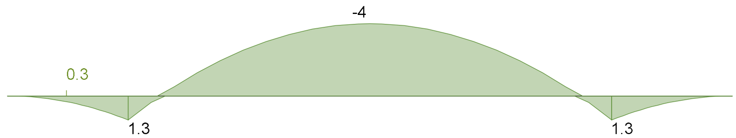
Design shear force $V_{Ed.x.max}$ = **8.8** kN Design shear resistance $V_{Rd.c}$ = **174** kN

PASS - Design shear resistance exceeds design shear force

Shear diagram, y axis (kN)



Moment diagram, y axis (kNm)



Rectangular section in flexure (Section 6.1)

Design bending moment abs($M_{Ed.y.min}$) = **4** kNm K = **0.001** K' = **0.176**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sy.top.req}$ = **952** mm^2

Tens.reinforcement provided A393 Square mesh (10 ϕ bars @ 200 c/c) $A_{sy.top.prov}$ = **1021** mm^2

Min.area of reinforcement $A_{s.min}$ = **952** mm^2 Max.area of reinforcement $A_{s.max}$ = **26460** mm^2

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

Crack control (Section 7.3)

Limiting crack width w_{max} = **0.3** mm Maximum crack width w_k = **0.013** mm

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear (Section 6.2)

Design shear force $V_{Ed.y.max}$ = **5.9** kN Design shear resistance $V_{Rd.c}$ = **313.2** kN

PASS - Design shear resistance exceeds design shear force

Punching shear (Section 6.4)

Maximum shear resiastance $v_{Rd.max}$ = **4.529** N/mm^2 Punching shear resistance $v_{Rd.c}$ = **0.494** N/mm^2

Column No.1 - Punching shear perimeter at column face

Punching shear perimeter u_0 = **960** mm Area within shear perimeter A_0 = **0.057** m^2

Max.punching shear force $V_{Ed.max}$ = **9.7** kN

Punching shear stress factor β = **1.500** Max.punching shear stress $v_{Ed.max}$ = **0.063** N/mm^2

PASS - Maximum punching shear resistance exceeds maximum punching shear stress

Column No.1 - Punching shear perimeter at 1d from column face

Punching shear perimeter u_1 = **1044** mm Area within shear perimeter A_1 = **0.309** m^2

Design punching shear force $V_{Ed.1}$ = **5.8** kN

Punching shear stress factor β = **1.500** Design punching shear stress $v_{Ed.1}$ = **0.035** N/mm^2

PASS - Design punching shear resistance exceeds increased design punching shear stress

Column No.1 - Punching shear perimeter at 2d from column face

Punching shear perimeter u_2 = **1415** mm Area within shear perimeter A_2 = **0.604** m^2

Design punching shear force $V_{Ed.2}$ = **1.1** kN

Punching shear stress factor β = **1.500** Design punching shear stress $v_{Ed.2}$ = **0.005** N/mm^2

PASS - Design punching shear resistance exceeds design punching shear stress

Column No.2 - Punching shear perimeter at column face

Punching shear perimeter u_0 = **960** mm Area within shear perimeter A_0 = **0.057** m^2

Max.punching shear force $V_{Ed.max}$ = **9.7** kN

Punching shear stress factor β = **1.500** Max.punching shear stress $v_{Ed.max}$ = **0.063** N/mm^2

PASS - Maximum punching shear resistance exceeds maximum punching shear stress

Column No.2 - Punching shear perimeter at 1d from column face

Punching shear perimeter u_1 = **1044** mm Area within shear perimeter A_1 = **0.309** m^2

Design punching shear force $V_{Ed.1}$ = **5.8** kN

Punching shear stress factor β = **1.500** Design punching shear stress $v_{Ed.1}$ = **0.035** N/mm^2

PASS - Design punching shear resistance exceeds increased design punching shear stress

Column No.2 - Punching shear perimeter at 2d from column face

Punching shear perimeter u_2 = **1415** mm   Area within shear perimeter A_2 = **0.604** m^2

Design punching shear force $V_{Ed.2}$ = **1.1** kN

Punching shear stress factor β = **1.500**   Design punching shear stress $v_{Ed.2}$ = **0.005** N/mm^2

PASS - Design punching shear resistance exceeds design punching shear stress

Column No.3 - Punching shear perimeter at column face

Punching shear perimeter u_0 = **960** mm   Area within shear perimeter A_0 = **0.057** m^2

Max.punching shear force $V_{Ed.max}$ = **9.7** kN

Punching shear stress factor β = **1.500**   Max.punching shear stress $v_{Ed.max}$ = **0.063** N/mm^2

PASS - Maximum punching shear resistance exceeds maximum punching shear stress

Column No.3 - Punching shear perimeter at 1d from column face

Punching shear perimeter u_1 = **1746** mm   Area within shear perimeter A_1 = **0.408** m^2

Design punching shear force $V_{Ed.1}$ = **4.2** kN

Punching shear stress factor β = **1.500**   Design punching shear stress $v_{Ed.1}$ = **0.015** N/mm^2

PASS - Design punching shear resistance exceeds increased design punching shear stress

Column No.4 - Punching shear perimeter at column face

Punching shear perimeter u_0 = **960** mm   Area within shear perimeter A_0 = **0.057** m^2

Max.punching shear force $V_{Ed.max}$ = **9.7** kN

Punching shear stress factor β = **1.500**   Max.punching shear stress $v_{Ed.max}$ = **0.063** N/mm^2

PASS - Maximum punching shear resistance exceeds maximum punching shear stress

Column No.4 - Punching shear perimeter at 1d from column face

Punching shear perimeter u_1 = **1746** mm   Area within shear perimeter A_1 = **0.408** m^2

Design punching shear force $V_{Ed.1}$ = **4.2** kN

Punching shear stress factor β = **1.500**   Design punching shear stress $v_{Ed.1}$ = **0.015** N/mm^2

PASS - Design punching shear resistance exceeds increased design punching shear stress

Column No.5 - Punching shear perimeter at column face

Punching shear perimeter u_0 = **960** mm   Area within shear perimeter A_0 = **0.057** m^2

Max.punching shear force $V_{Ed.max}$ = **9.7** kN

Punching shear stress factor β = **1.500**   Max.punching shear stress $v_{Ed.max}$ = **0.063** N/mm^2

PASS - Maximum punching shear resistance exceeds maximum punching shear stress

Column No.5 - Punching shear perimeter at 1d from column face

Punching shear perimeter u_1 = **1044** mm   Area within shear perimeter A_1 = **0.309** m^2

Design punching shear force $V_{Ed.1}$ = **5.8** kN

Punching shear stress factor β = **1.500**   Design punching shear stress $v_{Ed.1}$ = **0.035** N/mm^2

PASS - Design punching shear resistance exceeds increased design punching shear stress

Column No.5 - Punching shear perimeter at 2d from column face

Punching shear perimeter u_2 = **1415** mm   Area within shear perimeter A_2 = **0.604** m^2

Design punching shear force $V_{Ed.2}$ = **1.1** kN

Punching shear stress factor β = **1.500**   Design punching shear stress $v_{Ed.2}$ = **0.005** N/mm^2

PASS - Design punching shear resistance exceeds design punching shear stress

Column No.6 - Punching shear perimeter at column face

Punching shear perimeter u_0 = **960** mm   Area within shear perimeter A_0 = **0.057** m^2

Max.punching shear force $V_{Ed.max}$ = **9.7** kN

Punching shear stress factor β = **1.500**   Max.punching shear stress $v_{Ed.max}$ = **0.063** N/mm^2

PASS - Maximum punching shear resistance exceeds maximum punching shear stress

Column No.6 - Punching shear perimeter at 1d from column face

Punching shear perimeter u_1 = **1044** mm Area within shear perimeter A_1 = **0.309** m^2

Design punching shear force $V_{Ed.1}$ = **5.8** kN

Punching shear stress factor β = **1.500** Design punching shear stress $v_{Ed.1}$ = **0.035** N/mm^2

PASS - Design punching shear resistance exceeds increased design punching shear stress

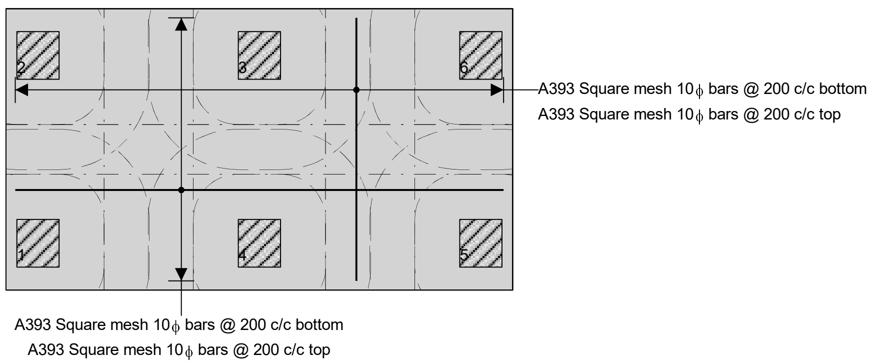
Column No.6 - Punching shear perimeter at 2d from column face

Punching shear perimeter u_2 = **1415** mm Area within shear perimeter A_2 = **0.604** m^2

Design punching shear force $V_{Ed.2}$ = **1.1** kN

Punching shear stress factor β = **1.500** Design punching shear stress $v_{Ed.2}$ = **0.005** N/mm^2

PASS - Design punching shear resistance exceeds design punching shear stress



REV B- 2025.09.30 DATED

The client has omitted the roof lights but is placing pv panel to the roof, the current roof is made of 100mm thick concrete with some insulation and felt at roof level. The PV panel will be placed on a big foot system , the panel weight with the big foot is 25+75=100kg with a total panels of 24 therefore a total load of 2400kg.

As the client is unable to provide reinforcement layout and rebar size , it was agreed to make the slab around the pv panel reduntent and install steel beams below to support the slab around the area in questions.

Exisitng roof build up
Concrete slab 100= 0.1x24= 2.4kN/m2
Insulation = 0.1kN/m2
Felt= 0.15kN/m2
Ceiling and serives= 0.15kN/m2
Total dead load of existing = 2.8kN/m2

Impoaded load = 0.6kN/m2

PV panel area= 1.2 x 1.8= 2.16m2 , weight = 1.0kN
Area load = ½.16=0.47kN/m2

BR-2

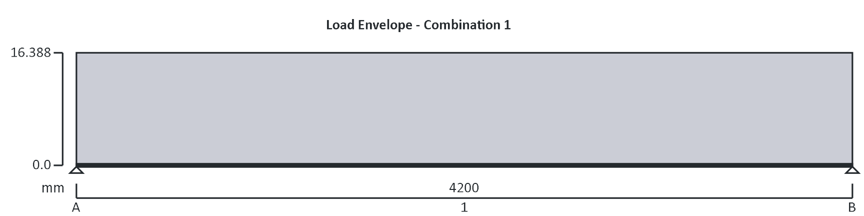
Beam length = 4.2m
UDL
DL= (2.8+0.5) x 5.7/2= 9.4kN/m , IL= 0.6 x 5.7/2= 1.7kN/m

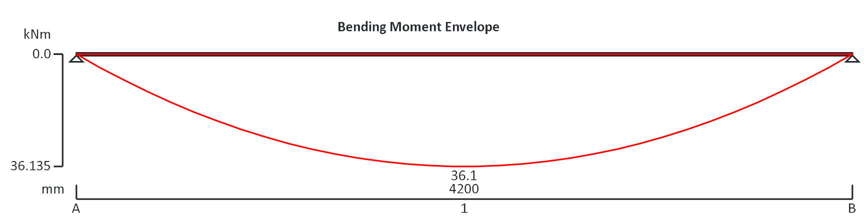
STEEL BEAM ANALYSIS & DESIGN (BS5950)

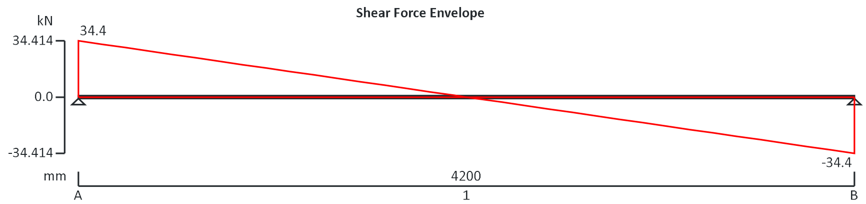
STEEL BEAM ANALYSIS & DESIGN (BS5950)

In accordance with BS5950-1:2000 incorporating Corrigendum No.1

TEDDS calculation version 3.0.08







Support conditions

Support A — Vertically restrained; Rotationally free

Support B — Vertically restrained; Rotationally free

Applied loading

Beam loads — Dead self weight of beam × 1; Dead full UDL 9.4 kN/m; Imposed full UDL 1.7 kN/m

Load combinations

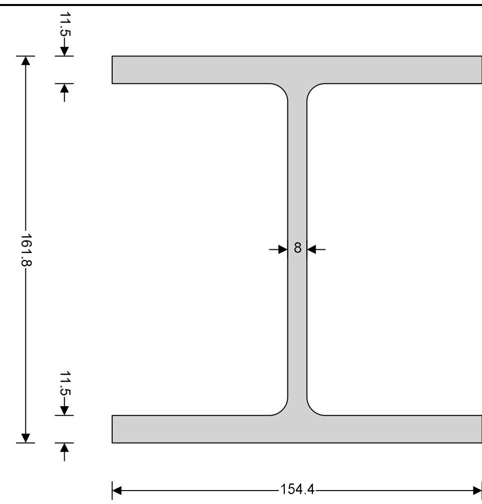
Load combination 1	Support A	Dead × 1.40
		Imposed × 1.60
		Dead × 1.40
		Imposed × 1.60
	Support B	Dead × 1.40
		Imposed × 1.60

Analysis results

Maximum moment	M_{max} = **36.1** kNm	M_{min} = **0** kNm
Maximum shear	V_{max} = **34.4** kN	V_{min} = **-34.4** kN
Deflection	δ_{max} = **10.2** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **34.4** kN	R_{A_min} = **34.4** kN
Unfactored dead load reaction at support A	R_{A_Dead} = **20.5** kN	
Unfactored imposed load reaction at support A	$R_{A\_Imposed}$ = **3.6** kN	
Maximum reaction at support B	R_{B_max} = **34.4** kN	R_{B_min} = **34.4** kN
Unfactored dead load reaction at support B	R_{B_Dead} = **20.5** kN	
Unfactored imposed load reaction at support B	$R_{B\_Imposed}$ = **3.6** kN	

Section details

Section type **UC 152x152x37 (British Steel Section Range 2022 (BS4-1))** Steel grade **S355**



Classification of cross sections - Section 3.5

Tensile strain coefficient ε = **0.88** Section classification **Plastic**

Shear capacity - Section 4.2.3

Design shear force F_v = **34.4** kN Design shear resistance P_v = **275.7** kN

PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment M = **36.1** kNm Moment capacity low shear M_c = **109.6** kNm

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment M_b = **73.4** kNm M_b / m_{LT} = **79.3** kNm

PASS - Buckling resistance moment exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to dead and imposed loads

Limiting deflection δ_{lim} = **16.8** mm Maximum deflection δ = **10.249** mm

PASS - Maximum deflection does not exceed deflection limit

BR-1

Beam length = 5.7m

Point load

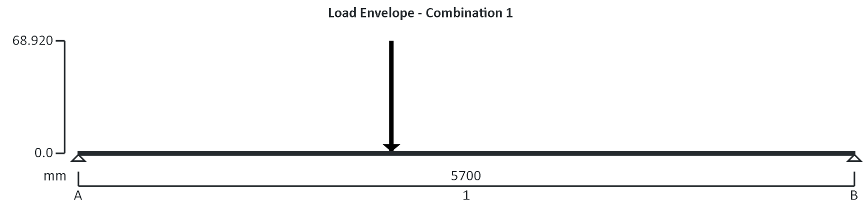
DL= 20.5x2=41kN , IL = 3.6x2= 7.2kN at 2.3m

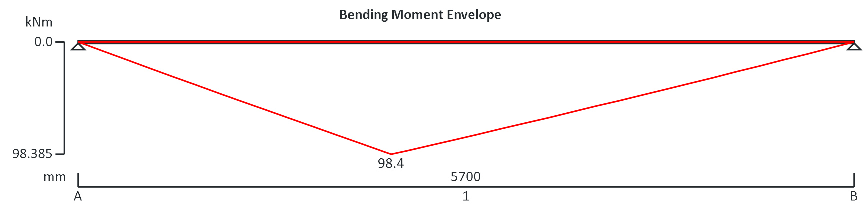
STEEL BEAM ANALYSIS & DESIGN (BS5950)

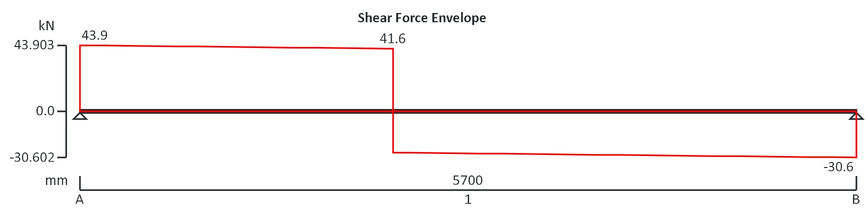
STEEL BEAM ANALYSIS & DESIGN (BS5950)

In accordance with BS5950-1:2000 incorporating Corrigendum No.1

TEDDS calculation version 3.0.08







Support conditions

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

Applied loading

Beam loads	Dead self weight of beam × 1	
	Dead point load 41 kN at 2300 mm	
	Imposed point load 7.2 kN at 2300 mm	

Load combinations

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

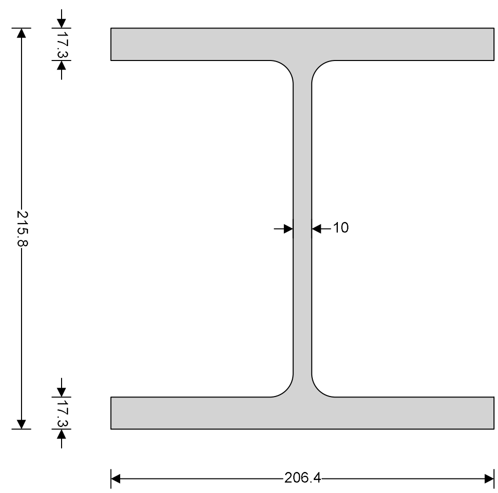
Analysis results

Maximum moment	M_{max} = **98.4** kNm	M_{min} = **0** kNm
Maximum moment span 1 segment 1	$M_{s1\_seg1\_max}$ = **98.4** kNm	$M_{s1\_seg1\_min}$ = **0** kNm
Maximum moment span 1 segment 2	$M_{s1\_seg2\_max}$ = **83.2** kNm	$M_{s1\_seg2\_min}$ = **0** kNm
Maximum shear	V_{max} = **43.9** kN	V_{min} = **-30.6** kN
Maximum shear span 1 segment 1	$V_{s1\_seg1\_max}$ = **43.9** kN	$V_{s1\_seg1\_min}$ = **-27.8** kN

Maximum shear span 1 segment 2	$V_{s1\_seg2\_max}$ = **0** kN	$V_{s1\_seg2\_min}$ = **-30.6** kN
Deflection segment 3	δ_{max} = **11.9** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **43.9** kN	R_{A_min} = **43.9** kN
Unfactored dead load reaction at support A	R_{A_Dead} = **26.5** kN	
Unfactored imposed load reaction at support A	$R_{A\_Imposed}$ = **4.3** kN	
Maximum reaction at support B	R_{B_max} = **30.6** kN	R_{B_min} = **30.6** kN
Unfactored dead load reaction at support B	R_{B_Dead} = **18.5** kN	
Unfactored imposed load reaction at support B	$R_{B\_Imposed}$ = **2.9** kN	

Section details

Section type **UC 203x203x71 (British Steel Section Range 2022 (BS4-1))** Steel grade **S355**



Classification of cross sections - Section 3.5

Tensile strain coefficient ε = **0.89** Section classification **Plastic**

Shear capacity - Section 4.2.3

Design shear force F_v = **43.9** kN Design shear resistance P_v = **446.7** kN

PASS - Design shear resistance exceeds design shear force

Moment capacity at span 1 segment 1 - Section 4.2.5

Design bending moment M = **98.4** kNm Moment capacity low shear M_c = **277** kNm

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment M_b = **253.3** kNm M_b / m_{LT} = **361.9** kNm

PASS - Moment capacity exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to dead and imposed loads

Limiting deflection δ_{lim} = **22.8** mm Maximum deflection δ = **11.889** mm

PASS - Maximum deflection does not exceed deflection limit

PS1

ULS= 44kN

COMPLIES WITH LATEST EUROPEAN DESIGN CODES

structural calculations for padstones

Beam End Reaction = 44.00 kN (factored) Variable Load Safety Factor = 1.5
Factored Load at End of Beam Permanent Load Safety Factor = 1.35

Characteristic strength of masonry = 2.6 N/mm² (Brickwork usually = 4.5 N/mm²)
(3.6N Blockwork usually = 2.6 N/mm²)
Width of beam end bearing = 100 mm (A Engineering Brick = 13.2 N/mm²)
Length of beam end bearing = 100 mm (B Engineering Brick = 10.5 N/mm²)
(Weak Brickwork = approx 2.8 N/mm²)
(7.3N Blockwork usually = 4.2 N/mm²)
(10.4N Blockwork usually = 5.4 N/mm²)

γm = 3.0

Bearing Factor = 1.25

Results

Maximum Bearing Stress = 1.08 N/mm²
Actual Bearing Stress = 4.40 N/mm²

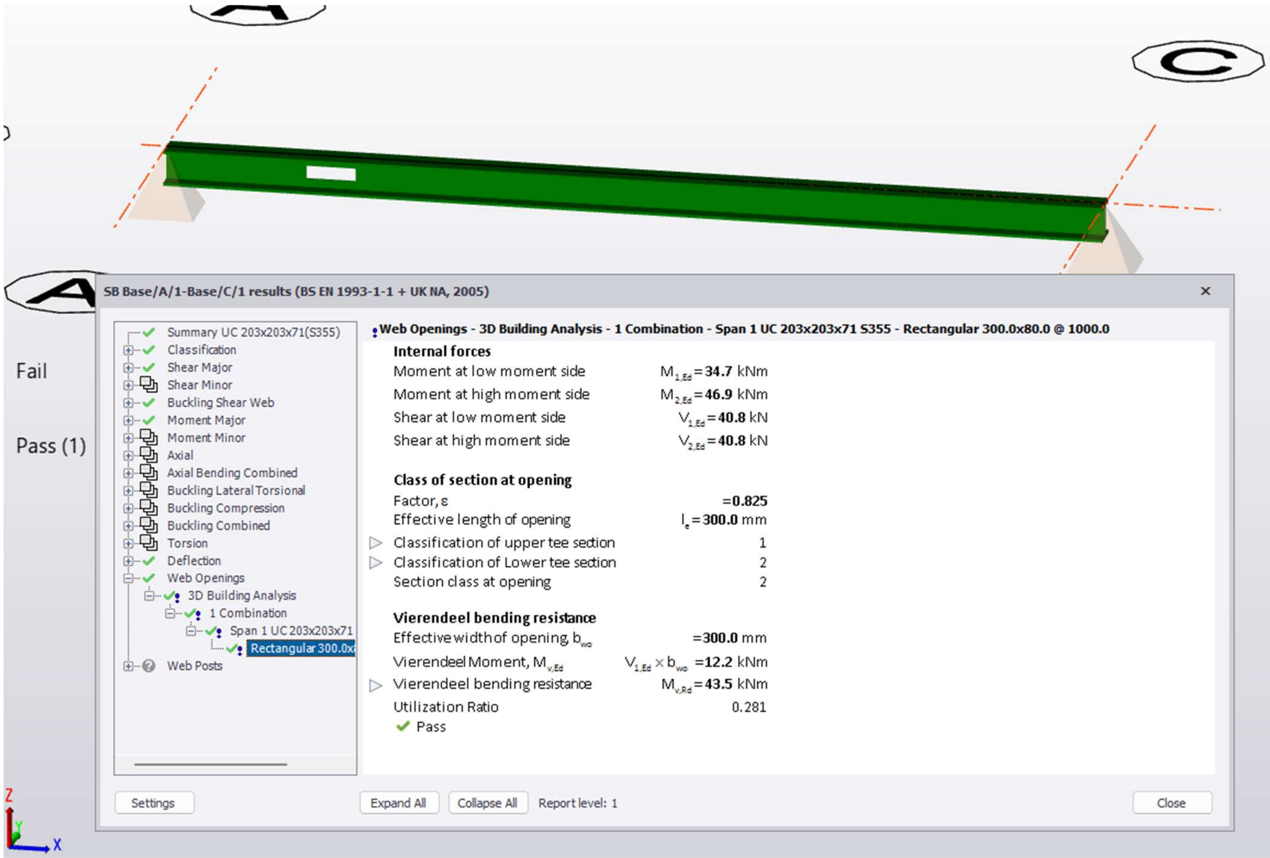
Padstone Required

Padstone Results

Characteristic strength of Padstone = 15.0 N/mm² (A Engineering Brick = 13.2 N/mm²)
(B Engineering Brick = 10.5 N/mm²)
Width of Padstone = 100 mm (Concrete C15 = 15 N/mm²)
Length of Padstone = 440 mm (Concrete C30 = 30 N/mm²)
(Concrete C40 = 40 N/mm²)
(Steel Plate = 275 N/mm²)

Allowable padstone stress = 6.25 N/mm²
Stress under beam end bearing = 4.40 N/mm² Therefore Padstone Stress OK
Allowable masonry stress = 1.08 N/mm²
Stress under padstone = 1.00 N/mm² Therefore Masonry Stress OK

WEB OPENING CHECK



Above confirmed current section is able to take 80x 300 opening with 1m away from support and no stiffeners are required.