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STRUCTURAL AND CIVIL ENGINEERING

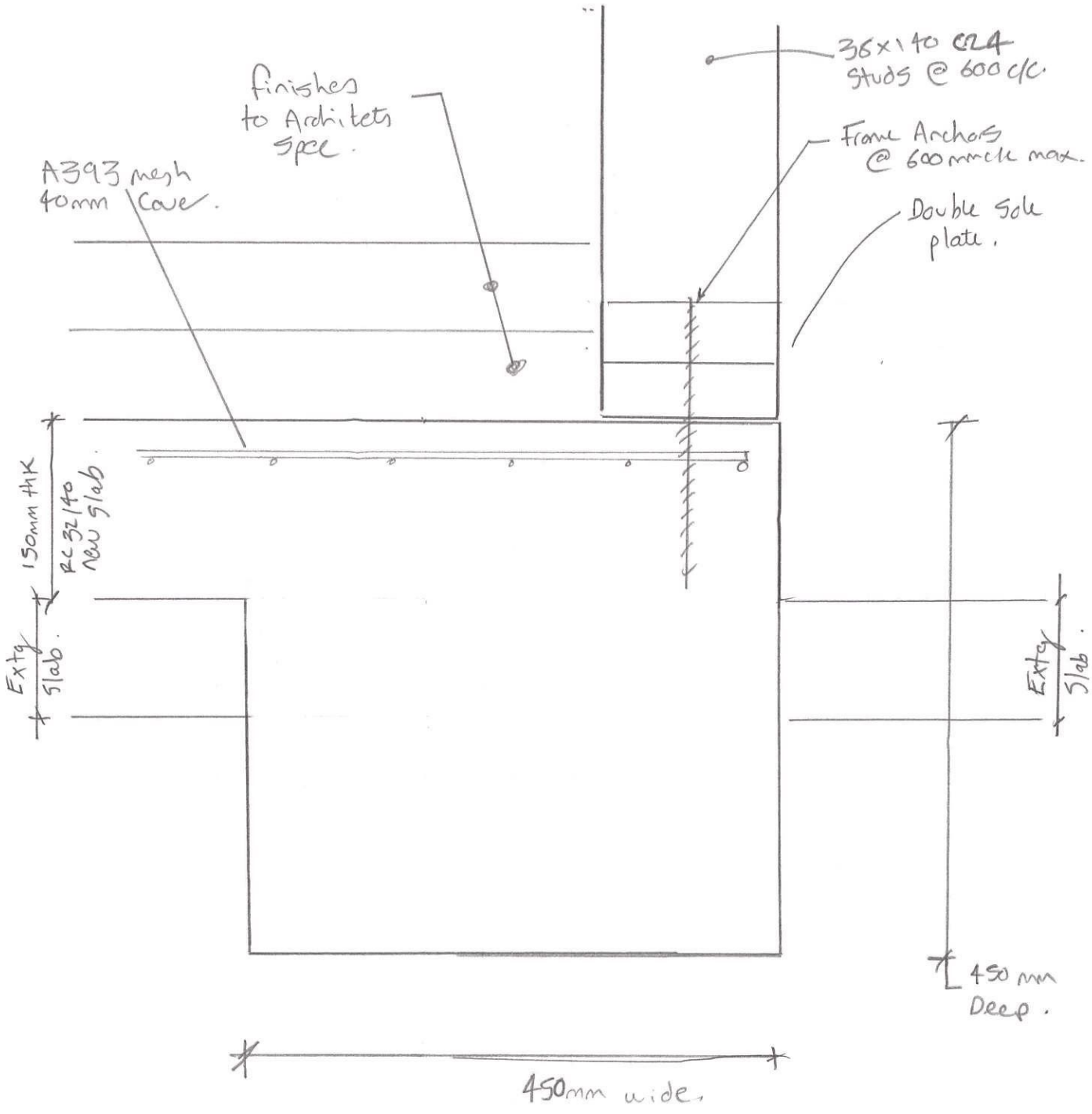
Structural Calculations	Project:	Date: Oct 23	Designer: APW
Project No: 23-249.	Subject:	Sheet No:	Rev: –

Title : Structural Calculations.
Project : Barn Conversion
Location Mercy Bridge Lane
West Pinchbeck
client J. Cassidy.
Engineer A. Wilson CEng MIStructE
Reference SW23-249-CAL-01
Revision Preliminary Issue.

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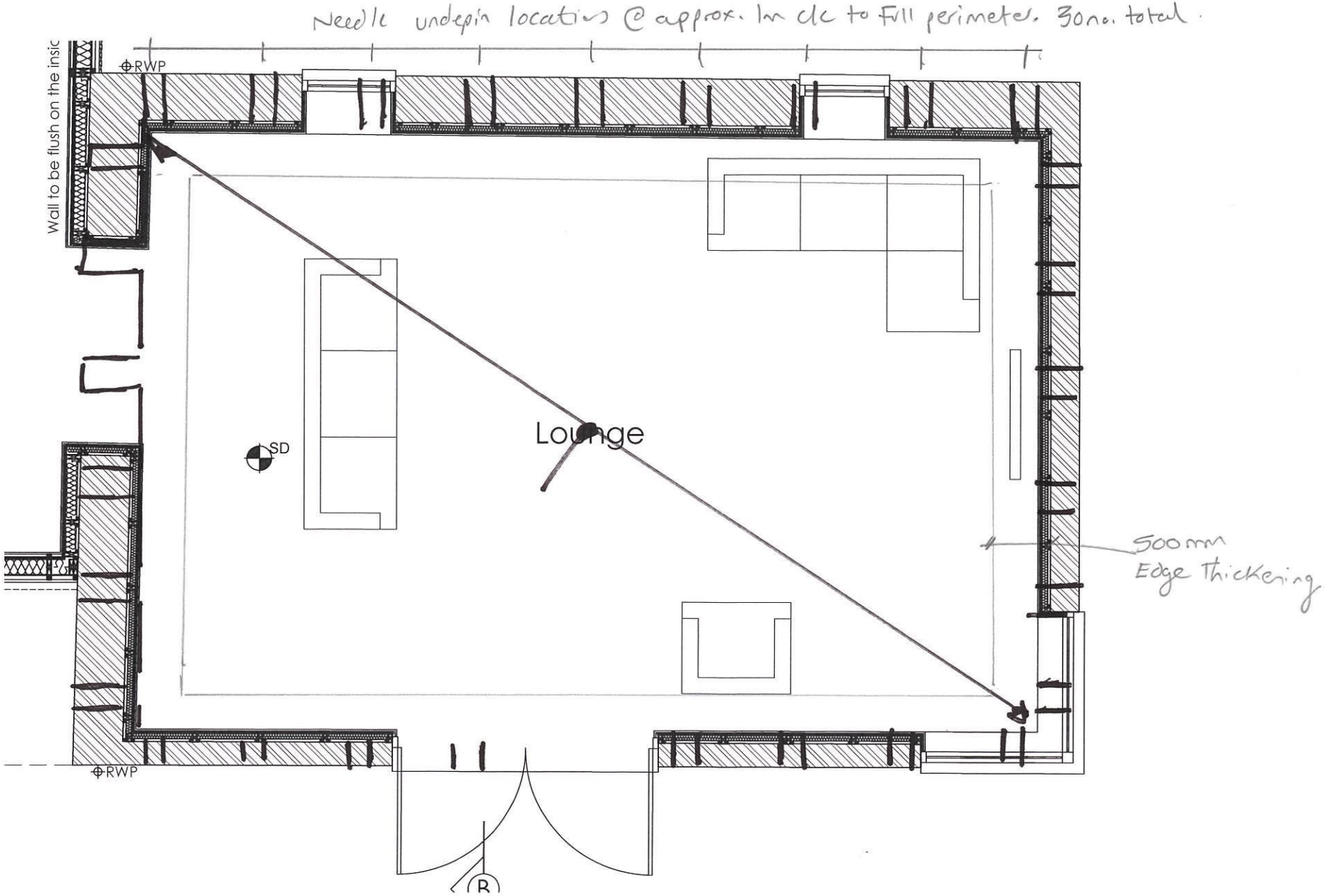
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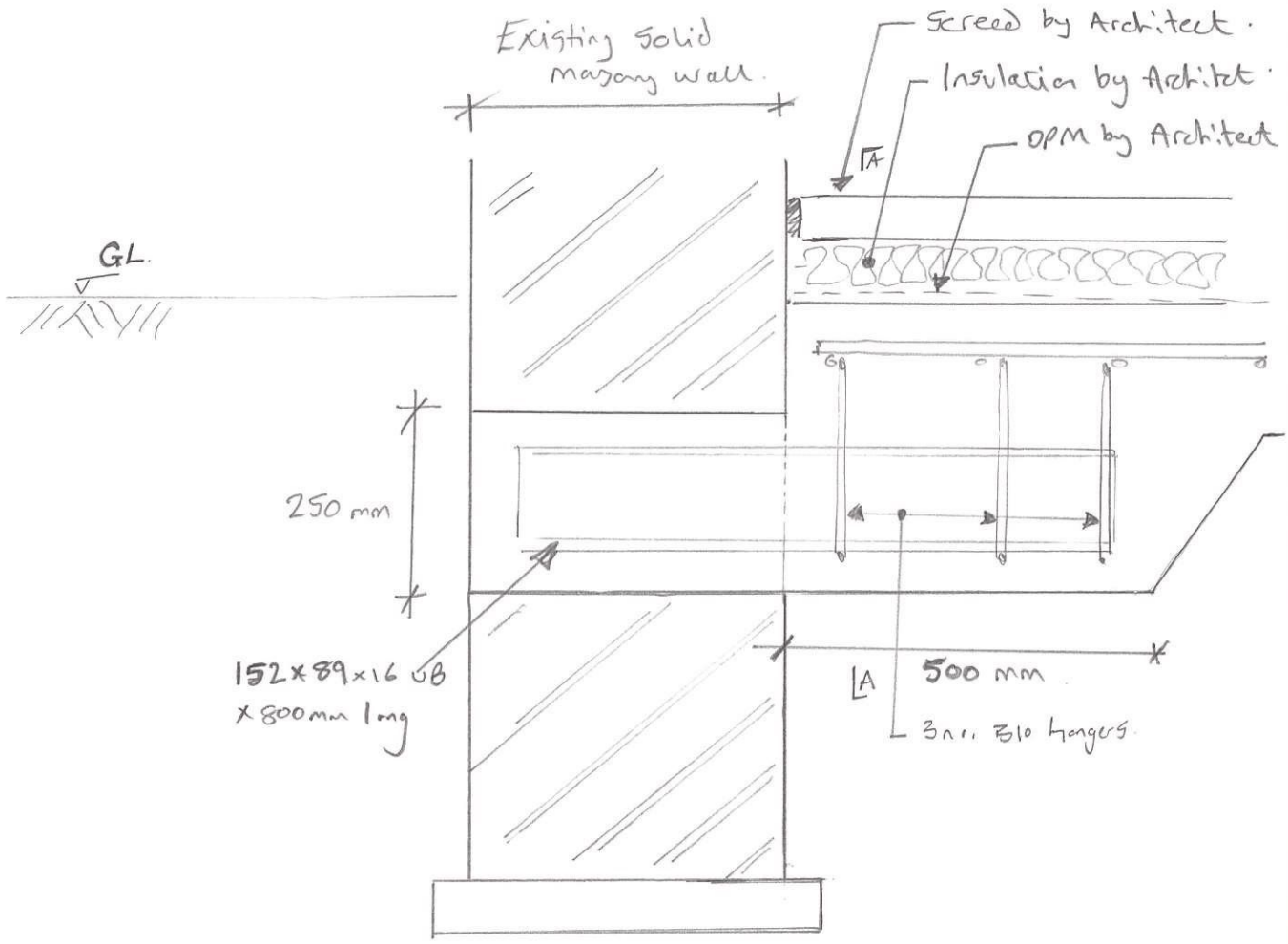
Typical External Foundation Detail.

Copyright Shields Wilson Limited.


Needle underpin locations @ approx. 1m clc to Full perimeter. 30no. total.
Wall to be flush on the insic
RWP
RWP
SD
Lounge
500mm
Edge Thickening
R

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Typical Section on Raft slab underpin.

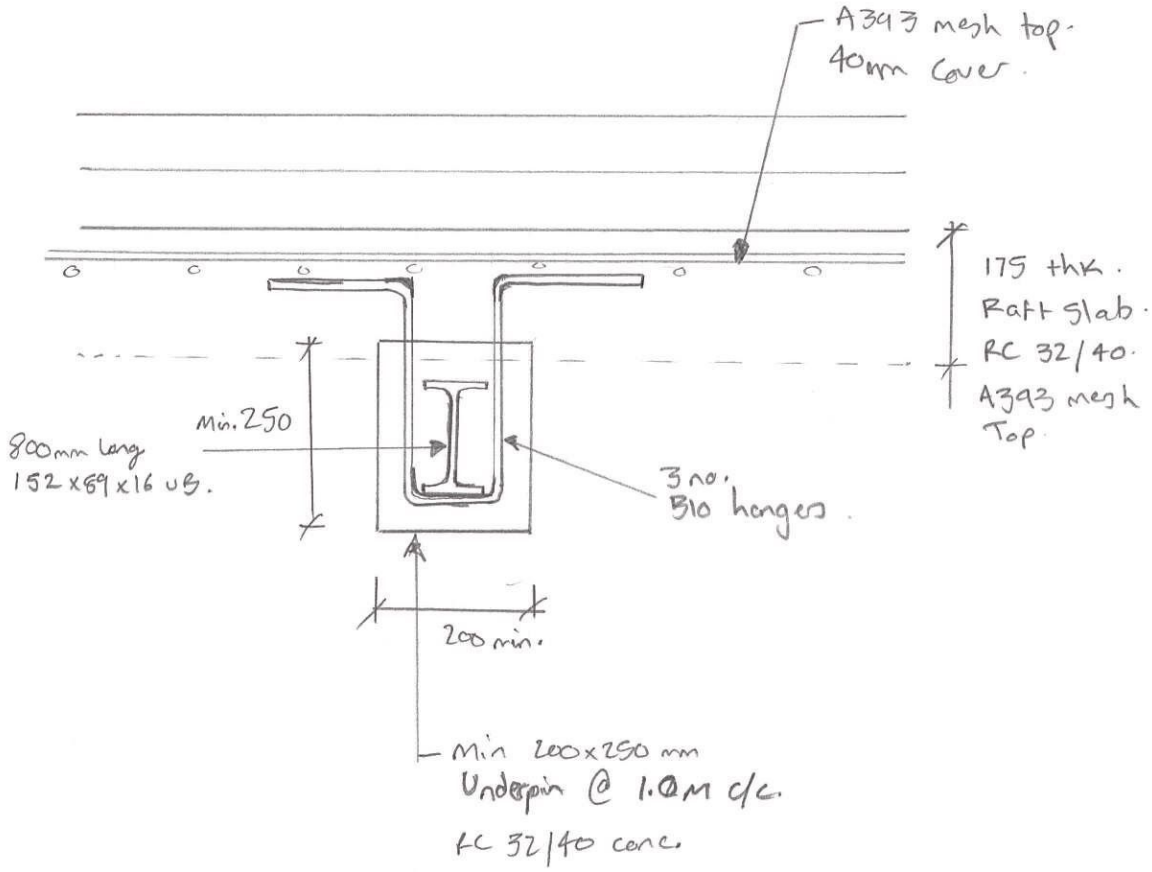
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Section A-A

Underpin Detail

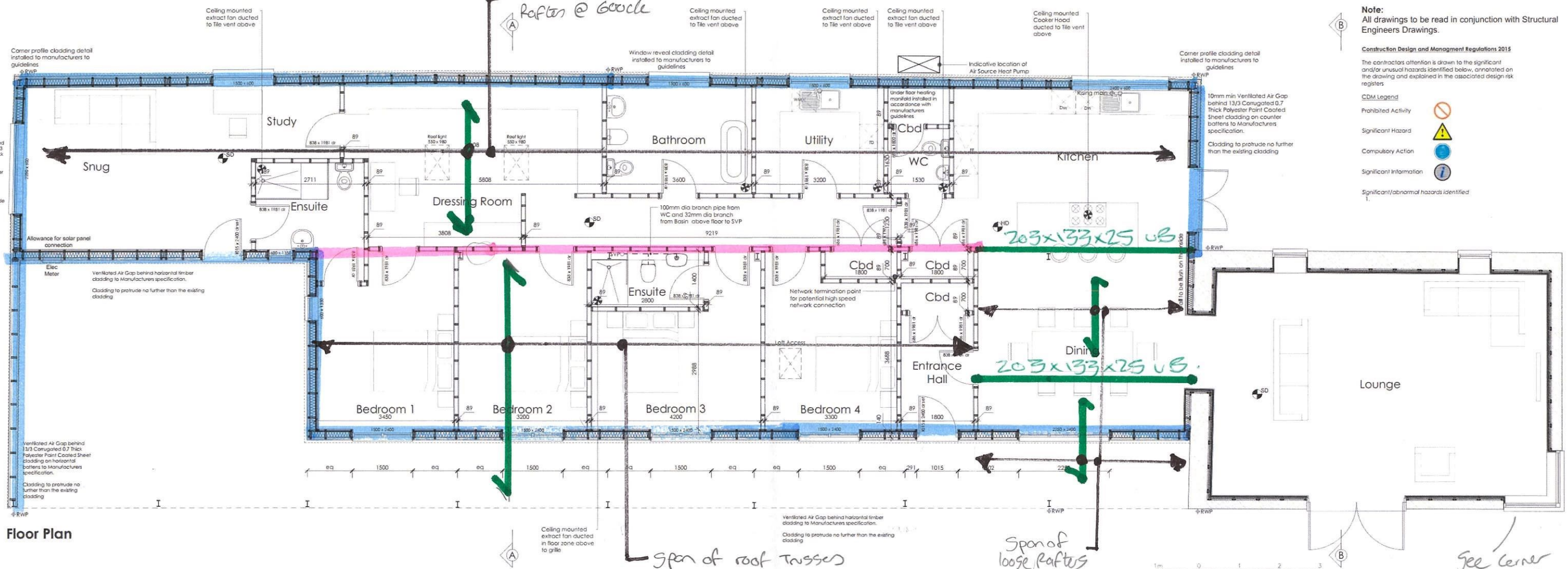
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STUDIO 11 ARCHITECTURE

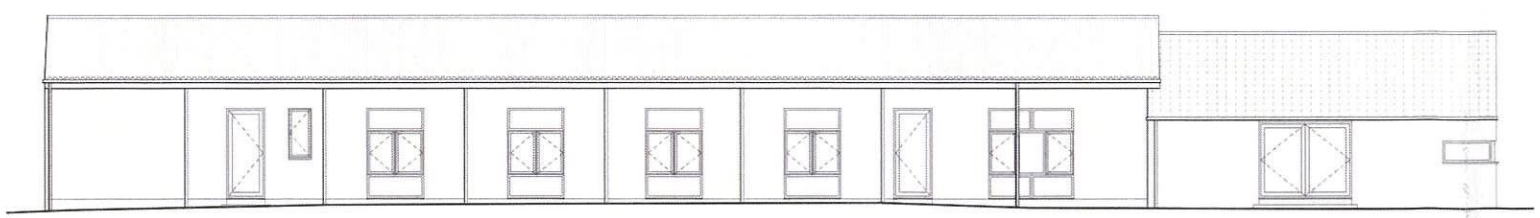
– Internal load bearing stud 38x89 C24 @ 600 c/c.

– External studs 38 x 140 C24 @ 600 c/c

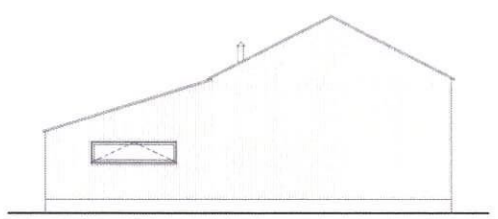
Lean to roof
Span of 47x195 C24
Rafters @ 600c/c



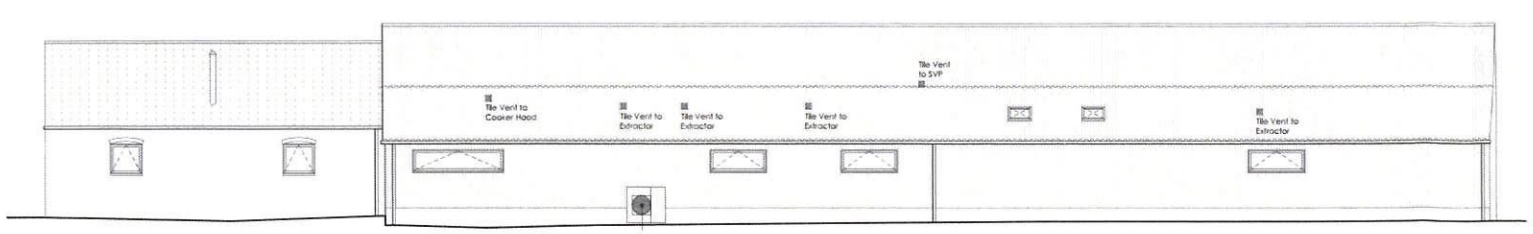
Floor Plan



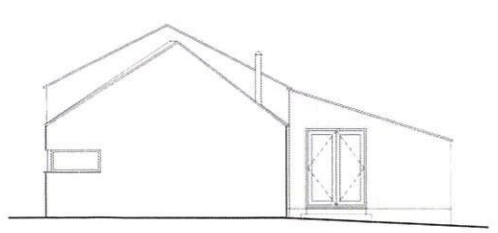
South Elevation



West Elevation



North Elevation



East Elevation

Do not scale directly from this drawing. All discrepancies are to be brought to the attention of the below office.

The copyright to this drawing is owned by studio 11 architecture.

The General Contractor is to check all dimensions on site and report discrepancies to the designer.

All details shown on this drawing, including foundations, are based upon typical site conditions related to the area. No responsibility can be accepted for abnormal conditions which may be discovered during construction, unless reported to the designer, so that design amendments may be considered. Site soil surveys are recommended in respect of foundations to establish specific site conditions before foundation work is undertaken.

The details and information shown hereon relating to existing underground drains, main services, cables, etc. and existing structural details, are as obtained by normal survey observation method. Although all reasonable effort has been made, no guarantee can be made or given for the completeness or accuracy of this information.

Note:
All drawings to be read in conjunction with Structural Engineers Drawings.

Construction Design and Managment Regulations 2015

The contractors attention is drawn to the significant and/or unusual hazards identified below, annotated on the drawing and explained in the associated design risk registers

CDM Legend

Prohibited Activity

Significant Hazard

Compulsory Action

Significant Information

Significant/abnormal hazards identified
1.

REVISION	DATE	DRAWN	DESCRIPTION
A	25.05.2022	AK	Client updates

ISSUE STATUS
BUILDING REGULATIONS

STUDIO11 architecture
KING'S LYNN INNOVATION CENTRE,
INNOVATION DRIVE, KING'S LYNN,
PE30 5BY
T: 01553 970033
E: design@studio11architecture.co.uk
W: www.studio11architecture.co.uk

CLIENT	Mrs J Cassidy
PROJECT	Barn Conversion at Money Bridge Lane, West Pinchbeck
DRAWING	Ground Floor Plan & Elevations

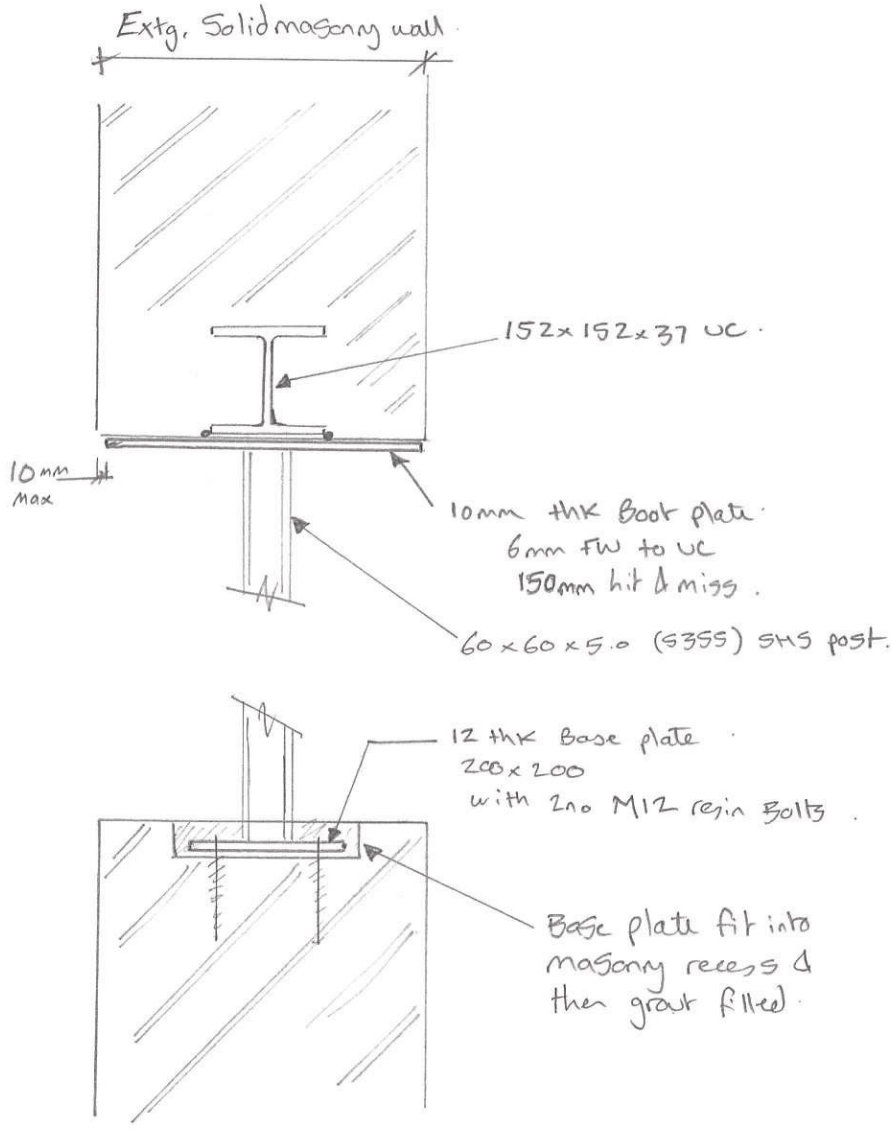
DRAWN	PROJECT DESIGNER	PROJECT DIRECTOR
JMG	JMG	KB
DATE	**SCALE**	**PAPER SIZE**
12.04.2022	1:50 & 1:100	A1

DRAWING NUMBER
541.WD.01 A

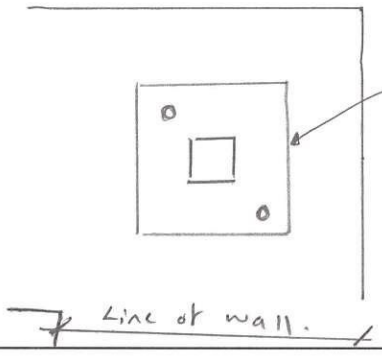
ARCHITECTURE

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Structural Calculations	Project:	Date: Sept 23	Designer: APW
Project No: 23-249	Subject:	Sheet No:	Rev:

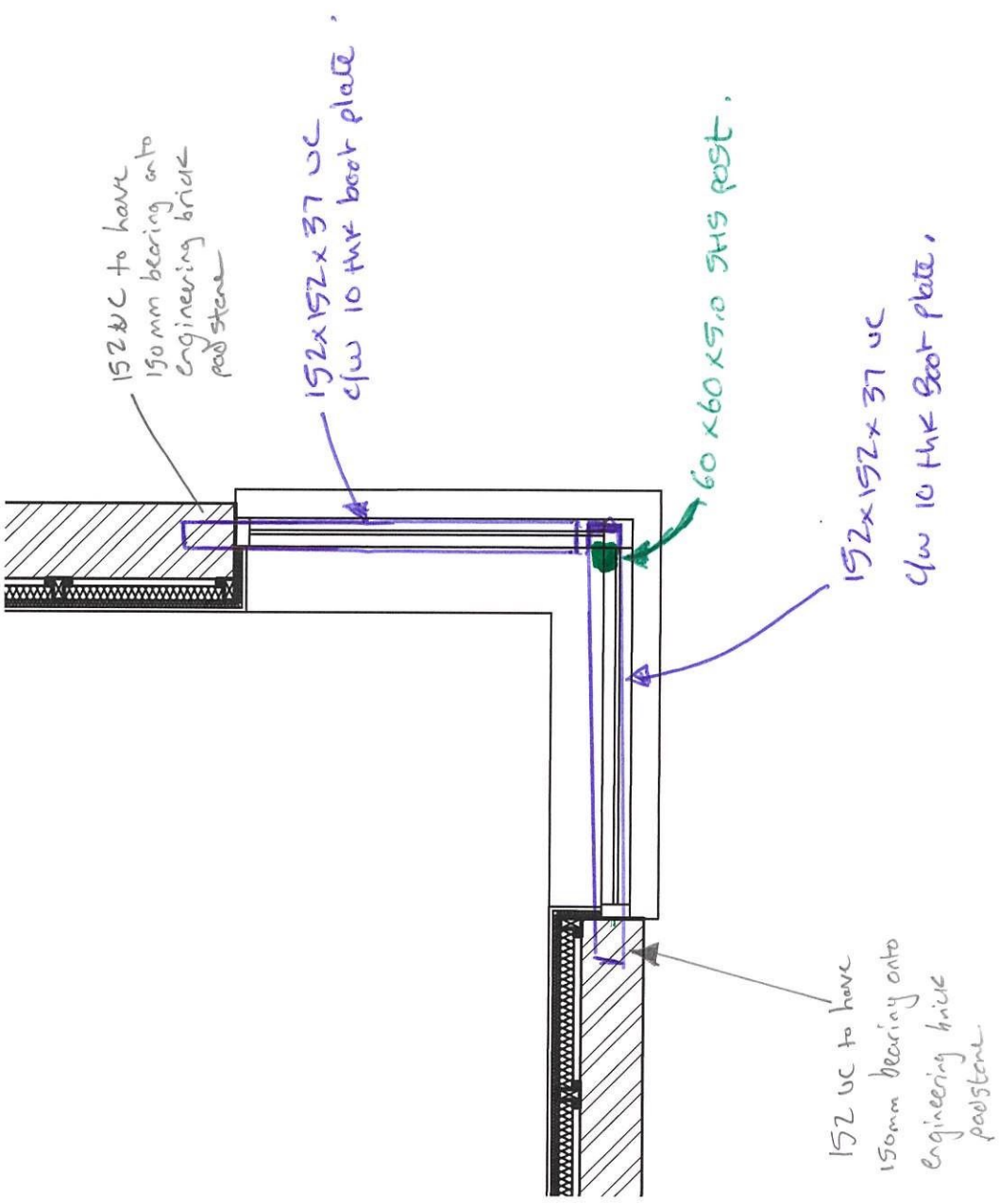


Detail on Corner Lintel & Corner post



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SW 23-249 APW


152 UC to have
150 mm bearing onto
engineering brick
pedestal
152x152x37 UC
c/w 10 thk base plate.
60 x 60 x 5.0 SHS post.
152x152x37 UC
c/w 10 thk base plate.
152 UC to have
150mm bearing onto
engineering brick
pedestal.

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Structural Calculations	Project: Barn Conversion, Money Bridge	Date: Sept 23	Designer: APW
Project No: 23-249	Subject:	Sheet No:	Rev:

Loads -

Roof - Dead	- Cladding	=	0.13		
	Slw Timber	=	0.25		
	ceiling	=	0.20		
	Insulation etc	=	0.10		
			0.68	1.4	0.95
- Imposed	- Snow	=	0.60	1.6	0.96
			1.28		1.91

Wind load calculated using Brave software output on following sheet

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/ MetSPEC / ®
DESIGN SUITE

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Metsec Plc
Purlin Division
Broadwell Road, Oldbury, West Midlands B69 4HF
Tel: 0121 601 6000 Fax: 0121 601 6111
Email: purlin@metsec.com
Website: http://www.metsec.com

Sheet No: of
Job No.: SW23249
Designer: APW
Date: 06/10/2023

Registered Details:-
Shields Wilson Ltd
Bank House, Broad Street,
Spalding, PE11 1TB
Tel: 01775 729252 **Fax:**
Email: info@shieldswilson.co.uk

Wind Assessment to BS6399-2

Data Entry:-

Site Altitude	*3.000*	m	Reference Height (Hr)			Diagonal Dimension (a)		
Basic Wind Speed	*23.300*	m/s	Roof	*5.000*	m	Roof	*7.000*	m
Seasonal Factor (Ss)	*1.000*		Side Walls	*3.000*	m	Sides	*6.000*	m
Probability Factor(Sp)	*1.000*		Gables	*5.000*	m	Gables	*5.000*	m
Site ID	*TF214258*							

Dynamic Pressure Results

Wind Direction (deg)		0	30	60	90	120	150	180	210	240	270	300	330
Direction Factor Sd		0.78	0.73	0.73	0.74	0.73	0.80	0.85	0.93	1.00	0.99	0.91	0.82
Topographic Location Factor s		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Altitude Factor Sa		1.003	1.003	1.003	1.003	1.003	1.003	1.003	1.003	1.003	1.003	1.003	1.003
Effective Height He(m)	Roof	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	Sides	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
	Gable	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Terrain & Building Factor Sb	Roof	1.465	1.510	1.550	1.465	1.465	1.465	1.465	1.465	1.465	1.465	1.465	1.465
	Sides	1.329	1.371	1.407	1.329	1.329	1.329	1.329	1.329	1.329	1.329	1.329	1.329
	Gable	1.465	1.510	1.550	1.465	1.465	1.465	1.465	1.465	1.465	1.465	1.465	1.465
Site Wind Speed Vs(m/s)	Roof	18.23	17.06	17.06	17.29	17.06	18.70	19.86	21.73	23.37	23.14	21.27	19.16
	Sides	18.23	17.06	17.06	17.29	17.06	18.70	19.86	21.73	23.37	23.14	21.27	19.16
	Gable	18.23	17.06	17.06	17.29	17.06	18.70	19.86	21.73	23.37	23.14	21.27	19.16
Effective Wind Speed Ve(m/s)	Roof	26.70	25.77	26.44	25.33	24.99	27.38	29.09	31.83	34.23	33.88	31.15	28.07
	Sides	24.23	23.40	24.00	22.99	22.68	24.86	26.41	28.89	31.07	30.76	28.27	25.48
	Gable	26.70	25.77	26.44	25.33	24.99	27.38	29.09	31.83	34.23	33.88	31.15	28.07
Dynamic Pressure q (kN/m²)	Roof	0.437	0.407	0.428	0.393	0.383	0.460	0.519	0.621	0.718	0.704	0.595	0.483
	Sides	0.360	0.336	0.353	0.324	0.315	0.379	0.428	0.512	0.592	0.580	0.490	0.398
	Gable	0.437	0.407	0.428	0.393	0.383	0.460	0.519	0.621	0.718	0.704	0.595	0.483
Size Effect Factor Cae	Roof	0.975	0.975	0.975	0.975	0.975	0.975	0.975	0.975	0.975	0.975	0.975	0.975
	Sides	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
	Gable	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

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Structural Calculations	Project:	Date: Sep 23	Designer: AFW
Project No: 23-249	Subject:	Sheet No:	Rev:

Stud line load & wind load.

Weight Cage external

Vertical load = $3.3m \times \text{roof} \begin{pmatrix} 1.28 \\ 1.91 \end{pmatrix} = \begin{matrix} 4.22 \\ 6.3 \end{matrix}$ kN/m

Wind load. basic site q derived using BRE software in Loadings.

$p = (\overset{C_{pe}}{0.85} + \overset{C_{pi}}{0.3}) \times 0.592 = 0.681$ kN/m^2.

Stud wall checks undertaken in teeds output on following sheets.

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Structural Calculations	Project:	Date: Sep 23	Designer: APW
Project No: 23-249	Subject:	Sheet No:	Rev:

External wall standard lintel – 1.5m opening design span = 1.7 m.

$w = 4.2$ kN/m.

$W = 1.7 \times 4.2 = 7.1$ kN

$M = 7.1 \times 1.7/8 = 1.5$ kNm.

Doubled up 47 x 140 C24 $G_{11} = 7.5$ N/mm² $E_{min} = 7200$ N/mm². $K_9 = 1.14$.

$M_c = \frac{47 \times 140^2}{6} \times 2 \times 7.5 \times 10^{-6} = 2.3$ kNm. > 1.5 OK.

$\delta = 5 \times 7100 \times 1700^3 / 384 \times 7200 \times 1.14 \left(\frac{47 \times 140^3}{12}\right) = 5.1$ mm.

Allowable = 1700/300 = 5.7 mm > 5.1 OK.

Provide min 2 no. 47 x 140 C24 lintels.

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External Stud Lintel - 2.25m Opening. design span = 2.45m.

$w = 3.3 \times 1.28 = 4.2$ kN/m.

$W = 2.75 \times 4.2 = 10.3$ kN.

$M = 10.3 \times 2.45/8 = 3.15$ kNm

Check doubled up. 47x140. $\sigma_{11} = 5.3$ N/mm² $E_{min.} = 5800$ N/mm².

$M_L = \frac{47 \times 140^2}{6} \times 2 \times 5.3 \times 10^{-6} = 1.63$ kNm <

Try 47x195 C24 Tripled up. $\sigma_{11} = 7.5$ N/mm² $E_{min} = 7200$ N/mm². K

$M_L = \frac{47 \times 195^2}{6} \times 3 \times 7.5 = 6.7$ kNm.

check deflection

$\delta = 5 \times 10300 \times 2250^3 / 384 \times 7200 \times \left(\frac{47 \times 195^3}{12}\right) = 7.3$ mm.

Allowable = $2250/300 = 7.5 > 7.3$ OK.

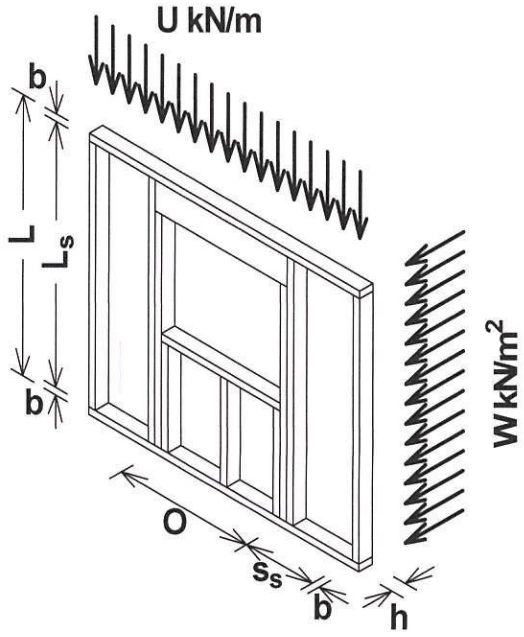
Provide 3 no. 47x195 C24 lintel head over large external opening

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Tekla Tedds Shields Wilson Ltd	Project Money Bridge Barn				Job no. SW23-249	
	Calcs for External Wall stud				Start page no./Revision 1	
	Calcs by APW	Calcs date 06/10/2023	Checked by	Checked date	Approved by APW	Approved date

TIMBER STUD DESIGN (BS5268-2:2002)

TEDDS calculation version 1.0.05



Stud details

Stud breadth	b = **38** mm
Stud depth	h = **140** mm
Number of studs	N_s = **1**

Strength class C16 timber (Table 8 BS5268:Pt 2:2002)

Section properties

Cross sectional area	$A = N_s \times b \times h$ = **5320** mm²
Section modulus	$Z = N_s \times b \times h^2 / 6$ = **124133** mm³
Moment of inertia in the major axis	$I_x = N_s \times b \times h^3 / 12$ = **8689333** mm⁴
Moment of inertia in the minor axis	$I_y = N_s \times h \times b^3 / 12$ = **640173** mm⁴
Radius of gyration in the major axis	$r_x = \sqrt{(I_x / A)}$ = **40.4** mm
Radius of gyration in the minor axis	$r_y = \sqrt{(I_y / A)}$ = **11.0** mm

Panel details - Studs restrained by sheathing in the plane of the panel

Panel height	L = **2400** mm
Stud length	$L_s = L - (2 \times b)$ = **2324** mm
Standard stud spacing	s_s = **600** mm
Panel opening	O = **2250** mm
Loaded panel length	$s = \max(s_s, (O + s_s) / 2)$ = **1425** mm
Effective length in the major axis	$L_{ex} = 0.85 \times L_s$ = **1975** mm
Slenderness ratio	$\lambda = L_{ex} / r_x$ = **48.88**

Vertical loading details	**Dead loads**	**Imposed loads**
Wall UDL	U_{w_d} = **0.75** kN/m	
Roof UDL	U_{r_d} = **2.24** kN/m	U_{r_i} = **1.98** kN/m

Lateral loading details

Wind loading	W = **0.68** kN/m^2
Wind load duration	**Very short term**

Modification factors

Section depth factor	$K_7 = (300\ mm / h)^{0.11}$ = **1.09**
Load sharing factor	K_8 = **1.10**

Consider combined axial compression and bending under very short term loads

Load duration factor	K_3 = **1.75**
Vertical loading	$F = (U_{w_d} + U_{r_d} + U_{r_i}) \times s$ = **7.08** kN

Check bending stress

Bending parallel to grain	σ_m = **5.300** N/mm^2
Permissible bending stress	$\sigma_{m_adm} = \sigma_m \times K_3 \times K_7 \times K_8$ = **11.095** N/mm^2
Bending moment	$M_{max} = W \times s \times L^2 / 8$ = **0.699** kNm
Applied bending stress	$\sigma_{m_max} = M_{max} / Z$ = **5.629** N/mm^2

PASS - Applied bending stress under very short term loads is within permissible limits

Check compressive stress on stud

Compression member factor	K_{12} = **0.67**
Compression parallel to grain	σ_c = **6.800** N/mm^2
Permissible compressive stress	$\sigma_{c_adm} = \sigma_c \times K_3 \times K_8 \times K_{12}$ = **8.791** N/mm^2
Applied compressive stress	$\sigma_{c_max} = F / (N_s \times b \times h)$ = **1.331** N/mm^2

PASS - Applied compressive stress under very short term loads is within permissible limits

Check compressive stress on rail

Bearing stress modification factor	K_4 = **1.36**
Compression perpendicular to grain (no wane)	σ_{cp1} = **2.200** N/mm^2
Permissible compressive stress	$\sigma_{cp1_adm} = \sigma_{cp1} \times K_3 \times K_4$ = **5.223** N/mm^2
Applied compressive stress	$\sigma_{cp1_max} = F / (N_s \times b \times h)$ = **1.331** N/mm^2

PASS - Applied compressive stress under very short term loads is within permissible limits

Check combined axial compression and bending

Euler critical stress	$\sigma_e = (\pi^2 \times E_{min}) / \lambda^2$ = **23.960** N/mm^2
Euler coefficient	$K_{eu} = 1 - (1.5 \times \sigma_{c_max} \times K_{12} / \sigma_e)$ = **0.944**
Combined axial compression and bending value	$K = \sigma_{m_max} / (\sigma_{m_adm} \times K_{eu}) + \sigma_{c_max} / \sigma_{c_adm}$ = **0.689** < 1

PASS - Combined compressive and bending stresses under very short term loads are within permissible limits

Check stud deflection

Euler critical stress	$\sigma_e = (\pi^2 \times E_{min}) / \lambda^2$ = **23.960** N/mm^2
Maximum deflection	δ_{adm} = min(7.0 mm, 0.003 × (L - 2 × b)) = **6.972** mm
Bending deflection	$\delta_{max} = 5 \times W \times s \times L_s^4 / (384 \times E_{mean} \times I_x)$ = **4.820** mm

PASS - Deflection due to wind loading is less than permissible limit

Consider axial compression without bending under medium term loads

Load duration factor	K_3 = **1.25**
Vertical loading	$F = (U_{w_d} + U_{r_d} + U_{r_i}) \times s$ = **7.08** kN

Check compressive stress on stud

Compression member factor	K_{12} = **0.72**
Compression parallel to grain	σ_c = **6.800** N/mm^2
Permissible compressive stress	$\sigma_{c_adm} = \sigma_c \times K_3 \times K_8 \times K_{12}$ = **6.702** N/mm^2

Applied compressive stress $\sigma_{c_max} = F / (N_s \times b \times h) = \mathbf{1.331}$ N/mm²

PASS - Applied compressive stress under medium term loads is within permissible limits

Check compressive stress on rail

Bearing stress modification factor $K_4 = \mathbf{1.36}$

Compression perpendicular to grain (no wane) $\sigma_{cp1} = \mathbf{2.200}$ N/mm²

Permissible compressive stress $\sigma_{cp1_adm} = \sigma_{cp1} \times K_3 \times K_4 = \mathbf{3.731}$ N/mm²

Applied compressive stress $\sigma_{cp1_max} = F / (N_s \times b \times h) = \mathbf{1.331}$ N/mm²

PASS - Applied compressive stress under medium term loads is within permissible limits

Consider axial compression without bending under long term loads

Load duration factor $K_3 = \mathbf{1.00}$

Vertical loading $F = (U_{w_d} + U_{r_d}) \times s = \mathbf{4.26}$ kN

Check compressive stress on stud

Compression member factor $K_{12} = \mathbf{0.74}$

Compression parallel to grain $\sigma_c = \mathbf{6.800}$ N/mm²

Permissible compressive stress $\sigma_{c_adm} = \sigma_c \times K_3 \times K_8 \times K_{12} = \mathbf{5.515}$ N/mm²

Applied compressive stress $\sigma_{c_max} = F / (N_s \times b \times h) = \mathbf{0.801}$ N/mm²

PASS - Applied compressive stress under long term loads is within permissible limits

Check compressive stress on rail

Bearing stress modification factor $K_4 = \mathbf{1.36}$

Compression perpendicular to grain (no wane) $\sigma_{cp1} = \mathbf{2.200}$ N/mm²

Permissible compressive stress $\sigma_{cp1_adm} = \sigma_{cp1} \times K_3 \times K_4 = \mathbf{2.985}$ N/mm²

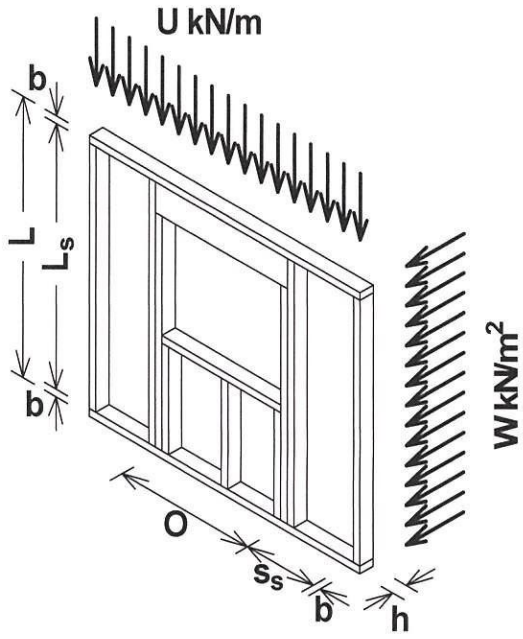
Applied compressive stress $\sigma_{cp1_max} = F / (N_s \times b \times h) = \mathbf{0.801}$ N/mm²

PASS - Applied compressive stress under long term loads is within permissible limits

Tekla Tedds Shields Wilson Ltd	Project Money Bridge Barn				Job no. SW23-249	
	Calcs for Internal Load bearing stud				Start page no./Revision 1	
	Calcs by APW	Calcs date 06/10/2023	Checked by	Checked date	Approved by APW	Approved date

TIMBER STUD DESIGN (BS5268-2:2002)

TEDDS calculation version 1.0.05



Stud details

Stud breadth	b = **38** mm
Stud depth	h = **89** mm
Number of studs	N_s = **1**

Strength class C16 timber (Table 8 BS5268:Pt 2:2002)

Section properties

Cross sectional area	$A = N_s \times b \times h$ = **3382** mm^2
Section modulus	$Z = N_s \times b \times h^2 / 6$ = **50166** mm^3
Moment of inertia in the major axis	$I_x = N_s \times b \times h^3 / 12$ = **2232402** mm^4
Moment of inertia in the minor axis	$I_y = N_s \times h \times b^3 / 12$ = **406967** mm^4
Radius of gyration in the major axis	$r_x = \sqrt{(I_x / A)}$ = **25.7** mm
Radius of gyration in the minor axis	$r_y = \sqrt{(I_y / A)}$ = **11.0** mm

Panel details - Studs restrained by sheathing in the plane of the panel

Panel height	L = **2400** mm
Stud length	$L_s = L - (2 \times b)$ = **2324** mm
Standard stud spacing	s_s = **600** mm
Panel opening	O = **1200** mm
Loaded panel length	$s = \max(s_s, (O + s_s) / 2)$ = **900** mm
Effective length in the major axis	$L_{ex} = 0.85 \times L_s$ = **1975** mm
Slenderness ratio	$\lambda = L_{ex} / r_x$ = **76.89**

Vertical loading details	**Dead loads**	**Imposed loads**
Wall UDL	U_{w_d} = **0.75** kN/m	
Roof UDL	U_{r_d} = **3.74** kN/m	U_{r_i} = **3.30** kN/m

Lateral loading details

Wind loading $W = \mathbf{0.35}$ kN/m²

Wind load duration **Very short term**

Modification factors

Section depth factor $K_7 = (300 \text{ mm} / h)^{0.11} = \mathbf{1.14}$

Load sharing factor $K_8 = \mathbf{1.10}$

Consider combined axial compression and bending under very short term loads

Load duration factor $K_3 = \mathbf{1.75}$

Vertical loading $F = (U_{w_d} + U_{r_d} + U_{r_i}) \times s = \mathbf{7.01}$ kN

Check bending stress

Bending parallel to grain $\sigma_m = \mathbf{5.300}$ N/mm²

Permissible bending stress $\sigma_{m_adm} = \sigma_m \times K_3 \times K_7 \times K_8 = \mathbf{11.662}$ N/mm²

Bending moment $M_{max} = W \times s \times L^2 / 8 = \mathbf{0.227}$ kNm

Applied bending stress $\sigma_{m_max} = M_{max} / Z = \mathbf{4.521}$ N/mm²

PASS - Applied bending stress under very short term loads is within permissible limits

Check compressive stress on stud

Compression member factor $K_{12} = \mathbf{0.40}$

Compression parallel to grain $\sigma_c = \mathbf{6.800}$ N/mm²

Permissible compressive stress $\sigma_{c_adm} = \sigma_c \times K_3 \times K_8 \times K_{12} = \mathbf{5.264}$ N/mm²

Applied compressive stress $\sigma_{c_max} = F / (N_s \times b \times h) = \mathbf{2.073}$ N/mm²

PASS - Applied compressive stress under very short term loads is within permissible limits

Check compressive stress on rail

Bearing stress modification factor $K_4 = \mathbf{1.36}$

Compression perpendicular to grain (no wane) $\sigma_{cp1} = \mathbf{2.200}$ N/mm²

Permissible compressive stress $\sigma_{cp1_adm} = \sigma_{cp1} \times K_3 \times K_4 = \mathbf{5.223}$ N/mm²

Applied compressive stress $\sigma_{cp1_max} = F / (N_s \times b \times h) = \mathbf{2.073}$ N/mm²

PASS - Applied compressive stress under very short term loads is within permissible limits

Check combined axial compression and bending

Euler critical stress $\sigma_e = (\pi^2 \times E_{min}) / \lambda^2 = \mathbf{9.683}$ N/mm²

Euler coefficient $K_{eu} = 1 - (1.5 \times \sigma_{c_max} \times K_{12} / \sigma_e) = \mathbf{0.871}$

Combined axial compression and bending value $K = \sigma_{m_max} / (\sigma_{m_adm} \times K_{eu}) + \sigma_{c_max} / \sigma_{c_adm} = \mathbf{0.839} < \mathbf{1}$

PASS - Combined compressive and bending stresses under very short term loads are within permissible limits

Check stud deflection

Euler critical stress $\sigma_e = (\pi^2 \times E_{min}) / \lambda^2 = \mathbf{9.683}$ N/mm²

Maximum deflection $\delta_{adm} = \min(7.0 \text{ mm}, 0.003 \times (L - 2 \times b)) = \mathbf{6.972}$ mm

Bending deflection $\delta_{max} = 5 \times W \times s \times L_s^4 / (384 \times E_{mean} \times I_x) = \mathbf{6.090}$ mm

PASS - Deflection due to wind loading is less than permissible limit

Consider axial compression without bending under medium term loads

Load duration factor $K_3 = \mathbf{1.25}$

Vertical loading $F = (U_{w_d} + U_{r_d} + U_{r_i}) \times s = \mathbf{7.01}$ kN

Check compressive stress on stud

Compression member factor $K_{12} = \mathbf{0.48}$

Compression parallel to grain $\sigma_c = \mathbf{6.800}$ N/mm²

Permissible compressive stress $\sigma_{c_adm} = \sigma_c \times K_3 \times K_8 \times K_{12} = \mathbf{4.533}$ N/mm²

Applied compressive stress $\sigma_{c_max} = F / (N_s \times b \times h) = \mathbf{2.073}$ N/mm²

PASS - Applied compressive stress under medium term loads is within permissible limits

Check compressive stress on rail

Bearing stress modification factor $K_4 = \mathbf{1.36}$

Compression perpendicular to grain (no wane) $\sigma_{cp1} = \mathbf{2.200}$ N/mm²

Permissible compressive stress $\sigma_{cp1_adm} = \sigma_{cp1} \times K_3 \times K_4 = \mathbf{3.731}$ N/mm²

Applied compressive stress $\sigma_{cp1_max} = F / (N_s \times b \times h) = \mathbf{2.073}$ N/mm²

PASS - Applied compressive stress under medium term loads is within permissible limits

Consider axial compression without bending under long term loads

Load duration factor $K_3 = \mathbf{1.00}$

Vertical loading $F = (U_{w_d} + U_{r_d}) \times s = \mathbf{4.04}$ kN

Check compressive stress on stud

Compression member factor $K_{12} = \mathbf{0.53}$

Compression parallel to grain $\sigma_c = \mathbf{6.800}$ N/mm²

Permissible compressive stress $\sigma_{c_adm} = \sigma_c \times K_3 \times K_8 \times K_{12} = \mathbf{3.986}$ N/mm²

Applied compressive stress $\sigma_{c_max} = F / (N_s \times b \times h) = \mathbf{1.195}$ N/mm²

PASS - Applied compressive stress under long term loads is within permissible limits

Check compressive stress on rail

Bearing stress modification factor $K_4 = \mathbf{1.36}$

Compression perpendicular to grain (no wane) $\sigma_{cp1} = \mathbf{2.200}$ N/mm²

Permissible compressive stress $\sigma_{cp1_adm} = \sigma_{cp1} \times K_3 \times K_4 = \mathbf{2.985}$ N/mm²

Applied compressive stress $\sigma_{cp1_max} = F / (N_s \times b \times h) = \mathbf{1.195}$ N/mm²

PASS - Applied compressive stress under long term loads is within permissible limits

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STRUCTURAL AND CIVIL ENGINEERING

Structural Calculations	Project:	Date: Sep 23	Designer: APW
Project No: 23-249	Subject:	Sheet No:	Rev:

Lean to roof.

Rafter design.

Span = 4.1 m. @ 600 c/c

$W = 0.6 \times 4.1 \times 1.28 = 3.15$ kN.

$M = 3.15 \times 4.1 / 8 = 1.61$ kNm.

$V = 1.575$ kN.

Try 47 x 195 C24. $G_{11} = 7.5$ N/mm² $K_8 = 1.1$.

$M_c = 7.5 \times 1.1 \times \frac{47 \times 195^2}{6} \times 10^{-6} = 2.46$ kNm > 1.6 OK. PASS.

Check deflection.

$\delta = 5 \times 3.15 \times 4.1^3 / 384 \times 7200 \times \left(\frac{47 \times 195^3}{12}\right) = 13.5$ mm.

Allowable = $4.1/300 = 13.6$ mm OK.

Provide 47 x 195 C24 rafters @ 600 c/c for lean to roof.

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Corner Lintel Detail

Design Span = 1.4m.

load = $\begin{matrix}1.28\\1.91\end{matrix}$ x 3 + $\begin{matrix}4.0\\5.6\end{matrix}$ x 0.3 = $\begin{matrix}5.04\\7.41\end{matrix}$ kN/m.

W = $\begin{matrix}5.04\\7.41\end{matrix}$ x 1.4 = $\begin{matrix}7.06\\10.4\end{matrix}$ kN.

$M = 10.4 \times \frac{1.4}{8} = 1.82$ kNm.

$I_{xreq} = 5 \times 7.06 \times 1.4^3 / 384 \times 205 \times 10^{-2} \times \left(1.4/360\right) = 31.6\ cm^4$.

Provide 152x152x30 UC. By inspection.
c/w 10mm thk Btm plate.

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Roof Support Beam

Design Span = 5.4m.

load w = 3.5 × 1.28 = 4.48 kN/m.
1.91 6.69

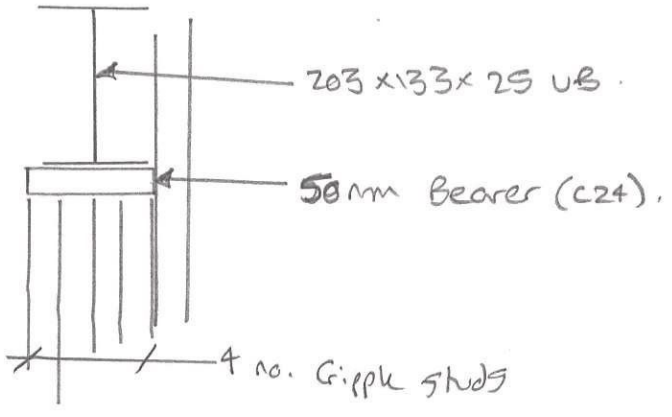
W = 5.4 × 4.48 = 24.2 kN.
6.69 36.1

$M = 36.1 \times 5.4/8 = 24.4$ kNm.

$I_{req} = 5 \times 24.2 \times 5.4^3 / 384 \times 205 \times 10^{-2} \times (5.4/360) = 161.4$ cm⁴.

Provide 203 × 133 × 25 UB. $M_{b@5.0} = 32$ kNm
$I_x = 2340$ cm⁴.

Loading onto 4 No. 38 × 89 Gipple studs.



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