

## Construction Monitoring – Building Regulation Clause(s) B1

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|                           |                                         |              |                     |
|---------------------------|-----------------------------------------|--------------|---------------------|
| <b>Issued By:</b>         | Structx Harvard Ltd.                    | <b>Date:</b> | 11 April 2017       |
| <b>To:</b>                | Clip 'n' Climb                          |              |                     |
| <b>To be Supplied To:</b> | Christchurch City Council               |              |                     |
| <b>In Respect Of:</b>     | Proposed Office Addition                |              |                     |
| <b>At:</b>                | 80 Byron Street, Sydenham, Christchurch | <b>Lot:</b>  | 1 <b>DP:</b> 449853 |

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Construction monitoring is limited to structural elements as described in the Producer Statement – PS1 Design.

Structex Harvard Limited has been engaged by Clip 'n' Climb to undertake construction monitoring of the work covered by our Producer Statement – PS1 Design. The extent of the construction monitoring will be to CM3 level and appropriate to the scale and complexity of the project and will include inspections and observations of the following:

- Excavation (subgrade beneath foundation footprint) to be inspected by geotechnical engineer.
- Foundations before casting.
- Concrete block walls after reinforcing but before grouting.
- Structural steelwork after erection.
- Connections between structural components.

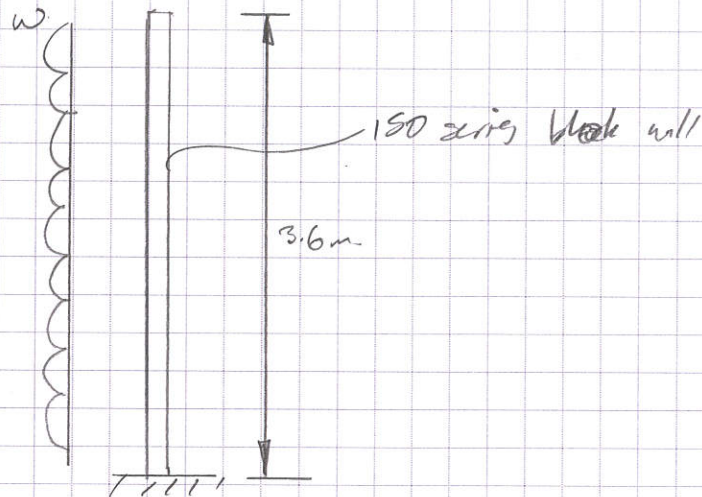
At completion, and on request, Structex Harvard Limited will supply a Producer Statement – Construction Review (PS4) of the standard form agreed by Joint ACENZ/NZIA/IPENZ committee, in conjunction with the Contractor's Producer Statement – Construction (PS3).

A record of each site visit made by our firm to check Building Code compliance matters will be left on site at the completion of that site visit.



.....  
Julia Clendon  
Structural Engineer

Design Cantilever block wall on Grid A.  
check fire first (0.5 kPa)



$$W_{\text{fire}} = 0.5 \text{ kPa}$$

$$M^u = \frac{0.5 \times 3.6^2}{2}$$

$$= 3.24 \text{ kNm}$$

Try H12's @ 400 c/m

$$A_s R_y = 12^2 \times \frac{\pi}{4} \times \frac{1000}{400} \times 500$$

$$= 141371$$

$$\phi M_n = A_s R_y \left( d - \frac{a}{2} \right)$$

$$a = A_s R_y / \alpha_s f_c b$$

$$= 141371 / 0.85 \times 15 \times 1000$$

$$= 13 \text{ mm} = 16 \text{ mm}$$

$$\phi M_n = 141371 \times \left( 75 - \frac{13}{2} \right) \times 7$$

$$= 9.68 \text{ kNm} \times 0.85$$

$$= 8.23 \text{ kNm} > 3.24 \text{ OK}$$

Earthquake loads

$$T = 0.4 \text{ seconds}$$

$$\eta(T, 0) = 1$$

$$\mu = 1.25 \text{ seismic}$$

$$Z = 0.3$$

Soil Class D

$$\mu = 1.25 \text{ (maximally ductile)}$$

$$S_p = 0.9$$

$$C_u(T_1) = 3.0$$

$$\begin{aligned} C(T) &= Z R_u \times C_u(T) \times \eta(T, 0) \\ &= 0.3 \times 1 \times 3 \\ &= 0.9 \end{aligned}$$

$$\begin{aligned} R_u &= (1.25 - 1) \times \frac{0.4}{0.7} + 1 \\ &= 1.14 \end{aligned}$$

$$\begin{aligned} C_d(T_1) &= \frac{S_p C(T)}{R_u} \\ &= \frac{0.9 \times 0.9}{1.14} \\ &= 0.71 \end{aligned}$$

Seismic Mass of wall:

$$\begin{aligned} W_{eq} &= 24 \text{ kN/m}^3 \times 0.14 \\ &= 3.36 \text{ kN/m}^2 \times 0.91 \\ &= 2.39 = 2.45 \text{ kN/m}^2 \leftarrow 0.728 \end{aligned}$$

Pure Cantilever

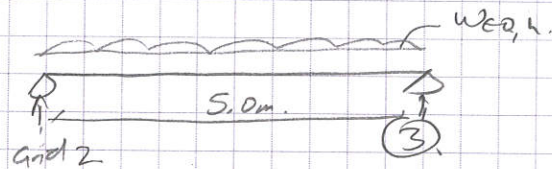
$$\begin{aligned} M^* &= \frac{wL^2}{2} \\ &= \frac{2.39 \times 3.6^2}{2} \end{aligned}$$

$$= 15.85 \text{ kNm} \rightarrow \text{Not going to achieve this}$$

→ Distribute out-of-plane load back into timber framed bracing walls on Grids 2 & 3.

→ check horizontal span between 2 & 3.





$$w_{eq,h} = 2.45 \text{ kN/m}$$

$$M_u = \frac{wL^2}{8}$$

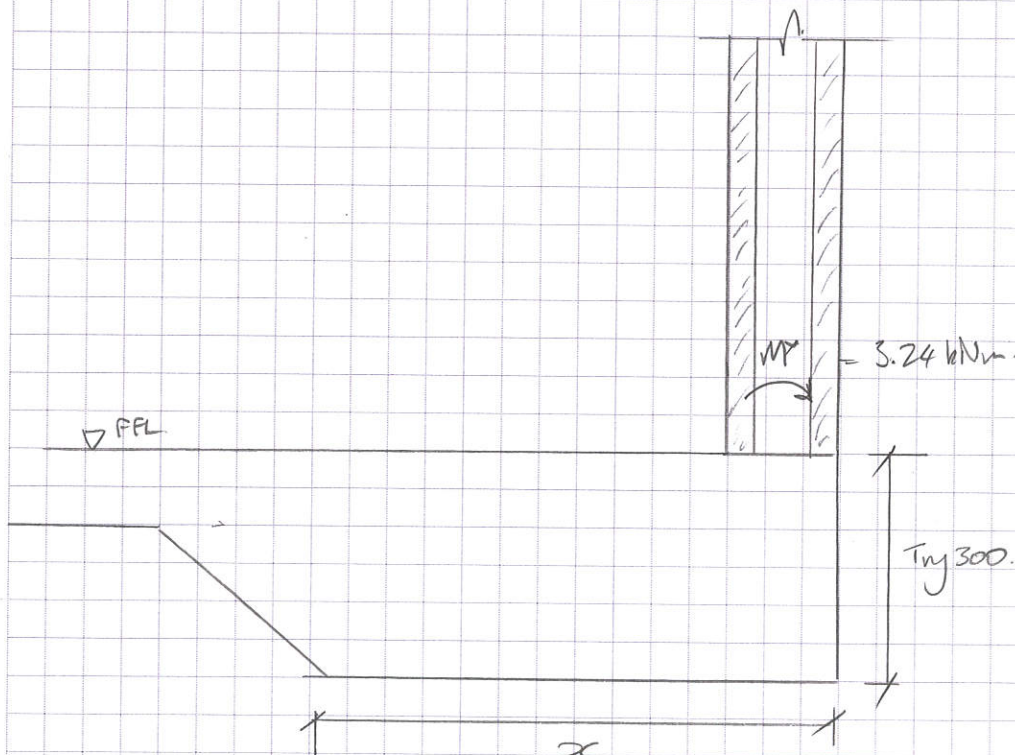
$$= \frac{2.45 \times 5^2}{8}$$

$$= 7.47 \text{ kNm} < 8.23$$

$$7.66 \text{ kNm}$$

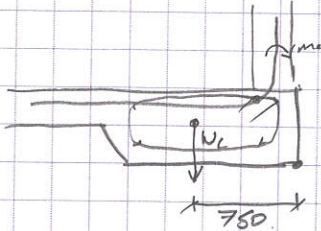
→ HRS @ 400mm Horizontal  
OK

Design foundation to take 3.24 kNm of Moment





Try  $\alpha = 1500 \text{ mm}$ .



$$\begin{aligned} M_R &= 1500 \times 300 \times 25 \times 0.75 \\ &= 8.43 \text{ kNm} > 3.24 \text{ OK} \end{aligned}$$

Foundation  $\rightarrow$  Gravelly reinforced with 2 layers H12 bars  
@ 400 c/s.

Design Timber framed shear wall on Grid 2.

$$\text{Trib width} = 2.5 + 3.8 \\ = 6.3 \text{ m.}$$

Load from block wall:

$$P_{\text{wall},A} = 2.39 \text{ kPa} \times 6.3 \times 3.6/2 \\ = 27 \text{ kN.}$$

$$P_{\text{wall},C} = 27/2 \\ = 13.6 \text{ kN}$$

$$P_{\text{roof}} = 0.3 \text{ kPa} \times 0.71 \times 6.3 \times 8 \text{ m} \\ = 10.7 \text{ kN.}$$

$$P_{\text{total}} = 51.3 \text{ kN.}$$

$$\text{OR} = 51.3 \times 20 \frac{\text{BU's}}{\text{MN}} \\ = 1026 \text{ BU's.}$$

(at  $n=1.25$ , this is very conservative)

$\Rightarrow$  Over 8m length of wall is required.

$$\text{BU's}_{\text{req}} = 1026/8 \text{ m} \\ = 128 \text{ BU's/m for EQ.}$$

$$\text{BLG-H gives a rating of } 145 \text{ BU's} \times \frac{2.4}{3.2} = 106 < 128 \text{ NOT OK}$$

$$\text{GSP-H gives } 150 \text{ BU's/m} \times 0.73 = 110 \text{ BU's/m}$$

Check Wall 3

$$\text{Trib width} = 2.5 + 1.5 \\ = 4 \text{ m.}$$

$$P_{\text{wall},A} = 2.39 \times 4 \times 3.6/2 = 17.2 \text{ kN.}$$

$$P_{\text{wall},C} = 17.2/2 = 8.6 \text{ kN.}$$

$$P_{\text{roof}} = 0.3 \times 0.71 \times 4 \times 8 = 6.9 \text{ kN.}$$

$$32.6 \text{ kN. OR } 652 \text{ BU's}$$

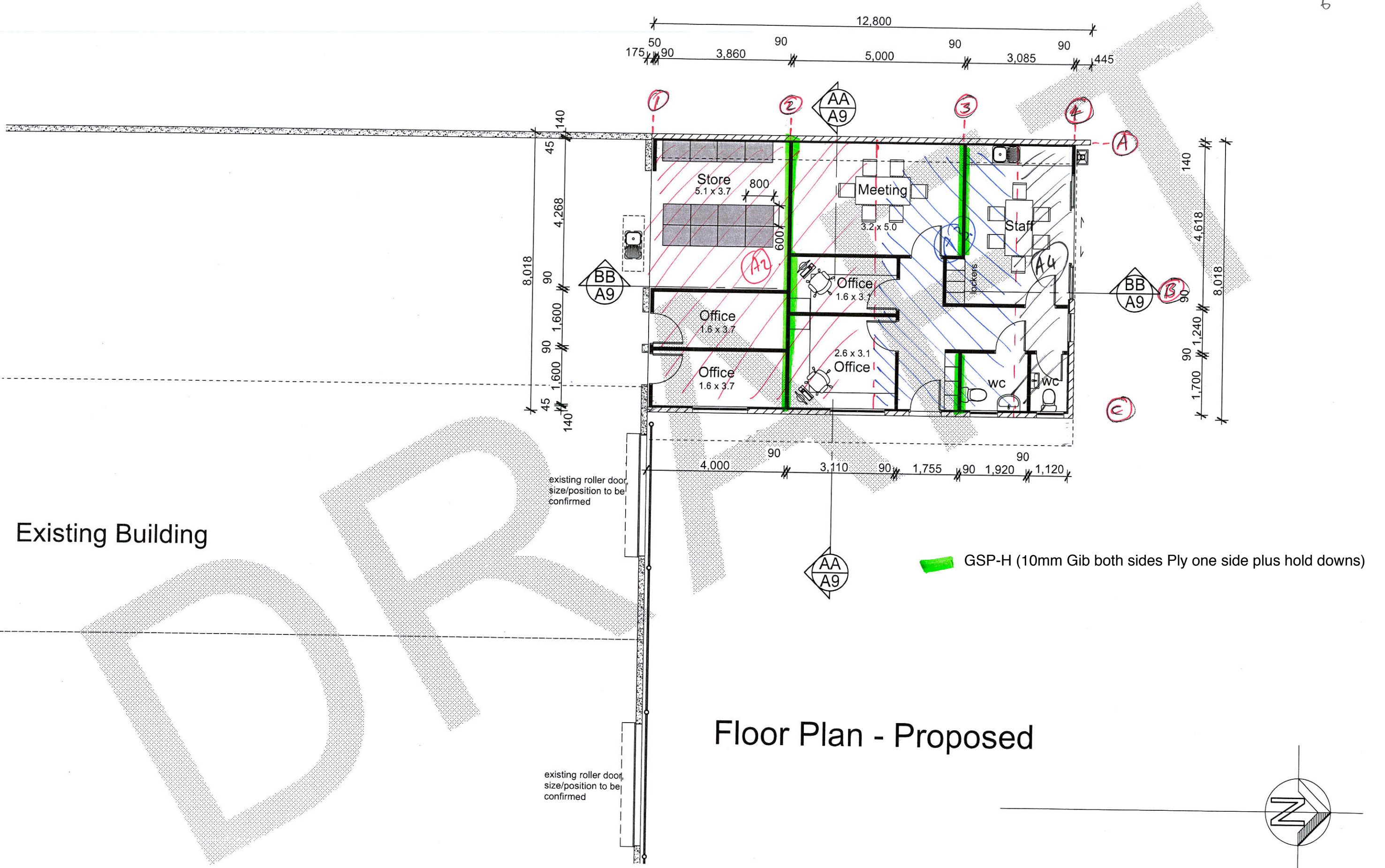
$$\text{Length wall available} = 3 \text{ m} + 1.7 \text{ m.} \\ = 4.7 \text{ m.}$$

$$\text{BU's}_{\text{req}} = 652/4.7 = 138 \text{ BU's/m}$$

This is OK ~~as~~ given we are at  $n=1.25$ .

$\Rightarrow$  GSP-H for both walls on Grids 2 & 3.





Existing Building

Floor Plan - Proposed



Size Partials

will be governed by snow or wind

Snow

$$S_u = S_g \mu_i$$

$$S_g = 0.9 \text{ kPa}$$

$$\mu_i = 0.7 \quad (5^\circ \text{ pitch})$$

$$\Rightarrow S_{u1} = 0.63 \text{ kPa} \quad (\text{ULS})$$

$$S_s = 0.42 \text{ kPa} \quad (\text{SLS})$$

WIND

$$P = 0.5 \rho_{\text{air}} V_{\text{des}}^2 C_{\text{pe}} C_{\text{pe}}$$

$$V_{\text{des}} = V_R M_d (M_{z,\text{cat}} M_s M_t)$$

$$R = 500$$

$$V_R = 4.5 \text{ m/s}$$

$$M_d = 1.0 \quad (\text{any direction})$$

$$M_{z,\text{cat}} = 0.83 \quad (\text{TCS, light industrial})$$

$$M_s = 1.0$$

$$M_t = 1.0$$

$$V_{\text{des}} = 4.5 \times 0.83$$

$$= 3.74 \text{ m/s}$$

$$\Rightarrow P_{\text{basic}} = 0.5 \times 1.2 \times 3.74^2$$

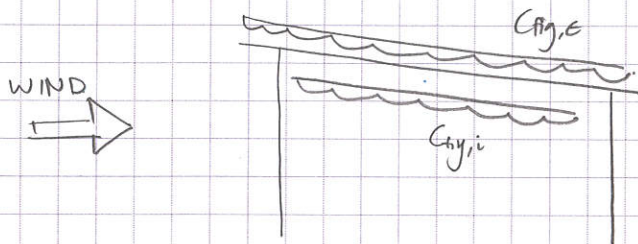
$$= 0.839 \text{ kPa}$$

(ULS)

$$= 0.567 \text{ kPa}$$

(SLS)



Determine  $C_{fig}$  for roof

$$C_{fig,e} = C_{p,e} K_a K_{ec} K_{ed} K_p$$

$$C_{fig,i} = C_{p,i} K_{ci}$$

$$C_{p,i} = 0.2, -0.1$$

$$K_L = 0.9 \text{ or } 1$$

$$C_{p,e} = -0.9, -0.4$$

$$K_e = 0.9 \text{ or } 1$$

$$C_{fig, total} = 0.2 \times 0.9 + 0.9 \times 0.9$$

$$= \underline{0.99}$$

say 1.0.

$$P_{uplift} = 0.839 \times 1.0$$

$$= 0.84 \text{ kPa}$$

If we have purlins @ 1200 c/c.  $W_u = 0.84 \times 1.2 = 1.0 \text{ kN/m}$   
 $W_s = 0.567 \times 1.2 = 0.68 \text{ kN/m}$

DHS 150/purlins  $\rightarrow$  max span = 5.5m w 1 brace.  $> 3.8 \text{ OK}$

DHS 250/13 purlins max span = 9.0m w 2 brace.  $> 8.0 \text{ OK}$

from DHS loadspan  
tables,

$\Rightarrow$  use DHS 150/12 purlins on short span

& DHS 250/13 purlins on long span.

Size Beam for Grid 1

$$\text{Trib Width} = 3.866 + 10$$

$$= 3950 \text{ mm.}$$

Governed by WIND OR SNOW.

$$P_n = 0.839 \text{ kPa. (snow).}$$

$$P_n + S_n = 0.3 + 0.63$$

$$= 0.93 \text{ kPa. (Wind + Grav).}$$

governs.

$$W_u = 0.93 \times 3.95$$

$$= 3.67 \text{ kN/m.}$$

$$W_s = (0.42 + 0.3) \times 3.95$$

$$= 2.84 \text{ kN/m.}$$

largest span: 40m.



$$M^* = \frac{WL^2}{8}$$

$$= \frac{3.67 \times 4^2}{8}$$

$$= 7.34 \text{ kNm.}$$

$$Z_{req} = \frac{7.34}{0.9 \times 300}$$

$$= 27.2 \times 10^{-6} \text{ m}^3$$

$$= 27.2 \times 10^{-3} \text{ mm}^3$$

$$D_{min} = \frac{SPAN}{500} = 13.5 \text{ mm}$$

OK 12mm.

$$S = \frac{WL^4}{384EI}$$

$$I_{req} = \frac{WL^4}{384 \times 12 \times 6}$$

$$= \frac{3 \times 284 \times 10^3 \times 4000^4}{384 \times 12 \times 200 \times 10^9}$$

$$= 39.4 \times 10^6 \text{ mm}^4$$

200 PFC

$$Z_e = 221 \times 10^3 > 27.2 \text{ OK}$$

$$I_x = 19.1 \times 10^6 \text{ mm}^4 < 39.4 \text{ NOX}$$

250 PFC

$$I_x = 45.1 \times 10^6 \text{ mm}^4 > 39.4 \text{ OK}$$

Min B OK



Design Lintel over Sliding door on Grid 4

Length of span = 3.6m

$$\text{Trib Width} = 3.09/2 \\ = 1.55 \text{ m}$$

$$P_u = 0.93 \text{ kPa (Snow + Grav.)}$$

$$W_u = 0.93 \times 1.55 \\ = 1.44 \text{ kN/m}$$

$$W_s = (0.42 + 0.3) \times 1.55 \\ = 1.12 \text{ kN/m}$$

Try S48 2/190x90 LINTELS

$$\phi M^e = \frac{1.44 \times 3.6^2}{8} \\ = 2.33 \text{ kNm}$$

$$\phi M_n = \phi k_1 k_2 k_3 k_4 Z$$

$$\phi = 0.8$$

$$k_1 = 0.8$$

$$k_5 = k_4 = 1.0$$

$$k_8 = 0.95$$

$$F_0 = 14 \text{ MPa}$$

$$L_y/B = 40$$

$$d/B = 2.1$$

$$\phi M_n = 0.8 \times 0.8 \times 0.95 \times 14 \times 541500 \\ = 4.61 \text{ kNm} > 2.33 \text{ OK for ULS}$$

$$Z = \frac{bh^2}{6} \\ = \frac{90 \times 190^2}{6} \\ = 541500$$

Check SLS

$$\Delta = \frac{S_w L^4}{384 EI} \times k_2$$

$$k_2 = 1.0$$

$$I = \frac{bh^3}{12} \\ = 51.4 \times 10^6$$

$$= \frac{5 \times 1.12 \times 3.6^4}{384 \times 6.7 \times 51.4}$$

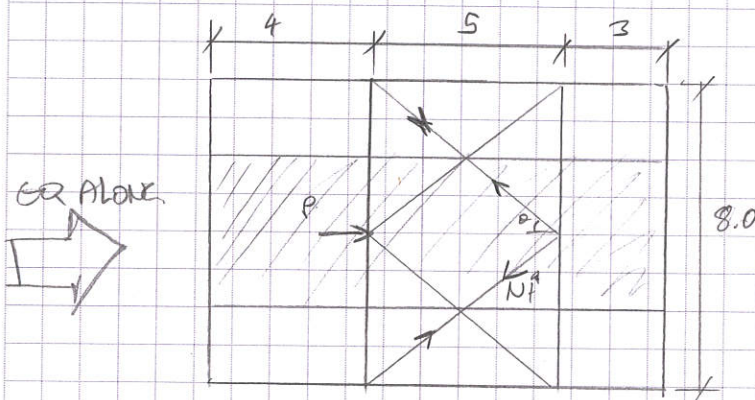
$$E = 6.7 \text{ GPa}$$

$$= 0.0071 \text{ m}$$

$$= 7.1 \text{ mm} \Rightarrow$$

$$\frac{\text{SPAN}}{500} \quad \underline{\underline{\text{OK}}}$$

Design strap bracing to transfer loads to exterior walls



$$\theta = \tan^{-1}\left(\frac{4}{5}\right) = 39^\circ$$

$$\cos \theta = \frac{a}{c}$$

$$P = 0.3 \text{ kPa} \times 4 \text{ m} \times 12 \text{ m} \times 0.71$$

$$= 10.2 \text{ kN}$$

→ This can be taken by purlins with ease.

$$N_t = 10.2 / \cos 39^\circ$$

$$= 6.6 \text{ kN}$$

× Cs factor of 1.1

Using Multibrace (MITek)

$$Q_n = 14.8 \text{ kN}$$

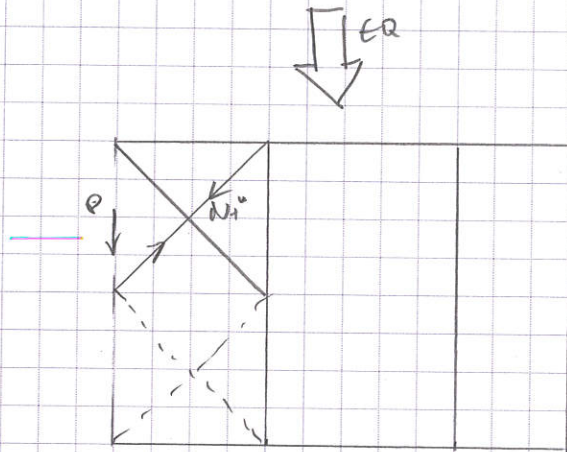
$$\phi N_t = \phi \times k_c \times 14.8$$

$$= 0.7 \times 14.8$$

$$= 10.36 \text{ kN} > 6.6 \text{ kN} \quad \underline{\underline{OK}}$$



Check Strap bracing can work in other direction



$$P = P_{\text{roof}} + P_{\text{wall}}$$

$$P_{\text{wall}} = 2m \times 5.6 \times \frac{3}{8} \times 0.14 \times 25 \times 0.71 \times 1.5$$

$$= 10.1 \text{ kN}$$

$$P_{\text{roof}} = 0.36 P_g \times 2m \times 8m \times 0.571$$

$$= 3.4 \text{ kN}$$

$$P_{\text{total}} = 13.5 \text{ kN} \quad \text{OK}$$

$$N_s = 13.5 / \sin 45$$

$$= 19.1 \text{ kN} > 10.4 \text{ kN} \quad \text{NOK}$$

NEED TWO BAYS OF STRAP BRACING

$$N_s = 19.1 / 2$$

$$= 9.5 \text{ kN} < 10.4 \text{ kN} \quad \text{OK}$$

Size Cantilever 90x45 S48 - spacing TBD.



$$w_u = P_u \times S$$

$$\phi M_n (90 \times 45) = \phi k_1 k_2 k_3 k_4 \phi_b Z$$

$$Z = \frac{b d^2}{6}$$

$$= 60750$$

$$\phi = 0.8$$

$$k_1 = 10 \text{ (Cantilever)}$$

$$k_2 = k_4 = 10$$

$$k_3 = 10$$

$$f_b = 14 \text{ MPa}$$

$$\phi M_n = 0.8 \times 14 \times 60750$$

$$= 0.68 \text{ kNm}$$

$$w_u = \frac{w L^2}{2} < 0.68 \text{ kNm}$$

$$w < \frac{0.68 \times 2}{L^2}$$

$$< 2.13 \text{ kN/m} = P_u \times \text{Spacing}$$

$$S < 2.13 / P_u$$

$$P_u = 0.839 \times 2$$

$$= 1.678$$

$$S_{max} = 2.13 / 1.678$$

$$= 1.27 \text{ m}$$

→ C.A. for up so it's conservative

Check SLS with 1200mm spacing

$$P_s = 0.567$$

$$w_s = 0.567 \times 1.2$$

$$= 0.68 \text{ kN/m}$$

$$I = \frac{b h^3}{12}$$

$$= 2.73 \times 10^8$$

$$\Delta = \frac{w L^4}{8 E I}$$

$$= \frac{0.68 \times 0.8^4}{8 \times 6.7 \times 2.73}$$

$$= 1.9 \text{ mm} \Rightarrow \text{SPAN OK}$$

Use 90x45 @ 900 cks.



## Internal Review of MB design:

lintels span over walls - support purlins & roof

→ geometry: 150 series block wall 140 wide.  
140 wide top plate  
 $45 \times 3 = 135$  wide lintel.  
? Sticks? 90 x 45? Architect can make up?

SK01 - is this a ceiling & spread loads by bracing walls across?  
suspended ceiling

→ wall starter height in wall? SK02 - cantilever detail!  
lintel support at block wall interface?

bracing to pick up  
roofing length?

SK03 - "jack" studs. Correct word?

What does 140mm bracing wall mean? 140 thick?

\* Load from roof to bracing walls? above lintel etc.  
→ Put bracing walls to roof plane.

SK04 - why not extend bracing wall full length? 4 sheets 2.7m tall  
plaster board + plywood 1.2 wide = 4.8m  
easier than 4.3m

Q: Concept - so not all connection details needed? One that isn't standard.  
strap bracing to PFC? → Detail  
SHS to block walls?

Purlins 5m span? Continuous or simply supported?  
estimate on roof G.

$$S_u \downarrow \quad 0.63 \text{ kPa} + 1.2(0.2 \text{ kPa} + 0.17 \text{ kPa}) = 1.07 \text{ kPa}$$

@ 1200 c/s → 1.3 kN/m

$$M_u \uparrow \quad 0.839 \text{ kPa} - 0.9(0.2 \text{ kPa} + 0.09 \text{ kPa}) = 0.58 \text{ kPa}$$

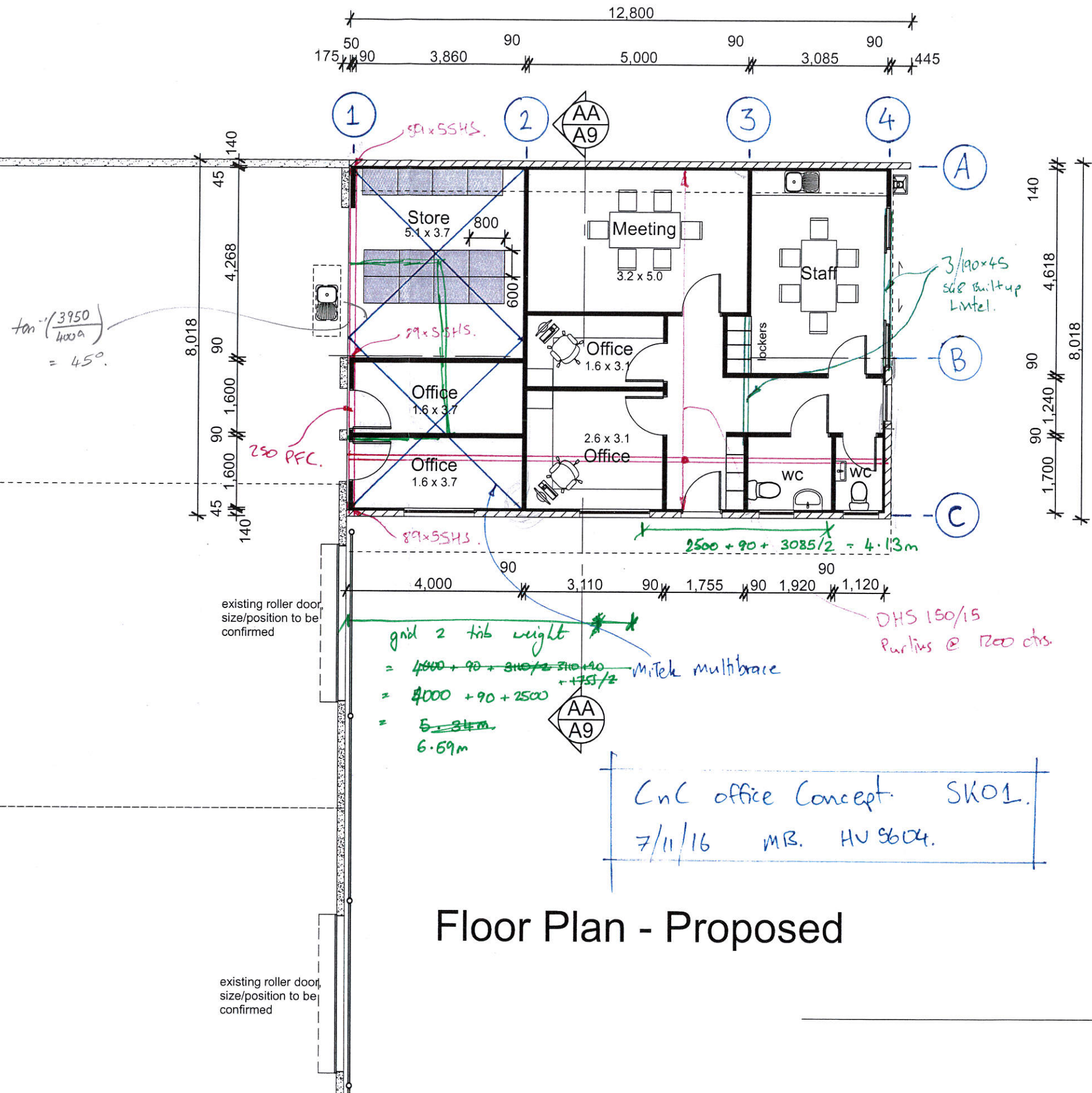
→ 0.7 kN/m

DHS 150/15 OK from beam  
span tables → restraints  
from cladding.

Displacement compatibility & old building and between walls.



Existing Building



## Floor Plan - Proposed



Architectural Design Group

A DIVISION OF  
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Proposed Proposed Additions

80 Byron Street

Christchurch

For Clip & Climb

Drawing: Floor Plan - Proposed  
Scale at A3: 1:100  
Date: October 2016  
Job no: 5996

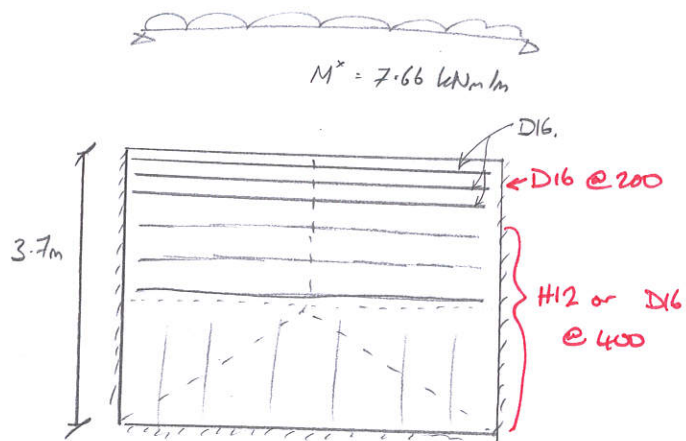
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Design Group) unless otherwise agreed in writing.

Issue: 1  
Sheet no.

A5

of sheets





Horizontal span at top.

H12 @ 200 c/s. at top.

$\phi M_n = 12 \text{ kNm/m} \rightarrow 0.86 \text{ of balanced failure}$

D16 @ 200 c/s

$\phi M_n = 12.6 \text{ kNm/m}$  OK.

$\rightarrow 4 \text{ kNm/m extra capacity over } 0.6 \text{ m} = 2.4 \text{ kN}$

D16 @ 400 c/s =  $7 \text{ kNm/m}$

$\rightarrow 0.66 \text{ kNm/m extra demand}$

( $2 \text{ m} = 1.32 \text{ kN}$ )

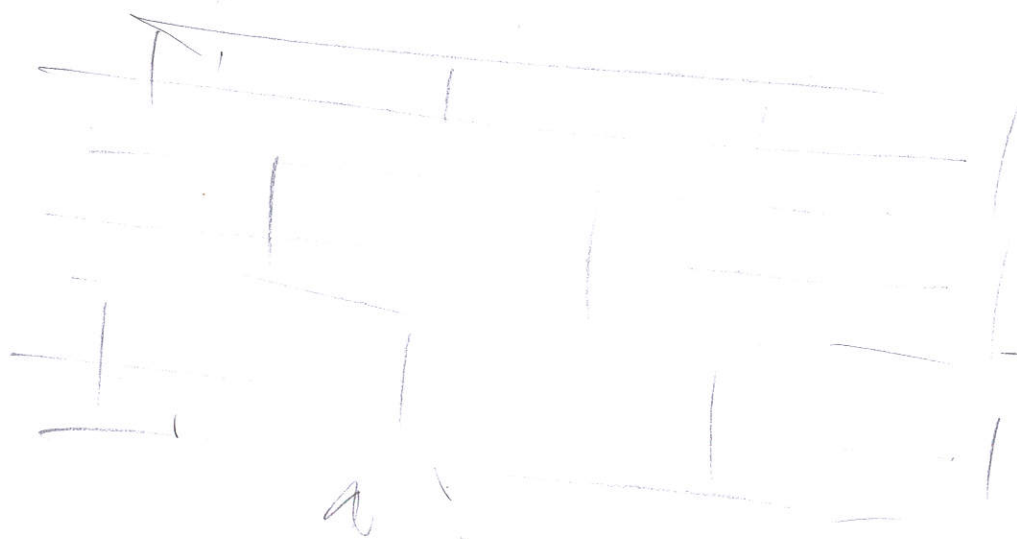
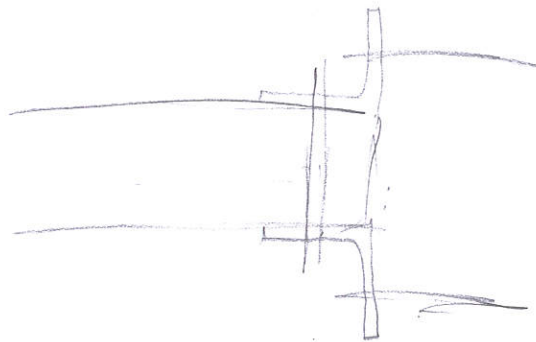
OK.

base cantilever can take  $3.24 \text{ kNm/m}$   
 $\Rightarrow$  equivalent to taking UDL of  $h$ .

$$2.45 \text{ kPa} \times \frac{h^2}{2} \leq 3.24 \text{ kNm/m}$$

$$h^2 \leq 2.64 \text{ m}^2$$

$$h \leq 1.6 \text{ m.}$$



project Cnl office

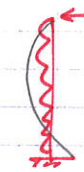
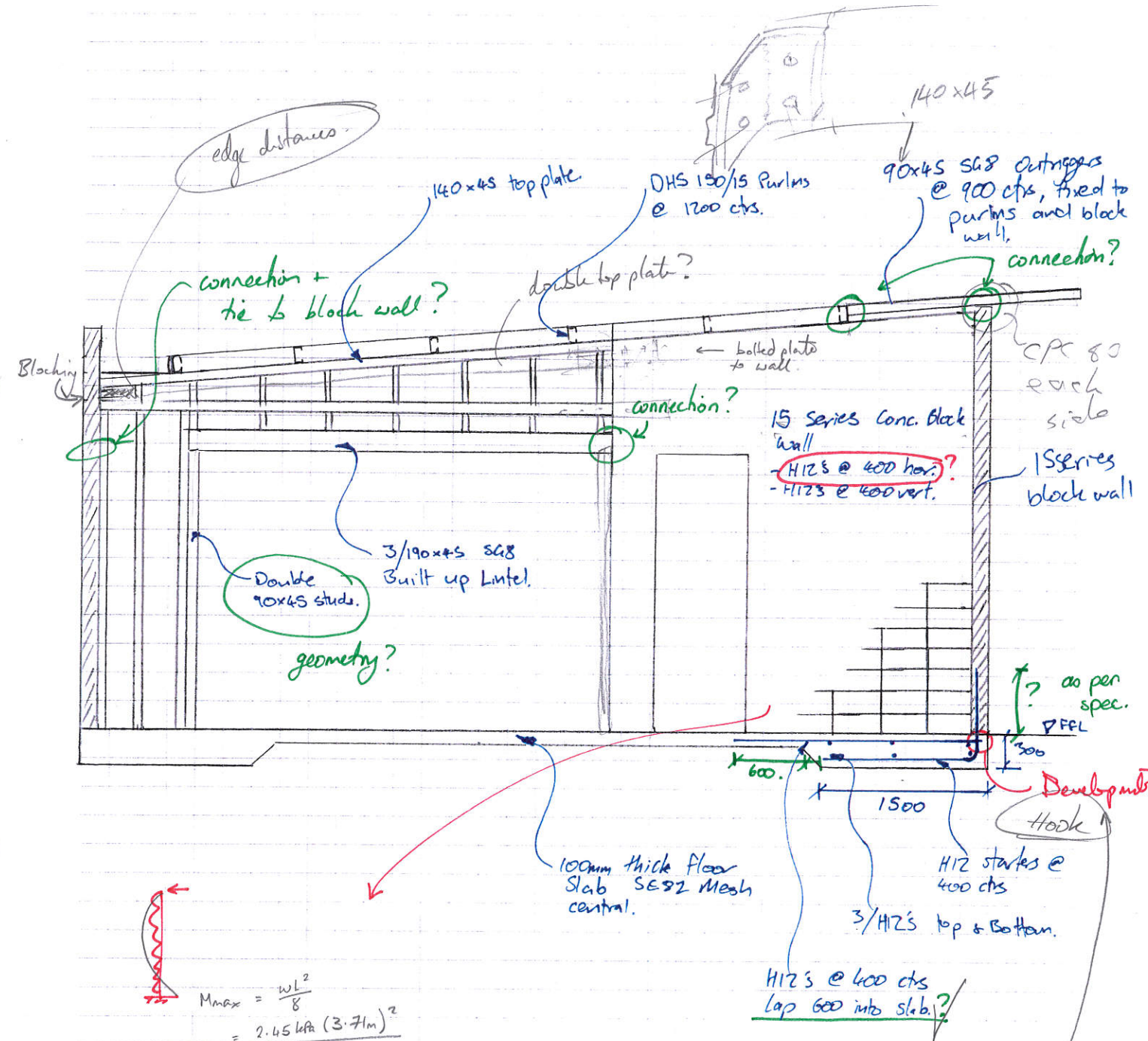
date 7/11/16

structex

file HUS604

by MBS

ref SK02



$$M_{max} = \frac{wL^2}{8}$$

$$= \frac{2.45 \text{ kPa} (3.7 \text{ m})^2}{8}$$

$$= 4.22 \text{ kNm/m}$$

GRID 4 ELEVATION

$\phi M_n = 6.9 \text{ kNm/m} > 4.22 \text{ kNm/m}$  OK.

Reinforcing as detailed OK on grid 4.

- A) Check Rebar detailing
- 1) Connection to block wall
- 2) bracing connection point
- 3) wall reinforcing
- 4) lintel connection to wall
- 5) purlin overhang connects
- 6) spread of roof load across



$$Trib\ width = 4.13m$$

$$P_A = 2.45\ kPa \times 4.13m \times \frac{3.7m}{2} \\ = 18.7\ kN$$

$$P_c \approx 10\ kN \quad (openings)$$

$$P_{roof} = 0.3 \times 0.728 \times 4.13m \times 8m \\ = 7.2\ kN$$

$$P = 36\ kN \quad at \quad u=1.25$$

$$For \ u=3: \quad 36\ kN \times \frac{0.378}{0.728} = 19\ kN \rightarrow 375\ BU.$$

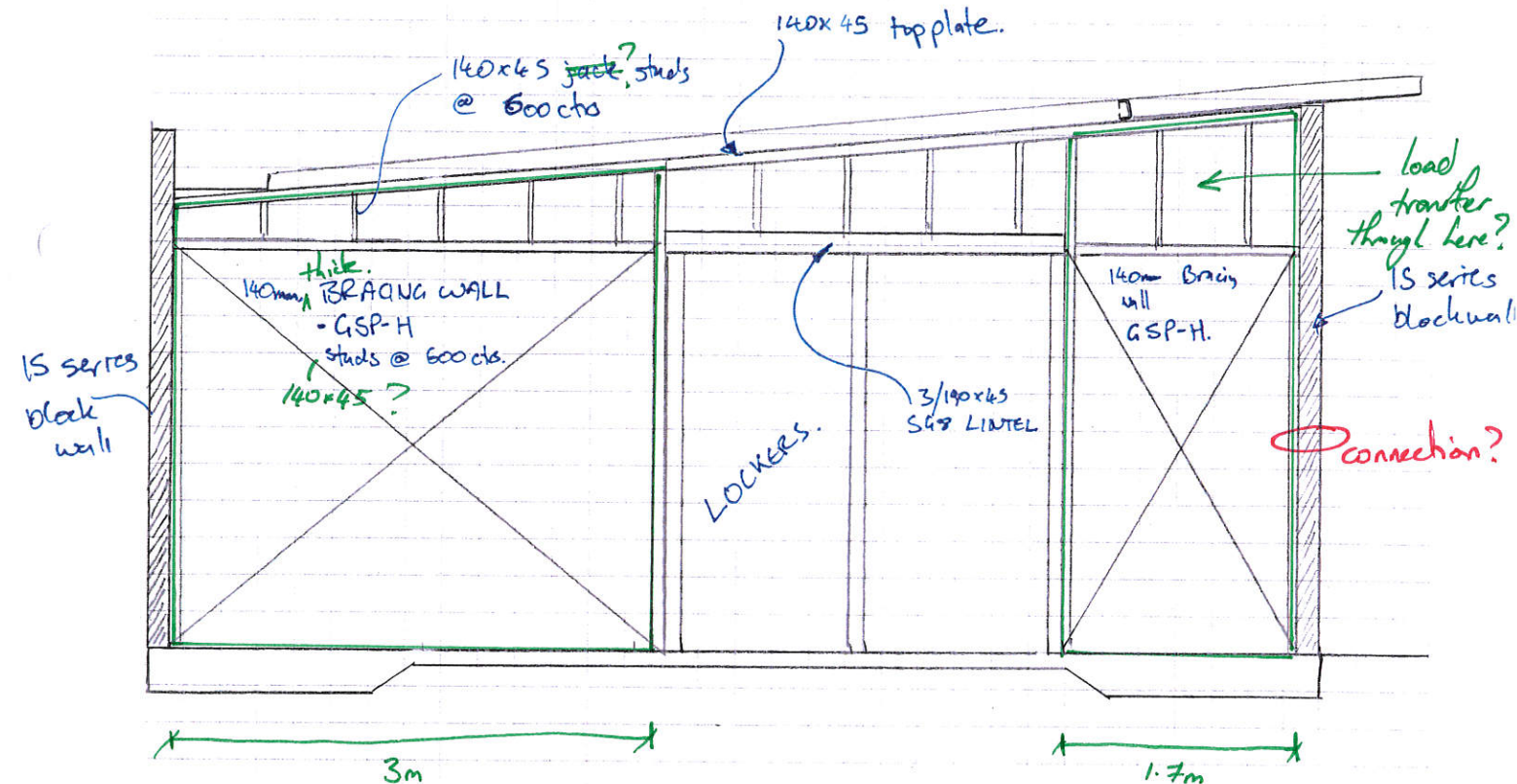
Bracing wall -  $\Sigma L = 4.7m$  available

From average stud height 3.1m and 3.6m

$$BU\ of\ GSP-H: \quad 150\ BU/m \times \frac{2.4m}{3.6m} = 100\ BU/m.$$

$$100 \times 4.7m = 470\ BU. \quad > \quad 375\ BU. \quad OK.$$

project *LnL Office* date *7/11/16* **structex**  
file *HVS604* by *NWS* ref *SK03*



Full height, full length walls.

GRID 3 ELEVATION.

Wall framing + *NBS3604*



Load onto grid 2

$$2.45 \text{ kPa} \times 6.6 \text{ m} \times \frac{3.6 \text{ m}}{2} \\ = 29.1 \text{ kN from wall A.}$$

~15 kN from wall C (openings)

$$\text{Roof: } 0.8 \text{ kPa} \times 0.728 \times 6.6 \text{ m} \times 8 \text{ m} \\ = 11.5 \text{ kN}$$

$$\Sigma P = 55.6 \text{ kN at } \mu = 1.25$$

$$\text{For } \mu = 3; \quad 55.6 \text{ kN} \times \frac{0.378}{0.728} \text{ or } 0.294 \\ = 29 \text{ kN} \rightarrow 580 \text{ BU}$$

$$\text{GSP-H; } \frac{150 \text{ BU/m}}{150} \times 4.8 \text{ m} = 720 \text{ BU. at 2.4m stud height.}$$

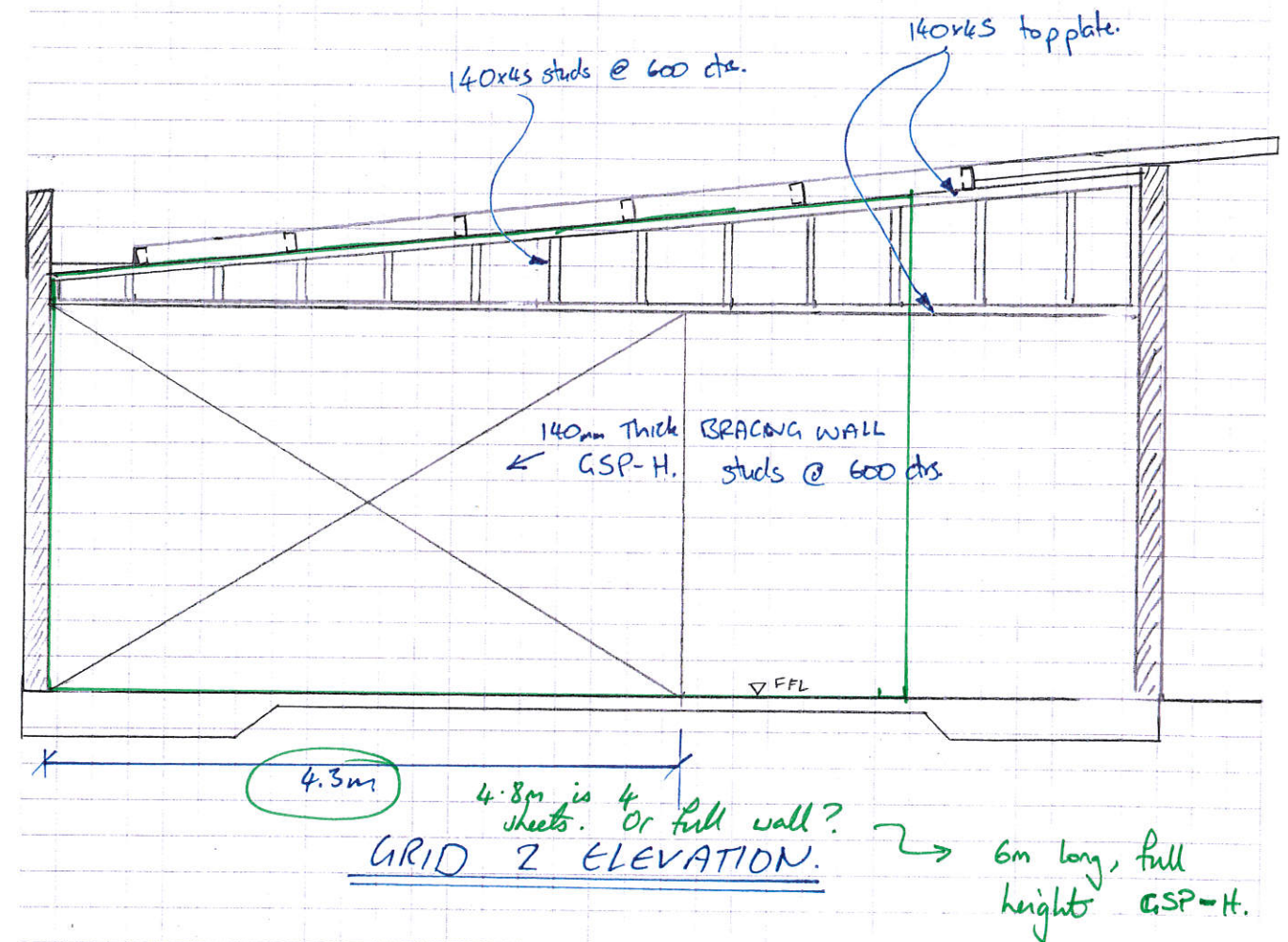
↓

$$\text{average stud height} = \frac{3.7 \text{ m} + 2.9 \text{ m}}{2} = 3.3 \text{ m.}$$

$$150 \text{ BU/m} \times \frac{2.4}{3.3} \\ = 109 \text{ BU/m}$$

$$109 \text{ BU/m} \times 6 \text{ m} = 654 \text{ BU.}$$

Put full height so load gets to wall from roof and upper wall.



Q: connection of block wall & timber wall?

project cul office

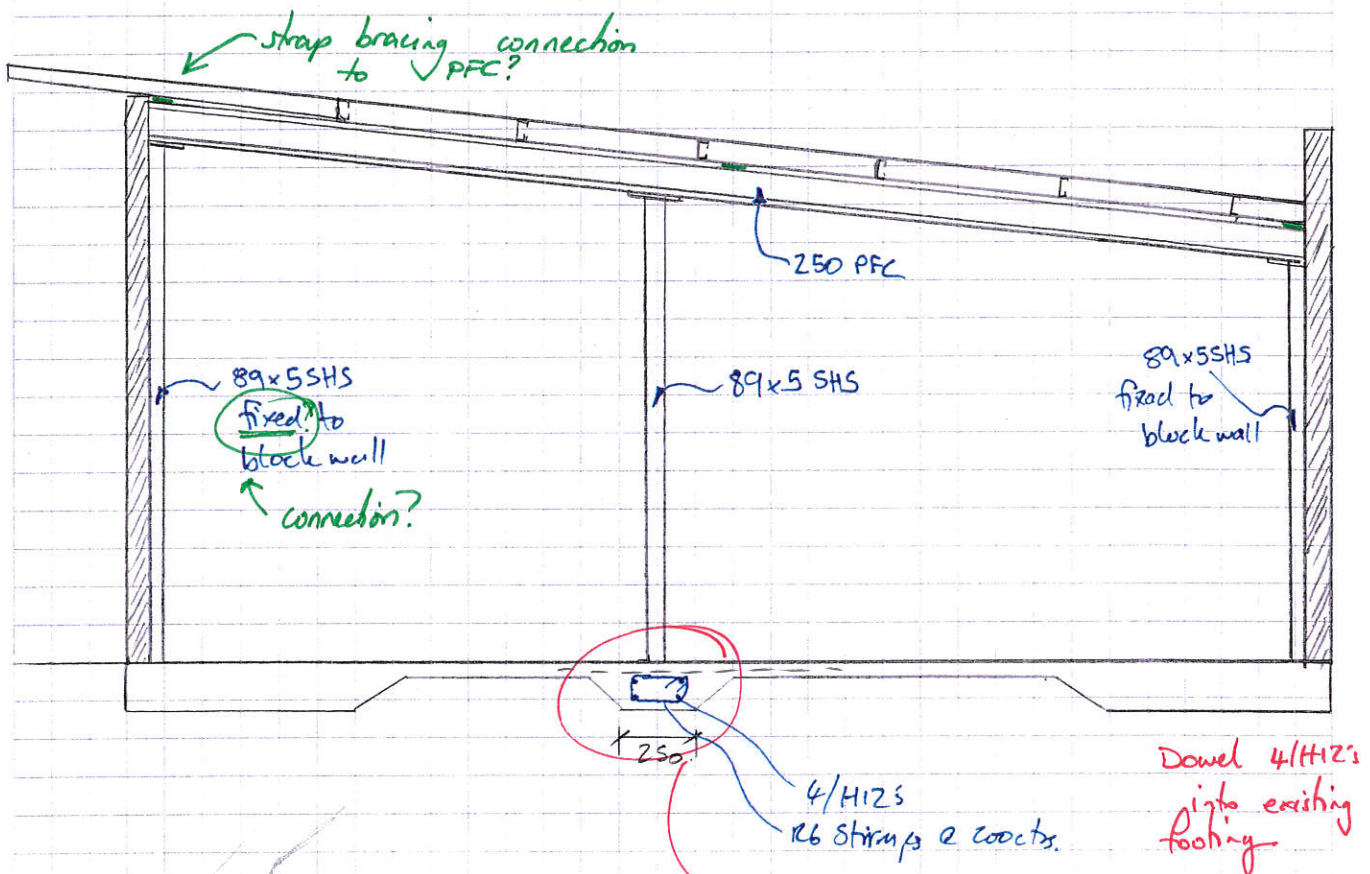
date 7/11/16

**structex**

file HUS604

by mo

ref SKOS



### GRID 1 ELEVATION.

Vertical roof load is snow governed:  
 $1.2 S_n = 0.99 \text{ kPa}$

$$P = 0.99 \text{ kPa} \times 7.82 \text{ m}^2 = 7.74 \text{ kN}$$

On 250 square:  $\sigma = \frac{7.74 \text{ kN}}{(0.25 \text{ m})^2} = 125 \text{ kPa}$

If 50 kPa safe bearing  
 $A = \frac{7.74 \text{ kN}}{50 \text{ kPa}} = 0.155 \text{ m}^2$

$$\begin{aligned} \text{TA of roof} &= \left( 90 + \frac{3860}{2} \right) \\ &\times \left( \frac{4268}{2} + 90 + 1600 + 45 \right) \\ &= 2020 \times 3870 \\ &= 7.82 \text{ m}^2 \end{aligned}$$

Use this footing strategy • engineering • design  
350x500  
250 x 0.62 m — tie into existing slab.



project

date

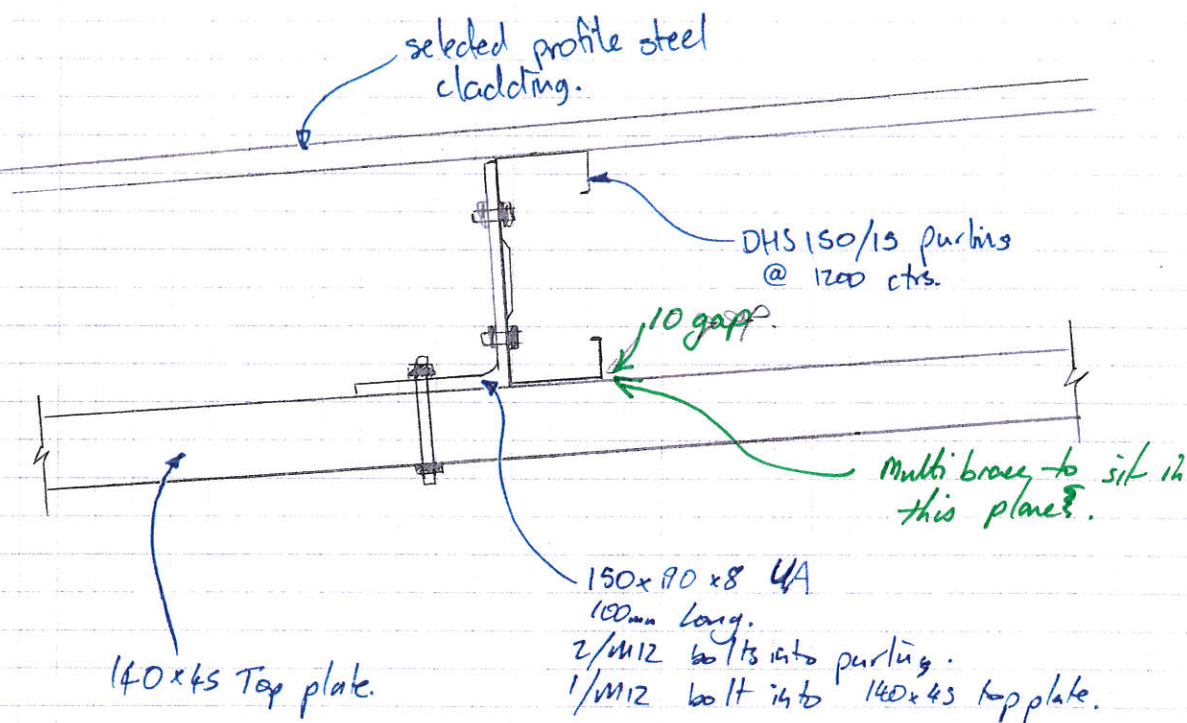
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Typical Purlin cleat.

Grid A and C walls fixed to walls on grid:

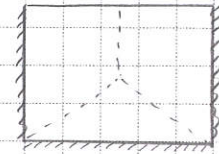
Demand based on tributary width.

2.45 kPa at  $\mu = 1.25$

- ① 2m
- ② 4.59m
- ③ 4.13m
- ④ 1.63m

← worst case

← using continuous wall on ③.



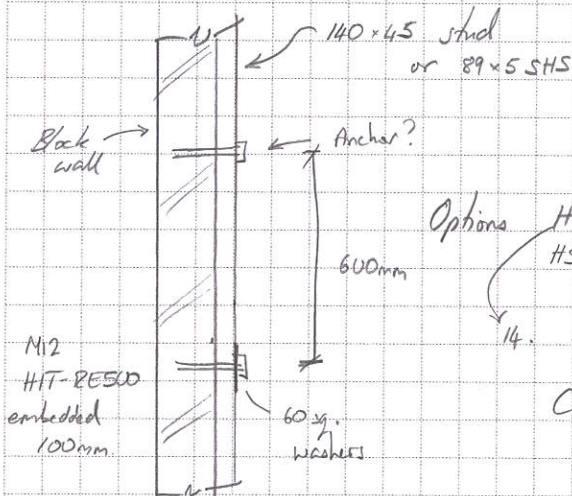
← 3.24 kN/m

$2.45 \text{ kPa} \times 4.59 \text{ m} = 11.24 \text{ kN/m}$  max (grid 2).  
tension on fixings

(direct bearing on 140 wide timber)

$8.9 \text{ MPa} \times 140 \text{ mm} \times 0.8 \times \phi 1.0 \times 1000 \text{ mm} = 900 \text{ kN}$  ok by inspection ✓

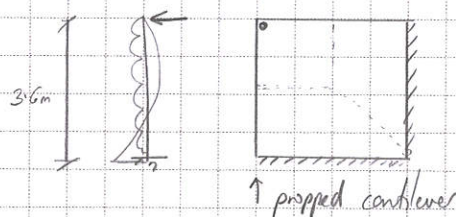
12 kN capacity at 600cs = 6.7 kN demand.  
Washers → 60 mm sq.



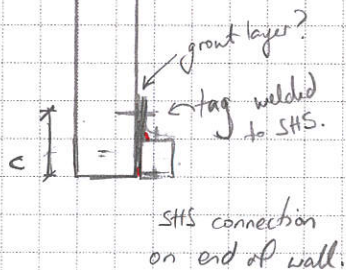
Options: HUS screw anchor (3 or HR)  
HST or HCR stud anchor  
14. min edge distance  $c = 75 \text{ mm}$

Chemical: HIT-RE 500 V3  
HIT-HY 200 R

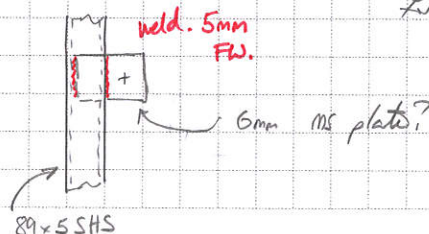
Grid 1 and 4 → all load to corner



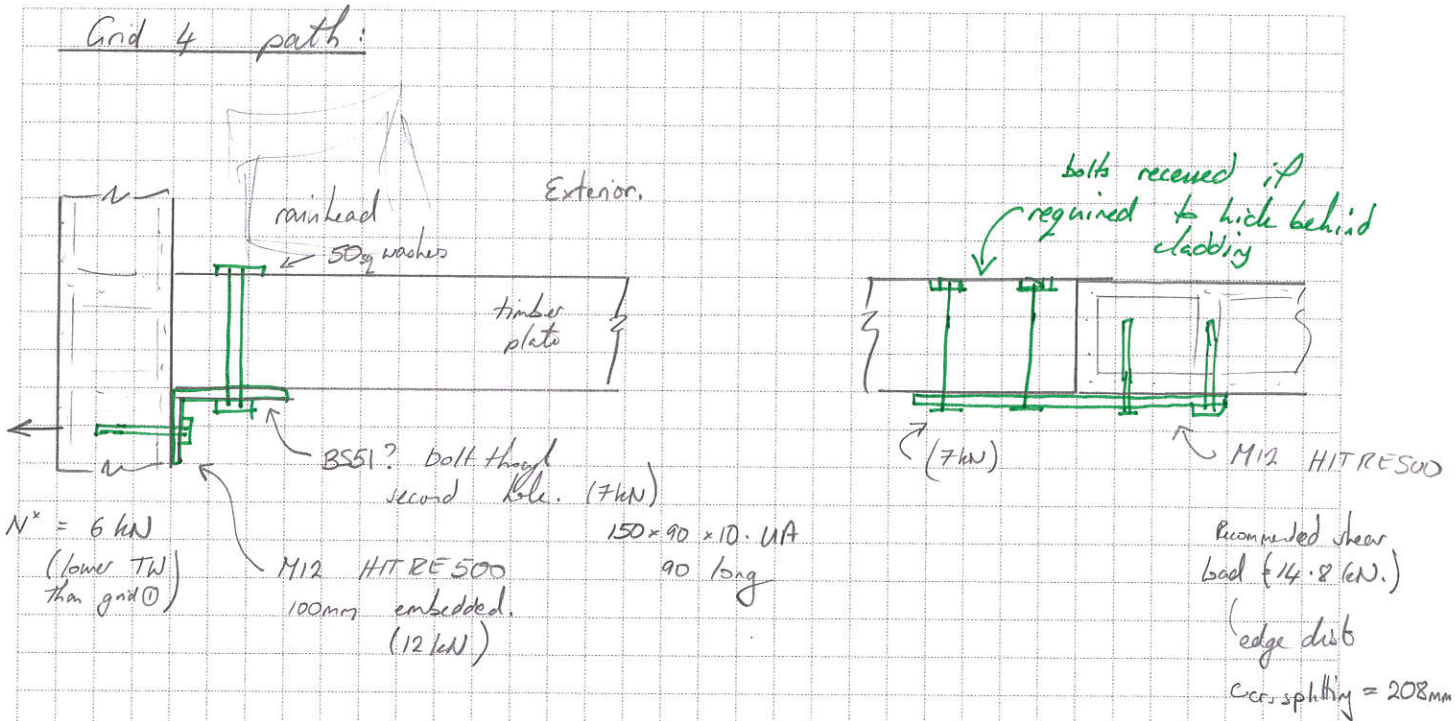
Reaction force =  $2 \text{ m} \times 2.45 \text{ kPa} \times \frac{3}{8} \times 3.6 \text{ m} = 6.6 \text{ kN}$ .



Anchor: M12 → embedded 105 mm → 12.3 kN recommended tensile load for HIT-RE 500 SD.







In tension - edge distance for timber =  $8 \times 12 \text{ mm}$   
= 96 mm

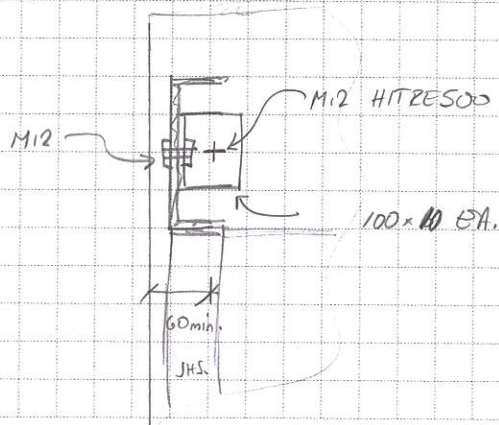
M12 in single shear  $0.7 \times 10.4 \text{ kN} = 7.28 \text{ kN}$ , 2 of them ok.

Timber plate: 140 x 45 tp plate  
 $\phi N_t = 0.8 \times 1.0 \times 6 \text{ MPa} \times 140 \times 45 \text{ mm}^2$   
= 30 kN.

Not governing, but use 2 for connections.

Grid 1:

No space to bolt to JHS. Need to connect at PFC level



45 thick timber is narrow to bolt through - min edge distance =  $2d = 22 \text{ mm}$  needs 50mm thick min → turn on side as for litch. 90 x 90  $\phi N_t = 38 \text{ kN}$

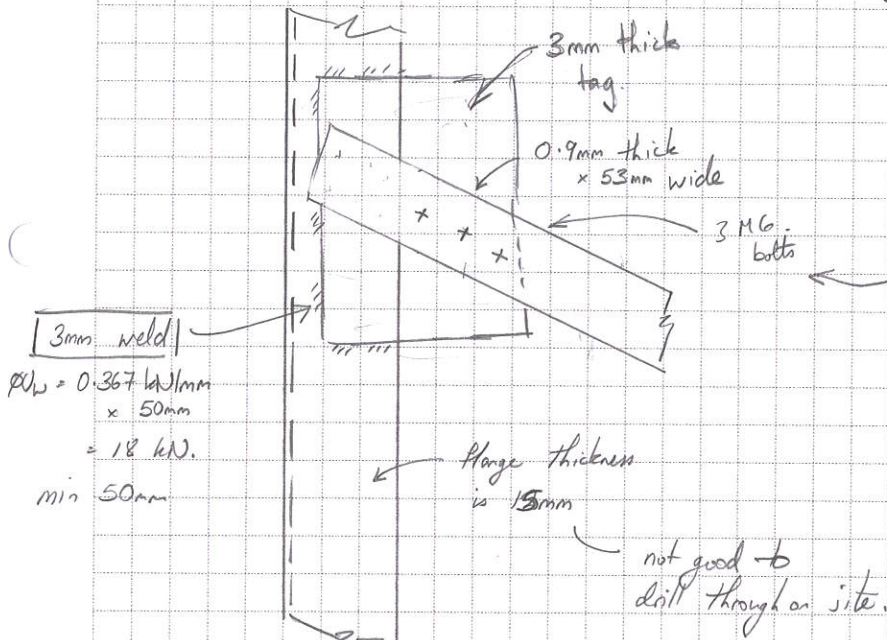


## Roof bracing Multibrace

- Standard connection is nailing to timber top plate  
OK for grid 2.

At grid 1 connection is to ~~250~~ PFC:  
250

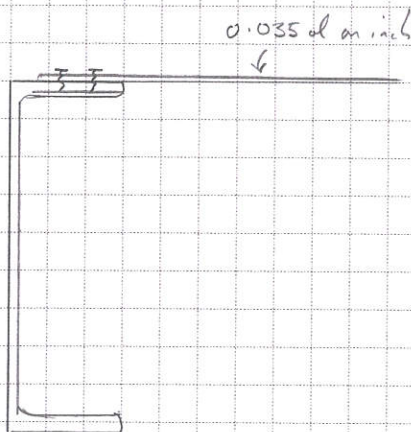
$$\text{Capacity of brace} = 14.8 \text{ kN} \times 0.7 = 10.36 \text{ kN}$$



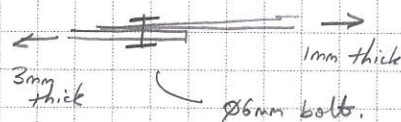
Strap is so thin that tearing of strap out of a connection is critical.

Use thinner weld plate to screw brace onto?

Shear: 2.94 kN for strap thickness (11/11)  
→ needs 4 screws min at #7 screws (3.83mm  $\phi$  approx).



Try 3 M6 Bolts



M6: steel strength in shear

$$\begin{aligned} \phi &= \phi 0.62 f_{up} (n A) \\ &= 0.8 \times 0.62 \times 400 \text{ MPa} \times \frac{(6 \text{ mm})^2 \pi}{4} \\ &= 5.6 \text{ kN} \end{aligned}$$

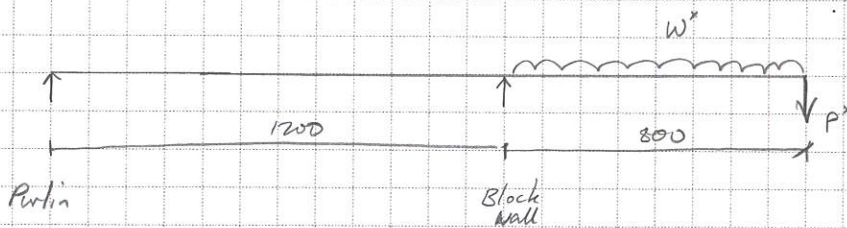
$$\begin{aligned} 3 \phi &= 16.8 \text{ kN} \quad \text{OK.} \\ &\times 0.67 \text{ for threaded area} \\ &= 11.2 \text{ kN} \quad \leftarrow \text{still OK.} \end{aligned}$$

$$\begin{aligned} \text{Ply: bearing} &= 0.9 \times 3.2 \times 200 \text{ MPa} \times 0.9 \text{ mm} \times 6 \text{ mm} \\ &= 4.67 \text{ kN} \quad \rightarrow \times 3 = 14 \text{ kN OK.} \end{aligned}$$

20mm spacing min.



800 overhang:  
Connection design.



[ULS] Snow:  $0.63 \text{ kPa} + 1.2 \times 0.3 \text{ kPa}$   
 $= 0.99 \text{ kPa} \leftarrow$

Wind:  $0.839 \text{ kPa}$

[SLS] Wind:  $0.567 \text{ kPa}$   
 snow:  $0.43 \text{ kPa} + 0.3 \text{ kPa}$   
 $= 0.73 \text{ kPa} \leftarrow$

And overhang edge line load needs to be included:

$S_e = 0.5 (0.63 \text{ kPa})^2 / 2.9 \text{ kN/m}^3$  (8 from cl. 5.4.3)  
 $P^* = 0.07 \text{ kN/m}$

At 900 CS  $W^* = 1 \text{ kPa} \times 0.9 \text{ m}$   
 $= 0.9 \text{ kN/m}$   
 $P^* = 0.07 \text{ kN/m} \times 0.9 \text{ m}$   
 $= 0.063 \text{ kN}$

$M^*$  at block wall  $= 0.9 \text{ kN/m} \times (0.8 \text{ m})^2 / 2 + 0.063 \text{ kN} \times 0.8 \text{ m}$   
 $= 0.34 \text{ kNm}$

Reaction at purlin to create stability  $= \frac{0.34 \text{ kNm}}{1.2 \text{ m}} = 0.3 \text{ kN}$

bolted connection ok by inspection.

At block wall - reaction  $= 0.3 \text{ kN} + 0.063 \text{ kN} + 0.9 \text{ kN/m} \times 0.8 \text{ m}$   
 $= 1.1 \text{ kN}$

CPC 80 pair ok by inspection

## Flexural Design for RC Beams

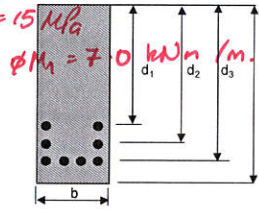
Project #: HV5604  
 Project Name: CnC office  
 Element Description: Block wall cantilever

By JC

### Design Assumptions

- Up to three layers of tension reinforcing can be counted for flexural strength.
- No account is made of the negligible flexural strength increase provided by compression steel.

|                                          |                                                                      |
|------------------------------------------|----------------------------------------------------------------------|
| Limiting Concrete Strain at ULS          | 0.003 Ref NSZ3101:2006, Clause 7.4.2.3                               |
| Reinforcing Steel $f_y$ (MPa)            | 500                                                                  |
| Concrete Strength (MPa)                  | 12                                                                   |
| Undercapacity Factor " $\Phi$ "          | 0.85 Ref NSZ3101:2006, Clause 2.3.2.2                                |
| $\alpha_1$                               | 0.85 Ref NSZ3101:2006, Clause 7.4.2.7                                |
| $\beta_1$                                | 0.85 Ref NSZ3101:2006, Clause 7.4.2.7                                |
| Concrete Strain " $\epsilon_c$ "         | 0.0009                                                               |
| c (mm)                                   | 16 Alter this to get internal equilibrium                            |
| a (mm)                                   | 14                                                                   |
| Beam Width, " $b_w$ " (mm)               | 1,000                                                                |
| Beam Depth, " $h$ " (mm)                 | 140                                                                  |
| $d_1$ (mm)                               | 0                                                                    |
| $d_2$ (mm)                               | 0                                                                    |
| $d_3$ (mm)                               | 64 Cover = 58                                                        |
| $\epsilon_{s1}$                          | 0.0000                                                               |
| $\epsilon_{s2}$                          | 0.0000                                                               |
| $\epsilon_{s3}$                          | 0.0025 = $f_y/E_s$ (lower tension steel at yield for ULS)            |
| Shear Stirrup Dia. (mm)                  | 12                                                                   |
| Tension Bar Dia. 1 (mm)                  | 0                                                                    |
| Tension Bar Dia. 2 (mm)                  | 0                                                                    |
| Tension Bar Dia. 3 (mm)                  | 12                                                                   |
| # of Bars 1                              | 0                                                                    |
| # of Bars 2                              | 0                                                                    |
| # of Bars 3                              | 2.5 → = 400 mm centres (excluding allowance for edge cover concrete) |
| $A_{s1}$ (mm <sup>2</sup> )              | 0                                                                    |
| $A_{s2}$ (mm <sup>2</sup> )              | 0                                                                    |
| $A_{s3}$ (mm <sup>2</sup> )              | 283                                                                  |
| $A_{s \text{ Total}}$ (mm <sup>2</sup> ) | 283                                                                  |
| $f_{s1}$ (MPa)                           | 0                                                                    |
| $f_{s2}$ (MPa)                           | 0                                                                    |
| $f_{s3}$ (MPa)                           | 500                                                                  |
| Flexural Steel Ratio " $\rho$ "          | 0.0044                                                               |
| Min Flexural Steel Ratio                 | 0.0028 Ref NSZ3101:2006, Clause 9.3.8.2.1                            |
| Steel Elastic Modulus (MPa)              | 200,000                                                              |
| Cover to Flexural Reo (mm)               | 70                                                                   |
| Reinforcing steel yield strain           | 0.0025                                                               |



MB used  $d = 75 \text{ mm}$

$$T = \sum A_s \times f_s = 141,372 \text{ N}$$

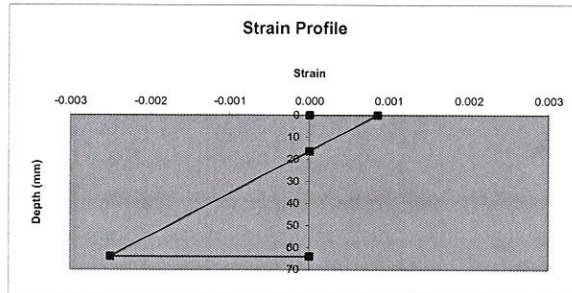
$$C = \alpha_1 \times f_c \times a \times b = 141,372 \text{ N}$$

Use "Goal Seek" to make  $T - C = 0$ , by changing " $c$ "

$$T - C = 0 \text{ N}$$

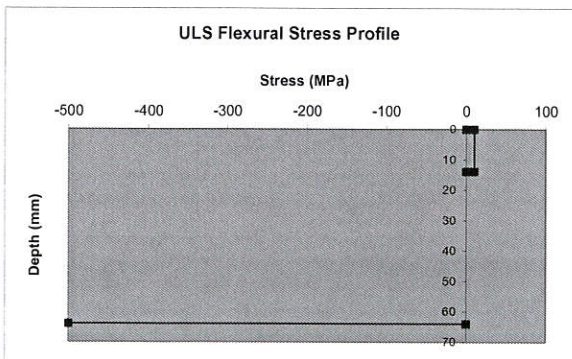
### Strain Profile Input Co-ordinates

| Desc.           | x (strain) | y (depth) |
|-----------------|------------|-----------|
| $\epsilon_c$    | 0          | 0         |
| c               | 0.0009     | 16        |
| $\epsilon_{s3}$ | -0.0025    | 64        |
|                 | 0          | 64        |
| $\epsilon_{s1}$ | 0.0000     | 0         |
| $\epsilon_{s2}$ | 0.0000     | 0         |



### Stress Profile Input Co-ordinates

|                | x (stress) | y (depth) |
|----------------|------------|-----------|
| $\alpha_1 f_c$ | 0          | 0         |
|                | 10.2       | 0         |
|                | 10.2       | 14        |
|                | 0          | 14        |
| $f_{s1}$       | 0          | 0         |
|                | 0          | 0         |
| $f_{s2}$       | 0          | 0         |
|                | 0          | 0         |
| $f_{s3}$       | 0          | 64        |
|                | -500       | 64        |

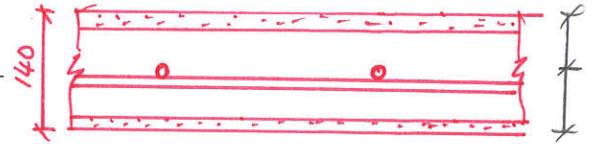


Nominal ULS Flexural Capacity,  $M_n$  (kNm)

8.1

Dependable ULS Flexural Capacity,  $\Phi M_n$  (kNm)

6.9



If bars central.  
 worse case direction is  
 with acting base cover  
 $140 \text{ mm} / 2 - 6 \text{ mm} = 64 \text{ mm}$

H12 @ 400.

starter length to  
 get this capacity?

Horizontal span:

Horizontal demand between  
 grids 2+3 = 7.66 kNm/m

Max  $d_b = 16 \text{ mm}$

$$\text{reqd: } \frac{13}{f_y} \times 12000 \text{ mm}^2$$

$$= 312 \text{ mm}^2 \text{ for HD}$$

$$520 \text{ mm}^2 \text{ for D.}$$

$$2 \text{ } \phi 16 \text{ } A = 402 \text{ mm}^2$$

$$2 \text{ } \phi 12 \text{ } A = 276 \text{ mm}^2$$

$$D16 @ 400 \rightarrow \phi M_n = 7.0 \text{ kNm/m}$$

Not OK.

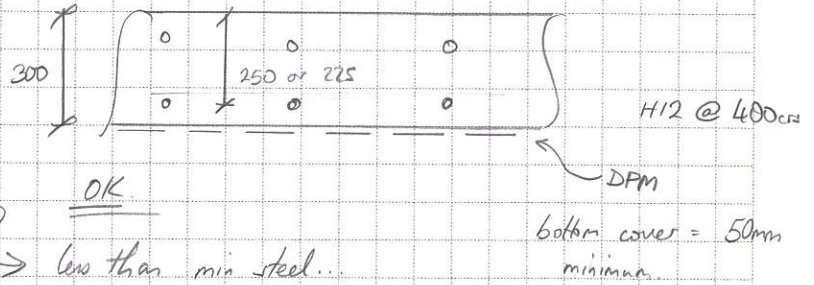
> 3.5 kNm demand MB calcs pg 1



Check footing reinforcing to pick up and develop required base fixing for wall stability

3.24 kNm stability demand  
6 kNm wall capacity  
8.4 kNm footing stability

Current detailed footing:



$$\phi M_n = 15 \text{ kNm}$$

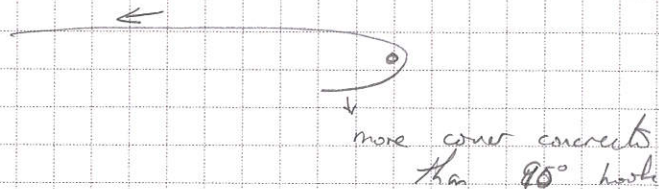
OK

less than min steel..

Bar development of top bars.. under wall..

$$H12: L_{bd} = 600 \text{ mm}$$

Use 180° hook



Demand: 3.24 kNm

Tension and compression couple (conservatively taking lever arm as distance between top and bottom steel for it cover lot)

$$e = 300 - 75 - 35 - 12 = 178 \text{ mm}$$

$$T = 3.24 \text{ kNm} / 0.178 \text{ m} = 18.2 \text{ kN}$$

$$f_c = 20 \text{ MPa}$$

$$\therefore V_c = 0.08 \sqrt{20 \text{ MPa}} = 0.358 \text{ MPa}$$

shear friction of concrete only:

$$V_c = k_d k_a V_c A_{cv} = 0.85 \times 1 \times 0.358 \text{ MPa} \times (219 \times 1000 \text{ mm}^2) = 66 \text{ kN}$$

$$\phi V_c = 0.75 \times 66 \text{ kN} = 50 \text{ kN} > 18 \text{ kN} \text{ OK}$$

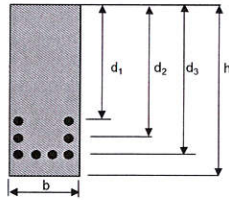
## Flexural Design for RC Beams

Project #: HV5604 By JC  
 Project Name: 80 Byron St  
 Element Description: Footing for after fire stability

### Design Assumptions

- Up to three layers of tension reinforcing can be counted for flexural strength.
- No account is made of the negligible flexural strength increase provided by compression steel.

|                                  |         |                                                                              |
|----------------------------------|---------|------------------------------------------------------------------------------|
| Limiting Concrete Strain at ULS  | 0.003   | Ref NSZ3101:2006, Clause 7.4.2.3                                             |
| Reinforcing Steel $f_y$ (MPa)    | 500     |                                                                              |
| Concrete Strength (MPa)          | 20      |                                                                              |
| Undercapacity Factor " $\Phi$ "  | 0.85    | Ref NSZ3101:2006, Clause 2.3.2.2                                             |
| $\alpha_1$                       | 0.85    | Ref NSZ3101:2006, Clause 7.4.2.7                                             |
| $\beta_1$                        | 0.85    | Ref NSZ3101:2006, Clause 7.4.2.7                                             |
| Concrete Strain " $\epsilon_c$ " | 0.0001  |                                                                              |
| c (mm)                           | 10      | Alter this to get internal equilibrium                                       |
| a (mm)                           | 8       |                                                                              |
| Beam Width, " $b_w$ " (mm)       | 1,000   |                                                                              |
| Beam Depth, " $h$ " (mm)         | 300     |                                                                              |
| $d_1$ (mm)                       | 0       |                                                                              |
| $d_2$ (mm)                       | 0       |                                                                              |
| $d_3$ (mm)                       | 219     | Cover = 75                                                                   |
| $\epsilon_{s1}$                  | 0.0000  |                                                                              |
| $\epsilon_{s2}$                  | 0.0000  |                                                                              |
| $\epsilon_{s3}$                  | 0.0025  | $= f_y/E_s$ (lower tension steel at yield for ULS)                           |
| Shear Stirrup Dia. (mm)          | 0       |                                                                              |
| Tension Bar Dia. $_1$ (mm)       | 0       |                                                                              |
| Tension Bar Dia. $_2$ (mm)       | 0       |                                                                              |
| Tension Bar Dia. $_3$ (mm)       | 12      |                                                                              |
| # of Bars $_1$                   | 0       |                                                                              |
| # of Bars $_2$                   | 0       |                                                                              |
| # of Bars $_3$                   | 2.5     | $\rightarrow = 400$ mm centres (excluding allowance for edge cover concrete) |
| $A_{s1}$ (mm <sup>2</sup> )      | 0       |                                                                              |
| $A_{s2}$ (mm <sup>2</sup> )      | 0       |                                                                              |
| $A_{s3}$ (mm <sup>2</sup> )      | 283     |                                                                              |
| $A_s$ Total (mm <sup>2</sup> )   | 283     |                                                                              |
| $f_{s1}$ (MPa)                   | 0       |                                                                              |
| $f_{s2}$ (MPa)                   | 0       |                                                                              |
| $f_{s3}$ (MPa)                   | 500     |                                                                              |
| Flexural Steel Ratio " $\rho$ "  | 0.0013  |                                                                              |
| Min Flexural Steel Ratio         | 0.0028  | Ref NSZ3101:2006, Clause 9.3.8.2.1                                           |
| Steel Elastic Modulus (MPa)      | 200,000 |                                                                              |
| Cover to Flexural Reo (mm)       | 75      |                                                                              |
| Reinforcing steel yield strain   | 0.0025  |                                                                              |



Use "Goal Seek" to make  $T - C = 0$ , by changing " $c$ "

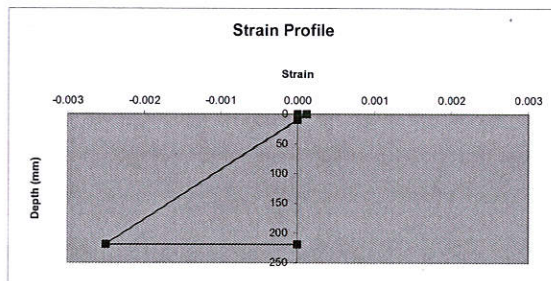
$$T = \sum A_s \times f_s = 141,372 \text{ N}$$

$$C = \alpha_1 \times f'_c \times a \times b = 141,372 \text{ N}$$

$T - C = 0$

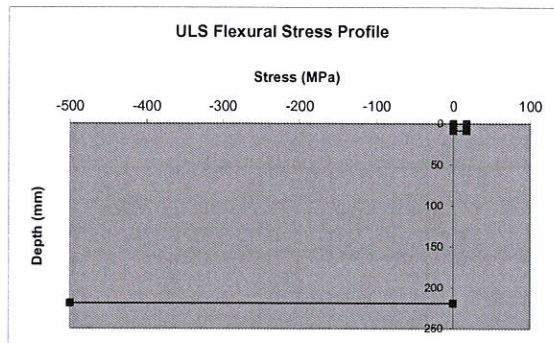
### Strain Profile Input Co-ordinates

| Desc.           | x (strain) | y (depth) |
|-----------------|------------|-----------|
| $\epsilon_c$    | 0          | 0         |
| c               | 0.0001     | 10        |
| $\epsilon_{s3}$ | -0.0025    | 219       |
| $\epsilon_{s1}$ | 0.0000     | 0         |
| $\epsilon_{s2}$ | 0.0000     | 0         |



### Stress Profile Input Co-ordinates

|                 | x (stress) | y (depth) |
|-----------------|------------|-----------|
| $\alpha_1 f'_c$ | 0          | 0         |
|                 | 17         | 0         |
|                 | 17         | 8         |
|                 | 0          | 8         |
| $f_{s1}$        | 0          | 0         |
|                 | 0          | 0         |
| $f_{s2}$        | 0          | 0         |
|                 | 0          | 0         |
| $f_{s3}$        | 0          | 219       |
|                 | -500       | 219       |



Nominal ULS Flexural Capacity,  $M_n$  (kNm) 30.4

Dependable ULS Flexural Capacity,  $\Phi M_n$  (kNm) 25.8

WARNING! BEAM SECTION HAS LESS THAN MINIMUM FLEXURAL STEEL RATIO



Grid 1 PFC:

$$t_w = \frac{3260\text{mm}}{2} + 90 = 2020\text{mm}$$

$$S_u \downarrow = 1.07\text{ kPa} \times 202\text{m} \\ = 2.2\text{ kN/m}$$

$$Span = 4.3\text{m}$$

$$M^* = \frac{(4.3\text{m})^2 (2.2\text{ kN/m})}{8}$$

$$= 5.1\text{ kNm} \quad \leftarrow \text{less.}$$

MB values over this  
JD PFC size will be  
OK.

Listel grid 4:

$$w_u = 1.6\text{m} \times 1.07\text{ kPa} = 1.7\text{ kN/m}$$

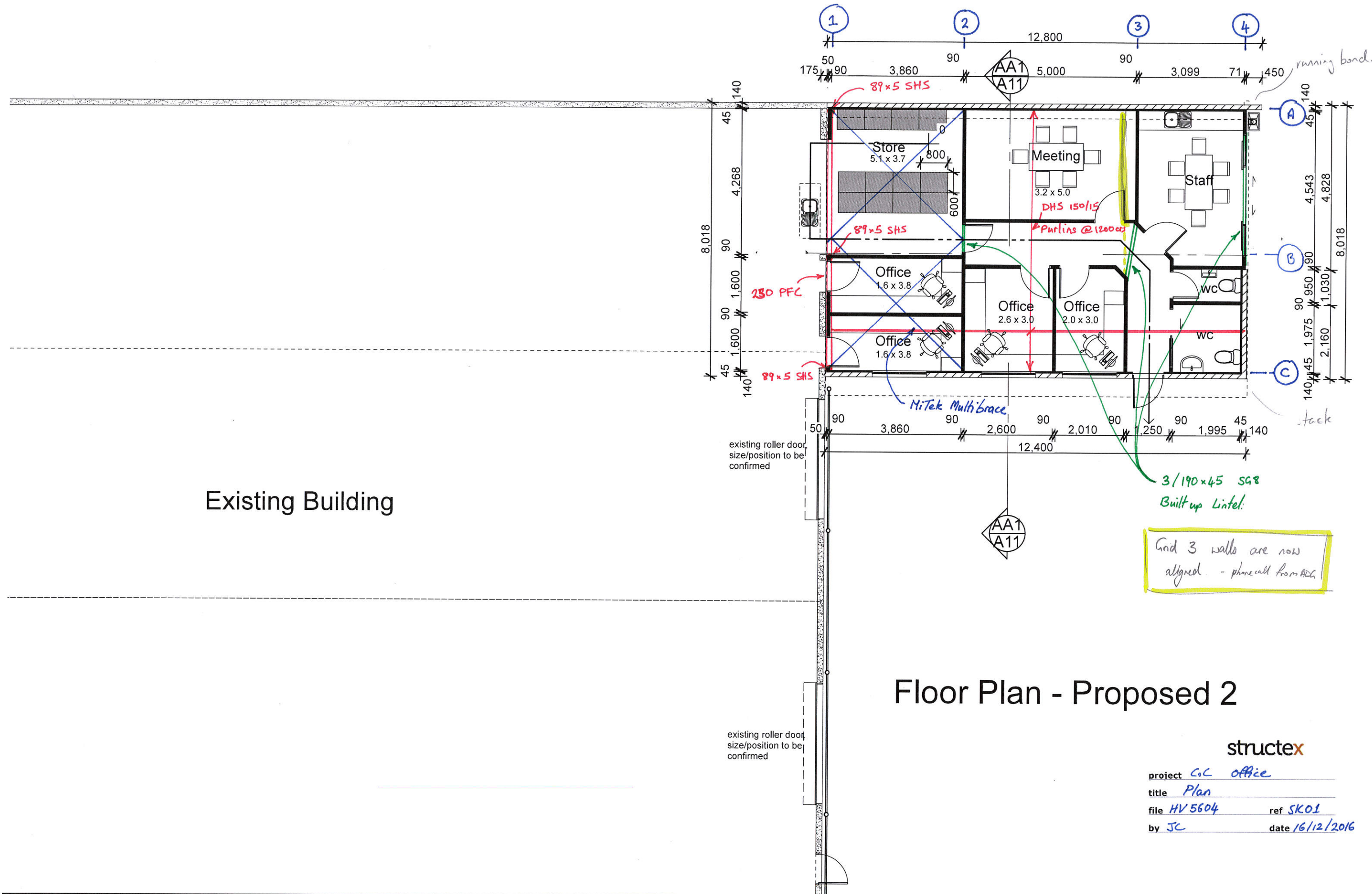
~~H40~~ 190 x 135 listel:

$$Z = \frac{190^2 \times 135}{6}$$

$$\phi M_n = 0.8 \times 0.8 \times 0.95 \times 14\text{ MPa} \times Z \downarrow \\ = 6.9\text{ kNm}$$

OK.





# Floor Plan - Proposed 2

structex

project C/L Office  
 title Plan  
 file HV 5604 ref SK01  
 by JC date 16/12/2016



Info from Architect → floor plan has changed! (7 Nov 2016...)

Grid 1 unchanged structurally  
2 → door in bracing wall.

2 wall lengths 3.3m, 3.4m

109 BU/m → over 6.7m = 730 BU. OK.  
Demand = 580 BU

lintel to support purlins + wall above.  
Does 3/190 x 45 still work?

$$TW = 3860/2 + 90 + 5000/2$$

$$= 4520 \text{ mm}$$

L = 1m

$$1.2G + S_u = 0.99 \text{ kPa} \quad \text{ULS}$$

$$G + S_s = 0.3 \text{ kPa} + 0.43 \text{ kPa}$$

$$= 0.73 \text{ kPa} \quad \text{SLS}$$

$$M^* = \frac{wL^2}{8} = 0.56 \text{ kNm}$$

OK, No problem!

MB calc  $\phi M_n = 4.6 \text{ kNm}$

$$\text{SLS}; \quad \Delta = \frac{5wL^4}{384EI}$$

$$I = \frac{(135 \text{ mm})(190 \text{ mm})^3}{12}$$

$$= 77.2 \times 10^6 \text{ mm}^4$$

$$\frac{5(3.3 \text{ kN/m})(1 \text{ m})^4}{384(6.7 \text{ kPa} \times 77.2 \times 10^6 \text{ mm}^4)}$$

$$= 0.1 \text{ mm}$$

OK!

3 → offset bracing walls - no problem ~ 300mm

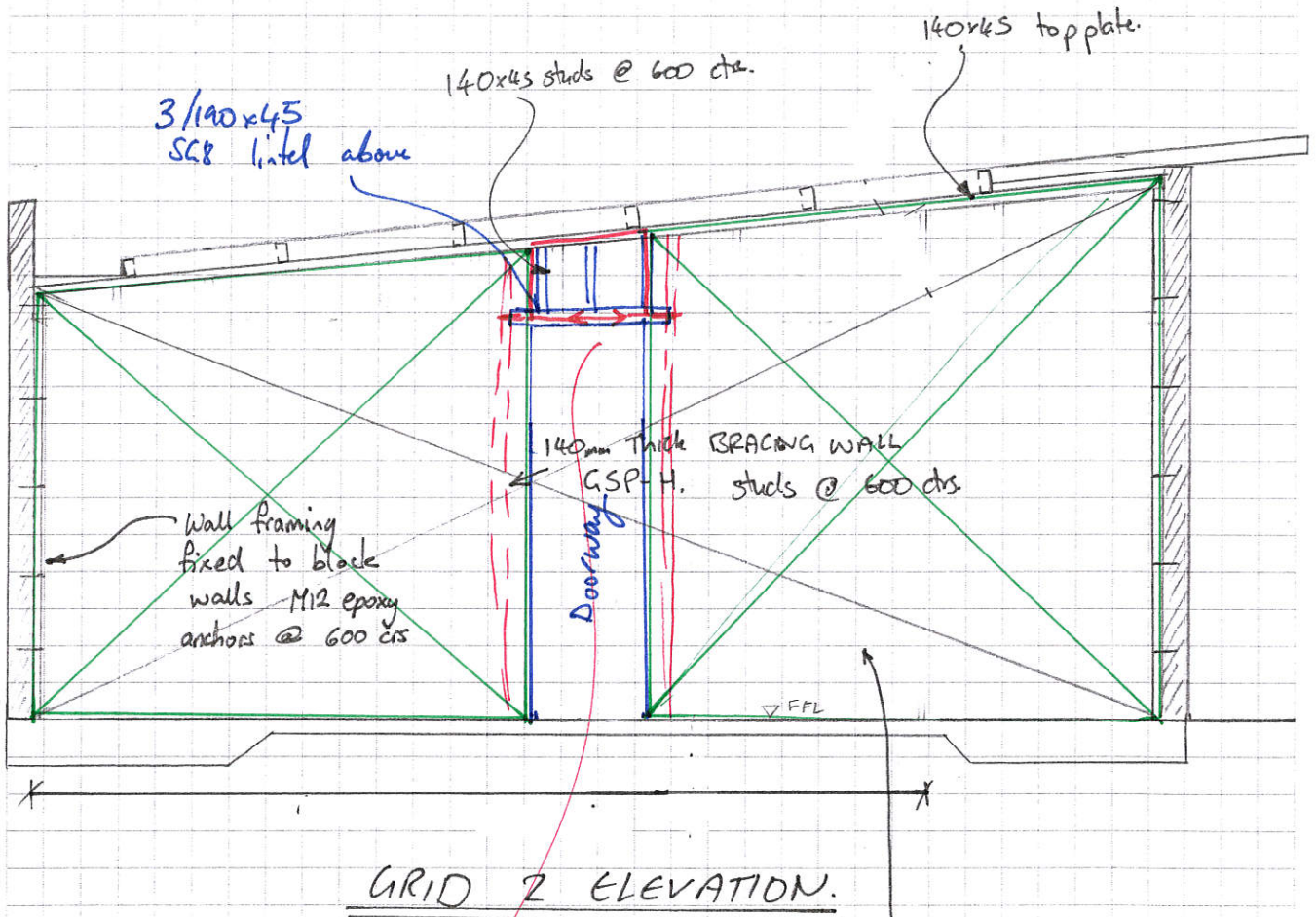
$$100 \text{ BU/m} \times (3.1 \text{ m} + 2.6 \text{ m}) = 570 \text{ BU} > 375 \text{ BU} \quad \text{OK}$$

Keep as load bearing wall - just think the lintel

Smaller lintel spans means can probably decrease depth,  
but OK for now.

Lintels must be able to hold bracing walls together and transfer  
load between so they act together. Framing and lining in between  
should be able to do this no problem.





Load transfer?

One wall can take all but 11kN of the load.

$$\text{Wall } C = 15\text{kN at } n=1.25 \\ = 7.8\text{kN at } n=3$$

3.2kN to transfer.  
6kN from roof. Pretty even...

Brace out top of opening to transfer loads if required.

Top plate 140 x 45 has  $\phi N_t = 30\text{kN} \therefore \text{OK. if continuous.}$

Bracing wall full height and length of wall.  
≥ 6m min

Sheet brace strap 6kN characteristic capacity  
one around studs + lintel



### Shear capacity of stack band wall.

$$U_n = v_n b_w d$$

where  $d = 0.8L_w$   
 $b_w = t$   
 $b_w = 1400 \leq 3t$  in plane out of plane

$$U_{nm} = 0.7 \text{ MPa}$$

$$\rho_w = \frac{(12\text{mm})^2 \frac{\pi}{4}}{150 \times 400\text{mm}} = 0.188 \%$$

$$U_m = 1.1 \times 0.7 \text{ MPa} = 0.77 \text{ MPa}$$

$$\zeta = 33 (0.00188) \frac{500}{300} = 0.104$$

$$\zeta_2 = 1.0$$

$$b_{\text{plane}} = (0.77 \text{ MPa}) 0.8 \times 3190\text{mm} \times 140\text{mm} = 275 \text{ kN}$$

OK by inspection.

Stack band only affects face shear

$$(2.45 \text{ kPa} \times 3.7\text{m} \times \frac{5}{8}) = 5.7 \text{ kN/m}$$

$$\begin{aligned} \text{shear capacity} &= U_m \times L_w \times d \\ &= 0.77 \text{ MPa} \times 400\text{mm} \times \frac{1400\text{mm}}{2} \\ &= 21.5 \text{ kN} \\ \phi U_m &= 15 \text{ kN} \quad \text{with } \phi = 0.7 \end{aligned}$$

Will be OK.

Grid 4: wall tied into grid C wall for alternative stability

footing width:

50kPa bearing

$$\begin{aligned} \text{Load} &= 1 \text{ kPa} \quad \text{roof + snow load} \times 1.7 \text{ m TW} = 1.7 \text{ kN/m} \\ 1.2 \times 3.5 \text{ kPa wall} \times 3.7 \text{ m high} &= 15.5 \text{ kN/m} \end{aligned}$$

$$1.2G + S_n = 17.2 \text{ kN/m on section under wall}$$

$$\text{Required footing thickness} = \frac{17.2 \text{ kN/m}}{50 \text{ kN/m}^2} = 0.344 \text{ m wide.}$$

350 wide, 300 deep strip footing under wall



# Foundation thickenings under load bearing walls

300 wide - 50 kPa safe bearing

$$50 \text{ kPa} \times 0.3 \text{ m} = 15 \text{ kN/m}$$

Roof  $G = 0.3 \text{ kPa}$   
 $S_u = 0.63 \text{ kPa}$

over  $TN = \frac{4.8 \text{ m}}{2} + \frac{3.9 \text{ m}}{2}$   
 $= 4.35 \text{ m}$

Walls 140 wide studs 0.25 kPa over  $h = 3.79 \text{ m}$  max  
 $3.11 \text{ m}$  min. } 3.5 m avg

$$\begin{aligned} 1.2 G + S_u &= 1.2 \times 0.25 \text{ kPa} \times 3.5 \text{ m} + (1.2 \times 0.3 \text{ kPa} + 0.63 \text{ kPa}) \times 4.35 \text{ m} \\ &= 1.05 \text{ kN/m} + 4.31 \text{ kN/m} \\ &= 5.36 \text{ kN/m} < 15 \text{ kN/m} \end{aligned}$$

300 wide thickening OK.



Design

| WALL OR BRACING LINE         |                            | BRACING ELEMENTS PROVIDED |                                          |                               |
|------------------------------|----------------------------|---------------------------|------------------------------------------|-------------------------------|
| 1                            | 2                          | 3                         | 4                                        | 5                             |
| Line Label<br>(and<br>lines) | Minimum<br>BUs<br>Required | Bracing<br>Element<br>No. | Bracing<br>Type                          | Length<br>Element<br>(m)<br>L |
| (A)                          | ok gives<br>capacity.      |                           | running band block<br>walling ok by insp |                               |
| <del>B</del>                 |                            |                           |                                          |                               |
| (C)                          |                            |                           | running band block<br>walling ok by insp |                               |
| <del>D</del>                 |                            |                           |                                          | 1                             |
| <del>E</del>                 |                            |                           |                                          | 1.5                           |
|                              |                            |                           |                                          | 0.6                           |
|                              |                            |                           |                                          | 2.4                           |
|                              |                            |                           |                                          |                               |
|                              |                            |                           |                                          |                               |
|                              |                            |                           |                                          |                               |

| WIND                    |                                    |
|-------------------------|------------------------------------|
| 6 W                     | 7 W                                |
| Rating<br>BU/m<br><br>W | BUs<br>Achieved<br>(BU/m x L)<br>W |
|                         |                                    |
| <u>hèn.</u>             | (Full L)                           |
|                         |                                    |
|                         |                                    |
|                         |                                    |
| <u>h.</u>               |                                    |
|                         |                                    |
| 171 km                  | 3420                               |
| 256 km                  | 5120                               |
| 102 km                  | 2040                               |
| 410 km.                 | 8200                               |

[illegible]

3600  
tall.

|                                       |  |
|---------------------------------------|--|
| W achieved                            |  |
| W required*                           |  |
| W achieved must exceed<br>W required* |  |

|                                       |  |
|---------------------------------------|--|
| E achieved                            |  |
| E required*                           |  |
| E achieved must exceed<br>E required* |  |

$n=3$  demand from NZ\$1170.5. (refer calcs).

| WALL OR BRACING LINE |                            | BRACING ELEMENTS PROVIDED |                        |                               |
|----------------------|----------------------------|---------------------------|------------------------|-------------------------------|
| 1                    | 2                          | 3                         | 4                      | 5                             |
| Line Label           | Minimum<br>BUs<br>Required | Bracing<br>Element<br>No. | Bracing<br>Type        | Length<br>Element<br>(m)<br>L |
| <del>1</del> 1       |                            |                           | strap brace to line 2. |                               |
| <del>2</del> 2       | 580 ✓                      | 1                         | GSP-H                  | 3.3                           |
|                      |                            | 2                         | GSP-H                  | 3.4                           |
| <del>3</del> 3       | 375 ✓                      | 1                         | GSP-H                  | 3.1                           |
|                      |                            | 2                         | GSP-H                  | 2.7                           |
| <del>4</del> 4       | ok given capacity          | 1                         | Stack bond black wall  | 3.1                           |
| 8                    |                            |                           |                        |                               |

| WIND                       |                               |
|----------------------------|-------------------------------|
| 6 W                        | 7 W                           |
| Rating<br>BU/m             | BUs<br>Achieved<br>(BU/m x L) |
| W                          | W                             |
|                            |                               |
|                            |                               |
|                            |                               |
| $150 \times \frac{2.4}{3}$ | 360                           |
| 109                        | 370                           |
|                            |                               |
| 100                        | 310                           |
| 100                        | 270                           |
|                            |                               |
| 1233404                    | 5500                          |
| (4N x 20)                  |                               |
|                            |                               |
|                            |                               |

| EARTHQUAKE     |                               |
|----------------|-------------------------------|
| 6 E            | 7 E                           |
| Rating<br>BU/m | BUs<br>Achieved<br>(BU/m x L) |
| E              | E                             |
|                |                               |
|                |                               |
|                |                               |
| 109            | 360                           |
| 109            | 370                           |
|                |                               |
| 100            | 310                           |
| 100            | 270                           |
|                |                               |
|                | 5500.                         |
|                |                               |
|                |                               |
|                |                               |

avg stud  
3.3m.

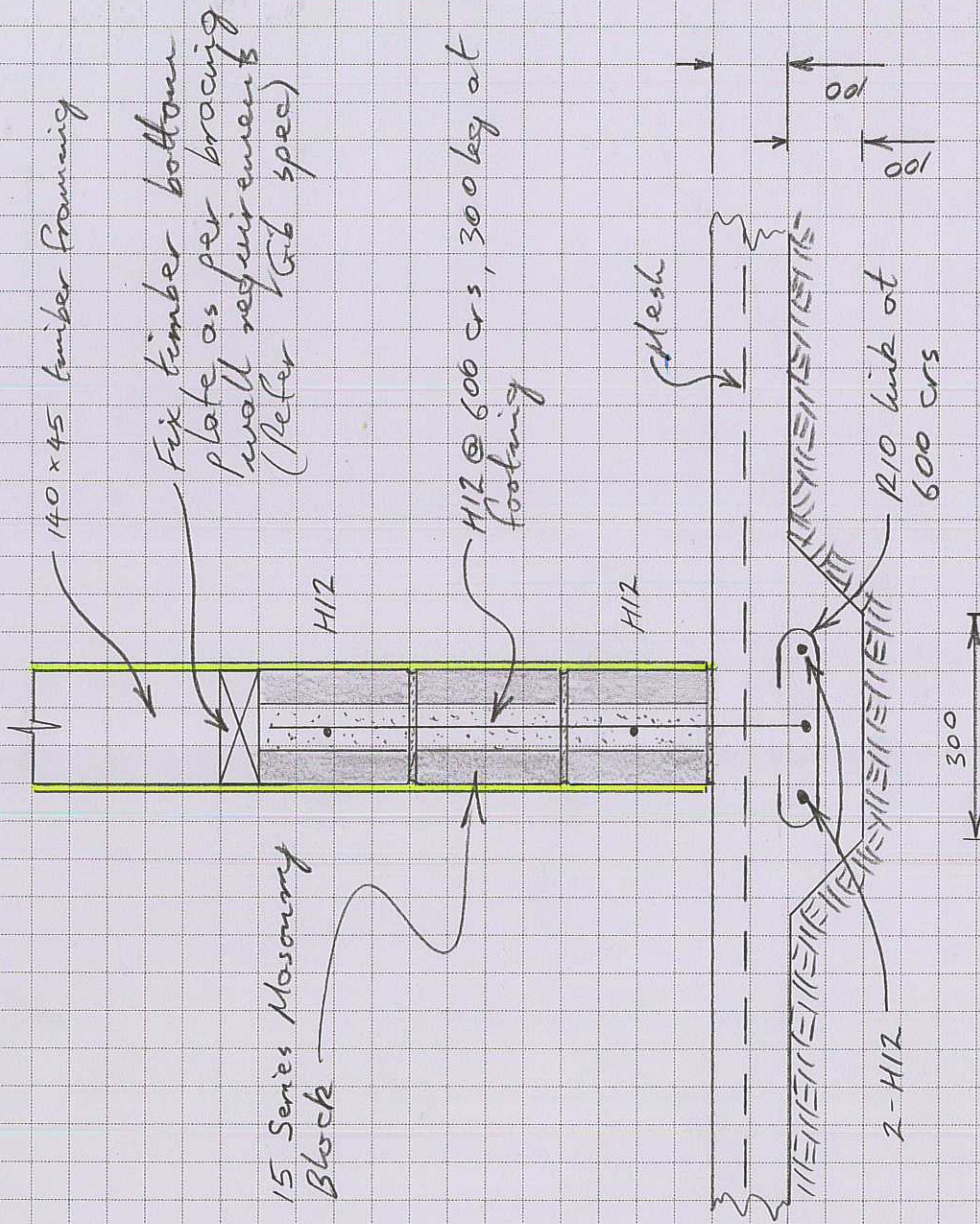
avg stud  
2 3.6m

|                        |       |
|------------------------|-------|
| W achieved             | 6810. |
| W required*            |       |
| W achieved must exceed |       |
| W required*            |       |

|                                       |      |
|---------------------------------------|------|
| E achieved                            | 6810 |
| E required*                           |      |
| E achieved must exceed<br>E required* |      |

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INTERNAL BRACING WALL LOWER  
DETAIL (TYPICAL)

Scale 1:10 (A4)





# New Zealand Fire Service Building Memorandum

Memo Issue 1  
Date 20 April 2017  
Design Review No 10138

In accordance with section 47 of the Building Act 2004 the New Zealand Fire Service (NZFS) provides advice to the Christchurch City Council in respect of the following building:

## Building Consent Authority (BCA) Reference

|          |               |         |                                |
|----------|---------------|---------|--------------------------------|
| File Ref | BCN/2017/2013 | Contact | Building Consent Administrator |
|----------|---------------|---------|--------------------------------|

## Property Information

|                             |              |                   |              |
|-----------------------------|--------------|-------------------|--------------|
| Street Number               | 80           | Legal Description | -            |
| Street Name                 | Byron Street |                   |              |
| Town/Suburb                 | Sydenham     | City/Region       | Christchurch |
| Owner/Registered Proprietor |              |                   |              |
| Premises / Company Name     |              |                   |              |

## Design Details

|                   |                                                                                                                                 |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Architect         | Architectural Design Group                                                                                                      |
| Fire Engineer     | Nick Chen, Cosgroves Ltd                                                                                                        |
| Fire Report Title | Clip'N Climb Factory C/- Spaghetti Junction Ltd Proposed EQ Strengthening and Office Extension 80 Byron St Fire Strategy Report |
| Fire Report Date  | 07/11/2016                                                                                                                      |
| Version           | B                                                                                                                               |
| Identifier        | 16175CC                                                                                                                         |



## Drawings Referenced

| Description                             | Date       | Project No. | Revision |
|-----------------------------------------|------------|-------------|----------|
| Cosgroves Fire Plan SK01                | 07/11/2016 | -           | B        |
| ADG Architectural Drawing Set A1 to A20 | Feb 2017   | 5996        | -        |

This memorandum is provided based on the information shown above. Note that the memorandum provides advice on the following matters:

1. Provision of the means of escape from fire.
2. The needs of persons who are authorised by law to enter the building to undertake fire-fighting.

The fire report uses the Acceptable Solutions Amendment 3 as a basis for design. The NZFS has also referred to this compliance route when providing the advice contained in this memo.

The NZFS considers this design to be alterations of, and additions to, an existing building. The additions have therefore been assessed as for a new building in terms of compliance with the Building Code, while the rest of the building has been assessed for means of escape in accordance with s.112 of the Building Act 2004.

## Introduction

The building consent application concerns an existing building known as the Clip'n Climb factory located at 80 Byron St, Christchurch. The proposed work includes earthquake strengthening and office extension.

The proposed work does not change the building fabric except for the proposed extension at north-western corner (facing Byron St) and removing of the existing mezzanine floors. The single level extension contains offices, meeting room, staff room, stores and toilets. The building including the extension has a footprint of 770 m<sup>2</sup> with an apex height of 5m. The storage within the building is to be limited to 3m.

The existing building has no active fire alarm system and it is proposed not to install any active fire alarm system as the building accommodates less than 50 people and the storage height is less than 3m. The western external wall of the extension is to be fire rated as it is located on the boundary.

# New Zealand Fire Service Advice Under Section 47

## 1. MEANS OF ESCAPE

- 1.1. ***Lack of signage – Sliding door - Eastern side of existing building*** – The fire plan SK01 shows a partition is in between the two spaces in the eastern side of the existing building. The partition appears to feature a sliding door.

The NZFS notes that the means of escape through the sliding door has not been assessed in the fire report. In particular, no signage has been provided to direct people through the sliding door.

The level of information provided in the fire report does not demonstrate compliance as required by AS1/F8.

**The NZFS recommends that the BCA requires the applicant to confirm the nature of the opening mentioned above and, if it is a sliding door, to amend the documentation and show adequate signage design on the fire plan, in order to demonstrate compliance with the Building Code.**

- 1.2. ***Completeness of documentation*** – The plans and specifications provided to the NZFS do not contain the following information, necessary to demonstrate compliance with the Building Code and/or carry out the proposed building work in accordance with the recommendations of the fire report:

- a. Fire-rated construction details, showing how the assembly is to achieve the fire resistance rating specified in the fire report.
- b. Confirmation that co-ordination of the fire safety requirements between the fire design and the drawings, specifications and documents produced by other design disciplines has occurred.

**The NZFS recommends that the BCA ensures the applicant provides the information listed above in order to demonstrate compliance with the Building Code.**

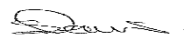
## Disclaimer

The fire report indicates that property protection has not been addressed in this design (other than as required by the building code). This may impact on the insurability of the completed building, and may affect the ability of the NZFS to successfully extinguish a fire and thus reduce property loss.

This memorandum is provided in accordance with section 47 of the Building Act 2004 and as such does not constitute a regulatory review of all fire safety systems in the design.



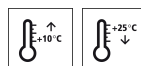
## Document Control

| Action       | Name             | Signature                                                                          | Date          |
|--------------|------------------|------------------------------------------------------------------------------------|---------------|
| Produced by: | Frank Fan        |   | 10 April 2017 |
| Checked by:  | Etienne Hermouet |   | 19 April 2017 |
| Approved by: | Simon Davis      |  | 20 April 2017 |

# Technical Data Sheet

## StoPur WV 200 transparent

PUR sealer, water-based, matt, transparent



### Characteristics

- Area of application**
- interior
  - as a transparent sealing coat on industrial flooring with low stress

- Properties**
- good stability under the effects of light
  - rapid curing at ambient room temperature

- Appearance**
- matt
  - transparent

- Information/notes**
- application on wall surface areas is also possible

### Technical data

| Criterion               | Standard / test specification | Value/ Unit                   | Notes    |
|-------------------------|-------------------------------|-------------------------------|----------|
| Viscosity (at 23 °C)    | EN ISO 3219                   | 350 - 550 mPa.s               | mi xture |
| Density (mixture 23 °C) | EN ISO 2811                   | 1.03 - 1.09 g/cm <sup>3</sup> |          |

The characteristic values stated are average values or approximate values. Due to the natural raw materials in our products, the stated values can vary slightly in the same delivery batch; this does not affect the suitability of the product for its intended use.

### Substrate

#### Requirements

Hardened, dry and clean StoPur sealing coats or coatings

New coatings on a polyurethane basis can be sealed directly with StoPur WV 200 transparent up to a period of 72 h.

In the case of longer waiting times sand matt the old coating using an abrasive pad (green/black) before sealing it.

Substrate temperature higher than +12 °C and 3 K above dew point.

Average bond strength 1.5 N/mm<sup>2</sup>

Bond strength of the single smallest value 1.0 N/mm<sup>2</sup>



# Technical Data Sheet

## StoPur WV 200 transparent

### Application

**Application temperature**      Lowest application temperature: +10 °C  
 Highest application temperature: +25 °C  
 permitted relative air humidity: max. 80% (min. 30%)

**Time for application**      At +12 °C: approx. 70 minutes  
 At +23 °C: approx. 60 minutes

**Mixing ratio**      Component A : component B = 100.0 : 11.1 parts by weight

**Material preparation**      Component A and Component B are supplied in the correct mixing ratio and should be mixed in accordance with the following instructions. Stir component A, then add all of component B.  
 Mix thoroughly with a slow-running paddle mixer (max. 300 rpm) until a homogeneous, streak-free compound develops. It is also vital to stir thoroughly at the sides and the bottom in order to evenly distribute the hardener. Mixing time is at least 3 minutes.  
 After mixing, pour the compound into a clean container and mix again.  
 Do not apply from the delivery container!

The temperature of the individual components must be at least +15 °C when mixing.  
 Transfer the material into a clean container using a paint sieve and stir it once again. Eliminate any lumps that occur during mixing.

| Consumption | Type of application                          | Approx. consumption |                   |
|-------------|----------------------------------------------|---------------------|-------------------|
|             | as a sealing coat for each application cycle | 0.08 - 0.1          | kg/m <sup>2</sup> |

Material consumption depends on the application, substrate, and consistency, among other factors. The stated consumption values are only to be used as a guide. If required, determine precise consumption values on the basis of the specific project.

**Coating build-up**      Matt sealant on smooth coatings, colourless, transparent  
 1) Substrate preparation  
 2). Sealing StoPur WV 200 transparent  
 3) StoDivers P 120 care treatment

### Application

Sealing coat on smooth coatings, transparent, matt  
 1) If necessary, substrate preparation on an old coating  
 2) StoPur WV 200 transparent sealing coat  
 Apply StoPur WV 200 transparent using a short-pile roller (Sto-Glaze Roller Micro-Fibre, Sto-Tool Catalogue) in a criss-cross pattern.  
 Creating some roller seams is unavoidable. In order to minimise them, work in a

# Technical Data Sheet

## StoPur WV 200 transparent

criss-cross pattern.

Apply the material evenly. Using a paint grid in the application container is recommended.

Consumption: approx. 0.1 - 0.2 kg/m<sup>2</sup>, depending on the substrate

### 3) Care treatment using StoDivers P 120

When the industrial flooring is clean and has cured, evenly apply a thin layer of care treatment. Apply the material using a pre-dampened mop. Leave the floor to dry sufficiently, approx. 20 - 30 min. Carry out the second application cycle at right angles (perpendicular) to the previous application.

In order to minimise seams, work in a criss-cross pattern. Avoid creating overlaps. Depending on the expected stress, several application cycles may be necessary. It is very important to observe the specified drying times between application cycles. Consumption: approx. 30 - 50 ml/m<sup>2</sup> per application cycle

### Drying, curing, ready for next coat

Dust-dry: after approx. 3 hours (at +23 °C)

Ready for foot traffic: after approx. 12 hours (at +23 °C)

Mechanically and chemically resistant: after approx. 7 days (at +23 °C)

### Cleaning the tools

Clean with water immediately after use; hardened material can only be removed mechanically.

### Notes, recommendations, special information, miscellaneous

The gloss level of the dead-matt sealing coat StoPur WV 200 is increased by adding StoDivers P 120.

The layer thickness for sealing coats is normally < 0.5 mm and decreases as a result of mechanical use. This should be taken into account with regard to the required service life.

StoPur WV 200 and the StoDivers P 120 care treatment are not plasticiser resistant!

If glossy, coloured coatings are matted with StoPur WV 200 transparent, the basic colour shade will become lighter.

This should be particularly observed when matting dark and bright colour shades.

When applying StoPur WV 200 transparent it is possible that the colour shade differs from the original colour shade of the substrate coating.

Roller marks might be visible, due to applying the sealer manually.

Ensure sufficient ventilation when applying water-based coating systems. However, avoid draughts. Different layer thicknesses, too high humidity, and too low temperatures can lead to visual defects (differences in the gloss levels).

General application instructions can be found at [www.stocretec.de](http://www.stocretec.de) (Products) and



# Technical Data Sheet

## StoPur WV 200 transparent

in the latest issue of the "Technical Data Sheets" manual, in the appendix.

### Delivery

| Article number | Designation                      | Container   |
|----------------|----------------------------------|-------------|
| 04446/001      | StoPur WV 200 Set<br>transparent | 8.07 kg set |

### Storage

**Storage conditions** Store in dry and frost-free conditions; avoid direct sunlight.

**Storage life** In the original container until ... (see packaging).

### Designation

**Product group** Sealer

### Safety

This product is subject to compulsory designation in accordance with the current EU directive.

You will receive an EU Safety Data Sheet with your first order.

Please observe the information regarding the handling of the product, its storage, and disposal.

### Special notes

The information in this Technical Data Sheet serves to ensure the product's intended use, or its suitability for use, and is based on our findings and experience. Users are nevertheless responsible for establishing the product's suitability and use.

Applications not specifically mentioned in this Technical Data Sheet are permissible only after prior consultation. Where no approval is given, such applications are at the user's own risk. This applies in particular when the product is used in combination with other products.

When a new Technical Data Sheet is published, all previous Technical Data Sheets are no longer valid. The latest version is available on the Internet.

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## Technical Data Sheet

**S-Protect WS405**

Aqueous emulsion on organofunctional silanes for the water repellent impregnation of absorbent, mineral substrates

**Product Description**

- Milky white emulsion based on organofunctional silane systems
- A hydrophobic agent for mineral building materials with high porosity
- Flash point 72°C
- Viscosity at 20 °C: 15 mPa•s
- pH-value (20°C) 6-8

**Intended Use**

- suited for the water repellent impregnation of porous, mineral substrates
- penetrates deeply in porous, mineral substrates
- shows no formation of sticky silicone films
- vapour permeable protection
- reduces significantly the uptake of water
- reduces the uptake of water soluble pollutants (eg. chlorides)
- protects hair like cracks of up to 0.3mm

**Application**

The amount of S-Protect WS405 to be applied is dependent on the absorbance of the substrate and the desired penetration depth.

Very absorbent substrates may require up to 1 Litre/m<sup>2</sup> of S-Protect WS405

**Application Method**

Low pressure spray with block brush to control

Airless spray or Silane pump

**Substrate****Application Rate**

Lightweight Concrete ( Poren Panel & Block)

min. 250 ml/m<sup>2</sup>

Clinker Masonry

min. 240 ml/m<sup>2</sup>

Sand Limestone

min. 400 ml/m<sup>2</sup>

Mineral Plaster

min. 200 ml/m<sup>2</sup>

The substrates to be treated should be dry and clean. Acceptable surface cleaning methods include honing, chemical cleaning and water blasting. During application outside temperature and surfaces temperatures should be between +5°C and +40°C. S-Protect WS405 should not be applied during strong wind or when rain is imminent.

S-Protect WS405 is applied in a full flood coat normally in 2 coats. On vertical surfaces the solution should run down in visible descending wet curtain achieved by allowing the solution to flow against the surface of the building material without pressure. Most liquid delivery devices eg. airless pump or backpack sprayer are suitable. The material should not be atomized or applied with a brush.

The water repellent effect of S-Protect WS405 can develop within minutes depending on the substrate and weather conditions. The impregnation should be applied continuously and without a break to avoid overlapping.

A substrate which has already been treated will repeal any reapplied aqueous silane/siloxane emulsion solution. Non-absorbent sustrates such as window frames, window sills, plastic fittings, window glass, etc., should be covered before application. Surfaces which accidentally come into contact with S-Protect WS405 can be cleaned with alcohol (spirit) or aqueous chemical solution. Cleaning should be carried out as quickly as possible (within a few hours), otherwise formation of a silicone resin film can make cleaning more difficult. Silicone resin films are best removed using ethanol (or spirit). Plant life should be protected from overspray.

S-Protect WS405 reacts with the interfaces in pores and capillaries for the mineral surface and forms an invisible, water repellent interfacial compounds To determine the exact amount to be applied a sample is required as the porosities of mineral materials varies.

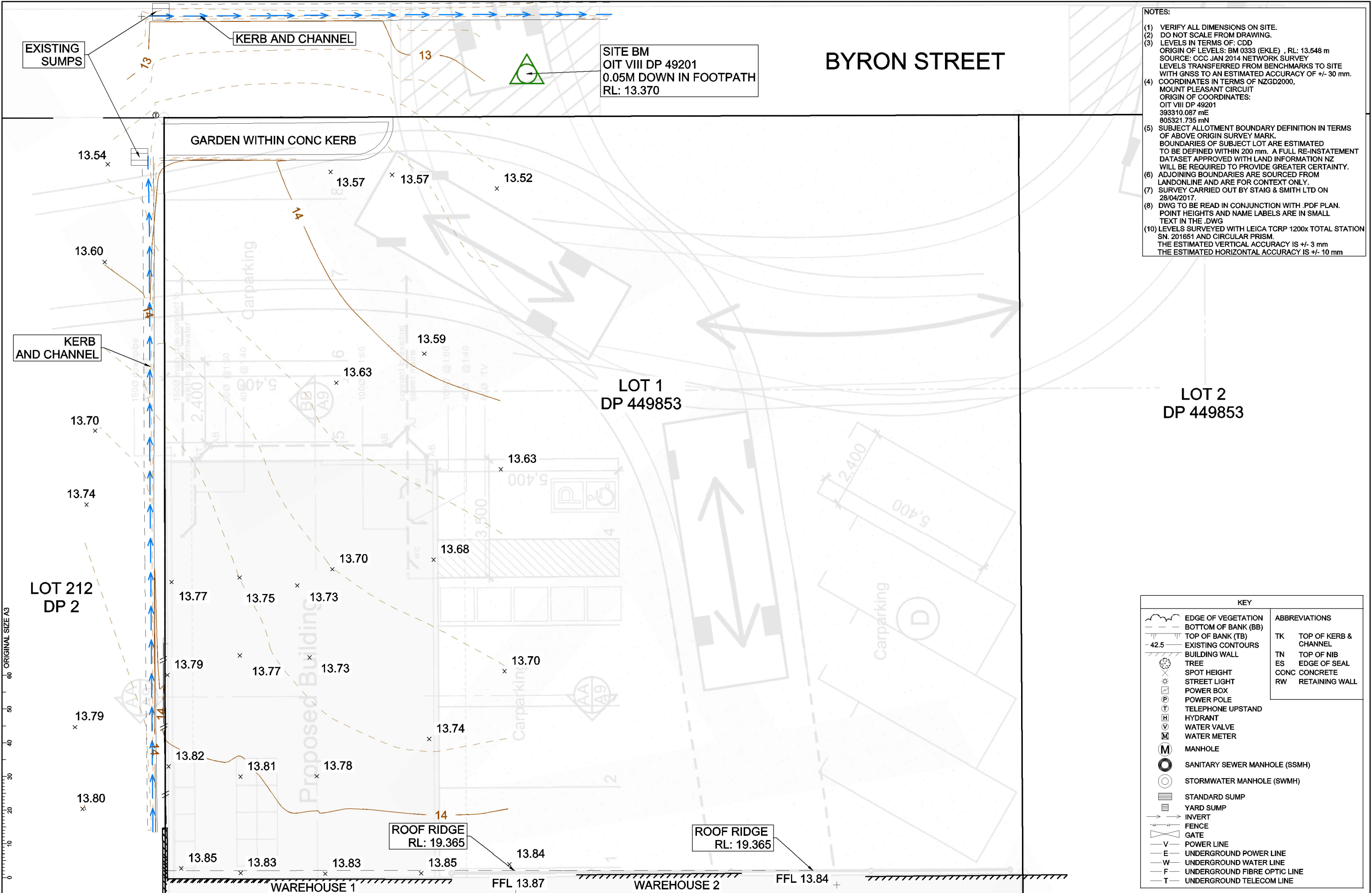
Before application read the Material Safety Data Sheet thoroughly for safely and toxicological data as well as for information on proper transportation, storage and use. The Material Safety Data Sheet is available upon request from Stoanz Ltd.

**Packaging, Storage and Handling**

S-Protect WS405 is supplied in ready-to-use 20 Litre container.

S-Protect WS405 is not resistant to frost and should be stored at temperatures between +3°C and +40°C. S-Protect WS405 has a shelf life of 12 months if stored in originally sealed containers.





- NOTES:
- (1) VERIFY ALL DIMENSIONS ON SITE.
  - (2) DO NOT SCALE FROM DRAWING.
  - (3) LEVELS IN TERMS OF: CDD  
ORIGIN OF LEVELS: BM 0333 (EKLE) , RL: 13.548 m  
SOURCE: CCC JAN 2014 NETWORK SURVEY  
LEVELS TRANSFERRED FROM BENCHMARKS TO SITE  
WITH GNSS TO AN ESTIMATED ACCURACY OF +/- 30 mm.
  - (4) COORDINATES IN TERMS OF NZGD2000,  
MOUNT PLEASANT CIRCUIT  
ORIGIN OF COORDINATES:  
OIT VIII DP 49201  
393310.087 mE  
805321.735 mN
  - (5) SUBJECT ALLOTMENT BOUNDARY DEFINITION IN TERMS  
OF ABOVE ORIGIN SURVEY MARK.  
BOUNDARIES OF SUBJECT LOT ARE ESTIMATED  
TO BE DEFINED WITHIN 200 mm. A FULL RE-INSTATEMENT  
DATASET APPROVED WITH LAND INFORMATION NZ  
WILL BE REQUIRED TO PROVIDE GREATER CERTAINTY.
  - (6) ADJOINING BOUNDARIES ARE SOURCED FROM  
LANDONLINE AND ARE FOR CONTEXT ONLY.
  - (7) SURVEY CARRIED OUT BY STAIG & SMITH LTD ON  
28/04/2017.
  - (8) DWG TO BE READ IN CONJUNCTION WITH .PDF PLAN.  
POINT HEIGHTS AND NAME LABELS ARE IN SMALL  
TEXT IN THE .DWG
  - (10) LEVELS SURVEYED WITH LEICA TCPR 1200x TOTAL STATION  
SN. 201651 AND CIRCULAR PRISM.  
THE ESTIMATED VERTICAL ACCURACY IS +/- 3 mm  
THE ESTIMATED HORIZONTAL ACCURACY IS +/- 10 mm

| KEY |                               | ABBREVIATIONS            |
|-----|-------------------------------|--------------------------|
|     | EDGE OF VEGETATION            | TK TOP OF KERB & CHANNEL |
|     | BOTTOM OF BANK (BB)           |                          |
|     | TOP OF BANK (TB)              | TN TOP OF NIB            |
|     | EXISTING CONTOURS             | ES EDGE OF SEAL          |
|     | BUILDING WALL                 | CONC CONCRETE            |
|     | TREE                          | RW RETAINING WALL        |
|     | SPOT HEIGHT                   |                          |
|     | STREET LIGHT                  |                          |
|     | POWER BOX                     |                          |
|     | POWER POLE                    |                          |
|     | TELEPHONE UPSTAND             |                          |
|     | HYDRANT                       |                          |
|     | WATER VALVE                   |                          |
|     | WATER METER                   |                          |
|     | MANHOLE                       |                          |
|     | SANITARY SEWER MANHOLE (SSMH) |                          |
|     | STORMWATER MANHOLE (SWMH)     |                          |
|     | STANDARD SUMP                 |                          |
|     | YARD SUMP                     |                          |
|     | INVERT                        |                          |
|     | FENCE                         |                          |
|     | GATE                          |                          |
|     | POWER LINE                    |                          |
|     | UNDERGROUND POWER LINE        |                          |
|     | UNDERGROUND WATER LINE        |                          |
|     | UNDERGROUND FIBRE OPTIC LINE  |                          |
|     | UNDERGROUND TELECOM LINE      |                          |

## BRANZ NZS 4218:2009 CALCULATION METHOD TOOL

### BUILDING ELEMENTS

**Roofs/ceilings:** Skylights are not included here. Enter them in the skylights table below.

| Roof/ceiling element | Description                                       | Area (m <sup>2</sup> ) | Construction R-value | Heat loss |
|----------------------|---------------------------------------------------|------------------------|----------------------|-----------|
| 1                    | Roof - Dimond Top Span-DHS Purlin-R3.2 Pink Batts | 103.85                 | 3.51                 | 29.6      |
| 2                    |                                                   |                        |                      |           |
| 3                    |                                                   |                        |                      |           |
| 4                    |                                                   |                        |                      |           |
| 5                    |                                                   |                        |                      |           |

Total area 103.85 m<sup>2</sup>

Total roofs/ceilings heat loss 29.6

**Skylights:** Skylights are at an angle of 60° or less to the horizontal. If the skylight R-value is not known, use a value of 0.15.

| Skylight | Description            | Area (m <sup>2</sup> ) | Construction R-value | Heat loss |
|----------|------------------------|------------------------|----------------------|-----------|
| 1        | Velux VCS 3030 solar   | 0.801                  | 0.31                 | 2.6       |
| 2        | Velux VCS 2222 solar   | 0.478                  | 0.31                 | 1.5       |
| 3        |                        |                        |                      |           |
| 4        |                        |                        |                      |           |
| 5        |                        |                        |                      |           |
|          | From Skylight Schedule | 0                      |                      | 0.0       |

Total area 1.279 m<sup>2</sup>

Total skylight heat loss 4.1

**Walls:** Doors are not included here. Enter them in the door table.

| Wall element | Description                                         | Area (m <sup>2</sup> ) | Construction R-value | Heat loss |
|--------------|-----------------------------------------------------|------------------------|----------------------|-----------|
| 1            | Wall - 90mm framed timber wall-R2.4 batts office to | 11.31                  | 1.97                 | 5.7       |
| 2            | wall-140mm framed timber storeroom R 2.4 batts      | 12.22                  | 2.35                 | 5.2       |
| 3            | Wall-140mm running bond masonry block timber st     | 44.57                  | 1.13                 | 39.4      |
| 4            | Wall - 140mm stack bond masonry block timber str    | 51.66                  | 1.13                 | 45.7      |
| 5            | Wall-140mm frame-Dimond Rib50-R2.2 batts            | 6.86                   | 2.36                 | 2.9       |
| 6            | Wall - 90mm framed timber R-2.4 batts office to stc | 12                     | 1.98                 | 6.1       |

Total area 138.62 m<sup>2</sup>

Total wall heat loss 105.1

**Floors:** Only include the ground or exterior floors. Intermediate floors not exposed to the exterior are excluded.

| Floor element | Description                    | Area (m <sup>2</sup> ) | Construction R-value | Heat loss |
|---------------|--------------------------------|------------------------|----------------------|-----------|
| 1             | Slab floor - 100mm thick conc. | 100                    | 1.49                 | 67.1      |
| 2             |                                |                        |                      |           |
| 3             |                                |                        |                      |           |
| 4             |                                |                        |                      |           |
| 5             |                                |                        |                      |           |

Total area 100 m<sup>2</sup>

Floor heat loss 67.1

**Vertical glazing:** Vertical glazing only (steeper than 60°), including glazing in doors. Skylights are on the Skylight table.

If the glazing R-value is not known, use a value of 0.15

| Glazing element | Description           | Area (m <sup>2</sup> ) | Construction R-value | Heat loss |
|-----------------|-----------------------|------------------------|----------------------|-----------|
| 1               | glazing windows       | 8                      | 0.26                 | 30.8      |
| 2               |                       |                        |                      |           |
| 3               |                       |                        |                      |           |
| 4               |                       |                        |                      |           |
| 5               | glazing doors         | 4.38                   | 0.26                 | 16.8      |
| 6               |                       |                        |                      |           |
| 7               |                       |                        |                      |           |
| 8               |                       |                        |                      |           |
| 9               |                       |                        |                      |           |
| 10              |                       |                        |                      |           |
|                 | From Glazing Schedule | 0                      |                      | 0.0       |

Total area 12.38 m<sup>2</sup>

Total vertical glazing heat loss 47.6

**Doors:** Only the non-glazed area of doors is included. The glazed area of doors must be entered in the Glazing table.

The heat loss of doors is automatically set to 0 if the total door area is ≤ 6m<sup>2</sup> or 6% of the total wall area.

If the R-value of a door is not entered a default value of R 0.18 is automatically used.

| Door element | Description        | Area (m <sup>2</sup> ) | Construction R-value | Heat loss |
|--------------|--------------------|------------------------|----------------------|-----------|
| 1            | Window frames      | 2.4                    | 0.18                 | 13.3      |
| 2            | Door frames        | 2.77                   | 0.18                 | 15.4      |
| 3            |                    |                        |                      | 0.0       |
| 4            |                    |                        |                      | 0.0       |
| 5            |                    |                        |                      |           |
|              | From Door Schedule | 0                      |                      | 0.0       |

Total area 5.17

Total door heat loss 0.0



# BRANZ NZS 4218:2009 CALCULATION METHOD TOOL

## PROJECT SUMMARY

|                         |                                     |
|-------------------------|-------------------------------------|
| <b>Project name</b>     | Proposed Industrial Building        |
| <b>Address</b>          | 80 Byron St, Sydenham, Christchurch |
| <b>Designer</b>         | ADG                                 |
| <b>Address</b>          | 47 Second Ave                       |
| <b>Phone</b>            | 578 2899                            |
| <b>Date</b>             | Jul-17                              |
| <b>Reference number</b> | 5996                                |

|                               |                                                                                                                                                                                                                                                           |  |                                                   |   |                                                        |     |                                         |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---------------------------------------------------|---|--------------------------------------------------------|-----|-----------------------------------------|
| <b>Climate zone</b>           | 3: South Island, Taupo and Ruapehu Districts, northern part of Rangitikei District, Stewart Islan                                                                                                                                                         |  |                                                   |   |                                                        |     |                                         |
| <b>Wall construction type</b> | 4: Mix of types 1, 2 or 3                                                                                                                                                                                                                                 |  |                                                   |   |                                                        |     |                                         |
| <b>If mixed wall types</b>    | <table> <tr> <td></td><td>Percentage of wall area solid timber construction</td></tr> <tr> <td>0</td><td>Percentage of wall area high thermal mass construction</td></tr> <tr> <td>100</td><td>Percentage of wall area "Any wall type"</td></tr> </table> |  | Percentage of wall area solid timber construction | 0 | Percentage of wall area high thermal mass construction | 100 | Percentage of wall area "Any wall type" |
|                               | Percentage of wall area solid timber construction                                                                                                                                                                                                         |  |                                                   |   |                                                        |     |                                         |
| 0                             | Percentage of wall area high thermal mass construction                                                                                                                                                                                                    |  |                                                   |   |                                                        |     |                                         |
| 100                           | Percentage of wall area "Any wall type"                                                                                                                                                                                                                   |  |                                                   |   |                                                        |     |                                         |
| <b>If solid timber wall</b>   | 1: External 75 mm thick solid timber and timber framed internal walls                                                                                                                                                                                     |  |                                                   |   |                                                        |     |                                         |

## Summary of calculation method heat loss

| Element          | Area (m <sup>2</sup> ) | Proposed building heat loss (W/°C) | Reference building heat loss (W/°C) |
|------------------|------------------------|------------------------------------|-------------------------------------|
| Roofs/ceilings   | 103.9                  | 29.6                               | 31.9                                |
| Walls            | 138.6                  | 105.1                              | 71.9                                |
| Floors           | 100.0                  | 67.1                               | 76.9                                |
| Vertical glazing | 12.4                   | 47.6                               | 180.2                               |
| Skylights        | 1.3                    | 4.1                                | -                                   |
| Doors            | 5.2                    | 0.0                                | -                                   |
| Total            |                        | 253.5                              | 360.9                               |

**Glazing percentage:** 8%

**Glazing <40%:** Yes

**Minimum R-values OK:** Maybe      Cannot be determined by this tool - apply Clause 4.2.1

**Issues to check:**

Check that the thermal mass is exposed to the interior.

Check that the high thermal mass walls have a surface density  
 $\geq 215 \text{ kg/m}^2$

**PASS/FAIL**

**PASS**

Provisional - confirm all min R-values and all issues



## Construction R-value Calculator

This webpage calculates the R-value of walls, roofs and suspended floors for most insulation material R-values. It uses the "iso-thermal planes" method, the same method as used in NZS4214:2006.

Some of the possible material combinations may not be suitable for actual constructions, i.e. EPS based claddings directly fixed on timber framing. Please make sure to select only appropriate material combinations.

If your construction is not listed, please send an e-mail to [designnavigator@gmail.com](mailto:designnavigator@gmail.com) with a description and a detail drawing (pdf) of it or use the new [Design Navigator message board](#) [1].

Please select the element type. Then choose the construction details and enter the R-value of the insulation either directly in the text box or by choosing a product from the right panel [1].

- Floors ☒  
Walls ☐  
Roofs ☐

Floor slab

1.49 m<sup>2</sup>K/W

Type: Floor: Slab floor

Slab floor

internal surface 0.09

Flooring : none (Example: polished surface of a concrete floor)

R-value: 0.00

Slab Insulation

Slab floor area [m<sup>2</sup>]: 100

Perimeter length [m]: 40.8

External wall thickness [mm]: 140 [1]

Soil conductivity [W/m °C]: 1.2 [1]

Underslab insulation: none Insulation : [1]

Piles Footings: Number: Penetration Diameter: [1]

Slab edge insulation: none Insulation : [1]

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Floors ☐

Walls ☒

Roofs ☐

|                                                                                                     |                         |
|-----------------------------------------------------------------------------------------------------|-------------------------|
| Masonry Block                                                                                       | 1.13 m <sup>2</sup> K/W |
| Type: Wall: Solid wall (concrete, masonry or other) without vented cavity, with internal insulation |                         |
| Solid wall (concrete, masonry or other) without vented cavity, with internal insulation             |                         |
| external surface 0.03                                                                               |                         |
| Cladding : None (facing outside air)                                                                | R-value: 0.00           |
| Solid Masonry : Standard Blocks, 150mm, all cells filled                                            | R-value: 0.13           |
| Strapping : Timber batten, 45mm deep, 45mm wide @ 600mm centers                                     | Cavity Area: 89.0%      |
| Thermal Break : none                                                                                | Insulation : 1          |
| Strapping : R-value: 0.00                                                                           | still Airgap: none      |
| Strapping : R-value: 0.37                                                                           | R-value: 0.00           |
| Wall Lining : Gypsum plasterboard 10mm                                                              |                         |
| R-value: 0.04                                                                                       |                         |
| internal surface 0.09                                                                               |                         |

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Floors ☐

Walls ☐

Roofs ☒

|                                                                                                            |                                                |                    |
|------------------------------------------------------------------------------------------------------------|------------------------------------------------|--------------------|
| Skillion Roof                                                                                              |                                                | 3.51 m²K/W         |
| Type: Roof: Steel framed skillion roof with insulated roofing                                              |                                                |                    |
| Steel framed skillion roof                                                                                 |                                                |                    |
| external surface 0.03                                                                                      |                                                |                    |
| Roofing : Corrugate iron with building paper                                                               |                                                |                    |
| R-value: 0.01                                                                                              |                                                |                    |
| Pink®Batts® Skillion Roof R3.2 3.2                                                                         |                                                |                    |
| Steel Frame & Cavity : 150/15DHS (150x75x1.45) rafters or joists @ 1200mm, battens covered with insulation |                                                |                    |
| Roof Frame Area: 6.3%                                                                                      |                                                | Cavity Area: 93.7% |
| Framing :                                                                                                  | still Airgap : 10-30mm airgap (non-reflective) |                    |
| R-value: 0.22                                                                                              | R-value: 0.13                                  |                    |
| Thermal Break :                                                                                            | Insulation :                                   |                    |
| Timber 35mm                                                                                                |                                                |                    |
| R-value: 0.30                                                                                              |                                                |                    |
| Roof Lining : Gypsum plasterboard 10mm                                                                     |                                                |                    |
| R-value: 0.04                                                                                              |                                                |                    |
| internal surface 0.09                                                                                      |                                                |                    |

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Floors ☐

Walls ☒

Roofs ☐

|                                                  |  |                                               |                    |
|--------------------------------------------------|--|-----------------------------------------------|--------------------|
| Timber frame vertical metal clad                 |  | 2.36                                          | m <sup>2</sup> K/W |
| Type: Wall: Timber frame (direct fixed cladding) |  |                                               |                    |
| timber frame (direct fixed cladding)             |  |                                               |                    |
| external surface 0.03                            |  |                                               |                    |
| Cladding :                                       |  | Metal weatherboard (corr. iron)               |                    |
|                                                  |  | R-value: 0.08                                 |                    |
| Air Barrier :                                    |  | none                                          |                    |
|                                                  |  | R-value: 0.00                                 |                    |
| Timber Frame & Cavity :                          |  | 144mm, studs @ 400mm, dwangs @ 800mm          |                    |
| Wall Frame Area: 17.9%                           |  | Cavity Area: 82.1%                            |                    |
| Framing :                                        |  | Pink®Batts® R2.4 Wall 2.4                     |                    |
| R-value: 1.19                                    |  | still Airgap: 20-90mm airgap (non-reflective) |                    |
|                                                  |  | R-value: 0.16                                 |                    |
| Wall Lining :                                    |  | Gypsum plasterboard 10mm                      |                    |
|                                                  |  | R-value: 0.04                                 |                    |
|                                                  |  | internal surface 0.09                         |                    |

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Floors ☐

Walls ☒

Roofs ☐

|                                                                   |                                            |                         |
|-------------------------------------------------------------------|--------------------------------------------|-------------------------|
| Timber frame storeroom                                            |                                            | 2.35 m <sup>2</sup> K/W |
| Type:                                                             | Wall: Timber frame (direct fixed cladding) |                         |
| timber frame (direct fixed cladding)                              |                                            |                         |
| external surface 0.03                                             |                                            |                         |
| Cladding : Gypsum plasterboard 10mm into still air (garage, etc.) |                                            |                         |
| R-value: 0.10                                                     |                                            |                         |
| Air Barrier : none                                                |                                            |                         |
| R-value: 0.00                                                     |                                            |                         |
| Timber Frame & Cavity : 144mm, studs @ 600mm, dwangs @ 800mm      |                                            |                         |
| Wall Frame Area: 14.4% Cavity Area: 85.6%                         |                                            |                         |
| Framing :                                                         | Pink®Batts® R2.4 Wall 2.4                  |                         |
| R-value: 1.19                                                     | still Airgap: none                         |                         |
|                                                                   | R-value: 0.00                              |                         |
| Wall Lining : Gypsum plasterboard 10mm                            |                                            |                         |
| R-value: 0.04                                                     |                                            |                         |
| internal surface 0.09                                             |                                            |                         |

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Floors ☐

Walls ☒

Roofs ☐

|                                                                             |                           |                         |
|-----------------------------------------------------------------------------|---------------------------|-------------------------|
| Timber frame office to Workshop                                             |                           | 1.97 m <sup>2</sup> K/W |
| Type: Wall: Timber frame (direct fixed cladding)                            |                           |                         |
| timber frame (direct fixed cladding)                                        |                           |                         |
| external surface 0.03                                                       |                           |                         |
| Cladding : None (facing inside air, i.e. internal bulkhead into roof space) |                           |                         |
| R-value: 0.09                                                               |                           |                         |
| Air Barrier : none                                                          |                           |                         |
| R-value: 0.00                                                               |                           |                         |
| Timber Frame & Cavity : 90mm, studs @ 400mm, dwangs @ 800mm                 |                           |                         |
| Wall Frame Area: 17.9% Cavity Area: 82.1%                                   |                           |                         |
| Framing :                                                                   | Pink®Batts® R2.4 Wall 2.4 |                         |
| R-value: 0.75                                                               |                           |                         |
| still Airgap:                                                               | none                      |                         |
|                                                                             | R-value: 0.00             |                         |
| Wall Lining : Gypsum plasterboard 10mm                                      |                           |                         |
| R-value: 0.04                                                               |                           |                         |
| internal surface 0.09                                                       |                           |                         |

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