# Timber Frame Construction

- **Introduction**
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  - Forms of timber frame construction

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- **Construction Problems**
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**Stratherpeffer Spa Pavilion**

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**Post War Swedish House Circa 1948**

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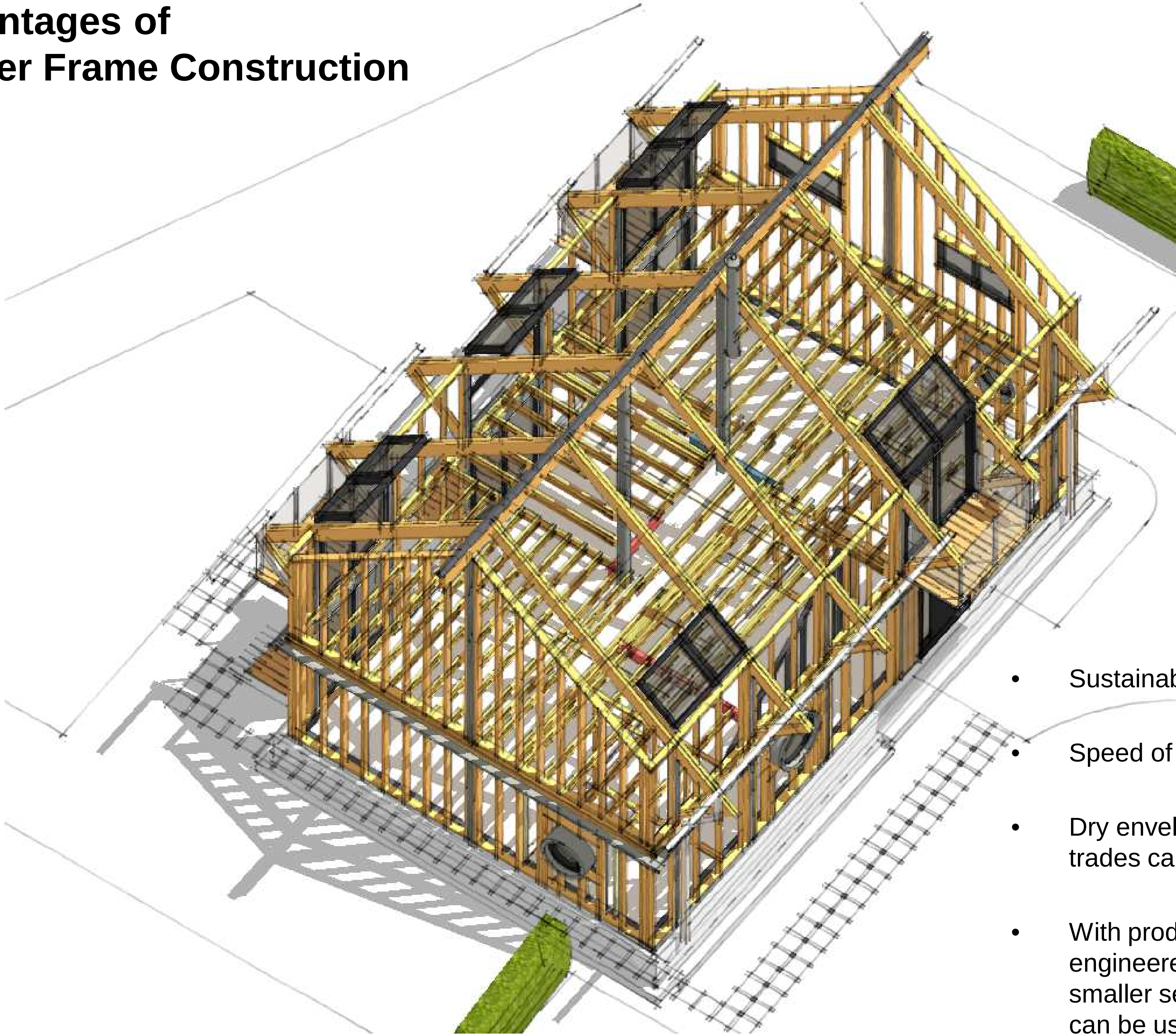
# Advantages of Timber Frame Construction



- Sustainable construction
- Speed of construction
- Dry envelope so finishing trades can start earlier
- With production of engineered lumber smaller sections of wood can be used in manufacture of sections

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**Timber Floor Cassette**

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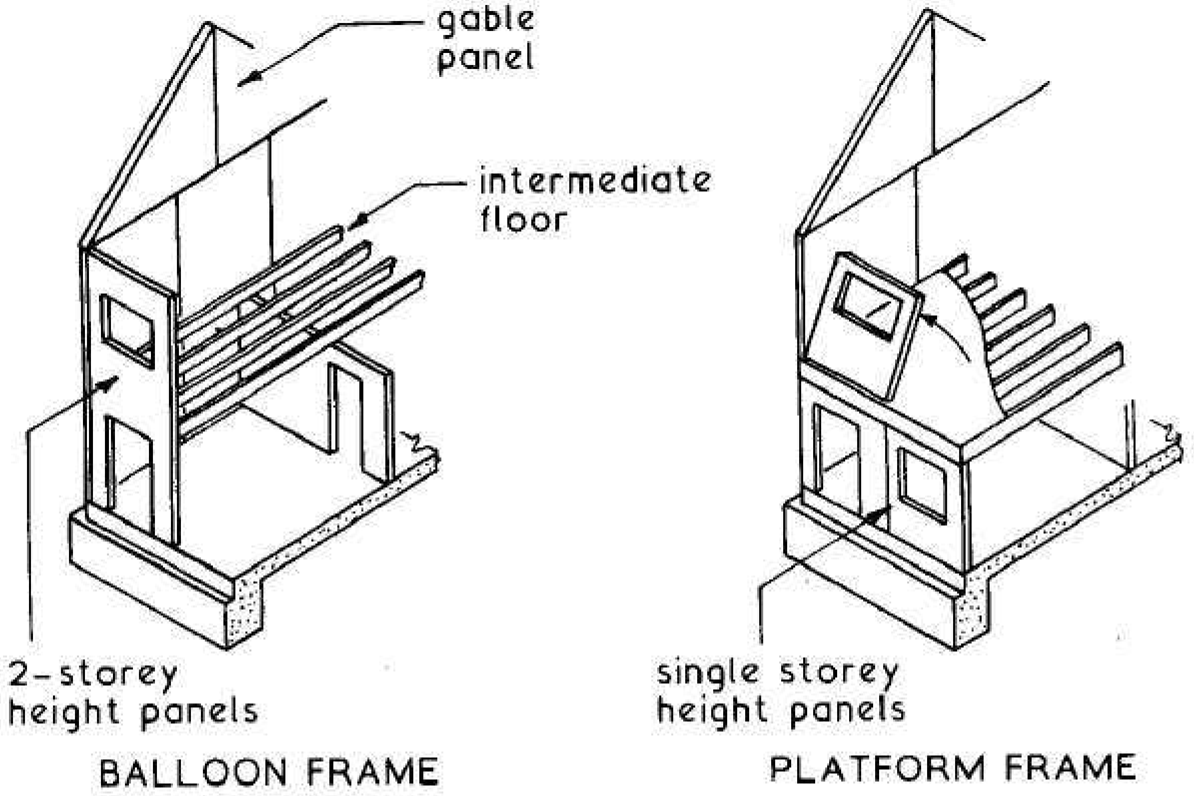


**Timber Frame Construction Methods**

# Design and Detailing

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DEAD LOAD CONSTRUCTION

**Slate Roof**

| Material | Thickness (mm) | γ (kN/m³) | Weight (kN/m²) |
|---|---|---|---|
| Slate | 20 | 28 | 0.560 |
| Softwood Sarking | 20 | 5 | 0.100 |
| Plasterboard | 12.5 | 9 | 0.113 |
| Glass wool | 200 | 0.1 | 0.020 |
| **Totals** | **252.5** | | **0.793** |

**1st Floor**

| Material | Thickness (mm) | γ (kN/m³) | Weight (kN/m²) |
|---|---|---|---|
| Chipboard | 22 | 8 | 0.176 |
| Softwood Floor Joists | 200 | 5 | 0.150 |
| Glass wool | 200 | 0.1 | 0.020 |
| Plasterboard | 12.5 | 9 | 0.113 |
| **Totals** | **434.5** | | **0.459** |



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SNOW LOADING TO BS6399:PART 3:1988

TEDDS calculation version 1.0.01

**Site location**

Location of site **Inverness**

Site altitude A = **75** m

**Calculate site snow load**

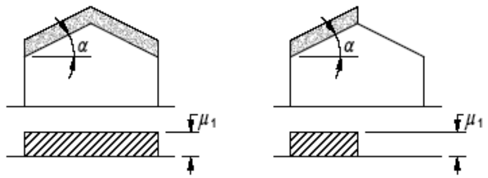
**From BS6399:Part 3: 1988 - Figure 1. Basic snow load on the ground**

Basic snow load $s_b$ = **0.80** kN/m²

$s_{alt} = 0.1 \times s_b + (0.09\ \text{kN/m}^2) = \mathbf{0.17}$ kN/m²

Site snow load $s_0 = s_b + s_{alt} \times (A - (100\ \text{m})) / 100\ \text{m} = \mathbf{0.76}$ kN/m²

BS6399:Part3:1988 Cl.6.2




**Uniform loading** **Asymmetric loading**

**Roof geometry**

Roof type **Pitched**

Distance on plan from gutter to ridge b = **5.000** m

Angle of pitch of roof α = **35.0** deg

**Calculate uniform snow load**

**From BS6399:Part 3: 1988 - Figure 3. Snow load shape coefficients for pitched roofs**

Snow load shape coefficient $\mu_1 = 0.8 \times [(60\ \text{deg} - \alpha) / 30\ \text{deg}] = \mathbf{0.67}$

Uniform roof snow load $s_{d1} = \mu_1 \times s_0 = \mathbf{0.51}$ kN/m²

BS6399:Part3:1988 Cl.5

**Calculate asymmetric snow load**

**From BS6399:Part 3: 1988 - Figure 3. Snow load shape coefficients for pitched roofs**

Snow load shape coefficient $\mu_1 = 1.2 \times [(60\ \text{deg} - \alpha) / 30\ \text{deg}] = \mathbf{1.00}$

Asymmetric roof snow load $s_{d1} = \mu_1 \times s_0 = \mathbf{0.76}$ kN/m²

BS6399:Part3:1988 Cl.5

**Snow sliding down roof**

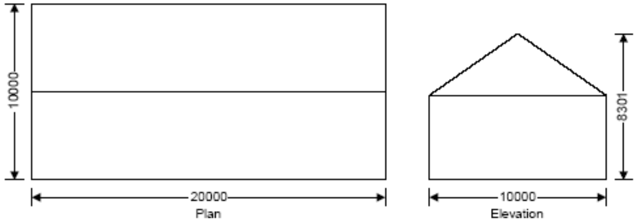
Maximum uniform snow load on roof $s_{d\_max}$ = **0.76** kN/m²

Force from sliding snow load $F_s = s_{d\_max} \times b \times \sin(\alpha) = \mathbf{2.17}$ kN/m

BS6399:Part3:1988 Cl.8

**WIND LOADING (BS6399)**

TEDDS calculation version 3.0.04




**Building data**

| | | | |
|---|---|---|---|
| Type of roof | Duopitch | | |
| Length of building | L = **20000** mm | Width of building | W = **10000** mm |
| Pitch of roof | $\alpha_0$ = **35.0** deg | | |
| Reference height | $H_r$ = **8301** mm | | |

**Dynamic classification**

| | | | |
|---|---|---|---|
| Building type factor (table 1) | $K_b$ = **0.5** | Dynamic augmentation factor (1.6.1) | $C_r$ = **0.01** |

**Site wind speed**

| | | | |
|---|---|---|---|
| Location | Inverness | Basic wind speed | $V_b$ = **24.1** m/s |
| Site altitude | $\Delta_S$ = **75** m | Upwind dist from sea to site | $d_{sea}$ = **2** km |
| Direction factor | $S_d$ = **1.00** | Seasonal factor | $S_s$ = **1.00** |
| Probability factor | $S_p$ = **1.00** | Critical gap between buidlings | g = **5000** mm |
| Topography not significant | | | |
| Altitude factor | $S_a$ = **1.08** | Site wind speed | $V_s$ = **25.9** m/s |
| Terrain category | Town | | |
| Ave height of surround builds | $H_o$ = **5000** mm | Distance to nearest building | $X_o$ = **35000** mm |
| Displ height (cl.1.7.3.3) | $H_d$ = **0** mm | | |

**The velocity pressure for the windward face of the building with a 0 degree wind is to be considered as 1 part as the height h is less than b (cl.2.2.3.2)**

**The velocity pressure for the windward face of the building with a 90 degree wind is to be considered as 1 part as the height h is less than b (cl.2.2.3.2)**

**Dynamic pressure - windward wall - Wind 0 deg**

| | | | |
|---|---|---|---|
| Reference height | $H_e$ = **4800** mm | | |
| Fetch factor (Table 22) | $S_c$ = **0.972** | Turbulence factor (Table 22) | $S_t$ = **0.194** |
| Fetch adjust factor (T.23) | $T_c$ = **0.745** | Turbulence adjust factor (T.23) | $T_t$ = **1.650** |
| Gust peak factor | $g_t$ = **3.44** | Terrain and building factor | $S_b$ = **1.52** |
| Effective wind speed | $V_e$ = **39.4** m/s | Dynamic pressure | $q_s$ = **0.950** kN/m$^2$ |

**Dynamic pressure - windward wall - Wind 90 deg**

| | | | |
|---|---|---|---|
| Reference height | $H_e$ = **8301** mm | | |
| Fetch factor (Table 22) | $S_c$ = **1.075** | Turbulence factor (Table 22) | $S_t$ = **0.178** |
| Fetch adjust factor (T.23) | $T_c$ = **0.803** | Turbulence adjust factor (T.23) | $T_t$ = **1.544** |
| Gust peak factor | $g_t$ = **3.44** | Terrain and building factor | $S_b$ = **1.68** |





| | | | |
|---|---|---|---|
| Effective wind speed | $V_e$ = **43.5** m/s | Dynamic pressure | $q_s$ = **1.160** kN/m$^2$ |

**Dynamic pressure - roof**

| | | | |
|---|---|---|---|
| Reference height | $H_e$ = **8301** mm | | |
| Fetch factor (Table 22) | $S_c$ = **1.075** | Turbulence factor (Table 22) | $S_t$ = **0.178** |
| Fetch adjust factor (T.23) | $T_c$ = **0.803** | Turbulence adjust factor (T.23) | $T_t$ = **1.544** |
| Gust peak factor | $g_t$ = **3.44** | Terrain and building factor | $S_b$ = **1.68** |
| Effective wind speed | $V_e$ = **43.5** m/s | Dynamic pressure | $q_s$ = **1.160** kN/m$^2$ |

**Size effect factors**

| | | | |
|---|---|---|---|
| Diag dim for gablewall | $a_{eg}$ = **13.0** m | Exte size effect factor | $C_{aeg}$ = **0.941** |
| Diag dim for side wall | $a_{es}$ = **20.6** m | Exte size effect factor | $C_{aes}$ = **0.912** |
| Diag dim for roof | $a_{er}$ = **20.9** m | Exte size effect factor | $C_{aer}$ = **0.911** |
| Volume for int size effect | $V_i$ = **0.1** m$^3$ | Diag dim for int size effect | $a_i$ = **5.0** m |
| Internal size effect factor | $C_{ai}$ = **1.000** | | |

**Pressures and forces**

Net pressure $p = q_s \times c_{pe} \times C_{ae} - q_s \times c_{pi} \times C_{ai}$

Net force $F_w = p \times A_{ref}$

**Roof loadcase 1 - Wind 0, $c_{pi}$ 0.20, $-c_{pe}$**

| Zone | Ext pressure coefficient, $c_{pe}$ | Dynamic pressure, $q_s$ (kN/m$^2$) | External size factor, $C_{ae}$ | Net Pressure, p (kN/m$^2$) | Area, $A_{ref}$ (m$^2$) | Net force, $F_w$ (kN) |
|---|---|---|---|---|---|---|
| A (-ve) | -0.33 | 1.16 | 0.911 | -0.58 | 33.65 | -19.65 |
| B (-ve) | -0.33 | 1.16 | 0.911 | -0.58 | 6.89 | -4.02 |
| C (-ve) | -0.13 | 1.16 | 0.911 | -0.37 | 81.54 | -30.40 |
| E (-ve) | -0.73 | 1.16 | 0.911 | -1.01 | 33.65 | -33.87 |
| F (-ve) | -0.43 | 1.16 | 0.911 | -0.69 | 6.89 | -4.75 |
| G (-ve) | -0.43 | 1.16 | 0.911 | -0.69 | 81.54 | -56.24 |

| | | | |
|---|---|---|---|
| Total vertical net force | $F_{w,v}$ = **-122.00** kN | Total horizontal net force | $F_{w,h}$ = **23.40** kN |

**Walls loadcase 1 - Wind 0, $c_{pi}$ 0.20, $-c_{pe}$**

| Zone | Ext pressure coefficient, $c_{pe}$ | Dynamic pressure, $q_s$ (kN/m$^2$) | External size factor, $C_{ae}$ | Net Pressure, p (kN/m$^2$) | Area, $A_{ref}$ (m$^2$) | Net force, $F_w$ (kN) |
|---|---|---|---|---|---|---|
| A | -1.36 | 1.16 | 0.941 | -1.72 | 19.80 | -33.99 |
| B | -0.82 | 1.16 | 0.941 | -1.13 | 45.71 | -51.51 |
| w | 0.76 | 0.95 | 0.912 | 0.47 | 96.00 | 44.97 |
| l | -0.50 | 0.95 | 0.912 | -0.62 | 96.00 | -59.85 |

**Overall loading**

| | | | |
|---|---|---|---|
| Leeward force overall | $F_l$ = **-59.9** kN | Windward force overall | $F_w$ = **45.0** kN |
| Overall loading overall | $F_{w,w}$ = **113.1** kN | | |

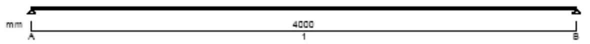
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **A.F. Cruden Associates**<br>**Consulting Engineers**<br>24 Bank Street, Inverness IV1 1QU<br>Tel: 01463 719200 Fax: 01463 719201 | Project<br>Example 2 Storey House | | | | Job Ref.<br>CA0 | |
| | Section<br>1st Floor Joists | | | | Sheet no./rev.<br>1 | |
| | Calc. by<br>NW | Date<br>26/04/2011 | Chk'd by | Date | App'd by | Date |

## TIMBER JOIST DESIGN (BS5268-2:2002)

TEDDS calculation version 1.1.02

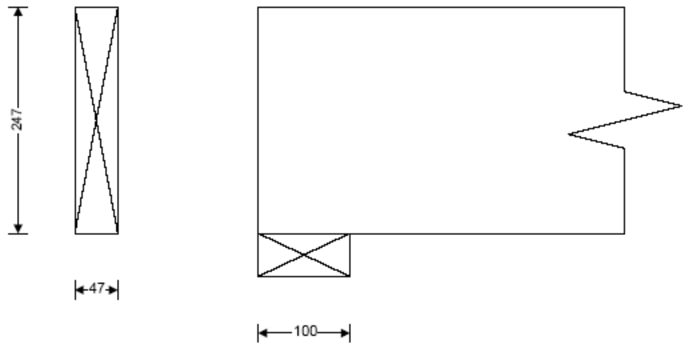
**Joist details**

| | | | |
|---|---|---|---|
| Joist breadth | $b$ = **47** mm | Joist depth | $h$ = **247** mm |
| Joist spacing | $s$ = **600** mm | Service class of timber | **1** |
| Timber strength class | **C24** | | |




**Span details**

| | | | |
|---|---|---|---|
| Number of spans | $N_{span}$ = **1** | Length of bearing | $L_b$ = **100** mm |
| Clear length of span | $L_{s1}$ = **4000** mm | | |




**Section properties**

| | | | |
|---|---|---|---|
| Second moment of area | $I$ = **59021123** mm$^4$ | Section modulus | $Z$ = **477904** mm$^3$ |

**Loading details**

| | | | |
|---|---|---|---|
| Joist self weight | $F_{swt}$ = **0.04** kN/m | Dead load | $F_{d\_udl}$ = **0.75** kN/m$^2$ |
| Imposed UDL(Long term) | $F_{i\_udl}$ = **1.50** kN/m$^2$ | | |
| Imposed point load (Medium) | $F_{i\_pt}$ = **1.40** kN | | |

**Consider long term loads**

| | | | |
|---|---|---|---|
| Design bending moment | $M$ = **2.780** kNm | Design shear force | $V$ = **2.780** kN |
| Design support reaction | $R$ = **2.780** kN | Design deflection | $\delta$ = **7.694** mm |

**Check bending stress**

| | | | |
|---|---|---|---|
| Permissible bending stress | $\sigma_{m\_adm}$ = **8.428** N/mm$^2$ | Applied bending stress | $\sigma_{m\_max}$ = **5.816** N/mm$^2$ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **A.F. Cruden Associates**<br>**Consulting Engineers**<br>24 Bank Street, Inverness IV1 1QU<br>Tel: 01463 719200 Fax: 01463 719201 | Project<br>Example 2 Storey House | | | | Job Ref.<br>CA0 | |
| | Section<br>1st Floor Joists | | | | Sheet no./rev.<br>2 | |
| | Calc. by<br>NW | Date<br>26/04/2011 | Chk'd by | Date | App'd by | Date |

***PASS - Applied bending stress within permissible limits***

**Check shear stress**

| | | | |
|---|---|---|---|
| Permissible shear stress | $\tau_{adm}$ = **0.781** N/mm$^2$ | Applied shear stress | $\tau_{max}$ = **0.359** N/mm$^2$ |

***PASS - Applied shear stress within permissible limits***

**Check bearing stress**

| | | | |
|---|---|---|---|
| Permissible bearing stress | $\sigma_{c\_adm}$ = **2.640** N/mm$^2$ | Applied bearing stress | $\sigma_{c\_max}$ = **0.591** N/mm$^2$ |

***PASS - Applied bearing stress within permissible limits***

**Check deflection**

| | | | |
|---|---|---|---|
| Permissible deflection | $\delta_{adm}$ = **12.000** mm | Actual deflection | $\delta$ = **7.694** mm |

***PASS - Actual deflection within permissible limits***

**Consider medium term loads**

| | | | |
|---|---|---|---|
| Design bending moment | $M$ = **2.380** kNm | Design shear force | $V$ = **2.380** kN |
| Design support reaction | $R$ = **2.380** kN | Design deflection | $\delta$ = **5.854** mm |

**Check bending stress**

| | | | |
|---|---|---|---|
| Permissible bending stress | $\sigma_{m\_adm}$ = **10.535** N/mm$^2$ | Applied bending stress | $\sigma_{m\_max}$ = **4.979** N/mm$^2$ |

***PASS - Applied bending stress within permissible limits***

**Check shear stress**

| | | | |
|---|---|---|---|
| Permissible shear stress | $\tau_{adm}$ = **0.976** N/mm$^2$ | Applied shear stress | $\tau_{max}$ = **0.307** N/mm$^2$ |

***PASS - Applied shear stress within permissible limits***

**Check bearing stress**

| | | | |
|---|---|---|---|
| Permissible bearing stress | $\sigma_{c\_adm}$ = **3.300** N/mm$^2$ | Applied bearing stress | $\sigma_{c\_max}$ = **0.506** N/mm$^2$ |

***PASS - Applied bearing stress within permissible limits***

**Check deflection**

| | | | |
|---|---|---|---|
| Permissible deflection | $\delta_{adm}$ = **12.000** mm | Actual deflection | $\delta$ = **5.854** mm |

***PASS - Actual deflection within permissible limits***

- Joist Designed to Eurocode 5
- Considering long term loads
  - Permissible bending stress = 14.215 N/mm$^2$
  - Applied bending stress = 8.417 N/mm$^2$
  - Permissible deflection = 14 mm
  - Applied deflection = 10.030 mm
- Considering medium term loads
  - Permissible bending stress = 16.246 N/mm$^2$
  - Applied bending stress = 7.162 N/mm$^2$
  - Permissible deflection = 14 mm
  - Applied deflection = 7.899 mm

**Solid Timber Floor Joists**

**Timber Frame Construction with JJI Joist and Temporary Bracing**

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**Posi-Joists**

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**Solid Timber Deck - EURBAN System**

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## Timber Frame Construction showing Wall Studs

- 100/150/200 x 50 studs at 600c/c
- Support vertical loads
- Withstand wind load on wall face

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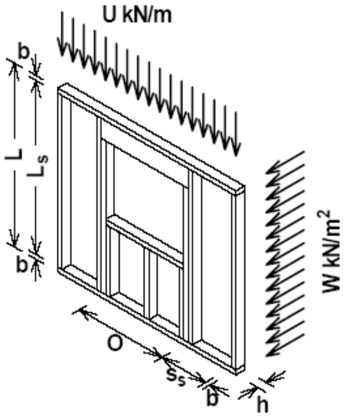
| A.F. Cruden Associates<br>Consulting Engineers<br>24 Bank Street, Inverness IV1 1QU<br>Tel: 01463 719200 Fax: 01463 719201 | Project<br>Example 2 Storey House | | | Job Ref.<br>CA0 | |
|---|---|---|---|---|---|
| | Section<br>2.4m External Stud Wall | | | Sheet no./rev.<br>1 | |
| | Calc. by<br>NW | Date<br>19/04/2011 | Chk'd by | Date | App'd by | Date |

**TIMBER STUD DESIGN (BS5268-2:2002)**

TEDDS calculation version 1.0.03




**Stud details**

| | | | |
|---|---|---|---|
| Stud breadth | $b = 47$ mm | Stud depth | $h = 147$ mm |
| Number of studs | $N_s = 1$ | Stud grade | C16 |

**Section properties**

| | | | |
|---|---|---|---|
| Cross sectional area | $A = 6909$ mm² | Section modulus | $Z = 169270$ mm³ |
| Moment of inertia major axis | $I_x = 12441382$ mm⁴ | Moment of inertia minor axis | $I_y = 1271832$ mm⁴ |
| Radius of gyration major axis | $r_x = 42.4$ mm | Radius of gyration minor axis | $r_y = 13.6$ mm |

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

| | | | |
|---|---|---|---|
| Panel height | $L = 2400$ mm | Stud length | $L_s = 2306$ mm |
| Standard stud spacing | $s_s = 600$ mm | Panel opening | $O = 1200$ mm |
| Loaded panel length | $s = 900$ mm | Effective length major axis | $L_{ex} = 1960$ mm |
| | | Slenderness ratio | $\lambda = 46.19$ |

| **Vertical loading details** | **Dead loads** | **Imposed loads** | |
|---|---|---|---|
| Wall UDL | $U_{w\_d} = 1.20$ kN/m | | |
| Roof UDL | $U_{r\_d} = 6.25$ kN/m | $U_{r\_i} = 3.75$ kN/m | |
| Floor UDL | $U_{f\_d} = 1.50$ kN/m | $U_{f\_i} = 3.00$ kN/m | |
| Imposed floor load duration | Long term | | |

**Lateral loading**

| | | | |
|---|---|---|---|
| Wind loading | $W = 1.58$ kN/m² | Wind load duration | **Very short term** |

**Modification factors**

| | | | |
|---|---|---|---|
| Section depth factor | $K_7 = 1.08$ | Load sharing factor | $K_8 = 1.10$ |

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| A.F. Cruden Associates<br>Consulting Engineers<br>24 Bank Street, Inverness IV1 1QU<br>Tel: 01463 719200 Fax: 01463 719201 | Project<br>Example 2 Storey House | | | Job Ref.<br>CA0 | |
|---|---|---|---|---|---|
| | Section<br>2.4m External Stud Wall | | | Sheet no./rev.<br>2 | |
| | Calc. by<br>NW | Date<br>19/04/2011 | Chk'd by | Date | App'd by | Date |

**Check bending stress**

Permissible bending stress $\sigma_{m\_adm} = 11.035$ N/mm² Applied bending stress $\sigma_{m\_max} = 6.049$ N/mm²

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

**Check compressive stress on stud**

Permissible comp.stress $\sigma_{c\_adm} = 9.144$ N/mm² Applied comp.stress $\sigma_{c\_max} = 2.045$ N/mm²

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

**Check compressive stress on rail**

Permissible comp.stress $\sigma_{cp1\_adm} = 4.770$ N/mm² Applied comp.stress $\sigma_{cp1\_max} = 2.045$ N/mm²

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

**Check combined axial compression and bending**

Combined axial compression and bending value $K = 0.819 < 1$

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

**Check stud deflection**

Permissible deflection $\delta_{adm} = 6.900$ mm Actual deflection $\delta_{max} = 4.782$ mm

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

**Check compressive stress on stud**

Permissible comp.stress $\sigma_{c\_adm} = 6.897$ N/mm² Applied comp.stress $\sigma_{c\_max} = 2.045$ N/mm²

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

**Check compressive stress on rail**

Permissible comp.stress $\sigma_{cp1\_adm} = 3.407$ N/mm² Applied comp.stress $\sigma_{cp1\_max} = 2.045$ N/mm²

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

**Check compressive stress on stud**

Permissible comp.stress $\sigma_{c\_adm} = 5.650$ N/mm² Applied comp.stress $\sigma_{c\_max} = 1.557$ N/mm²

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

**Check compressive stress on rail**

Permissible comp.stress $\sigma_{cp1\_adm} = 2.726$ N/mm² Applied comp.stress $\sigma_{cp1\_max} = 1.557$ N/mm²

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

- Stud Designed to Eurocode 5
  - Permissible bending stress = 9.515 N/mm²
  - Applied bending stress = 6.061 N/mm²
  - Interaction factor = 0.836
  - Permissible deflection = 9.6 mm
  - Applied deflection = 5.247 mm

**Solid Engineering Lumber Wall - EURBAN System**

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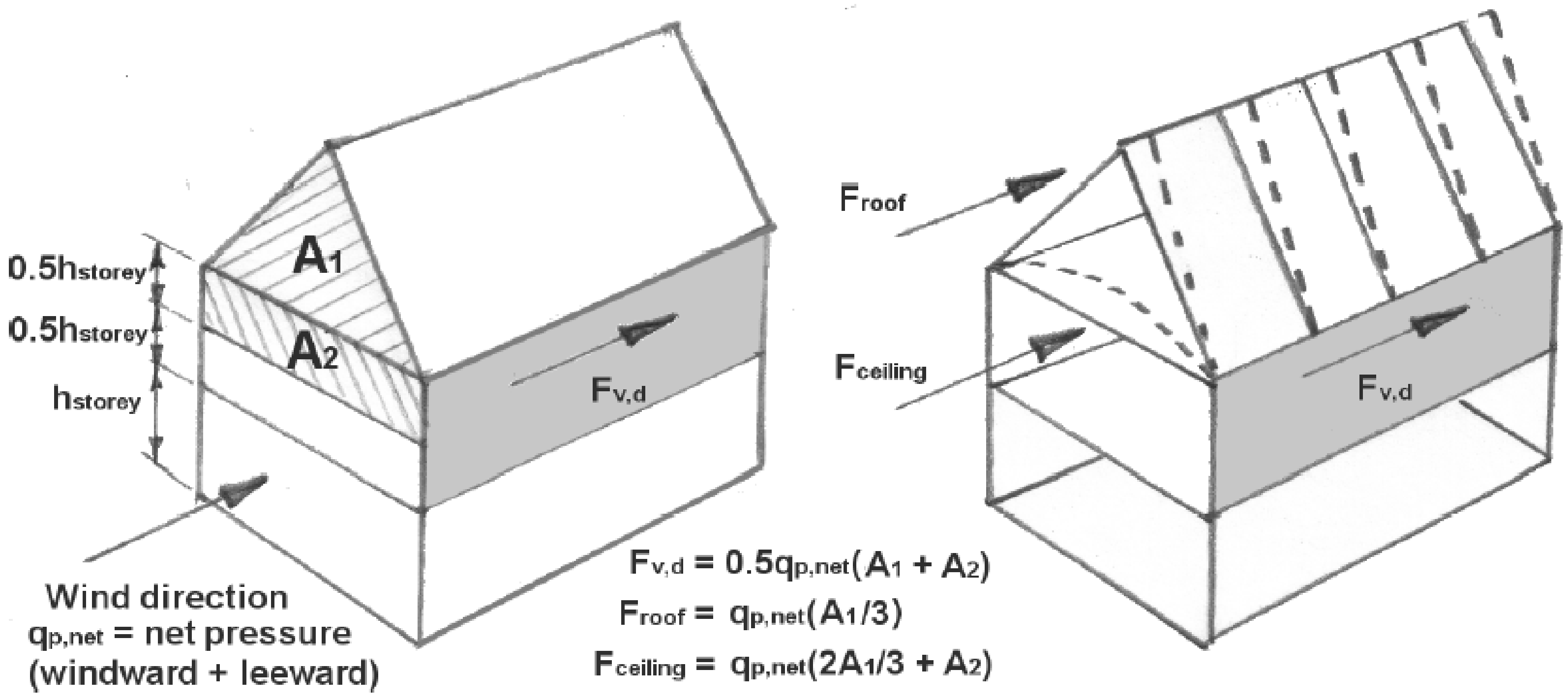



(a) Area of gable wall transferring wind load to front racking wall

(b) Diaphragm action of roof trusses and ceiling transferring wind on gable wall to front and rear walls

(c) First floor acts as diaphragm transferring wind on gable to ground floor front and rear walls

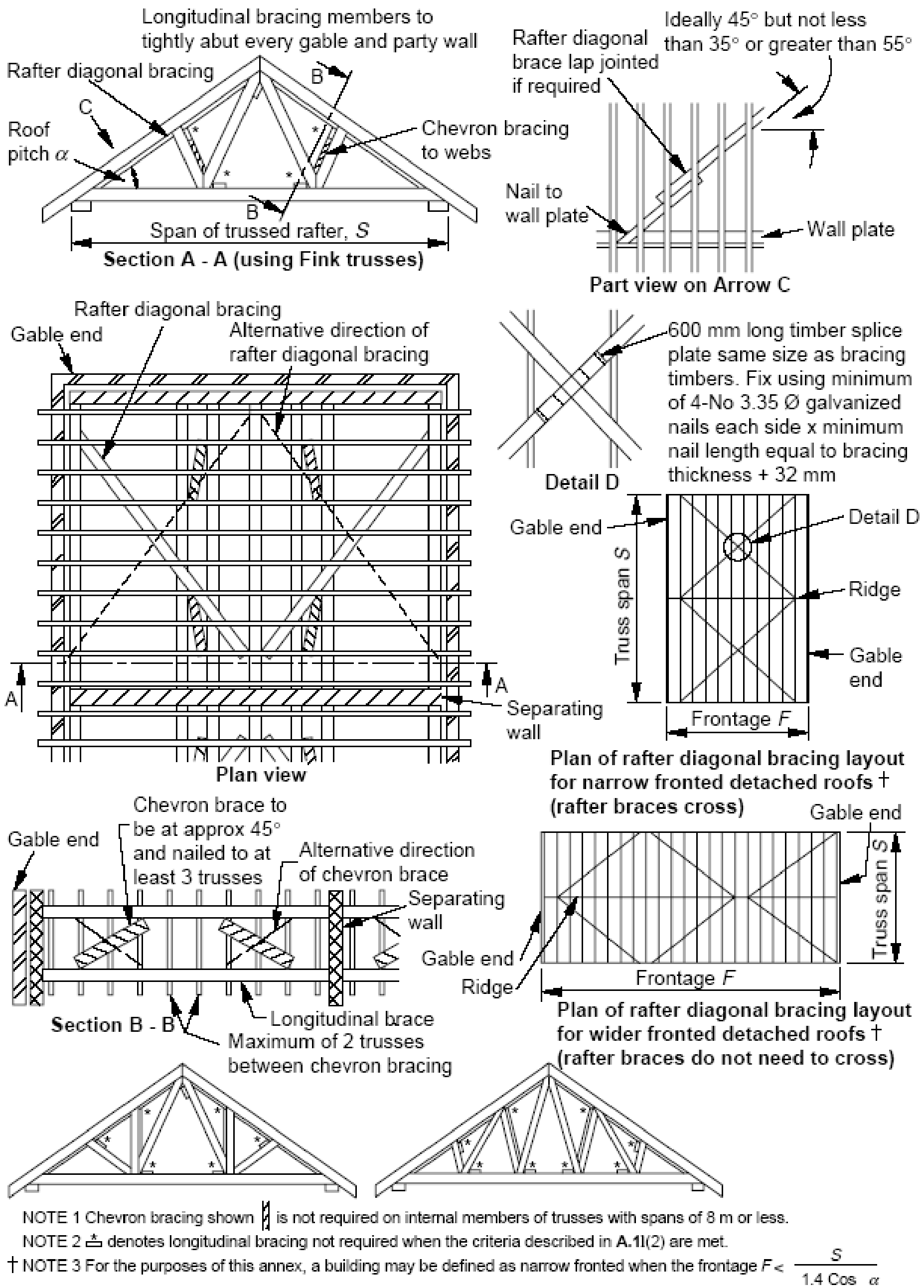
## Racking Load on First Floor Wall from Wind on Gable Wall

## BS5268-6.1: 1996
## Clause 4.5 Horizontal diaphragms

The design method for timber frame walls given in this British Standard assumes that, for the range of dwellings covered, the normal construction of floors and roofs provides adequate diaphragm action, provided that, in the case of intermediate floors, a floor deck or sub-deck is fixed directly to the top faces of the joists, or the floor is braced by some other means. In the case of pitched roofs it is assumed that the plasterboard ceiling under the roof, together with the roof bracing recommended in BS 5268-3 is sufficient to transfer applied wind forces to the resisting walls.

Due account should be taken of the eccentricity of the loading in relation to the wall panels providing resistance.

- Not enough nails in bracing to act as diaphragm
- Plasterboard and trusses act together
- Easier in Scotland as most roofs sarked with ply/OSB/20mm timber boarding
- Eurocode 5 Clause 9.2.3.2 is more onerous and requires calculations to be undertaken




**BS5268-3 1998 Standard bracing for rafter and web members of duopitch trussed rafters**

**Table A.4 — Permissible horizontal wind force (kN/m) at bottom chord level on 12.5 mm thick plasterboard ceiling diaphragms**

| Diaphragm depth m | Diaphragm span m[a] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 6 | 1.77 | 1.59 | 1.45 | 1.33 | 1.22 | 1.14 | 1.06 | 0.99 | 0.93 |
| 7 | 2.06 | 1.86 | 1.69 | 1.55 | 1.43 | 1.33 | 1.24 | 1.16 | 1.09 |
| 8 | 2.36 | 2.12 | 1.93 | 1.77 | 1.63 | 1.52 | 1.41 | 1.33 | 1.25 |
| 9 | 2.66 | 2.39 | 2.17 | 1.99 | 1.84 | 1.71 | 1.59 | 1.49 | 1.40 |
| 10 | 2.95 | 2.66 | 2.41 | 2.21 | 2.04 | 1.90 | 1.77 | 1.66 | 1.56 |
| 11 | 3.25 | 2.92 | 2.66 | 2.43 | 2.25 | 2.09 | 1.95 | 1.82 | 1.72 |
| 12 | 3.54 | 3.19 | 2.90 | 2.66 | 2.45 | 2.28 | 2.12 | 1.99 | 1.87 |
| 13 | 3.84 | 3.45 | 3.14 | 2.88 | 2.66 | 2.47 | 2.30 | 2.16 | 2.03 |
| 14 | 4.13 | 3.72 | 3.38 | 3.10 | 2.86 | 2.66 | 2.48 | 2.32 | 2.19 |
| 15 | 4.43 | 3.99 | 3.62 | 3.32 | 3.06 | 2.85 | 2.66 | 2.49 | 2.34 |
| 16 | 4.72 | 4.25 | 3.86 | 3.54 | 3.27 | 3.04 | 2.83 | 2.66 | 2.50 |
| 17 | 5.02 | 4.52 | 4.11 | 3.76 | 3.47 | 3.23 | 3.01 | 2.82 | 2.66 |

[a] Intermediate values may be obtained by linear interpolation.

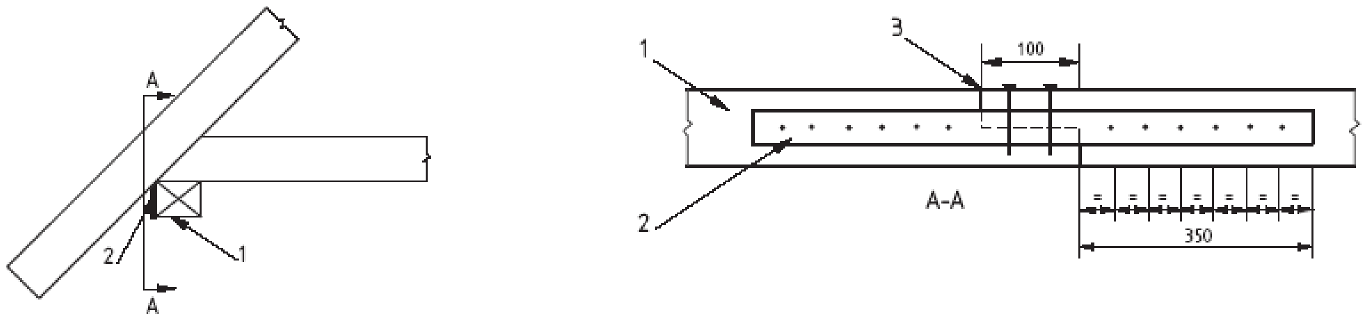
For plasterboard ceiling diaphragms greater than 9 m span, wallplates should be spliced in accordance with the detail provided below or using an alternative spliced detail capable of resisting a short-term axial load of 3.3 kN.

**Table A.5 — Permissible horizontal wind force (kN/m) at bottom chord level on 15 mm thick plasterboard ceiling diaphragms**

| Diaphragm depth m | Diaphragm span m[a] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 6 | 1.98 | 1.78 | 1.62 | 1.49 | 1.37 | 1.27 | 1.19 | 1.11 | 1.05 |
| 7 | 2.31 | 2.08 | 1.89 | 1.73 | 1.60 | 1.49 | 1.39 | 1.30 | 1.22 |
| 8 | 2.65 | 2.38 | 2.16 | 1.98 | 1.83 | 1.70 | 1.59 | 1.49 | 1.40 |
| 9 | 2.98 | 2.68 | 2.44 | 2.23 | 2.06 | 1.91 | 1.78 | 1.67 | 1.57 |
| 10 | 3.31 | 2.98 | 2.71 | 2.48 | 2.29 | 2.13 | 1.98 | 1.86 | 1.75 |
| 11 | 3.64 | 3.28 | 2.98 | 2.73 | 2.52 | 2.34 | 2.18 | 2.05 | 1.93 |
| 12 | 3.97 | 3.57 | 3.25 | 2.98 | 2.75 | 2.55 | 2.38 | 2.23 | 2.10 |
| 13 | 4.30 | 3.87 | 3.52 | 3.23 | 2.98 | 2.76 | 2.58 | 2.42 | 2.28 |
| 14 | 4.63 | 4.17 | 3.79 | 3.47 | 3.21 | 2.98 | 2.78 | 2.60 | 2.45 |
| 15 | 4.97 | 4.47 | 4.06 | 3.72 | 3.44 | 3.19 | 2.98 | 2.79 | 2.63 |
| 16 | 5.30 | 4.77 | 4.33 | 3.97 | 3.67 | 3.40 | 3.18 | 2.98 | 2.80 |
| 17 | 5.63 | 5.06 | 4.60 | 4.22 | 3.90 | 3.62 | 3.38 | 3.16 | 2.98 |

[a] Intermediate values may be obtained by linear interpolation.

For plasterboard ceiling diaphragms greater than 9 m span, wallplates should be spliced in accordance with the detail provided below or using an alternative spliced detail capable of resisting a short-term axial load of 3.3 kN.




**Key**

1) Wallplate
2) Steel strap fixed using 6 no. 3.75 × 30 mm square twist nails into each member
3) 100 mm long half lap joint with 2 no. nail fixings

## BS5268-3: 2006 Tables A.4 and A.5

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- Opening at stairwell has effect on diaphragm - internal ground floor wall may need to be sheathed to act as racking wall
- Flooring not laid but upper floor wall plate fixed

## Opening in Floor Deck

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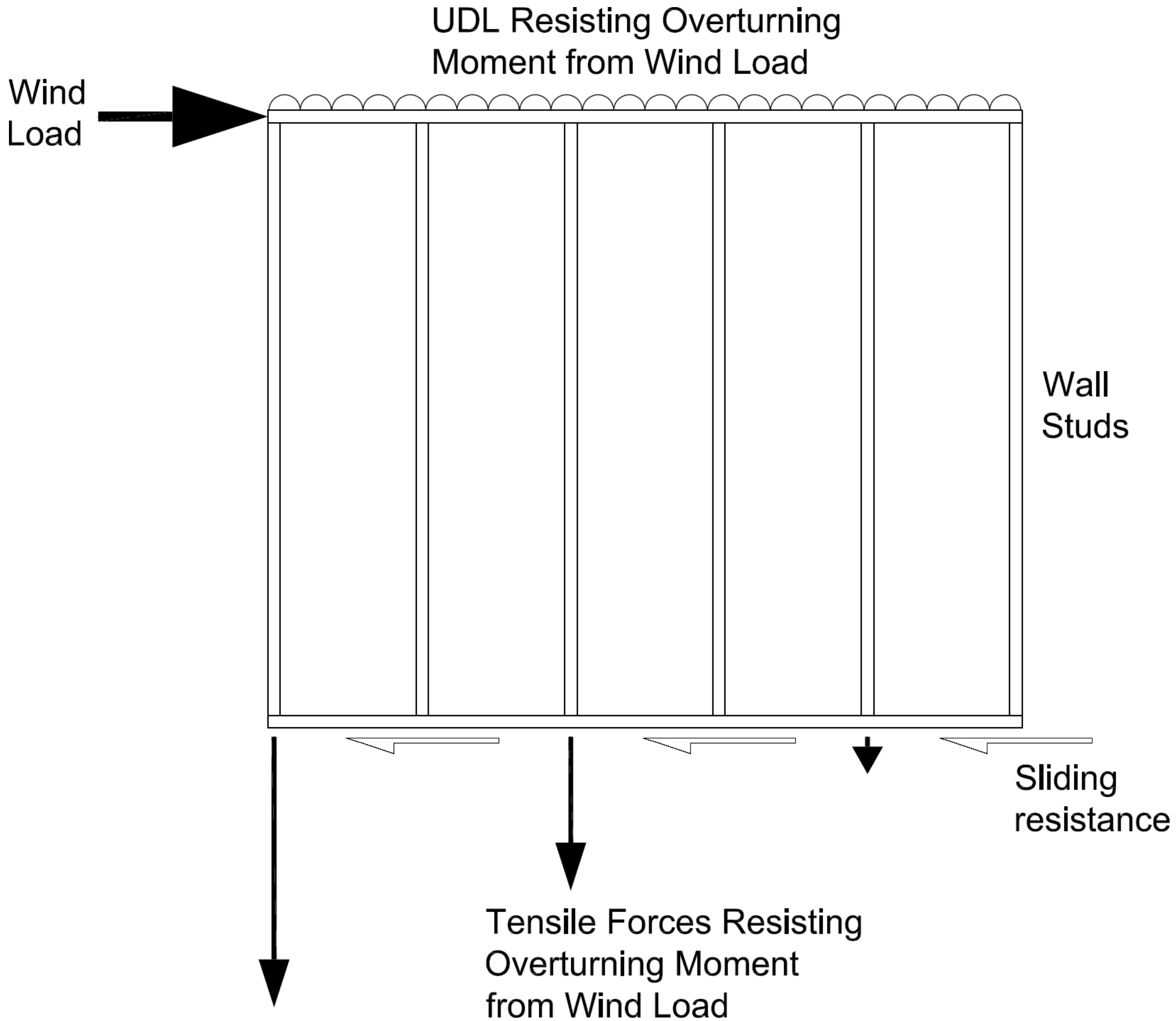



- Diaphragm action of roof and floor takes wind to stud wall
- Wall is sheathed to stop studs toppling and tied down to stop overturning
- CF bracing in steel frame
- Also the sliding of stud frame on underbuilding is to be checked and resisted
- Coefficient of Friction
  - BS5268 = 0 (but Trada suggest 0.3)
  - Eurocode 5 = 0.25

**Typical Racking Panel**

## RACKING LOADS DESIGN – BS6399-2:1997

TEDDS calculation version 1.0.06

### Considering wind loads to the front elevation

**General details**

Building type Dwelling

Overall height of building $H = 8.300$ m

Number of storeys 2

Depth of building $D = 10.000$ m

Breadth of building $B = 20.000$ m

Roof type Duopitch

Roof pitch $\alpha = 35.0$ deg

**Windloading details**

Dynamic augmentation factor $C_r = 0.010$

Dynamic pressure eaves level $q_{se} = 1.160$ kN/m²

Dynamic pressure roof level $q_{sr} = 1.160$ kN/m²

| Wall details | Area on elevation | Pressure coefficient | Size effect factor |
|---|---|---|---|
| Ground floor w/w elevation | $Area_{w0} = 48.000$ m² | $C_{pew} = 0.832$ | $C_{aw0} = 1.000$ |
| Ground floor l/w elevation | $Area_{l0} = 48.000$ m² | $C_{pel} = -0.500$ | $C_{al0} = 1.000$ |
| First floor w/w elevation | $Area_{w1} = 48.000$ m² | $C_{pew} = 0.832$ | $C_{aw1} = 1.000$ |
| First floor l/w elevation | $Area_{l1} = 48.000$ m² | $C_{pel} = -0.500$ | $C_{al1} = 1.000$ |

| Roof details | Area on plan | Pressure coefficient |
|---|---|---|
| Roof zone A | $Plan_A = 27.556$ m² | $C_{peA} = 0.800$ |
| Roof zone B | $Plan_B = 5.644$ m² | $C_{peB} = 0.533$ |
| Roof zone C | $Plan_C = 66.800$ m² | $C_{peC} = 0.500$ |
| Roof zone E | $Plan_E = 27.556$ m² | $C_{peE} = -0.733$ |
| Roof zone F | $Plan_F = 5.644$ m² | $C_{peF} = -0.433$ |
| Roof zone G | $Plan_G = 66.800$ m² | $C_{peG} = -0.433$ |

**Shielding effect of masonry cladding on windward elevation**

Masonry wall with buttresses or returns at one end only

Total area of elevation $Area_w = 96.000$ m²

Total area of openings $Open_w = 15.000$m²

Percentage of openings $p_w = Open_w / Area_w = 15.6$ %

**From BS 5268:Section 6.1:1996 - Table 1**

Windward modification factor $K_{100w} = 0.663$

**Shielding effect of masonry cladding on leeward elevation**

Masonry wall with buttresses or returns at one end only

Total area of elevation $Area_l = 96.000$ m²

Total area of openings $Open_l = 15.000$m²

Percentage of openings $p_l = Open_l / Area_l = 15.6$ %

**From BS 5268:Section 6.1:1996 - Table 1**

Leeward modification factor $K_{100l} = 0.663$

**Calculate racking load at ground floor level**

Comb w/w loading coefficient $C_w = C_{aw0} \times (1 + C_r) = 1.010$

Comb l/w loading coefficient $C_l = C_{al0} \times (1 + C_r) = 1.010$



Area of w/w elevation $TotalArea_{w0:1} = Area_{w0} / 2 + Area_{w1} = 72.000$ m²

Loads applied to w/w elevation $P_{w0} = 0.85 \times K_{100w} \times TotalArea_{w0:1} \times q_{se} \times C_{pew} \times C_w = 39.522$ kN

Area of l/w elevation $TotalArea_{l0:1} = Area_{l0} / 2 + Area_{l1} = 72.000$ m²

Loads applied to l/w elevation $P_{l0} = 0.85 \times K_{100l} \times TotalArea_{l0:1} \times q_{se} \times C_{pel} \times C_l = -23.751$ kN

Loads applied to roof Zone A $P_{rA} = 0.85 \times Plan_A \times \tan(\alpha) \times q_{sr} \times C_{peA} \times C_w = 15.372$ kN

Loads applied to roof Zone B $P_{rB} = 0.85 \times Plan_B \times \tan(\alpha) \times q_{sr} \times C_{peB} \times C_w = 2.098$ kN

Loads applied to roof Zone C $P_{rC} = 0.85 \times Plan_C \times \tan(\alpha) \times q_{sr} \times C_{peC} \times C_w = 23.290$ kN

Loads applied to roof Zone E $P_{rE} = 0.85 \times Plan_E \times \tan(\alpha) \times q_{sr} \times C_{peE} \times C_l = -14.085$ kN

Loads applied to roof Zone F $P_{rF} = 0.85 \times Plan_F \times \tan(\alpha) \times q_{sr} \times C_{peF} \times C_l = -1.704$ kN

Loads applied to roof Zone G $P_{rG} = 0.85 \times Plan_G \times \tan(\alpha) \times q_{sr} \times C_{peG} \times C_l = -20.169$ kN

Racking load at ground floor $P_0 = P_{w0} - P_{l0} + P_{rA} + P_{rB} + P_{rC} - P_{rE} - P_{rF} - P_{rG} = 139.991$ kN

**Calculate racking load at first floor level**

Comb w/w loading coefficient $C_w = C_{aw1} \times (1 + C_r) = 1.010$

Comb l/w loading coefficient $C_l = C_{aw1} \times (1 + C_r) = 1.010$

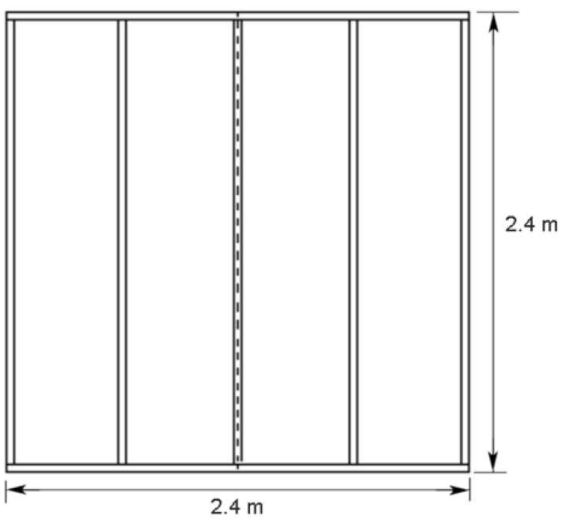
Area of w/w elevation $TotalArea_{w1} = Area_{w1} / 2 = 24.000$ m²

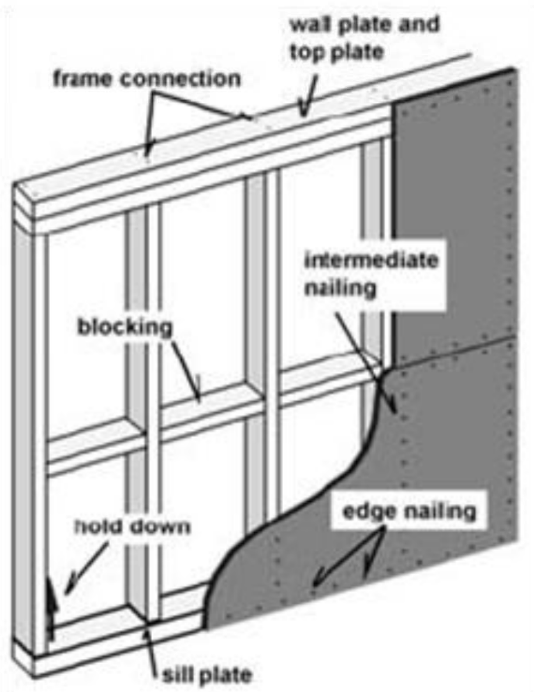
Loads applied to w/w elevation $P_{w1} = 0.85 \times K_{100w} \times TotalArea_{w1} \times q_{se} \times C_{pew} \times C_w = 13.174$ kN

Area of l/w elevation $TotalArea_{l1} = Area_{l1} / 2 = 24.000$ m²

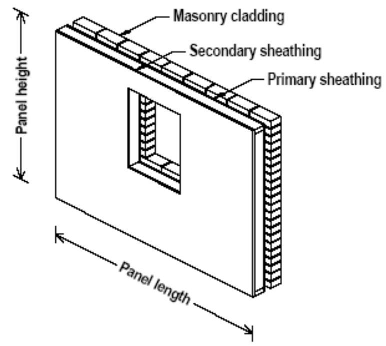
Loads applied to l/w elevation $P_{l1} = 0.85 \times K_{100l} \times TotalArea_{l1} \times q_{se} \times C_{pel} \times C_l = -7.917$ kN

Racking load at first floor $P_1 = P_{w1} - P_{l1} + P_{rA} + P_{rB} + P_{rC} - P_{rE} - P_{rF} - P_{rG} = 97.809$ kN




**Standard timber frame wall panel**




**TIMBER PANEL RACKING RESISTANCE – BS5268:SECTION 6.1:1996**

TEDDS calculation version 1.0.04

**Dwellings not exceeding seven storeys**

**Panel 1**

**Wall panel details**

| | | | |
|---|---|---|---|
| Length of panel | L = **3.600** m | Height of panel | $H_{wp}$ = **2.400** m |
| Area of openings | $A_a$ = **2.400** m² | Timber studs | **>= 38 x 72** |
| UDL on timber frame | F = **4.000** kN/m | | |

**Primary sheathing details**

| | | | |
|---|---|---|---|
| Primary board type | **Plywood** | Board thickness | $T_p$ = **9.50** mm |
| Nail diameter | $D_p$ = **3.00** mm | Perimeter nail spacing | $S_p$ = **150** mm |
| Basic racking resistance | $R_{bp}$ = **1.680** kN/m | | |

**Secondary sheathing details**

| | | | |
|---|---|---|---|
| Secondary board type | **Plasterboard** | Board thickness | $T_s$ = **12.50** mm |
| Nail diameter | $D_s$ = **2.65** mm | Perimeter nail spacing | $S_s$ = **150** mm |
| Basic racking resistance | $R_{bs}$ = **0.180** kN/m | | |

**Masonry cladding details**

| | | | |
|---|---|---|---|
| Length of cladding | $L_{mas}$ = **2.400** m | Density of wall ties | **3.7 ties / m²** |
| Basic racking resistance | $R_{bmas}$ = **0.400** kN/m | | |

**Racking resistance of wall panel and masonry cladding**

| | | | |
|---|---|---|---|
| Racking resistance of panel | $R_{wp}$ = **4.546** kN | Racking resistance of cladding | $R_{mas}$ = **0.960** kN |
| Total Racking resistance | $R_R$ = **5.506** kN | Racking resistance of p/board | $R_{PO}$ = **0.440** kN |

**BASIC RESISTANCES kN/m** **BS 5268 - 6.1 1996**

| | Ply | P'board | Masonry | | | |
|---|---|---|---|---|---|---|
| | 1.68 | 0.28 | 0.4 | | | |
| **Factors** | | | | **Ply data** | | |
| $K_{101}$= | 1.000 | 1.000 | N/A | Nail diameter = | 3 | mm |
| $K_{102}$= | 1.000 | 1.000 | N/A | Nail spacing = | 150 | mm |
| $K_{103}$= | 1.000 | 1.000 | N/A | Ply thickness = | 9.5 | mm |
| $K_{104}$= | 1.000 | 1.000 | N/A | Wall height = | 2.4 | m |
| $K_{105}$= | 1.176 | 1.176 | N/A | Wall length = | 3.6 | m |
| $K_{106}$= | 0.408 | 0.408 | N/A | Opening area = | 2.4 | m² |
| $K_{107}$= | 1.286 | 1.286 | N/A | .oad above wall = | 4 | kN/m |
| $K_{108}$= | 1.100 | 1.100 | N/A | Share factor = | 110% | |
| r/m = | 1.141 | 0.190 | 0.400 | Total per m= | 1.731 | kN/m |
| Length= | 3.6 | 3.6 | 2.4 | m | | |
| Totals | 4.106 | 0.684 | 0.960 | Sum Total= | 5.750 | kN |

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| Primary board material | Fixing | Racking resistance | Additional contribution of secondary board on timber frame wall | |
|---|---|---|---|---|
| | | | Category 2 or 3 materials | Category 1 material |
| | | kN/m | kN/m | kN/m |
| Category 1 materials:<br>— 9.5 mm plywood;<br>— 9.0 mm medium board;<br>— 12.0 mm chipboard (type C3M, C4M or C5);<br>— 6.0 mm tempered hardboard;<br>— 9.0 mm 0SB (type F2) | 3.00 mm diameter wire nails at least 50 mm long, maximum spacing 150 mm on perimeter, 300 mm internal | 1.68 | 0.28 | 0.84 |
| Category 2 materials:<br>— 12.5 mm bitumen impregnated insulation board; | 3.00 mm diameter wire nails at least 50 mm long, maximum spacing 75 mm on perimeter, 150 mm internal | 0.90 | 0.45 | 1.06 |
| — separating wall of minimum 30 mm plasterboard (in two or more layers) | Each layer should be individually fixed with 2.65 mm diameter plasterboard nails at 150 mm spacing, nails for the outmost layer should be at least 60 mm long | 0.90 | 0.45 | 1.06 |
| Category 3 materials:<br>— 12.5 mm plasterboard | 2.65 mm diameter plasterboard nails at least 40 mm long, maximum spacing 150 mm | 0.90 | 0.45 | 1.06 |

NOTE 1 Timber members in wall panels should be not less than 38 mm × 72 mm rectangular section with linings fixed to the narrower face, with ends cut square and assembled in accordance with the relevant clauses of section **6**.

NOTE 2 Timber members of rectangular section less than 38 mm × 72 mm, but not less than 38 mm × 63 mm, should be taken into account for internal walls (excluding separating walls), but in such cases all values for basic racking resistance given in this table should be reduced by 15 %.

NOTE 3 Studs should be spaced at centres not exceeding 610 mm.

NOTE 4 Board edges should be backed by, and nailed to timber framing at all edges except in the case of the underlayers in separating wall construction where it is normal to fix boards horizontally, in which case the intermediate horizontal joint may be unsupported.

NOTE 5 Studs should be of species and stress grade satisfying strength class C16 or better (as defined in BS 5268-2).

NOTE 6 The additional contribution from a secondary layer of category 1, 2 or 3 materials should only be included once in the determination of basic racking resistance, no matter how many additional layers may be fixed to the wall panel.

NOTE 7 The values given in Table 2 together with the modification factors in **4.8** and **4.9** assume that the wall under consideration is adequately fixed to ensure resistance to sliding and overturning.

NOTE 8 Where a secondary board is fixed on the same side of a wall as the primary sheathing then the nail lengths given in the table should be increased to take account of the additional thickness.

**BS5268-6.1:1996 Table 2 Basic Racking Resistances for a Range of Materials and Combinations of Materials**

| Wall type | Party Walls | | Interior Walls | | Exterior Walls | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A:Party | B:Party | C:Int | D:Int | E:Ext | F:Ext | G:Ext | H:Ext | I:Ext | J:Ext | K:Ext |
| Primary board[b] | GYP + GYP | GYP + GYP | GYP | GYP | OSB | OSB | OSB | OSB | OSB+ GYP | OSB | PLY |
| Service class | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 2 |
| $t_1$ (mm) | 19+12.5 | 15+15 | 12.5 | 12.5 | 9 | 9 | 9 | 9 | 9 +12.5 | 11 | 9.5 |
| Fastener type[c] | S | S | S | S | N | N | N | N | N + S | N | N |
| $d_1$ (mm) | 3.9+3.9 | 3.5+3.5 | 3.9 | 3.5 | 2.8 | 3.1 | 3.1 | 3.1 | 3.1+3.9 | 3.1 | 3.1 |
| $l_1$ (mm) | 55+55 | 60+60 | 55 | 45 | 50 | 50 | 50 | 50 | 50 + 55 | 75 | 75 |
| $s_1$ $m$[d] | 0.15+0.15 | 0.15+0.15 | 0.15 | 0.15 | 0.15 | 0.1 | 0.075 | 0.05 | 0.1+0.1 | 0.05 | 0.05 |
| $F_{f,Rd,1}$ (kN) | 0.488[e] | 0.476[e] | 0.417 | 0.399 | 0.495 | 0.51 | 0.51 | 0.51 | 0.595[e] | 0.564 | 0.61 |
| $k_{s,1}'$ ($m^{-1}$) | 7.48 | 7.90 | 5.05 | 5.23 | 5.60 | 7.09 | 8.37 | 10.20 | 10.20 | 10.20 | 10.20 |
| $F_{f,Rd,1}k_{s,1}'$ (kN/m) | 3.65 | 3.76 | 2.10 | 2.09 | 2.77 | 3.62 | 4.27 | 5.20 | 6.07 | 5.76 | 6.22 |
| Secondary board[b] | n/a | n/a | GYP | GYP | GYP | GYP | GYP | GYP | OSB | GYP | GYP |
| Service class | – | – | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| $t_2$ (mm) | – | – | 12.5 | 12.5 | 12.5 | 12.5 | 12.5 | 12.5 | 9 | 12.5 | 12.5 |
| Fastener type[c] | – | – | S | S | S | S | S | S | N | S | S |
| $d_2$ (mm) | – | – | 3.9 | 3.5 | 3.5 | 3.9 | 3.9 | 3.9 | 3.1 | 3.5 | 3.5 |
| $l_2$ (mm) | – | – | 55 | 45 | 45 | 55 | 55 | 55 | 50 | 45 | 45 |
| $s_2$ (m)[d] | – | – | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.05 | 0.15 | 0.15 |
| $F_{f,Rd,2}$ (kN) | – | – | 0.417 | 0.399 | 0.399 | 0.417 | 0.417 | 0.417 | 0.51 | 0.399 | 0.399 |
| $k_{s,2}'$ ($m^{-1}$) | – | – | 5.05 | 5.23 | 5.23 | 5.05 | 5.05 | 5.05 | 10.20 | 5.23 | 5.23 |
| $F_{f,Rd,2}\,k_{s,2}'$ (kN/m) | – | – | 2.10 | 2.09 | 2.09 | 2.10 | 2.10 | 2.10 | 5.20 | 2.09 | 2.09 |
| $F_{i,Rd}$[f] (kN/m) | 3.65 | 3.76 | 3.16 | 3.13 | 3.81 | 4.67 | 5.32 | 6.26 | 8.67 | 6.80 | 7.27 |

Key

A Party wall, one layer of 19mm gypsum wallboard with a layer of 12.5mm plasterboard on top, each fixed with 55mm long plasterboard screws. The perimeter spacings on both boards are 150mm with the screws in the outer board positioned between the screws in the inner board. The outer board contributes to the racking resistance only by helping the inner wallboards to act as a continuous diaphragm, but the screws in it are treated like additional (55 – 12.5) = 42.5mm screws through the inner board. 0.488kN is the mean of the resistance of the two sets of screws, and the resultant spacing of 75mm is used to calculate $k_{s,1}'$.

B Party wall, like A, but with two layers of 15mm plasterboard each fixed with 60mm long screws. The outer board itself does not contribute to the racking resistance, but the screws in it are treated like additional (60 – 15) = 45mm screws through the inner board. 0.476kN is the mean of the resistance of the two sets of screws.

C Interior wall with one 12.5mm layer of plasterboard on each side, 3.9mm plasterboard screws.

D Interior wall, like C, but with 3.5mm plasterboard screws.

E Exterior wall, low strength.

F Exterior wall, standard strength.

G Exterior wall, extra strength.

H Exterior wall, high strength.

I Exterior wall, very high strength. This wall type has a layer of OSB on the exterior and interior face, with an additional layer of 12.5mm plasterboard on the interior face. On the interior face it is in service class 1 so the connections are stronger, hence the interior OSB is the 'primary' sheathing. The perimeter spacings are 50mm on the exterior OSB board and 100mm on each of the two interior boards, with the plasterboard screws positioned between the OSB nails. The plasterboard itself does not contribute to the racking resistance, but the screws in it are treated like additional (55 - 12.5) = 42.5mm screws through the OSB. 0.595kN is the mean of the resistance of the nails and the screws in the OSB, and the resultant spacing of 50mm is used to calculate $k_{s,1}'$. With spacing on the interior boards closer than 100mm it is difficult to ensure that the plasterboard screws are not inserted too close to the OSB nails unless the process is computer controlled.

J Exterior wall, high strength with 11mm OSB.

K Exterior wall, high strength with 9.5mm plywood.

Notes

a See Section 10.8.1.4 iii) for definitions of the symbols. The tabulated values of $F_{i,Rd}$ may be used in Section 10.8.1.4 iii) expression 3) to obtain the shear resistance of a wall.

b OSB = OSB Type 3 or 4 to BS EN 300[20], characteristic density 550kg/m³
PLY = softwood plywood, exterior grade, characteristic density 505kg/m³ (any plywood listed in Table 3.28).
GYP = Type A gypsum plasterboard or better, characteristic density 640kg/m³.

c N = smooth machine driven nail, ultimate tensile strength 700N/mm².
S = plasterboard screw, ultimate tensile strength 540N/mm².

d Spacing around board perimeter. On intermediate studs fastener spacing should be $2s$.

e Mean value of $F_{f,Rd}$ for the fasteners for the two boards in the inner board only (see A, B and I).

f $F_{i,Rd} = F_{f,Rd,1}\,k_{s,1}' + 0.5\,F_{f,Rd,2}\,k_{s,2}'$ where $F_{f,Rd,1}\,k_{s,1} \geqslant F_{f,Rd,2}\,k_{s,2}'$.

# BS EN1995:2004 Basic Racking Resistances of Some Common C16 Grade Timber Frame Wall Configurations

Structural Engineers Registration Ltd

**Extracted from Manual for the design of timber building structures to Eurocode 5 by IStructE and Trada**

Table 1 — Modification factor $K_{100}$

| Number of storeys | Percentage of loaded wall occupied by openings[a] | $K_{100}$ | | |
|---|---|---|---|---|
| | | For masonry walls with buttresses or returns not less than 550 mm and not greater than 9 m centre to centre[b] | For masonry walls with buttresses or returns at one end of wall not less than 550 mm, other end without buttresses or returns or with buttresses or returns less than 550 mm, wall length no greater than 4.5 m[c] | For masonry walls without buttresses or returns or with buttresses or returns of less than 550 mm[d] |
| 1 and 2 | 0 | 0.45 | 0.60 | 0.75 |
| | 10 | 0.50 | 0.64 | 0.78 |
| | 20 | 0.56 | 0.68 | 0.80 |
| | 30 | 0.61 | 0.72 | 0.83 |
| | 40 | 0.66 | 0.76 | 0.85 |
| | 50 | 0.71 | 0.80 | 0.88 |
| | 60 | 0.77 | 0.84 | 0.90 |
| | 70 | 0.82 | 0.88 | 0.93 |
| | >70 | 1.00 | 1.00 | 1.00 |
| 3 | 0 | 0.50 | 0.68 | 0.85 |
| | 10 | 0.55 | 0.71 | 0.87 |
| | 20 | 0.60 | 0.74 | 0.88 |
| | 30 | 0.65 | 0.78 | 0.90 |
| | 40 | 0.70 | 0.81 | 0.92 |
| | 50 | 0.75 | 0.84 | 0.93 |
| | 60 | 0.80 | 0.87 | 0.94 |
| | 70 | 0.85 | 0.91 | 0.96 |
| | >70 | 1.00 | 1.00 | 1.00 |
| | | For masonry walls with buttresses or returns not less than 950 mm and not greater than 9 m centre to centre[b] | For masonry walls with buttresses or returns at one end of wall not less than 950 mm, other end without buttresses or returns less than 950 mm, wall length no greater than 4.5 m[c] | For masonry walls without buttresses or returns or with buttresses or returns of less than 950 mm[d] |
| 4 | 0 | 0.60 | 0.74 | 0.88 |
| | 10 | 0.64 | 0.77 | 0.89 |
| | 20 | 0.69 | 0.80 | 0.91 |
| | 30 | 0.73 | 0.83 | 0.93 |
| | 40 | 0.77 | 0.86 | 0.95 |
| | 50 | 0.81 | 0.89 | 0.96 |
| | 60 | 0.86 | 0.92 | 0.98 |
| | 70 | 0.90 | 0.95 | 1.00 |
| | >70 | 1.00 | 1.00 | 1.00 |

NOTE 1 Values for intermediate percentages of wall occupied by openings may be obtained by linear interpolation.

NOTE 2 The $K_{100}$ factors and support conditions (where relevant) should be selected on the basis of the maximum height of the wall under consideration and be applied to the whole wall.

NOTE 3 For walls longer than 9 m, the values of $K_{100}$ given in column 3 may be used provided additional buttresses or returns are added to the masonry wall at a maximum centre to centre spacing of 9 m.

[a] In calculating the percentage of wall occupied by openings, the height of the wall should be taken as the height to the eaves.

[b] Values of $K_{100}$ to be used where a masonry wall is supported at both ends by adequate masonry buttresses or returns.

[c] Values of $K_{100}$ to be used where a wall, which otherwise has adequate buttresses or returns, incorporates a vertical movement joint (i.e. the wall has the required buttress or return at one end, but is not adequately supported at the other).

[d] Values of $K_{100}$ to be used where a wall has no masonry returns or buttresses or has inadequate supports at its ends.

Brick / blockwork skin enhances timber frame in 2 ways:-

- Shields stud in wall from wind as noted in BS5268-6.1 Table 1
- Adds to racking resistance of panel

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# BS5268-6.1:1996 Shielding Factors

**Table 10.1 Values of $k_{masonry}$**

| Percentage of shielded wall occupied by openings | Number of storeys shielded by masonry | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 and 2 | | | 3 | | | 4 | | |
| | A | B | C | A | B | C | D | E | F |
| 0 | 0.45 | 0.60 | 0.75 | 0.50 | 0.68 | 0.85 | 0.60 | 0.74 | 0.88 |
| 10 | 0.50 | 0.64 | 0.78 | 0.55 | 0.71 | 0.87 | 0.64 | 0.77 | 0.89 |
| 20 | 0.56 | 0.68 | 0.80 | 0.60 | 0.74 | 0.88 | 0.69 | 0.80 | 0.91 |
| 30 | 0.61 | 0.72 | 0.83 | 0.65 | 0.78 | 0.90 | 0.73 | 0.83 | 0.93 |
| 40 | 0.66 | 0.76 | 0.85 | 0.70 | 0.81 | 0.92 | 0.77 | 0.86 | 0.95 |
| 50 | 0.71 | 0.80 | 0.88 | 0.75 | 0.84 | 0.93 | 0.81 | 0.89 | 0.96 |
| 60 | 0.77 | 0.84 | 0.90 | 0.80 | 0.87 | 0.94 | 0.86 | 0.92 | 0.98 |
| 70 | 0.82 | 0.88 | 0.93 | 0.85 | 0.91 | 0.96 | 0.90 | 0.95 | 1.00 |
| >70 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

*Notes*

A For masonry walls with buttresses or returns of length ≥ 550mm and spaced at not more than 9m centres.

B For masonry walls with buttresses or returns of length ≥ 550mm at one end only, wall length ≤ 4.5m.

C For masonry walls other than A and B.

D For masonry walls with buttresses or returns of length ≥ 950mm and spaced at not more than 9m centres.

E For masonry walls with buttresses or returns of length ≥ 950mm at one end only, wall length ≤ 4.5m.

F For masonry walls other than D or E.

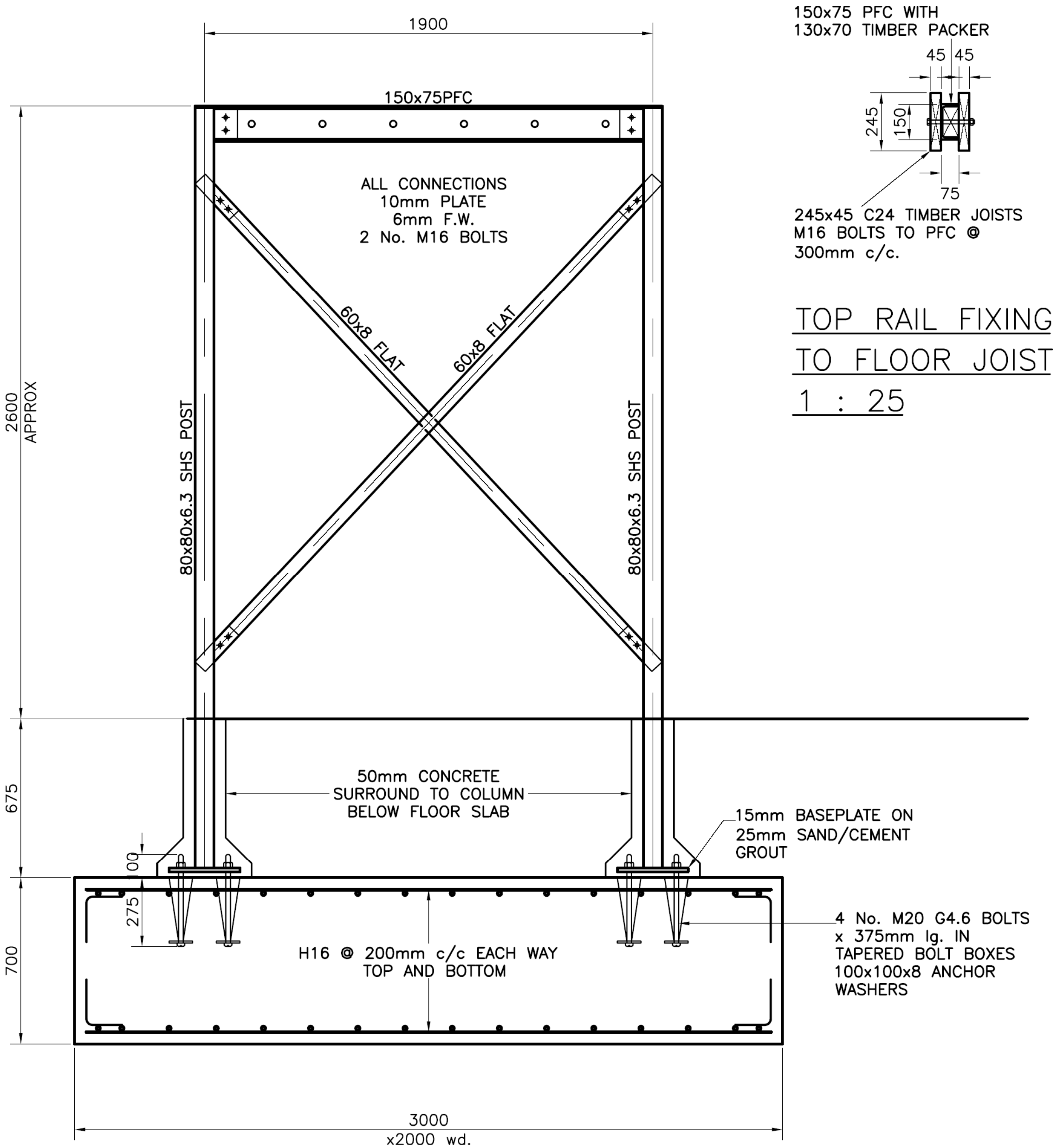
a In calculating the percentage of wall occupied by openings, the height of the wall should be taken as the height to the eaves, the top of the fourth storey of masonry or 10m, whichever is less.

b Values for intermediate percentages of wall occupied by openings may be obtained by linear interpolation.

c For walls longer than 9m the tabulated values may be used provided that additional buttresses or returns are added to the masonry wall spaced at not more than 9m centres.

d If the selected support conditions do not extend to the full shielded height of the wall in question then the number of storeys and percentage of loaded wall should be based on the height to which the selected support conditions reach.

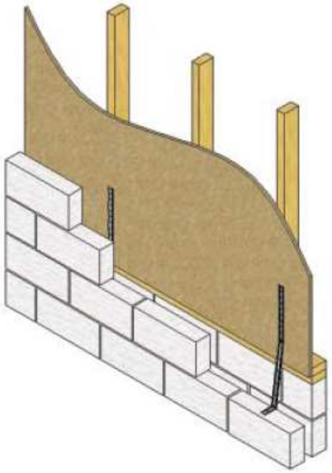
# BS EN1995:2004 Shielding Factors

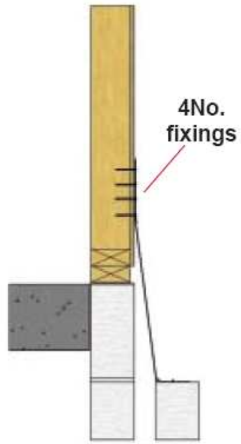



- Demand for more light
- Larger areas of glazing
- Not enough wall panels
- Need for alternative solutions:
  - steel braced panel

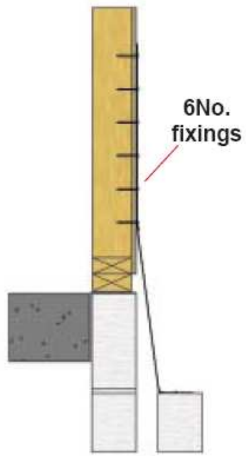
# Typical Steel Braced Racking Panel

**Timber Frame Construction with Steel Braced Racking Panel**

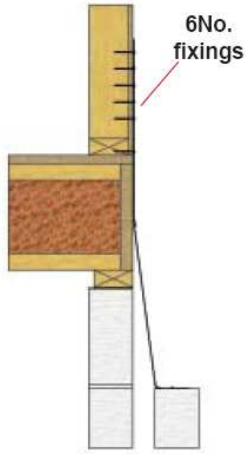





Typical concrete
ground floor ST-PFS-M



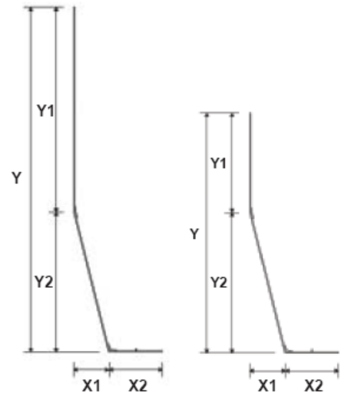

Typical concrete
ground floor ST-PFS




Typical suspended
ground floor ST-PFS

## ST-PFS/ST-PFS-M Performance

| Product Code | Dimensions | | | | | Safe Working Load (kN) Short Term | Characteristic Capacity of Strap (kN) |
|---|---|---|---|---|---|---|---|
| | X1 | X2 | Y | Y1 | Y2 | | |
| ST-PFS-50 | 50 | 75 | 721 | 346 | 375 | 3.45 | 6.9 |
| ST-PFS-75 | 75 | 75 | 716 | 346 | 370 | 3.45 | 6.9 |
| ST-PFS-100 | 100 | 75 | 711 | 346 | 365 | 3.45 | 6.9 |
| ST-PFS-50-M | 50 | 75 | 521 | 140 | 375 | 2.7 | 5.4 |
| ST-PFS-75-M | 75 | 75 | 516 | 140 | 370 | 2.7 | 5.4 |
| ST-PFS-100-M | 100 | 75 | 511 | 140 | 365 | 2.7 | 5.4 |



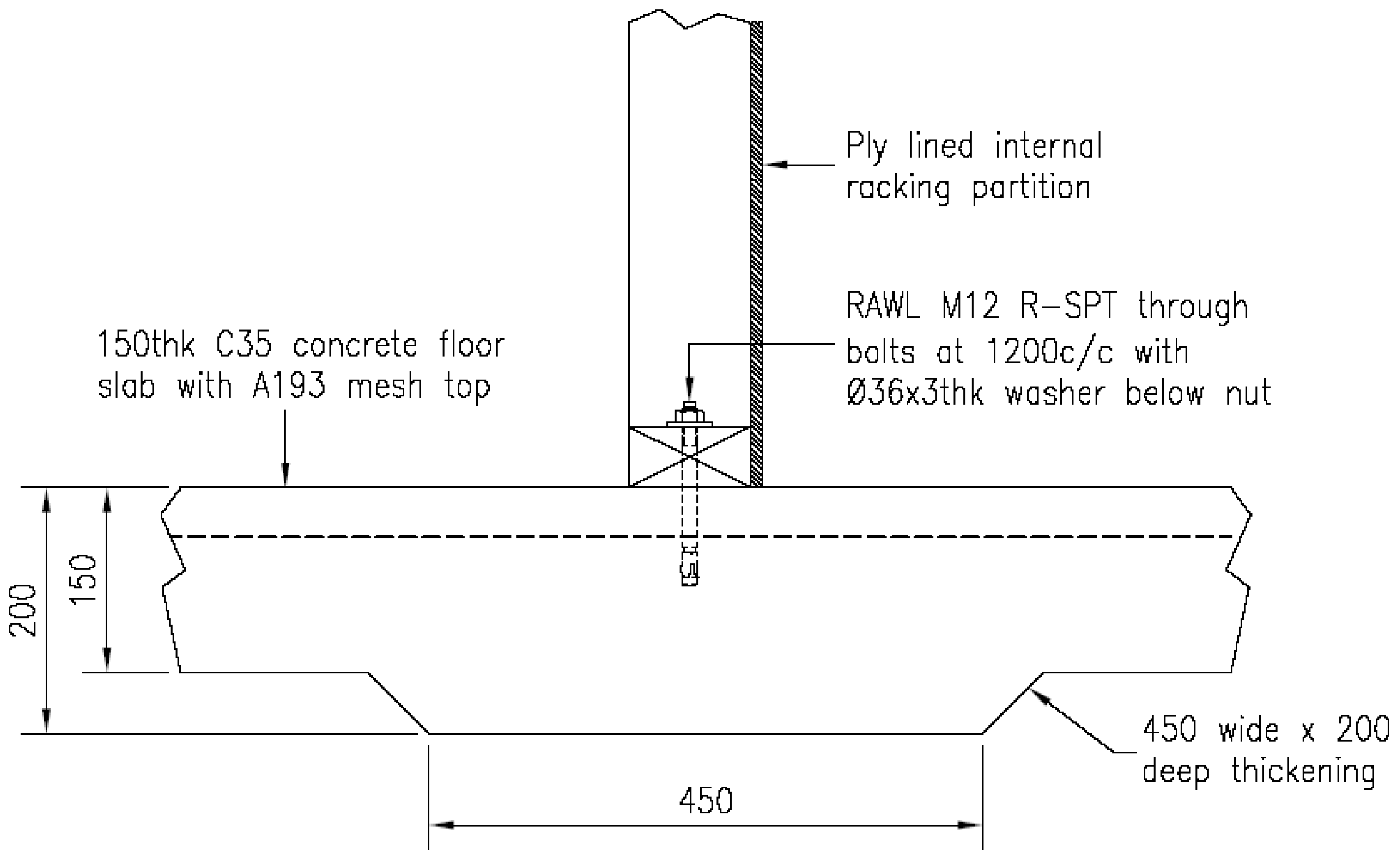

ST-PFS ST-PFS-M

**NAIL SPECIFICATION**

6No. 3.35 x 50mm stainless steel annular ring shank nails (ST-PFS)
4No. 3.35 x 50mm stainless steel annular ring shank nails (ST-PFS-M)
Nails are available from Cullen, to order st/st nails state code ST-PFS-FIXINGPACK or ST-PFS-MINI-FIXINGPACK. 1 pack = 25 straps

# Cullen Timber Frame Holding Down Straps

**Timber Frame Holding Down Straps**




**Timber Frame Holding Down to Concrete Floor**

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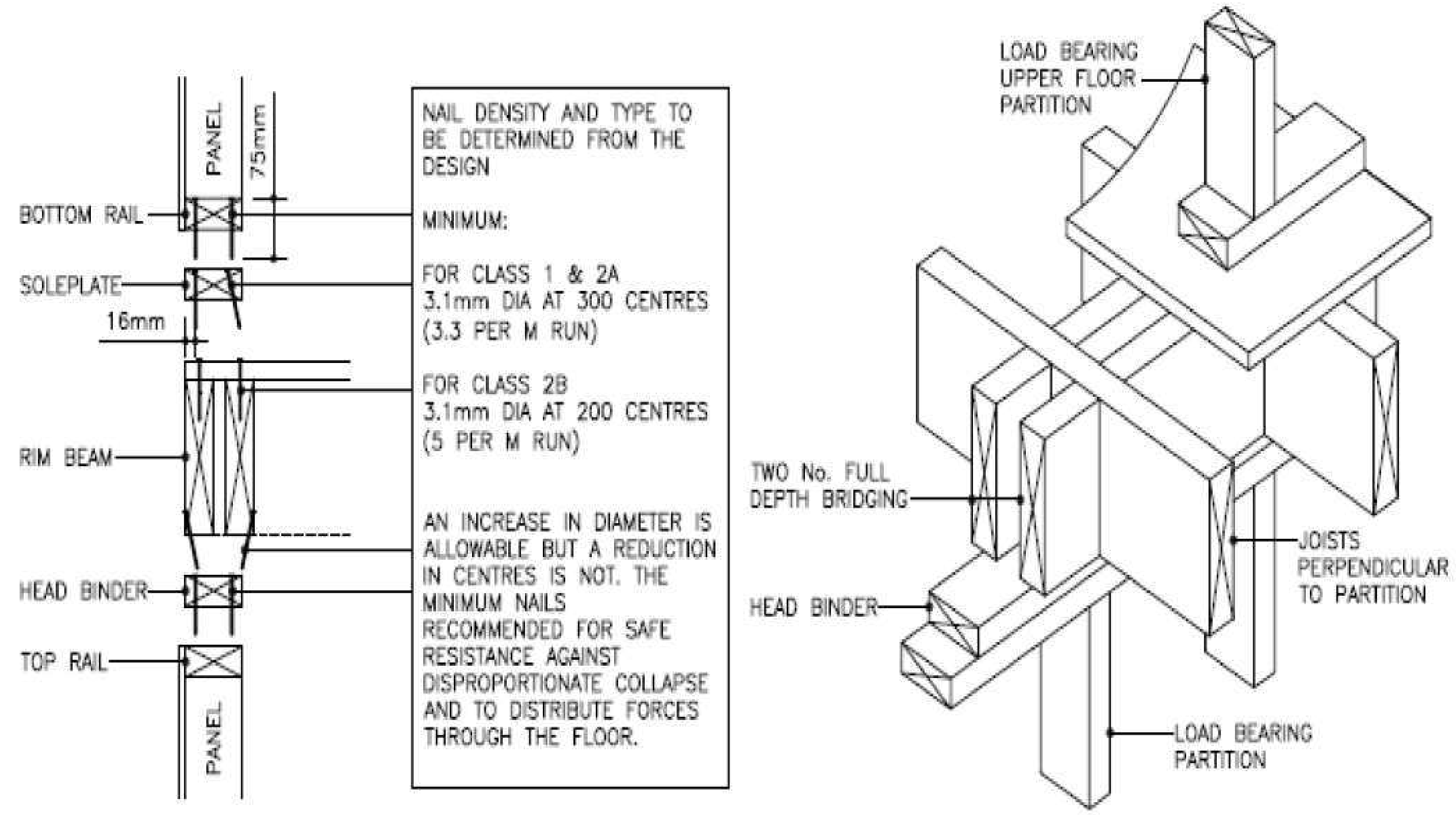


PANEL TO FLOOR DECK/PANEL NAILING – EXPLODED VIEW

Inherent robustness of typical floor to wall junctions- each interface is designed to resist horizontal forces

*Diagrammatic details suitable for solid timber, I-joists and metal web beams.*

**Detailing to Ensure Robustness**

**Block Clad Timber Frame Building**

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**Timber Frame Building Clad in Various Materials**

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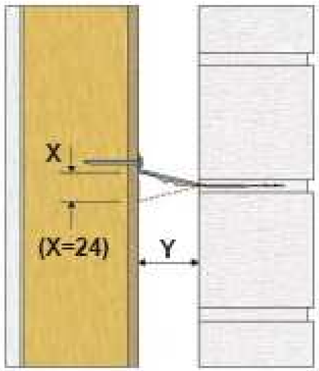
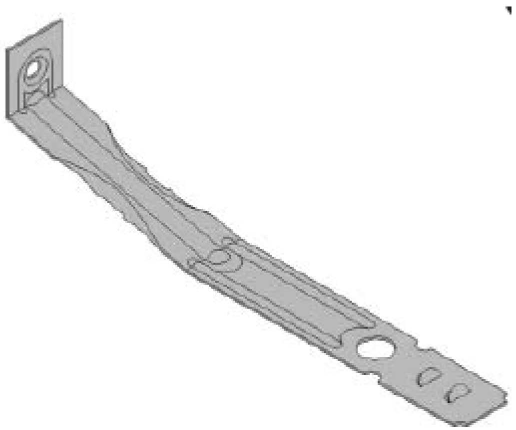
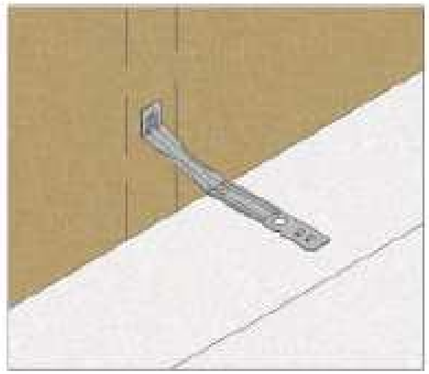


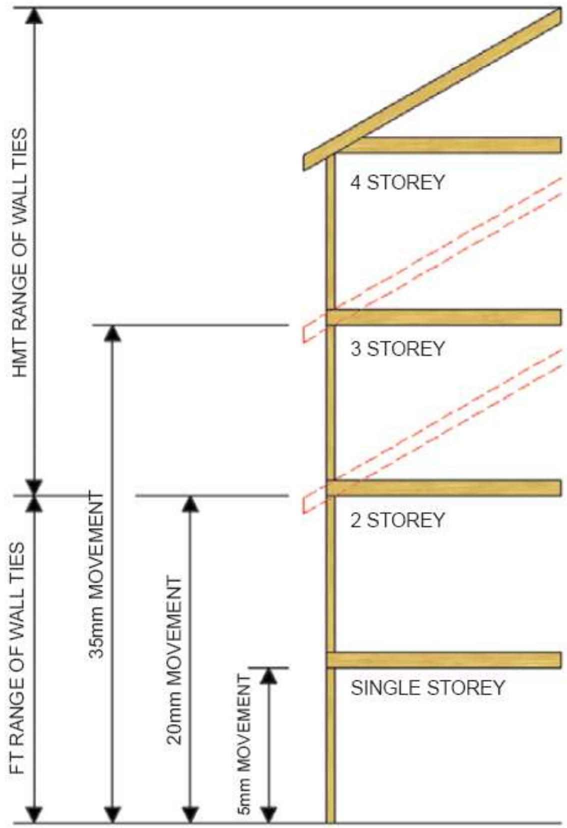





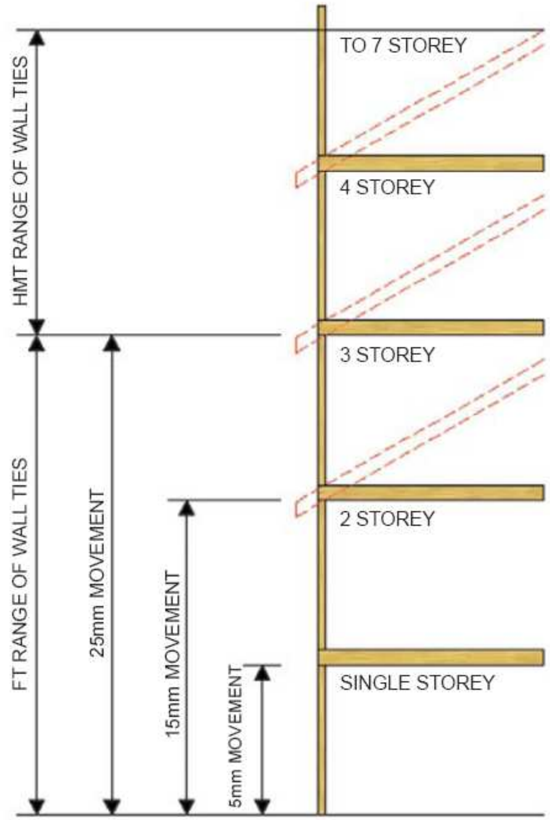
## Recommended vertical tie spacing for FT range of brick / timber wall-ties subject to various surface wind pressures.

| Maximum net surface wind pressure kN/m² | Stud Spacing (mm) | | | | | |
|---|---|---|---|---|---|---|
| | 600 | 400 | 600 | 400 | 600 | 400 |
| | FT-50 | FT-50 | FT-75 | FT-75 | FT-100 | FT-100 |
| **0.6** | 525 | 600 | 450 | 600 | 450 | 600 |
| **0.8** | 375 | 600 | 300 | 525 | 375 | 525 |
| **1.0** | 300 | 450 | 225 | 375 | 300 | 450 |
| **1.2** | 225 | 375 | 225 | 300 | 225 | 375 |
| **1.4** | 225 | 300 | 150 | 300 | 150 | 300 |
| **1.6** | 150 | 300 | 150 | 225 | 150 | 225 |
| **1.8** | 150 | 225 | 150 | 225 | 150 | 225 |
| **2.0** | 150 | 225 | 75 | 150 | 150 | 225 |
| **2.2** | 150 | 225 | 75 | 150 | 75 | 150 |
| **2.4** | 75 | 150 | 75 | 150 | 75 | 150 |

**Cullen Wall Tie Details**




INTERMEDIATE FLOORS CONSTRUCTED USING SOLID TIMBER JOISTS




INTERMEDIATE FLOORS CONSTRUCTED USING EWP JOISTS

| Gap Location | W | Gap sizes Closing Gap (CG) at window sills levels and Opening (OG) at windows head levels | |
|---|---|---|---|
| | | Joist material | |
| | | Solid Timber (mm) | Engineered I-Joist (mm) |
| Bottom level (single storey) | A | 5 | 5 |
| Level 1 (2 storey) | B | 20 | 15 |
| Level 2 (3 storey) | C | 35 | 20 |
| Level 3 (4 storey) | D | 45 | 35 |
| level 4 (5 storey) | E | Specialist calculation to be submitted to NHBC | 40 |
| level 5 (6 storey) | F | | 50 |
| level 6 (7 storey) | G | | 60 |
| Eaves/verge | | Add 5mm to level below | |

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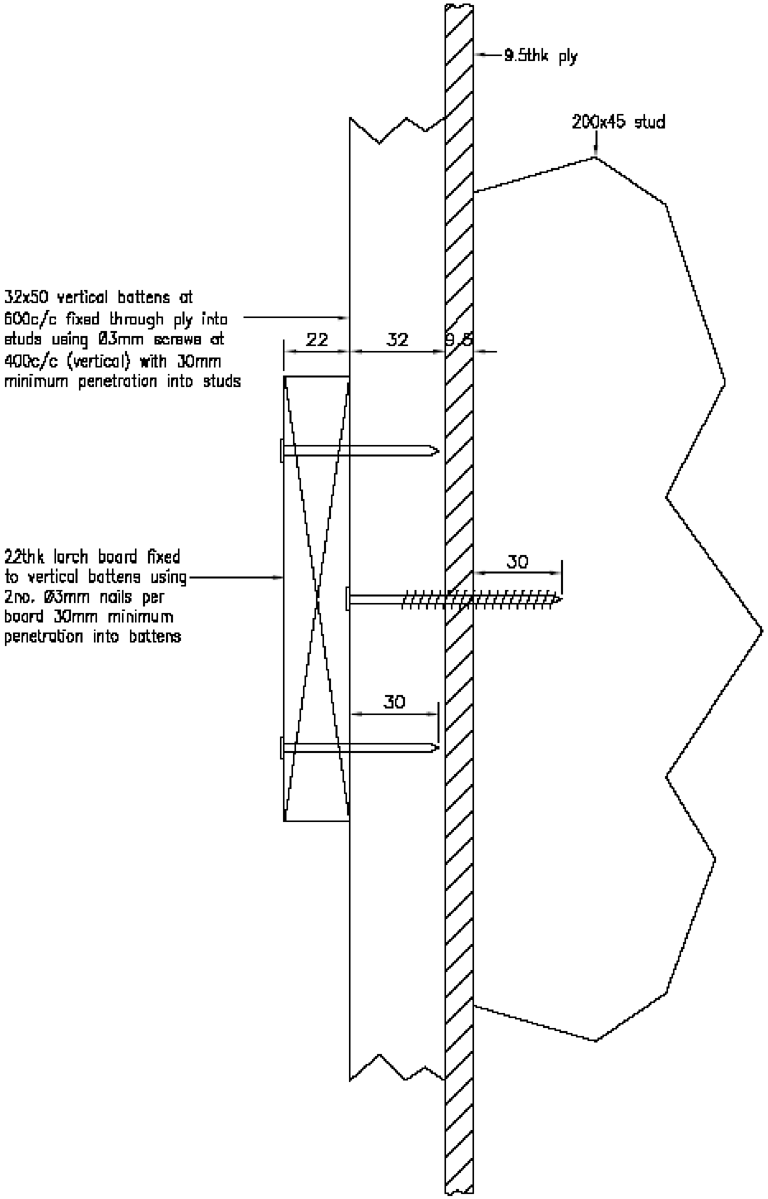
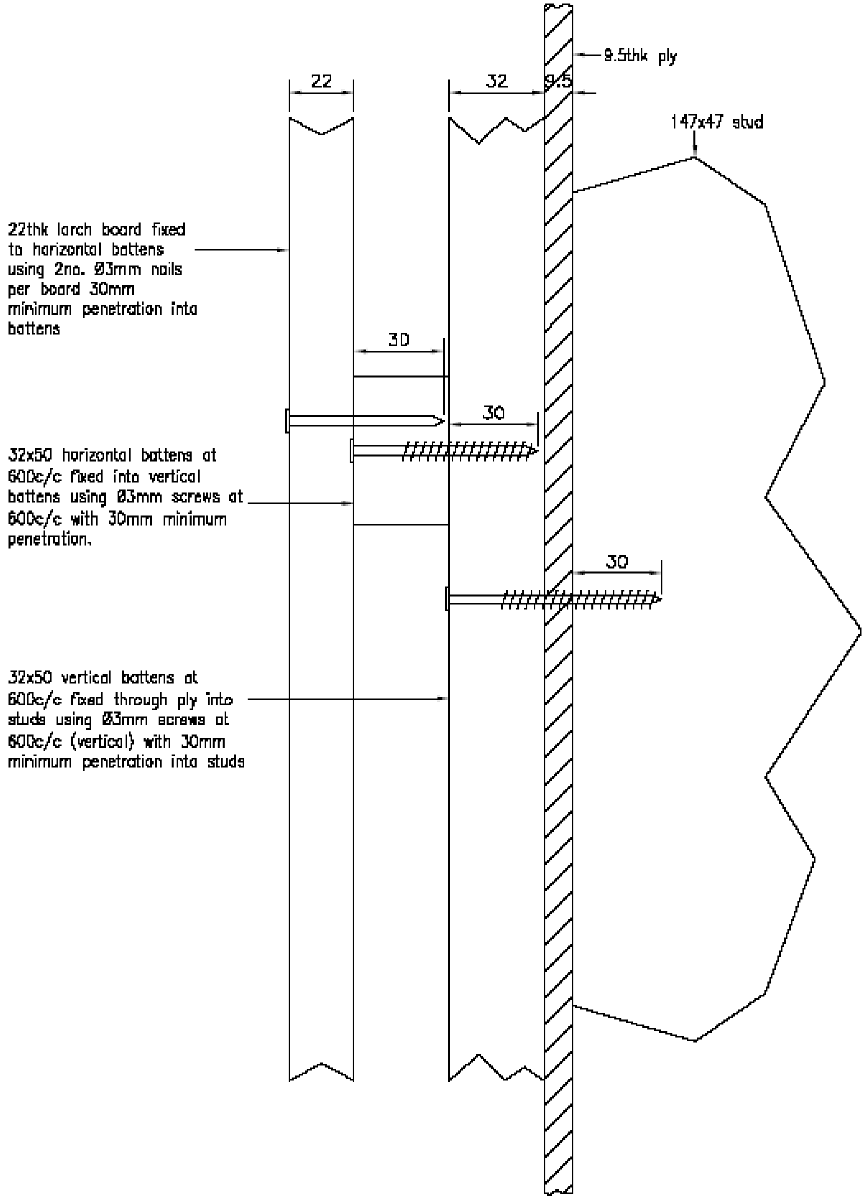
# Differential Movement in Timber Frame




HORIZONTAL CLADDING FIXING DETAILS




VERTICAL CLADDING FIXING DETAILS

# Typical Timber Cladding Fixing Details

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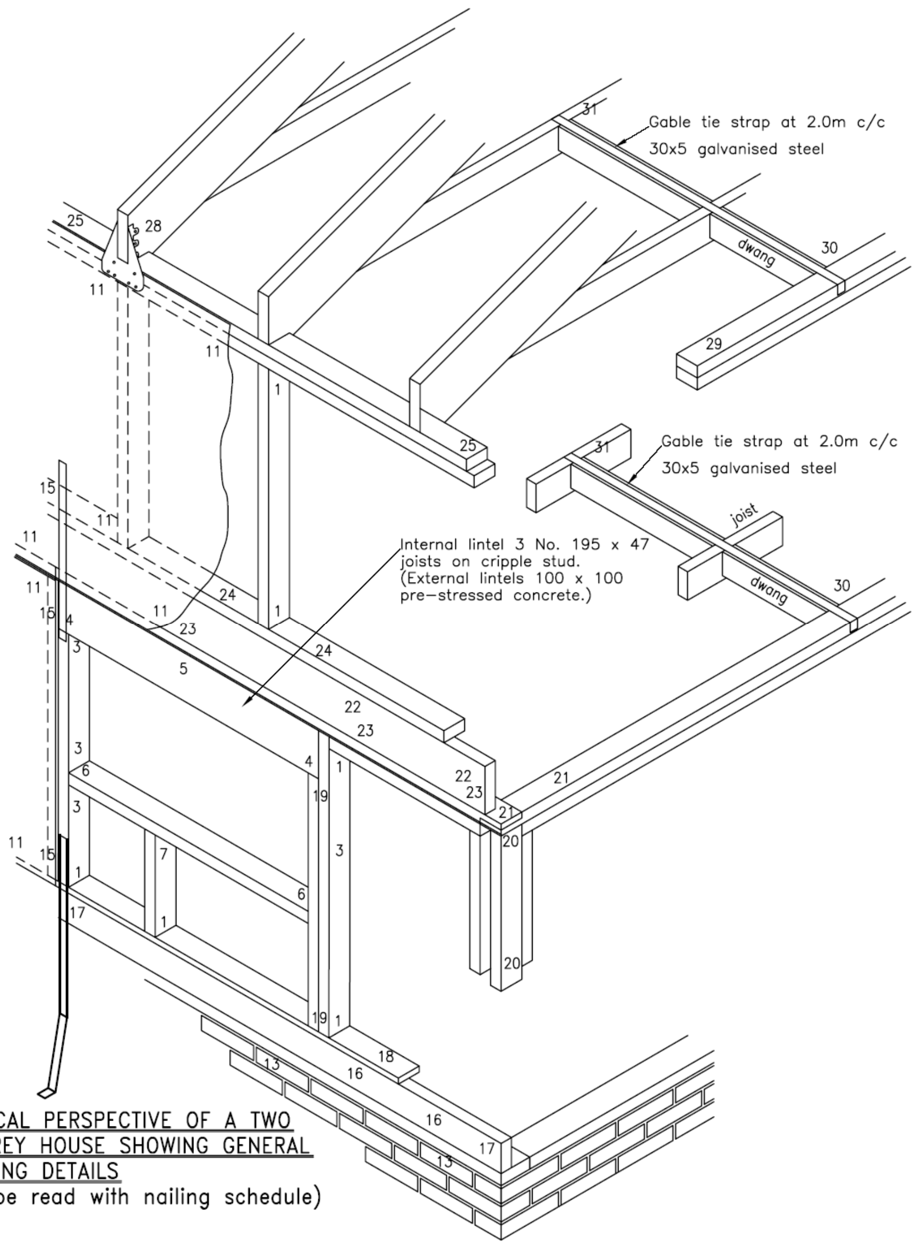


TYPICAL PERSPECTIVE OF A TWO STOREY HOUSE SHOWING GENERAL NAILING DETAILS
(to be read with nailing schedule)

## SHOP NAILING

### TIMBER FRAMING – 100mm x 4mm

| | |
|---|---|
| 1. Studs to head and sole plate | 2 No. end nailed each end |
| 2. Noggings to studs | 2 No. toe nailed each end |
| 3. Studs to cripple | 600mm c/c, face nailed, staggered |
| 4. Lintel (bearing on cripple stud) | 4 No. end nailed each end |
| 5. Lintel/lintel | 300mm c/c, face nailed, staggered |
| 6. Plate below opening to cripple | 2 No. end nailed each end |
| 7. Stunds below opening to plate above | 2 No. end nailed |
| 8. Beam : Joist/joist | 300mm c/c, face nailed, staggered |

### PLYWOOD NAILING – 65mm x 3.35mm

| | |
|---|---|
| 9. Gable panels | 3.35mm at 150mm c/c perimeter, 300mm c/c internal |
| 11. Front and back wall panels | 3.35mm at 150mm c/c perimeter, 300mm c/c internal |
| 12. Internal sheathed panels (where applicable) | 3.35mm at 150mm c/c perimeter, 300mm c/c internal |

## SITE NAILING

| FOUNDATION | NAIL SIZE | NUMBER OR SPACING |
|---|---|---|
| 13. Wall plate/brick base | Hilti HLC 10x100/68 | 1800mm c/c |
| 14. Wall plate/half lapped joint | 100mm x 4mm | 2 No. toe nailed |
| 15. Anchor strap to stud | 100mm x 4mm stainless steel | 6 No. face nailed |

### WALL FRAMING

| | | |
|---|---|---|
| 18. G.F. storey sole plate/wall plate | 100mm x 4mm ring shank | 150mm c/c face nailed |
| 19. Stud/stud | 100mm x 4mm | 200mm c/c |
| 20. Stud/corner post | 100mm x 4mm | 200mm c/c |
| 21. Head binder/panel | 100mm x 4mm | 300mm c/c face nailed, staggered |
| 22. 1st floor header joist/1st floor joists | 100mm x 4mm | 2 No. face nailed |
| 23. 1st floor header joist/head binder | 100mm x 4mm ring shank | 450mm c/c toe nailed |
| 24. Upper storey sole plate/header joist | 100mm x 4mm ring shank | 450mm c/c face nailed |
| 25. Roof head binder/panel | 100mm x 4mm | 350mm c/c face nailed |
| 26. Stud/stud – internal sheathed wall to external | 100mm x 4mm | 300mm c/c face nailed, staggered |

### ROOF FRAMING

| | | |
|---|---|---|
| 28. Roof truss/head binder | 45mm x 4mm | 12 No. by trussclip (6+6) |
| 29. Gable truss/head binder | 100mm x 4mm | 450mm c/c toe nailed, staggered |
| 30. End gable tie/gable truss | 100mm x 4mm | 3 No. top nailed |
| 31. End gable tie/ceiling tie | 100mm x 4mm | 1 No. top nailed per ceiling tie |

### FIRST FLOOR DIAPHRAGM

| | | |
|---|---|---|
| 32. Chipboard/joist or dwang | 60mm x 3mm deformed | 75mm c/c |
| 33. Chipboard/joist or dwang parallel to front and back walls | 60mm x 3mm deformed | 150mmc/c |

NOTE : ALL NAILS TO BE SHERARDISED (U.N.O.)

# Timber Frame Nailing Specification

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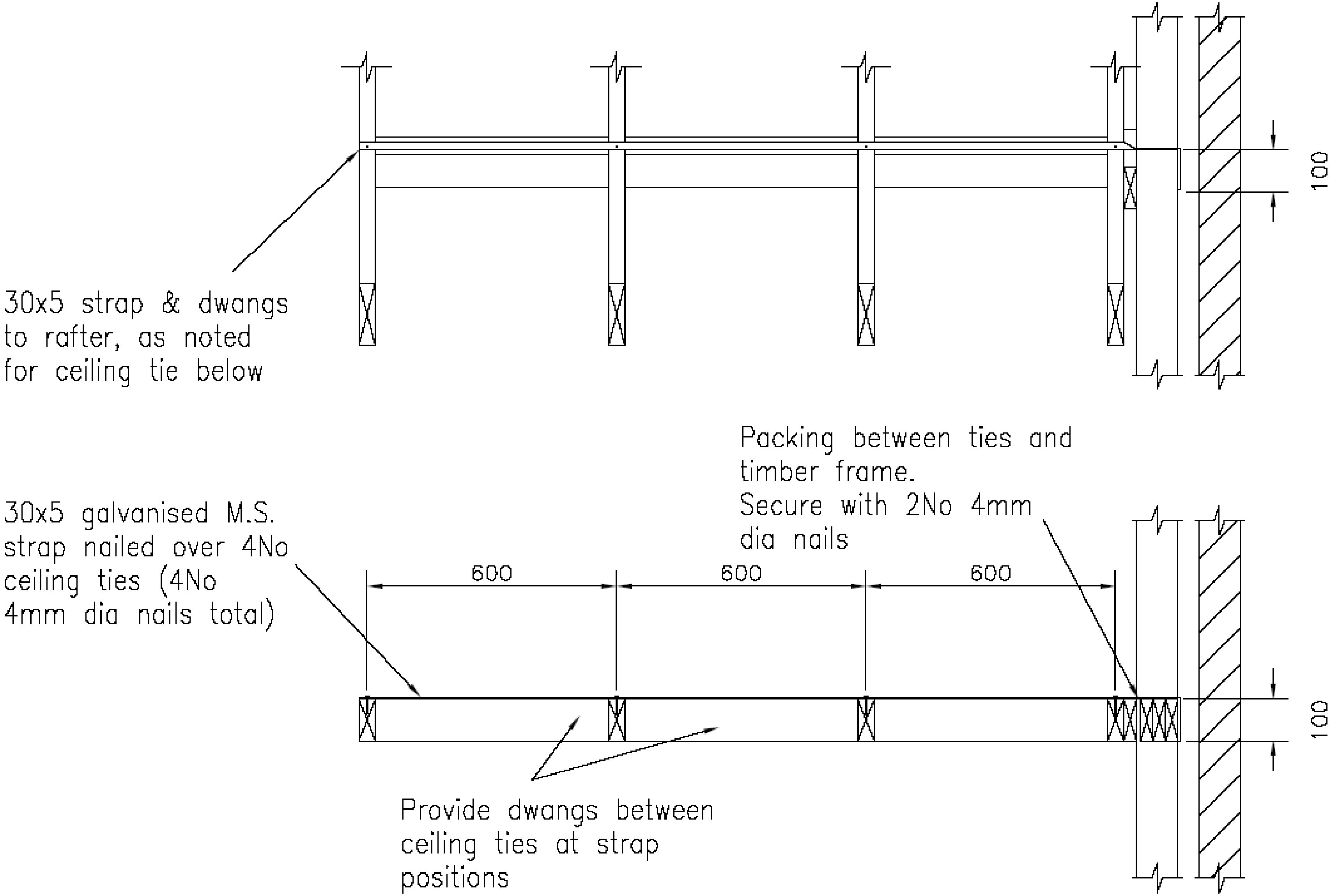


# Gable Restraint Strap

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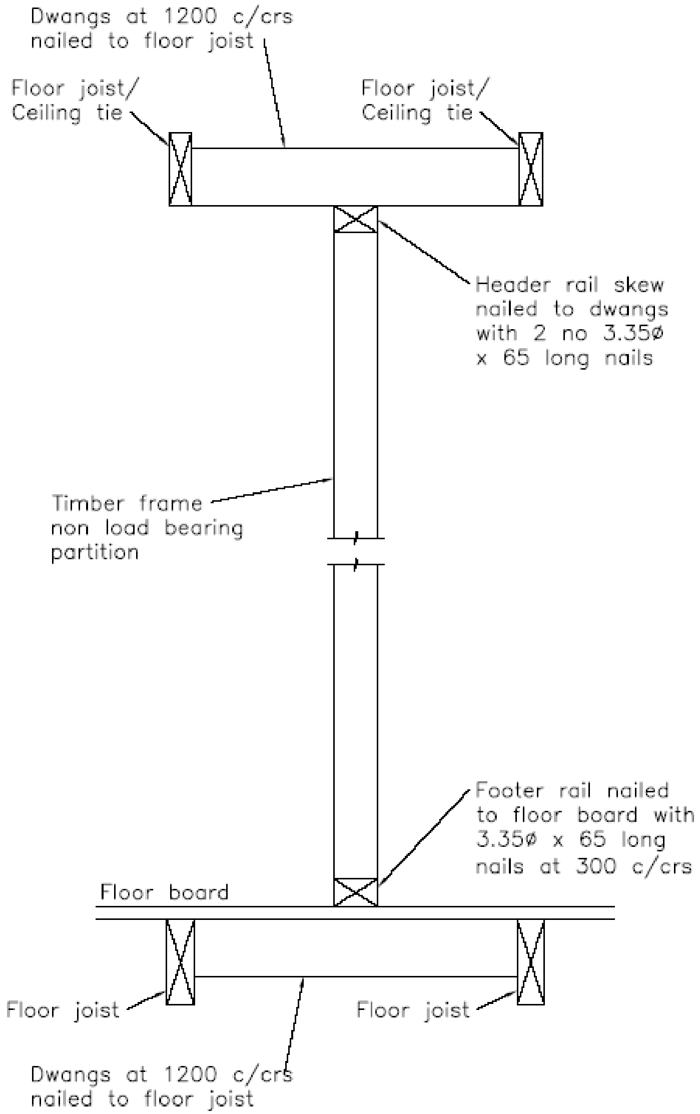
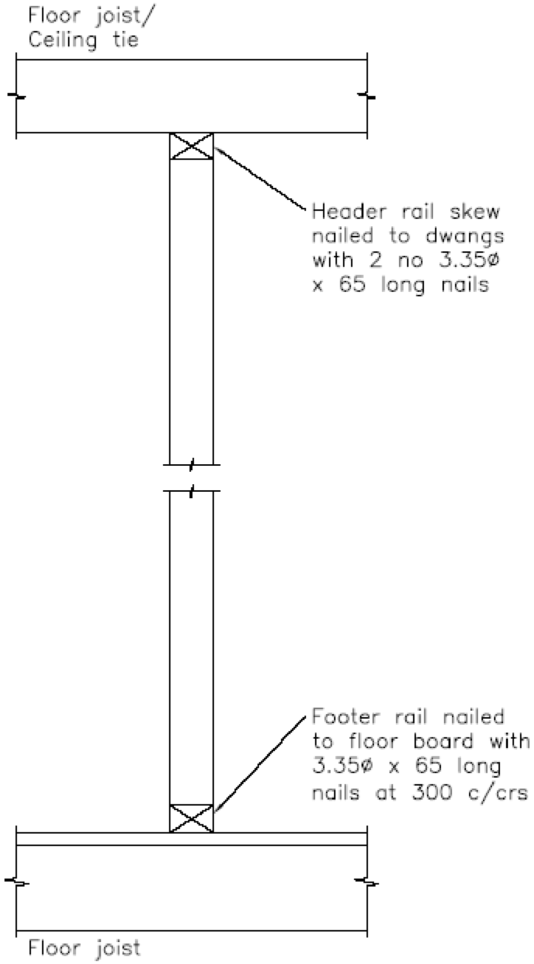



PARTITION PARALLEL WITH FLOOR JOISTS AND CEILING TIES




PARTITION TRANSVERSE TO FLOOR JOISTS AND CEILING TIES

# Non Load Bearing Partition Tie-in Detail to Floor Joists and Ceiling Ties

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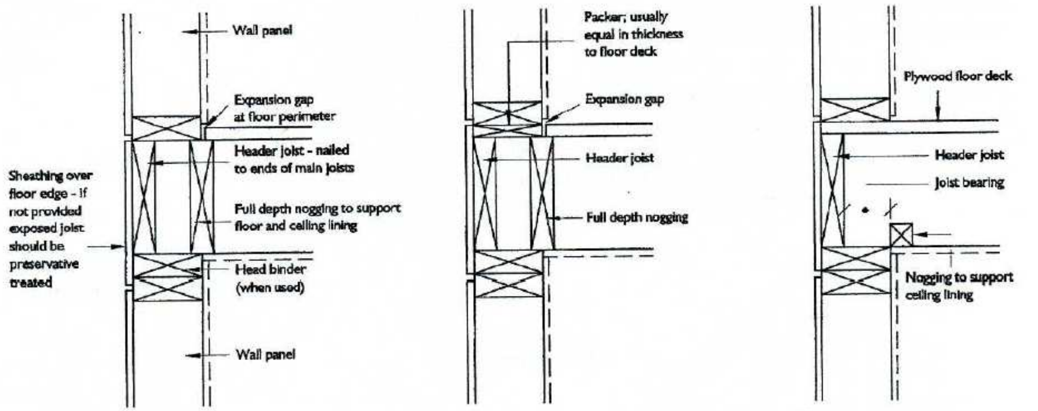
**Figure 6.2 Typical floor/ external wall junctions: Joists at right angles to wall** (Insulation not shown for clarity)

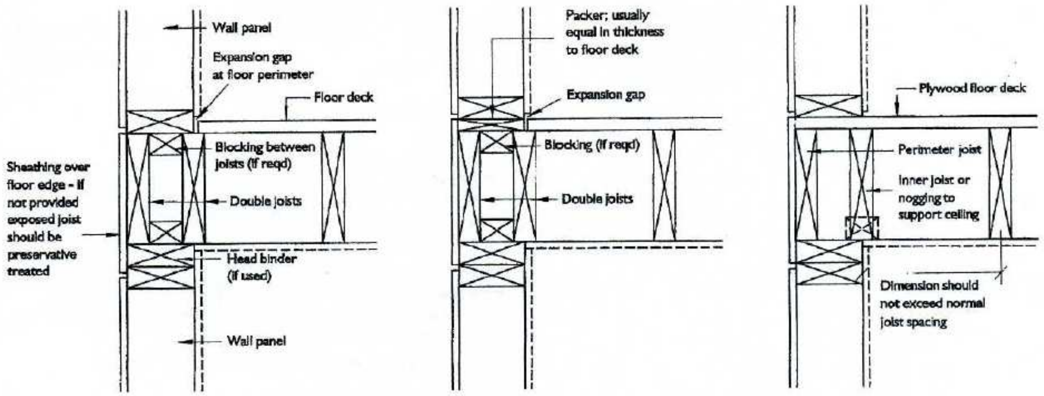



a:
Upper panel fixed directly to joists - (generally used when ground floor is timber and the same detail is appropriate)

b:
Upper panel fixed with packer to maintain dimension discipline of underside of panel at finished floor level

c:
Floor deck run through, for example in a prefabricated panel floorl

**Figure 6.3 Typical floor/ external wall junctions: Joists parallel with wall** (Insulation not shown for clarity)

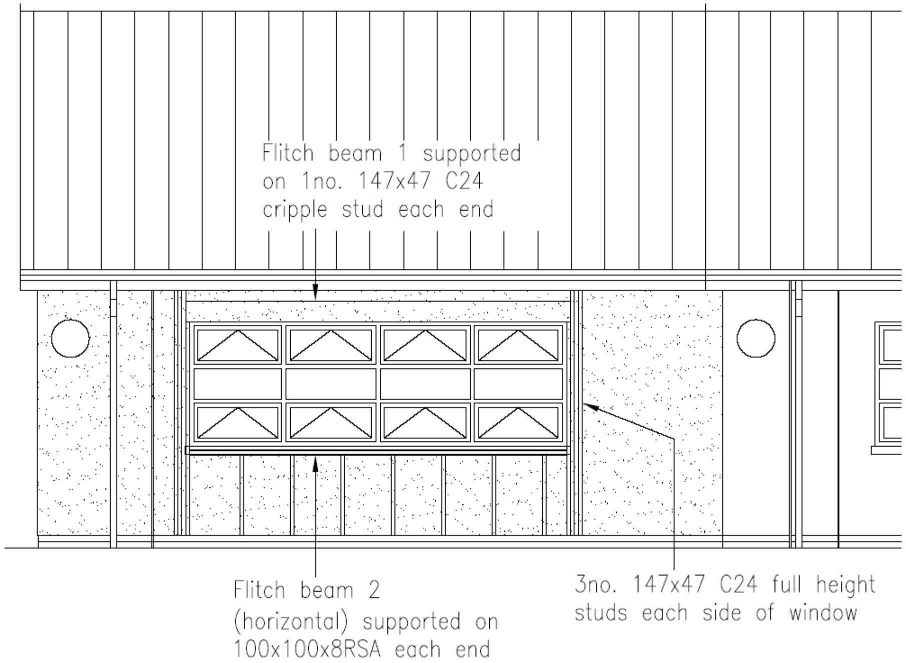



a:
Upper floor wall panel fixed directly to joists

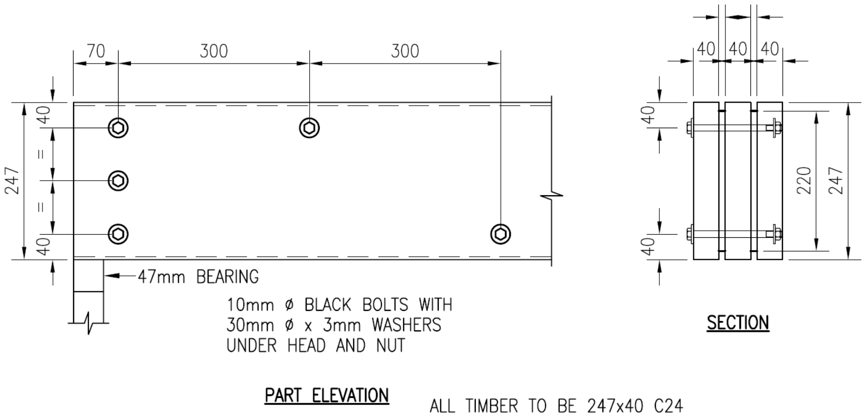
b:
Upper panel fixed with packer

c:
Floor deck run through, for example in a prefabricated panel floor

# Trada Intermediate Floor Tying Details

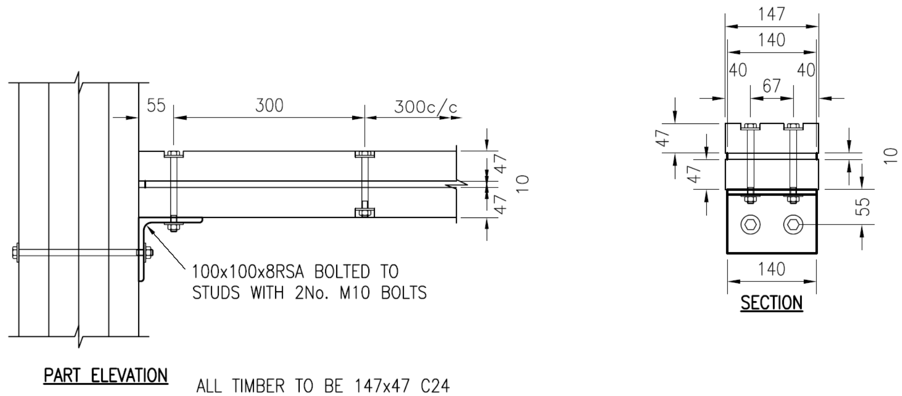



**Typical Elevation Showing Timber Frame Around Large Windows**




ALL TIMBER TO BE 247x40 C24
ALL FLITCH PLATES TO BE 220x10thk MILD STEEL
ALL BOLTS M10 G4.6 at 300 c/c STAGGERED

**Flitch Beam 1**




ALL TIMBER TO BE 147x47 C24
ALL FLITCH PLATES TO BE 140x10thk MILD STEEL
ALL BOLTS M10 G4.6 at 300 c/c STAGGERED

**Flitch Beam 2**

# Typical Flitch Beam Detail at Large Window Opening

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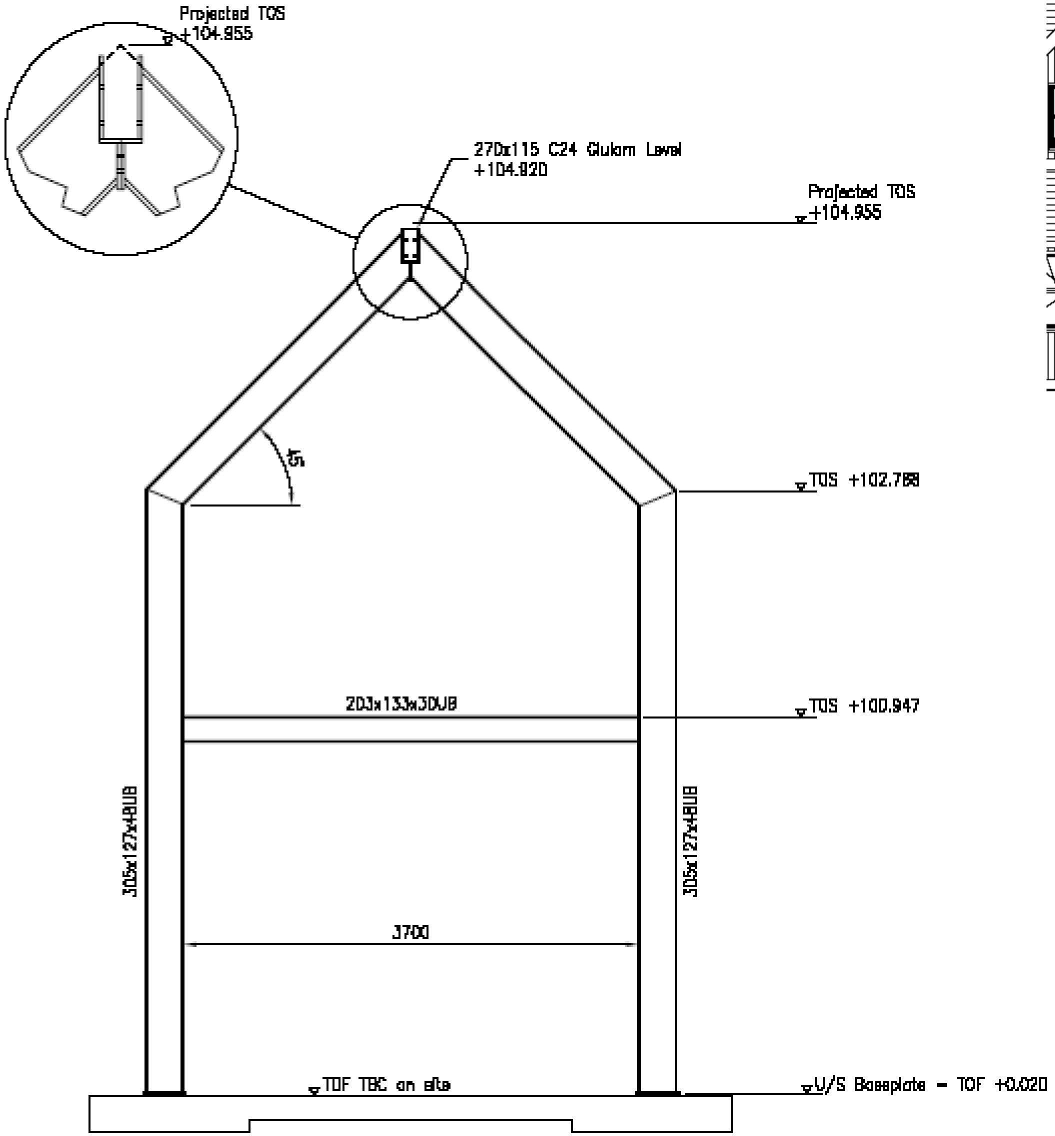


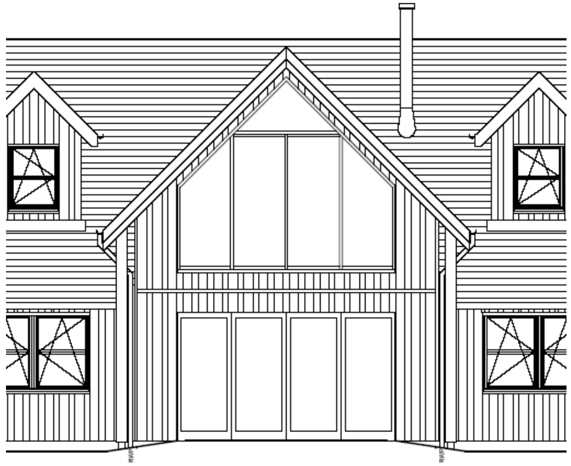

# Typical Steel Portal Frame Required for Glazed Gable

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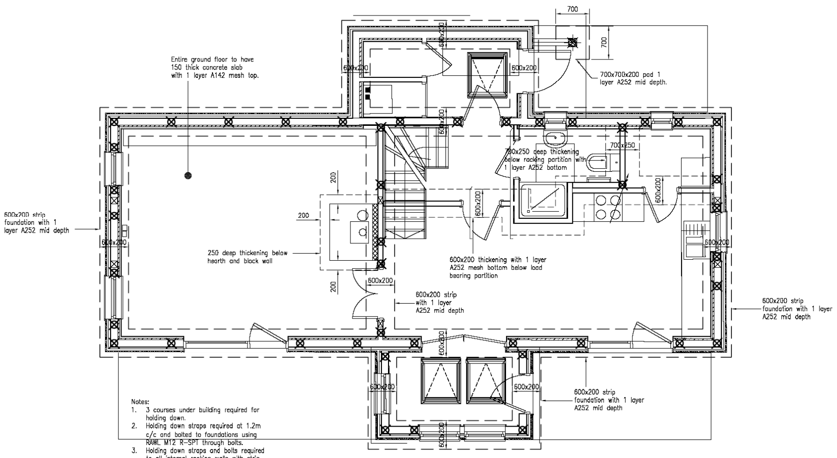
**A F CRUDEN ASSOCIATES**

**SER CERTIFICATE CHECKLIST**

| | | | |
|---|---|---|---|
| Job Title: | New Dwelling House | | Job No: CA6611 |
| Description of Project: | New $1\frac{1}{2}$ storey block clad timber frame | | Risk Classification: |
| Building Type: | Block clad timber frame | | RC 1 |
| Approximate Value: | £180,000 | | Design Check Level: |
| Designer: | A.B. | | DCL 1 |
| Checker: | C.D. | | |
| Certifier: | C.D. | | |
| Date Certificate Signed: | 18/04/11 | | |
| Staged Warrants: | N/A | | |
| Amended Warrants: | N/A | | |
| General Structural Issues, Design Philosophy and Structural Solutions: | Ridge beam supporting loose timber rafters.<br>Timber floor joists supported by externally by timber frame stud wall and internally by LB stud walls.<br>Shallow spread foundations | | |
| Contractor Design Elements: | Timber staircase, handrails, balustrade | | |
| Design Standards Used: | BS6399 - Loading<br>BS5268 - Timber<br>BS5628 - Masonry | BS8110 - Concrete<br>BS5950 - Steel | |
| Loading Summary: | Ground Floor: | Dead Load<br>Live Load | 4.0 kN/m²<br>1.5 kN/m² |
| | Upper Floor(s): | Dead Load:<br>Live Load: | 0.75 kN/m²<br>1.5 kN/m² |
| | Roof Load: | Dead Load:<br>Live Load: | 1.25 kN/m²<br>0.75kN/m² |
| | Wind Loads: | q = | 1.10 kN/m² |
| Ground Conditions/ Soils Investigation: | Trial pits - medium dense sands and gravels | | |
| Safe Bearing Value: | 150 kN/m² | | |
| Ground Improvements (if applicable): | N/A | | |
| Disproportionate Collapse Issues: | No special requirements for this class of structure. | | |
| Cladding Design: | Cladding details specified - wall ties generally at 450c/c vert and 225c/c horizontally | | |
| Fixings Generally: | Details specified | | |
| Fire Engineering Issues: | Short duration required - plasterboard adequate - refer to Architects specification | | |

**Typical Check List**

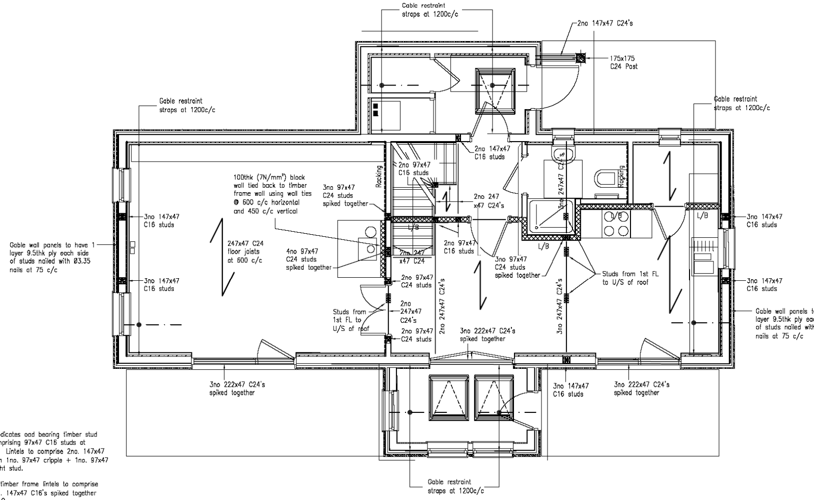



Notes:

1. 3 courses under building required for holding down.
2. Holding down straps required at 1.2m c/c and bolted to foundations using RAWL M12 R-SPT through bolts.
3. Holding down straps and bolts required to all internal rocking walls with strip foundations.
4. Rocking walls on floor slab thickenings to be bolted to floor slab using RAWL M12 R-SPT through bolts at 1.2m c/c.

Indicates holding down location.

FOUNDATION PLAN
Scale 1:50




Notes:

L/B Hatch indicates oad bearing timber stud wall comprising 97x47 C16 studs at 600c/c. Lintels to comprise 2no. 147x47 C16's on 1no. 97x47 cripple + 1no. 97x47 full height stud.

1. All timber frame lintels to comprise 3no. 147x47 C16's spiked together U.N.O.
2. External timber frame walls to have 9.5thk ply sheathing nailed using Ø3.35 nails at 75c/c U.N.O.

GROUND FLOOR PLAN SHOWING FIRST FLOOR SUPPORT STRUCTURE
Scale 1:50

INTERNAL DOMESTIC STAIR & LANDING

Timber stair & balustrade to contractors design in accordance with BS 585 and following loading...

| | |
|---|---|
| Plan imposed load | 1.5 kN/m² |
| Handrail line load | 0.36 kN/m at 1.1m height |
| Infill u.d.l. of | 0.50 kN/m² or |
| Infill point load of | 0.25 kN |

GENERAL NOTES

1. This drawing and the following notes to be read in conjunction with
   a) Engineer's drawings and specifications.
   b) Architect's drawings.
   c) Services Engineer's drawings.
2. Main contractor to be responsible for checking all site dimensions.
3. Filling around foundations shall be executed in layers not exceeding 250mm in thickness. well consolidated. Fill material shall be clean granular ballast and must be approved by the Engineer.
4. Hardcore shall be good clean stone or ballast broken before placing to pass 75mm ring, and free from all rubbish.
5. Foundation sizes are designed on the basis of a safe bearing capacity of 50kN/sq.m. This must be confirmed before construction commences. Soft spots below the foundations are to be removed and made up in lean mix concrete. Soft spots below the floor slab to be upfilled as specified in 3.
6. Concrete to have a minimum crushing strength of 35N/sq.mm. at 28 days. Maximum size of aggregate to be 20mm. Ordinary Portland cement to be used.
7. No admixtures to be used.
8. Aggregate for structural concrete to have a drying shrinkage not exceeding 0.05%.
9. Contractors source of aggregate to be approved by Engineer.
10. Cover to reinforcement to be 40mm.
11. Reinforcement to be in accordance with BS 4449. Mesh fabric to be in accordance with BS4483. All mesh to be high yield unless otherwise noted on drawings.
12. The location of construction and contraction joints to be agreed with the Engineer. Maximum bay length to be 6m.
13. All workmanship to be in accordance with the relevant Clauses in the Codes of Practice and British Standards;
    Steelwork – BS 5950 Part 2 1985
    Concrete – BS 8110 Part 1 1985
    Timber – BS 5268 Part 2 1984
14. Notation:
    A.B.R. – Alternate Bars Reversed
    A.B.S. – Alternate Bars Staggered
    T. – Top
    B. – Bottom
    E.F. – Each Face
    F.F. – Far Face
    N.F. – Near Face
    H. – High Yield Steel
    R. – Mild Steel
15. Brickwork and blockwork to have a basic crushing strength of 7N/sq.mm. Irrespective of thickness, no individual block to weigh more than 20kg.
16. Mortar to be 1:3 cement:sand plus approved plasticiser.
17. Wall control joints to be at 6m max or as otherwise noted on plans.
18. Wall ties to be at 450mm c/c vertically 900mm c/c horizontally.
19. 2 rows stainless steel expamet bed joint reinforcement to be provided above and below structural openings extending 600mm from each edge.

NEW STEELWORK

1. Structural Steel Grades:
   a) Hot Rolled Hollow Sections EN 10210 S 275 J2
   b) All Other Hot Rolled Sections EN 10113 S 275 JR
2. All steelwork connections and design to be in accordance with BS 5950 Part 1 1990.
3. All bolts to be sherardized I.S.O. bolts grade 4.6 to BS 4190 or 8.8 to BS 3692 U.O.N.
4. All welds to be 6mm fillet weld U.O.N.
5. Details of all temporary bracings during various stages of construction to be submitted to the Engineer for approval.
6. Steelwork to be grit blast cleaned to BS 7079 Part A1, preparation grade SA 2½.
7. Within 2 hours of blasting, apply twin pack epoxy zinc rich primer to minimum D.F.T. of 20 microns.
8. Prior to delivery to site, apply twin pack epoxy, zinc rich, high build primer to minimum D.F.T. of 75 microns.
9. After fabrication, welds and damaged areas to be thoroughly wire brushed,scraped and degreased and touched up with the high build primer.
10. All dimensions marked * to be confirmed on site prior to fabrication of steelwork.
11. All first floor support steelwork to be coated with intumescent paint to provide medium duration resistance to fire integrity value and certificate made available to the Authority at completion.

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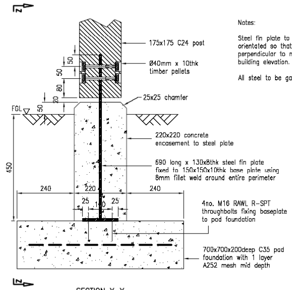
**Client:**
VALERIE WARDLAW
& ADRIAN MUSCUTT

**Project:**
PLOT 7
BRIACH FARM, RAFFORD
IV36 2RW

**Drawing**
STRUCTURAL FLOOR PLANS

| Drawing No. | Drawn By |
|---|---|
| CA6589/01 | NW |
| | Date 13/09/10 |
| | Scale 1:50 |

**Revisions** Date By

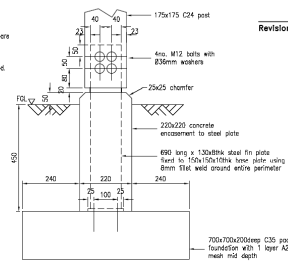



Notes:

Steel fin plate to be orientated so that they are perpendicular to main building elevation.

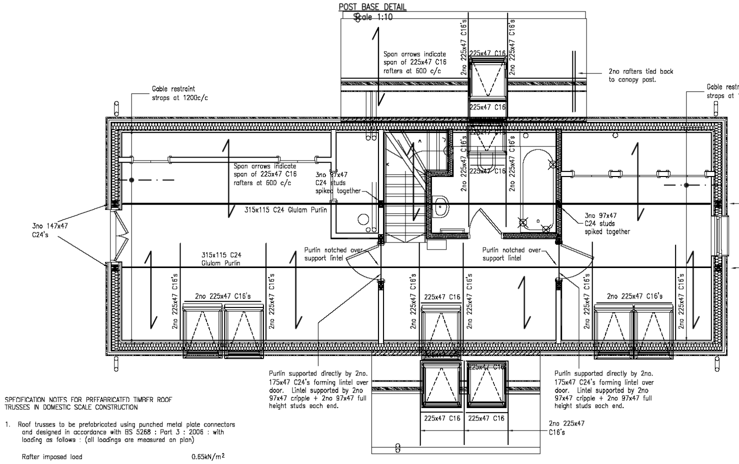
All steel to be galvanised.

SECTION Y-Y
Scale 1:10




VIEW Z-Z
Scale 1:10

POST BASE DETAIL
Scale 1:10




SPECIFICATION NOTES FOR PREFABRICATED TIMBER ROOF TRUSSES IN DOMESTIC SCALE CONSTRUCTION

1. Roof trusses to be prefabricated using punched metal plate connectors and designed in accordance with BS 5268 : Part 3 : 2006 : with loading as follows : (all loadings are measured on plan)

| | |
|---|---|
| Rafter imposed load | 0.65kN/m² |
| Self weight of trusses | 0.15kN/m² |
| Concrete tiles, (or slates), battens, counter battens | 0.75kN/m² |
| Sarking boards | 0.10kN/m² |
| Ceiling tie imposed load | 0.25kN/m² |
| Ceiling tie dead load | 0.10kN/m² |

2. Layout and design of trusses to be submitted for the Engineers approval prior to fabrication.
3. Roof truss supplier shall in addition to the prefabricated trusses also design, detail and supply all longitudinal and diagonal ceiling level bracing timber. The layout of these also shall be submitted for the Engineers approval.
4. All timber to be preservative treated.
5. Minimum thickness of timber for trusses to be 47mm.
6. Truss supplier shall provide an original Design Certificate signed by a Chartered Civil or Structural Engineer in respect of the roof trusses for this project.

FIRST FLOOR PLAN SHOWING ROOF STRUCTURE
Scale 1:50

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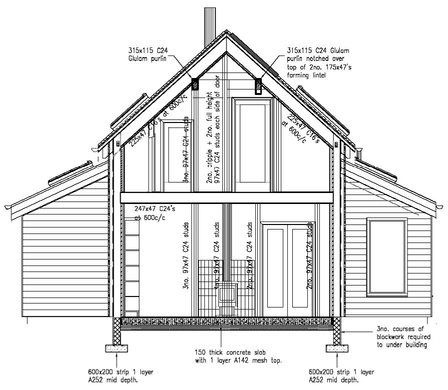
**Client:**
VALERIE WARDLAW
& ADRIAN MUSCUTT

**Project:**
PLOT 7
BRIACH FARM, RAFFORD
IV36 2RW

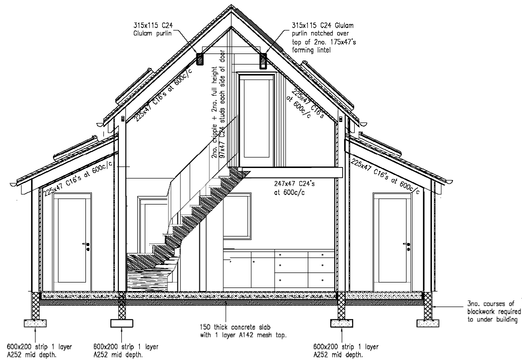
**Drawing**
CROSS SECTIONS,
STRUCTURAL DETAILS
AND SPECIFICATIONS

| Drawing No. | Drawn By |
|---|---|
| CA6589/02 | NW |
| | Date 13/09/10 |
| | Scale As Shown |

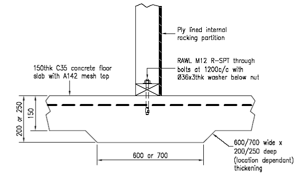
**Revisions** Date By



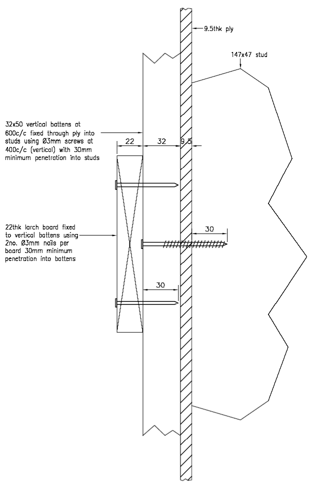

CROSS SECTION A–A
Scale 1:50



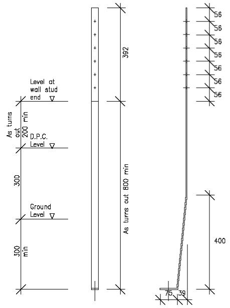

CROSS SECTION B–B
Scale 1:50




CROSS SECTION THROUGH FLOOR SLAB THICKENING
Scale 1:10

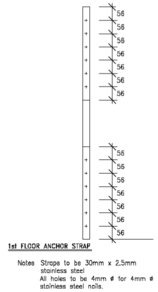



HORIZONTAL CLADDING FIXING DETAILS
Scale 1:2



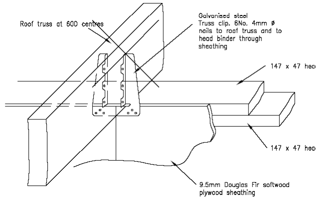

GROUND FLOOR ANCHOR STRAP

Straps at corners, sides of each opening and at 1.2m c/c max.
Straps bolted to foundation using RAWL M12 R-SPT Through bolts

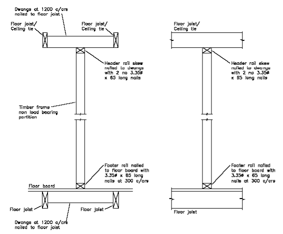



1st FLOOR ANCHOR STRAP

Notes: Straps to be 30mm x 2.5mm stainless steel
All holes to be 4mm ø for 4mm ø stainless steel nails.



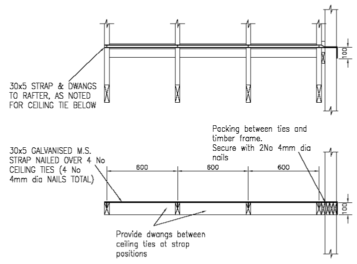

TRUSS CLIP DETAIL



PARTITION PARALLEL WITH FLOOR JOISTS AND CEILING TIES

PARTITION TRANSVERSE TO FLOOR JOISTS AND CEILING TIES

TYPICAL TIE–IN DETAIL OF NON–LOAD BEARING PARTITIONS TO FLOOR JOISTS AND CEILING TIES




GABLE TIE–IN STRAP 1 : 20

## MATERIALS SPECIFICATION

In all cases the materials are required to be supplied and used in accordance with appropriate British Standards, Codes of Practice, Agrément Certificate, Local Building By–laws and in accordance with good building practice. Recommendations of the NHBC Standards Chapter 6.2 "External Timber Framed Wall and Wall Panels" will be regarded a minimum standard.

1. CONCRETE BLOCKWORK: Above and below DPC 7N/mm$^2$ standard dense blocks to BS 6073 : Part 2 : 1981
2. WALL TIES IN NEW CONCRETE CAVITY BLOCKWORK BELOW DPC: Cavity ties shall be austenitic stainless steel vertical twist ties to comply with BS 1243, Figure 3. Ties are required at 900mm horizontal centres and 450mm vertical centres.
3. CAVITY FRAME TIES BETWEEN TIMBER FRAME AND BLOCKWORK CLADDING: Cavity ties shall be selected according to the width of cavity. Ties shall be of austenitic stainless steel and they shall be covered by an Agrément Certificate. They shall have 75mm grip into blockwork.
   They shall be located so that they have a slight fall towards the outside.
   Nailing of ties to the timber frame shall be at a stud and shall be of austentic stainless steel.
   Ties are required at 600 centres horizontally and 450mm centres vertically. Additional ties are required around openings and ingoes.
4. DAMP–PROOF COURSE: Shall be permaflex pitch/polymer in accordance with Agrément Certificate 86/1666 with all joints lapped and sealed.
5. BLOCKWORK GENERALLY: Workmanship shall be in accordance with the recommendations of BS 5628 : Part 3 : 1985 – "Code of Practice for Structural Use of Masonry" – Materials and Components, Design and Workmanship. Cavity laths shall be used at all times to keep the wall cavity free from mortar droppings or other contamination. All completed cavities will be inspected closely by lamp, where necessary by using and optical instrument. Wherever there is evidence of build–up of mortar on the backs of bricks or blocks or on the ties, then the appropriate section of wall will be ordered to be cut out, the cavity cleaned and then the walling built again.
   Austenitic stainless steel coil mesh to BS1449 : Part 2 : of 64mm width by Catnic Components Ltd., shall be used as a bed reinforcement in 2 blockwork courses below window openings, mesh to extend 600mm beyond sides of windows.
6. CONTROL JOINTS IN CLADDING: Joints are required in the blockwork and wherever these are specified the Contractor shall take steps to ensure that the joint is truly continuous through the wall at the required position. External gaps between materials across a joint will be sealed using a Polysulphide Sealant and the correct type and depth of joint filler must be selected so as to ensure that the sealing is accomplished in the intended manner.
7. STRUCTURAL TIMBER: All timber framing, floor joists, sole plates, shall be preservative treated by O.S. (Organic Solvent) Double Vacuum Process in accordance with composition and application requirements of the British Wood Preserving Association 1975 specification and with BS 5268 : Part 5 : 1977
   Unless otherwise noted on drawing, timber to be redwood/whitewood strength class C24 to EN 338. No wane is permitted in structural timbers.
8. NAILING: Nailing to be sherardised wire nails as per the Nailing Schedule. (U.N.O.)
9. WALL TIMBER SIZES: External walls shall comprise 147 x 47mm studs at 600 centres.
   All internal load bearing walls shall comprise 97 x 47mm studs at 600mm centres.
   All internal partitions shall comprise 72 x 47mm studs at 600mm centres.
   Moisture content in framing timber shall be 18% maximum
10. PANELVENT FOR SHEATHING AND SARKING: Panelvent to be 9.2mm thickness and installed in accordance with manufacturers instructions. Excel Industries Ltd. Maerdy Industrial Estate (South), Rhymney, Gwent NP22 5PY www.excelfibre.com.
11. BREATHER MEMBRANE: Use TYVEK 1050 Agrément Certificate No. 86/1673 with stainless steel staples.
12. WALL INSULATION: Provide a 150mm thickness of rockwool insulation cavity batts, neatly cut to fit between timber studs.
13. CAVITY BARRIERS: Treated redwood/whitewood of minimum 30mm thickness x 50mm width protected on the upper and external surfaces by DPC in locations as noted on plans.
14. HOLDING DOWN STRAPS: Where noted on drawing and as detailed, stainless steel straps of 30mm x 2.5mm section shall be used to anchor timber frame to foundation. Strap shall be nailed to a stud with 6No. 4mm diameter stainless steel nails.
15. ROOF TRUSS HOLDING DOWN: As detailed, galvanised mild steel truss clip shall be provided at each truss fixed with 4mm sherardised nails.
16. ROOF TRUSSES: Trussed rafter shall be 600mm centres except where doubled up around dormer windows. Trusses shall comply in all respects with BS 5268 : Part 3 : and be designed for the self weight loading from concrete tiles.
   Design snow loading shall be 0.75kN/sq m Attic floor load 1.5 kN/sqm
   Install diagonal and longitudinal bracing as in BS 5268 : Part 3.

## NAILING SCHEDULE

SHOP NAILING

TIMBER FRAMING – 100mm x 4mm

| | |
|---|---|
| 1. Studs to head and sole plate | 2 No. end nailed each end |
| 2. Noggings to studs | 2 No. toe nailed each end |
| 3. Studs to cripple | 600mm c/c, face nailed, staggered |
| 4. Lintel (bearing on cripple stud) | 4 No. end nailed each end |
| 5. Lintel/lintel | 300mm c/c, face nailed, staggered |
| 6. Plate below opening to cripple | 2 No. end nailed each end |
| 7. Stunds below opening to plate above | 2 No. end nailed |
| 8. Beam : Joist/joist | 300mm c/c, face nailed, staggered |

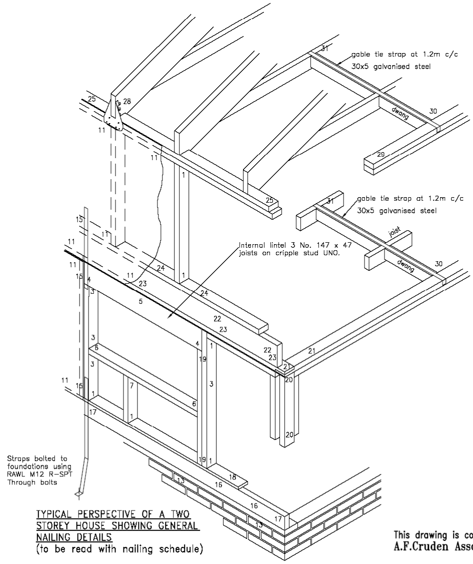
PLYWOOD NAILING – 65mm x 3.35mm

| | |
|---|---|
| 9. Gable panels | 3.35mm at 75mm c/c perimeter, 300mm c/c internal |
| 11. Front and back wall panels | 3.35mm at 75mm c/c perimeter, 300mm c/c internal |
| 12. Internal sheathed panels (where applicable) | 3.35mm at 75mm c/c perimeter, 300mm c/c internal |

SITE NAILING

| FOUNDATION | NAIL SIZE | NUMBER OR SPACING |
|---|---|---|
| 13. Wall plate/brick base | Hilti HLC 10x100/68 | 1800mm c/c |
| 14. Wall plate/half lapped joint | 100mm x 4mm | 2 No. toe nailed |
| 15. Anchor strap to stud | 100mm x 4mm stainless steel | 6 No. face nailed |
| **WALL FRAMING** | | |
| 18. G.F. storey sole plate/wall plate | 100mm x 4mm ring shank | 150mm c/c face nailed |
| 19. Stud/stud | 100mm x 4mm | 200mm c/c |
| 20. Stud/corner post | 100mm x 4mm | 200mm c/c |
| 21. Head binder/panel | 100mm x 4mm | 300mm c/c face nailed, staggerec |
| 22. 1st floor header joist/1st floor joists | 100mm x 4mm | 2 No. face nailed |
| 23. 1st floor header joist/head binder | 100mm x 4mm ring shank | 450mm c/c toe nailed |
| 24. Upper storey sole plate/header joist | 100mm x 4mm ring shank | 450mm c/c face nailed |
| 25. Roof head binder/panel | 100mm x 4mm | 350mm c/c face nailed |
| 26. Stud/stud – internal sheathed wall to external | 100mm x 4mm | 300mm c/c face nailed, staggerec |
| **ROOF FRAMING** | | |
| 28. Roof truss/head binder | 45mm x 4mm | 12 No. by trussclip (6+6) |
| 29. Gable truss/head binder | 100mm x 4mm | 450mm c/c toe nailed, staggered |
| 30. End gable tie/gable truss | 100mm x 4mm | 3 No. top nailed |
| 31. End gable tie/ceiling tie | 100mm x 4mm | 1 No. top nailed per ceiling tie |
| **FIRST FLOOR DIAPHRAGM** | | |
| 32. Chipboard/joist or dwang | 60mm x 3mm deformed | 75mm c/c |
| 33. Chipboard/joist or dwang parallel to front and back walls | 60mm x 3mm deformed | 150mmc/c |

NOTE : ALL NAILS TO BE SHERARDISED (U.N.O.)




TYPICAL PERSPECTIVE OF A TWO STOREY HOUSE SHOWING GENERAL NAILING DETAILS
(to be read with nailing schedule)

# Construction Problems

Structural Engineers Registration Ltd

**Spandrel Panel Not Tied Back to Roof Trusses**

Structural Engineers Registration Ltd


**Outer Wall Not Fixed to 1st Floor Joist**

Structural Engineers Registration Ltd

**Gable with Large Window**

- Design by Consultant was steel purlins supporting roof and spanning on to RHS at window
- This was timber kit as supplied by Timber Kit Manufacturer although their own designer had glulam roof purlins spanning on to glulam posts at windows
- Problem - Hinge formed at window head and no structural continuity between gable window and spandrel panel

Structural Engineers Registration Ltd


**Gable Wall Adjacent to Staircase**

Structural Engineers Registration Ltd

# References


- BS6399 Parts 1, 2 & 3
- BS5268 Parts 3 & 6
- BS EN1991-1-1, 1-3 & 1-4
- BS EN1995-1-1
- Dr Robert Hairstans Seminar Presentation 2009
- UK Timber Frame Association Technical Bulletin Number 3 2005
- Cullen Timber Engineering Connectors 2009
- Simpson Strong Tie
- Manual for the Design of Timber Frame Structures to Eurocode 5 by Arnold Page
- Timber Frame: Standard Details for Houses and Flats, by Trada
- Other information from www.trada.co.uk



# Acknowledgements


Pleased to acknowledge help and use of information from the following:

- Institution of Structural Engineers
- SER
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- LND Architects
- Trevor Black Architects
- Affordable TM Architects
- Rural Design