STRUCTURAL ENGINEERING SPECIFICATION

Job Title
DURBIN HOUSE
23 RELIANCE CRES
BEACHLANDS, AUCKLAND

Job No.
20249

22 May 2013

Architect
S3 Architects
PO Box 16 234
SANDRINGHAM 1351
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Prepared by

Paula Hugens
BE (Civil) MIPENZ CPEng

20249 Structural Spec.docx
1. STRUCTURAL OUTLINE SPECIFICATION

1.1 Scope
This section of the Specification consists of specifically designed structurally engineered components. This section shall be read in conjunction with all other specifications.

1.2 Related Documents
In this Specification, reference is made to the following documents.

- The New Zealand Building Code
- NZS 3604:2011 Timber Framed Buildings
- AS/NZS 1170 Structural Design Actions set
- NZS 3602:2003 Timber and Wood-based Products for use in Buildings
- NZS 3603:1993 Timber Structures
- NZS 3404:1997 Steel Structures
- NZS 3101:1995 Concrete Structures
- NZS 4230:2004 Design of Reinforced Concrete Masonry Structures
- NZS 4402 Methods of testing soils for civil engineering purposes
- NZS 4218:2009 Thermal Insulation - Housing and Small buildings
- AS1366 Rigid cellular plastics for thermal insulation

1.3 Quality Assurance
The work shall be carried out by a Licensed Building Practitioner, in accordance with best trade practice of sound repute by competent craftsmen using equipment, materials and processes that are best suited for the purpose and shall be of the very highest standard.

No Change or Variation is permitted unless the Engineer provides appropriate written instructions.

Dimensions and details shall be read in conjunction with the Architect’s drawings. The contractor shall check all dimensions before construction commences.

The contractor shall fully comply with all the provisions of the New Zealand Building Code, including all requirements for site and worker safety.

Ensure that all contract insurances are in place before starting work on site. Insurances shall remain in place for the full duration of the project until a Certificate of Practical Completion is issued.

All permits required by any authorities shall be obtained and paid for and all necessary deposits, plans and specifications lodged as required before any work is commenced.

All tests and inspections required by any of the above regulations or authorities shall be made at the appropriate time. Any works covered up before such required tests or inspections have been made shall be uncovered and opened up for testing and inspection at the Contractor’s expense.
1.4 Excavation and Hard filling

Foundations shall be excavated down to a suitable depth to achieve a solid bearing subgrade level. A safe bearing pressure of 100kPa (300kPa ultimate bearing capacity as defined in NZS3604:2011) has been assumed for the design. This assumption is to be verified on site by a suitable qualified person once excavation commences. Any soft spots are to be located by the contractor and referred to the Engineer for written instructions.

Excavate all topsoil from areas that are to be hard filled or concreted. Fully compact all subgrade surfaces prior to any placement. Provide adequate notice to the Engineer to allow the subgrade to be inspected before placing formwork, steel reinforcement or DPM.

Hard fill material under floor slabs and foundation beams (where shown on the details) shall be free from all non-mineral matter. Fill material shall have a maximum size of 100mm, with 35-55% passing 19mm and not more than 15% passing 600μm standard sieves. It shall be free from material which may cause it to weave when wet. Compact in layers no more than 250mm or less than 130mm thick to achieve at least 90% standard compaction as per NZS 4431:1989 Earth Fill for Residential Development. Blind all surfaces to receive DPM with a 20mm layer of sand.

1.5 Epoxy Grouting of Steel Reinforcement into Concrete

Drill and epoxy grout deformed reinforcing bars into concrete as shown on the drawings and when specifically instructed by the Engineer.

The holes must be drilled with hammer drills. Diamond core drilling is not acceptable. Holes for horizontal starters may slope downward at up to 15 degrees. The depth of hole and embedment of the reinforcing bars shall be to the minimum depths set out in the table below unless noted otherwise.

Holes must be dry prior to filling with epoxy.

<table>
<thead>
<tr>
<th>Bar Diameter</th>
<th>Hole Diameter</th>
<th>Grade 300E</th>
<th>Grade 500E</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>16</td>
<td>160</td>
<td>250</td>
</tr>
<tr>
<td>12</td>
<td>18</td>
<td>200</td>
<td>320</td>
</tr>
<tr>
<td>16</td>
<td>22</td>
<td>270</td>
<td>450</td>
</tr>
<tr>
<td>20</td>
<td>26</td>
<td>350</td>
<td>570</td>
</tr>
<tr>
<td>25</td>
<td>32</td>
<td>520</td>
<td>750</td>
</tr>
</tbody>
</table>

All holes shall be cleaned out using a stiff bristled wire bottlebrush and a compressed air source so that all dust and debris are removed from the side of the hole.

The holes shall be partially filled from the bottom up with epoxy grout prior to inserting the reinforcing bar. Standard nozzles shall be modified by placing plastic hosing over the cartridge nozzle of sufficient length to reach the base of the drilled hole.

After the bars have been placed in position, ensure that the epoxy entirely fills the hole to the surface of the concrete.

Bars shall be placed in the holes, given one turn to expel air voids and shall be fully supported (if necessary) and left undisturbed for at least 24 hours. After 24 hours horizontal bars installed at 15 degree slope can be bent horizontal.
Use Hilti Hit HY 150, Ramset Epcon Ceramic 6, (or similar with written approval of the Engineer). The epoxy grouts shall be used strictly in accordance with the manufacturers’ instructions.

1.6 **Structural Steel**

Structural Steel shall comply with NZS 3404:1997 Steel Structures.

Welding shall be carried out by correctly certified welders to comply with AS/NZS 1554.1:2004 Structural Steel Welding. All welds shall be 6mm fillet welds all around unless noted otherwise. All splice joints in members shall be full penetration butt welded. All welds shall be category SP unless noted otherwise

Unless noted otherwise all bolts and nuts shall be category 8.8/S to AS/NZS 1252:1996.

1.6.1 **Steel Finishes**

Structural steel finishes are to be in accordance with AS/NZS2312:2002 Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings. Alternative systems may be considered, provided that the nominated system achieves a similar level of performance in accordance with AS/NZS2312. Refer to the Architect’s Specification for further finish requirements.

- Interior steelwork concealed in its completed state: AKL2 or IZS2
- Interior steelwork exposed in its completed state: ACC5
- Exterior steelwork, accessible for regular cleaning and maintenance: PUR5
- Inaccessible exterior steelwork: HDG600P6 to P8 or TSA225S
- Galvanize steelwork where noted in accordance with AS/NZS 4680:1999.

1.7 **Timber**

Timber construction shall comply with NZS 3604:2011. All member sizes or details not shown on the drawings shall be correctly sized and installed by the Contractor, to NZS 3604:2011 requirements.

All structural timber shown on the drawings shall be mechanically stress graded MSG8.

Engineered timber shall be HyneBeam glue laminated timber, J90 Laminated Veneer Lumber or I-Built I-Beam engineered I joists in accordance with their standard specifications.

In particular, special care is required in assessing the durability requirements for all fixings given their exposure and environment. If in doubt, the level of protection shall be discussed and agreed with the Local Territorial Authority.

Refer to the Architect’s specification for additional timber construction requirements.
2. DESIGN SUMMARY

2.1 Scope
The house is comprised of a two level light timber framed structure on insitu concrete foundations walls and insitu concrete slab on grade. Lateral bracing was determined using NZS3604 and Gib® EzyBrace™ Systems with some RAB™ Board and Villaboard® systems employed.

Some larger span floor framing members were specifically engineered in structural steel to form an open plan living area below the mezzanine floor.

The home is to be a Certified Passive House, particular care has been taken to avoid structural and geometrical thermal bridging at the building envelope. It is important for the building to have a uninterrupted layer of insulation throughout. The design also employs an airtightness layer using INTELLO® vapour check. This not only provides the high level of airtightness required for the Passive House Standard but will also reduce risk of interstitial condensation forming in the exterior wall and roof elements.

A site soils investigation for the project was not undertaken.

2.2 Design Imposed (Live) Loads
The imposed floor and roof actions have generally been designed using AS/NZS1170.1 with the following: -

Uniformly distributed load
- General areas Q = 1.5kPa
- Decks, stairs, storage Q = 2.0kPa
- No access roof Q = 0.25kPa

2.4 Seismic Loads
Calculated in accordance with NZS3604, Zone 1
Conservatively assumed soil type D & E, deep and or very soft soils.

2.5 Wind Loads
Calculated in accordance with NZS3604, Wind Zone High
Timber framed stud walls.

Walls constructed using 90x45 studs at 600mm centres in general.

Maximum stud loading occurs under mezzanine walls.

Studs will be balloon framed up to roof height, full lateral restraint is provided at mezzanine floor.

Axial load calculation:

Floor SW = 0.8kPa x 1.3m frib width = 1.04 kN/m

Wall SW above = 0.8kPa x 3.4m height = 2.72

Roof SW = 0.9kPa x 1.9m frib width = 1.71

\[ \varepsilon \sigma = 5.47 \text{ kN/m} \]

Floor LL = 1.5kPa x 1.3m frib width = 1.95 \[ \frac{1}{\psi} = 0.7 = 1.37 \]

Roof LL = 0.25 kPa x 1.9 = 0.48

\[ 129 + 1.5 \alpha = 10.21 \text{ kN/m} \]

Calculate axial capacity of stud:

SG8, dry condition, \( f_c = 18 \text{ MPa} \)

\( \alpha = 0.8 \)

\( k_1 = 0.8 \)

\( L_1 = 2.9 \text{ m} \) (floor to floor between support lines)

Assume \( k_{10} = 1.0 \) as no real end fixity in stud framing (could be argued 0.85)

\[ S_2 = 1.0 \times 2.9 / 0.69 = 3.22 \]

\[ S_2 = 3.5 \times 90 / 45 = 7.0 \] (one edge continuously restrained)
\[ k_b = 1.00 \text{ - assumes } \alpha = 0.2; \text{ lay } \beta = 52 \]

\[ X-x \text{ axis } \phi N_{Ncx} = \phi k_1 k_3 f_c A \]
\[ = 0.8 \times 0.8 \times 1.0 \times 1.0 \times 90 \times 45 \times 10^{-3} \]
\[ = 47 \text{ kN} \]

Sheets at 600mm crs : \[ N_x = 10.21/0.6 = 17 \text{ kN} \text{ - easily ok} \]

1-tons by inspection ok, although may free sheets restrained on one side by 45x45 battens at 600crs and fibre-cement sheet on other side.

Check for load bending:

Conservatively apply 12 kpa wind load.

\[ k_4 = 1.0 \]

\[ k_5 = 1 + (1.2 - 1) \left( 1 - \frac{2 \times 0.6}{2.3} \right) = 1.12 \]

\[ F_b = 14 \text{ MPa} \]

\[ k_1 = 1.0 \]

\[ \phi M_n = 0.8 \times 1.0 \times 1.0 \times 1.12 \times 1.0 \times 14 \times 45 \times 90 \times 10^{-6} \]
\[ = 0.762 \text{ kN-m} \]

\[ M_x = 12 \times 0.6 \times 2q^2 / 10 = 0.605 \text{ kN-m} \text{ - ok} \]

Combined stress check \[ M_x / \phi M_n = 0.99 \]

\[ N_x = 6.83 \]
\[ \phi N_{Ncx} = 47 = 0.145 \]

\[ U_c = 0.94 \leq 1.0 \text{ - ok} \]
**TIMBER BEAM DESIGN**

**SIMPLY SUPPORTED WITH UNIFORMLY DISTRIBUTED LOAD**

**Description**
Upper floor joists - outdoor deck

**Beam Properties**
- **nominal beam depth**: \(d = 245\) mm
- **nominal beam width**: \(b = 44\) mm
- **beam span**: \(L = 5.00\) m
- **lateral buckling length for top**: \(l_t = 0.90\) m
- **lateral buckling length for bottom**: \(l_b = 0.90\) m

**timber specification**
- **moisture content (dry, green)**
  - **at installation**: \(= 1\) (assumes kiln dried)
  - **in service**: \(= 1\)

**characteristic stresses**
- At installation: \(f_b = 30\) MPa
- In service: \(f_b = 13.3\) GPa

**visually graded timber**
- \(f_s = 3.7\) MPa
- \(E_{lbs} = 13.3\) GPa

**Dead load**
- \(f_c = 30\) MPa

**Distributed Loads**

<table>
<thead>
<tr>
<th>Description</th>
<th>(Q) (kPa)</th>
<th>Width (m)</th>
<th>(G) (kPa)</th>
<th>(Q) (kPa)</th>
<th>(y)</th>
<th>(S)</th>
<th>(W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor sw</td>
<td>0.8</td>
<td>0.4</td>
<td>2</td>
<td>0.4</td>
<td>0.7</td>
<td>0.7</td>
<td>0.32</td>
</tr>
<tr>
<td>Wall sw</td>
<td>0.7</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.32</td>
</tr>
</tbody>
</table>

**Total Distributed Loads**
- 0.32
- 0.80
- 0.56
- 0.32

**Modification Factors**
- **k1 = 0.80** medium (live)
- **k2 = 1.00** brief
- **k3 = 1.00**
- **k4 = 1.00**
- **k5 = 1.00**
- **k8 = 0.85**

**Deflection**

<table>
<thead>
<tr>
<th></th>
<th>Dead load</th>
<th>Unfactored live load</th>
<th>Short term live load</th>
<th>Long term live load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate</td>
<td>3.63</td>
<td>9.08</td>
<td>6.35</td>
<td>3.63</td>
</tr>
<tr>
<td>with creep</td>
<td>7.26</td>
<td>9.08</td>
<td>6.35</td>
<td>3.63</td>
</tr>
</tbody>
</table>

**Deflection Checks**
- \((G + \psi Q + W_s + S_s)\)

**Bending Moment Check**
- \(M_{1.40} = 1.40\) kNm
- \(M_{1.20 + 1.40} = 4.95\) kNm
- \(M_{1.20 + S_s} = 2.20\) kNm
- \(M_{1.20 + Q + W_s} = 2.20\) kNm

**Shear**
- \(V = 3.96\) kN

**Beam 245 x 44** is satisfactory
TIMBER BEAM DESIGN
SIMPLY SUPPORTED WITH UNIFORMLY DISTRIBUTED LOAD

Description
2. Kitchen ceiling beam, supports storage deck and load bearing wall for roof above

Beam Properties
nominal beam depth

\[ d = 450 \text{ mm} \]

nominal beam width

\[ b = 85 \text{ mm} \]

beam span:

\[ L_1 = 6.00 \text{ m} \]

lateral buckling length for top

\[ l_1 = 0.90 \text{ m} \]

lateral buckling length for bottom

\[ l_1 = 0.90 \text{ m} \]

timber specification

HYNEBEAM 2TC

moisture content (dry, green)
at installation = dry (assumes kiln dried) in service = dry

characteristic stresses

\[ f_y = 50 \text{ MPa} \]
at installation \[ E_{sy} = 21.0 \text{ GPa} \]
in service \[ E_{sy} = 21.0 \text{ GPa} \]

visually graded timber

\[ f_y = 27 \text{ MPa} \]

(bearing area factor)

select duration of load for strength (applies to 1.2G + 1.5Q case only)

Modification Factors
select duration of load for deflection

medium (live) k1 = 0.80

brief k2 = 1.00

bearing area factor

length of bearing = 150 mm k3 = 1.00

load sharing - grid systems support spacing = 1000 mm k5 = 1.00

select stability - lateral restraint system

continuous S1 = 15.88 k6 = 0.88

Deflection

Immediate with creep

\[ \Delta = 9.77 \text{ mm} \]

\[ \Delta = 14.94 \text{ mm} \]

\[ \Delta = 0.35 \text{ mm} \]

\[ \Delta = 30.56 \text{ mm} \]

\[ \Delta = 13.74 \text{ mm} \]

SLS Wind Load, \[ W_1 = 1.1 \text{ kN/m} \]

SLS Wind Load, \[ W_2 = 0.85 \text{ kN/m} \]

Deflection Checks

\[ (G = W_1 + W_2 + S_1) \]

\[ \Delta = 9.77 \text{ mm} \]

\[ \Delta = 14.94 \text{ mm} \]

\[ \Delta = 0.35 \text{ mm} \]

\[ \Delta = 33.33 \text{ mm} \]

\[ \Delta = 24.00 \text{ mm} \]

Bending Moment Check

\[ M_{w,1} = 34.78 \text{ kNm} \]

\[ \phi_{M_w} = 0.90 \text{ x 1.00 x 1.00 x 1.00 x 1.00} = 68.19 \text{ kNm} \]

\[ Q_{w,1} = 90.92 \text{ kNm} \]

\[ M_{w,1 - 1.5Q} = 52.25 \text{ kNm} \]

\[ \phi_{M_w} = 0.90 \text{ x 1.00 x 1.00 x 1.00 x 1.00} = 90.92 \text{ kNm} \]

\[ Q_{w,1} = 90.92 \text{ kNm} \]

\[ M_{w,1 - 0.75Q} = 34.13 \text{ kNm} \]

\[ \phi_{M_w} = 0.90 \text{ x 1.00 x 1.00 x 1.00 x 1.00} = 90.92 \text{ kNm} \]

\[ Q_{w,1} = 90.92 \text{ kNm} \]

Beam Properties

Beam size

\[ 250UB25.7 \]

Proposed beam

\[ I = 35.4 \times 10^3 \text{ mm}^4 \]

Deflection Checks

\[ (G = W_1 + W_2 + S_1) \]

\[ \Delta = 18.70 \text{ mm} \]

\[ \Delta = 15.44 \text{ mm} \]

\[ \Delta = 36.20 \text{ mm} \]

\[ \Delta = 13.16 \text{ mm} \]

Bending Moment Check

\[ M_{w,1} = 52.44 \text{ kNm} \]

\[ \phi_{M_w} = 92 \text{ kNm} \]

\[ \phi_{Q_{w,1}} = 92 \text{ kNm} \]

Solid block at 1/4 points
**Job Title**: Ideal House  
**25 Reliance Cres, Beachlands**  
**Job No.**: 20249  
**Sheet No.**:  
**Revision**: 1  
**Calcs By**: PFH  
**Date**: 24 Apr 13

### SIMPLY SUPPORTED WITH UNIFORMLY DISTRIBUTED LOAD

**Description**:  
2a. Master bedroom floor beam

**Beam Properties**
- Nominal beam depth: d = 300 mm  
- Nominal beam width: b = 135 mm
- Beam span: L = 5.80 m
- Lateral buckling length for top: l = 0.80 m  
- Lateral buckling length for bottom: l = 0.90 m

**Timber Specification**
- HYNEBEAM 21C
- Moisture content (dry, green)
  - At installation: dry (assumes kiln dried)
  - In service: dry

**Characteristic stresses**
- t_p = 50 MPa
- t_p = 5.0 MPa (in service)
- t_p = 27 MPa

**Modification Factors**
- Total distributed loads
  - g = 20.0 kPa
- q = 5.0 kPa
- Total loads (kN/m)
  - Immediate
    - Medium (live) load: k_l = 0.80
  - Brief: k_b = 1.00
  - Background: k_r = 1.00

**Distributed Loads**

<table>
<thead>
<tr>
<th>Description</th>
<th>G (kPa)</th>
<th>Width (m)</th>
<th>Q (kPa)</th>
<th>Width (m)</th>
<th>y</th>
<th>z</th>
<th>G</th>
<th>Q</th>
<th>Q</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor sw</td>
<td>0.8</td>
<td>2.5</td>
<td>2</td>
<td>2.5</td>
<td>0.7</td>
<td>0.4</td>
<td>2.0</td>
<td>5.0</td>
<td>3.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Roof sw</td>
<td>0.7</td>
<td></td>
<td>0.4</td>
<td></td>
<td>2</td>
<td></td>
<td>4.6</td>
<td>4.6</td>
<td>4.6</td>
<td>4.6</td>
</tr>
<tr>
<td>Wall sw</td>
<td>0.7</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**Other Load Cases**
- S_1 = 6.67
- S_2 = 6.67
- k_l = 1.00

**Deflection**

<table>
<thead>
<tr>
<th>Dead load</th>
<th>Unfactored</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate</td>
<td>with creep</td>
</tr>
<tr>
<td>live load</td>
<td>Long term live load</td>
</tr>
<tr>
<td>Immediate</td>
<td>with creep</td>
</tr>
<tr>
<td>S_1</td>
<td>W_1</td>
</tr>
</tbody>
</table>

**Solid block at 1/4 points**

**Deflection Check**
- (G + Q) < 100 kN/m
  - Immediate: 23.20 mm
  - With creep: 23.20 mm

**Bending Moment Check**
- M_b < 117.7 kNm
  - Immediate: 54.68 kNm
  - With creep: 54.68 kNm

**Steel Beam Alternative**

**Beam Properties**
- Beam size: 200UB22.3
- Proposed beam I = 21 x 10^6 mm^3

**Deflection Check**
- (G + Q) < 100 kN/m
  - Immediate: 23.20 mm
  - With creep: 23.20 mm

**Bending Moment Check**
- M_b < 41.63 kNm
  - Immediate: 66.3 kNm
  - With creep: 66.3 kNm
  - Solid block at 1/4 points
**TIMBER BEAM DESIGN**

**SIMPLY SUPPORTED WITH UNIFORMLY DISTRIBUTED LOAD**

**Description**
2b. Master bedroom load bearing joist check

**Beam Properties**
- Nominal beam depth: d = 200 mm
- Nominal beam width: b = 100 mm
- Beam span: L = 2.40 m
- Lateral buckling length for top: l = 0.90 m
- Lateral buckling length for bottom: l = 0.90 m
- Timber specification: MSG8

**Distributed Loads**
<table>
<thead>
<tr>
<th>Description</th>
<th>G (kPa)</th>
<th>Width (m)</th>
<th>Q (kPa)</th>
<th>Width (m)</th>
<th>V,</th>
<th>y,</th>
<th>G</th>
<th>Q</th>
<th>Q,</th>
<th>Q,</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor sv</td>
<td>0.8</td>
<td>0.45</td>
<td>2</td>
<td>0.45</td>
<td>0.7</td>
<td>0.4</td>
<td>0.36</td>
<td>0.90</td>
<td>0.63</td>
<td>0.36</td>
</tr>
<tr>
<td>Roof sv</td>
<td>1.332</td>
<td>0.42</td>
<td>0.7</td>
<td>0</td>
<td>1.33</td>
<td>0.42</td>
<td>0.29</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall sv</td>
<td>1.08</td>
<td>0.7</td>
<td>0.4</td>
<td>1.08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Loads (kN/m)**
- Floor: 2.41
- Roof: 0.42
- Wall: 0.29

**Point Loads**
<table>
<thead>
<tr>
<th>Description</th>
<th>G (kN)</th>
<th>Q (kN)</th>
<th>V,</th>
<th>y,</th>
<th>G</th>
<th>Q</th>
<th>Q,</th>
<th>Q,</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor sv</td>
<td>1.100</td>
<td>1.665</td>
<td></td>
<td></td>
<td>1.33</td>
<td>0.42</td>
<td>0.29</td>
<td>0.00</td>
</tr>
<tr>
<td>Roof sv</td>
<td>0.850</td>
<td>1.665</td>
<td></td>
<td></td>
<td>1.08</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Modification Factors**
- Select duration of load for deflection (applies to 1.2G + 1.5Q case only)
- K1 = 0.80
- K2 = 1.00
- K3 = 1.00
- K4 = 1.00
- K5 = 1.00
- S1 = 6.16
- K8 = 1.00

**Deflection**
<table>
<thead>
<tr>
<th>Deflection</th>
<th>Dead load</th>
<th>Live load</th>
<th>S,</th>
<th>W,</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate</td>
<td>3.02</td>
<td>0.56</td>
<td>0.00</td>
<td>1.44</td>
</tr>
<tr>
<td>With creep</td>
<td>6.03</td>
<td>0.56</td>
<td>0.00</td>
<td>2.41</td>
</tr>
</tbody>
</table>

**Deflection Checks**
- (G + Q + W, + S,)
- Immediate with creep
- Immediate

**Bending Moment Check**

<table>
<thead>
<tr>
<th>Moment</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1,40</td>
<td>2.37 kN.m</td>
</tr>
<tr>
<td>M1,50</td>
<td>3.38 kN.m</td>
</tr>
<tr>
<td>M1,60</td>
<td>3.59 kN.m</td>
</tr>
</tbody>
</table>

**Shear**

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>V*</td>
</tr>
</tbody>
</table>

**Beam**

<table>
<thead>
<tr>
<th>Beam</th>
<th>200</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** All values are satisfactory.
## Timmer Beam Design

### Simply Supported With Uniformly Distributed Load

#### Description
- Beam: Upper bedroom edge beam.

#### Beam Properties
- Nominal beam depth: d = 245 mm
- Nominal beam width: b = 130 mm
- Beam span: L = 4.50 m
- Lateral building length for top: l = 0.90 m
- Lateral building length for bottom: l = 0.90 m

#### Timber Specification
- Moisture content (dry, green): all installation
- Characteristic stresses: f = 50 MPa at installation
- Usually graded timber: f = 50 MPa in service

#### Distributed Loads
<table>
<thead>
<tr>
<th>Q (kN/m)</th>
<th>Width (m)</th>
<th>Q (kN/m)</th>
<th>Width (m)</th>
<th>Q</th>
<th>Q</th>
<th>Q</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor Sw</td>
<td>0.8</td>
<td>0.4</td>
<td>2</td>
<td>0.4</td>
<td>0.7</td>
<td>0.4</td>
<td>0.32</td>
</tr>
<tr>
<td>Roof Sw</td>
<td>0.84</td>
<td>2.16</td>
<td>0.7</td>
<td>0.48</td>
<td>2.16</td>
<td>1.51</td>
<td>0.04</td>
</tr>
<tr>
<td>Wall Sw</td>
<td>0.7</td>
<td>0.4</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Total Loads (kN/m)
- Dead load + Service (S)
- Dead load + S + LL (medium)

#### Load Combination
- k1 = 0.80
- k2 = 1.00
- Load sharing - parallel support: length of bearing = 100 mm
- Load sharing - grid system: support spacing = 1000 mm

#### Deflection
<table>
<thead>
<tr>
<th></th>
<th>Immediate</th>
<th>With creep</th>
<th>Immediate</th>
<th>With creep</th>
<th>Immediate</th>
<th>With creep</th>
<th>Immediate</th>
<th>With creep</th>
</tr>
</thead>
<tbody>
<tr>
<td>(G + ψ Q + Ws + S)</td>
<td>15.63</td>
<td>33.05</td>
<td>15.77</td>
<td>33.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Deflection Checks
- Dead load + Short term LL: A = 26.67 mm
- Dead load + Long term LL: A = 37.10 mm
- 1/4 Point Load: A = 0.55 mm
- Dead load + Short term LL + Ws: A = 42.20 mm
- Dead load + S: A = 31.26 mm
- Immediate: A = 18.00 mm

#### Bending Moment Check
- M = 43.36 kNm
- M = 85.13 kNm
- M = 48.99 kNm

#### Shear Force
- V = 7.88 kN

### Steel Beam Alternative

#### Beam Properties
- Beam size: 250UB25.7

#### Deflection Checks
- Immediate: A = 13.68 mm
- Immediate: A = 10.54 mm
- Dead load + Short term LL: A = 13.68 mm
- Dead load + S: A = 7.67 mm

#### Bending Moment Check
- M = 85.13 kNm
- φM = 92 kN/m
- φM = 92 kN/m

### Notes
- Steel beam alternative is not satisfactory.
TIMBER BEAM DESIGN
SIMPLY SUPPORTED WITH UNIFORMLY DISTRIBUTED LOAD

Description
4. Window W.001 lintel supporting mezzanine floor joists and roof above

Beam Properties
nominal beam depth
\( d = 250 \text{ mm} \)
nominal beam width
\( b = 100 \text{ mm} \)
beam span
\( L = 2.00 \text{ m} \)
lateral buckling length for top
\( l = 0.90 \text{ m} \)
lateral buckling length for bottom
\( l = 0.90 \text{ m} \)

TIMBER SPECIFICATION
moisture content (dry, green)
at installation = 1 (assumes kiln dried)
in service = 1

characteristic stresses
\( f_b = 14 \text{ MPa} \)
\( E_{lb} = 5.4 \text{ GPa} \)
visually graded timber
\( f_s = 3.8 \text{ MPa} \)
\( E_{lbl} = 5.4 \text{ GPa} \)
\( f_p = 8.9 \text{ MPa} \)

Distributed Loads

<table>
<thead>
<tr>
<th>Description</th>
<th>G (kPa)</th>
<th>Width (m)</th>
<th>Q (kPa)</th>
<th>Width (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor sw</td>
<td>0.8</td>
<td>1.5 2</td>
<td>1.5</td>
<td>0.7 0</td>
</tr>
<tr>
<td>Roof sw</td>
<td>0.00</td>
<td>1.8 0.25</td>
<td>1.8</td>
<td>0.7 0</td>
</tr>
<tr>
<td>Wall sw</td>
<td>0.8</td>
<td>3.4</td>
<td>0.7</td>
<td>0.4 2.72</td>
</tr>
</tbody>
</table>

Total distributed loads
5.54 3.45 2.42 1.20

Modification Factors
select duration of load for strength (applies to 1.2G+1.5Q case only)
k1 = 0.80
select duration of live load for deflection
k2 = 1.00
bearing area factor
length of bearing = 150 mm
k3 = 1.00
load sharing - parallel support
no. elements = 1
k4 = 1.00
load sharing - grid systems
support spacing = 1000 mm
k5 = 1.00
select stability - lateral restraint system
S1 = 7.76
k8 = 1.00

Deflection

\( (G + \psi Q + W_s + S_s) \)

Immediate load

\( \Delta = 2.97 \text{ mm} \)
Limit = 8.00 mm
OK

\( \Delta = 4.58 \text{ mm} \)
Limit = 5.71 mm
OK

\( \Delta = 0.30 \text{ mm} \)
Limit = 5 mm
OK

\( \Delta = 5.57 \text{ mm} \)
Limit = 11.11 mm
OK

\( \Delta = 2.14 \text{ mm} \)
Limit = 8.00 mm
OK

Bending Moment Check

\[ M_{1.4G}^{\text{immediate with creep}} \leq \phi M_n = 0.8 \times 0.6 \times 1 \times 1 \times 1 \times 1 \times 1 = 5.84 \text{ kN m} \]

\[ M_{1.2G + 1.5Q}^{\text{immediate with creep}} \leq \phi M_n = 0.8 \times 0.8 \times 1 \times 1 \times 1 \times 1 \times 1 = 7.78 \text{ kN m} \]

Shear

\[ V^* \leq 11.82 \text{ kN} \]

Beam 250 x 100 is satisfactory
**TIMBER BEAM DESIGN**

SIMPLY SUPPORTED WITH UNIFORMLY DISTRIBUTED LOAD

**Description**

5. Window W.008 lintel to kids living room

**Beam Properties**

- **Nominal beam depth (d):** 300 mm
- **Nominal beam width (b):** 88 mm
- **Beam span:** L = 3.50 m
- **Lateral buckling length for top:** l = 0.90 m
- **Lateral buckling length for bottom:** l = 0.90 m

**Beam Specification**

- **Material:** Select stability - lateral restraint system
- **Load Sharing:** Grid systems
- **Load Sharing:** Parallel support
- **Bearing Area Factor:** 0
- **Select Duration of Load for Strength:** (Applies to 1.2G+1.5Q case only)

**Modification Factors**

- **Other Load Cases:**
  - Wall sw
  - Roof sw
  - Floor sw

- **Description:**
  - Visually graded timber
  - Characteristic Stresses
  - Moisture Content (Dry, Green)
  - Timber Specification
  - Lateral Buckling Length for Top Beam Span
  - Nominal Beam Depth

**Beam Properties**

<table>
<thead>
<tr>
<th>Description</th>
<th>G (kPa)</th>
<th>Width (m)</th>
<th>Q (kPa)</th>
<th>Width (m)</th>
<th>Wl</th>
<th>W</th>
<th>Ws</th>
<th>W</th>
<th>Total Loads (kN/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor sw</td>
<td>0.90</td>
<td>2.2</td>
<td>0.25</td>
<td>2.5</td>
<td>0.7</td>
<td>0.4</td>
<td>1.98</td>
<td>0.63</td>
<td>0.44</td>
</tr>
<tr>
<td>Roof sw</td>
<td>0.8</td>
<td>2.7</td>
<td></td>
<td></td>
<td>0.7</td>
<td>0.4</td>
<td>2.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall sw</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Loads</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.14</td>
</tr>
</tbody>
</table>

**Deflection**

<table>
<thead>
<tr>
<th>Description</th>
<th>Immediate with creep</th>
<th>Unfactored live load</th>
<th>Short term live load immediate with creep</th>
<th>Long term live load immediate with creep</th>
<th>Sn</th>
<th>Wn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead load</td>
<td>4.22 mm</td>
<td>limit = 14.00 mm</td>
<td>OK</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Def. load</td>
<td>7.64 mm</td>
<td>limit = 10.00 mm</td>
<td>OK</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load point load</td>
<td>0.42 mm</td>
<td>limit = 5 mm</td>
<td>OK</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load point load</td>
<td>9.88 mm</td>
<td>limit = 19.44 mm</td>
<td>OK</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load point load</td>
<td>7.64 mm</td>
<td>limit = 14.00 mm</td>
<td>OK</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Bending Moment Check**

- **M<sub>max</sub>**
  - 8.88 kNm
  - 9.04 kNm
  - 7.61 kNm
  - 11.82 kNm

**Shear**

- 10.33 kN

**STEEL BEAM ALTERNATIVE**

<table>
<thead>
<tr>
<th>Beam Properties</th>
<th>Beam size</th>
<th>150UB18.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed beam l</td>
<td>9.05 x 10&lt;sup&gt;3&lt;/sup&gt; mm&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

**Deflection Checks**

<table>
<thead>
<tr>
<th>Description</th>
<th>Immediate with creep</th>
<th>Unfactored live load</th>
<th>Short term live load immediate with creep</th>
<th>Long term live load immediate with creep</th>
<th>Sn</th>
<th>Wn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead load</td>
<td>4.94 mm</td>
<td>limit = 14.00 mm</td>
<td>OK</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Def. load</td>
<td>4.47 mm</td>
<td>limit = 10.00 mm</td>
<td>OK</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load point load</td>
<td>0.40 mm</td>
<td>limit = 5.00 mm</td>
<td>OK</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load point load</td>
<td>7.10 mm</td>
<td>limit = 19.44 mm</td>
<td>OK</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load point load</td>
<td>4.47 mm</td>
<td>limit = 14.00 mm</td>
<td>OK</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Bending Moment Check**

- 7.64 x 10<sup>3</sup> kNm
- 9.04 x 10<sup>3</sup> kNm
- 7.61 x 10<sup>3</sup> kNm
- 11.82 x 10<sup>3</sup> kNm

*Solid block at 1/4 points*
TIMBER BEAM DESIGN
SIMPLY SUPPORTED WITH UNIFORMLY DISTRIBUTED LOAD

Description
6. Bedroom window W.004 lintel, similar for other bedroom windows

Beam Properties
nominal beam depth \( d = 250 \text{ mm} \)
nominal beam width \( b = 100 \text{ mm} \)
beam span \( L = 2.40 \text{ m} \)
lateral buckling length for top \( l = 0.90 \text{ m} \)
lateral buckling length for bottom \( l = 0.90 \text{ m} \)

timber specification
9
moisture content (dry, green) at installation = (assumes kiln dried) in service =
characteristic stresses
\( f_b = 14 \text{ MPa} \) at installation
\( E_b = 5.4 \text{ GPa} \)
visually graded timber
\( f_s = 3.8 \text{ MPa} \) in service
\( E_b = 5.4 \text{ GPa} \)
\( f_p = 8.9 \text{ MPa} \) (default lower bound values used for beams)
\( f_c = 18 \text{ MPa} \)

Distributed Loads

<table>
<thead>
<tr>
<th>Description</th>
<th>G (kPa)</th>
<th>Width (m)</th>
<th>Q (kPa)</th>
<th>Width (m)</th>
<th>L (m)</th>
<th>Q (kN/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor sw</td>
<td>0.7</td>
<td>0.4</td>
<td>0.25</td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof sw</td>
<td>0.8</td>
<td>2.2</td>
<td>0.7</td>
<td>0.4</td>
<td>1.98</td>
<td>0.63</td>
</tr>
<tr>
<td>Wall sw</td>
<td>0.8</td>
<td>2.2</td>
<td>0.7</td>
<td>0.4</td>
<td>1.76</td>
<td>0.44</td>
</tr>
<tr>
<td>total distributed loads</td>
<td>3.74</td>
<td></td>
<td>0.63</td>
<td></td>
<td>0.44</td>
<td>0.00</td>
</tr>
</tbody>
</table>

other load cases

<table>
<thead>
<tr>
<th>Load Case</th>
<th>(kPa)</th>
<th>(m)</th>
<th>(kN/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULS Wind Load, ( W_u )</td>
<td>1.1</td>
<td>1</td>
<td>2.75</td>
</tr>
<tr>
<td>SLS Wind Load, ( W_s )</td>
<td>0.8</td>
<td>2.5</td>
<td>2.00</td>
</tr>
</tbody>
</table>

Modification Factors

<table>
<thead>
<tr>
<th>Description</th>
<th>( k_1 )</th>
<th>( k_2 )</th>
<th>( k_3 )</th>
<th>( k_4 )</th>
<th>( k_5 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>select duration of load for strength (applies to 1.2G+1.5Q case only)</td>
<td></td>
<td></td>
<td>medium (live)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>select duration of live load for deflection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>brief</td>
</tr>
<tr>
<td>bearing area factor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>length of bearing</td>
<td>150</td>
<td></td>
<td></td>
<td></td>
<td>mm</td>
</tr>
<tr>
<td>load sharing - parallel support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>no. elements = 1</td>
</tr>
<tr>
<td>load sharing - grid systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>support spacing = 1000 mm</td>
</tr>
<tr>
<td>select stability - lateral restraint system</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>continous</td>
</tr>
<tr>
<td>S1 = 7.76</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>k8 = 1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Deflection

\[ \Delta = \frac{6}{100 \times 250 \times 100} = 0.00 \text{ mm} \]

\[ \Delta = \frac{6.51 \text{ kN/m}}{53.25 \text{ kN}} = 0.12 \text{ mm} \]

\[ \Delta = \frac{3.77 \text{ kN/m}}{5.84 \text{ kN/m}} = 0.66 \text{ mm} \]

\[ \Delta = \frac{3.91 \text{ kN/m}}{7.78 \text{ kN/m}} = 0.50 \text{ mm} \]

\[ \Delta = \frac{3.23 \text{ kN/m}}{7.78 \text{ kN/m}} = 0.42 \text{ mm} \]

\[ \Delta = \frac{5.21 \text{ kN/m}}{9.73 \text{ kN/m}} = 0.53 \text{ mm} \]

\[ \Delta = \frac{6.51 \text{ kN/m}}{53.25 \text{ kN/m}} = 0.12 \text{ mm} \]

Beam 250 X 100 is satisfactory
TIMBER BEAM DESIGN
SIMPLY SUPPORTED WITH UNIFORMLY DISTRIBUTED LOAD

Description
7. Master bedroom window W.13 lintel supporting roof

Beam Properties
nominal beam depth \(d = 250\, \text{mm}\)
nominal beam width \(b = 100\, \text{mm}\)
beam span \(L = 2.40\, \text{m}\)
lateral buckling length for top \(l_1 = 0.90\, \text{m}\)
lateral buckling length for bottom \(l_1 = 0.90\, \text{m}\)

Timber Specification
Moisture content (dry, green)
at installation \(\text{dry}\) (assumes kiln dried)
in service \(\text{dry}\)

Characteristic Stresses
fully graded timber
at installation \(f_b = 14\, \text{MPa}\)
in service \(f_b = 8.9\, \text{MPa}\)
visually graded timber
at installation \(f_s = 3.8\, \text{MPa}\)
in service \(f_s = 8.9\, \text{MPa}\)

Distributed Loads

<table>
<thead>
<tr>
<th>Description</th>
<th>(G) (kN/m)</th>
<th>Width (m)</th>
<th>(Q) (kN/m)</th>
<th>Width (m)</th>
<th>(y_s)</th>
<th>(y_l)</th>
<th>(G)</th>
<th>(Q)</th>
<th>(Q_s)</th>
<th>(Q_l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor sw</td>
<td>0.7</td>
<td>0.4</td>
<td>0.25</td>
<td>1.8</td>
<td>0.7</td>
<td>0.4</td>
<td>1.62</td>
<td>0.45</td>
<td>0.32</td>
<td>0.00</td>
</tr>
<tr>
<td>Wall sw</td>
<td>0.8</td>
<td>1.2</td>
<td>0.25</td>
<td>1.8</td>
<td>0.7</td>
<td>0.4</td>
<td>0.96</td>
<td>0.45</td>
<td>0.32</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Total distributed loads
2.58

Other Load Cases
ULS Wind Load, \(W_u = 1.1\) \(1.8\, \text{kN/m}\)
SLS Wind Load, \(W_s = 0.8\) \(1.8\, \text{kN/m}\)

Modification Factors
select duration of load for strength (applies to 1.2G + 1.5Q case only) \(k_1 = 0.80\)
space duration of live load for deflection \(k_2 = 1.00\)
Length of bearing \(150\, \text{mm}\)

Stability - lateral restraint system

Deflection

<table>
<thead>
<tr>
<th>Deflection Checks</th>
<th>((G + \phi Q + W_u + S_u))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead load + Short term LL ( \Delta = 2.24, \text{mm})</td>
<td>limit = 9.60 mm</td>
</tr>
<tr>
<td>Dead load + Long term LL ( \Delta = 3.99, \text{mm})</td>
<td>limit = 6.86 mm</td>
</tr>
<tr>
<td>1kN Point Load ( \Delta = 0.52, \text{mm})</td>
<td>limit = 5 mm</td>
</tr>
<tr>
<td>Dead load + Short term LL + (W_u) ( \Delta = 5.35, \text{mm})</td>
<td>limit = 13.33 mm</td>
</tr>
<tr>
<td>Dead load + (S_u) ( \Delta = 3.99, \text{mm})</td>
<td>limit = 9.60 mm</td>
</tr>
</tbody>
</table>

Bending Moment Check
\n
Shear
\(V^* = 4.53\, \text{kN}\) | limit = 53.25 kN | OK |

Beam 250 x 100 is satisfactory
TIMBER BEAM DESIGN
SIMPLY SUPPORTED WITH UNIFORMLY DISTRIBUTED LOAD

Description
B. Main deck window D.006 and D.007 lintel

Beam Properties
nominal beam depth d = 300 mm
nominal beam width b = 100 mm
beam span L = 3.00 m
lateral buckling length for top L = 0.90 m
lateral buckling length for bottom L = 0.90 m

timber specification

moisture content (dry, green)
at installation = dry (assumes kiln dried)
in service = dry

characteristic stresses

at installation
Es = 5.4 GPa

in service
Es = 5.4 GPa

visually graded timber

f_b = 14 MPa
E_lbs = 5.4 GPa

f_s = 3.8 MPa
E_lbl = 5.4 GPa

f_p = 8.9 MPa
(flat lower bound values used for beams)

f_c = 18 MPa

Distributed Loads

<table>
<thead>
<tr>
<th>Description</th>
<th>G (kPa)</th>
<th>Width (m)</th>
<th>Q (kPa)</th>
<th>Width (m)</th>
<th>y_s</th>
<th>y_l</th>
<th>G</th>
<th>Q</th>
<th>Q_s</th>
<th>Q_l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor sw</td>
<td>0.00</td>
<td>3.2</td>
<td>0.25</td>
<td>3.2</td>
<td>0.7</td>
<td>0.4</td>
<td>2.88</td>
<td>0.80</td>
<td>0.56</td>
<td>0.00</td>
</tr>
<tr>
<td>Wall sw</td>
<td>0.8</td>
<td>0.3</td>
<td>0.7</td>
<td>0.4</td>
<td>0.24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total distributed loads 3.12 0.80 0.56 0.00

other load cases

ULS Wind Load, W_u = 1.1 3.2 W_u = 3.52
SLS Wind Load, W_s = 0.85 3.2 W_s = 2.72

Modification Factors

bearings area factor
length of bearing = 156 mm
k3 = 1.00

load sharing - parallel support
no. elements = 1
k4 = 1.00

load sharing - grid systems
support spacing = 1000 mm
k5 = 1.00

select stability - lateral restraint system
S1 = 9.36
k8 = 1.00

Deflection

Dead load immediate with creep | Unfactored with live load | Short term live load | Long term live load Immediate with creep | S_s Immediate | W_s Immediate
3.36 6.72 0.86 0.60 0.00 0.00 2.93

Deflection Checks

(G + \psi Q + W_s + S_s)

Dead load + Short term LL A = 3.97 mm limit = 12.00 mm OK

Dead load + Long term LL A = 6.72 mm limit = 8.57 mm OK

1kN Point Load A = 0.57 mm limit = 5 mm OK

Dead load + Short term LL + W_s A = 10.26 mm limit = 16.67 mm OK

Dead load + S_s A = 6.72 mm limit = 12.00 mm OK

Bending Moment Check

M*_{1.2G + Q} = 4.91 kN.m < \phi M_s = 0.8 x 0.6 x 1 x 1.00 x 1.0 x 1 x 1.263 = 8.49 kN.m
M*_{1.2G + Q} = 5.56 kN.m < \phi M_s = 0.8 x 0.6 x 1 x 1.00 x 1.0 x 1 x 1.263 = 11.32 kN.m
M*_{1.2G + Q} = 4.21 kN.m < \phi M_s = 0.8 x 0.8 x 1 x 1.00 x 1.0 x 1 x 1.263 = 11.32 kN.m
M*_{1.2G + Q} = 8.17 kN.m < \phi M_s = 0.8 x 1 x 1 x 1.00 x 1.0 x 1 x 1.263 = 14.15 kN.m

Shear
V* = 7.42 kN < \phi V_s = 0.8 x 0.5 x 1 x 1.00 x 3.8 x 26404 / 1000 = 64.21 kN OK

Beam 300 X 100 is satisfactory
Timber Beam Design

Simply supported with uniformly distributed load

Description
- 9. Canopy beam, supports shade screen above

Beam Properties
- Nominal beam depth: d = 300 mm
- Nominal beam width: b = 100 mm
- Beam span: L = 6.00 m
- Lateral/buckling length for top: l = 6.00 m
- Lateral/buckling length for bottom: l = 6.00 m

Timber Specification
- MSGB
- Moisture content (dry, green): at installation = dry (assumes kiln dried)

Characteristic Stresses
- Characteristic stress: fck = 14 MPa
- Characteristic stress: fck = 3.8 MPa
- Characteristic stress: fck = 8.9 MPa
- Characteristic stress: fck = 18 MPa

Pitch Plate Properties
- Plate depth: d = 285 mm
- Plate thickness: t = 8 mm

Deflection
- 8.02 kN < qL = 0.8 x 0.8 x 1.0 x 1.0 x 1.0 x 14 x 5.274 = 35.44 kNm
- 12.85 kNm < Mxx = 0.8 x 0.6 x 1.0 x 1.0 x 1.0 x 14 x 5.274 = 93.24 kNm
- 12.03 kNm < Mxx = 0.8 x 0.8 x 1.0 x 1.0 x 1.0 x 14 x 5.274 = 47.26 kNm
- 11.02 kNm < Mxx = 0.8 x 0.6 x 1.0 x 1.0 x 1.0 x 14 x 5.274 = 47.26 kNm
- 13.99 kNm < Mxx = 0.8 x 1.0 x 1.0 x 1.0 x 1.0 x 14 x 5.274 = 59.07 kNm

Shear
- 8.02 kN < qL = 0.8 x 0.8 x 1.0 x 1.0 x 3.8 x 28404 / 1000 = 64.21 kN

Bending Moment Check
- 24.00 mm < limit = 24.00 mm
- 17.14 mm < limit = 17.14 mm
- 3.00 mm < limit = 3.00 mm
- 24.00 mm < limit = 24.00 mm
- 24.00 mm < limit = 24.00 mm

Steel Beam Alternative

Beam Properties
- Beam size = 150UB18.0

Deflection Checks
- 4.81 mm < limit = 24.00 mm
- 4.58 mm < limit = 17.14 mm
- 5.96 mm < limit = 5.96 mm
- 4.58 mm < limit = 24.00 mm

Bending Moment Check
- 13.99 kNm
- 140 kNm
- 93.6 kNm

Date: 22 May 13

PFH
20249
25 Reliance Cres, Beachlands
**TIMBER BEAM DESIGN**
SIMPLY SUPPORTED WITH UNIFORM DILUTELY DISTRIBUTED LOAD

**Description**
10. Canopy beams to front edge

**Beam Properties**
- nominal beam depth: \( d = 250 \text{ mm} \)
- nominal beam width: \( b = 100 \text{ mm} \)
- beam span: \( L = 3.00 \text{ m} \)
- lateral buckling length for top: \( l_1 = 0.90 \text{ m} \)
- lateral buckling length for bottom: \( l_2 = 0.90 \text{ m} \)

**timber specification**
- moisture content (dry, green)
  - at installation: \( f_b = 14 \text{ MPa} \)
  - in service: \( f_b = 14 \text{ MPa} \)
- characteristic stresses
  - at installation: \( E_{ls} = 5.4 \text{ GPa} \)
  - in service: \( E_{ls} = 4.4 \text{ GPa} \)

**Distributed Loads**

<table>
<thead>
<tr>
<th>Description</th>
<th>( G ) (kPa)</th>
<th>Width (m)</th>
<th>( Q ) (kPa)</th>
<th>Width (m)</th>
<th>( y_s )</th>
<th>( y_l )</th>
<th>( G )</th>
<th>( Q )</th>
<th>( Q_s )</th>
<th>( Q_l )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor sw</td>
<td>0.90</td>
<td>1.5</td>
<td>0.25</td>
<td>1.5</td>
<td>0.7</td>
<td>0.4</td>
<td>1.35</td>
<td>0.38</td>
<td>0.26</td>
<td>0.00</td>
</tr>
<tr>
<td>Wall sw</td>
<td>0.90</td>
<td>1.5</td>
<td>0.25</td>
<td>1.5</td>
<td>0.7</td>
<td>0.4</td>
<td>1.35</td>
<td>0.38</td>
<td>0.26</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>1.35</td>
<td>0.38</td>
<td>0.26</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Modification Factors**
- select duration of load for strength (applies to 1.2*G+1.5*Q case only)
- select duration of live load for deflection
- bearing area factor
- load sharing - parallel support
- load sharing - grid systems
- select stability - lateral restraint system

**Deflection**

<table>
<thead>
<tr>
<th>(G + ( \psi Q ) + ( W_s ))</th>
<th>Dead load + Short term LL</th>
<th>( \Delta )</th>
<th>limit</th>
<th>( S_s )</th>
<th>( W_s )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate</td>
<td>2.55</td>
<td>5.10</td>
<td>0.71</td>
<td>0.60</td>
<td>0.00</td>
</tr>
<tr>
<td>Immediate</td>
<td>Unfactored</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediate</td>
<td>Medium (live)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediate</td>
<td>Brief</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediate</td>
<td>Continuous</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Bending Moment Check**

- \( M_{\text{ub}} \) = 2.13 kN.m \( < \) \( M_{\text{ub}} = 0.8 \times 0.6 \times 1 \times 1.00 \times 1.0 \times 14 \times 869 = 5.84 \text{ kN.m} \) OK
- \( M_{\text{ub}} \) = 2.13 kN.m \( < \) \( M_{\text{ub}} = 0.8 \times 0.6 \times 1 \times 1.00 \times 1.0 \times 14 \times 869 = 5.84 \text{ kN.m} \) OK
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- \( M_{\text{ub}} \) = 2.13 kN.m \( < \) \( M_{\text{ub}} = 0.8 \times 0.6 \times 1 \times 1.00 \times 1.0 \times 14 \times 869 = 5.84 \text{ kN.m} \) OK

**Shear**

- \( V^* \) = 3.27 kN \( < \) \( V^* = 0.8 \times 0.6 \times 1 \times 1.00 \times 3.8 \times 21896 / 1000 = 53.25 \text{ kN} \) OK

**Beam**
- 250 x 100

is satisfactory
TIMBER BEAM DESIGN
SIMPLY SUPPORTED WITH UNIFORMLY DISTRIBUTED LOAD

Description
1. Garage window lintel

Beam Properties
nominal beam depth
\( d = 300 \text{ mm} \)
nominal beam width
\( b = 88 \text{ mm} \)
beam span
\( L = 3.00 \text{ m} \)
lateral buckling length for top
\( l = 0.90 \text{ m} \)
lateral buckling length for bottom
\( l = 0.90 \text{ m} \)

timber specification
[8-Built J90]

- moisture content (dry, green) at installation = dry
- assumes kiln dried
- in service = dry

characteristic stresses
\( f_p = 42 \text{ MPa} \)

visually graded timber
\( f_p = 3.8 \text{ MPa} \)

- select duration of live load for deflection
- select duration of load for strength (applies to 1.2G + 1.5Q case only)

Modification Factors
- other load cases
- total distributed loads

Distributed Loads
- visually graded timber
- characteristic stresses
- moisture content (dry, green)

Roof sw
Floor sw

description
- Distributed Loads
- characteristic stresses
- moisture content (dry, green)

Distributed Loads

<table>
<thead>
<tr>
<th>Description</th>
<th>Q (kPa)</th>
<th>Width (m)</th>
<th>Q (kPa)</th>
<th>Width (m)</th>
<th>( y )</th>
<th>( Q )</th>
<th>( Q )</th>
<th>( Q )</th>
<th>( Q )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof sw</td>
<td>0.90</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>0.7</td>
<td>0.7</td>
<td>6</td>
<td>2.70</td>
<td>6.00</td>
</tr>
<tr>
<td>Dead load</td>
<td>0.7</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>total distributed loads</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.70</td>
<td>6.00</td>
<td>4.00</td>
<td>0.00</td>
<td></td>
</tr>
</tbody>
</table>

other load cases
- total distributed loads

Modification Factors
- select duration of live load for deflection
- select duration of load for strength (applies to 1.2G + 1.5Q case only)
- bearing area factor
- length of bearing
- load sharing - parallel support

Deflection
- Deflection Checks
- Bending Moment Check
- Shear

Deflection Checks

<table>
<thead>
<tr>
<th>( \Delta )</th>
<th>immediate</th>
<th>with creep</th>
<th>Immediate</th>
<th>Immediate</th>
<th>Long term live load</th>
<th>Immediate</th>
<th>Immediate</th>
<th>Immediate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead load + Short term LL</td>
<td>3.43 mm</td>
<td>limit = 12.00 mm</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead load + Long term LL</td>
<td>2.69 mm</td>
<td>limit = 8.57 mm</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Point Load</td>
<td>0.27 mm</td>
<td>limit = 5 mm</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead load + Short term LL + ( W_s )</td>
<td>6.05 mm</td>
<td>limit = 16.67 mm</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead load + ( S_L )</td>
<td>2.69 mm</td>
<td>limit = 12.00 mm</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bending Moment Check

<table>
<thead>
<tr>
<th>( M_{\text{max}} )</th>
<th>( kN.m )</th>
<th>|</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead load + Short term LL</td>
<td>4.20 kN.m</td>
<td>&lt;</td>
<td>( M_{\text{max}} = 0.9 \times 0.6 \times 1 \times 1.0 \times 1.0 \times 1.0 = 30.65 \text{ kN.m} )</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead load + Long term LL</td>
<td>13.77 kN.m</td>
<td>&lt;</td>
<td>( M_{\text{max}} = 0.9 \times 0.6 \times 1 \times 1.0 \times 1.0 \times 1.0 = 40.87 \text{ kN.m} )</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead load + Short term LL + ( W_s )</td>
<td>3.65 kN.m</td>
<td>&lt;</td>
<td>( M_{\text{max}} = 0.9 \times 0.6 \times 1 \times 1.0 \times 1.0 \times 1.0 = 40.87 \text{ kN.m} )</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead load + ( S_L )</td>
<td>7.38 kN.m</td>
<td>&lt;</td>
<td>( M_{\text{max}} = 0.9 \times 0.6 \times 1 \times 1.0 \times 1.0 \times 1.0 = 51.09 \text{ kN.m} )</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Shear

<table>
<thead>
<tr>
<th>( V^* )</th>
<th>( kN )</th>
<th>|</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead load + Short term LL</td>
<td>18.36 kN</td>
<td>&lt;</td>
<td>( V_{\text{max}} = 0.9 \times 0.6 \times 1 \times 1.0 \times 3.8 \times 26400 / 1000 = 64.20 \text{ kN} )</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

STEEL BEAM ALTERNATIVE

Beam Properties
- Beam size = 150UB18.0
- Proposed beam I = 9.06 x 10^3 mm^4

Deflection Checks

<table>
<thead>
<tr>
<th>( \Delta )</th>
<th>immediate</th>
<th>with creep</th>
<th>Immediate</th>
<th>Immediate</th>
<th>Long term live load</th>
<th>Immediate</th>
<th>Immediate</th>
<th>Immediate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead load + Short term LL</td>
<td>4.02 mm</td>
<td>limit = 12.00 mm</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead load + Long term LL</td>
<td>1.57 mm</td>
<td>limit = 8.57 mm</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Point Load</td>
<td>0.31 mm</td>
<td>limit = 5.00 mm</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead load + Short term LL + ( W_s )</td>
<td>5.51 mm</td>
<td>limit = 16.67 mm</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead load + ( S_L )</td>
<td>1.57 mm</td>
<td>limit = 12.00 mm</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bending Moment Check

<table>
<thead>
<tr>
<th>( M_{\text{max}}^* )</th>
<th>( kN.m )</th>
<th>|</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead load + Short term LL</td>
<td>13.77 kN.m</td>
<td>&lt;</td>
<td>( M_{\text{max}} = 140 \text{ kN.m} )</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead load + Long term LL</td>
<td>93.6 kN.m</td>
<td>&lt;</td>
<td>( M_{\text{max}} = 93.6 \text{ kN.m} )</td>
<td>OK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Solid block at 1/4 points
TIMBER BEAM DESIGN
SIMPLY SUPPORTED WITH UNIFORMLY DISTRIBUTED LOAD

Description
12. Canopy beam to back of garage

Beam Properties
nominal beam depth d = 250 mm
nominal beam width b = 150
beam span L = 3.80 m
lateral buckling length for top l = 0.90 m
lateral buckling length for bottom i = 0.90

Timber Specification
at installation = dry (assumes kiln dried)
in service = green

characteristic stresses
f_b = 14 MPa at installation
E = 5.4
visually graded timber
f_s = 3.8 MPa in service
E = 4.4
f_p = 8.9 MPa (default lower bound values used for beams)
f_c = 18 MPa

Distributed Loads
<table>
<thead>
<tr>
<th>Description</th>
<th>G (kPa)</th>
<th>Width (m)</th>
<th>Q (kPa)</th>
<th>Width (m)</th>
<th>k1</th>
<th>k2</th>
<th>k3</th>
<th>k4</th>
<th>k5</th>
<th>k8</th>
<th>total loads (kN/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor sw</td>
<td>0.7</td>
<td>0.4</td>
<td>0.25</td>
<td>1.5</td>
<td>1.35</td>
<td>0.38</td>
<td>0.26</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>0.7</td>
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<td>0.38</td>
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<tr>
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<td>0.38</td>
<td>0.26</td>
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<td>Total</td>
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<td>0.38</td>
<td>0.26</td>
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</tbody>
</table>

other load cases
ULS Wind Load, W_u = 1.1
SLS Wind Load, W_s = 0.85

Modification Factors
k1 = 0.80
k2 = 1.00
k3 = 1.00
k4 = 1.00
k5 = 1.00
k8 = 1.00

Deflection Checks
(G + ψ Q + W_s + S_s)

Dead load + Short term LL
Δ = 5.15 mm limit = 15.20 mm

Dead load + Long term LL
Δ = 8.63 mm limit = 10.86 mm

1kN Point Load
Δ = 1.35 mm limit = 5 mm

Dead load + Short term LL + W_s
Δ = 14.47 mm limit = 21.11 mm

Dead load + S_s
Δ = 8.63 mm limit = 15.20 mm

Bending Moment Check
M* = 3.41 kN.m < 8.88 kN.m
M* = 3.94 kN.m < 11.84 kN.m
M* = 2.92 kN.m < 11.84 kN.m
M* = 5.90 kN.m < 14.80 kN.m

Shear V* = 4.15 kN < 81.03 kN

Beam 250 X 150 is satisfactory
3. **INSTRUCTION REGIME**

The house should not generally require inspection by a Structural Engineer. A copy of the Building Consent conditions are to be provided to any inspecting engineer and GreenBeing prior to the commencement of work on site to ensure they are aware of the obligations.

Checks would possibly be required for:

1. Ground bearing capacity check
4. STRUCTURAL SKETCHES

S1  Foundation plan
S2  First floor framing plan
S3  Roof framing plan
S4  Typical floor edge detail
S5  Load bearing wall footing
S6  Interfloor detail
S7  Stud strap brace connection
S8  Stud to UB connection
S9  Joist connection
S10 SHS to floor slab
S11 Steel beam connection
S12 Steel post connection
S13 Bracing plans
Refer to Wilton Joubert design for Rib Raft slab floor details.
Details S4 and S5 have been deleted.

Notes:
1. Check all dimensions on site.
2. All drawings to be read in conjunction with the Specification.
1. Hyne LVL 24x48x94
   at 280mm C/C
   (25uW)

2. 110x90x8 45x45c
   from load bearing
   wall above
   mark left red

3. 360x190 x 190
   I-Bent
   I-Beam
   at 190cm
   2 lines of
   blocking

Sheathing with
nailers on top
of rafters/flooring

Revision History

1. Check all dimensions on site.
2. All drawings to be read in conjunction with the Specification.
240 x 10 I-Built I Beans at 900mm CRS

Notes:
1. Check all dimensions on site.
2. All drawings to be read in conjunction with the Specification.
INTERFLOOR DETAIL
1:100

RAB Board
Bracing units

INTELLO Vapour Check

Floor joists, refer s2

Balloon Frame 90x45 studs
STUD STRAP BRACE CONNECTION
1:10

- Engineered HYPEBEAM or SBR, ref plans

25 x 1 strap brace
continuous, fully nail to timbers & stud

90 x 90 solid timber or
2 x 90 x 45 timbers
well nailed together
STUD TO UB CONNECTION
1:10

6mm end cap, 6mm fwar

UB to solid bear onto
timber studs

80 x 6 flat, 6 fwar centrally
to PFC

2 - ø14 holes for M12 bolts,
provide 35 x 35 x 3 flat washers
to all timber faces

2 - 90 x 45 timbers neatly
checked out to house 6mm
flat, well nailed together
JOIST CONNECTION
1:10

proprietary joist hangers, fully nail to timbers & joists

continuous solid timber plates with Ø14 holes for M12 bolts at 800

crs. provide 35 x 35 x 3 flat washers to all timber faces
SHS TO FLOOR
1:10

2 - ø18 holes for DP16110 Dynabolts

x 10 base plate, 6 far to post
STEEL BEAM CONNECTION

200UB shown hatched
Some connections at 250UB

150x80x6mm web side cleat
2 - M20 4½ bolts at 70mm c/c
6mm FVWR
STEEL POST CONNECTION

Seal plate

250x825 connection sim to sill
Slot cleat through SHS.

89x6 SHS

Post positioned inside
airtightness layer
in timber return wall.
1. Check all dimensions on site.
2. All drawings to be read in conjunction with the Specification.
## Demand Calculation Sheet

**single storey**

### Job Details

<table>
<thead>
<tr>
<th>Details</th>
<th>Details</th>
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<tbody>
<tr>
<td>Name</td>
<td>iDeal Home</td>
</tr>
<tr>
<td>Street and Number</td>
<td>35 Reliance Crescent</td>
</tr>
<tr>
<td>Lot and DP Number</td>
<td>Beachlands</td>
</tr>
<tr>
<td>City/Town/District</td>
<td>Auckland</td>
</tr>
<tr>
<td>Designer</td>
<td>Green Being Ltd</td>
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<tr>
<td>Company Name</td>
<td>Green Being Ltd</td>
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<tr>
<td>Date</td>
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### Building Specification

**Number of storeys**: single  
**Floor Loading**: 3kPa  
**Foundation Type**: slab  

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<tr>
<th>Specification</th>
<th>Single Floor</th>
<th>Column only</th>
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<tr>
<td>Cladding Weight</td>
<td>light</td>
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<tr>
<td>Roof Weight</td>
<td>light</td>
<td></td>
</tr>
<tr>
<td>Room in Roof Space</td>
<td>25 to 37.5%</td>
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<tr>
<td>Roof Pitch (degrees)</td>
<td>5</td>
<td></td>
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<tr>
<td>Roof height above eaves (m)</td>
<td>0.2</td>
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<tr>
<td>Building height to apex (m)</td>
<td>6.4</td>
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<tr>
<td>Ground to lower floor level (m)</td>
<td>0.3</td>
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</table>

| Specification                  |             |             |
| Stud Height (m)                | 2.6         |             |
| Building Length (m)            | 26.6        |             |
| Building Width (m)             | 13.6        |             |
| Building Plan Area (m²)        | 203         |             |

### Building Location

**Wind Zone**: High  
**Earthquake Zone**:  
**Soil Type**: D&E (deep to very)  
**Annual exceedance probability**: 1/500 (NZS3604:2011 default)

| Site Exposure                  | Urban       |
| Site Exposure                  | Exposed     |
| Topographic Class              | T3          |

### Bracing Units required for Wind

<table>
<thead>
<tr>
<th>Demand W (BU)</th>
<th>920</th>
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<tr>
<td>Walls single</td>
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<tr>
<td>along slab</td>
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<tr>
<td>across slab</td>
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### Bracing Units required for Earthquake

<table>
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<tr>
<th>Demand along / across E (BU)</th>
<th>1192</th>
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<tr>
<td>Walls single</td>
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<tr>
<td>slab</td>
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## Single or Upper Storey Walls Along

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<tr>
<td>819</td>
<td>B</td>
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<td>689</td>
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<tr>
<td>222</td>
<td>D</td>
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</table>

### Wind Earthq.

- **Totals Achieved**
  - W: 248%
  - EQ: 169%
  - **Total**: 2283
  - **Total**: 2014

- **Concrete Slab**
  - OK
  - OK

- **Totals Required (from Demand)**
  - 920
  - 1192
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<th>3</th>
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<td>RAB™</td>
<td>139</td>
<td>117</td>
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</table>

Wind Earthq. Totals Achieved W 121% EQ 160% 2099 1912
Concrete Slab OK OK
Totals Required (from Demand) 1741 1192
PRODUCER STATEMENT - DESIGN

ISSUED BY: GREEN BEING LTD
(Design Firm)

TO: MURRAY DURBIN
(Building Consent Applicant)

SUPPLIED TO: AUCKLAND CITY COUNCIL
(Building Consent Authority)

IN RESPECT OF: STRUCTURAL DESIGN OF NEW RESIDENTIAL DWELLING
(Description of Building Work)

AT: 23 RELIANCE CRESENT BEAUCHLANDS, AUCKLAND
(Address)

LEGAL DESCRIPTION: LOT 35 LT 449888

GreenBeing Ltd has been engaged by PALLADIUM HOMES LTD to provide Structural Engineering services in respect of the requirements of clause B1 of the Building Code for:

PART ONLY

of the proposed building work.

The design carried out by us has been prepared in accordance with:

Compliance Documents issued by Department of Building and Housing:

B1/VM1, NZS3404:1997 (steel), NZS3101:2006 (concrete), NZS3603:1993(timber), and

Compliance with B2 is achieved on the following specific items using the standards noted below.

- Steel members – coatings in accordance with the specification to AS/NZS2312
- Concrete members – covers in accordance with the specification to NZS3101

The proposed building work covered by this producer statement is described on the GreenBeing Ltd drawings titled: iDEAL House and numbered 20249 S1 to S13 inclusive together with the specification, and other documents set out in the schedule attached to this statement.

On behalf of GreenBeing Ltd and subject to:

(i) the site verification of the following design assumptions: that the ultimate soil bearing pressure under all foundations is 300kPa, and

(ii) all proprietary products meeting the performance specification requirements;

I BELIEVE ON REASONABLE GROUNDS the building, if constructed in accordance with the drawings, specifications, and other documents provided or listed in the attached schedule, will comply with the relevant provisions of the Building Code.

I, PAULA FRANCISCA HUGENS CPEng no. 250441
I am a member of IPENZ and hold the following qualifications BE (Civil), MIPENZ, CPEng, IntPE

GreenBeing Ltd issuing this statement holds a current policy of Professional Indemnity Insurance no less than $200,000*.

GreenBeing Ltd is NOT a member of ACENZ.

SIGNED BY PAULA FRANCISCA HUGENS ON BEHALF OF GREEN BEING LTD.

22 May 2013
(Date)

Signature

Note: This statement shall only be relied upon by the Building Consent Authority named above. Liability under this statement accrues to the Design Firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in contract, tort or otherwise (including negligence), is limited to the sum of $200,000*.

This form is to accompany Form 2 of the Building (Forms) Regulations 2004 for the application of a Building Consent.
GUIDANCE ON USE OF PRODUCER STATEMENTS

Producer statements were first introduced with the Building Act 1992. The producer statements were developed by a combined task committee consisting of members of the New Zealand Institute of Architects, Institution of Professional Engineers New Zealand, and Association of Consulting Engineers New Zealand in consultation with the Building Officials Institute of New Zealand. The original suite of producer statements has been revised at the date of the form as a result of enactment of the Building Act (2004) by these organisations to ensure standards use within the industry.

The producer statement system is intended to provide Build Consent Authorities (BCAs) with reasonable grounds for the issue of a Building Consent or a Code of Compliance Certificate, without having to duplicate design or construction checking undertaken by others.

Four producer statements are available and brief details on the purpose of each are as follows:-

**PS1 Design:** Intended for use by a suitably qualified independent design professional in circumstances where the BCA accepts a producer statement for establishing reasonable grounds to issue a Building Consent.

**PS2 Design Review:** Intended for use by a suitably qualified independent design professional where the BCA accepts an independent design professional’s review as the basis for establishing reasonable grounds to issue a Building Consent.

**PS3 Construction:** Forms commonly used as a certificate of completion of building work are Schedule 6 of NZS 3910:2003 or schedules E1/E2 of NZIA’s SCC 2007.

**PS4 Construction Review** Intended for use by a suitably qualified independent design professional who undertakes construction monitoring of the building works where the BCA requests a producer statement prior to issuing a Code Compliance Certificate. This must be accompanied by a statement of completion of building work (Schedule 6).

The following guidelines are provided by ACENZ, IPENZ and NZIA to interpret the Producer Statement.

**Competence of Design Professional**
This statement is made by a Design firm that has undertaken a contract of services for the services named, and is signed by a person authorised by that firm to verify the processes within the firm and competence of its designers.

A competent design professional will have a professional qualification and proven current competence through registration on a national competence-based register, either as a Chartered Professional Engineer (CPEng) or a Registered Architect.

Membership of a professional body, such as the Institution of Professional Engineers New Zealand (IPENZ) or the New Zealand Institute of Architects (NZIA), provides additional assurance of the designer’s standing within the profession. If the design firm is a member of the Association of Consulting Engineers New Zealand (ACENZ), this provides additional assurance about the standing of the firm.

Persons or firms meeting these criteria satisfy the term “suitably qualified design professional”.

* **Professional Indemnity Insurance**
As part of membership requirements, ACENZ requires all member firms to hold Professional Indemnity Insurance to a minimum level.

The PI insurance minimum stated on the front of this form reflects standard, small projects. If the parties deem this inappropriate for large projects the minimum may be up to $500,000.

**Professional Services during Construction Phase**
There are several levels of service which a Design Firm may provide during the construction phase of a project. (CM1-CM5) (OL1-OL4). The Building Consent Authority is encouraged to require that the service to be provided by the Design Firm is appropriate for the project concerned.

**Requirement to provide Producer Statement PS4**
Building Consent Authorities should ensure that the applicant is aware of any requirement to provide producer statements for the construction phase of building work at the time the building consent is issued as no design professional should be expected to provide a producer statement unless such a requirement forms part of the Design Firm’s engagement.

**Attached Particulars**
Attached particulars referred to in this producer statement refer to supplementary information appended to the producer statement.

**Refer Also:**
Form 2A

Memorandum from licensed building practitioner of design work:

CERTIFICATE OF DESIGN
Section 30C or section 45, Building Act 2004

The building
Street address of building:

23 Reliance Crescent Beachlands, Auckland

The owner
Name: Murray Durbin
Address: C/- S3 Architects
Telephone number: 09 638 9062
Email address: matt@s3a.co.nz

Identification of design work that is restricted building work
I carried out or supervised the following design work that is restricted building work:

<table>
<thead>
<tr>
<th>Design work that is restricted building work</th>
<th>Description</th>
<th>Carried out/ supervised</th>
<th>Reference to plans and specifications</th>
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<tbody>
<tr>
<td>[Tick]</td>
<td>[If appropriate, provide details of the restricted building work]</td>
<td>[Specify whether you carried out this design work or supervised someone else carrying out this design work]</td>
<td>[If appropriate, specify references]</td>
</tr>
<tr>
<td>Primary structure</td>
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</tr>
<tr>
<td>Foundations and subfloor framing (-)</td>
<td>Strip footings, concrete slab on grade</td>
<td>( ) Carried out ( ) Supervised</td>
<td>By others</td>
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<tr>
<td>Walls (X)</td>
<td>Timber framed</td>
<td>(X) Carried out ( ) Supervised</td>
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<tr>
<td>Roof (-)</td>
<td>Timber framed, proprietary I beams</td>
<td>(X) Carried out ( ) Supervised</td>
<td>S3</td>
</tr>
<tr>
<td>Columns and beams (X)</td>
<td>Timber and steel beams and posts</td>
<td>(X) Carried out ( ) Supervised</td>
<td>S1, S2, S3</td>
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<tr>
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<td>NZS3604 bracing</td>
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Note: continue on another page if necessary.
Are waivers or modifications of the building code required? ( ) Yes (X) No

If Yes, provide details of the waivers or modifications below:

<table>
<thead>
<tr>
<th>Clause</th>
<th>Waiver/modification required</th>
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<tbody>
<tr>
<td>[List relevant clause numbers of building code]</td>
<td>[Specify nature of waiver or modification of building code]</td>
</tr>
</tbody>
</table>

Issued by

Name: Paula Francisca Hugens
LBP or registration number: 250441
The practitioner is a: ( ) Design LBP ( ) Registered architect (X) Chartered Professional Engineer

Mailing address: PO Box 2329 Wakatipu 9349
Street address or registered office: Unit 5, 70 Glenda Drive, Frankton, Queenstown 9300
Phone number: Landline: 03 442 8998 Mobile: 021 772 852
Email address: paula@greenbeing.co.nz
Website: www.greenbeing.co.nz

Declaration

I, Paula Francisca Hugens, state on reasonable grounds that the design work that is restricted building work recorded on this form:
(a) complies with the relevant clauses of the building code; or
(b) complies with the building code subject to any waiver or modification of the building code recorded on this form.

Signature: [Signature]

Date: 22 May 2013