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SPECIFIC ENGINEERING DESIGN CALCULATIONS

PROJECT DETAILS:

PROJECT:	Proposed Sheds
CLIENT:	Three Blokes Ltd
SITE:	362 Matakana Valley Road Matakana
ARCHITECT:	Campbell Registered Architects Ltd
JOB REF:	24742
DATE:	16 September 2022
BY:	Paul Wilson

DESIGN SUMMARY:

- Specific design of structural elements outside the scope of NZS 3604:2011.
- Bracing demand and allocation calculations in accordance with AS/NZS 1170.
- Foundation design in accordance with geotechnical report by Hutchinson Consulting Engineers Ltd referenced L20145 dated 4 October 2017.
- Masonry Wall Design.




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GENERAL SPECIFICATION

BRIEF OUTLINE OF STRUCTURAL REQUIREMENTS / SPECIFICATIONS

1.0 GENERAL

Engineering details are to be read in conjunction with all other relevant documentation.

Do not scale any drawings. For setting out information refer to Architect's documentation.

The contractor is to ensure temporary stability of the building and ground at all times. Any temporary loading conditions imposed by the construction techniques are to be checked by the contractor.

All workmanship and construction practice is to be to the latest editions of NZ Standards (and other relevant standards).

All work is to be carried out to the NZ Building Code and any Territorial Authority requirements.

Any engineering discrepancies should be immediately referred to the Engineer for resolution.

For any nominated products, acceptable alternative products may be submitted by the Contractor for approval.

Contractor and fabricators shall confirm all dimensions prior to commencement of work. Discrepancies, if found, shall be brought to the immediate attention of the Architect.

Health and Safety by Design principles acknowledging the users who will interact with the artefact being designed throughout its lifecycle, from the concept through to decommissioning and disposal, have been considered in the design process and should also be embedded throughout the procurement and construction processes.

ABBREVIATIONS

UB	Universal Beam e.g. a 250UB 31.4 is a 252x146 'I' beam and weighs 31.4kg per metre
TFB	Tapered Flange Beam e.g. 125TFB 13.1
UC	Universal Column e.g. a 200UC 46.2 is a 203x203 'I' beam and weighs 46.2kg per metre
EA	Equal Angle e.g. 50x50x6 EA has 6mm thick sides
UA	Unequal Angle e.g. 125x75x10 UA
CHS	Circular Hollow Section e.g. 102x8.6 CHS has an 8.6mm wall thickness
SHS	Square Hollow Section e.g. 89x89x3.6 SHS has 3.6mm wall thickness
RHS	Rectangular Hollow Section e.g. 89x38x4.0 RHS
PFC	Parallel Flange Channel e.g. 200PFC is a 200x75 channel
P/C	Pre-camber
PL	Steel Plate
SG	Stress Graded timber, available in grade 6, 8, 10, and 12
G	Only available in G8, verified green timber, typically used in wet service situations
GL	Glulam Timber
c/c	Centre to centre distance (also CTRS)

2.0 DESIGN LOADS

2.1 All imposed loads have been calculated in accordance with AS / NZS 1170.1, and structural elements designed for the following loads.

2.2 Permanent Loads

ELEMENTS	LOADINGS kPa (Plan area)
Timber Floors	0.5
Timber Decks	0.5
Heavy/Light Roof	0.85/0.45

ELEMENTS	LOADINGS kPa (Face area)
Timber Framed walls	0.5
Timber Framed walls + brick veneer	2.1
20/25 Series Masonry	4.1/5.1

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2.3 Imposed Loads

	LOADINGS	
Residential Elements	**Udl Q_b kPa**	**Pt Loads Q_b kN**
Decks	2.0	1.8
Roofs	0.25	1.1
Garages	2.5	13*
All Other floors	1.5	1.8

*For garages with timber floors, this can be reduced to 9kN acting over 300mm x 300mm.

2.4 Specific Loads

The following specific loads have been allowed for: Nil.

3.0 SITE WORKS – GENERAL

3.1 Origin of levels is the LINZ datum – refer to Survey drawings.

3.2 All drawings to be read in conjunction with the specification.

3.3 Existing services are shown indicatively only. Before construction commences, it is the contractor's responsibility to locate the position and depth of all services that could be adversely affected by their operations. Inform Architect of any variations.

3.4 All work to be in accordance with the Territorial Authority standards.

3.5 Concrete for site works only to be 10MPa unless noted otherwise.

3.6 Catchpit positions and grate levels are approximate. Final positions are to suit kerb levels.

3.7 All work on public drains is to be carried out by an approved licensed drain layer, to the relevant Territorial Authorities' standards.

4.0 SITE WORKS – EARTHWORKS

4.1 Temporary batters to have a 1V:1H maximum slope, but also refer to any specific requirements in the geotechnical report.

4.2 Work to include the stripping of vegetation, topsoil, and any surface deleterious matter. This includes the breaking out of substructures and hard paving where required.

4.3 Care is to be exercised adjacent to existing trees that are to be retained. Any excavations shall be performed by hand in the vicinity of existing trees.

4.4 The subgrade shall be inspected by the Engineer and proof rolled as necessary. Any soft spots shall be over-excavated and compacted back to level with imported GAP65 material.

5.0 FOUNDATIONS

5.1 Unless noted otherwise, foundations have been designed in accordance with the 'good ground' assumption as defined by NZS 3604 2011 for:

100kPa safe bearing capacity (under unfactored loads).
150kPa dependable bearing capacity (under factored loads).

5.2 All founding material is to be approved by the Engineer before any concrete, including blinding concrete, is placed. Note that all footings are to be founded in original ground or certified engineered earth fill as approved by the Engineer. Refer also to the requirements of any specific Geotechnical Report.

5.3 No services excavations shall be formed within a 1:1 line of the underside of any foundation unless specifically instructed by the Engineer.

5.4 Slabs on grade are to be constructed onto prepared basecourse.

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5.5 All backfill behind retaining walls, if any, is to be of approved free-draining material. Drain coils are to be fitted to drain, to approved silt traps.

6.0 REINFORCED CONCRETE

6.1 Minimum 28 day compressive concrete strengths to be as follows:

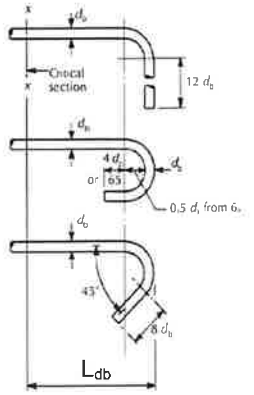
Exposure Zone (as defined in NZS 3604: 2011)	GRADE (MPa)
B	17.5
C	20
D	25

6.2 Concrete sizes indicated on the drawings do not include the thickness of applied finishes.

6.3 Chamfers to be formed on all exposed corners, generally 15mm x 15mm.

6.4 Sizes indicated show depth x width for beams. Depth excludes depth of slab unless noted otherwise.

6.5 If construction joints are not shown, their location shall be the contractor's responsibility to suit the conditions of the design. The Contractor is to allow for all construction joints necessary to complete the work, without causing distress to the structure. Location to be agreed with Engineer. In general, for slabs on grade, saw cuts (25mm deep x 5mm wide) are to be formed to produce a grid of 5.0m x 5.0m maximum, after the initial cure (approximately 24 – 48 hours after concrete pour).



6.6 All penetrations are to be located to the written approval of the Engineer and as shown on the drawings. Services to be cast in where shown.

6.7 Ensure adequate gaps maintained between suspended concrete work and all non-structural elements.

6.8 Finish to concrete to be as follows (if not specified elsewhere):

ELEMENT	TYPE OF FINISH (to NZS 3411)
Walls and all exposed concrete faces	F5 with special features – see Architects drawings
Floor slab	U3 for application of floor finish – see drawings

6.9 For all proprietary concrete materials, full calculations and shop drawings are to be submitted to the Engineer in adequate time by the Contractor for approval. These are to show full compliance with the design intent. Where necessary this documentation is to be submitted to the Territorial Authority for the necessary Building Consents.

7.0 REINFORCEMENT

Hook definitions;

a. A 90° turn plus an extension of at least 12 bar diameters at the free end of the bar
b. A semi-circular turn plus an extension of at least 4 bar diameters but not less than 65mm at the free end of the bar
c. A stirrup hook, which is defined as a 135° turn around a longitudinal bar plus an extension of at least 8 stirrup bar diameters for plain bars and 6 stirrup bar diameters for deformed bars at the free end of the bar embedded in the core concrete of the member

Minimum lap length as follows:

a. Masonry lap lengths;
Grade 300 reinforcing = 40 x bar diameter
Grade 500 reinforcing = 70 x bar diameter
b. Concrete lap lengths;

$$L_{db} = \frac{(0.5\alpha_a f_y)\, d_b}{\sqrt{f'_c}}$$

Where α_a = 1.3 for top reinforcement where more than 300mm of fresh concrete is cast in the member below the bar, or 1.0 for all other cases.

For example; (α_a = 1.0)

Concrete Strength	*Steel Strength*	*Lap length required*
20MPa	*300MPa*	*34 x d_b*
20MPa	*500MPa*	*56 x d_b*
25MPa	*300MPa*	*30 x d_b*
25MPa	*500MPa*	*50 x d_b*
30MPa	*300MPa*	*28 x d_b*
30MPa	*500MPa*	*46 x d_b*

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Minimum bend diameters of Class E steel bars, with yield strength 300MPa or 500MPa

a. Normal
   i. Bar diameter (d_b) 6-20mm = $5d_b$
   ii. Bar diameter (d_b) 24-32mm = $6d_b$

b. Stirrups or ties
   i. For **deformed** bars:
      1. Bar diameter (d_b) 6-20mm = $4d_b$
      2. Bar diameter (d_b) 24-32mm = $6d_b$
   ii. For **plain** bars:
      1. Bar diameter (d_b) 6-20mm = $2d_b$
      2. Bar diameter (d_b) 24-32mm = $3d_b$

For example;

Bar Diameter	***Type***	***Required Bend Diameter (d_i)***
R6	*Stirrup or tie*	*12mm*
R10	*Stirrup or tie*	*20mm*
D10	*Stirrup or tie*	*40mm*
D10/H10	*Normal*	*50mm*
D12	*Stirrup or tie*	*48mm*
D12/H12	*Normal*	*60mm*
D16/H16	*Normal*	*80mm*
D20/H20	*Normal*	*100mm*
D24/H24	*Normal*	*144mm*
D32/H32	*Normal*	*192mm*

Minimum cover to reinforcement:

a. Masonry:

Exposure Classification	**Minimum cover (mm)**
Coastal Frontage*	60
Coastal Perimeter	50
External (inland)	45
Closed interior	35

b. Concrete:

Exposure Classification	**Concrete Strength (MPa)**				
	17.5	20	25	30	40
	Minimum cover (mm)				
Closed Interior	30	25	25	20	20
External (Inland)	50	40	35	30	25
Coastal Perimeter	65	50	40	35	30
Coastal Frontage*	-	-	50	45	40
Cast against Ground	75	75	75	75	75
Cast against Ground with DPC	50	50	50	50	50

* Within 100m of high tide mark or within 500mm of high tide mark to the direction of the prevailing wind

7.1 All reinforcement shall comply with the following:

SYMBOL	TYPE
R	Structural grade plain bars to NZS 3402 (300MPa)
D	Structural grade deformed bars to NZS 3402 (300MPa)
HD/H	Deformed bars grade 500 to NZS 3402 (500MPa)
HR	Plain bars grade 500 to NZS 3402 (500MPa)

7.2 Minimum distribution steel shall be D12 at 300 centres.

7.3 Reinforcement laps to be to NZS 3109. Mesh lap to be one mesh + 25mm.

7.4 Adequate support to all reinforcement to be made by the use of spacers, stools and the like.

7.5 All bending of reinforcement to be to NZS 3109.

7.6 Notation used for reinforcement fixing:

B/W	Both ways
B/F	Both faces
E/F	Earth face
V	Vertical
H	Horizontal
N/F	Near face
BOT	Bottom
ABR	Alternative bars reversed

8.0 STRUCTURAL TIMBER

8.1 Timber beams shall be propped until dry to prevent premature creep.

8.2 All normal timber sizes given are nominal dimensions unless otherwise stated.

8.3 All glue laminated timber sizes are actual dimensions.

8.4 Timber treatment shall be specified and shall comply with the recommendations of the Timber Preservation Authority. Generally all timber to be treated to the requirements of the Building Code. Refer to Architects drawings / specifications.

Hazard	*Hazard Class*	*Examples*
Low	*H1.1*	*Interior linings, internal wall*
	H1.2	*Wall framing, skillion roof framing*
Moderate	*H3.1*	*Claddings, fascia, wall framing*
	H3.2	*Deck bearers, joists, boards*
High	*H4*	*Fence posts, landscaping timber*
Severe	*H5*	*House piles, retaining walls*
Marine	*H6*	*Marinas, wharf piles*

8.5 All structural timber to be stress graded SG8 Pinus Radiata unless noted otherwise.

8.6 Where timber connections are exposed to the weather, all steel connection shall be galvanised (unless in the sea spray zone in which case they are to be stainless steel). Faces and edges of steel elements which rest against tanalised timber shall be painted before positioning. Minimum connections are 5mm plate and 2/M16 bolts unless noted otherwise.

8.7 All bolts and nuts to have washers as the following table:

	ROUND (mm)	SQUARE (mm)
M6	30 x 1.6	25 x 25 x 1.6
M8	36 x 2.0	32 x 32 x 2.0
M10	45 x 2.5	40 x 40 x 2.5
M12	55 x 3.0	50 x 50 x 3.0
M16	65 x 4.0	57 x 57 x 4.0
M20	75 x 5.0	65 x 65 x 5.0
>M20	85 x 6.0	75 x 75 x 6.0

9.0 STRUCTURAL STEELWORK

9.1 Steelwork drawings show the design intent. The Contractor is to prepare shop drawings for review. No fabrication is to commence until shop drawings are reviewed by the Engineer and written notification issued.

9.2 All reactions are shown in kN.

9.3 All protective coatings to steelwork to be in accordance with the architectural specifications. Generally, all exposed structural steel is to be galvanised, unless noted otherwise. All external flitch beams are to have plates galvanised and top, bottom and side edges full sealed.

9.4 All steelwork beams, girders, trusses and the like are to be precambered to compensate for the effects of dead load deflection as noted on the drawings.

9.5 Where the weight of a steel section is omitted the heaviest commonly available steel section shall be utilized.

9.6 All bolts to a minimum of M12 and all welds to be a minimum of 6mm continuous fillet (SP).

9.7 All beam connection plates to be a minimum thickness of 10mm. All other plates to be a minimum thickness of 6mm. All cap plates to be a minimum thickness of 3mm. All hollow sections to be sealed with cap plates.

9.8 M12 bolts where specified to the grade 4.6/S. All other bolts to be grade 8.8/S, unless noted otherwise.

9.9 All HD bolts to be fabricated from material with a minimum yield stress of 250MPa, set to template, checked for level and position before casting. All grout under base plates to have a compressive strength of at least 25MPa.

9.10 All nuts and turning bolts are to have approved washers. All exposed nuts, bolts and washers to be galvanised and to have protective coatings to match general steelwork, unless noted otherwise.

9.11 All cold formed sections, including cold rolled purlins to be to AS 1538. To be formed from zinc coated high strength steel strip with a minimum yield stress of 450MPa. All to be galvanised with a minimum coating of 300g/m². All purlin connections to be to manufacturer's recommendations.

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9.12 All rod bracing to be a minimum of grade 300 plain reinforcing bar, unless noted otherwise.

9.13 Steel members shall be to the following grades, unless noted otherwise.

Member	Grade
UB, UC, TFC, PFC, TFB, Angles	300+
RHS, SHS, CHS	350
WB, WC	300+
Stainless steel	250+ (grade 315L)

9.14 All sealed sections to be galvanized shall have vent holes. To be shown on shop drawings.

9.15 Purlin cleats are to be in accordance with the manufacturer's standard details except where the top flange of the purlin is more than 300mm above supporting steelwork 75 x 75 x 8 angle cleats shall be used. Purlins shall be fixed using approved flanged bolts and washers.

9.16 Ceiling systems, ductwork, etc. to be suspended from purlins should be fixed with hook bolts through purlin web. The flanges of the purlins or girts shall not be holed.

10.0 REINFORCED MASONRY

10.1 Generally all concrete block masonry construction to be in accordance with NZS 4229:2013, and NZS 4210:2001.

10.2 Refer to figure 8.1, NZS 4229:2013 for D16 Trimmers around openings.

10.3 The top of all the concrete block walls to be continuous Bond Beam B1 or B2, as per figure 10.1 and 10.2, NZS 4229:2013. Continuous Bond Beam type B3 (figure 10.2, NZS 4229:2013) to be provided at mid-floor level of 2 storey walls.

10.4 Minimum reinforcing to be as follow unless shown otherwise:

Bond	15 Series		20 Series	
	Vertical	Horizontal	Vertical	Horizontal
Running	D12@800crs	D12@800crs	D12@600crs	D12@600crs
Stack	D10@400crs	D10@400crs	D12@400crs	D12@400crs

10.5 In general only load bearing masonry is shown on the structural drawings. All non-load bearing masonry is to be separated from structure by a 12mm compressible joint.

10.6 Concrete blocks shall have a minimum compressive strength of 12.5MPa, to NZS 4210. Density to be greater than 1750kg/m³.

10.7 Mortar shall comply with the requirements of NZS 4210 to a nominal mix of:

1 part cement / 3 parts sand / ½ part lime.

10.8 All cores with reinforcement to be grout filled as a minimum. Additional covers filled as noted on the drawings. Grout shall have a slump of 230mm and a compressive strength in accordance with NZS 3604:2011 clause 4.5.3.

10.9 In general, walls to be full height before grouting cores. Washout ports to be provided at bottom course where vertical bars are located for all walls where poured height exceeds 1.2m. Mortar joints to be 10mm thick with blocks fully bedded and perpends filled. Joints to be tooled at exposed or rendered surfaces.

Cores are to be cleaned of all mortar fins and droppings through washout ports which are not to be closed until inspected by Engineer.

Grout to be added to ensure fill of cores with a maximum continuous pour height of 3600mm.

10.10 No construction of masonry on suspended floors is to take place until floor is fully depropped.

10.11 All Grade A masonry to be supervised by a registered mason, including grouting. All masonry to be inspected by Engineer prior to grouting.

10.12 Chasing of load bearing masonry only permitted as shown on Engineer's drawings.

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SHED 1 DESIGN

Hutchinson CONSULTING ENGINEERS	JOB: Three Blokes Ltd		
	SUBJECT: Shed 1 Wind Bracing Demand		
	BY: Paul W	DATE: Sep 2022	JOB NO: 24742

in accordance with AS/NZS 1170.2 2002

Building Importance: 2 *Normal Structures and structures not falling into other levels*
Design life: 50 years
Probability of Exceedance: 1/500 *(Ultimate)* 1/25 *(servicability)*

Wind Region = A6 Rodney District

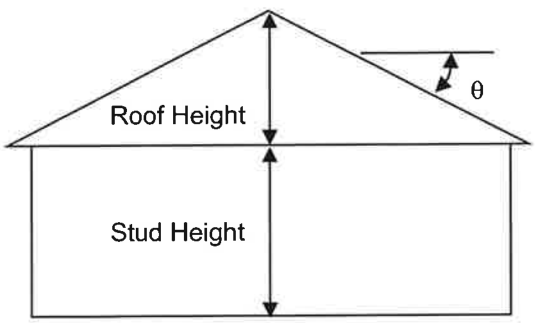
Site wind speed $V_{(site,\beta)} = V_R M_d \{M_{z\,cat} M_s M_t\}$

	ULTIMATE LIMIT STATE	***SERVICABILITY LIMIT STATE***
Regional wind speed	V_{500} = 45 m/s	V_{25} = 37 m/s
Direction multiplier	M_d = 1.00	M_d = 1.00
Terrain category (1 - 4)	= 2	= 2
Building height	= 4.7 m	= 4.7 m
Terrain/height multiplier	$M_{(z\,cat)}$ = 0.91	$M_{(z\,cat)}$ = 0.91
Shielding multiplier	M_s = 1.00	M_s = 1.00
Elevation above mean sea level	E = 30.0 m	E = 30 m
Topographic multiplier	M_t = 1.00	M_t = 1.00
Hill-shape multiplier	M_h = 1.00	M_h = 1.00
Lee multiplier	M_{lee} = 1.00	M_{lee} = 1.00

(site not in lee zone refer to figure 3.1(b) AS/NZS 1170.2:2002)

Site wind speed	$V_{(site,\beta)}$ = 41.0 m/s (High)	$V_{(site,\beta)}$ = 33.7 m/s
Design wind speed	= $V_{(des,\theta)}$	
Design wind pressure	$\rho_u = (0.5\rho_{air})\{V_{(des,\theta)}\}^2 C_{fig} C_{dyn}$	
	C_{dyn} = 1.00	
	= 1.01 kPa x C_{fig}	ρ_s = 0.68 kPa
Design force on building	$F = \Sigma(\rho_z A_z)$	

BUILDING DIMENSIONS

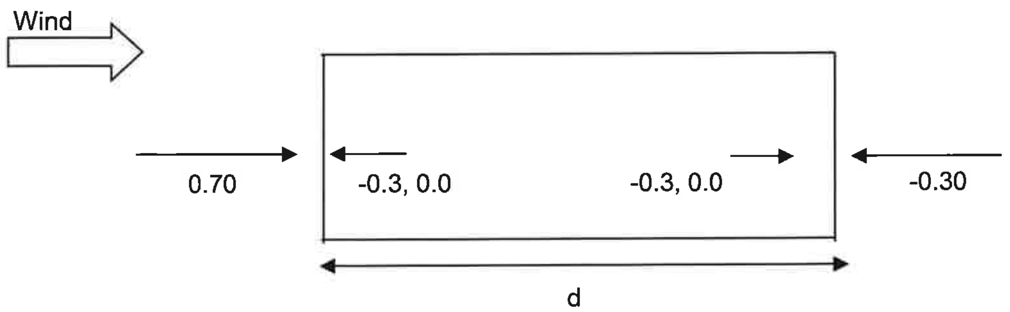


Roof Pitch, θ = 15°
Roof Height = 1.6 m
Stud Height = 3.9 m
Building Breadth, b = 12.0 m (Varies with wind direction)
Building Depth, d = 30.2 m (Varies with wind direction)

ALONG-WIND AERODYNAMIC SHAPE FACTOR

Internal and external pressure coefficients, $C_{p,i}$ & $C_{p,e}$:

Breadth, b = 12.0 m	
Depth, d = 30.2 m	h/d = 0.16
Average height of building, h = 4.7 m	d/b = 2.52
Roof pitch, θ = 0°	b/d = 0.40
Rafter length, x = 0.00 m	x/h = 0.00



$C_{fig} = (C_{p,e} + C_{p,i}) \times K_c$

Action combination factor, K_c = 0.90

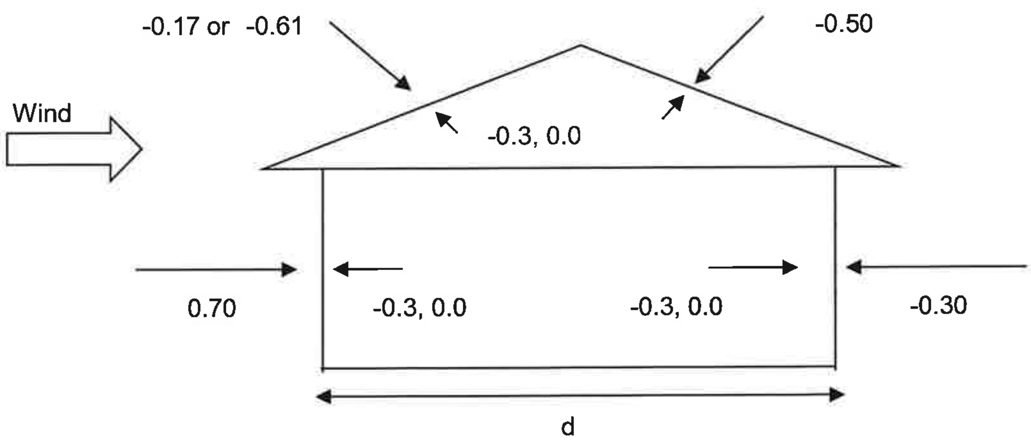
$C_{fig\ roof}$ = 0.00

$C_{fig\ wall}$ = 0.90

CROSSWIND AERODYNAMIC SHAPE FACTOR

Internal and external pressure coefficients, $C_{p,i}$ & $C_{p,e}$:

Breadth, b = 30.2 m	
Depth, d = 12.0 m	h/d = 0.39
Average Height, h = 4.7 m	d/b = 0.40
Roof Pitch, θ = 15°	b/d = 2.52
Rafter length, x = 6.21 m	x/h = 1.32



$C_{fig} = (C_{p,e} + C_{p,i}) \times K_c$

Action combination factor, K_c = 0.80

$C_{fig\ roof}$ = 0.26

$C_{fig\ wall}$ = 0.80

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BRACING DEMAND

Horizontal design force on building, $F = \Sigma(\rho_z A_z)$

$F = \Sigma(\rho_u \times A_{wall} \times C_{fig\ wall} + \rho_u \times A_{roof} \times C_{fig\ roof} \times \sin\theta)$

ALONG-WIND DIRECTION:

F = 29.9 kN x 20 = 600 BU's

CROSSWIND DIRECTION:

F = 60.2 kN x 20 = 1250 BU's

Along-Wind Bracing Demand = 600 BU's
Crosswind Bracing Demand = 1250 BU's

Hutchinson CONSULTING ENGINEERS	JOB: Three Blokes Ltd		
	SUBJECT: Shed Earthquake Bracing Demand		
	BY: Paul W	DATE: Sep 2022	JOB NO: 24742

in accordance with NZS 1170.5:2004

Lateral force coefficient, $C(T) = C_h(T)\,Z\,R\,N(T,D)$

	ULTIMATE LIMIT STATE		***SERVICABILITY LIMIT STATE***
Structural ductility factor	$\mu = 3$		$\mu = 1$
Site subsoil class	= C	Shallow soil site	= C
Period	< 0.40 s		< 2.00 s
Hazard factor	$Z = 0.13$	(table 3.3)	$Z = 0.13$
Return period factor	$R_{(1/500)} = 1.00$	(table 3.5)	$R_{(1/25)} = 0.25$
Near-fault factor	$N(T,D) = 1.00$		$N(T,D) = 1.00$
Basic acceleration hazard	$C_h = 2.36$		$C_h = 0.66$
Lateral force coefficient	$C(T) = C_h(T)\,Z\,R\,N(T,D)$ $= 0.31$		$C(T) = C_h(T)\,Z\,R\,N(T,D)$ $= 0.02$
Structural performance factor	$S_p = 0.70$		$S_p = 0.70$
Inelastic spectrum scaling factor	$k_\mu = 2.1$		$k_\mu = 1.0$
Horizontal design action coefficent	$C_d(T_1) = C(T_1)S_p/k_\mu$ $= 0.10$		$C_d(T_1) = C(T_1)S_p/k_\mu$ $= 0.02$

$V = C_d(T_1)W_t$
$= 39.0$ kN

$W_t = 389.5$ kN
$W_ih_i = 1402.2$ kNm

GROUND FLOOR DEAD LOADS

Roof:	0.45 kPa x	510.0 m² =	229.5 kN
External Timber Framed Walls:	0.50 kPa x	320.0 m² =	160.0 kN
		ΣG =	**389.5 kN**

GROUND FLOOR LIVE LOADS

Roof:	0.25 kPa x	510.0 m² =	127.5 kN
		ΣQ =	**127.5 kN**

$\psi_u = 0.0$

Ground Bracing Demand = $F_t + 0.92V\{W_ih_i/\Sigma W_ih_i\}$
= 39.0 kN

$W_i = 390$ kN
$h_i = 3.6$ m
$F_t = 3.1$ kN (top level)

Ground Bracing Demand = 800 BU's

3.3 IBS RigidRAP® WALL BRACING SYSTEM

3.3.1 BRACING CAPACITY

The following table provides the bracing value for the different systems:

Table 1	Concrete Slab		Timber Floor	
System	Wind	EQ	Wind	EQ
SYSTEM 1: OSB - 300 mm x 2400 mm wall with GIB HandiBrac® Fixing 30 mm x 2.5 mm Galv clouts	49 BU/m	58BU/m	49 BU/m	58 BU/m
SYSTEM 2: OSB - 400 mm x 2400 mm wall with GIB HandiBrac® Fixing 30 mm x 2.5 mm Galv clouts.	70 BU/m	79 BU/m	70 BU/m	79 BU/m
SYSTEM 3: OSB - 600 mm x 2400 mm wall with GIB HandiBrac® Fixing 30 mm x 2.5 mm Galv clouts	76 BU/m	81 BU/m	76 BU/m	81 BU/m
SYSTEM 4: OSB - 1200 mm x 2400 mm wall with GIB HandiBrac® Fixing 30 mm x 2.5 mm Galv clouts	131 BU/m	107 BU/m	131 BU/m	107 BU/m
SYSTEM 5: OSB - 2400 mm x 2400 mm wall with GIB HandiBrac® Fixing 30 mm x 2.5 mm Galv clouts	108 BU/m	89 BU/m	108 BU/m	89 BU/m
SYSTEM 6: OSB - 1200 mm x 2400 mm wall **without** GIB HandiBrac® Fixing 30 mm x 2.5 mm Galv clouts	93 BU/m	78 BU/m	93 BU/m	78BU/m
SYSTEM 7: OSB - 400 mm x 2400 mm wall with GIB HandiBrac® GIB standard 10 mm board on the inside Fixing 30 mm x 2.5 mm Galv clouts	94 BU/m	104 BU/m	94 BU/m	104 BU/m
SYSTEM 8: OSB - 600 mm x 2400 mm wall with GIB HandiBrac® GIB standard 10 mm board on the inside Fixing 30 mm x 2.5 mm Galv clouts	130 BU/m	130 BU/m	120 BU/m	120 BU/m
SYSTEM 9: OSB - 1200 mm x 2400 mm wall with GIB HandiBrac® GIB standard 10 mm board on the inside Fixing 30 mm x 2.5 mm Galv clouts	150 BU/m	150 BU/m	130 BU/m	130 BU/m

NOTE:

- For all bracing systems no product substitution is allowed. Installation must be in accordance with these instructions. If these requirements are not met, IBS provides no assurance that the bracing capacity (claimed in this design and installation guide) will be achieved.
- The allowable racking resistances for the IBS RigidRAP® systems are applicable to frames lined with IBS RigidRAP® on one side only.
- Panels must always be installed vertically if used as bracing sheet. Sheets can be installed horizontally if not used as a bracing element.
- All IBS RigidRAP systems have been tested with no nogs or dwangs
- Stud sizes and centres will vary depending on height load and loads ref: NZS3604:2011.

The systems may be used on walls of lengths different to those in TABLE 1 but is limited to:

- Wall lengths no greater than twice the tested system length.
- For walls greater than the tested system length multiply the length of the wall on a pro-rata basis, up to double the length of the system.
- A wall height less than 1.5 meters should be referred to a specific engineer design.
- A wall height less than 2.4 meters should be rated as if they are 2.4 meters high.
- Panels higher than IBS RigidRAP® 2440 mm must be fixed top plate to bottom plate. When walls are higher than 2440 mm, IBS RigidRAP® 2745 or 3050 mm sheets can be used.
- A part sheet can be used but must be nogged and nailed as per specification.

BCO10364430 Received by Auckland Council 10/03/2023

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Hutchinson CONSULTING ENGINEERS

JOB: Three Blokes Ltd			
SUBJECT: Shed 1 bracing allocation tables			
BY: Paul W	DATE: Sep 2022	JOB NO: 24742	

BRACING ALLOCATION - ALONG DIRECTION

(in accordance with NZS 3604:2011)

Wall or Bracing Line		Bracing Elements Provided					Earthquake		Wind	
Line Label	Minimum BU's Required	Bracing Element No.	Bracing Type	Element Length (m)	Stud Height (m)	Angle from Wind Direction	Rating BU's	BU's Achieved	Rating BU's	BU's Achieved
M	453 EQ	1	IBS	1.2	3.62	0	107	85	131	104
	453 Wind	2	IBS	2.4	3.62	0	89	142	108	172
		3	IBS	2.4	3.62	0	89	142	108	172
		4	IBS	1.2	3.62	0	107	85	131	104
	EQ Achieved = 453.5									
	Wind Achieved = 552.1									
N	133.4 EQ	1	GS1-N	1.2	5.15	0	60	34	70	39
	100 Wind	2	GS1-N	1.2	5.15	0	60	34	70	39
		3	GS1-N	1.2	5.15	0	60	34	70	39
		4	GS1-N	1.2	5.15	0	60	34	70	39
	EQ Achieved = 167.8	5	GS1-N	1.2	5.15	0	60	34	70	39
	Wind Achieved = 195.7									
O	453 EQ	1	IBS	1.2	3.62	0	107	85	131	104
	453 Wind	2	IBS	2.4	3.62	0	89	142	108	172
		3	IBS	2.4	3.62	0	89	142	108	172
		4	IBS	1.2	3.62	0	107	85	131	104
	EQ Achieved = 453.5									
	Wind Achieved = 552.1									

	Achieved	EQ	1075	Wind	1300
$Wind_{req}$ / EQ_{req} 0.75 Earthquake Bracing	Required	EQ	800	Wind	600
			OK		OK

BCO10364430 Received by Auckland Council 10/03/2023

Hutchinson
CONSULTING ENGINEERS

JOB:	Three Blokes Ltd	
SUBJECT:	Shed 1 bracing allocation tables	
BY: Paul W	DATE: Sep 2022	JOB NO. 24742

BRACING ALLOCATION - ACROSS DIRECTION

(In accordance with NZS 3604:2011)

Wall or Bracing Line		Bracing Elements Provided					Earthquake		Wind	
Line Label	Minimum BU's Required	Bracing Element No.	Bracing Type	Element Length (m)	Stud Height (m)	Angle from Wind Direction	Rating BU's	BU's Achieved	Rating BU's	BU's Achieved
A	180 EQ 180 Wind	1	IBS	2.4	4.83	0	89	106	108	129
		2	IBS	2.4	4.83	0	89	106	108	129
EQ Achieved = 212.3 *Wind Achieved = 257.6*										
B	100 EQ 100 Wind	1	GS2-N	2.4	3.94	0	85	124	95	139
		2	GS2-N	2.4	3.94	0	85	124	95	139
EQ Achieved = 248.5 *Wind Achieved = 277.8*										
C	100 EQ 100 Wind	1	GS2-N	2.4	3.94	0	85	124	95	139
		2	GS2-N	2.4	3.94	0	85	124	95	139
EQ Achieved = 248.5 *Wind Achieved = 277.8*										
D	100 EQ 100 Wind	1	GS2-N	2.4	3.94	0	85	124	95	139
		2	GS2-N	2.4	3.94	0	85	124	95	139
EQ Achieved = 248.5 *Wind Achieved = 277.8*										
E	100 EQ 100 Wind	1	GS2-N	2.4	3.94	0	85	124	95	139
		2	GS2-N	2.4	3.94	0	85	124	95	139
EQ Achieved = 248.5 *Wind Achieved = 277.8*										
F	180 EQ 180 Wind	1	IBS	2.4	3.94	0	89	130	108	158
		2	IBS	2.4	3.94	0	89	130	108	158
EQ Achieved = 260.2 *Wind Achieved = 315.8*										
	100 EQ 100 Wind	1	IBS	0.84	2.42	0	0	0	0	0
		2	IBS	1.2	2.42	0	107	127	131	156
EQ Achieved = 127.3 *Wind Achieved = 155.9*										

			Achieved	EQ 1594	Wind 1840
$Wind_{req} / EQ_{req}$	1.56	Wind Bracing	Required	EQ 800	Wind 1250
				OK	OK

Hutchinson
CONSULTING ENGINEERS

JOB: Three Blokes Ltd			
SUBJECT: Verandah beam design			
BY: Paul W	BEAM: RB1	DATE: Sep 2022	JOB NO: 24742

UNIFORMLY DISTRIBUTED LOADS (SIMPLY SUPPORTED):

Dead Loads, G:

roof: 0.35 kPa x 1.3 m = 0.4 kN/m
floor: 0.50 kPa x 0.0 m = 0.0 kN/m
internal walls: 0.35 kPa x 0.0 m = 0.0 kN/m
external walls: 0.50 kPa x 0.0 m = 0.0 kN/m
self weight (member) = 0.14 kN/m

G = 0.6 kN/m

Live Loads, Q:

roof: 0.25 kPa x 1.3 m = 0.3 kN/m
external floor: 2.00 kPa x 0.0 m = 0.0 kN/m
internal floor: 1.50 kPa x 0.0 m = 0.0 kN/m

Q = 0.3 kN/m

ρ_u = 1.01 kPa
C_{fig} = 1.20
$W_u = \rho_u \times C_{fig} \times 1.3$ m

W_u = -1.5 kN/m

ρ_s = 0.67 kPa
$W_s = W_u \times \rho_s / \rho_u$

W_s = -1.0 kN/m

LOAD COMBINATIONS:

SLS = Serviceability Limit State
ULS = Ulitmate Limit State

ULS Distributed Loads:

1.35G = 0.8 kN/m
1.2G + 1.5Q = 1.2 kN/m
0.9G + W_u = -1.0 kN/m

Maximum ULS Distributed Load
w = 1.2 kN/m

SLS Distributed Loads:

G + ψ_sQ = 0.6 kN/m (Steel)
k_2G + ψ_sQ = 1.2 kN/m (Timber)
G + Q + W_s = -0.4 kN/m (Steel & Timber where Q = 0.0 kN/m)

Load duration factor (short term), ψ_s = 0.0
Duration of Load factor, k_2 = 2.0
(moisture content < 18%)

Working Stress Loads:

G + Q = 0.9 kN/m
G + W_s = -0.4 kN/m

ULTIMATE LIMIT STATE DESIGN:

design **moment (ULS):** $M^* = \dfrac{w\ell^2}{8}$

M^* = 5.2 kNm $< \Phi M_n$

w = 1.2 kN/m
ℓ = Beam Span
ℓ = 6000 mm

16/09/2022 2:36 PM

HUTCHINSON

Sheet: RB1
File: 24742 Shed 1 SED
Engineer: IH

Hutchinson CONSULTING ENGINEERS	JOB: Three Blokes Ltd			
	SUBJECT: Verandah beam design			
	BY: Paul W	BEAM: RB1	DATE: Sep 2022	JOB NO: 24742

MATERIAL PROPERTIES:

Timber member properties:

Member Type: Single
Timber Grade = Macrocarpa
Strength reduction factor, ϕ = 0.8
Load duration factor, k_1 = 0.8
Parallel support factor, k_4 = 1.00
Stability factor, k_8 = 1.00
Bending strength, f_b = 14 MPa

Steel member properties:

Strength reduction factor, ϕ = 0.9
Yield strength, f_y = 300 MPa

For Timber:

$F_b = \Phi k_1 k_4 k_8 f_b$
$F_b = 9.0$ MPa

For Steel:

$F_b = \Phi f_y$
$F_b = 270$ MPa

effective section moduli:
(assuming full lateral restraint)

$M^* = \Phi M_n$

$\Phi M_n = F_b Z$

$$Z_{req} \geq \frac{M^*}{F_b}$$

$Z_{req} \geq$ **585.1** $\times 10^3$ mm^3 (timber)

$Z_{req} \geq$ **19.4** $\times 10^3$ mm^3 (steel)

Try:	300x100 Macrocarpa

$Z_{(Actual)} =$ 1500.0 $\times 10^3$ mm^3

SERVICABILITY LIMIT STATE DESIGN:

limit **gravity deflection** to $\frac{span}{500}$ = 12.0 mm

limit **wind deflection** to $\frac{span}{500}$ = 12.0 mm

$$\Delta = \frac{5 w \ell^4}{384 EI}$$

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Hutchinson CONSULTING ENGINEERS

JOB: Three Blokes Ltd			
SUBJECT: Verandah beam design			
BY: Paul W	BEAM: RB1	DATE: Sep 2022	JOB NO: 24742

MATERIAL PROPERTIES:

Timber member properties:

Distributed dead load, w = 1.2 kN/m
Distributed dead and live load, w = 1.2 kN/m
Distributed dead and wind load, w = -0.4 kN/m
Modulus of elasticity, E = 7900 MPa

$I_{req} \geq$ 206.6 $\times 10^6$ mm^4

Steel member properties:

Distributed dead load, w = 0.6 kN/m
Distributed dead and live load, w = 0.6 kN/m
Distributed dead and wind load, w = -0.4 kN/m
Modulus of Elasticity, E = 200 GPa

$I_{req} \geq$ 4.1 $\times 10^6$ mm^4

Try: 300x100 Macrocarpa

$I_{(Actual)} =$ 225.0 $\times 10^6$ mm^4

Moment capacity, ϕM = 13.4 kNm OK!
Theoretical dead load deflection, Δ = 11.0 mm OK!
Theoretical dead and wind load deflection, Δ = -4.0 mm OK! -0.00067 l

Use 300x100 Macrocarpa

SUPPORT REACTIONS:

1.35G = 2.3 kN
1.2G + 1.5Q = 3.5 kN
0.9G + W_u = -3.0 kN
G + ψ_sQ = 1.7 kN
k_2G + ψ_sQ = 3.5 kN
G + W_s = -1.3 kN
G + Q = 2.7 kN
G + W_s = -1.3 kN

BCO10364430 Received by Auckland Council 10/03/2023

Hutchinson
CONSULTING ENGINEERS

JOB: Three Blokes Ltd			
SUBJECT: Cantilevered roof beam design			
BY: Paul W	BEAM: RB2	DATE: Sep 2022	JOB NO: 24742

CANTILEVER UNIFORMLY DISTRIBUTED LOADS:

Dead Loads, G:

roof: 0.35 kPa x 2.0 m = 0.7 kN/m
floor: 0.50 kPa x 0.0 m = 0.0 kN/m
internal walls: 0.35 kPa x 0.0 m = 0.0 kN/m
external walls: 0.50 kPa x 0.0 m = 0.0 kN/m
self weight (member) = 0.20 kN/m

G = 0.9 kN/m

ρ_u = 1.00 kPa
C_{fig} = 1.20
$W_u = \rho_u \times C_{fig} \times$ 2.0 m

W_u = -2.4 kN/m

Live Loads, Q:

roof: 0.25 kPa x 2.0 m = 0.5 kN/m
external floor: 2.00 kPa x 0.0 m = 0.0 kN/m
Internal floor: 1.50 kPa x 0.0 m = 0.0 kN/m

Q = 0.5 kN/m

ρ_s = 0.67 kPa
$W_s = W_u \times \rho_s / \rho_u$

W_s = -1.6 kN/m

CANTILEVER POINT LOADS:

G = 0.0 kN | **Q = 0.0 kN**

W_u = 0.0 kN | **W_s = 0.0 kN**

BACKSPAN UNIFORMLY DISTRIBUTED LOADS:

Dead Loads, G:

roof: 0.35 kPa x 2.0 m = 0.7 kN/m
floor: 0.50 kPa x 0.0 m = 0.0 kN/m
internal walls: 0.35 kPa x 0.0 m = 0.0 kN/m
external walls: 0.50 kPa x 0.0 m = 0.0 kN/m
self weight (member) = 0.20 kN/m

G = 0.9 kN/m

ρ_u = 1.00 kPa
uplift C_{fig} = 1.20
$W_u = \rho_u \times C_{fig} \times$ 2.0 m

W_u = -2.4 kN/m

Live Loads, Q:

roof: 0.25 kPa x 2.0 m = 0.5 kN/m
external floor: 2.00 kPa x 0.0 m = 0.0 kN/m
internal floor: 1.50 kPa x 0.0 m = 0.0 kN/m

Q = 0.5 kN/m

ρ_s = 0.67 kPa
$W_s = W_u \times \rho_s / \rho_u$

W_s = -1.6 kN/m

CANTILEVER LOAD COMBINATIONS:

SLS = Serviceability Limit State
ULS = Ulitmate Limit State

ULS Distributed Loads:	**Point Loads:**
1.35G = 1.2 kN/m	0.0 kN
1.2G + 1.5Q = 1.8 kN/m	0.0 kN
0.9G + W_u = -1.6 kN/m	0.0 kN

Maximum ULS Distributed Load
w = 1.8 kN/m

SLS Distributed Loads:

G + ψ_sQ = 0.9 kN/m	(Steel)	0.0 kN
k_2G + ψ_sQ = 1.8 kN/m	(Timber)	0.0 kN
G + Q + W_s = -0.7 kN/m		0.0 kN
	(where Q = 0.0 kN/m)	

Load duration factor (short term), ψ_s = 0.0
Duration of Load factor, k_2 = 2.0
(moisture content < 18%)

Working Stress Loads:

G + Q = 1.4 kN/m	0.0 kN
G + W_s = -0.7 kN/m	0.0 kN

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JOB: Three Blokes Ltd			
SUBJECT: Cantilevered roof beam design			
BY: Paul W	BEAM: RB2	DATE: Sep 2022	JOB NO: 24742

ULTIMATE LIMIT STATE DESIGN:

design **moment (ULS):**

$M_{cant}^* = \dfrac{w\ell^2}{2} + P\ell_p$

$M_{back}^* = \dfrac{w\ell_b^2}{8} - \dfrac{M_{cant}^*}{2}$

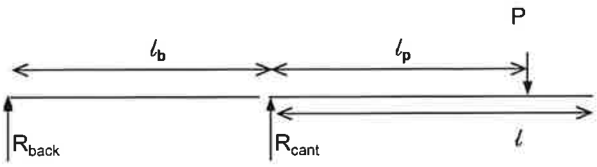
$M^* =$ 5.7 kNm $< \Phi M_n$

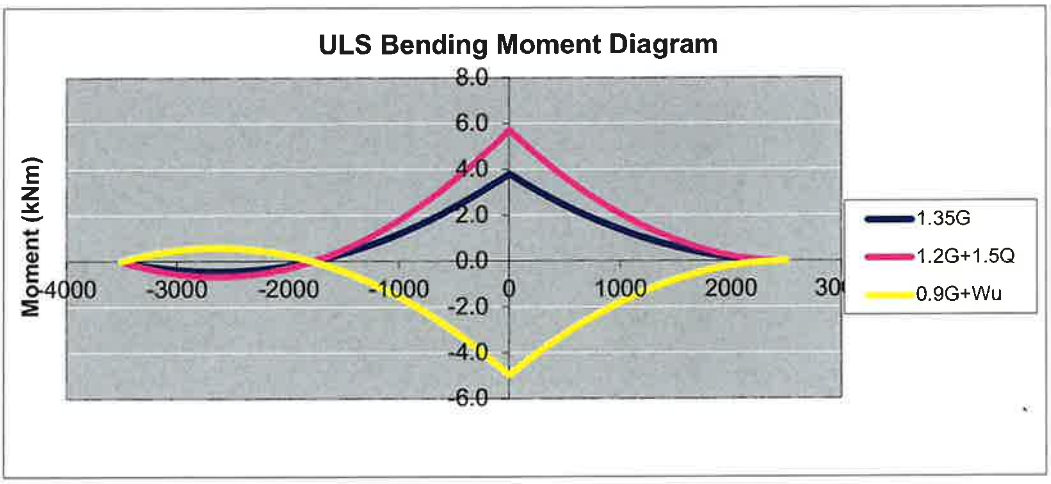
$\ell =$ Cantilever

$\ell =$ **2500 mm**

$\ell_p =$ **2500 mm**

backspan, $\ell_b =$ **3500 mm**





MATERIAL PROPERTIES:

Timber member properties:

Member Type: Single
Timber Grade = hySPAN
Strength reduction factor, ϕ = 0.8
Load duration factor, k_1 = 0.8
Parallel support factor, k_4 = 1.00
Stability factor, k_8 = 1.00
Bending strength, f_b = 48 MPa

Strength reduction factor, ϕ = 0.9
Yield strength, f_y = 320 MPa

For Timber:

$F_b = \Phi k_1 k_4 k_8 f_b$

F_b = 30.7 MPa

For Steel:

$F_b = \Phi f_y$

F_b = 288 MPa

effective section moduli:

$M^* = \Phi M_n$

$\Phi M_n = F_b Z$

$Z_{req} \geq \dfrac{M^*}{F_b}$

$Z_{req} \geq$ **186.2** $\times 10^3$ mm^3

$Z_{req} \geq$ **19.9** $\times 10^3$ mm^3

Try:	150PFC

$Z_{(Actual)} =$ 129.0 $\times 10^3$ mm^3

Hutchinson CONSULTING ENGINEERS

JOB: Three Blokes Ltd			
SUBJECT: Cantilevered roof beam design			
BY: Paul W	BEAM: RB2	DATE: Sep 2022	JOB NO: 24742

SERVICABILITY LIMIT STATE DESIGN:

$$\Delta = \frac{w\,l^4}{8\,EI} + \frac{P\,l_p^3}{3\,EI} + \text{rotation}$$

limit **cantilever deflection** to $\frac{\text{span}}{250}$ = 10 mm & **cantilever wind deflection** to $\frac{\text{span}}{250}$ = 10 mm

limit **backspan deflection** to $\frac{\text{span}}{500}$ = 7 mm

MATERIAL PROPERTIES:

Timber member properties:

Distributed dead load, w = 1.8 kN/m
Distributed dead and live load, w = 1.8 kN/m
Distributed dead and wind load, w = -0.7 kN/m
Point load dead load, P = 0.0 kN
Point load dead and live load, P = 0.0 kN
Point load dead and wind load, P = 0.0 kN

Modulus of elasticity, E = 13200 MPa

total timber $I_{req} \geq$ 130.0 $\times 10^6$ mm^4
(GRAVITY GOVERNS)
cantilever $I_{req} \geq$ 66.6 $\times 10^6$ mm^4
rotation $I_{req} \geq$ 63.4 $\times 10^6$ mm^4

Steel member properties:

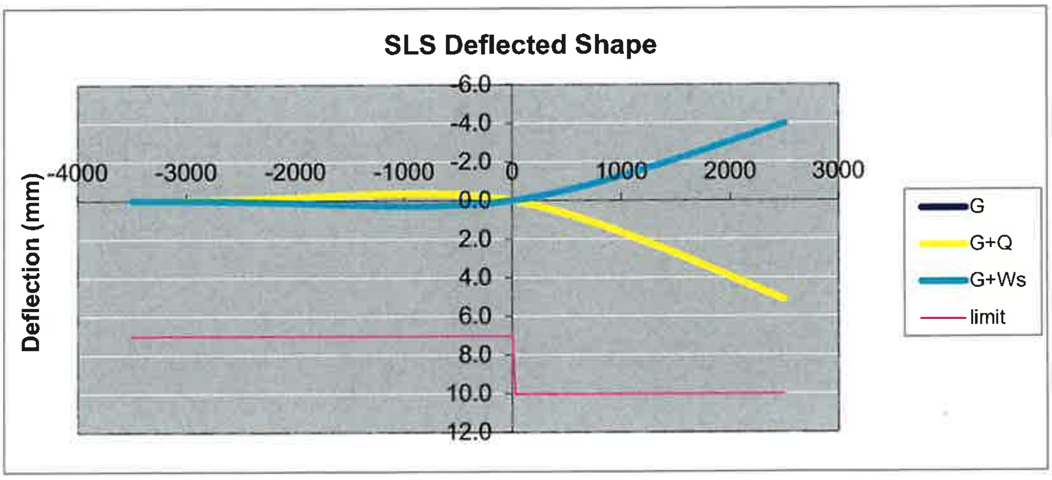
Distributed dead load, w = 0.9 kN/m
Distributed dead and live load, w = 0.9 kN/m
Distributed dead and wind load, w = -0.7 kN/m
Point load dead load, P = 0.0 kN
Point load dead and live load, P = 0.0 kN
Point load dead and wind load, P = 0.0 kN

Modulus of Elasticity, E = 200 GPa

total steel $I_{req} \geq$ 4.3 $\times 10^6$ mm^4
(GRAVITY GOVERNS)
cantilever $I_{req} \geq$ 2.2 $\times 10^6$ mm^4
rotation $I_{req} \geq$ 2.1 $\times 10^6$ mm^4

Try: 150PFC

$I_{(Actual)}$ = 8.3 $\times 10^6$ mm^4



Hutchinson
CONSULTING ENGINEERS

JOB: Three Blokes Ltd			
SUBJECT: Cantilevered roof beam design			
BY: Paul W	BEAM: RB2	DATE: Sep 2022	JOB NO: 24742

RB2 DESIGN SUMMARY:

Moment capacity, ϕM = 37.2 kNm	OK!	
Theoretical dead load deflection, Δ = 5.1 mm	OK!	
Theoretical dead and live load deflection, Δ = 5.1 mm	OK!	
Theoretical dead and wind load deflection, Δ = -4.0 mm	OK!	-0.002 mm
Backspan dead load deflection, Δ = -0.2 mm	<SPAN/300 - OK!	
Backspan dead and live load deflection, Δ = -0.2 mm	<SPAN/300 - OK!	
Backspan dead and wind load deflection, Δ = 0.2 mm	<SPAN/150 - OK!	

Use 150PFC

SUPPORT REACTIONS:

Cantilever Support	***Backspan Support***
1.35G = 6.2 kN	1.35G = 1.0 kN
1.2G + 1.5Q = 9.4 kN	1.2G + 1.5Q = 1.6 kN
$0.9G + W_u$ = -8.2 kN	$0.9G + W_u$ = -1.4 kN
$G + \psi_s Q$ = 4.6 kN	$G + \psi_s Q$ = 0.8 kN
$k_2 G + \psi_s Q$ = 9.3 kN	$k_2 G + \psi_s Q$ = 1.5 kN
$G + Q + W_s$ = -1.0 kN	$G + Q + W_s$ = -0.2 kN
G + Q = 7.2 kN	G + Q = 1.2 kN

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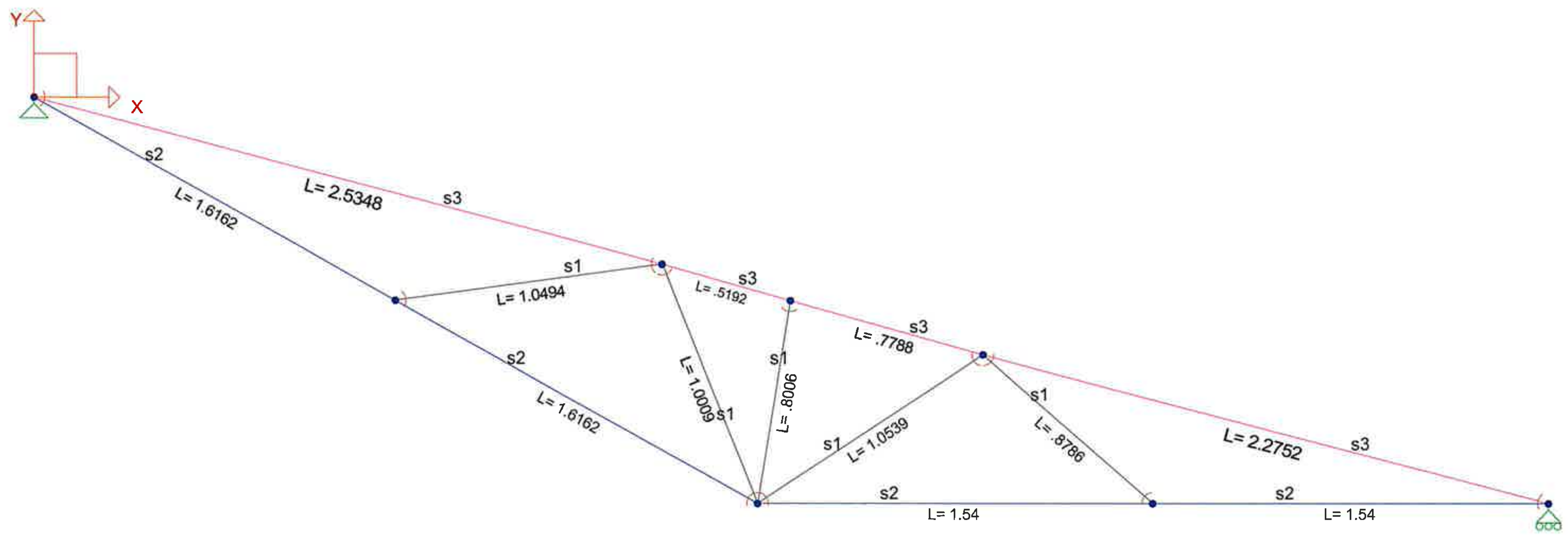
Filename: Type A Truss.TEL
Description: Type A Truss
Engineer: Paul Wilson

Page: 1 of 1



Section Properties

1 - 100x100	
2 - 150x100	
3 - 200x100	

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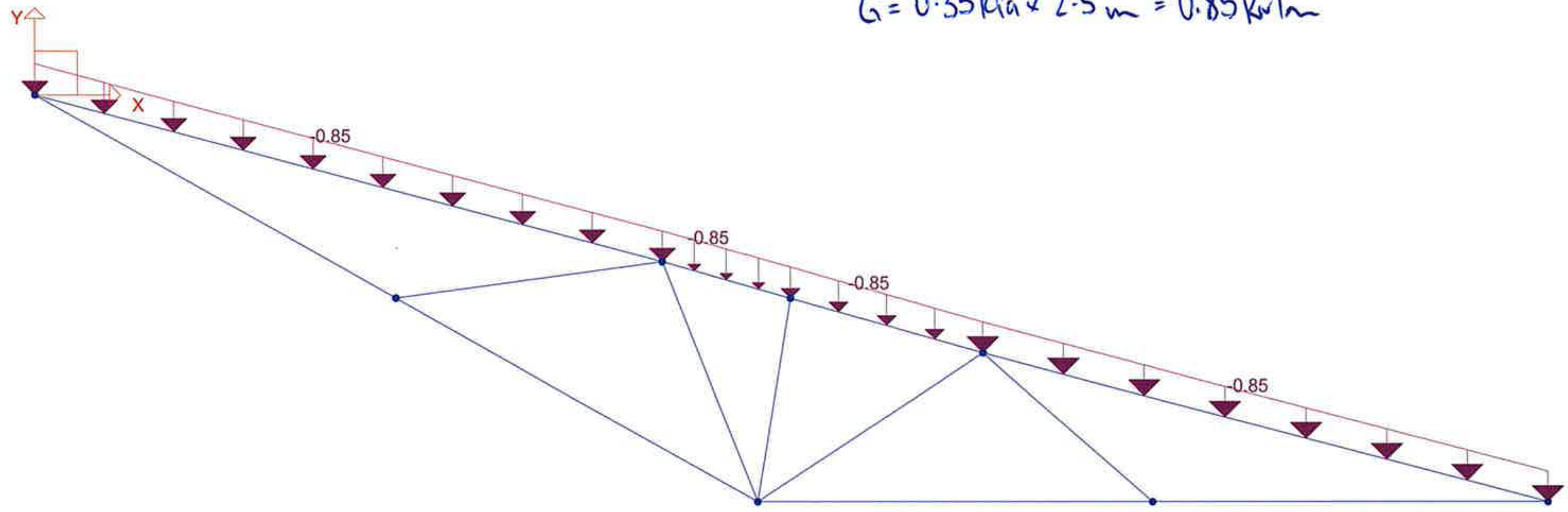
Filename: Type A Truss.TEL
Load Case 1: Dead (G)
Engineer: Paul Wilson

Page: 1 of 1

G = 0.35 kPa × 2.5 m = 0.85 kN/m



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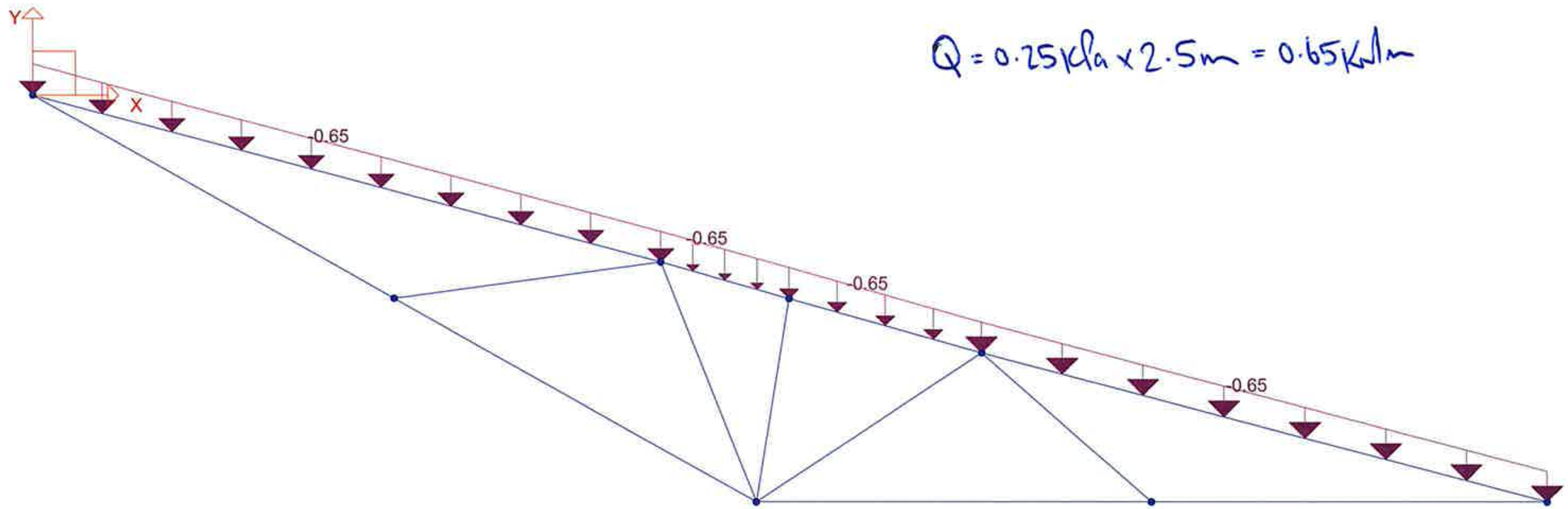
Filename: Type A Truss.TEL
Load Case 2: Live (Q)
Engineer: Paul Wilson

Page: 1 of 1

$Q = 0.25kPa \times 2.5m = 0.65kN/m$



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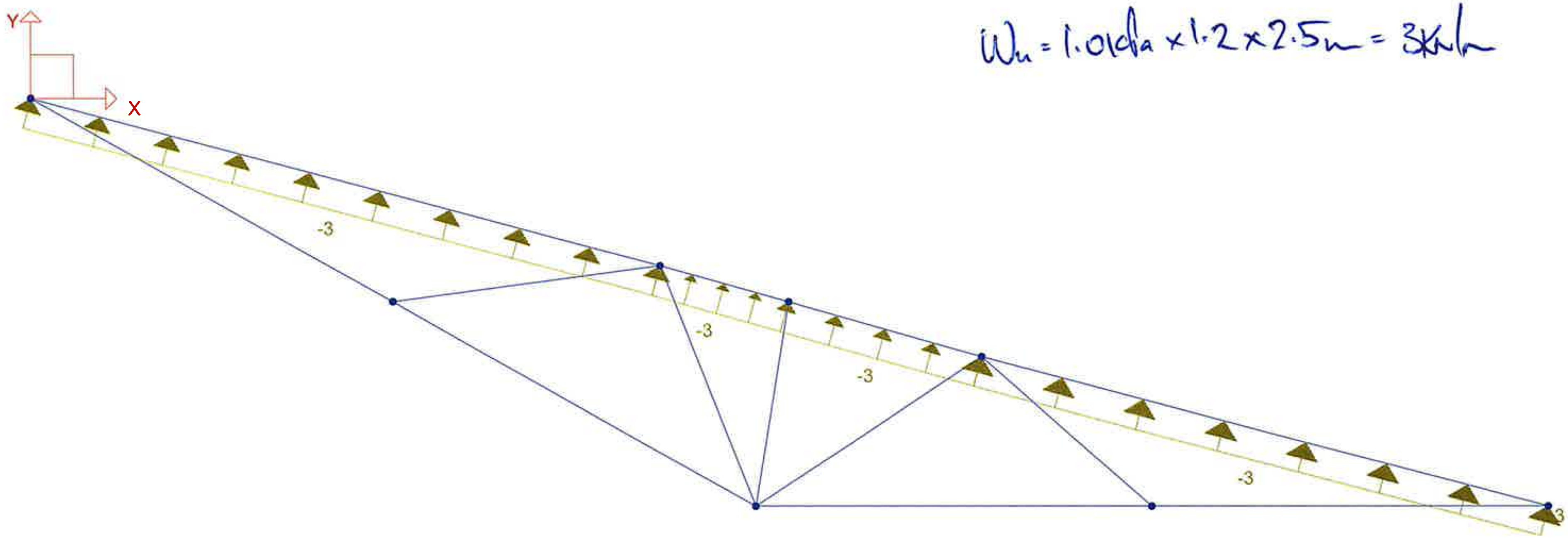
Filename: Type A Truss.TEL
Load Case 3: Wind (W)
Engineer: Paul Wilson

Page: 1 of 1



Wu = 1.01kPa × 1.2 × 2.5m = 3kN/m

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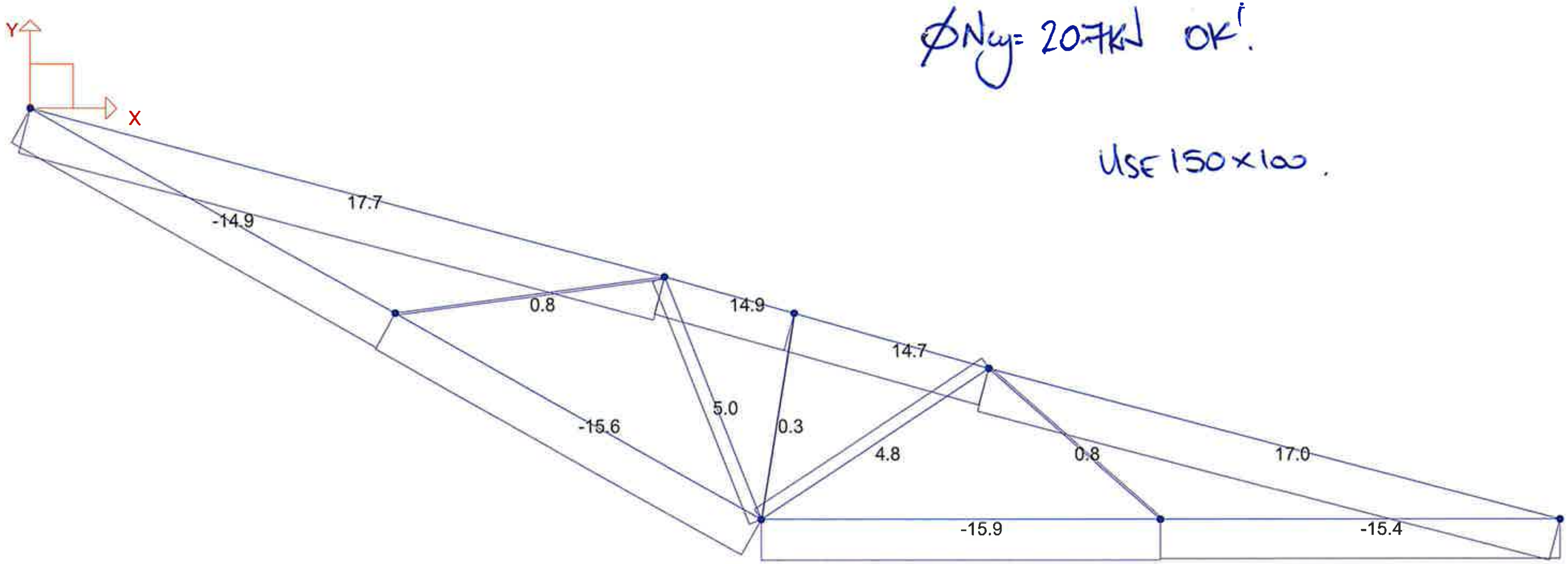
Three Blokes Ltd

Filename: Type A Truss.TEL
GRAPHICAL RESULTS - Ld Comb 3 0.9G+Wu->Axial Force (kN)
Engineer: Paul Wilson

ϕN_{cy} = 20.7kN OK!

USE 150×100.



l_e = 6.3m.

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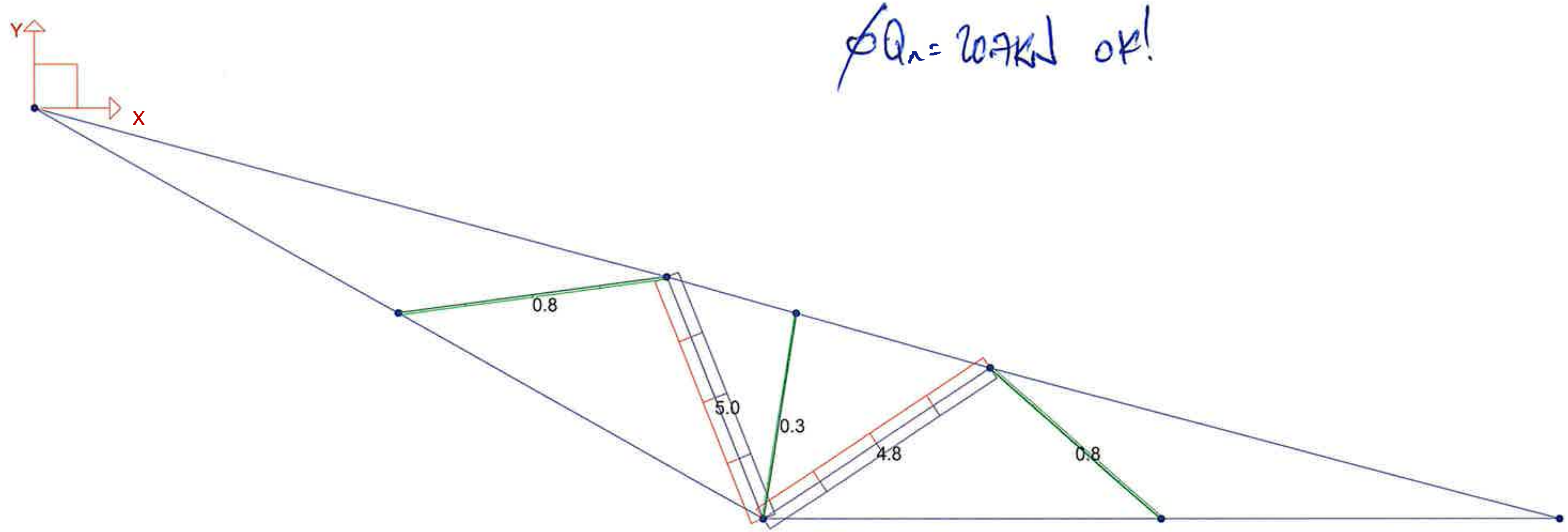
Three Blokes Ltd

Filename: Type A Truss.TEL
GRAPHICAL RESULTS - Envelopes of Axial Force (kN)
Engineer: Paul Wilson

Page: 1 of 1

$\phi Q_n = 20.7kN$ ok!



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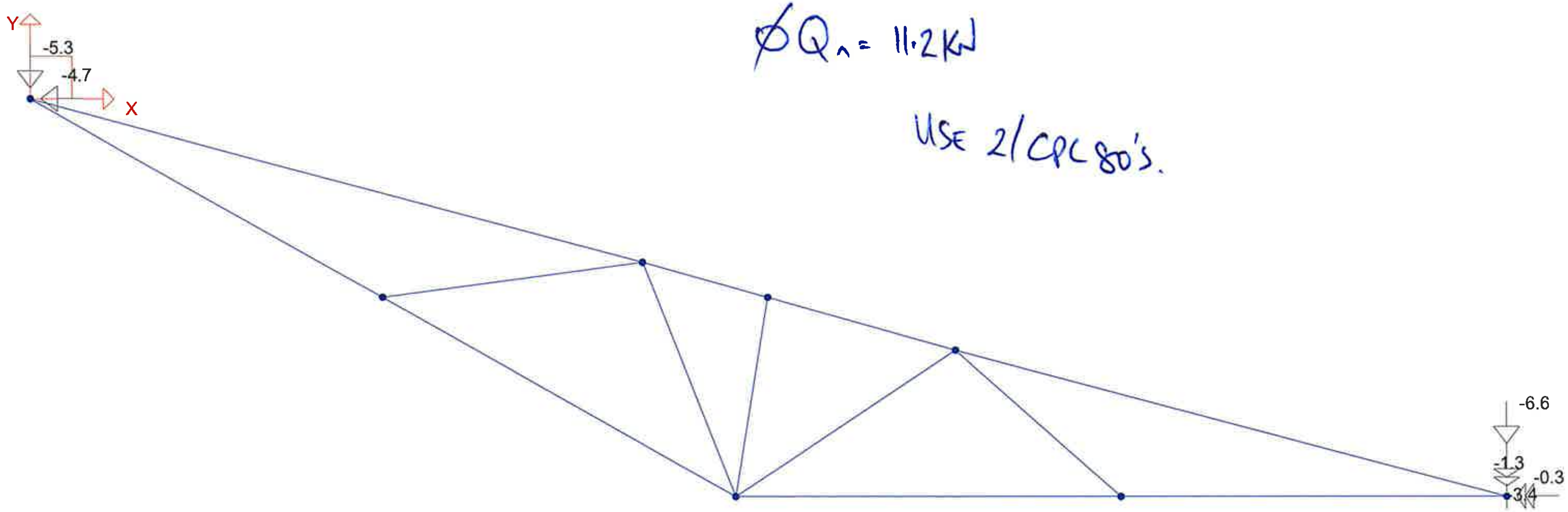
Three Blokes Ltd

Filename: Type A Truss.TEL
GRAPHICAL RESULTS - Ld Comb 3 0.9G+Wu->Reactions (kN)
Engineer: Paul Wilson

Page: 1 of 1

$\phi Q_n = 11.2$ kN

USE 2/CPC 80's.



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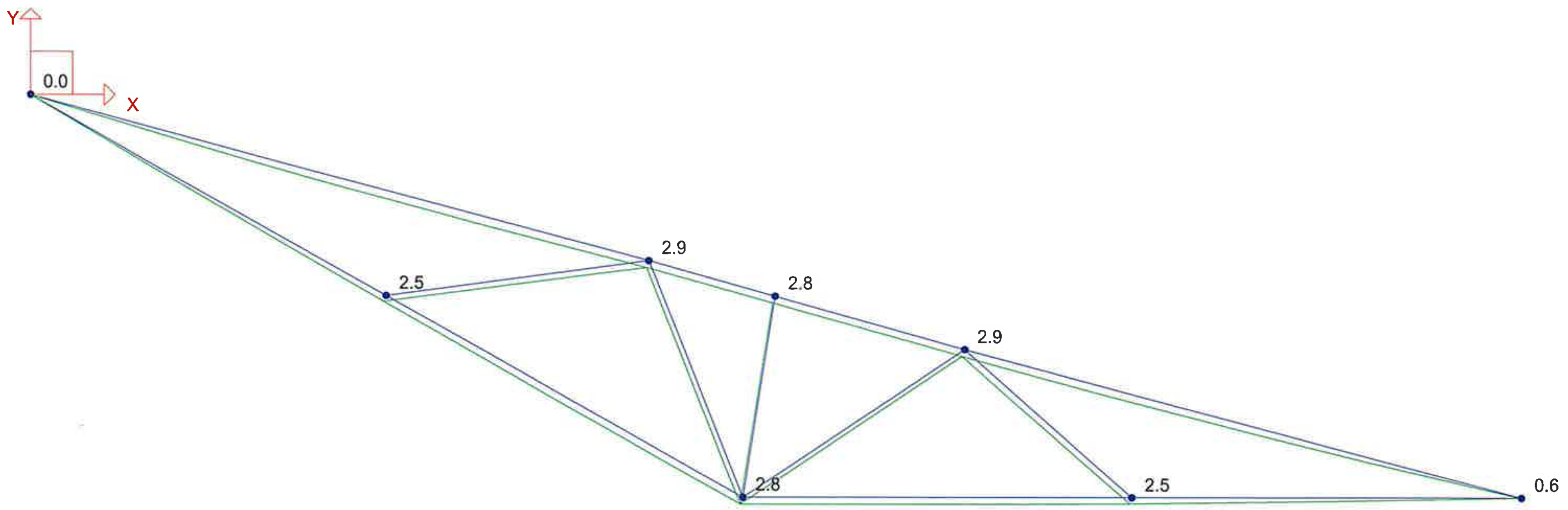
Three Blokes Ltd

Filename: Type A Truss.TEL
GRAPHICAL RESULTS - Ld Comb 4 kG+yQ->Deflections (mm)
Engineer: Paul Wilson

Page: 1 of 1



$\Delta_{LIMIT} = \frac{6000}{500} = 12mm.$ OK!

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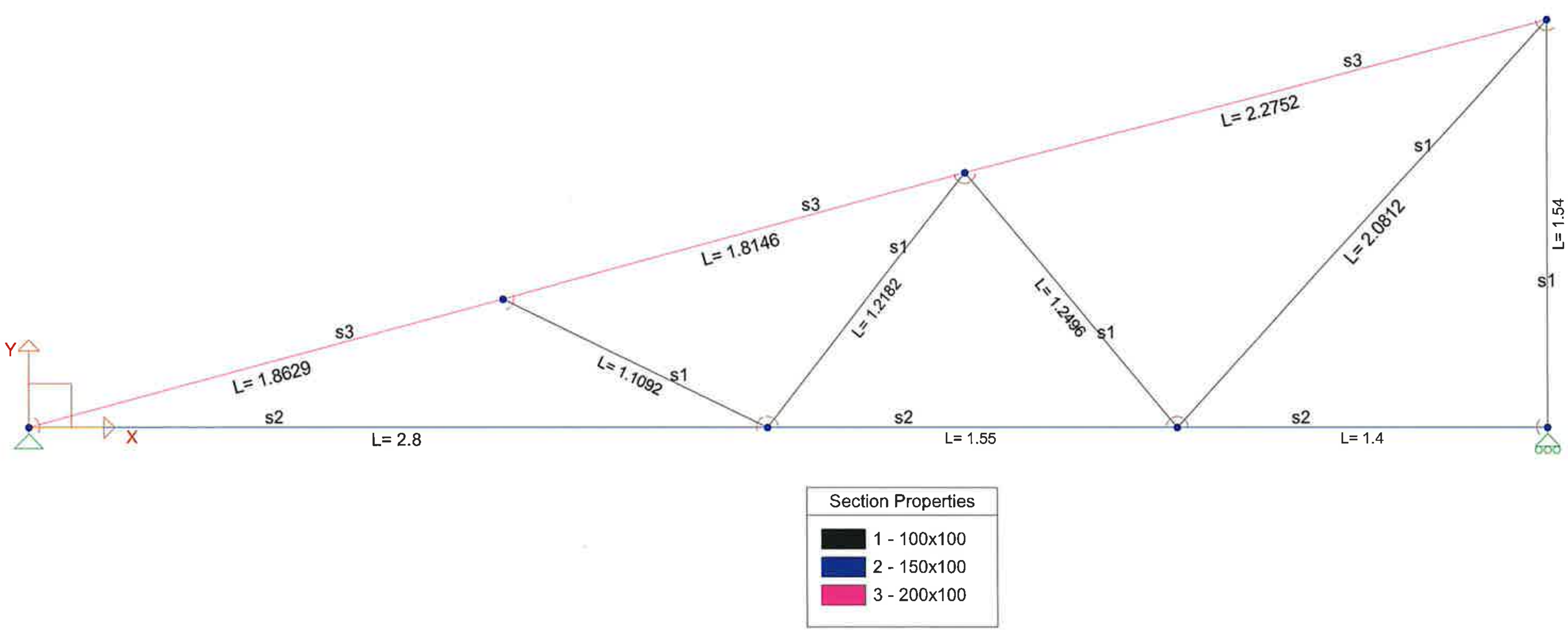
Page: 1 of 1

Three Blokes Ltd

Filename: Type B Truss.TEL
Description: Type B Truss
Engineer: Paul Wilson



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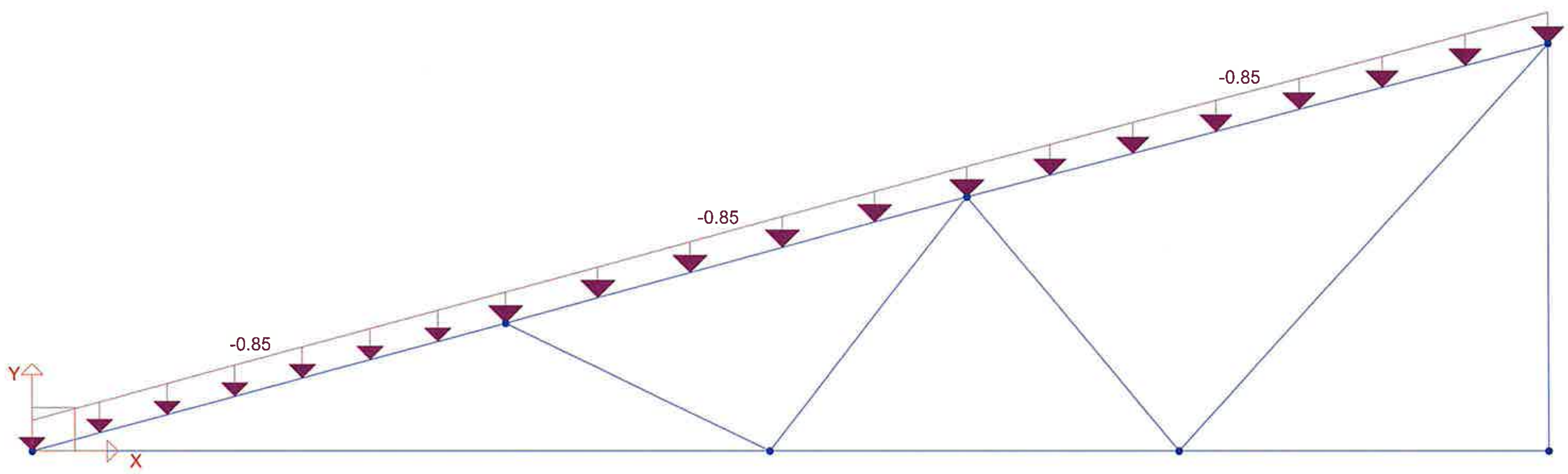
Three Blokes Ltd

Filename: Type B Truss.TEL
Load Case 1: Dead (G)
Engineer: Paul Wilson

Page: 1 of 1



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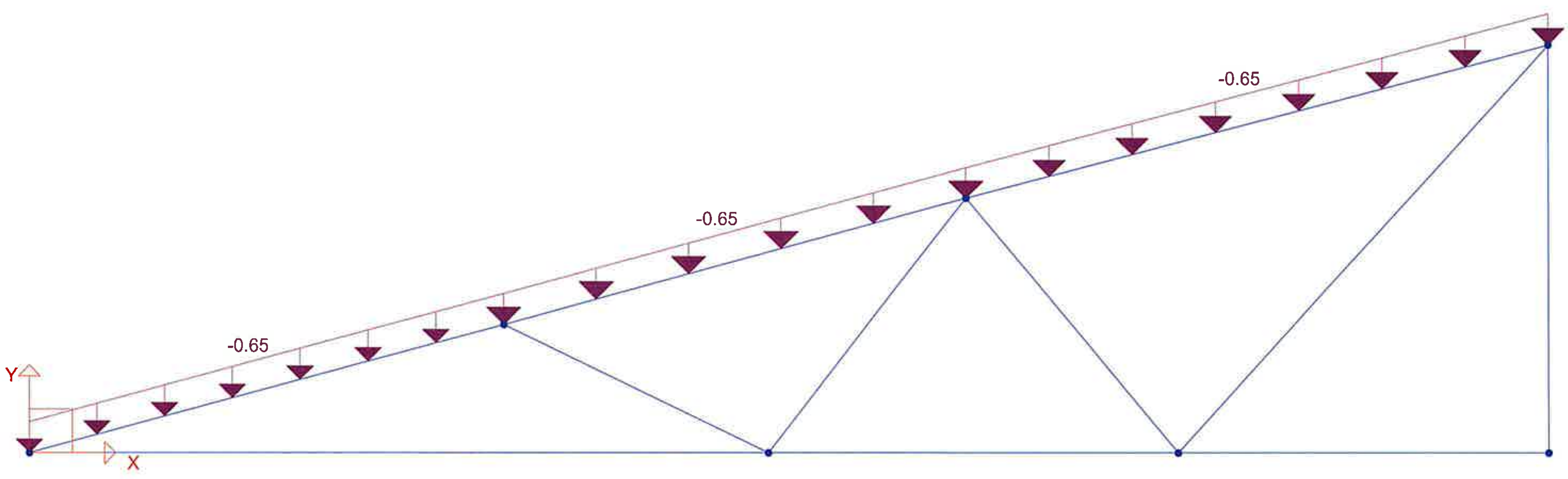
Three Blokes Ltd

Filename: Type B Truss.TEL
Load Case 2: Live (Q)
Engineer: Paul Wilson

Page: 1 of 1



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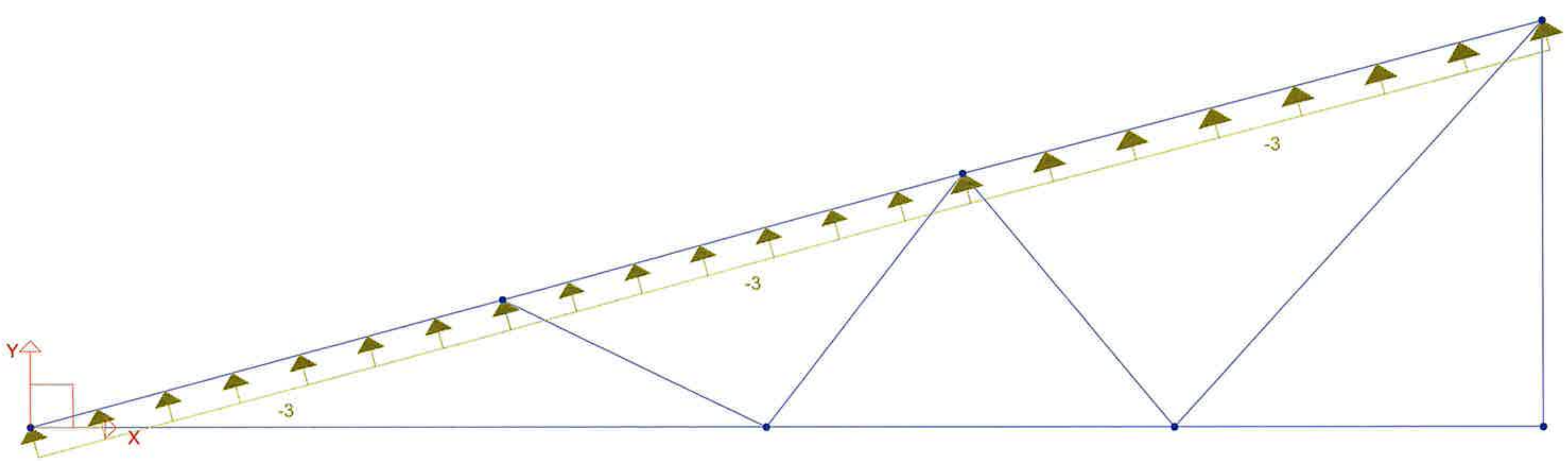
Three Blokes Ltd

Filename: Type B Truss.TEL
Load Case 3: Wind (W)
Engineer: Paul Wilson

Page: 1 of 1



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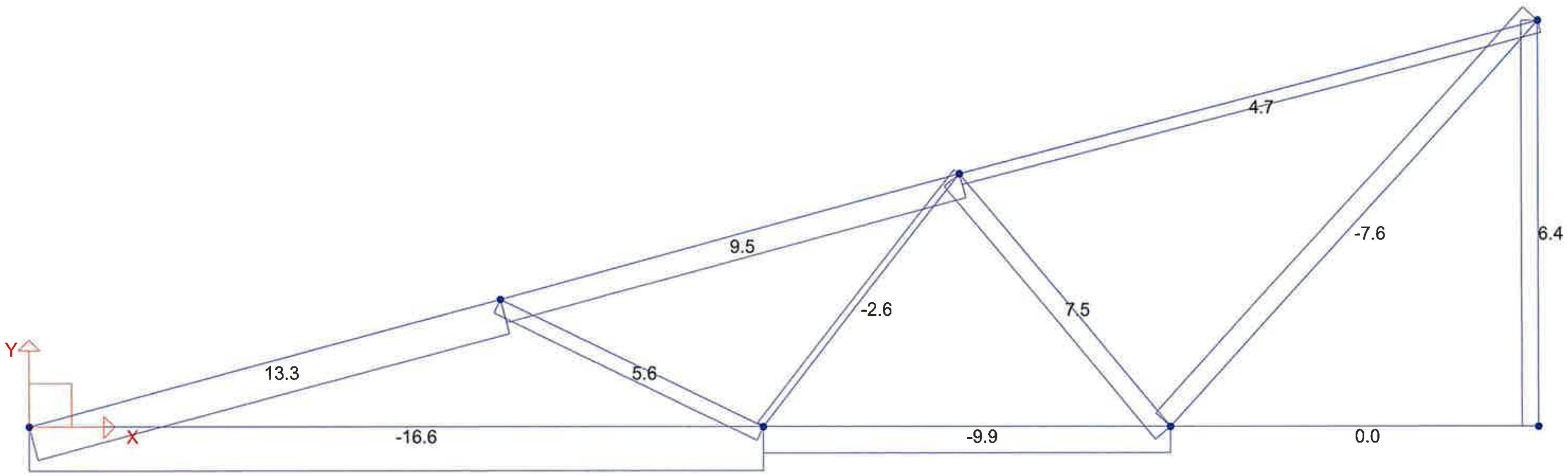
Three Blokes Ltd

Filename: Type B Truss.TEL
GRAPHICAL RESULTS - Ld Comb 3 0.9G+Wu->Axial Force (kN)
Engineer: Paul Wilson

Page: 1 of 1



φNcy = 20kN OK

USE 150x100

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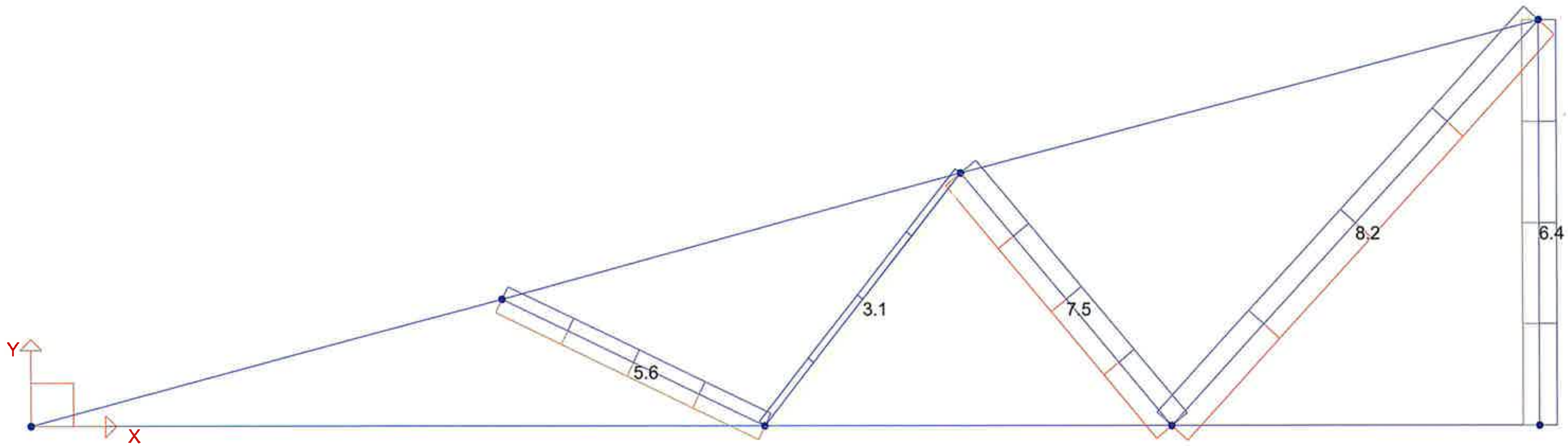
Three Blokes Ltd

Filename: Type B Truss.TEL
GRAPHICAL RESULTS - Envelopes of Axial Force (kN)
Engineer: Paul Wilson



$\phi Q_n = 20.7kN$ OK!

USE M16 BOLTS

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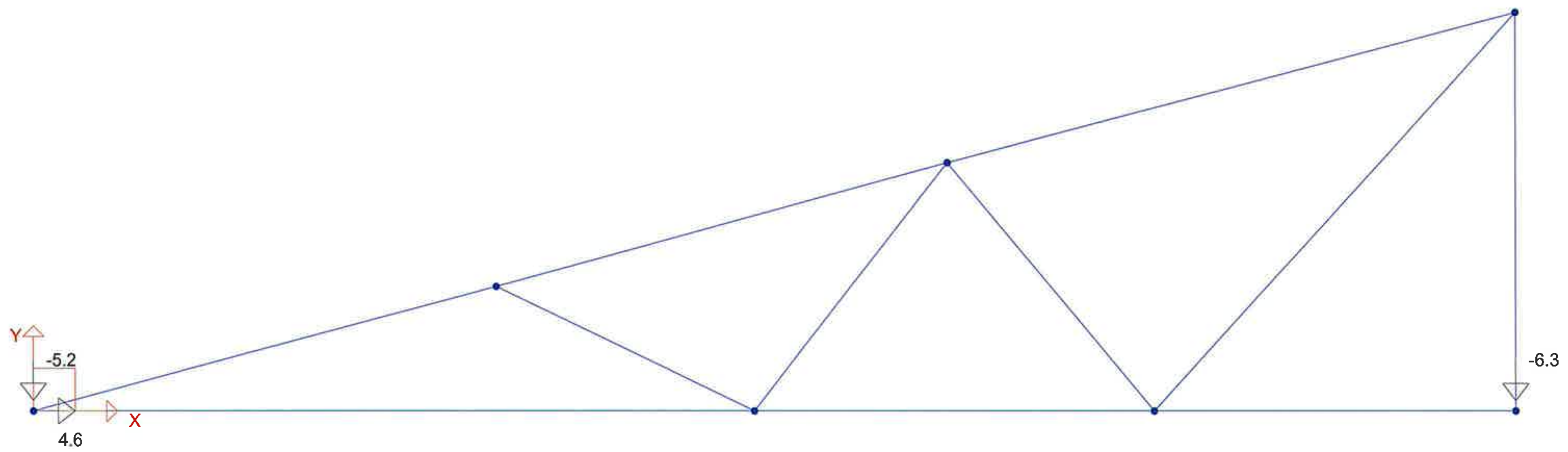
Page: 1 of 1

Three Blokes Ltd

Filename: Type B Truss.TEL
GRAPHICAL RESULTS - Ld Comb 3 0.9G+Wu->Reactions (kN)
Engineer: Paul Wilson



ϕQ_n = 11.2kN OK!   USE 2/CPC 80's.

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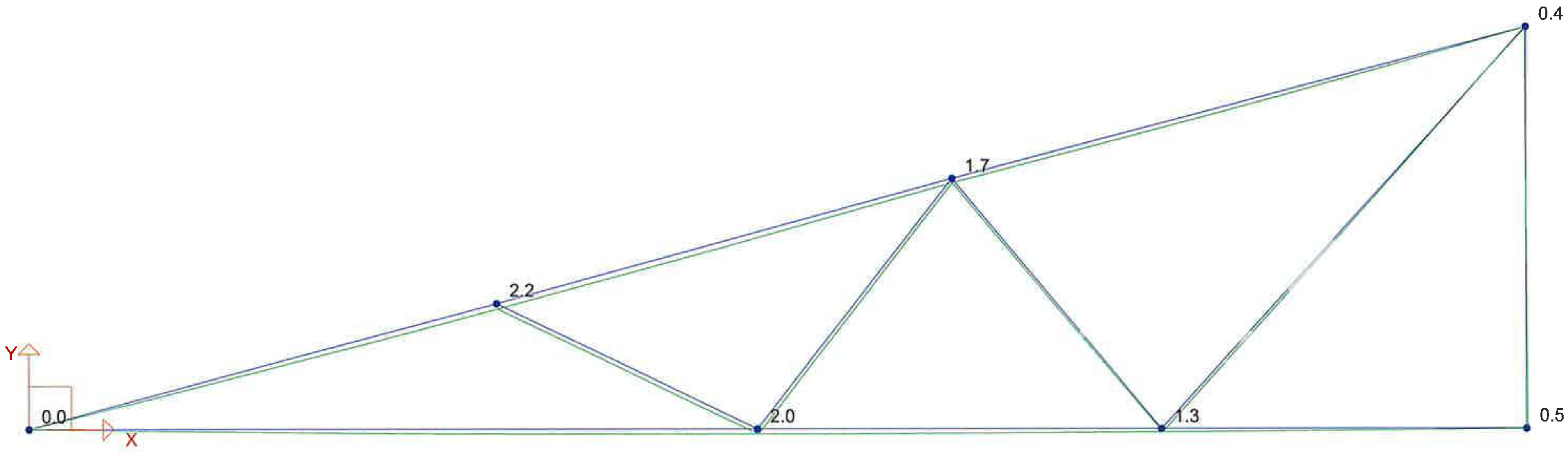
Three Blokes Ltd

Filename: Type B Truss.TEL
GRAPHICAL RESULTS - Ld Comb 4 kG+yQ->Deflections (mm)
Engineer: Paul Wilson

Page: 1 of 1



$\Delta_{LIMIT} = \frac{6000}{500} \approx 12mm$ ok!

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SHED 2 DESIGN

Hutchinson CONSULTING ENGINEERS	JOB: Three Blokes Ltd		
	SUBJECT: Shed 2 Wind Bracing Demand		
	BY: Paul W	DATE: Sep 2022	JOB NO: 24742

in accordance with AS/NZS 1170.2 2002

Building Importance: 2 *Normal Structures and structures not falling into other levels*
Design life: 50 years
Probability of Exceedance: 1/500 *(Ultimate)* 1/25 *(servicability)*

Wind Region = A6 Rodney District

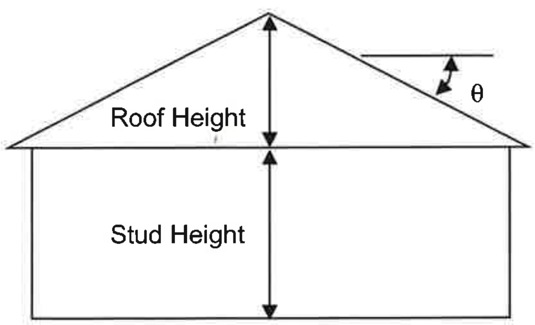
Site wind speed $V_{(site,\beta)} = V_R\, M_d\, \{M_{z\,cat}\, M_s\, M_t\}$

	ULTIMATE LIMIT STATE	***SERVICABILITY LIMIT STATE***
Regional wind speed	V_{500} = 45 m/s	V_{25} = 37 m/s
Direction multiplier	M_d = 1.00	M_d = 1.00
Terrain category (1 - 4)	= 2	= 2
Building height	= 4.4 m	= 4.4 m
Terrain/height multiplier	$M_{(z\,cat)}$ = 0.91	$M_{(z\,cat)}$ = 0.91
Shielding multiplier	M_s = 1.00	M_s = 1.00
Elevation above mean sea level	E = 28.3 m	E = 28 m
Topographic multiplier	M_t = 1.00	M_t = 1.00
Hill-shape multiplier	M_h = 1.00	M_h = 1.00
Lee multiplier	M_{lee} = 1.00	M_{lee} = 1.00

(site not in lee zone refer to figure 3.1(b) AS/NZS 1170.2:2002)

Site wind speed	$V_{(site,\beta)}$ = 41.0 m/s (High)	$V_{(site,\beta)}$ = 33.7 m/s
Design wind speed	= $V_{(des,\theta)}$	
Design wind pressure	$\rho_u = (0.5\rho_{air})\{V_{(des,\theta)}\}^2 C_{fig} C_{dyn}$	
	C_{dyn} = 1.00	
	= 1.01 kPa x C_{fig}	ρ_s = 0.68 kPa
Design force on building	$F = \Sigma(\rho_z\, A_z)$	

BUILDING DIMENSIONS

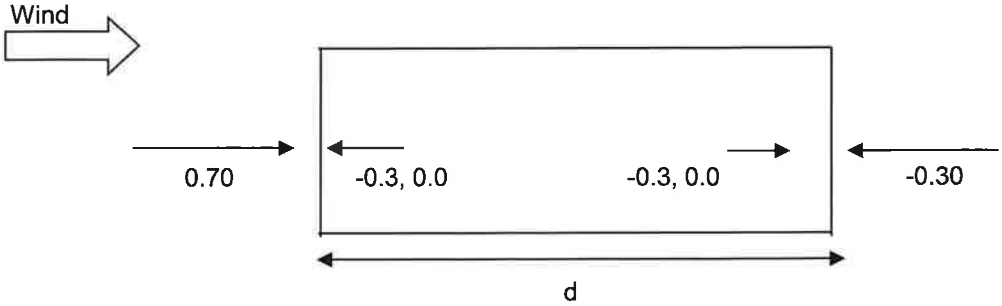


Roof Pitch, θ = 15°
Roof Height = 1.0 m
Stud Height = 3.9 m
Building Breadth, b = 7.0 m (Varies with wind direction)
Building Depth, d = 15.2 m (Varies with wind direction)

ALONG-WIND AERODYNAMIC SHAPE FACTOR

Internal and external pressure coefficients, $C_{p,i}$ & $C_{p,e}$:

Breadth, b = 7.0 m		
Depth, d = 15.2 m		h/d = 0.29
Average height of building, h = 4.4 m		d/b = 2.17
Roof pitch, θ = 0°		b/d = 0.46
Rafter length, x = 0.00 m		x/h = 0.00



$C_{fig} = (C_{p,e} + C_{p,i}) \times K_c$

Action combination factor, K_c = 0.90

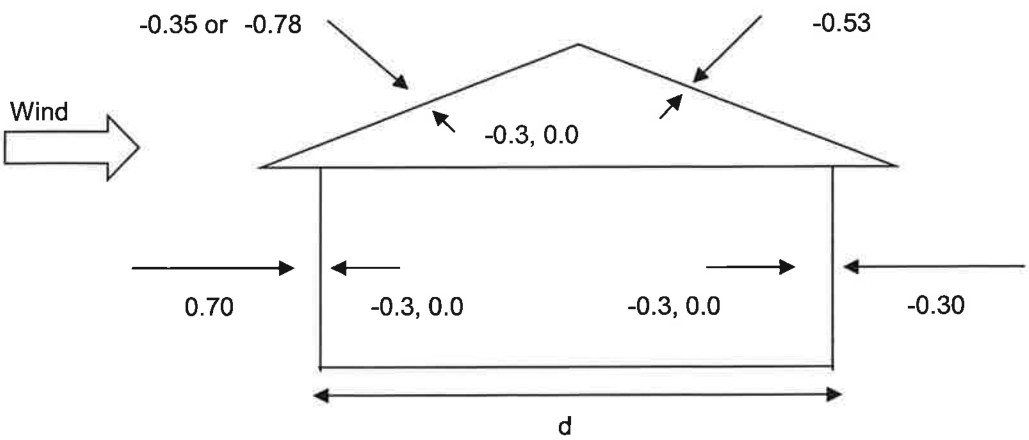
$C_{fig\ roof}$ = 0.00

$C_{fig\ wall}$ = 0.90

CROSSWIND AERODYNAMIC SHAPE FACTOR

Internal and external pressure coefficients, $C_{p,i}$ & $C_{p,e}$:

Breadth, b = 15.2 m	
Depth, d = 7.0 m	h/d = 0.63
Average Height, h = 4.4 m	d/b = 0.46
Roof Pitch, θ = 15°	b/d = 2.17
Rafter length, x = 3.62 m	x/h = 0.82



$C_{fig} = (C_{p,e} + C_{p,i}) \times K_c$

Action combination factor, K_c = 0.80

$C_{fig\ roof}$ = 0.14

$C_{fig\ wall}$ = 0.80

BRACING DEMAND

Horizontal design force on building, $F = \Sigma(\rho_z A_z)$

$F = \Sigma(\rho_u \times A_{wall} \times C_{fig\ wall} + \rho_u \times A_{roof} \times C_{fig\ roof} \times \sin\theta)$

ALONG-WIND DIRECTION:

F = 15.5 kN x 20 = 350 BU's

CROSSWIND DIRECTION:

F = 26.0 kN x 20 = 550 BU's

Along-Wind Bracing Demand = 350 BU's
Crosswind Bracing Demand = 550 BU's

Hutchinson CONSULTING ENGINEERS

JOB: Three Blokes Ltd		
SUBJECT: Shed 2 Earthquake Bracing Demand		
BY: Paul W	DATE: Sep 2022	JOB NO: 24742

in accordance with NZS 1170.5:2004

Lateral force coefficient, $C(T) = C_h(T)\,Z\,R\,N(T,D)$

	ULTIMATE LIMIT STATE		***SERVICABILITY LIMIT STATE***
Structural ductility factor	μ = 3		μ = 1
Site subsoil class	= C	Shallow soil site	= C
Period	< 0.40 s		< 2.00 s
Hazard factor	Z = 0.13	(table 3.3)	Z = 0.13
Return period factor	$R_{(1/500)}$ = 1.00	(table 3.5)	$R_{(1/25)}$ = 0.25
Near-fault factor	N(T,D) = 1.00		N(T,D) = 1.00
Basic acceleration hazard	C_h = 2.36		C_h = 0.66
Lateral force coefficient	$C(T) = C_h(T)\,Z\,R\,N(T,D)$ = 0.31		$C(T) = C_h(T)\,Z\,R\,N(T,D)$ = 0.02
Structural performance factor	S_p = 0.70		S_p = 0.70
Inelastic spectrum scaling factor	k_μ = 2.1		k_μ = 1.0
Horizontal design action coefficent	$C_d(T_1) = C(T_1)S_p/k_\mu$ = 0.10		$C_d(T_1) = C(T_1)S_p/k_\mu$ = 0.02

$V = C_d(T_1)W_t$
= 11.1 kN

W_t = 110.3 kN
W_ih_i = 386.1 kNm

GROUND FLOOR DEAD LOADS

Roof:	0.45 kPa x	145.0 m² =	65.3 kN
External Timber Framed Walls:	0.50 kPa x	90.0 m² =	45.0 kN
		ΣG =	**110.3 kN**

GROUND FLOOR LIVE LOADS

Roof:	0.25 kPa x	145.0 m² =	36.3 kN
		ΣQ =	**36.3 kN**

ψ_u = 0.0

Ground Bracing Demand = $F_t + 0.92V\{W_ih_i/\Sigma W_ih_i\}$
= 11.1 kN

W_i = 110 kN
h_i = 3.5 m
F_t = 0.9 kN (top level)

Ground Bracing Demand = 250 BU's

BCO10364430 Received by Auckland Council 10/03/2023

3.3 IBS RigidRAP® WALL BRACING SYSTEM

3.3.1 BRACING CAPACITY

The following table provides the bracing value for the different systems:

Table 1	Concrete Slab		Timber Floor	
System	Wind	EQ	Wind	EQ
SYSTEM 1: OSB - 300 mm x 2400 mm wall with GIB HandiBrac® Fixing 30 mm x 2.5 mm Galv clouts	49 BU/m	58BU/m	49 BU/m	58 BU/m
SYSTEM 2: OSB - 400 mm x 2400 mm wall with GIB HandiBrac® Fixing 30 mm x 2.5 mm Galv clouts.	70 BU/m	79 BU/m	70 BU/m	79 BU/m
SYSTEM 3: OSB - 600 mm x 2400 mm wall with GIB HandiBrac® Fixing 30 mm x 2.5 mm Galv clouts	76 BU/m	81 BU/m	76 BU/m	81 BU/m
SYSTEM 4: OSB - 1200 mm x 2400 mm wall with GIB HandiBrac® Fixing 30 mm x 2.5 mm Galv clouts	131 BU/m	107 BU/m	131 BU/m	107 BU/m
SYSTEM 5: OSB - 2400 mm x 2400 mm wall with GIB HandiBrac® Fixing 30 mm x 2.5 mm Galv clouts	108 BU/m	89 BU/m	108 BU/m	89 BU/m
SYSTEM 6: OSB - 1200 mm x 2400 mm wall **without** GIB HandiBrac® Fixing 30 mm x 2.5 mm Galv clouts	93 BU/m	78 BU/m	93 BU/m	78BU/m
SYSTEM 7: OSB - 400 mm x 2400 mm wall with GIB HandiBrac® GIB standard 10 mm board on the inside Fixing 30 mm x 2.5 mm Galv clouts	94 BU/m	104 BU/m	94 BU/m	104 BU/m
SYSTEM 8: OSB - 600 mm x 2400 mm wall with GIB HandiBrac® GIB standard 10 mm board on the inside Fixing 30 mm x 2.5 mm Galv clouts	130 BU/m	130 BU/m	120 BU/m	120 BU/m
SYSTEM 9: OSB - 1200 mm x 2400 mm wall with GIB HandiBrac® GIB standard 10 mm board on the inside Fixing 30 mm x 2.5 mm Galv clouts	150 BU/m	150 BU/m	130 BU/m	130 BU/m

NOTE:

- For all bracing systems no product substitution is allowed. Installation must be in accordance with these instructions. If these requirements are not met, IBS provides no assurance that the bracing capacity (claimed in this design and installation guide) will be achieved.
- The allowable racking resistances for the IBS RigidRAP® systems are applicable to frames lined with IBS RigidRAP® on one side only.
- Panels must always be installed vertically if used as bracing sheet. Sheets can be installed horizontally if not used as a bracing element.
- All IBS RigidRAP systems have been tested with no nogs or dwangs
- Stud sizes and centres will vary depending on height load and loads ref: NZS3604:2011.

The systems may be used on walls of lengths different to those in TABLE 1 but is limited to:

- Wall lengths no greater than twice the tested system length.
- For walls greater than the tested system length multiply the length of the wall on a pro-rata basis, up to double the length of the system.
- A wall height less than 1.5 meters should be referred to a specific engineer design.
- A wall height less than 2.4 meters should be rated as if they are 2.4 meters high.
- Panels higher than IBS RigidRAP® 2440 mm must be fixed top plate to bottom plate. When walls are higher than 2440 mm, IBS RigidRAP® 2745 or 3050 mm sheets can be used.
- A part sheet can be used but must be nogged and nailed as per specification.

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Hutchinson
CONSULTING ENGINEERS

JOB:	Three Blokes Ltd	
SUBJECT:	Shed 2 bracing allocation tables	
BY: Paul W	DATE: Sep 2022	JOB NO: 24742

BRACING ALLOCATION - ALONG DIRECTION

(in accordance with NZS 3604:2011)

Wall or Bracing Line		Bracing Elements Provided					Earthquake		Wind	
Line Label	Minimum BU's Required	Bracing Element No.	Bracing Type	Element Length (m)	Stud Height (m)	Angle from Wind Direction	Rating BU's	BU's Achieved	Rating BU's	BU's Achieved
M	228 EQ 228 Wind	1	IBS	1.2	3.54	0	107	87	131	107
		2	IBS	1.2	3.54	0	107	87	131	107
		3	IBS	1.2	3.54	0	107	87	131	107
		4	IBS	1.2	3.54	0	107	87	131	107
EQ Achieved = 348.2 *Wind Achieved = 426.3*										
N	228 EQ 228 Wind	1	IBS	1.2	3.54	0	107	87	131	107
		2	IBS	1.2	3.54	0	107	87	131	107
		3	IBS	1.2	3.54	0	107	87	131	107
		4	IBS	1.2	3.54	0	107	87	131	107
EQ Achieved = 348.2 *Wind Achieved = 426.3*										

Achieved	**EQ**	696	**Wind**	853
Required	**EQ**	**250**	**Wind**	**350**
		OK		OK

$Wind_{req}$ / EQ_{req} 1.40 Wind and Earthquake

BCO10364430 Received by Auckland Council 10/03/2023

Hutchinson CONSULTING ENGINEERS

JOB:	Three Blokes Ltd
SUBJECT:	Shed 2 bracing allocation tables
BY: Paul W	DATE: Sep 2022
JOB NO:	24742

BRACING ALLOCATION - ACROSS DIRECTION

(in accordance with NZS 3604:2011)

Wall or Bracing Line		Bracing Elements Provided					Earthquake		Wind	
Line Label	Minimum BU's Required	Bracing Element No.	Bracing Type	Element Length (m)	Stud Height (m)	Angle from Wind Direction	Rating BU's	BU's Achieved	Rating BU's	BU's Achieved
A	105 EQ 105 Wind	1	IBS	1.2	3.70	0	107	83	131	102
		2	IBS	1.2	3.70	0	107	83	131	102
EQ Achieved = 166.6 *Wind Achieved = 203.9*										
B-C	100 EQ 100 Wind	1	GS2-N	2.4	3.86	0	85	127	95	142
		2	GS2-N	2.4	3.86	0	85	127	95	142
EQ Achieved = 253.7 *Wind Achieved = 283.5*										
D	105 EQ 105 Wind	1	IBS	1.2	3.70	0	107	83	131	102
		2	IBS	1.2	3.70	0	107	83	131	102
EQ Achieved = 166.6 *Wind Achieved = 203.9*										

Achieved	**EQ**	587	**Wind**	691
Required	**EQ**	**250**	**Wind**	**550**
		OK		OK

$Wind_{req}$ / EQ_{req} 2.20 Wind Bracing

Hutchinson
CONSULTING ENGINEERS

JOB: THREE BLOKES LTD			
SUBJECT: FIRE WALL DESIGN			
BY: PRW	PAGE: 1/3	DATE: Nov 2022	JOB NO: 24742

FIXING DESIGN

$M^*_o = 3.1kNm/m.$

$T^* = \frac{3.1kNm/m}{0.07m} = 44.3kN/m.$

$\phi T = 0.9 \times 15kN \times 2 \times \frac{1.0m}{0.45m} = 60kN/m.$

USE 140x45 SG8 @ 450mm CRS w/
2/ GIB HANDIBRAC'S CENTRALLY PLACED

BCO10364430 Received by Auckland Council 10/03/2023

Hutchinson CONSULTING ENGINEERS

JOB: Three Blokes Ltd			
SUBJECT: Fire wall stud design			
BY: Paul W	STUD: -	DATE: Nov 2022	JOB NO: 24742

UNIFORMLY DISTRIBUTED LOADS (SIMPLY SUPPORTED):

Dead Loads, G:

roof: 0.45 kPa x 0.0 m = 0.0 kN/m
floor: 0.50 kPa x 0.0 m = 0.0 kN/m
internal walls: 0.35 kPa x 0.0 m = 0.0 kN/m
external walls: 0.50 kPa x 0.0 m = 0.0 kN/m

G = 0.0 kN/m

Live Loads, Q:

roof: 0.25 kPa x 0.0 m = 0.0 kN/m
external floor: 2.00 kPa x 0.0 m = 0.0 kN/m
internal floor: 1.50 kPa x 0.0 m = 0.0 kN/m

Q = 0.0 kN/m

FIRE PRESSURE:

p_z = 0.50 kPa

p_z = 0.50 KPa

LOAD COMBINATIONS:

SLS = Serviceability Limit State
ULS = Ulitmate Limit State

ULS Distributed Loads:

1.35G = 0.0 kN/m
1.2G + 1.5Q = 0.0 kN/m
$1.2G + W_u + \Psi_c Q$ = 0.0 kN/m

$\Psi_c = 0.4$

DESIGN ACTIONS:

design **moment (ULS):** $M^* = \frac{w h^2}{8}$

M* = 3.1 kNm/m

design **axial load (ULS):** N* = 0.0 kN/m

MATERIAL PROPERTIES:

Try = 140 x 45 MSG8 at 450mm centres

h = Stud Height
h = **3540 mm**

Axial load timber properties:

Member Type: Multiple
Timber Grade = MSG8
Strength reduction factor, ϕ = 0.8
Load duration factor, k_1 = 0.8
Parallel support factor, k_4 = 1.20
Compressive strength, f_c = 18 MPa
Area, A = 6300 mm2

Depth, d = 140 mm
Width, b = 45 mm
Spacing, s = 450 mm

Slenderness coefficient, S = 30
Stability factor, k_8 = 0.33

$\Phi N_c = \Phi k_1 k_4 k_8 f_c A$
ΦN_c = 28.7 kN

N* = 0.0 kN OK!

Hutchinson
CONSULTING ENGINEERS

JOB: Three Blokes Ltd			
SUBJECT: Fire wall stud design			
BY: Paul W	STUD: -	DATE: Nov 2022	JOB NO: 24742

Moment timber properties:

Member Type: Multiple
Timber Grade = MSG8
Strength reduction factor, ϕ = 0.8
Load duration factor, k_1 = 1.0
Parallel support factor, k_4 = 1.20
Stability factor, k_8 = 1.00
Bending strength, f_b = 14 MPa
Effective section moduli, Z = 147 mm3

$\Phi M_b = \Phi k_1 k_4 k_8 f_b Z$
ΦM_b = 1.98 kNm   M* = 1.41 kN   OK!

Combined check:

ΦM_b = 1.98 kNm   M* = 1.41 kN
ΦN_c = 28.7 kN   N* = 0.0 kN

$$\frac{M^*}{\Phi M_b} + \frac{N^*}{\Phi N_c} = 0.71 < 1.00$$ OK!

Use 140 x 45 MSG8 @ 450 mm

Hutchinson CONSULTING ENGINEERS	JOB: Three Blokes Ltd			
	SUBJECT: Verandah beam design			
	BY: Paul W	BEAM: RB1	DATE: Sep 2022	JOB NO: 24742

UNIFORMLY DISTRIBUTED LOADS (SIMPLY SUPPORTED):

Dead Loads, G:

roof: 0.35 kPa x 1.3 m = 0.4 kN/m
floor: 0.50 kPa x 0.0 m = 0.0 kN/m
internal walls: 0.35 kPa x 0.0 m = 0.0 kN/m
external walls: 0.50 kPa x 0.0 m = 0.0 kN/m
self weight (member) = 0.14 kN/m

G = 0.6 kN/m

ρ_u = 1.01 kPa
C_{fig} = 1.20
$W_u = \rho_u \times C_{fig} \times 1.3$ m

W_u = -1.5 kN/m

Live Loads, Q:

roof: 0.25 kPa x 1.3 m = 0.3 kN/m
external floor: 2.00 kPa x 0.0 m = 0.0 kN/m
internal floor: 1.50 kPa x 0.0 m = 0.0 kN/m

Q = 0.3 kN/m

ρ_s = 0.67 kPa
$W_s = W_u \times \rho_s / \rho_u$

W_s = -1.0 kN/m

LOAD COMBINATIONS:

SLS = Serviceability Limit State
ULS = Ulitmate Limit State

ULS Distributed Loads:

1.35G = 0.8 kN/m
1.2G + 1.5Q = 1.2 kN/m
$0.9G + W_u$ = -1.0 kN/m

Maximum ULS Distributed Load
w = 1.2 kN/m

SLS Distributed Loads:

$G + \psi_s Q$ = 0.6 kN/m (Steel)
$k_2 G + \psi_s Q$ = 1.2 kN/m (Timber)
$G + Q + W_s$ = -0.4 kN/m (Steel & Timber where Q = 0.0 kN/m)

Load duration factor (short term), ψ_s = 0.0
Duration of Load factor, k_2 = 2.0
(moisture content < 18%)

Working Stress Loads:

G + Q = 0.9 kN/m
$G + W_s$ = -0.4 kN/m

ULTIMATE LIMIT STATE DESIGN:

design **moment (ULS):** $M^* = \dfrac{w\ell^2}{8}$

M^* = 3.6 kNm $< \Phi M_n$

w = 1.2 kN/m

ℓ = Beam Span
ℓ = 5000 mm

Hutchinson
CONSULTING ENGINEERS

JOB: Three Blokes Ltd			
SUBJECT: Verandah beam design			
BY: Paul W	BEAM: RB1	DATE: Sep 2022	JOB NO: 24742

MATERIAL PROPERTIES:

Timber member properties:

Member Type: Single
Timber Grade = Macrocarpa
Strength reduction factor, ϕ = 0.8
Load duration factor, k_1 = 0.8
Parallel support factor, k_4 = 1.00
Stability factor, k_8 = 1.00
Bending strength, f_b = 14 MPa

Steel member properties:

Strength reduction factor, ϕ = 0.9
Yield strength, f_y = 300 MPa

For Timber:

$F_b = \Phi k_1 k_4 k_8 f_b$
F_b = 9.0 MPa

For Steel:

$F_b = \Phi f_y$
F_b = 270 MPa

effective section moduli:
(assuming full lateral restraint)

$M^* = \Phi M_n$

$\Phi M_n = F_b Z$

$$Z_{req} \geq \frac{M^*}{F_b}$$

$Z_{req} \geq$ **406.3** x 10^3 mm^3

$Z_{req} \geq$ **13.5** x 10^3 mm^3

Try: 300x100 Macrocarpa

$Z_{(Actual)}$ = 1500.0 x 10^3 mm^3

SERVICABILITY LIMIT STATE DESIGN:

limit **gravity deflection** to $\frac{span}{500}$ = 10.0 mm

limit **wind deflection** to $\frac{span}{500}$ = 10.0 mm

$$\Delta = \frac{5 w \ell^4}{384 EI}$$

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Hutchinson CONSULTING ENGINEERS	JOB: Three Blokes Ltd			
	SUBJECT: Verandah beam design			
	BY: Paul W	BEAM: RB1	DATE: Sep 2022	JOB NO: 24742

MATERIAL PROPERTIES:

Timber member properties:

Distributed dead load, w = 1.2 kN/m
Distributed dead and live load, w = 1.2 kN/m
Distributed dead and wind load, w = -0.4 kN/m
Modulus of elasticity, E = 7900 MPa

$I_{req} \geq$ 119.5 $\times 10^6$ mm^4

Steel member properties:

Distributed dead load, w = 0.6 kN/m
Distributed dead and live load, w = 0.6 kN/m
Distributed dead and wind load, w = -0.4 kN/m
Modulus of Elasticity, E = 200 GPa

$I_{req} \geq$ 2.4 $\times 10^6$ mm^4

Try: 300x100 Macrocarpa

$I_{(Actual)} =$ 225.0 $\times 10^6$ mm^4

Moment capacity, ϕM = 13.4 kNm OK!
Theoretical dead load deflection, Δ = 5.3 mm OK!
Theoretical dead and wind load deflection, Δ = -1.9 mm OK! -0.00039 ℓ

Use 300x100 Macrocarpa

SUPPORT REACTIONS:

1.35G = 2.0 kN
1.2G + 1.5Q = 2.9 kN
$0.9G + W_u$ = -2.5 kN
$G + \psi_s Q$ = 1.5 kN
$k_2 G + \psi_s Q$ = 2.9 kN
$G + W_s$ = -1.1 kN
G + Q = 2.2 kN
$G + W_s$ = -1.1 kN

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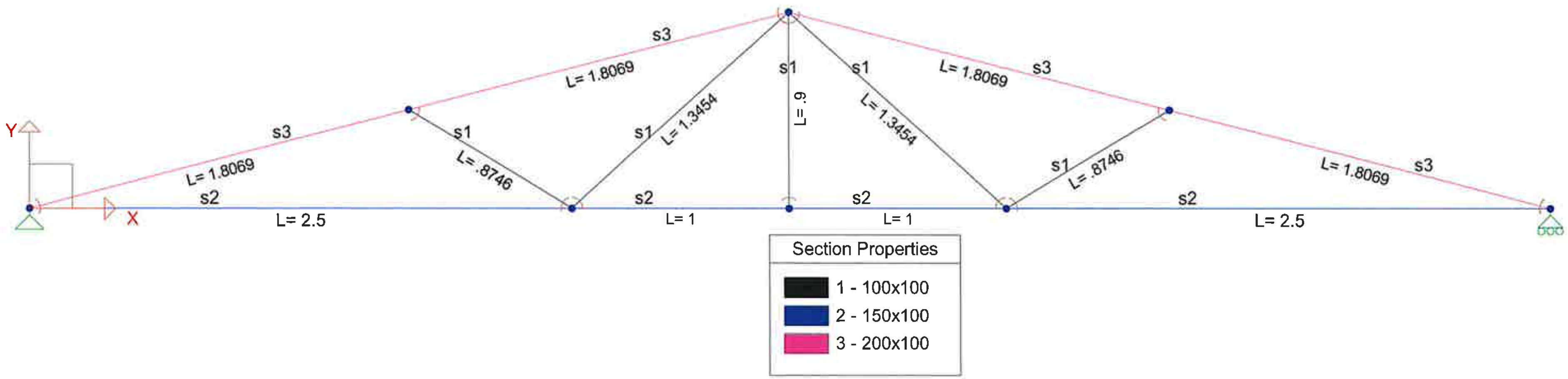
Three Blokes Ltd

Filename: TYPE C TRUSS.TEL
Description: Type C Truss
Engineer: Paul Wilson

Page: 1 of 1



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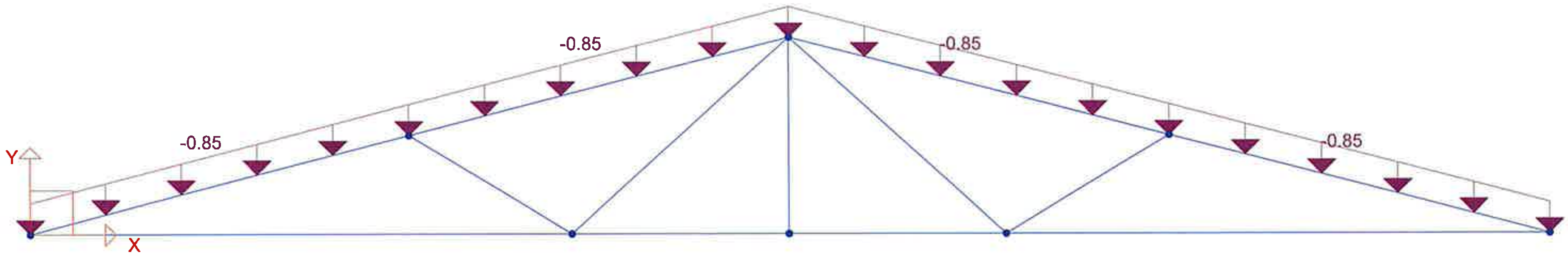
Filename: TYPE C TRUSS.TEL
Load Case 1: Dead (G)
Engineer: Paul Wilson

$G = 0.35\,kPa \times 2.5m = 0.85\,kN/m$



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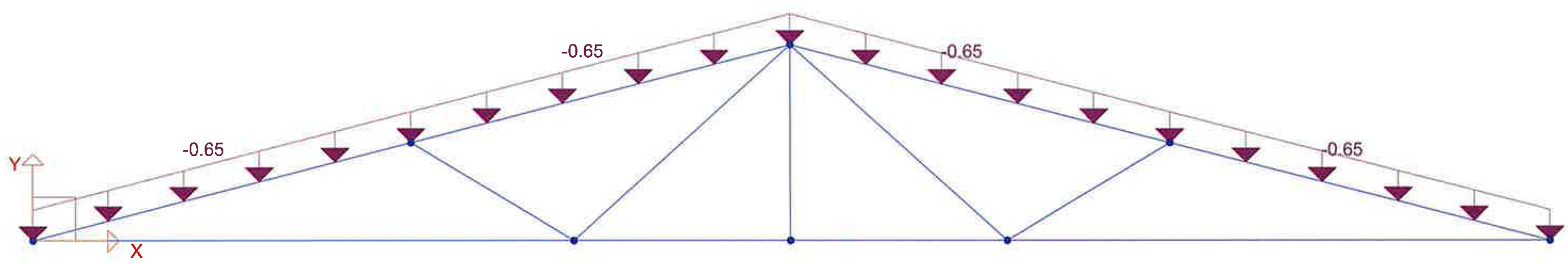
Filename: TYPE C TRUSS.TEL
Load Case 2: Live (Q)
Engineer: Paul Wilson

Page: 1 of 1

$Q = 0.25\,kPa \times 2.5\,m = 0.65\,kN/m$



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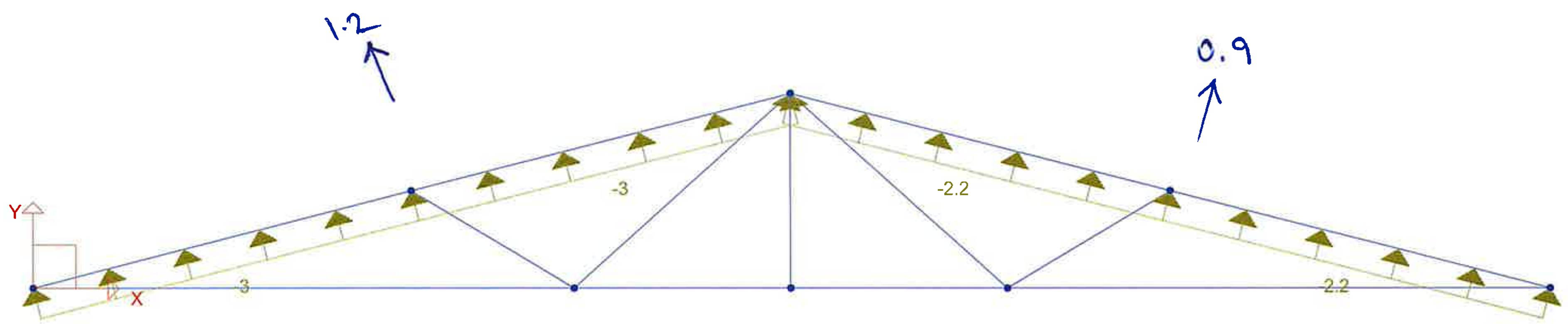
Filename: TYPE C TRUSS.TEL
Load Case 3: Wind (W)
Engineer: Paul Wilson

Page: 1 of 1



1.0kPa x 1.2 x 2.5m = 3kN/m

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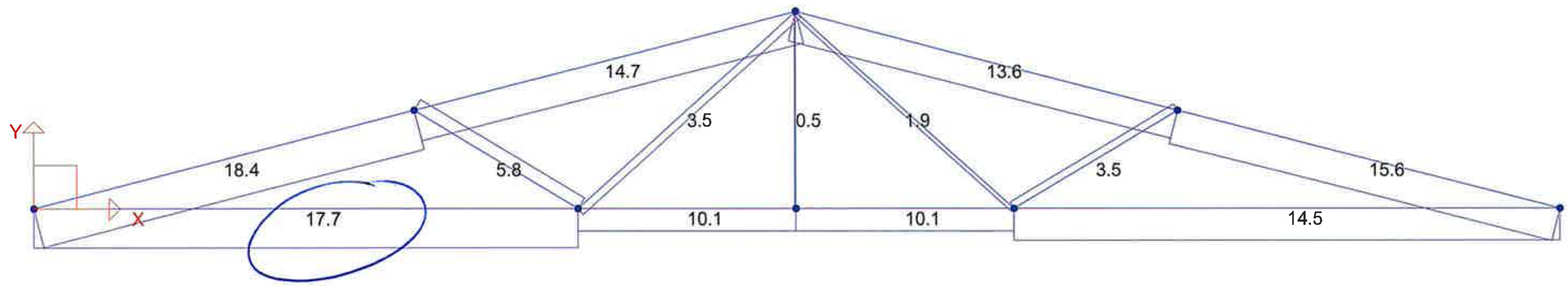
Three Blokes Ltd

Filename: TYPE C TRUSS.TEL
GRAPHICAL RESULTS - Ld Comb 3 0.9G+Wu->Axial Force (kN)
Engineer: Paul Wilson

$S = \frac{7000}{100} = 70$

$K_8 = 0.075$

$\phi N_{cy} = 0.8 \times 1.0 \times 0.075 \times 23\text{MPa} \times 150 \times 100$
$= 20.7\text{kN} \geq R^*$ OK!



USE 150x100 BOTTOM CHORD

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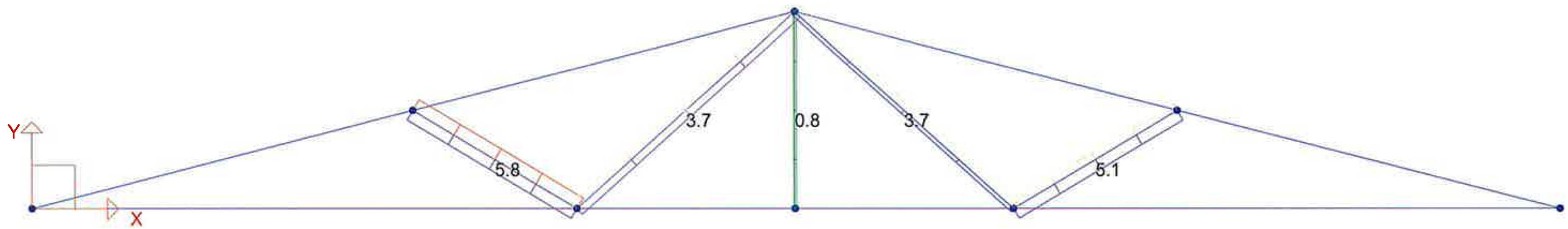
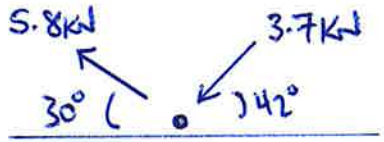
Filename: TYPE C TRUSS.TEL
GRAPHICAL RESULTS - Envelopes of Axial Force (kN)
Engineer: Paul Wilson

Page: 1 of 1

BOLT CHECK.

$\phi Q_{nf} = 0.7 \times 0.8 \times 2 \times 18.5\text{kN}$
$= 20.7\text{kN} \geq 5.8\text{kN}$ OK!





$\leftarrow 7.0\text{kN} \leq \phi Q_{nf}$ OK!

USE M16 BOLTS.

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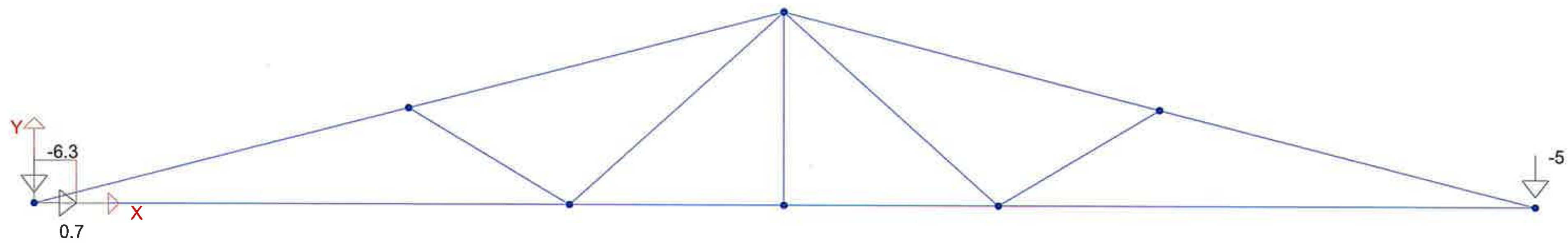
Filename: TYPE C TRUSS.TEL
GRAPHICAL RESULTS - Envelopes of Reactions (kN)
Engineer: Paul Wilson

Page: 1 of 1



$\phi R = 0.7 \times 16\text{kN} = 11.2\text{kN}$ OK!

USE 2/CPC80's.

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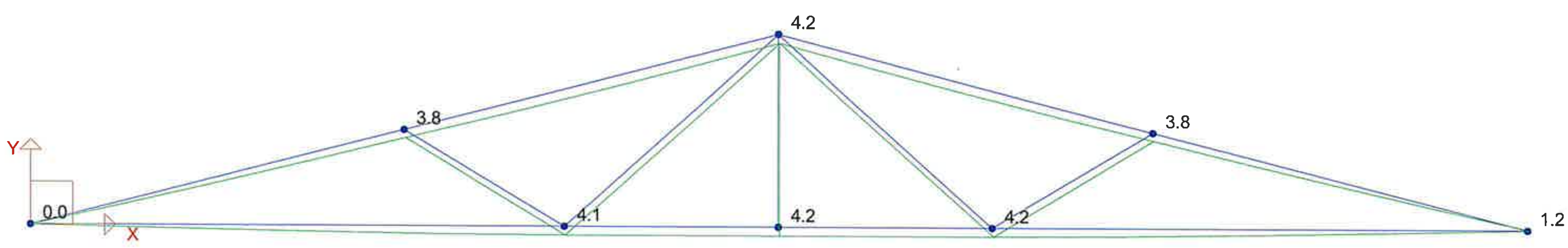
Filename: TYPE C TRUSS.TEL

GRAPHICAL RESULTS - Envelopes of Deflections (mm)

Engineer: Paul Wilson

Page: 1 of 1



Δ LIMIT = $\frac{7000}{500}$ = 14mm OK!

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