Hutchinson CONSULTING ENGINEERS

JOB:			
Three Blokes Ltd			
SUBJECT:			
Lintel design (D.01-D.05 & D.08-D.10)			
BY:	BEAM:	DATE:	JOB NO:
Paul W	L1	May 2023	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
self weight (member) = 0.12 kN/m

G = 0.1 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

Wind Loads, W:

ρ_u = 1.01 kPa
C_{fig} = 1.20
$W_u = \rho_u \times C_{fig} \times$ 0.0 m
Wind Direction = Up

W_u = 0.0 kN/m

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

W_s = 0.0 kN/m

POINT LOADS:

P_1	**G = 5.5 kN**	**Q = 3.3 kN**
P_2	**G = 5.5 kN**	**Q = 3.3 kN**
W_1	**W_u = -15.5 kN**	**W_s = -10.3 kN**
W_2	**W_u = -15.5 kN**	**W_s = -10.3 kN**

LOAD COMBINATIONS:

SLS = Serviceability Limit State
ULS = Ultimate Limit State

		Point Loads:	
ULS Distributed Loads:			
1.35G = 0.2 kN/m		7.4 kN	7.4 kN
1.2G + 1.5Q = 0.1 kN/m		11.4 kN	11.4 kN
0.9G + Wu = 0.1 kN/m		-10.6 kN	-10.6 kN
SLS Distributed Loads:			
G + 0Q = 0.1 kN/m	(Steel)	5.5 kN	5.5 kN
2.0G + 0Q = 0.2 kN/m	(Timber)	10.9 kN	10.9 kN
G + Ws = 0.1 kN/m		-4.9 kN	-4.9 kN
Working Stress Loads:			
G + Q = 0.1 kN/m		8.7 kN	8.7 kN
G + W_s = 0.1 kN/m		-4.9 kN	-4.9 kN

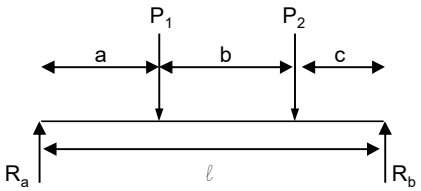
Load duration factor (short term), ψ_s = 0.0
Duration of Load factor, k_2 = 2.0
(moisture content < 18%)

Hutchinson CONSULTING ENGINEERS

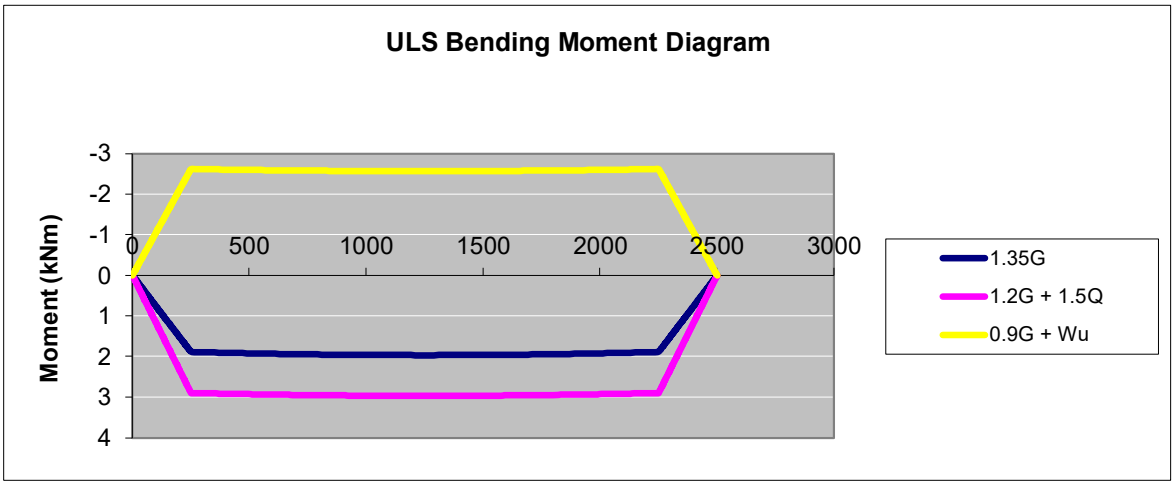
JOB: Three Blokes Ltd			
SUBJECT: Lintel design (D.01-D.05 & D.08-D.10)			
BY: Paul W	BEAM: L1	DATE: May 2023	JOB NO: 24742

ULTIMATE LIMIT STATE DESIGN:

Design **moment (ULS):**



ℓ = **Beam Span**
ℓ = **2500 mm**
a = 250 mm
b = 2000 mm
c = 250 mm



M* = 3.0 kNm < ϕM_n Load Case - 1.2G + 1.5Q

MATERIAL PROPERTIES:

Timber member properties:

Member Type: Multiple
Timber Grade = MSG8
Strength reduction factor, ϕ = 0.8
Load duration factor, k_1 = 0.6
Parallel support factor, k_4 = 1.20
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 = 8.1 MPa

For Steel:

$F_b = \Phi f_y$
F_b = 270 MPa

Effective section moduli:
(assuming full lateral restraint)

$\Phi M_n \geq M^*$
$\Phi M_n = F_b Z$
$Z_{req} \geq \frac{M^*}{F_b}$

$Z_{req} \geq$ **367.6** x 10^3 mm^3 $Z_{req} \geq$ **11.0** x 10^3 mm^3

Try: 3/190x45 SG8

$Z_{(Actual)}$ = 812.3 x 10^3 mm^3

Hutchinson CONSULTING ENGINEERS

JOB:			
Three Blokes Ltd			
SUBJECT:			
Lintel design (D.01-D.05 & D.08-D.10)			
BY:	BEAM:	DATE:	JOB NO:
Paul W	L1	May 2023	24742

SERVICABILITY LIMIT STATE DESIGN:

Limit **gravity deflection** to $\frac{\text{span}}{500}$ = 5.0 mm

Limit **wind deflection** to $\frac{\text{span}}{500}$ = 5.0 mm

MATERIAL PROPERTIES:

Timber member properties:

Distributed dead load, w = 0.2 kN/m
Distributed dead and live load, w = 0.2 kN/m
Distributed dead and wind load, w = 0.1 kN/m
Point load dead load, P_1 = 10.9 kN
Point load dead and live load, P_1 = 10.9 kN
Point load dead and wind load, P_1 = -4.9 kN
Point load dead load, P_2 = 10.9 kN
Point load dead and live load, P_2 = 10.9 kN
Point load dead and wind load, P_2 = -4.9 kN

Modulus of Elasticity, E = 8000 MPa

$I_{req} \geq$ 56.8 x 10^6 mm^4

Steel member properties:

Distributed dead load, w = 0.1 kN/m
Distributed dead and live load, w = 0.1 kN/m
Distributed dead and wind load, w = 0.1 kN/m
Point load dead load, P_1 = 5.5 kN
Point load dead and live load, P_1 = 5.5 kN
Point load dead and wind load, P_1 = -4.9 kN
Point load dead load, P_2 = 5.5 kN
Point load dead and live load, P_2 = 5.5 kN
Point load dead and wind load, P_2 = -4.9 kN

Modulus of Elasticity, E = 200000 MPa

$I_{req} \geq$ 1.1 x 10^6 mm^4

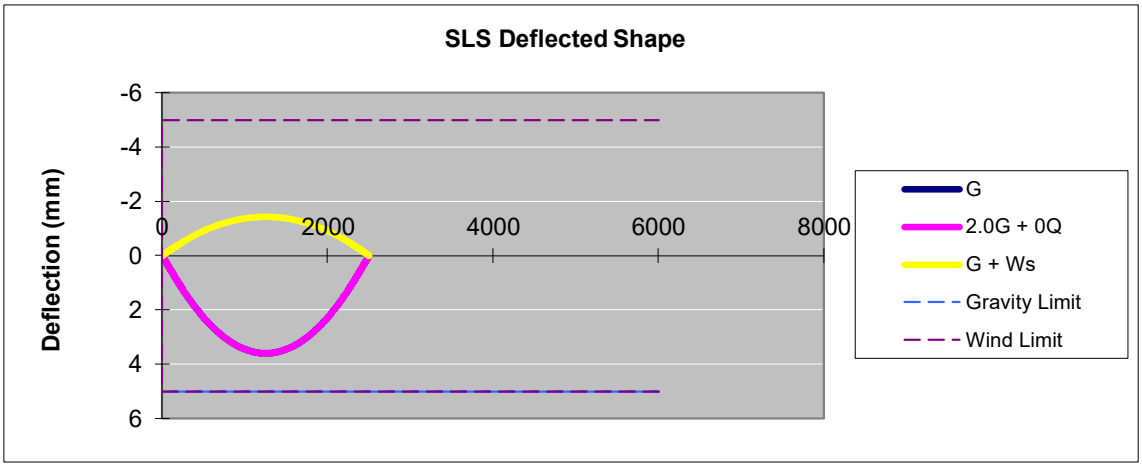
Try: 3/190x45 SG8

$I_{(Actual)}$ = 77.2 x 10^6 mm^4

1kN point load deflection:
(limited to between 1-2 mm)

$\Delta = \frac{P l^3}{48EI}$ P = 1kN

= 0.5 mm OK!



Max Gravity Deflection = 3.60 mm < 5.0mm, OK!
Max Wind Deflection = 1.43 mm < 5.0mm, OK!

Hutchinson CONSULTING ENGINEERS

JOB: Three Blokes Ltd			
SUBJECT: Lintel design (D.01-D.05 & D.08-D.10)			
BY: Paul W	BEAM: L1	DATE: May 2023	JOB NO: 24742

L1 DESIGN SUMMARY:

Moment capacity, ϕM =	6.5 kNm	OK!
Theoretical dead load deflection, Δ =	3.6 mm	OK!
Theoretical dead and live load deflection, Δ =	3.6 mm	OK!
Theoretical dead and wind load deflection, Δ =	-1.4 mm	OK!

Use 3/190x45 SG8 + Mitek type H fixing

SUPPORT REACTIONS:

	Ra	Rb
1.35G =	7.6 kN	7.6 kN
1.2G + 1.5Q =	11.6 kN	11.6 kN
0.9G + W_u =	-10.5 kN	-10.5 kN
G + ψ_sQ =	5.6 kN	5.6 kN
k_2G + ψ_sQ =	11.2 kN	11.2 kN
G + W_s =	-4.7 kN	-4.7 kN
G + Q =	8.8 kN	8.8 kN
G + W_s =	-4.7 kN	-4.7 kN

Hutchinson CONSULTING ENGINEERS

JOB:			
Three Blokes Ltd			
SUBJECT:			
Lintel design (D.14-D.15)			
BY:	BEAM:	DATE:	JOB NO:
Paul W	L2	May 2023	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
self weight (member) = 0.15 kN/m

G = 0.1 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

Wind Loads, W:

ρ_u = 1.01 kPa
C_{fig} = 1.20
$W_u = \rho_u \times C_{fig} \times$ 0.0 m
Wind Direction = Up

W_u = 0.0 kN/m

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

W_s = 0.0 kN/m

POINT LOADS:

P_1	**G = 5.5 kN**	**Q = 3.3 kN**
P_2	**G = 5.5 kN**	**Q = 3.3 kN**
W_1	**W_u = -15.5 kN**	**W_s = -10.3 kN**
W_2	**W_u = -15.5 kN**	**W_s = -10.3 kN**

LOAD COMBINATIONS:

SLS = Serviceability Limit State
ULS = Ultimate Limit State

ULS Distributed Loads:		**Point Loads:**	
1.35G = 0.2 kN/m		7.4 kN	7.4 kN
1.2G + 1.5Q = 0.2 kN/m		11.4 kN	11.4 kN
0.9G + Wu = 0.1 kN/m		-10.6 kN	-10.6 kN
SLS Distributed Loads:			
G + 0Q = 0.1 kN/m	(Steel)	5.5 kN	5.5 kN
2.0G + 0Q = 0.3 kN/m	(Timber)	10.9 kN	10.9 kN
G + Ws = 0.1 kN/m		-4.9 kN	-4.9 kN
Working Stress Loads:			
G + Q = 0.1 kN/m		8.7 kN	8.7 kN
G + W_s = 0.1 kN/m		-4.9 kN	-4.9 kN

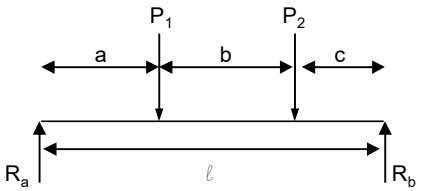
Load duration factor (short term), ψ_s = 0.0
Duration of Load factor, k_2 = 2.0
(moisture content < 18%)

Hutchinson CONSULTING ENGINEERS

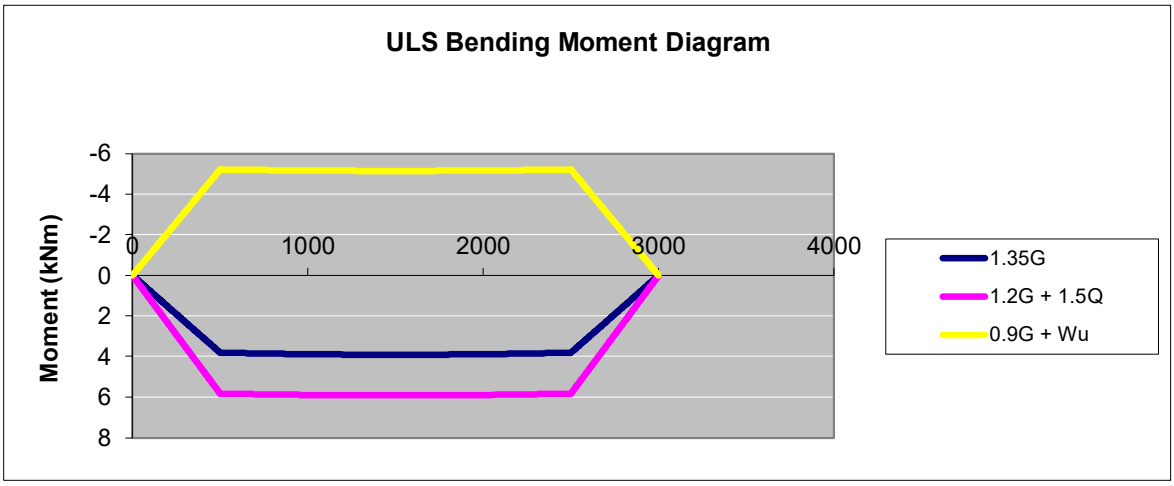
JOB: Three Blokes Ltd			
SUBJECT: Lintel design (D.14-D.15)			
BY: Paul W	BEAM: L2	DATE: May 2023	JOB NO: 24742

ULTIMATE LIMIT STATE DESIGN:

Design **moment (ULS):**



ℓ = **Beam Span**
ℓ = **3000 mm**
a = 500 mm
b = 2000 mm
c = 500 mm



M* = 5.9 kNm < ϕM_n Load Case - 1.2G + 1.5Q

MATERIAL PROPERTIES:

Timber member properties:

Member Type: Multiple
Timber Grade = MSG8
Strength reduction factor, ϕ = 0.8
Load duration factor, k_1 = 0.6
Parallel support factor, k_4 = 1.20
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 = 8.1 MPa

For Steel:

$F_b = \Phi f_y$
F_b = 270 MPa

Effective section moduli:
(assuming full lateral restraint)

$\Phi M_n \geq M^*$
$\Phi M_n = F_b Z$
$Z_{req} \geq \frac{M^*}{F_b}$

$Z_{req} \geq$ **732.7** x 10^3 mm^3 $Z_{req} \geq$ **21.9** x 10^3 mm^3

Try: 3/240x45 SG8

$Z_{(Actual)}$ = 1296.0 x 10^3 mm^3

JOB: Three Blokes Ltd			
SUBJECT: Lintel design (D.14-D.15)			
BY: Paul W	BEAM: L2	DATE: May 2023	JOB NO: 24742

SERVICABILITY LIMIT STATE DESIGN:

Limit **gravity deflection** to $\frac{\text{span}}{500}$ = 6.0 mm

Limit **wind deflection** to $\frac{\text{span}}{500}$ = 6.0 mm

MATERIAL PROPERTIES:

Timber member properties:

Distributed dead load, w = 0.3 kN/m
Distributed dead and live load, w = 0.3 kN/m
Distributed dead and wind load, w = 0.1 kN/m
Point load dead load, P_1 = 10.9 kN
Point load dead and live load, P_1 = 10.9 kN
Point load dead and wind load, P_1 = -4.9 kN
Point load dead load, P_2 = 10.9 kN
Point load dead and live load, P_2 = 10.9 kN
Point load dead and wind load, P_2 = -4.9 kN

Modulus of Elasticity, E = 8000 MPa

$I_{req} \geq$ 132.2 x 10^6 mm^4

Steel member properties:

Distributed dead load, w = 0.1 kN/m
Distributed dead and live load, w = 0.1 kN/m
Distributed dead and wind load, w = 0.1 kN/m
Point load dead load, P_1 = 5.5 kN
Point load dead and live load, P_1 = 5.5 kN
Point load dead and wind load, P_1 = -4.9 kN
Point load dead load, P_2 = 5.5 kN
Point load dead and live load, P_2 = 5.5 kN
Point load dead and wind load, P_2 = -4.9 kN

Modulus of Elasticity, E = 200000 MPa

$I_{req} \geq$ 2.6 x 10^6 mm^4

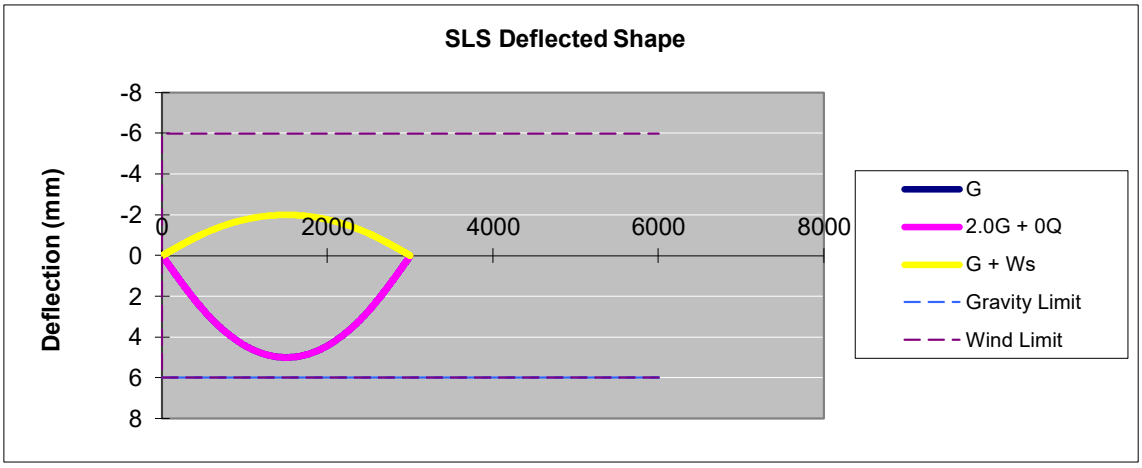
Try: 3/240x45 SG8

$I_{(Actual)}$ = 155.5 x 10^6 mm^4

1kN point load deflection:
(limited to between 1-2 mm)

$\Delta = \frac{P l^3}{48EI}$ P = 1kN

= 0.5 mm OK!



Max Gravity Deflection = 5.00 mm < 6.0mm, OK!
Max Wind Deflection = 2.00 mm < 6.0mm, OK!

Hutchinson CONSULTING ENGINEERS	JOB: Three Blokes Ltd			
	SUBJECT: Lintel design (D.14-D.15)			
	BY: Paul W	BEAM: L2	DATE: May 2023	JOB NO: 24742

L2 DESIGN SUMMARY:

Moment capacity, ϕM =	10.5 kNm	OK!
Theoretical dead load deflection, Δ =	5.0 mm	OK!
Theoretical dead and live load deflection, Δ =	5.0 mm	OK!
Theoretical dead and wind load deflection, Δ =	-2.0 mm	OK!

Use 3/240x45 SG8 + Mitek type H fixing

SUPPORT REACTIONS:

	Ra	Rb
1.35G =	7.7 kN	7.7 kN
1.2G + 1.5Q =	11.7 kN	11.7 kN
0.9G + W_u =	-10.4 kN	-10.4 kN
G + ψ_sQ =	5.7 kN	5.7 kN
k_2G + ψ_sQ =	11.3 kN	11.3 kN
G + W_s =	-4.7 kN	-4.7 kN
G + Q =	8.9 kN	8.9 kN
G + W_s =	-4.7 kN	-4.7 kN

Hutchinson CONSULTING ENGINEERS

JOB:			
Three Blokes Ltd			
SUBJECT:			
Gable end wall stud design			
BY:	BEAM:	DATE:	JOB NO:
Paul W	LBW	Apr 2023	24742

UNIFORMLY DISTRIBUTED LOADS (SIMPLY SUPPORTED):

Dead Loads, G:

roof:	0.45 kPa x	1.0 m =	0.5 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 = 0.5 kN/m

Live Loads, Q:

roof:	0.25 kPa x	1.0 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

WIND PRESSURE:

p_z = 1.01 kPa

$C_{pe} \times C_{pi}$ = 1

W_u = 1.01 KPa

W_s = 0.67 KPa

LOAD COMBINATIONS:

SLS = Serviceability Limit State
ULS = Ulitmate Limit State

ULS Distributed Loads:

1.35G = 0.6 kN/m
1.2G + 1.5Q = 0.9 kN/m
1.2G + W_u + Ψ_cQ = 0.6 kN/m

Ψ_c = 0.4

DESIGN ACTIONS:

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

M^* = 3.2 kNm/m

design **axial load (ULS):** N^* = 0.9 kN/m

MATERIAL PROPERTIES:

TRY: 190 x 45 SG8 @ 600 mm

h = Stud Height
h = **5050 mm**

Axial load timber properties:

Member Type:	Multiple	Depth, d =	190 mm
Timber Grade =	MSG8	Width, b =	45 mm
Strength reduction factor, ϕ =	0.8	Spacing, s =	600 mm
Load duration factor, k_1 =	0.8		
Parallel support factor, k_4 =	1.20		
Compressive strength, f_c =	18 MPa	Slenderness coefficient, S =	30
Area, A =	8550 mm2	Stability factor, k_8 =	0.33

$\Phi N_c = \Phi k_1 k_4 k_8 f_c A$

ΦN_c = 39.0 kN

N^* = 0.5 kN OK!

Hutchinson CONSULTING ENGINEERS	JOB: Three Blokes Ltd			
	SUBJECT: Gable end wall stud design			
	BY: Paul W	BEAM: LBW	DATE: Apr 2023	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 = 270.8 mm3

$\Phi M_b = \Phi k_1 k_4 k_8 f_b Z$
ΦM_b = 3.64 kNm M* = 1.92 kN OK!

Combined check:

ΦM_b = 3.64 kNm M* = 1.92 kN
ΦN_c = 39.0 kN N* = 0.4 kN

$$\frac{M^*}{\Phi M_b} + \frac{N^*}{\Phi N_c} = 0.54 < 1.00 \quad \text{OK!}$$

SERVICABILITY LIMIT STATE DESIGN:

limit **deflection** to $\frac{\text{span}}{180}$ = 15.0 mm $\Delta = \frac{5 w \ell^4}{384 EI}$

MATERIAL PROPERTIES:

Timber member properties:

Distributed wind load, w = 0.40 kN/m
Modulus of elasticity, E = 9130 MPa
Second moment of inertia, I = 25.72 mm4

Theoretical wind load deflection, Δ = 14.6 mm OK!

Use 190 x 45 SG8 @ 600 mm

Hutchinson CONSULTING ENGINEERS

JOB:			
Three Blokes Ltd			
SUBJECT:			
Lintel design (D.12-D.13)			
BY:	BEAM:	DATE:	JOB NO:
Paul W	L3	May 2023	24742

UNIFORMLY DISTRIBUTED LOADS (SIMPLY SUPPORTED):

Dead Loads, G:

roof:	0.45 kPa x	1.3 m =	0.6 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) =		0.10 kN/m

G = 0.7 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

POINT LOADS:

G = 3.8 kN

W_u = -9.8 kN

Q = 2.3 kN

W_s = -6.5 kN

LOAD COMBINATIONS:

SLS = Serviceability Limit State
ULS = Ulitmate Limit State

ULS Distributed Loads:		**Point Loads:**
1.35G =	0.9 kN/m	5.1 kN
1.2G + 1.5Q =	1.3 kN/m	8.0 kN
0.9G + W_u =	-0.9 kN/m	-6.4 kN

Maximum ULS Distributed Load
w = 1.3 kN/m
Maximum ULS Point Load
P = 8.0 kN

SLS Distributed Loads:			
G + ψ_sQ =	0.7 kN/m	(Steel)	3.8 kN
k_2G + ψ_sQ =	1.3 kN/m	(Timber)	7.6 kN
G + Q + W_s =	-0.3 kN/m		-2.7 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 =	1.0 kN/m	6.1 kN
G + W_s =	-0.3 kN/m	-2.7 kN

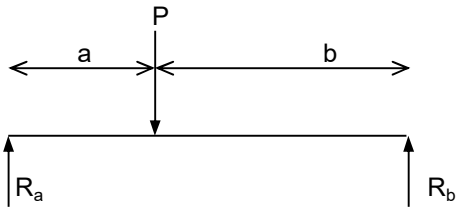
Hutchinson CONSULTING ENGINEERS	JOB: Three Blokes Ltd			
	SUBJECT: Lintel design (D.12-D.13)			
	BY: Paul W	BEAM: L3	DATE: May 2023	JOB NO: 24742

ULTIMATE LIMIT STATE DESIGN:

design **moment (ULS):**

$$M^* = \frac{w\ell^2}{8} + \frac{Pab}{\ell}$$

ℓ = **Beam Span**
ℓ = **2500 mm**
a = **1250 mm**
b = **1250 mm**



M^* = 6.0 kNm $< \phi M_n$

MATERIAL PROPERTIES:

Timber member 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
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 = 10.8 MPa

For Steel:

$F_b = \Phi f_y$
F_b = 270 MPa

effective section moduli:
(assuming full lateral restraint)

$M^* = \Phi M_n$

$\Phi M_n = F_b Z$

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

$Z_{req} \geq$ **557.4** x 10^3 mm^3

$Z_{req} \geq$ **22.2** x 10^3 mm^3

Try: 2/240x45 SG8

$Z_{(Actual)}$ = 864.0 x 10^3 mm^3

Hutchinson CONSULTING ENGINEERS	JOB: Three Blokes Ltd			
	SUBJECT: Lintel design (D.12-D.13)			
	BY: Paul W	BEAM: L3	DATE: May 2023	JOB NO: 24742

SERVICABILITY LIMIT STATE DESIGN:

limit **gravity deflection** to $\frac{\text{span}}{500}$ = 5.0 mm

limit **wind deflection** to $\frac{\text{span}}{500}$ = 5.0 mm

$$\Delta = \frac{5\,w\,\ell^4}{384\,EI} + \frac{P\,\ell^3\,\{(3a/\ell) - 4\,(a/\ell)^3\}}{48\,EI}$$

MATERIAL PROPERTIES:

Timber member properties:

Distributed dead load, w = 1.3 kN/m
Distributed dead and live load, w = 1.3 kN/m
Distributed dead and wind load, w = -0.3 kN/m
Point load dead load, P = 7.6 kN
Point load dead and live load, P = 7.6 kN
Point load dead and wind load, P = -2.7 kN

Modulus of elasticity, E = 8000 MPa

$I_{req} \geq$ 78.7 x 10^6 mm^4

Steel member properties:

Distributed dead load, w = 0.7 kN/m
Distributed dead and live load, w = 0.7 kN/m
Distributed dead and wind load, w = -0.3 kN/m
Point load dead load, P = 3.8 kN
Point load dead and live load, P = 3.8 kN
Point load dead and wind load, P = -2.7 kN

Modulus of Elasticity, E = 200 GPa

$I_{req} \geq$ 1.6 x 10^6 mm^4

Try: 2/240x45 SG8

$I_{(Actual)}$ = 103.7 x 10^6 mm^4

Moment capacity, ϕM =	9.3 kNm	OK!	
Theoretical dead load deflection, Δ =	3.8 mm	OK!	
Theoretical dead and live load deflection, Δ =	3.8 mm	OK!	
Theoretical dead and wind load deflection, Δ =	-1.3 mm	OK!	-5E-04 mm ℓ

Use 2/240x45 SG8 + Mitek type G fixing

SUPPORT REACTIONS:

	Ra	Rb
1.35G =	3.7 kN	3.7 kN
1.2G + 1.5Q =	5.6 kN	5.6 kN
0.9G + W_u =	-4.3 kN	-4.3 kN
G + ψ_sQ =	2.7 kN	2.7 kN
k_2G + ψ_sQ =	5.5 kN	5.5 kN
G + W_s =	-1.8 kN	-1.8 kN
G + Q =	4.3 kN	4.3 kN
G + W_s =	-1.8 kN	-1.8 kN

Hutchinson CONSULTING ENGINEERS

JOB: Three Blokes Ltd			
SUBJECT: Gable end wall stud design			
BY: Paul W	BEAM: LBW	DATE: Apr 2023	JOB NO: 24742

UNIFORMLY DISTRIBUTED LOADS (SIMPLY SUPPORTED):

Dead Loads, G:

roof:	0.45 kPa x	1.0 m =	0.5 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 = 0.5 kN/m

Live Loads, Q:

roof:	0.25 kPa x	1.0 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

WIND PRESSURE:

p_z = 1.01 kPa

$C_{pe} \times C_{pi}$ = 1

W_u = 1.01 KPa

W_s = 0.67 KPa

LOAD COMBINATIONS:

SLS = Serviceability Limit State
ULS = Ulitmate Limit State

ULS Distributed Loads:

1.35G = 0.6 kN/m
1.2G + 1.5Q = 0.9 kN/m
1.2G + W_u + Ψ_cQ = 0.6 kN/m

Ψ_c = 0.4

DESIGN ACTIONS:

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

M^* = 2.6 kNm/m

design **axial load (ULS):** N^* = 0.9 kN/m

MATERIAL PROPERTIES:

TRY: 2/140 x 45 SG8 @ 450 mm

h = Stud Height
h = **4550 mm**

Axial load timber properties:

Member Type:	Multiple	Depth, d =	140 mm
Timber Grade =	MSG8	Width, b =	90 mm
Strength reduction factor, ϕ =	0.8	Spacing, s =	450 mm
Load duration factor, k_1 =	0.8		
Parallel support factor, k_4 =	1.20		
Compressive strength, f_c =	18 MPa	Slenderness coefficient, S =	35
Area, A =	12600 mm2	Stability factor, k_8 =	0.25

$\Phi N_c = \Phi k_1 k_4 k_8 f_c A$

ΦN_c = 43.5 kN

N^* = 0.4 kN OK!

Hutchinson CONSULTING ENGINEERS	JOB: Three Blokes Ltd			
	SUBJECT: Gable end wall stud design			
	BY: Paul W	BEAM: LBW	DATE: Apr 2023	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 = 294 mm3

$\Phi M_b = \Phi k_1 k_4 k_8 f_b Z$
ΦM_b = 3.95 kNm M* = 1.17 kN OK!

Combined check:

ΦM_b = 3.95 kNm M* = 1.17 kN
ΦN_c = 43.5 kN N* = 0.3 kN

$$\frac{M^*}{\Phi M_b} + \frac{N^*}{\Phi N_c} = 0.30 < 1.00 \quad \text{OK!}$$

SERVICABILITY LIMIT STATE DESIGN:

limit **deflection** to $\frac{\text{span}}{180}$ = 15.0 mm $\Delta = \frac{5 w \ell^4}{384 EI}$

MATERIAL PROPERTIES:

Timber member properties:

Distributed wind load, w = 0.30 kN/m
Modulus of elasticity, E = 9130 MPa
Second moment of inertia, I = 20.58 mm4

Theoretical wind load deflection, Δ = 9.0 mm OK!

Use 2/140 x 45 SG8 @ 450 mm

Hutchinson CONSULTING ENGINEERS

JOB: Three Blokes Ltd			
SUBJECT: Gable end wall stud design			
BY: Paul W	BEAM: LBW	DATE: Apr 2023	JOB NO: 24742

UNIFORMLY DISTRIBUTED LOADS (SIMPLY SUPPORTED):

Dead Loads, G:

roof:	0.45 kPa x	1.0 m =	0.5 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 = 0.5 kN/m

Live Loads, Q:

roof:	0.25 kPa x	1.0 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

WIND PRESSURE:

p_z = 1.01 kPa

$C_{pe} \times C_{pi}$ = 1

W_u = 1.01 KPa

W_s = 0.67 KPa

LOAD COMBINATIONS:

SLS = Serviceability Limit State
ULS = Ulitmate Limit State

ULS Distributed Loads:

1.35G = 0.6 kN/m
1.2G + 1.5Q = 0.9 kN/m
1.2G + W_u + Ψ_cQ = 0.6 kN/m

Ψ_c = 0.4

DESIGN ACTIONS:

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

M^* = 2.3 kNm/m

design **axial load (ULS):** N^* = 0.9 kN/m

MATERIAL PROPERTIES:

TRY: 140 x 45 SG8 @ 450 mm

h = Stud Height
h = **4300 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 = 35
Stability factor, k_8 = 0.25

$\Phi N_c = \Phi k_1 k_4 k_8 f_c A$
ΦN_c = 21.8 kN

N^* = 0.4 kN OK!

Hutchinson CONSULTING ENGINEERS	JOB: Three Blokes Ltd			
	SUBJECT: Gable end wall stud design			
	BY: Paul W	BEAM: LBW	DATE: Apr 2023	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* = 1.05 kN OK!

Combined check:

ΦM_b = 1.98 kNm M* = 1.05 kN
ΦN_c = 21.8 kN N* = 0.3 kN

$$\frac{M^*}{\Phi M_b} + \frac{N^*}{\Phi N_c} = 0.54 < 1.00 \quad \text{OK!}$$

SERVICABILITY LIMIT STATE DESIGN:

limit **deflection** to $\frac{\text{span}}{180}$ = 15.0 mm $\Delta = \frac{5 w \ell^4}{384 EI}$

MATERIAL PROPERTIES:

Timber member properties:

Distributed wind load, w = 0.30 kN/m
Modulus of elasticity, E = 9130 MPa
Second moment of inertia, I = 10.29 mm4

Theoretical wind load deflection, Δ = 14.4 mm OK!

Use 140 x 45 SG8 @ 450 mm