

Project Title	MOSI Timber Repairs - 125x250mm Purlin			Project No:	Rev:
				11796R	A
<u>Calculations</u>	Notes	Meeting Minutes	Made By:	Checked By:	Date:
			JH		Jan' 25
					Scanned:

Introduction:

- This calculations is for a new timber repair splice connection to a 125x250mm Purlin spanning 4800mm
- The existing member is assumed to be C24 timber.
- Calculations are in accordance with BS5268-2

Final loads provided by Buro Happold via email on 23.11.2025:

Purlin Location A (1m)				
	Fy (kN) (Minor)	Fz (kN) (Major)	Mz (kNm) (Minor)	My (kNm) (Major)
DL	1.31	2.26	-1.81	3.13
LL	0.92	1.59	-1.27	2.20
WL	0	2.35	0	3.26

Loading Sheet

Combination Key

Timber (SLS) Combs

COMB 1 D + L

COMB 2 D + L + W

Load Duration to BS 5268-2

Medium-Term

Short term

k3

1.25

1.5

Steel (ULS) Combs

ULS COMB 1 1.4 D + 1.6 L

ULS Comb 2 1.2D + 1.2L + 1.2W

<u>Location A - 1m</u>	Fy (kN)	Fz (kN)	Mz (kNm)	My (kNm)
DL	1.31	2.26	1.81	3.13
LL	0.92	1.59	1.27	2.2
WL	0	2.35	0	3.26
COMB 1	2.23	3.9	3.1	5.3
COMB 2	2.23	6.2	3.08	8.59
ULS COMB 1	3.31	5.71	4.57	7.90
ULS COMB 2	2.68	7.44	3.70	10.31

Bolts in Timber

- Try M12 (4.6) bolts.

- From table 81: min. end distance = $7 * 12 = 84\text{mm}$, min. edge distance = min. pitch = $4 * 12 = 48\text{mm}$

- From table 77 - basic single shear loads for M12 in C24 timber with equivalent outer member thickness = 60mm: short term - para = 3.48kN, perp = 3.14kN, medium term - para = 3.2kN, perp = 2.89kN.

- Purlin is subject to both major and minor axis loads. Proposed connection = 2nr. steel plates, 1 each side of timber splice:

- Major axis moment and shear taken up in shear in bolts acting as group.

- Minor axis moment converted to equivalent longitudinal force based on lever arm between external plates, applied in addition to forces calculated for major axis.

Additional axial force due to minor axis moment: (M/member thk.)

Comb 1= 24.64 kN

Comb 2 = 24.64 kN

NOTE: Double axial force in calculation spreadsheet as this force is then divided between two shear planes

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Calculation of force/bolt for a pair of plates each side of member

Reference: 125 x 250 dp Purlin - COMB 1 Medium-term
M12 bolts

Design Moment 5.3 kNm

Design shear 3.9 kN

Design axial 49.3 kN

Check OK 76%

Vertical (one side of symmetrical arrangement):

Horizontal:

Total no. bolts

each side of joint 16 no.

Max. dist to bolt

from CoG 0.25 m

Total no. bolts 16 no.

Max. dist to

bolt from CL 0.06 m

End distance from

1st row to splice 0.09 m

No. bolts on CL 0 no.

1st row from CL 0.06 m

No. bolts row 1 6 no.

1st row from CL 0.1 m

No. bolts row 1 2 no.

2nd row from CL 0 m

No. bolts row 2 0 no.

2nd row from CL 0.175 m

No. bolts row 2 3 no.

3rd row from CL 0 m

No. bolts row 3 0 no.

3rd row from CL 0.25 m

No. bolts row 3 3 no.

4th row from CL 0 m

No. bolts row 4 0 no.

4th row from CL 0 m

No. bolts row 4 0 no.

5th row from CL 0 m

No. bolts row 5 0 no.

5th row from CL 0 m

No. bolts row 5 0 no.

Position of bolt

group centroid

from splice 0.34 m

Madd due to

offset from splice 1.33 kNm

Vertical shear per

bolt due to shear 0.24 kN

Horizontal shear

per bolt due to

axial 3.08 kN

Polar moment of

inertia 0.64

Fm, vert 2.58 kN

F,v 2.82 kN

Fm, horiz 0.62 kN

F,H 3.70 kN

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Vector force 4.66 kN
 Angle from grain, α 37.35 °
 Force in timber per shear plane 2.33 kN

Resistances:

Fparallel 3.20 kN
 Fperp 2.89 kN
 K46 1.00
 K56 1.00
 K57 1.00

Table 77 of BS5268-2.

1.0 if loaded perpendicular
 1.0 for joint in SC1 & 2

Basic load F, adj. for load inclination 3.08 kN

Reference: 125 x 250 dp Purlin - COMB 2 Short-term
 M12 bolts

Design Moment 8.6 kNm
 Design shear 6.2 kN
 Design axial 49.3 kN
 Check OK 93%

Vertical (one side of symmetrical arrangement):

Horizontal:

Total no. bolts each side of joint 16 no.
 Max. dist to bolt from CoG 0.25 m

Total no. bolts 16 no.
 Max. dist to bolt from CL 0.06 m

End distance from 1st row to splice 0.09 m
 No. bolts on CL 0 no.
 1st row from CL 0.1 m
 No. bolts row 1 2 no.
 2nd row from CL 0.175 m
 No. bolts row 2 3 no.
 3rd row from CL 0.25 m
 No. bolts row 3 3 no.
 4th row from CL 0 m
 No. bolts row 4 0 no.
 5th row from CL 0 m
 No. bolts row 5 0 no.

1st row from CL 0.06 m
 No. bolts row 1 6 no.
 2nd row from CL 0 m
 No. bolts row 2 0 no.
 3rd row from CL 0 m
 No. bolts row 3 0 no.
 4th row from CL 0 m
 No. bolts row 4 0 no.

Position of bolt group centroid from splice 0.34 m

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Madd due to
offset from splice 2.11 kNm

Vertical shear per
bolt due to shear 0.39 kN

Horizontal shear
per bolt due to
axial 3.08 kN

Polar moment of
inertia 0.64
Fm, vert 4.17 kN
F,v 4.56 kN
Fm, horiz 1.00 kN
F,H 4.08 kN

Vector force 6.12 kN
Angle from grain,
 α 48.15^\circ
Force in timber
per shear plane 3.06 kN

Resistances:

Fparallel	3.48 kN
Fperp	3.14 kN
K46	1.00
K56	1.00
K57	1.00

Table 77 of BS5268-2.

1.0 if loaded perpendicular
1.0 for joint in SC1 & 2

Basic load F, adj.
for load inclination 3.28 kN

Check on Central Flitch Plate to BS5950 - ULS Forces reqd

Location A - ULS Comb 2

my	10.3 kNm
Vz	7.44 kN
Vy	2.68 kN
Offset vy	0.18 m
Mz due to shear	0.4824 kNm
N	60 kN
h	200 mm
b	8 mm
Zmaj	106666.6667 mm ³
Zmin	4266.666667 mm ³
fyk	275 N/mm ²
Mrd,y	29.3 kNm
Mrd,z	1.2 kNm
shear stress	7.0 N/mm ²
σ_c	37.5 N/mm ²
Combined	OK

Taken as distance between first rows of bolts each side of splice
Noting that primary Mz moment is resisted via plates acting as couple
2*3.7/0.125

Thickness of each plate i.e. half moment each
Both Plates combined
Both Plates combined

0.35 UR
0.41 UR
0.03 Low shear
0.14 UR

89.86 %

Provide 2no. 8 mm Plates, 1 each side

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Location A - ULS Comb 1

my	7.9 kNm	
Vz	5.71 kN	
Vy	3.31 kN	
Offset vy	0.18 m	Taken as distance between first rows of bolts each side of splice
Mz due to shear	0.5958 kNm	Noting that primary Mz moment is resisted via plates acting as couple
N	74 kN	2*4.57/0.125
h	200 mm	
b	8 mm	Thickness of each plate i.e. half moment each
Zmaj	106666.6667 mm ³	Both Plates combined
Zmin	4266.666667 mm ³	Both Plates combined
fyk	275 N/mm ²	
Mrd,y	29.3 kNm	0.27 UR
Mrd,z	1.2 kNm	0.51 UR
shear stress	5.4 N/mm ²	0.02 Low shear
σc	46.25 N/mm ²	0.17 UR
Combined	OK	94.53 %

Provide 2no. 8 mm Plates, 1 each side

For Bolts in steel (Blue book to BS5950):

For M12 (4.6) bolt in 8mm ply, bearing resistance = 44.2kN > 3.06 * 1.5 = 4.6kN - OK

For M12 (4.6) bolt in double shear, capacity = 27kN > 3.06*1.5 = 4.6kN - OK

Provide min 25mm end distance

Minimum washer

dia 36 mm

Min. washer t 3 mm