# Glued Laminated Beams

## Introduction

Glued laminated timber (see Figure 1), Glulam for short, is a high specification engineered timber product made by gluing together strength graded timber laminations to make up larger sections and distribute the natural defects evenly throughout the volume. The laminations are finger jointed to allow long lengths to be formed. This results in a structural unit of great strength and dimensional stability. Glulam beams can be produced in a range of sectional sizes and are available in lengths up to 12m.

**Figure 1. Typical Glulam Sections**

Glulam beams offer many design & performance advantages over conventional timber sections making them ideal for use in domestic and commercial JJI-Joist floor systems where high load capacity is required.

- **Strong – high specification laminates make high strength Glulam**
- **Stiff - resulting in small deflections**
- **Consistent – quality assured production process**
- **Stable - Good dimensional stability and consistent sizing**
- **Reliable - Elimination of the drying splits/shakes common in solid timber**
- **Long - available in 12m lengths**
- **Straight - No twist even with large sections and longer lengths**

These characteristics make Glulam ideal for use as trimmers, beams, rim boards & lintels.

## Section Sizes

James Jones & Sons Ltd. can supply Glulam in two grades, JJ-Glulam and GL24c. JJ-Glulam is a high specification product in sizes to compliment the JJI-Joist range (Table 1). GL24c is a lower specification product in standard European sizes intended for less demanding applications (Table 2).

| Section Depth | Width | | |
|---|---|---|---|
| | 38 | 45 | 90 |
| 195 | √ | √ | √ |
| 220 | √ | √ | √ |
| 235 | √ | √ | √ |
| 245 | √ | √ | √ |
| 300 | √* | √ | √ |
| 350 | | √* | √ |
| 400 | | √* | √ |
| 450 | | √* | √ |

**Table 1. JJ-Glulam Sizes**

| Section Depth | Width | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 |
| 100 | | | √ | | | | | |
| 120 | √ | √ | √ | √ | | | | |
| 140 | | √ | √ | | √ | | | |
| 160 | √ | √ | √ | √ | | √ | | |
| 180 | | √ | √ | | | | √ | |
| 200 | | | √ | √ | √ | √ | | √ |
| 240 | | | √ | √ | √ | √ | √ | √ |
| 280 | | | | √ | | | | |

**Table 2. GL24c Sizes**

* *Indicates sections where the depth to breadth ratio exceeds 7:1, for stability these depths should only be used in multiply members or rim beams.*



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## Tolerances

Whilst every effort is made to ensure accuracy during production there is always some variability in the finished dimensions of any engineered timber product, both the JJ-Glulam and the GL24c are therefore subject to a small tolerance on their nominal dimensions (Table 3).

| Dimension | Tolerance |
|---|---|
| Width | ± 2mm |
| Depth | ± 2mm |
| Length | ± 5mm |

**Table 3. Tolerances**

## Mechanical Properties

Both grades of Glulam are outwith the scope of BS5268:2-2002 and should be designed using a limit state code like EN1995-1-1 (Eurocode 5). Designing to Eurocode 5 requires the use of characteristic values as shown in Table 4.

Care should be taken to ensure that all partial factors used to convert the characteristic values to design values are correctly chosen for the prevailing design conditions. For example, load duration, member depth, service class etc.

| Glulam Characteristic Values | | JJ-Glulam | GL24c |
|---|---|---|---|
| Bending strength | $f_{m,g,k}$ | 32 | 24 |
| Tension strength | $f_{t,0,g,k}$ | 22.5 | 16.5 |
| | $f_{t,90,g,k}$ | 0.5 | 0.4 |
| Compression strength | $f_{c,0,g,k}$ | 29 | 24 |
| | $f_{c,90,g,k}$ | 3.3 | 2.7 |
| Shear strength | $f_{v,g,k}$ | 3.8 | 2.7 |
| Modulus of elasticity | $E_{0,g,mean}$ | 13700 | 11600 |
| | $E_{0,g,05}$ | 11100 | 9400 |
| | $E_{90,g,mean}$ | 460 | 390 |
| Shear modulus | $G_{g,mean}$ | 856 | 720 |
| Density | $\rho_{g,k}$ | 430 | 380 |

**Table 4. Characteristic Values (N/mm$^2$,kg/m$^3$)**

To assist designers who are not familiar with Eurocode 5, Table 5 and 6 have been prepared by applying the appropriate factors to the characteristic values of JJ-Glulam and GL24c respectively for domestic floor application.


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## JJ-Glulam Design Values

| Width (mm) | Depth (mm) | Area ($mm^2$) | Section Modulus Z ($x10^5 mm^3$) | Inertia I ($x10^7 mm^4$) | EI ($x10^9$ $Nmm^2$) | GA ($x10^6$ N) | d/w (-) | EC5 $k_h$ | Moment Capacity (kNm) | Shear Capacity (kN) |
|---|---|---|---|---|---|---|---|---|---|---|
| 38 | 195 | 7410 | 2.41 | 2.35 | 322 | 6.30 | 5.1 | 1.10 | 3.62 | 8.01 |
| | 220 | 8360 | 3.07 | 3.37 | 462 | 7.11 | 5.8 | 1.10 | 4.60 | 9.04 |
| | 235 | 8930 | 3.50 | 4.11 | 563 | 7.59 | 6.2 | 1.10 | 5.24 | 9.65 |
| | 245 | 9310 | 3.80 | 4.66 | 638 | 7.91 | 6.4 | 1.09 | 5.68 | 10.06 |
| | 300 | 11400 | 5.70 | 8.55 | 1171 | 9.69 | 7.9 | 1.07 | 8.34 | 12.32 |
| 45 | 195 | 8775 | 2.85 | 2.78 | 381 | 7.46 | 4.3 | 1.10 | 4.28 | 9.48 |
| | 220 | 9900 | 3.63 | 3.99 | 547 | 8.42 | 4.9 | 1.10 | 5.45 | 10.70 |
| | 235 | 10575 | 4.14 | 4.87 | 667 | 8.99 | 5.2 | 1.10 | 6.21 | 11.43 |
| | 245 | 11025 | 4.50 | 5.51 | 756 | 9.37 | 5.4 | 1.09 | 6.72 | 11.92 |
| | 300 | 13500 | 6.75 | 10.13 | 1387 | 11.48 | 6.7 | 1.07 | 9.88 | 14.59 |
| | 350 | 15750 | 9.19 | 16.08 | 2203 | 13.39 | 7.8 | 1.06 | 13.24 | 17.02 |
| | 400 | 18000 | 12.00 | 24.00 | 3288 | 15.30 | 8.9 | 1.04 | 17.06 | 19.46 |
| | 450 | 20250 | 15.19 | 34.17 | 4682 | 17.21 | 10.0 | 1.03 | 21.34 | 21.89 |
| 90 | 195 | 17550 | 5.70 | 5.56 | 762 | 14.92 | 2.2 | 1.10 | 8.57 | 18.97 |
| | 220 | 19800 | 7.26 | 7.99 | 1094 | 16.83 | 2.4 | 1.10 | 10.90 | 21.40 |
| | 235 | 21150 | 8.28 | 9.73 | 1333 | 17.98 | 2.6 | 1.10 | 12.42 | 22.86 |
| | 245 | 22050 | 9.00 | 11.03 | 1511 | 18.74 | 2.7 | 1.09 | 13.44 | 23.83 |
| | 300 | 27000 | 13.50 | 20.25 | 2774 | 22.95 | 3.3 | 1.07 | 19.75 | 29.18 |
| | 350 | 31500 | 18.38 | 32.16 | 4405 | 26.78 | 3.9 | 1.06 | 26.48 | 34.05 |
| | 400 | 36000 | 24.00 | 48.00 | 6576 | 30.60 | 4.4 | 1.04 | 34.12 | 38.91 |
| | 450 | 40500 | 30.38 | 68.34 | 9363 | 34.43 | 5.0 | 1.03 | 42.68 | 43.78 |

**Table 5. JJ-Glulam Design Values**

*Notes*
*1. The moment & shear capacities are applicable for domestic floor constructions only. $k_{mod}$ = 0.8*
*2. Glulam Partial Material Factor $\gamma_M$ = 1.25, Glulam Partial Load Factor $\gamma_f$ = 1.5, Glulam Depth Factor = $(600/h)_{0.1}$*
*3 . Larger section properties are available upon request*


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## GL24c Design Values

| Width (mm) | Depth (mm) | Area ($mm^2$) | Section Modulus Z ($x10^5 mm^3$) | Inertia I ($x10^7 mm^4$) | EI ($x10^9$ $Nmm^2$) | GA ($x10^6$ N) | d/w (-) | EC5 $k_h$ | Moment Capacity (kNm) | Shear Capacity (kN) |
|---|---|---|---|---|---|---|---|---|---|---|
| 60 | 120 | 7200 | 1.44 | 0.86 | 100 | 6.12 | 2.0 | 1.10 | 1.62 | 5.53 |
| | 160 | 9600 | 2.56 | 2.05 | 238 | 8.16 | 2.7 | 1.10 | 2.88 | 7.37 |
| 80 | 140 | 11200 | 2.61 | 1.83 | 212 | 9.52 | 1.8 | 1.10 | 2.94 | 8.60 |
| | 160 | 12800 | 3.41 | 2.73 | 317 | 10.88 | 2.0 | 1.10 | 3.84 | 9.83 |
| | 180 | 14400 | 4.32 | 3.89 | 451 | 12.24 | 2.3 | 1.10 | 4.87 | 11.06 |
| 100 | 100 | 10000 | 1.67 | 0.83 | 97 | 8.50 | 1.0 | 1.10 | 1.88 | 7.68 |
| | 120 | 12000 | 2.40 | 1.44 | 167 | 10.20 | 1.2 | 1.10 | 2.70 | 9.22 |
| | 140 | 14000 | 3.27 | 2.29 | 265 | 11.90 | 1.4 | 1.10 | 3.68 | 10.75 |
| | 160 | 16000 | 4.27 | 3.41 | 396 | 13.60 | 1.6 | 1.10 | 4.81 | 12.29 |
| | 180 | 18000 | 5.40 | 4.86 | 564 | 15.30 | 1.8 | 1.10 | 6.08 | 13.82 |
| | 200 | 20000 | 6.67 | 6.67 | 773 | 17.00 | 2.0 | 1.10 | 7.51 | 15.36 |
| | 220 | 22000 | 8.07 | 8.87 | 1029 | 18.70 | 2.2 | 1.10 | 9.09 | 16.90 |
| | 240 | 24000 | 9.60 | 11.52 | 1336 | 20.40 | 2.4 | 1.10 | 10.77 | 18.43 |
| 120 | 120 | 14400 | 2.88 | 1.73 | 200 | 12.24 | 1.0 | 1.10 | 3.24 | 11.06 |
| | 160 | 19200 | 5.12 | 4.10 | 475 | 16.32 | 1.3 | 1.10 | 5.77 | 14.75 |
| | 200 | 24000 | 8.00 | 8.00 | 928 | 20.40 | 1.7 | 1.10 | 9.01 | 18.43 |
| | 240 | 28800 | 11.52 | 13.82 | 1604 | 24.48 | 2.0 | 1.10 | 12.93 | 22.12 |
| | 280 | 33600 | 15.68 | 21.95 | 2546 | 28.56 | 2.3 | 1.08 | 17.33 | 25.80 |
| 140 | 140 | 19600 | 4.57 | 3.20 | 371 | 16.66 | 1.0 | 1.10 | 5.15 | 15.05 |
| | 200 | 28000 | 9.33 | 9.33 | 1083 | 23.80 | 1.4 | 1.10 | 10.51 | 21.50 |
| | 240 | 33600 | 13.44 | 16.13 | 1871 | 28.56 | 1.7 | 1.10 | 15.08 | 25.80 |
| 160 | 160 | 25600 | 6.83 | 5.46 | 634 | 21.76 | 1.0 | 1.10 | 7.69 | 19.66 |
| | 200 | 32000 | 10.67 | 10.67 | 1237 | 27.20 | 1.3 | 1.10 | 12.01 | 24.58 |
| | 240 | 38400 | 15.36 | 18.43 | 2138 | 32.64 | 1.5 | 1.10 | 17.24 | 29.49 |
| 180 | 180 | 32400 | 9.72 | 8.75 | 1015 | 27.54 | 1.0 | 1.10 | 10.95 | 24.88 |
| | 240 | 43200 | 17.28 | 20.74 | 2405 | 36.72 | 1.3 | 1.10 | 19.39 | 33.18 |
| 200 | 200 | 40000 | 13.33 | 13.33 | 1547 | 34.00 | 1.0 | 1.10 | 15.02 | 30.72 |
| | 240 | 48000 | 19.20 | 23.04 | 2673 | 40.80 | 1.2 | 1.10 | 21.55 | 36.86 |

**Table 6. GL24c Design Values**

*Notes*

*1. The moment & shear capacities are applicable for domestic floor constructions only. $k_{mod} = 0.8$*

*2. Glulam Partial Material Factor $\gamma_M = 1.25$, Glulam Partial Load Factor $\gamma_f = 1.5$, Glulam Depth Factor = $(600/h)_{0.1}$*

*3. Larger section properties are available upon request*



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## Storage on Site

Glulam will arrive on site with moisture content between 10% and 15%, and will achieve a moisture content of approximately 10% when installed in Service Class 1 conditions. Glulam should be stored clear of the ground and protected from the weather. Once installed, if the structure will not be weather tight for a prolonged period of time, then the glulam should be protected from the weather to avoid changes in moisture. content.

## Fire Resistance

For the purpose of calculating fire resistance of Glulam members, a charring rate of 0.66mm per minute per face should be used.

## Holes or Notches

Holes or notches should be formed in accordance with the guidelines given for solid timber members in The Building Regulations Approved Document "Timber Intermediate Floors for Dwellings", clause 2.5. The hole and notch diagram is applicable to uniformly loaded single span beams only. For all other applications, consult the JJI-Joist supplier.

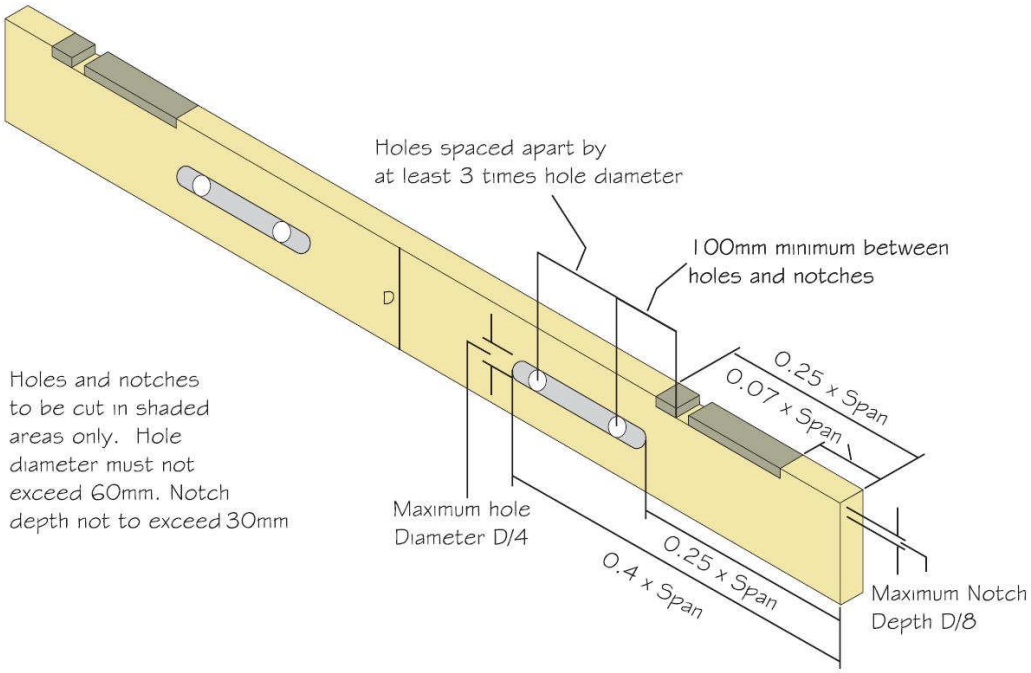


**Figure 2. Holes in Glulam**

## Additional Properties

Glulam is untreated, but when used in a Service Class 1 or 2 environment will have a natural durability comparable to that of solid timber. Following discussions with the NHBC it has been confirmed that when used as a rim beam in timber frame construction and is protected by a layer of sheathing and breather paper, no additional preservative treatment is required. Preservative treatment should not be undertaken without the consent of the manufacturer.


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## Fixing of Multiply Glulam Members

Under some circumstances it may be more structurally and stock efficient to combine two or more Glulam members side by side. Only members of the same width should be connected together.

James Jones & Sons Ltd recommend the use of large diameter self tapping screws rather than nails or bolts whenever possible. Both the approved JJI-Joist metalwork suppliers can supply large diameter self tapping screws;

- **Cullen LedgerLok @ Ø5.8mm**
- **Simpson SDS screw @ Ø6.15mm**

These products are ideal for the majority of multiply situations and should be held in stock along with the Glulam. For details of the available screw sizes and advice on how they can be used please refer to the relevant metalwork manufacturer's technical literature.

However, there are several different ways to connect multiply members together including Nails, Screws and Bolts and this section provides some standard nailing and bolting details for uniformly loaded multiply members loaded from one face only.

**Nails –** For two ply 38mm and 45mm members nails are the cheapest and most easily made fixing. Nails can also be used in three ply 38mm and 45mm members although designers are encouraged to use a screwed connection solution where possible. Table 7 shows the required fixing specification and spacing for given return spans (return span is given in metres).

| Multiply Member | | | Nail Specification | | | Load | Nail Spacing - S (mm) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Thick. | Plys | Width | Dia. | Length | Capacity | Ratio | 600 | 500 | 400 | 300 | 200 | 100 |
| 38 | 2 | 76 | 3.1mm | 75 | 0.381 | 0.50 | 2.26 | 2.71 | 3.39 | 4.52 | 6.77 | 13.55 |
| | 3 | 114 | 3.1mm | 75 | 0.381 | 0.67 | 1.69 | 2.03 | 2.54 | 3.39 | 5.08 | 10.16 |
| 45 | 2 | 90 | 3.1mm | 90 | 0.381 | 0.50 | 2.26 | 2.71 | 3.39 | 4.52 | 6.77 | 13.55 |
| | 3 | 135 | 3.1mm | 90 | 0.381 | 0.67 | 1.69 | 2.03 | 2.54 | 3.39 | 5.08 | 10.16 |

**Table 7. Nail Fixing Specifications**

*Notes*

1. *The values in the table above are only applicable to uniformly loaded beams supporting a dead load of 0.75kN/m$^2$ and an imposed load of 1.50kN/m$^2$ (standard domestic load with a partition allowance). For other applications please consult the JJI-Joist supplier.*
2. *For a flat loading of 1.15kN/m$^2$ dead load and 1.50kN/m$^2$ imposed load (standard flats loading with a partition allowance). the return spans on the table should be reduced by multiplying them by 0.85.*
3. *The values in the table above are applicable to Glulam members loaded to one face only.*
4. *Nail diameters indicated are based on power driven nails, hammer driven nails may be larger in diameter.*

Nails in two ply members should be fixed in two rows 65mm in from the top and bottom edge of the members driven from alternate sides (see Figure 3). The minimum end distance "e" should be 90mm.

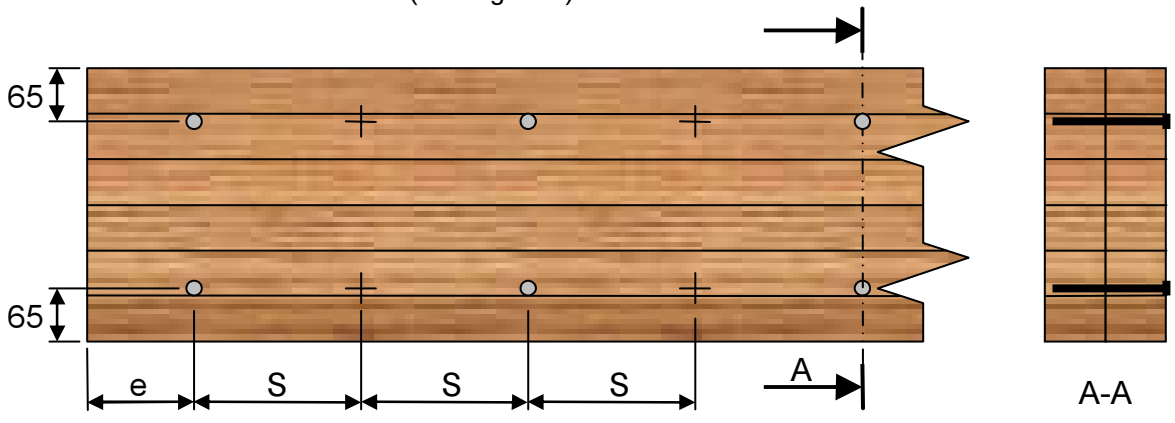


**Figure 3. Nail Detail for 2 ply Glulam**


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Nails in three ply members should be fixed in two rows 65mm in from the top and bottom edge of the members driven from alternate sides (see Figure 4). Note that nails from any one face should be at centres of S mm with the nails from the opposite face offset by S/2. The minimum distance "e" from the last column of nails to the end of the member should be 90mm.

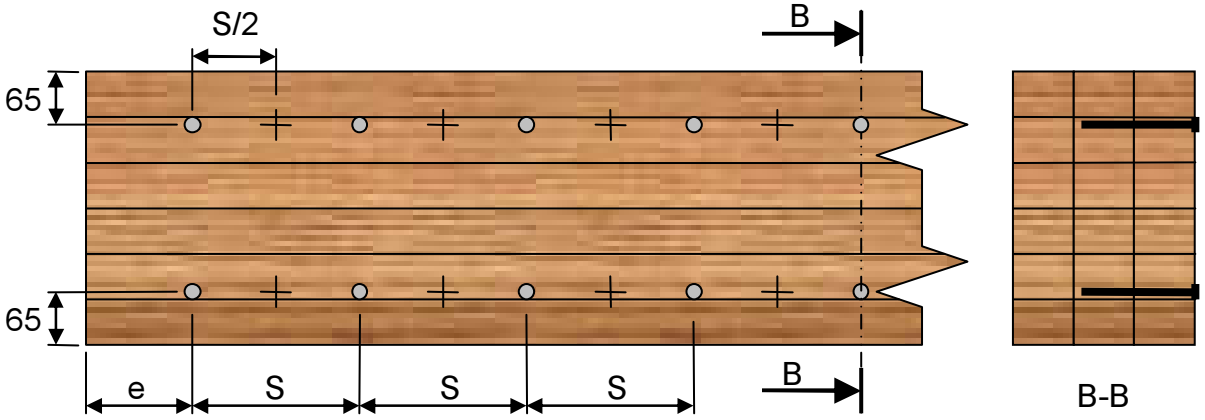


**Figure 4. Nail Detail for 3 ply Glulam**

**Bolts** – Bolts can be used to connect together up to 5 ply 45mm members. Table 8 shows the required fixing specification and spacing for given return spans when using 4.6 grade M10 bolts (return span is given in metres). The minimum end distance "e" should be 40mm.

| Multiply Member | | | Bolt Specification | | | Load | Bolt Spacing - S (mm) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Thick. | Plys | Width | Size | Length | Capacity | Ratio | 600 | 500 | 400 | 300 | 200 | 100 |
| 38 | 2 | 76 | M10 | 100 | 1.742 | 0.50 | 5.16 | 6.19 | 7.74 | 10.32 | 15.48 | 30.97 |
| | 3 | 114 | M10 | 140 | 1.683 | 0.67 | 3.74 | 4.49 | 5.61 | 7.48 | 11.22 | 22.44 |
| | 4 | 152 | M10 | 170 | 1.683 | 0.75 | 3.32 | 3.99 | 4.99 | 6.65 | 9.97 | 19.95 |
| | 5 | 190 | M10 | 210 | 1.683 | 0.80 | 3.12 | 3.74 | 4.68 | 6.23 | 9.35 | 18.70 |
| 45 | 2 | 90 | M10 | 110 | 2.065 | 0.50 | 6.12 | 7.34 | 9.18 | 12.24 | 18.36 | 36.71 |
| | 3 | 135 | M10 | 160 | 1.993 | 0.67 | 4.43 | 5.31 | 6.64 | 8.86 | 13.29 | 26.57 |
| | 4 | 180 | M10 | 200 | 1.993 | 0.75 | 3.94 | 4.72 | 5.91 | 7.87 | 11.81 | 23.62 |
| | 5 | 225 | M10 | 250 | 1.993 | 0.80 | 3.69 | 4.43 | 5.54 | 7.38 | 11.07 | 22.14 |

**Table 8. Bolt Fixing Specifications**

*Notes*

1. *The values in the table above are only applicable to uniformly loaded beams supporting a dead load of 0.75kN/m$^2$ and an imposed load of 1.50kN/m$^2$ (standard domestic load with a partition allowance). For other applications please consult the Glulam supplier.*
2. *For a flat loading of 1.15kN/m$^2$ dead load and 1.50kN/m$^2$ imposed load (standard flats loading with a partition allowance). the return spans on the table should be reduced by multiplying them by 0.85.*
3. *The values in the table above are applicable to Glulam members loaded to one face only.*
4. *38mm diameter x 3mm thick washers are required under each head and nut on M10 bolts*

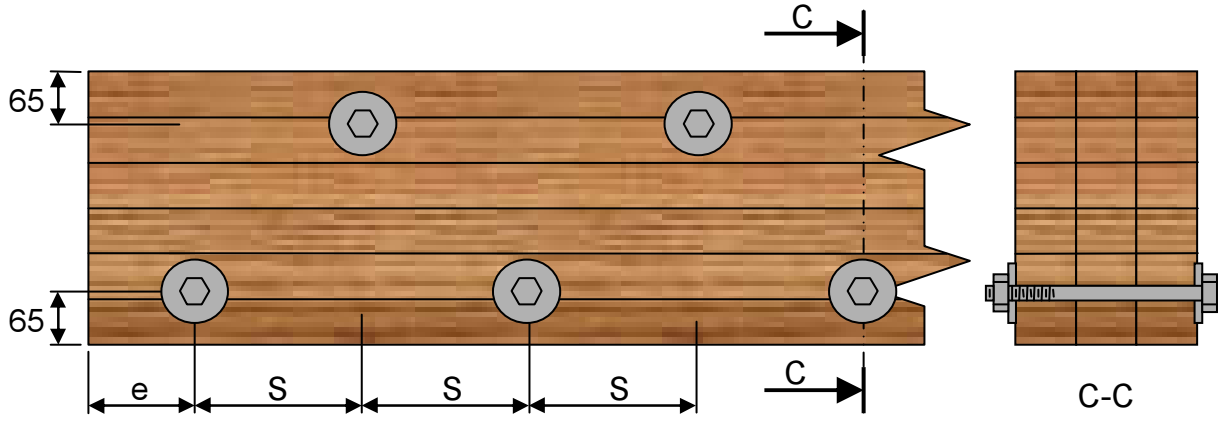


**Figure 5. Bolt Detail for Multiply Glulam**


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