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SPAN TABLES FOR CARPORT BEAMS
from "MAXbeam" Structural Laminated Veneer Lumber
Report for INDEPENDENT TIMBER SUPPLIES
August 2003

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14th August 2003

SPAN TABLES FOR CARPORT BEAMS from "MAXbeam Structural Laminated Veneer Lumber Report for INDEPENDENT TIMBER SUPPLIES August 2003

1. BACKGROUND

Currently available sawn timber sizes do not have the performance required to carry roof loads over carports. Builders have been making extensive use of steel beams within carport roof structures, even though the majority of material used in the roof is timber.

Independent Timber Supplies furnished test reports on MAXbeam materials and asked for preparation of some span tables to be used for three elements in carport roofs:

- Front beam across the carport opening. **Front Beam**
- Strutting beam parallel to the front beam and at mid-depth of the carport. **Centre Beam**
- Perimeter beams to span half of the depth of the carport. **Side beams**

Independent Timber Supplies indicated that the table would only be required for a total roof and ceiling weight of:

- 40 kg/m^2 for sheet roofs and
- 90 kg/m^2 for tiled roofs

Span tables have been produced in accordance with AS1684.1 for N1/N2 houses. Conventions and nomenclature used in the report are shown in Figure 1.

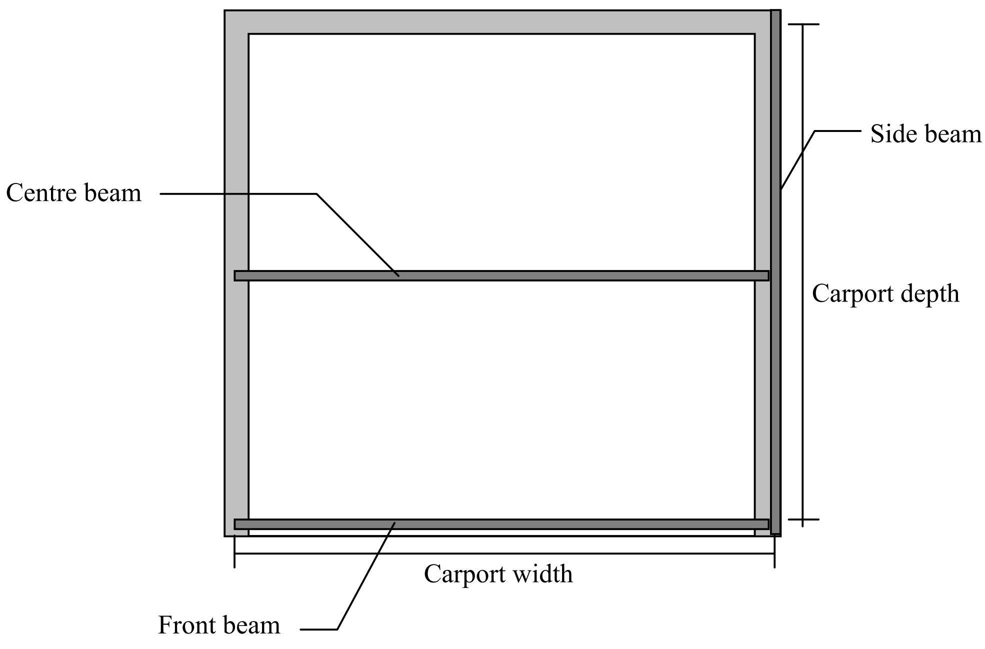

Figure 1 – Nomenclature and dimensions used in Span Tables

2. PREPARATION OF SPAN TABLES

2.1 Properties

The following properties have been used in preparation of the span tables:

- f'_b = 66.0 MPa
- f'_s = 5.0 MPa
- E = 18,500 MPa
- ρ_b = 1.07

Jack Taylor's report for Asian Timber Products (Monash University 10th October 2002) presents the bending strength by two different calculations methods.

- Using AS/NZS4063 to find the characteristic value gives f'_b = 80 MPa.
- The 5%ile of the tests on bending strength gives f'_b = 66 MPa.

Normally for sawn timber, the characteristic value obtained from AS/NZS4063 is lower than the 5%ile value, but in this case, because the variance ratio is so low, the correction to the characteristic value does not work the way it was intended.

After discussions with Jack Taylor by phone, it was decided:

- The most appropriate value of bending strength to use is the 5%ile value (f'_b = 66 MPa).
- The shear strength (f'_s) used was also the 5%ile value from the same Monash University report (f'_s = 5 MPa).
- The Modulus of Elasticity used was the mean value which corresponded with the value given by the analysis given in AS/NZS4063.

2.2 Basis of Span table preparation

The span tables were prepared using a spreadsheet that was created in accordance with the load cases, constraints and requirements for roof beams and lintels in AS1684.1:1999.

AS1684.1 does not contain tables for carport beams, but there were a number of possible members for consideration.

- Roof beams and Intermediate beams – needed to consider both roof loads and ceiling loads.
- Lintels – did not have some of the live load cases included in the roof beams and had a different loading configuration for wind loads.
- Combined strutting and hanging beams – gave similar load cases to the two above.

All of the roof beam load cases given in AS1684.1:1999 were considered with the addition of the wind load cases given for lintels. (These included downward wind loads that were not listed for the roof and intermediate beams.)

2.3 Roof construction

The span tables could be used with a number of different types of roof construction. The different types meant that different load paths would result, and cause different loading patterns on the beams to be designed.

2.3.1 Gable over the opening

Where there is a gable over the front opening, then the ridge beam is strutted onto the front beam of the carport directly. The ends of any underpurlins would also be strutted onto the Front beam.

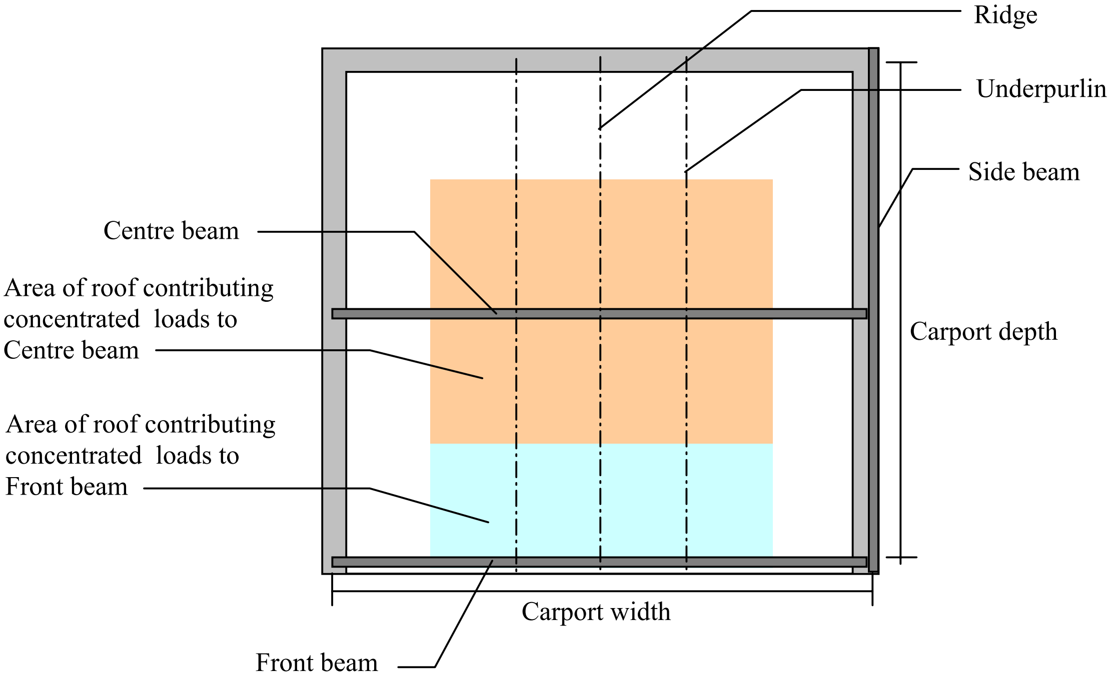

Figure 2 – Gable over Opening

In this case, the ceiling loads are close to uniformly distributed loads along the length of the front beam, but the roof loads are transmitted as concentrated loads by the struts.

- The area contributing to the concentrated loads to the Front beam is shown in Figure 2. It has depth of ¼ of the carport depth, and width of approximately 2/3 of the carport width.
- The area contributing to the distributed loads to the Front beam is the full width of the carport and ¼ of the carport depth.

Likewise for the Centre beam, the ceiling loads are uniformly distributed, and the roof loads carried by struts.

- The area contributing to the concentrated loads to the Centre beam is shown in Figure 2. It has depth of ½ of the carport depth, and width of approximately 2/3 of the carport width.
- The area contributing to the distributed loads to the Centre beam is the full width of the carport and ½ of the carport depth.

The Side beams carry the small, unshaded area on either side of the regions contributing to the Front and Centre beams.

2.3.2 Hip and Dutch Gable over the opening

Where there is a Dutch gable over the opening, the roof geometry is more complex. Another beam must be placed between the Centre beam and the Front beam to carry strutting loads from the Dutch gable. The ridge beam and underpurlin is strutted onto this intermediate beam. The intermediate beam transfers those loads as a concentrated load to the centre of the Front beam of the carport.

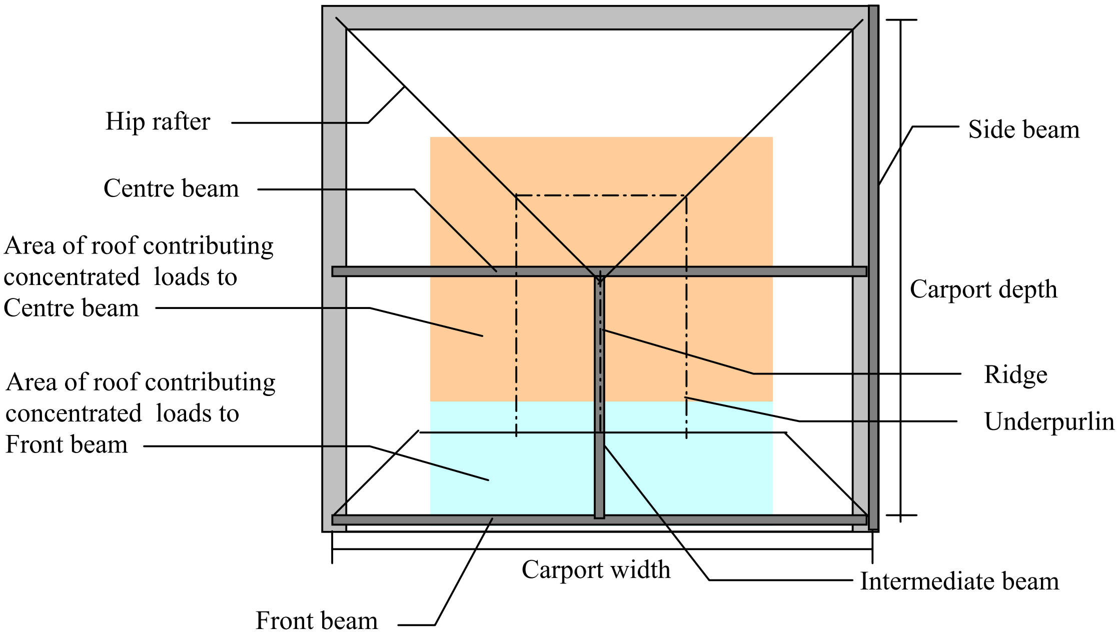

Figure 3 – Hip and Dutch Gable over Opening

In this case, the ceiling loads as before - uniformly distributed loads along the length of the front beam, but the roof loads are transmitted as a single concentrated load by the intermediate beam. However, the contributing area is the same as for the Gable over the opening. In this case, the concentrated load is delivered at one point only – the centre of the span.

- The area contributing to the concentrated loads to the Front beam is shown in Figure 3. It has depth of ¼ of the carport depth, and width of approximately 2/3 of the carport width.
- The area contributing distributed loads to the Front beam is the full width of the carport and ¼ of the carport depth.

Likewise for the Centre beam, the ceiling loads are uniformly distributed, and the roof loads carried by struts.

- The area contributing to the concentrated loads to the Centre beam is shown in Figure 3. It has depth of ½ of the carport depth, and width of approximately 2/3 of the carport width.
- The area contributing to the distributed loads to the Centre beam is the full width of the carport and ½ of the carport depth.

The Side beams carry the small unshaded area on either side of the regions contributing to the Front and Centre beams.

2.3.3 Gable over the side wall

Where there is a gable over the side wall, then the ridge beam runs directly over the Centre beam and is strutted directly onto it. Underpurlins would use fan struts onto the same Centre beam.

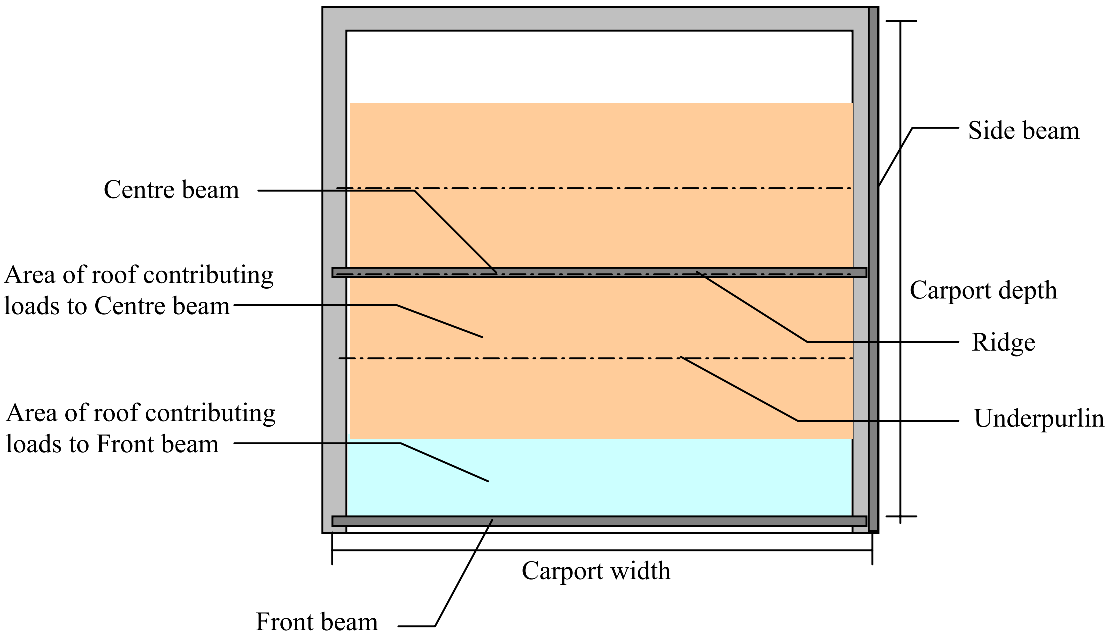

Figure 4 – Gable over Sidewall

In this case, both the ceiling and roof loads are close to uniformly distributed loads along the length of the front beam. The width of the contributing area is half of the distance to the underpurlin. It is conservative to assume that there is no underpurlin and that the supported roof width is ¼ of the depth of the carport.

For the Centre beam, the ceiling loads are uniformly distributed, and the roof loads carried by struts. However, as the Centre beam is positioned immediately under the ridge, it is possible to have struts at quite close centres. It can be assumed that the roof load is also uniformly distributed to the Centre beam. Again, the width of the contributing area is half of the distance from the underpurlin to the eaves on each side. In this case, it is conservative to assume underpurlins are used. The supported roof width is 2/3 of the depth of the carport.

Figure 4 shows that there is no small unshaded area on either side of the regions contributing to the Front and Centre beams. The Side beams are not strictly required for this construction detail.

2.3.4 Design parameters for beams

For each of the three beams, load cases were generated from the tributary area diagrams given in Figures 2 to 4.

- For the Front beam, two load cases were considered
  - a uniformly distributed case for both roof and ceiling as given in 2.3.3
  - a uniformly distributed ceiling load plus a concentrated load from the roof as given in 2.3.2

- For the Centre beam, two load cases were considered
  - a uniformly distributed case for both roof and ceiling as given in 2.3.3
  - a uniformly distributed ceiling load plus a concentrated load from the roof as given in 2.3.2

- For the Side beams, one load case was considered
  - a uniformly distributed case for both roof and ceiling as given in 2.3.1

2.3.5 AS1684.1 Residential Timber Framed Construction – Design criteria

Once the contributory areas had been determined, the performance of the beams was modelled using the loading and performance criteria set out in AS1684.1-1999 Clause 2.3.

Where concentrated loads were considered, these were modelled as follows:

- Bending moments calculated using $M = \frac{PL}{4}$ for single spans
- Maximum shear force calculated as $V = \frac{P}{2}$ for loads at mid span, and for concentrated loads at variable locations, $V = P$

Where uniformly distributed loads were considered, these were modelled as follows:

- Bending moments calculated using $M = \frac{wL^2}{8}$ for single spans
- Maximum shear force calculated as $V = \frac{wL}{2}$ for single spans
- Bending moments calculated using $M = \frac{wL^2}{8}$ for continuous spans
- Maximum shear force calculated as $V = \frac{5wL}{8}$ for continuous spans

Deformations were modelled as:

$\delta = j_2 \frac{5}{384} \frac{wL^4}{EI}$ for uniformly distributed loads on single spans

$\delta = j_2 \frac{1}{48} \frac{PL^3}{EI}$ for concentrated loads at mid-span in a single span

3. SPAN TABLES

Preliminary span tables were prepared based on the results of running software that matched performance against the criteria shown in the Design Criteria document AS1684.1.
After checking the results with a builder and with the producer, a range of standard sizes was adopted. The software was then re-run on those standard sizes to determine spanning ability. The resulting span tables are shown as an Appendix to this report.

The span tables are valid provided the MaxBeam properties remain unchanged.

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Span Tables for MAXbeam carport beams – unique properties
(N1/N2 wind conditions)

(A) Front beams

Front beam		Width of opening (mm)	
Carport depth (mm)		Sheet Roof	Tiled Roof
	Size	240 × 65	280 × 80
5600		5900	5900
5800		5800	5800
6000		5800	5800

(B) Side beams

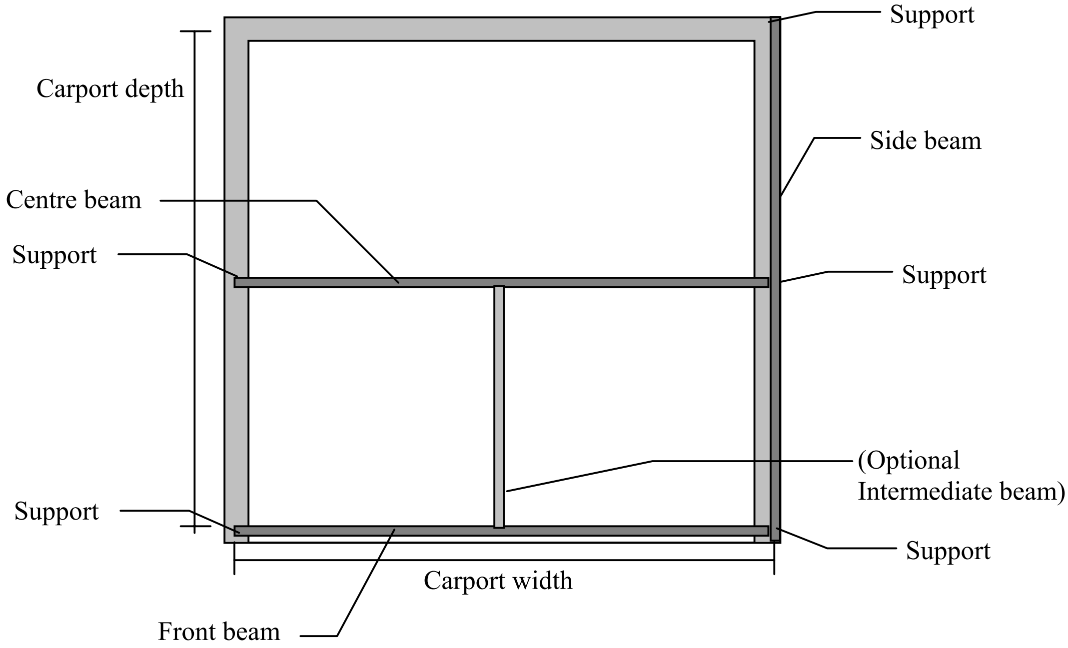
Side beam		span (mm)	
Carport width (mm)		Sheet Roof	Tiled Roof
	Size	200 × 50	240 × 50
5600		3600	3400
5800		3600	3400
6000		3600	3400

(C) Centre beams

Centre beam	Carport width (mm)	5600		5800		6000	
Carport depth (mm)	Beam	Sheet Roof	Tiled Roof	Sheet Roof	Tiled Roof	Sheet Roof	Tiled Roof
5600	Strutting Beam	280 × 65	350 × 65	290 × 65	370 × 65	300 × 65	380 × 65
5800	Strutting Beam	290 × 65	360 × 65	300 × 65	370 × 65	310 × 65	380 × 65
6000	Strutting Beam	290 × 65	360 × 65	300 × 65	370 × 65	310 × 65	390 × 65

Notes:
Sheet roof weight 10kg/m^2 for roofing and 30 kg/m^2 for ceiling
Tiled roof weight 60kg/m^2 for roofing and 30 kg/m^2 for ceiling
Beams must be tied down to resist uplift forces, and restrained to prevent twisting.

These beams are to be used in roof framing of carports in which the construction is as illustrated below:


Support
Carport depth
Side beam
Centre beam
Support
Support
(Optional
Intermediate beam)
Support
Support
Carport width
Front beam