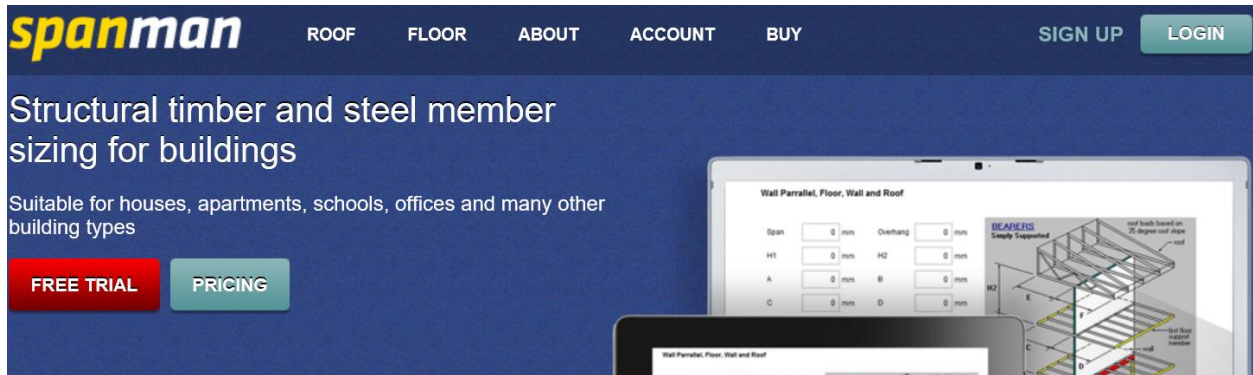


# DESIGNING BUILDING FRAMING UTILISING THE SPANMAN ONLINE DESIGN TOOL

[www.spanman.net](http://www.spanman.net)



## INTRODUCTION: WHAT IS SPANMAN

### SPANMAN SOFTWARE DESCRIPTION

Spanman is an elegant cloud based parametric design tool for the sizing of timber and steel structural members that is fast and easy to use. It works directly from the website [www.spanman.net](http://www.spanman.net)

Traditional engineering software is designed to analyse forces and deflections for a particular member and provide output based on the analysis. However the determination of the particular forces and the required load combinations to be adopted can be a time consuming process.

In creating SpanMan, the authors analysed the complete design cycle for a building. Seeking to understand the needs of an architect (or building designer), client, engineer, and builder, so as to create a software platform that incorporated the various Building Codes for structural members in an easy to use format.

An architect wishes to know what material is the most economic and sympathetic to their design, and of appropriate depth to be accommodated within their floor and roof depths. An engineer wishes to provide quick and accurate structural alternatives to architects and clients. Whilst a builder wishes economic and buildable alternatives.

SpanMan was created as a platform, in which the requirements of the various codes are incorporated. AS1170 loading codes, AS4100 steel code, AS1684 Light timber framing, AS1720 Structural timber, NASH standard, AS4600 cold formed steel code. On this basis with a large selection of timber and steel products contained within the software, the user is able to quickly design and specify alternatives in various materials, all rigorously calculated through mathematical algorithms.

Spanman was created to have a simple and easy to user interface. As most building practitioners are familiar with framing manuals, SpanMan adopts a similar theme.

The authors are Australian based structural engineers with over 35 years experience designing all types of buildings.

## **RATIONALISED AND TRANSPARENT DESIGN**

Utilising a tiered approach SpanMan is designed to be accessible to all building practitioners.

At Tier 1; Once a practitioner has selected the appropriate wind classification for the site, building type and floor use, the user can then enter spans and spacings etc, select a design material and click to produce an optimised design size. SpanMan has been programmed to automatically set the appropriate loads and load cases from the Australian standards and undertake all the deflection strength and shear checks for the various load cases. It determines the optimum size based on these algorithms.

At Tier 2; A competent building practitioner can make limited adjustments to the design parameters, provided they do not lead to designs that are less conservative to the Australian standards. Additional loads can also be applied to members.

At Tier 3; An engineer can undertake a detailed check of the calculations to certify the design.

## **BUILDING FRAMING DESIGN AUSTRALIA WIDE**

SpanMan has been designed so that it can be used for all wind regions in Australia.

The User has the choice of selecting a wind classification according to AS4055, or undertaking a Manual input in accordance with AS1170.2. By inputting the building height, and selecting, Region, Terrain Category, Shielding and Topographic factors the wind loads are automatically set. As the user has selected a building type, the importance factors are automatically set.

## **AUTOMATIC SETTING OF FLOOR LIVE LOADS**

In selecting a Building Type, and Floor Use the floor live loads are automatically set for the design.

## **BENEFITS TO INDUSTRY**

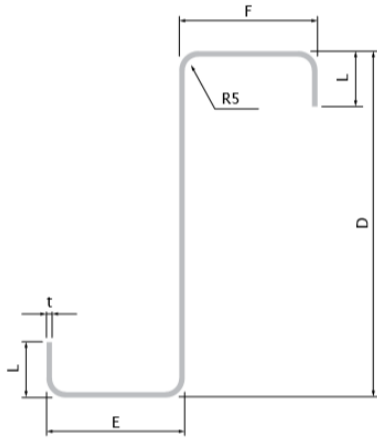
- Error minimisation
- Time savings
- Optimal design
- Ability to quickly compare design options on an apples to apples basis
- Unbiased design results
- Enhance service to generate more business
- Provide clients with responsive answers
- Provide a number of material options
- Develop the most economical solution
- Incorporates the requirements of the various Australian Standards in a clear format.

## **BENEFITS TO THE ENVIRONMENT**

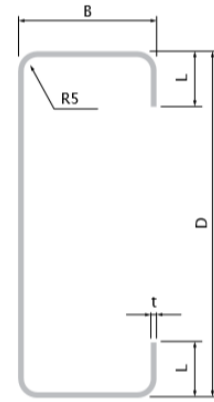
Optimum use of materials

# COLD FORMED “C” AND “Z” SECTIONS NOW INCLUDED IN SPANMAN

## Z AND C SECTION - DIMENSIONS



Standard Z-Section



Standard C-Section

Dimensions of Cold Formed Zed's & Cee's to AS4600 incorporated into SpanMan

Section	t (mm)	D (mm)	Mass (kg/m)	Zeds			Ceess	
				E (mm)	F (mm)	L (mm)	B (mm)	L (mm)
Z/C10010	1.0	102	1.78	53	49	12.5	51	12.5
Z/C10012	1.2	102	2.10	53	49	12.5	51	12.5
Z/C10015	1.5	102	2.62	53	49	13.5	51	13.5
Z/C10019	1.9	102	3.29	53	49	14.5	51	14.5
Z/C15012	1.2	152	2.89	65	61	15.5	64	14.5
Z/C15015	1.5	152	3.59	65	61	16.5	64	15.5
Z/C15019	1.9	152	4.51	65	61	17.5	64	16.5
Z/C15024	2.4	152	5.70	66	60	19.5	64	18.5
Z/C20015	1.5	203	4.49	79	74	15.0	76	15.5
Z/C20019	1.9	203	5.74	79	74	18.5	76	19.0
Z/C20024	2.4	203	7.24	79	73	21.5	76	21.0
Z/C25019	1.9	254	6.50	79	74	18.0	76	18.5
Z/C25024	2.4	254	8.16	79	73	21.0	76	20.5
Z/C30024	2.4	300	10.09	100	93	27.0	96	27.5
Z/C30030	3.0	300	12.76	100	93	31.0	96	31.5
Z/C35030	3.0	350	15.23	129	121	30.0	125	30.0

# EXAMPLE 1: DESIGNING A ROOF MEMBER

## 1. SELECT WIND SITE CLASSIFICATION

(i) In accordance with AS4055

**spanman** ROOF FLOOR ABOUT ACCOUNT BUY LOG OFF

Purlin Single Span Like Share 33

**SETTINGS** Country: Australia Wind: **N1** Building Type: College

**DESIGN DETAILS**

Roof Use: Normal roof

Span: 10000 mm Overhang: mm

Spacing: 1200 mm Roof Slope: 5 degrees

**ROOF PURLINS**  
Single span  
spacing  
slope

(ii) Or in accordance with AS1170.

**spanman** ROOF FLOOR ABOUT ACCOUNT BUY LOG OFF

Purlin Single Span Like Share 33

**SETTINGS** Country: Australia Wind: Manual input Building Type: College

**DESIGN DETAILS**

Roof Use: Normal roof

Span: 10000 mm Overhang: 0 mm

Spacing: 1200 mm Roof Slope: 5 degrees

**ROOF PURLINS**  
Single span  
spacing  
slope

Upon clicking Manual Input the user can then select Building height, Region, Terrain Category, Shielding and Topographic Multiplier and SpanMan will calculate the design wind speeds for the site.

## 2. SELECT BUILDING TYPE

## 3. SELECT ROOF FRAMING MEMBER TO BE DESIGNED

## FOR THIS EXAMPLE SELECT A PURLIN SINGLE SPAN

Input Span, Spacing, Overhang and Roof Slope, then select the roof and ceiling material that the purlin is supporting.

Tick box if purlin is located near ridge or edge of roof. Increased wind suction occurs at abrupt changes in roof geometry, and SpanMan automatically adopts appropriate pressure coefficients to take into account these local pressures.

The screenshot shows the SpanMan web application interface. At the top, there is a navigation bar with 'spanman' logo and menu items: ROOF, FLOOR, ABOUT, ACCOUNT, BUY, and LOG OFF. Below the navigation bar, the page title is 'Purlin Single Span'. A dropdown menu is open, showing options: Purlin Single Span, Purlin Double Span, Rafter Single Span, Rafter Double Span, Roof Beam Single Span, Roof Beam-Double Span, Ridge Beam Single Span, and Ridge Beam Double Span. The main form is divided into 'SETTINGS' and 'DESIGN DETAILS' sections. The 'SETTINGS' section includes 'Country: Aus', 'Building Type: College', and a 'HELP' button. The 'DESIGN DETAILS' section includes 'Roof Use: Normal roof', 'Span: 4000 mm', 'Overhang: 0 mm', 'Spacing: 1200 mm', and 'Roof Slope: 5 degrees'. There is a checkbox 'Is the purlin near a roof edge or a change of roof slope e.g. a ridge?' which is checked. Below this is a note: 'Note: Tick this box if the purlin is a distance "a" from a roof edge or a change in roof slope e.g. a ridge. "a" is the minimum of the building height, 0.2 of the building width or 0.2 of the building depth.' The 'Roof' material is '0.50 mm steel sheet, battens, pink batt insulation, wiring + sisal' and the 'Ceiling' material is '12 mm softwood T&G lining, pink batt insulation, wiring + sisal'. On the right side, there is a diagram titled 'ROOF PURLINS' showing a 'Single span' configuration with labels for 'spacing', 'slope', 'overhang', and 'span'. A red line indicates the 'Purlin to be designed'.

By selecting "List all suitable timber and steel sections" for Design Material and then clicking on the DESIGN button a list of suitable sections and materials will be displayed

The screenshot shows the SpanMan web application interface displaying a list of suitable sections and materials. The 'Design Material' dropdown is set to 'List all suitable timber and steel sections'. Below this, the 'SOLUTIONS' section is displayed with a table of results. The table has columns for 'Material', 'Name', 'kg/m', and 'Depth (mm)'. The table lists the following solutions:

Material	Name	kg/m	Depth (mm)
MGP12	90 deep x 35 wide	1.7	90
Light steel C Sections	C10010	1.8	102
Light steel Z Sections	Z10010	1.8	102
MGP15	90 deep x 35 wide	1.8	90

At the bottom of the interface, there are four buttons: DESIGN, CERTIFICATE, CALCULATIONS, and CRITERIA.



Alternatively scroll through the list of specific materials and then click DESIGN to obtain a list of appropriate section sizes. In this case select Cold Formed “ Light steel C Sections”

The screenshot shows a software interface with a sidebar on the left and a main panel on the right. The sidebar has a 'DESIGN' button at the bottom. The main panel shows a list of materials under the heading 'Cold Formed'. A dropdown menu is open, showing a list of section sizes under the heading 'Depth (mm)'.

Category	Material
Glue Laminated Timber	GL10 Radiata Pine
	GL10 Yellow Cedar
	GL10 Cypress Pine
	GL13 Oregon
Steel Hollow	Steel SHS C350LO
	Steel SHS C450 Plus
	Steel CHS C250LO
	Steel CHS C350LO
Hopleys Open Web Joists	Hopleys HB Joists
	Hopleys HJ Joists
Steel	Steel UB/TFB/WB 300 Plus
	Steel PFC 300 Plus
	Steel UC/WC 300 Plus
Cold Formed	Light steel C Sections
	Light steel Z Sections

Depth (mm)
90
102
102
90
90

The results are displayed listed either in terms of smallest weight section at the top or smallest depth (if Depth is clicked). The section at the top of the list is the most efficient. However the user may wish to adopt a larger section hence SpanMan provides a list of all sections that meet the design criteria.

The screenshot shows the software interface with the 'Design Material' dropdown set to 'Light steel C Sections'. A table of solutions is displayed, showing the Name, kg/m, and Depth (mm) for various section sizes. Below the table are buttons for 'DESIGN', 'CERTIFICATE', 'CALCULATIONS', and 'CRITERIA'.

Name	kg/m	Depth (mm)
C10010	1.8	102
C10012	2.1	102
C10015	2.6	102
C15012	2.9	152
C10019	3.3	102

Large spans can also be designed using SpanMan, as large sections are also included.

Roof Use: Normal roof

Span:  mm      Overhang:  mm

Spacing:  mm      Roof Slope:  degrees

Within 1.2m of roof edge, ridge or other change in roof pitch  ?

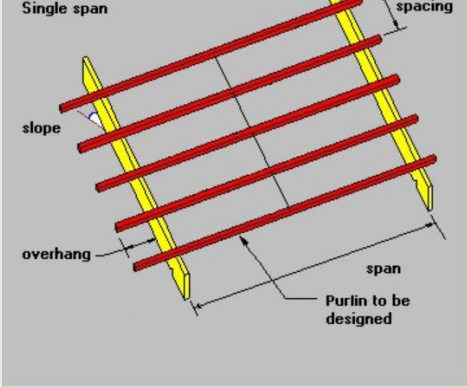
Roof: 0.50 mm steel sheet, battens, pink batt insulation, wiring + sisal ?

Ceiling: 12 mm softwood T&G lining, pink batt insulation, wiring + sisal ?

Design Material: Light steel C Sections

**SOLUTIONS**

Name	kg/m	Depth (mm)
C30024 1 row bridging	10.1	300
C30030 1 row bridging	12.8	300
C35030 1 row bridging	15.2	350



Single span

HELP

By clicking on a preferred section then clicking maximize on "Span" and/or "Overhang", the maximum span based on the design criteria will be displayed for that member

Span:  mm Maximise      Overhang:  mm Maximise

Spacing:  mm      Roof Slope:  degrees

Within 1.2m of roof edge, ridge or other change in roof pitch  ?

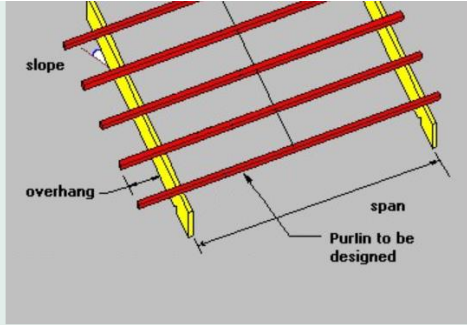
Roof: 0.50 mm steel sheet, battens, pink batt insulation, wiring + sisal ?

Ceiling: 12 mm softwood T&G lining, pink batt insulation, wiring + sisal ?

Design Material: Light steel C Sections

**SOLUTIONS**

Name	kg/m	Depth (mm)
C30024 1 row bridging	10.1	300



HELP



By clicking on the Criteria button the loading and design criteria for the member will be displayed

Main Span Deflection		Overhang Deflection	
Dead load maximum	<input type="text" value="20"/> mm	Dead load maximum	<input type="text" value="17"/> mm
Dead load span on	<input type="text" value="300"/>		
Live load maximum	<input type="text" value="24"/> mm	Live load maximum	<input type="text" value="17"/> mm
Live load span on	<input type="text" value="250"/>		
Wind load maximum	<input type="text" value="40"/> mm	Wind load maximum	<input type="text" value="17"/> mm
Wind load span on	<input type="text" value="150"/>		
Imposed Loads		Additional Midspan Point Loads	
Additional dead load	<input type="text" value="0"/> kPa ?	Dead load	<input type="text" value="0"/> kN
Live load main span	0.25 kPa ?	Live load	<input type="text" value="0"/> kN
Live load overhang	0.25 kPa ?		
Live load point load	1.1 kN ?		

By clicking on the Certificate or Computation button a PDF will be displayed showing a detailed computation for the member designed. A portion of a computation is shown below

$C_{rig}(\text{midspan serviceability}) = 0.7$   
 $C_{rig}(\text{midspan strength down}) = 0.7$   
 $C_{rig}(\text{midspan strength up}) = 1.1$

$V_{des}(\text{serviceability}) = 26 \text{ m/s}$   
 $V_{des}(\text{ultimate}) = 34 \text{ m/s}$

Serviceability pressure =  $(0.5 \times \rho_{air}) \times [V_{des, serviceability}]^2 \times C_{dyn} = (0.5 \times 1.2) \times 26^2 \times 1 \times 0.001 = 0.406 \text{ kPa}$   
 Ultimate pressure =  $(0.5 \times \rho_{air}) \times [V_{des, ultimate}]^2 \times C_{dyn} = (0.5 \times 1.2) \times 34^2 \times 1 \times 0.001 = 0.694 \text{ kPa}$

Wind load width = 1,200 mm

$w(\text{midspan serviceability}) = 0.406 \times 0.7 \times 1.2 = 0.341 \text{ kN/m}$   
 $w(\text{midspan strength down}) = 0.694 \times 0.7 \times 1.2 = 0.583 \text{ kN/m}$   
 $w(\text{midspan strength up}) = 0.694 \times 1.1 \times 1.2 = 0.916 \text{ kN/m}$

**CALCULATIONS**

Deflections, bending moments, shear forces and support reactions are calculated by the principles of structural analysis and match the output of any standard structural analysis software.

Where deflections, bending moments and shear forces are within 3% of allowable values they are marked in red.

**(1) Deflection - Long-Term Dead Load**  
 (+ downward deflection, - upward deflection)

$w_1(\text{long-term dead load}) = 0.399 \times \cos(5) = 0.398 \text{ kN/m}$

Deflection multiplier(1 span, 10,961 mm span) = 1.001  
 Deflection(5,480.5 mm from support) = 22 mm <= 22 (lesser 20 mm & span/300 ± 10%)

**(2) Deflection - Short-Term Point Live Load Span 1**

# EXAMPLE 2: DESIGNING A FLOOR MEMBER

## 1. SELECT FLOOR FRAMING MEMBER TO BE DESIGNED

The screenshot shows the 'spanman' website interface. The top navigation bar includes 'ROOF', 'FLOOR', 'ABOUT', 'ACCOUNT', and 'BUY'. A 'LOG OFF' button is in the top right. The 'FLOOR' menu is open, showing options: 'Joists - Single Span', 'Joists - Double Span', 'Floor Beam - Single Span', and 'Floor Beam - Double Span'. Below the menu, three design options are presented:

- > Simple**: JOISTS Single Span. Diagram shows floor beams, a central joist to be designed, span, overhang, and spacing.
- > Wall Parallel Over**: JOISTS Single Span. Diagram shows a wall, floor beam, joist to be designed, span, overhang, and spacing. Height H1 is indicated. Note: floor dynamic criteria is not considered in design as it is assumed that wall provides damping.
- > Wall Parallel And Roof Over**: JOISTS Single Span. Diagram shows a roof, roof support member, wall, floor beams, joist to be designed, span, overhang, and spacing. Height H1 and dimensions E and F are indicated. Note: floor dynamic criteria is not considered in design as it is assumed that wall provides damping.

## 2. SELECT JOIST WITHOUT WALLS FOR THIS EXAMPLE

This screenshot is identical to the one above, showing the 'spanman' website interface with the 'FLOOR' menu open and the three joist design options: Simple, Wall Parallel Over, and Wall Parallel And Roof Over. The diagrams and notes for each option are the same as in the previous image.

### 3. SELECT BUILDING TYPE

**spanman** ROOF FLOOR **JOISTS** BUY LOG OFF

Joist Single Span Like Share 33

**SETTINGS** Country: Australia Building Type: **Office**

**DESIGN DETAILS**

Floor Use: Public corridor or hallway without wheeled vehicles

Span: 4000 mm Overhang

Spacing: 450 mm

Floor: 19 mm hardwood strip flooring (21kg/m<sup>2</sup>)

Ceiling: 12 mm softwood T&G lining, pink batt insulation, wiring + sisal

Design Material: List all suitable timber and steel sections

**DESIGN**

**JOISTS Single Span**

Diagram labels: floor beams, joist to be designed, span, overhang, spacing

### 4. SELECT FLOOR USE

For the building type selected then select the floor use (this will automatically set the design loads for the floor)

**SETTINGS** Country: Australia Building Type: Office

**DESIGN DETAILS**

Floor Use: **Public corridor or hallway without wheeled vehicles**

Span: 4000 mm

Spacing: 450 mm

Floor: 19 mm hardwood strip flooring (21kg/m<sup>2</sup>)

Ceiling: 12 mm softwood T&G lining, pink batt insulation, wiring + sisal

Design Material: List all suitable timber and steel sections

**DESIGN**

**JOISTS Single Span**

Diagram labels: floor beams, joist to be designed, span, overhang, spacing

By clicking on the Criteria button the design loads for the particular building type and floor use selected will be viewed

SAVE
DEFAULT
CANCEL

Main Span Deflection		Overhang Deflection	
Dead load maximum	<input type="text" value="20"/> mm	Dead load maximum	<input type="text" value="6"/> mm
Dead load span on	<input type="text" value="300"/>	Dead load span on	<input type="text" value="150"/> for downward deflection
Live load maximum	<input type="text" value="25"/> mm	Live load maximum	<input type="text" value="5"/> mm
Live load span on	<input type="text" value="300"/>	Live load span on	<input type="text" value="180"/> for downward deflection

Imposed Loads		Additional Midspan Point Loads	
Additional dead load	<input type="text" value="1"/> kPa <span>?</span>	Dead load	<input type="text" value="0"/> kN
Live load main span	<input type="text" value="4"/> kPa <span>?</span>	Live load	<input type="text" value="0"/> kN
Live load overhang	<input type="text" value="4"/> kPa <span>?</span>		
Live load point load	<input type="text" value="4.5"/> kN <span>?</span>		

Distance Between Lateral Restraints		Minimum Vibration Frequency	
Top	<input type="text" value="Distance"/> <input type="text" value="100"/> mm	Frequency	<input type="text" value="4"/> Hz minimum <span>?</span>
Bottom	<input type="text" value="None"/>		

If we select “Light Steel C Sections” for the Design Material and click Design a list of suitable sizes will be displayed

**DESIGN DETAILS**

Floor Use

Span  mm      Overhang  mm

Spacing  mm

Floor  ?

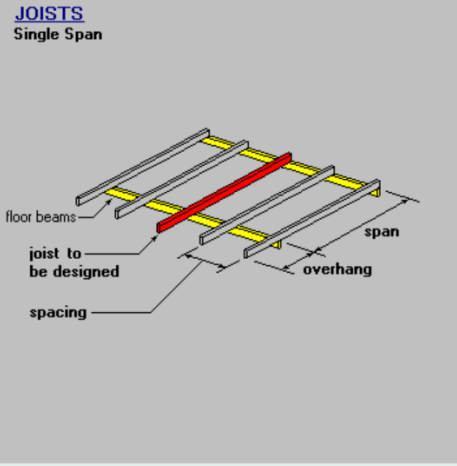
Ceiling  ?

Design Material  ?

**SOLUTIONS**

Name	kg/m	Depth (mm)
C25019	6.5	254
C25024	8.2	254
C30024	10.1	300
C30030	12.8	300
C35030	15.2	350

**JOISTS**  
Single Span



The diagram illustrates a single span joist system. It shows a series of parallel floor beams supported by a central joist. The span is the distance between the supports, and the overhang is the distance from the support to the end of the joist. The spacing is the distance between the floor beams. A red line highlights the joist to be designed.

HELP

We trust that this provides a useful insight with regards to using the SpanMan design tool, and wish you success with your project. Please feel free to contact us if you have any queries.