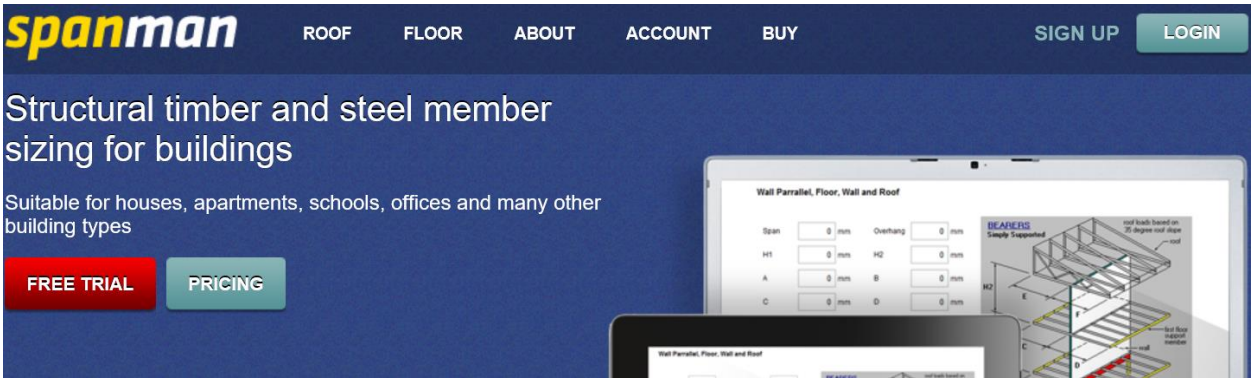
DESIGNING BUILDING FRAMING UTILISING THE SPANMAN ONLINE DESIGN TOOL

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

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

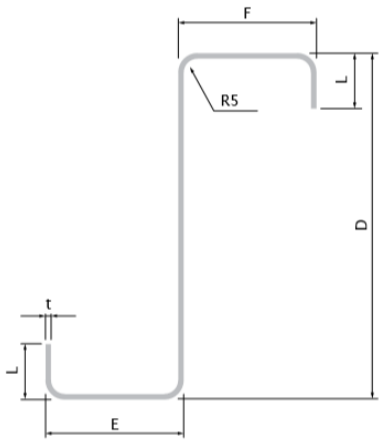
- Error minimisation
- Time savings
- Optimal design
- Ability to quickly compare design options on an apples to apples basis
- Unbiased design results
- Enhance service to generate more business
- Provide clients with responsive answers
- Provide a number of material options
- Develop the most economical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

BENEFITS TO THE ENVIRONMENT

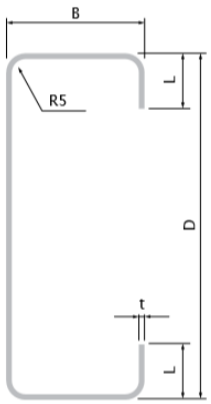
Optimum use of materials

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

Z AND C SECTION - DIMENSIONS



Standard Z-Section



Standard C-Section

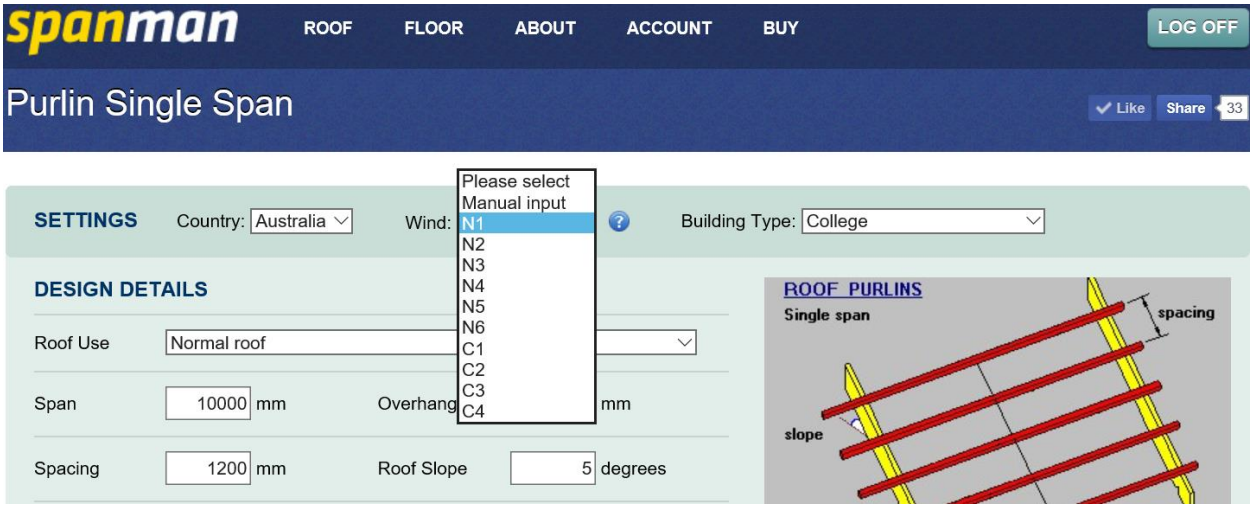
Dimensions of Cold Formed Zed’s & Cee’s to AS4600 incorporated into SpanMan

				Zeds			Cees	
Section	**t (mm)**	**D (mm)**	**Mass (kg/m)**	**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

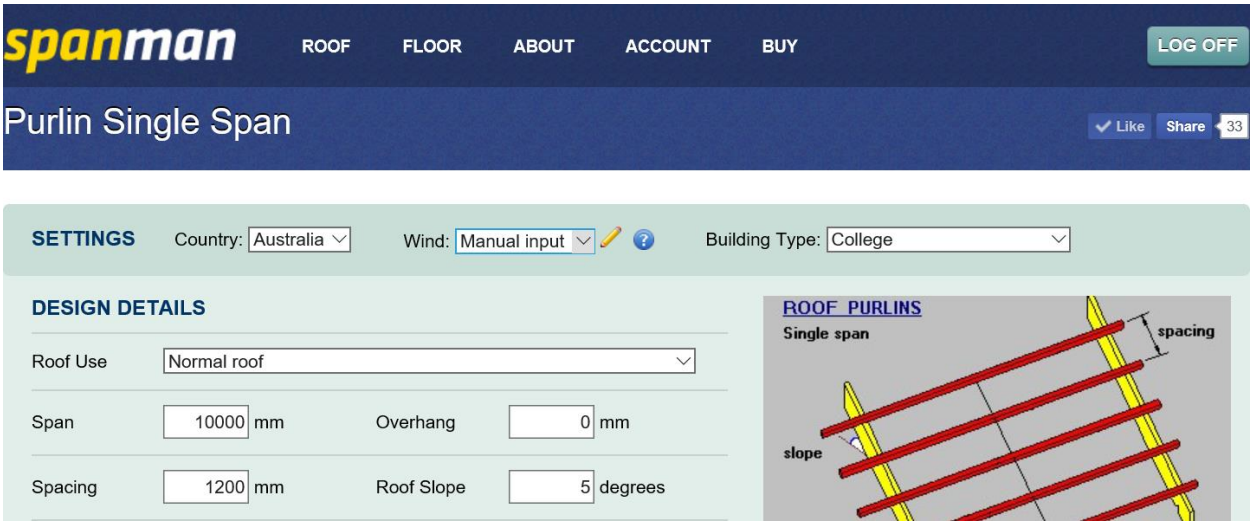
EXAMPLE 1: DESIGNING A ROOF MEMBER

1. SELECT WIND SITE CLASSIFICATION

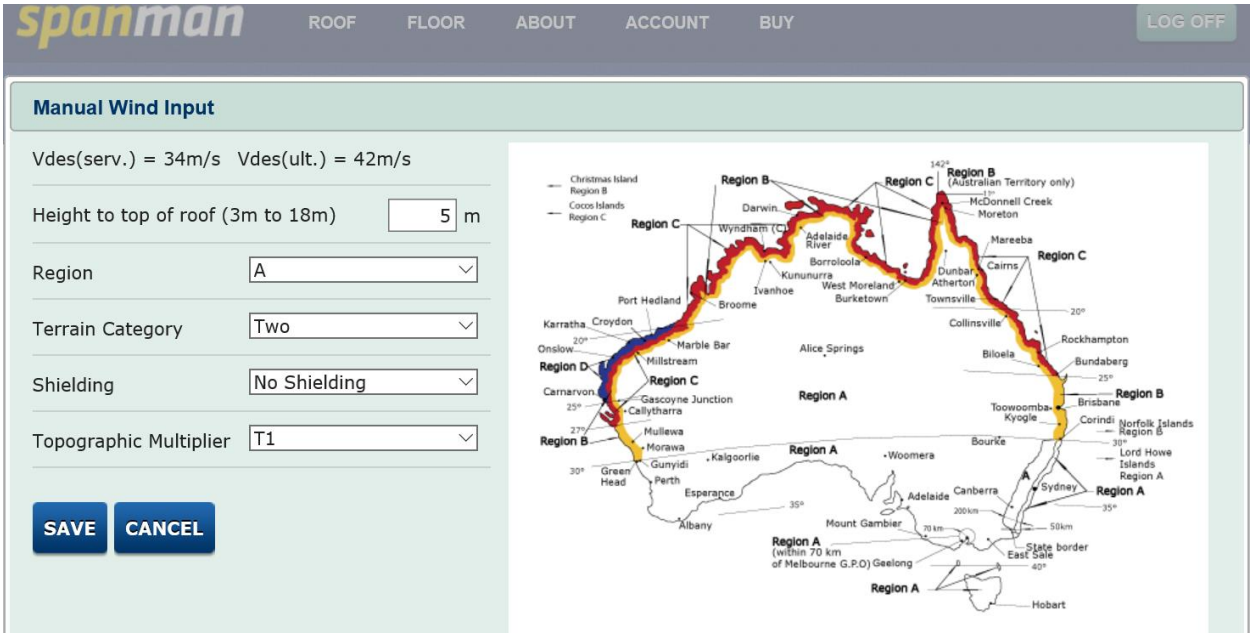
(i) In accordance with AS4055



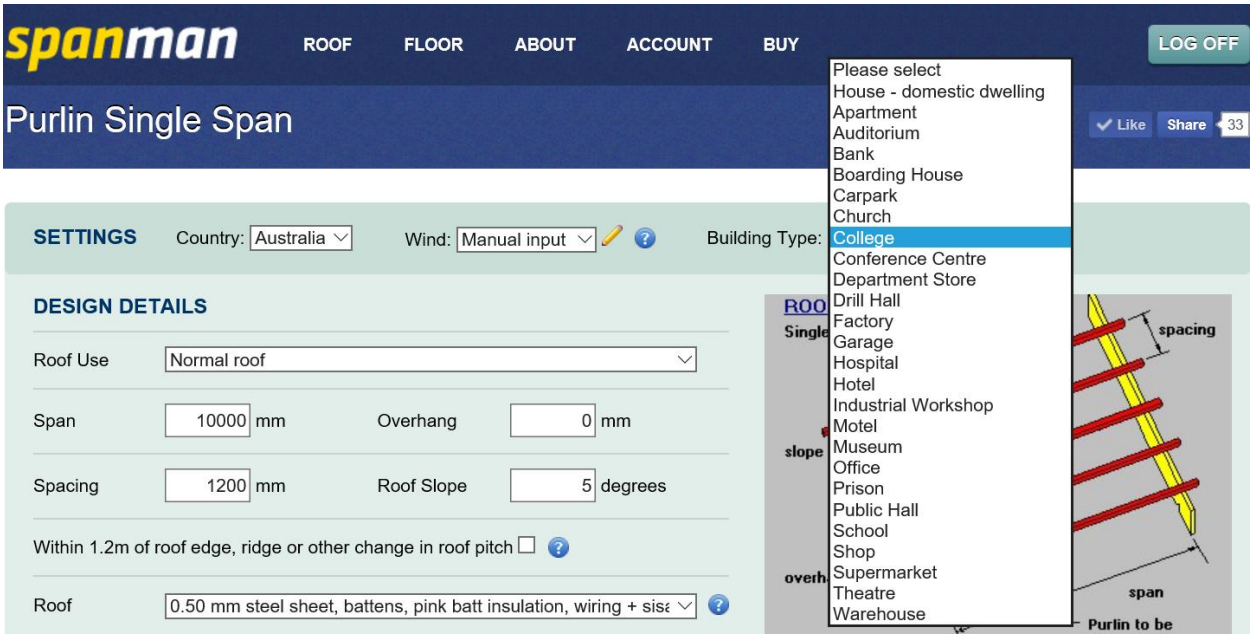
(ii) Or in accordance with AS1170.



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

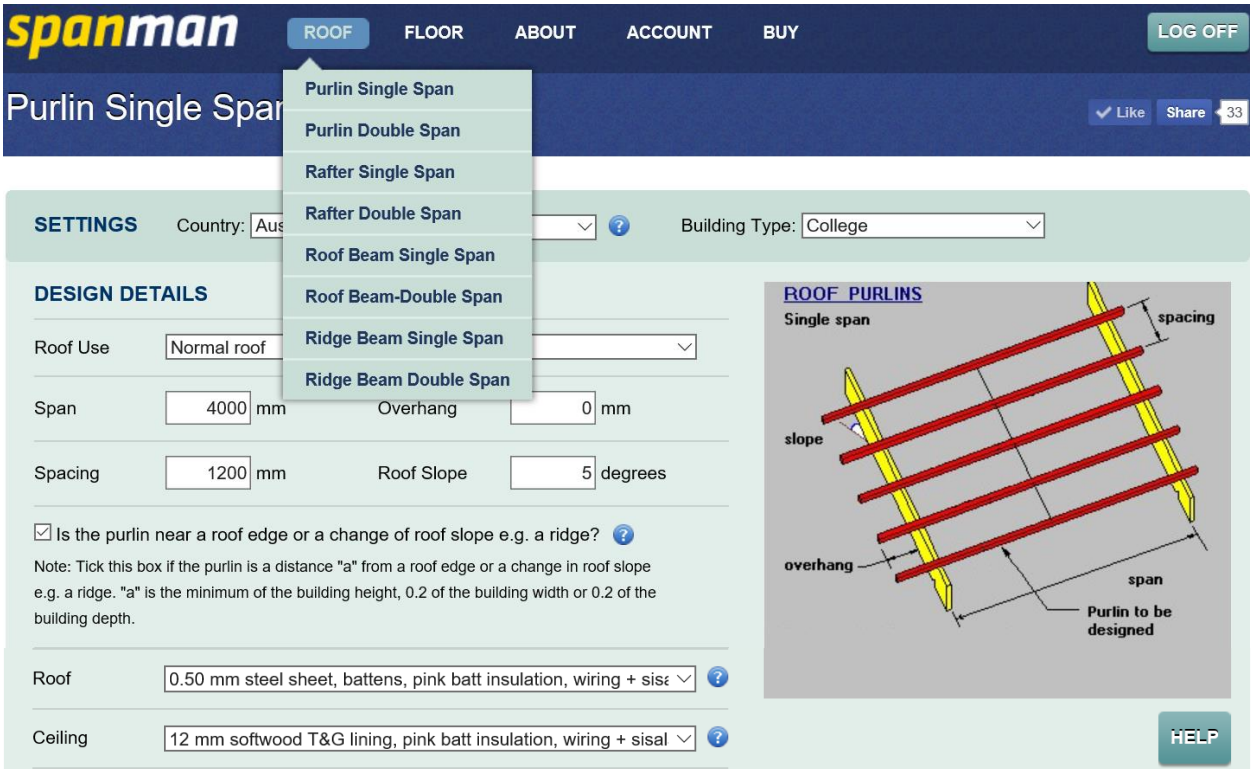


3. SELECT ROOF FRAMING MEMBER TO BE DESIGNED

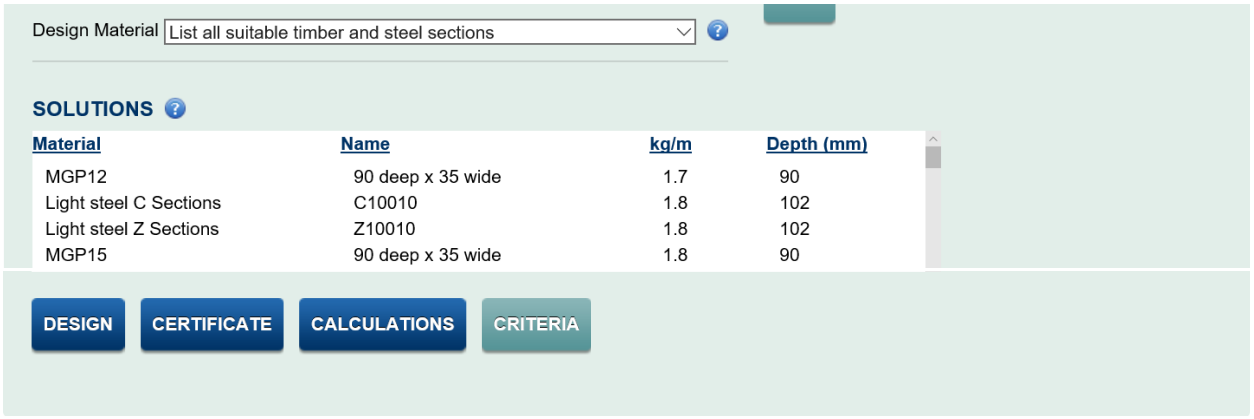
FOR THIS EXAMPLE SELECT A PURLIN SINGLE SPAN

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

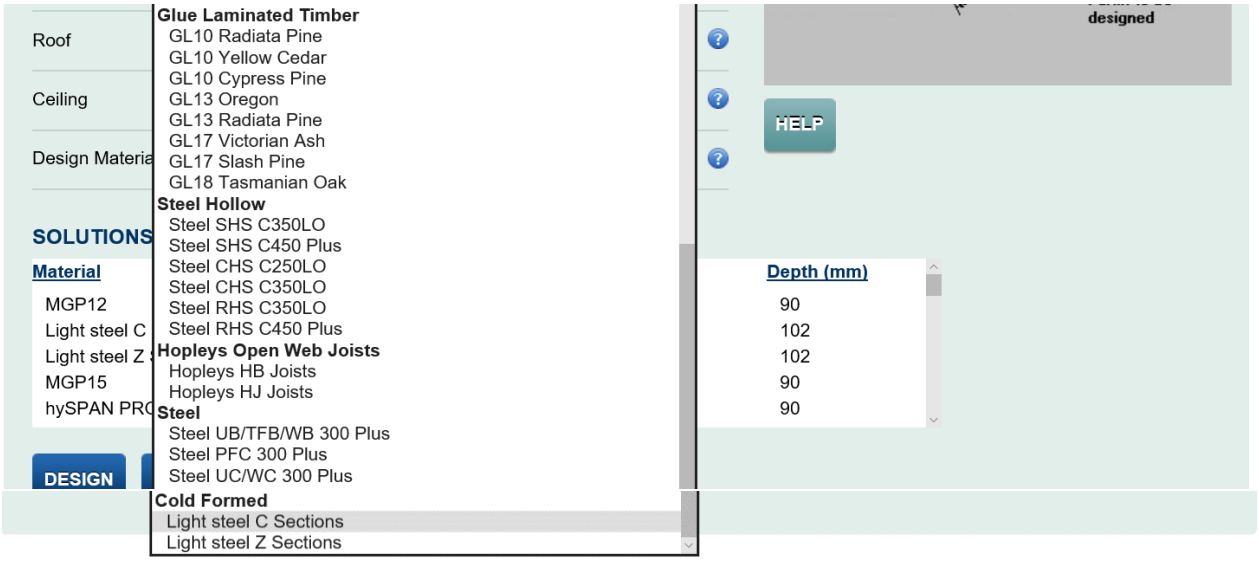
Tick box if purlin is located near ridge or edge of roof. Increased wind suction occurs at abrupt changes in roof geometry, and SpanMan automatically adopts appropriate pressure coefficients to take into account these local pressures.



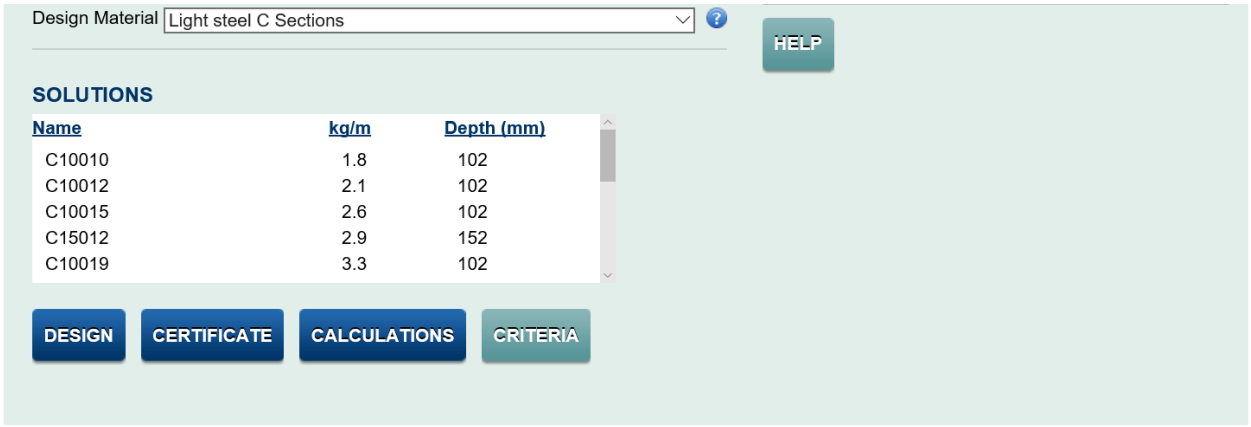
By selecting "List all suitable timber and steel sections" for Design Material and then clicking on the DESIGN button a list of suitable sections and materials will be displayed



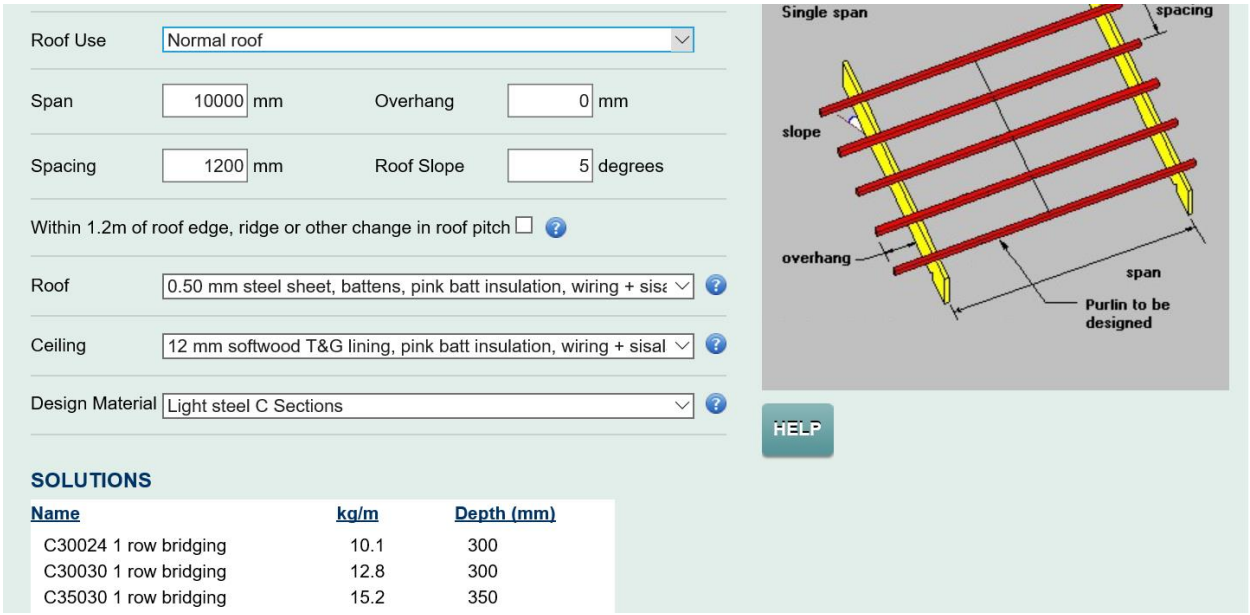
Alternatively scroll through the list of specific materials and then click DESIGN to obtain a list of appropriate section sizes. In this case select Cold Formed " Light steel C Sections"



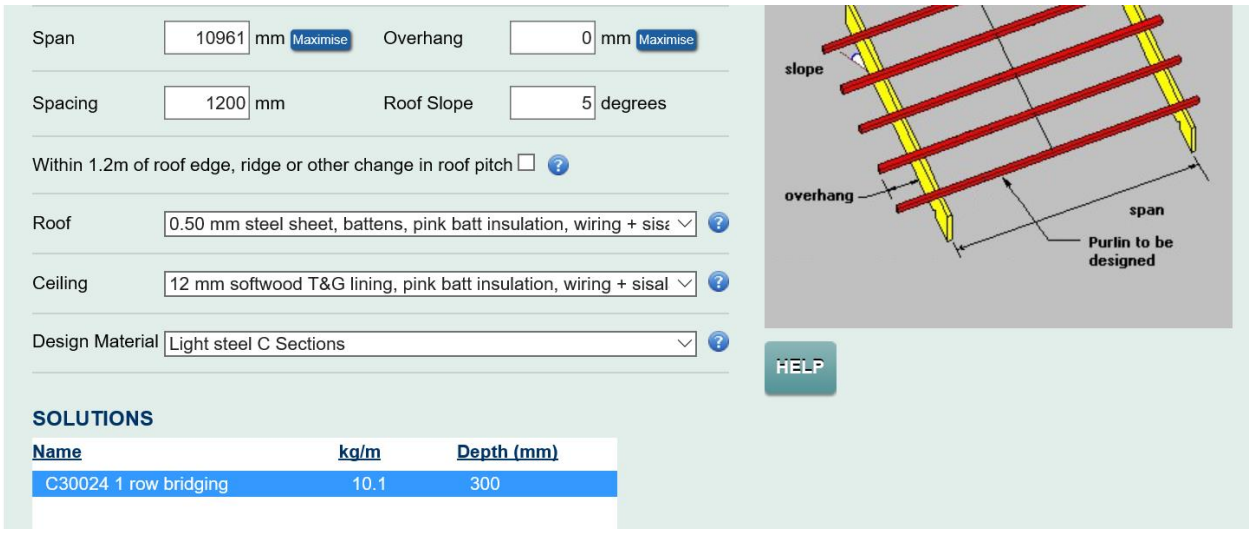
The results are displayed listed either in terms of smallest weight section at the top or smallest depth (if Depth is clicked). The section at the top of the list is the most efficient. However the user may wish to adopt a larger section hence SpanMan provides a list of all sections that meet the design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



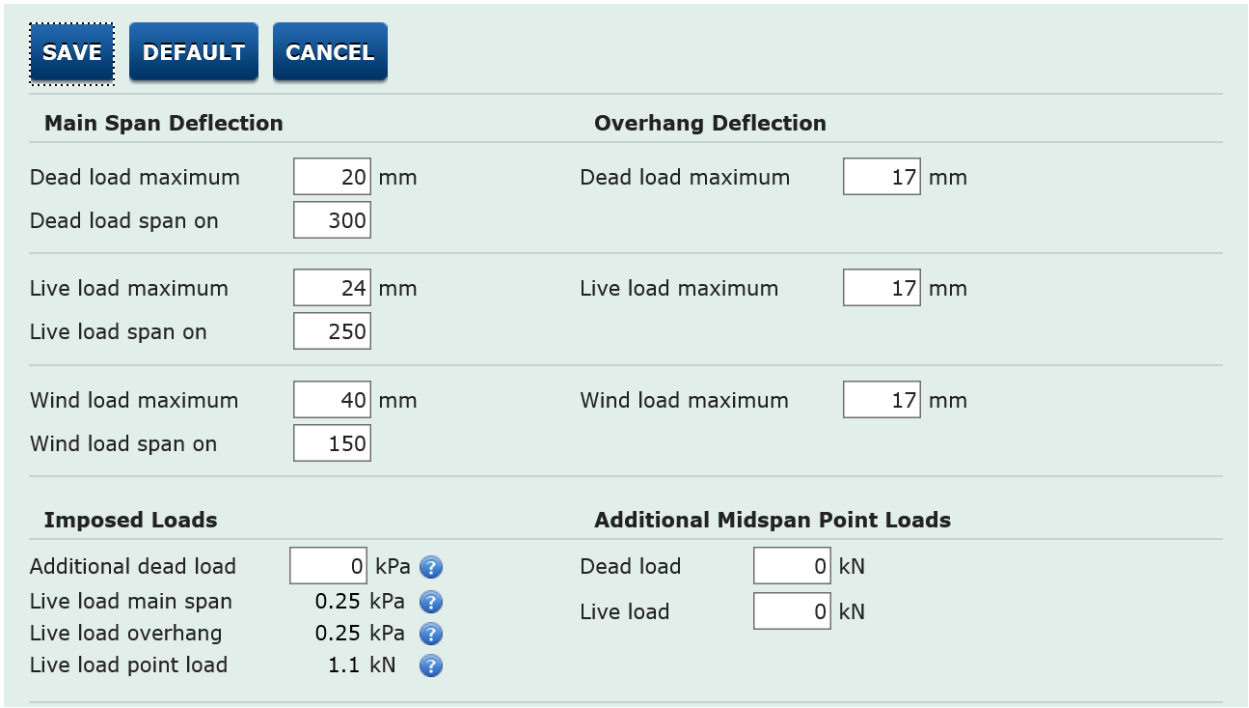
Large spans can also be designed using SpanMan, as large sections are also included.



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



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



SAVE DEFAULT CANCEL

Main Span Deflection			Overhang Deflection		
Dead load maximum	20	mm	Dead load maximum	17	mm
Dead load span on	300				
Live load maximum	24	mm	Live load maximum	17	mm
Live load span on	250				
Wind load maximum	40	mm	Wind load maximum	17	mm
Wind load span on	150				

Imposed Loads		Additional Midspan Point Loads	
Additional dead load	0 kPa	Dead load	0 kN
Live load main span	0.25 kPa	Live load	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_{fig}(midspan serviceability) = 0.7
C_{fig}(midspan strength down) = 0.7
C_{fig}(midspan strength up) = 1.1

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

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

Wind load width = 1,200 mm

w(midspan serviceability) = 0.406 x 0.7 x 1.2 = 0.341 kN/m
w(midspan strength down) = 0.694 x 0.7 x 1.2 = 0.583 kN/m
w(midspan strength up) = 0.694 x 1.1 x 1.2 = 0.916 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)

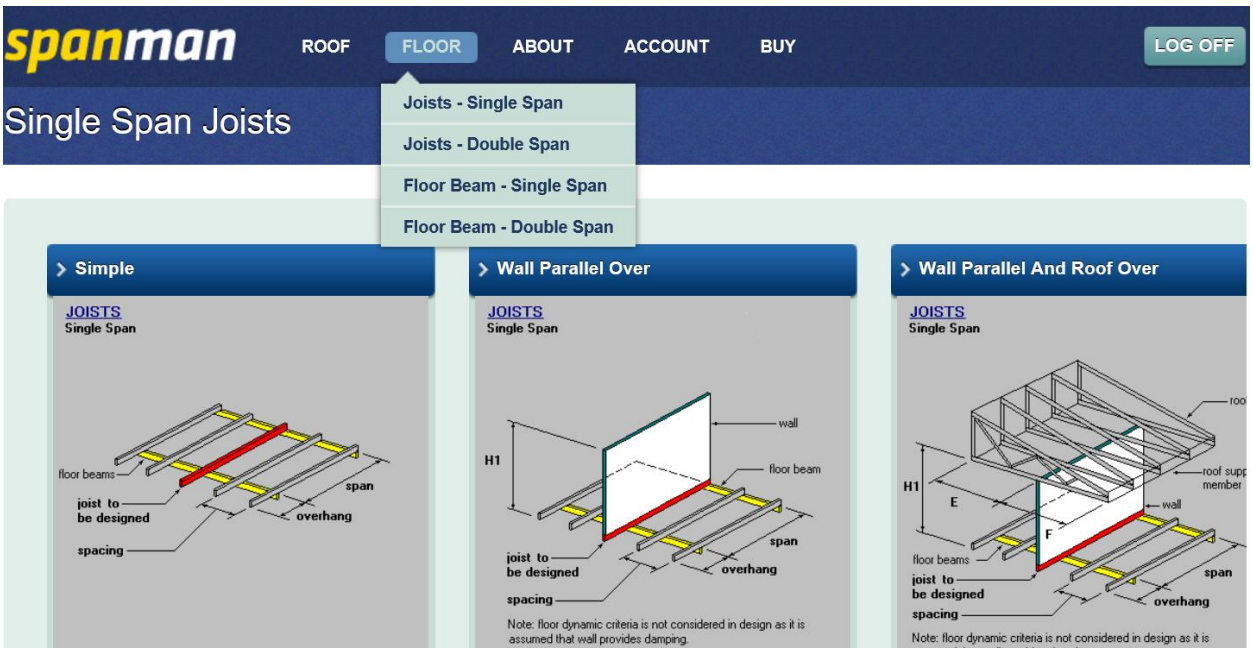
w_1(long-term dead load) = 0.399 x cos(5) = 0.398 kN/m

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%)

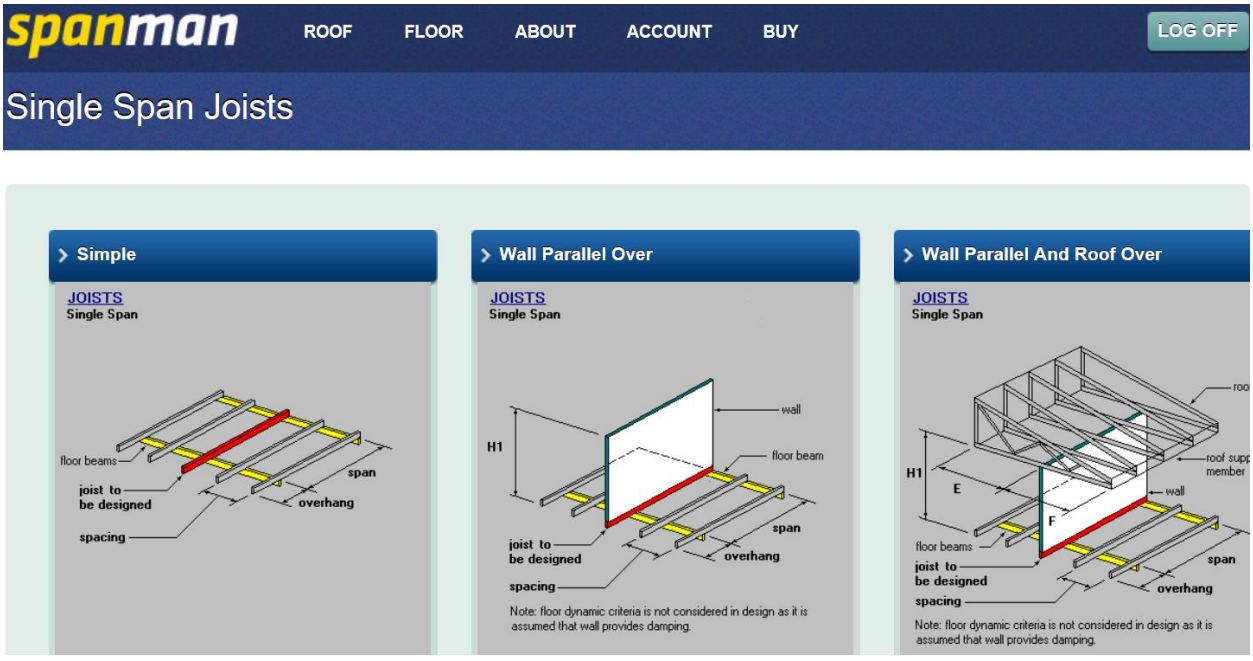
(2) Deflection - Short-Term Point Live Load Span 1

EXAMPLE 2: DESIGNING A FLOOR MEMBER

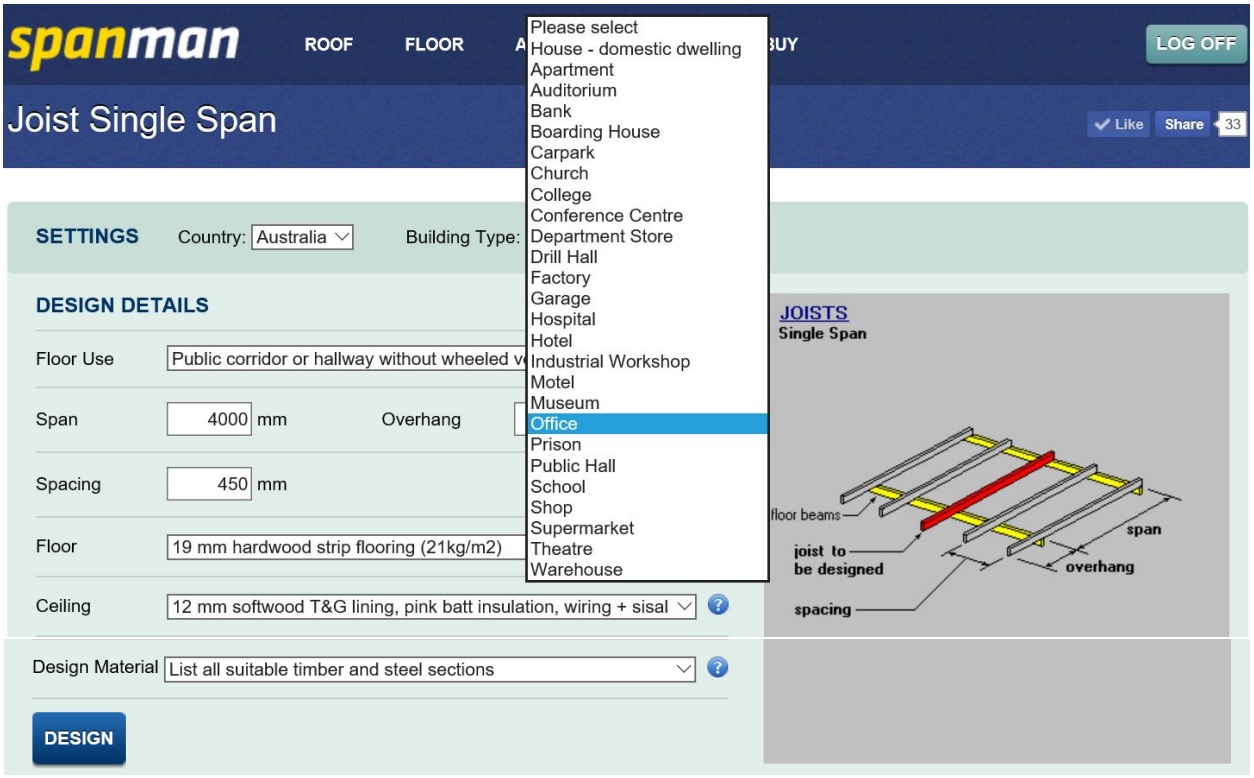
1. SELECT FLOOR FRAMING MEMBER TO BE DESIGNED



2. SELECT JOIST WITHOUT WALLS FOR THIS EXAMPLE

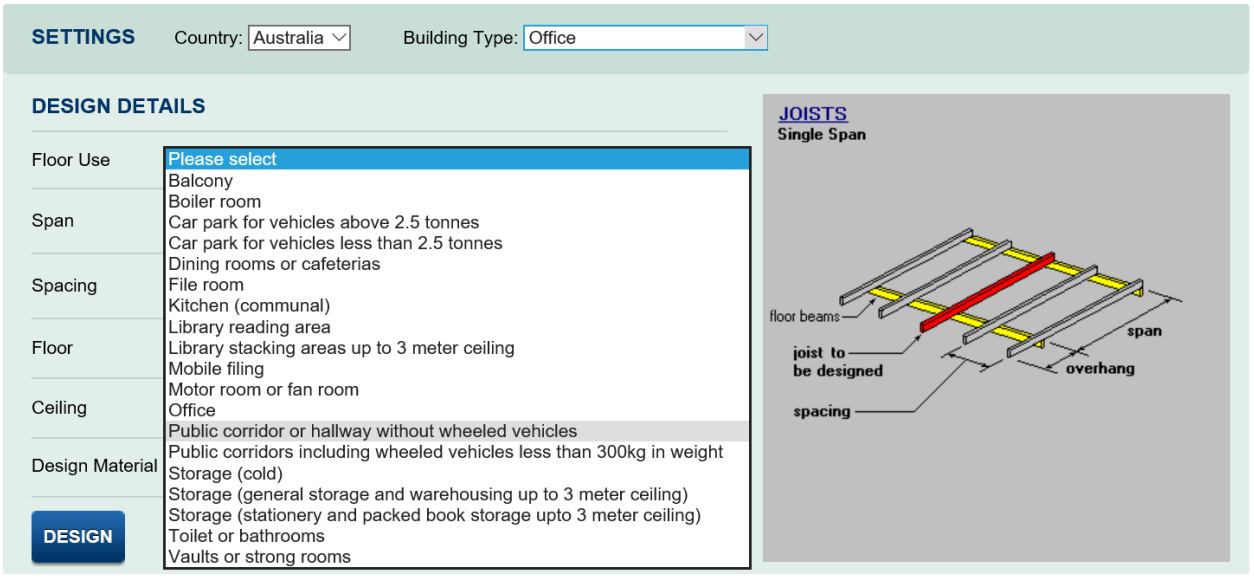


3. SELECT BUILDING TYPE

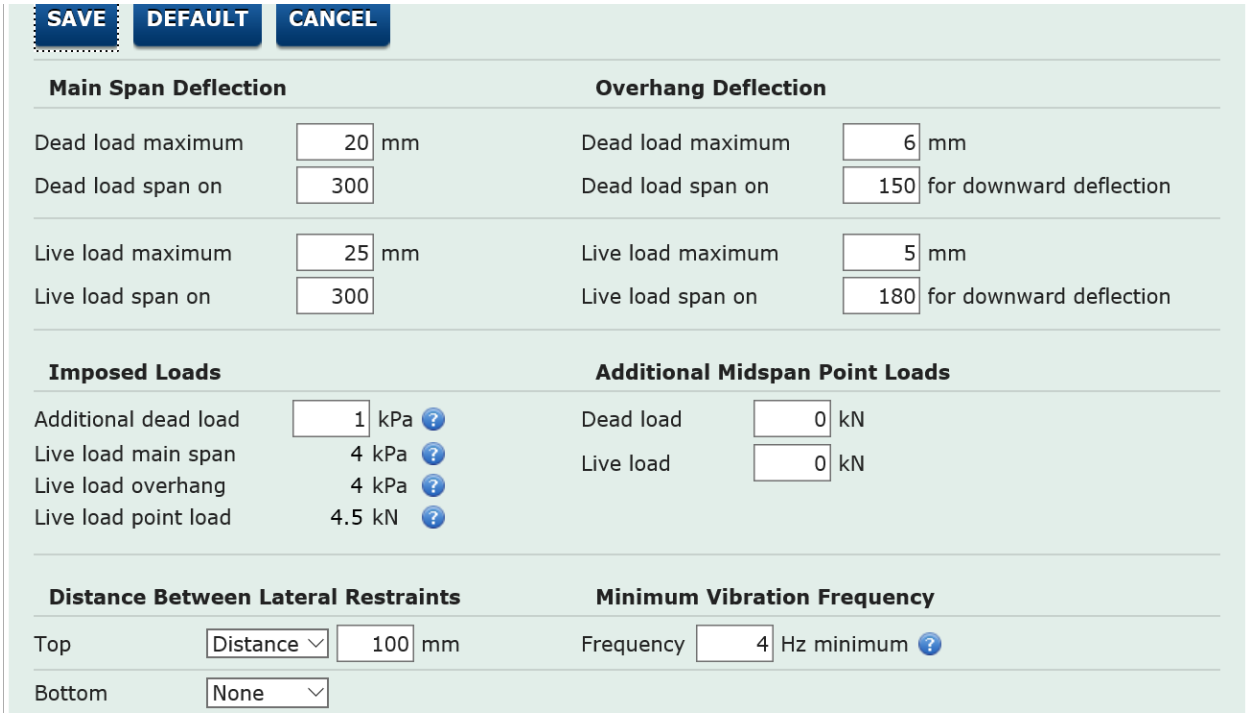


4. SELECT FLOOR USE

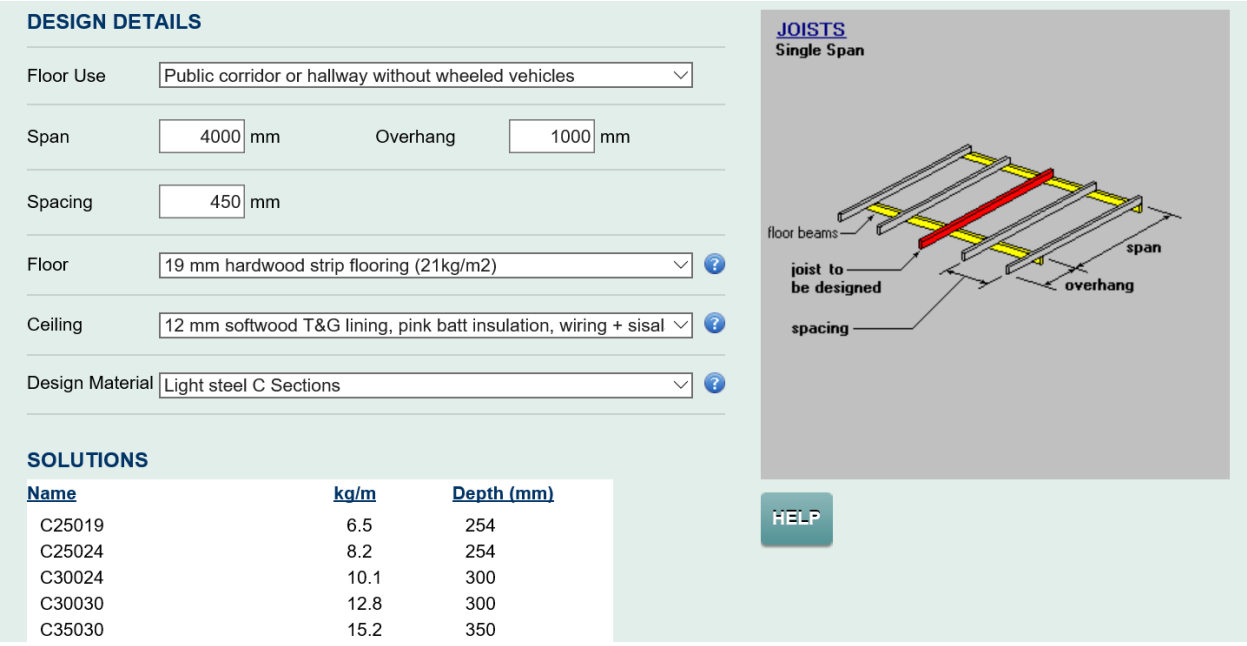
For the building type selected then select the floor use (this will automatically set the design loads for the floor)



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



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



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.