BBA BRITISH BOARD OF AGRÉMENT
CERTIFICATE No 06/4312

Design guide

Part 1: Structural Design

SBS
SIP BUILDING SYSTEMS

Design guide

Part 1:
Structural Design

Advantages:

Fast
Economical
Strong
Insulating
Environmentally friendly
Versatile


Modernist house supplied by SIPBuild


Vernacular house supplied by SIPit (Scotland) Ltd


Erecting panels by crane above and by hand below

Offsite fabrication means that your weatherproof building shell can be complete just a few days after the groundworks are ready to receive them. Internal and external work can immediately follow on together.

SIPs use less timber than timber frame and are one of the most economical and eco friendly forms of construction.

The high strength and low weight of SIPs allow large sections of building to be lifted in one piece for speed of erection but the panels may also be erected one at a time by hand where access is restricted.

SIP roofs do not require support trusses, leaving clear, warm, habitable roof spaces.
SIP insulation exceeds the current Building Regulation requirements on its own.

SIPs are fabricated using timber from sustainable sources. Offsite fabrication reduces waste. This, and light unit weight, also reduce embodied and transport energy. Their high insulation and airtightness reduce the major sources of building energy use, making them one of the 'greenest' construction materials. The foam insulation is (Ozone Depletion Potential ODP) zero and has a low GWP (Global Warming Potential).

SIPs, through their strength and ease of connection, offer the designer more versatility than other construction materials, allowing possibilities beyond the conventional, such as sloping walls and all with the advantages of offsite construction.

Structural Insulated Panels (SIPs)

SIPs are a sandwich of Oriented Strand Board (OSB) with an insulating polyurethane foam filling. The OSB and the foam are rigidly bonded together resulting in a strong, stiff, highly insulated panel suitable for structural use in buildings.

Sizes

Our standard range of panels has three thicknesses, 100mm, 125mm and 150mm, and panels are up to 1.2m wide and 6.5m long. The face boards are normally 11mm thick OSB3 (for structural use in damp conditions). Other thicknesses and constructions are available on request, including 15mm face boards, particle board faces and up to 200mm thickness panels.

Connections

Joints are made using expanding polyurethane glue and nails or screws. This ensures strong airtight joints.

Panels are joined edge to edge by gluing and nailing fillets into their rebated edges. These may be either thinner SIP fillets or timber. Timber fillets are used when additional strength is needed.

Rebated wall panel bases slot over pre-fixed timber sole plates and are secured with glue and nails.

Sloping roof panels rest on triangular timber eaves fillets and are secured with glue and screws.

Edge openings, such as window reveals, are lined with inset timber to allow easy fixing of frames.

Floors may be sandwiched between upper and lower walls or may be attached to panel inner faces with joist hangers. Floors are usually made from engineered joists but SIPs may be used in some cases, particularly where the underside is open, such as over passageways. Floors may also be supplied in cassette form.

Typical interior after erection and house supplied by Edward Halford Ltd

Modernist town house supplied by SIPit (Scotland) Ltd

Tall building clad in SIPs
supplied by SIPBuild

Uses

SIPs are usually used in roofs and external walls of buildings but may also be used in floors and internal walls. Their high axial load capacity and good bending strength, together with their excellent insulation and air tightness, produces sturdy warm structures. The current BBA certificate covers two storeys plus roof storey. However, the system is not necessarily limited in this respect and four storeys or more are possible when independently engineered.

Structural Design

Like timber, SIPs are stronger and stiffer along the grain and they undergo creep and shear deflections. In axial compression it is safe to use the values given for the panel properties below. Shear deflections are greater than in timber because the foam core has a lower shear modulus and in most cases the shear deflections dominate. Creep is also more important than with most other structural materials.

The method of calculating safe spans is given below after the safe span tables. Deflection is always the governing criterion. It should be noted that continuous beams where shear deflection is significant do not behave as ordinary continuous beams.

It has been demonstrated that floors and roofs are capable of spanning two ways, both lengthwise and transverse to the joints. This reduces deflections below the one-way span values that are given below. Deflections may also be reduced with help from non-structural items such as roof counter battens but no testing to check such effects has yet been undertaken.

Traditional house supplied by SIPit (Scotland) Ltd

SBS SIPs BBA accreditation:

SBS SIPs are the subject of British Board of Agrement Certificate No. 06/4312 which is available on request or may be downloaded from http://www.sipbuildingsystems.co.uk/files/4312i2_web.pdf .

Panels may be used in other situations not covered by the BBA certificate, provided that prior approval is obtained from any relevant checking authority. In the case of buildings falling outside the range covered by the BBA certificate the local authority building control might need to be satisfied. Depending upon the circumstances, reference to this design guide might be sufficient or it might be necessary to employ the services of a structural or civil engineer. The SBS technical department is able to advise in all circumstances.

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Modern bungalow designed for disabled occupant supplied by Edward Halford Ltd

Modern house supplied by SIPBuild

SIP buildings by SIPBuild

Award winning 'Chimney Pots' project by 'Urban Splash

Notes for using the following tables

1. The tables are based on limiting deflections in accordance with Eurocode 1
2. The dead load must include the panel self weight.
3. The dead and live loads in the tables are permissible (not ultimate) loads.
4. Eurocode 1 separates the effects of dead and live loads for creep.
5. The values given are for use in dry conditions (as BS 5268 class 1 & 2)
6. The deflections are mean values as would be expected in a roof of several panel widths.
7. The panels are more consistent than timber. Tests on a batch of 32 panels showed that the standard deviation of deflection was about 5%.
8. Panels may be reinforced along their edges with timber. Values for 150mm panels reinforced with 38mm x 128mm wide grade C16 timber along each edge are given below. The reinforcement must be glued with expanding polyurethane glue and screwed at 150mm centres to the face boards. At joints this will be a single timber 76mm wide.
9. The tables for floor spans and roof spans differ because the Eurocode 1 factors (¥) are different for floor loading and snow loading.
10. Increasing the face board thickness will not always produce an improvement in bending stiffness because it will also reduce the shear stiffness of the core.
11. The tables for two span beams are for the condition with both spans equally loaded. Calculations for multi-span SIPs are difficult. The tables may be used to estimate most real circumstances. If more accurate calculation is needed please contact our technical department.
12. SBS is continuously developing the product and its manufacturing systems and has an ongoing testing program. This guide relates to products being manufactured in 2008 using the test data available at that date. Creep is affected by many factors. The figures in this guide are based on a small number of tests and are for guidance in typical situations. Where creep deflections may be critical a conservative approach should be adopted.
13. The initial table for SHORT-TERM loading is given for comparison between the different panel types and other manufacturers' panels. These values may be used for walls subject to wind loading but should not be used for medium or long-term design. The long-term values are given in the tables for roofs and floors.
14. When assessing the walls for combined axial loading and wind loading a simple combined stress formula should be applied.
15. The parameters given for the component of SIPs apply only to the calculation methods given in this guide.

Typical Loads

The correct load should be calculated for each situation. It is important that the loads are assessed accurately to ensure that the maximum possible spans can be achieved. This applies both to dead and live loads. As a very rough guide the following values are typical:

	DL	LL
Flat roof with felt and ceiling board	0.5	0.6
30° slate roof and ceiling	1.1	0.6
45° slate roof and ceiling	1.3	0.36
60° slate roof and ceiling	1.9	0
Domestic floor with ceiling and boards	0.45	1.5

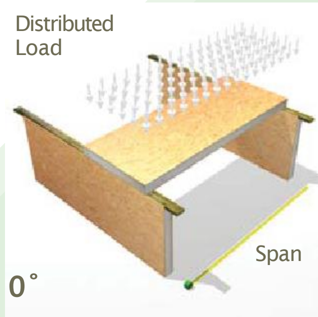

Erecting small house in Cambridgeshire (Edward Halford Ltd)

Short term panel stiffnesses

Table 1
Short term loading allowable spans (m) based on deflection of span/350

Plain Panels:

Load kN/m^2		0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Panel thickness mm	Face board thickness mm								
100	11	5.44	3.89	3.11	2.60	2.23	1.96	1.74	1.57
150	11	7.55	5.51	4.48	3.80	3.32	2.95	2.65	2.40
200	11	9.41	6.95	5.70	4.88	4.29	3.84	3.47	3.17
100	15	5.66	3.96	3.09	2.54	2.16	1.87	1.65	1.47
150	15	8.03	5.78	4.63	3.89	3.38	2.95	2.63	2.37
200	15	10.11	7.38	5.99	5.09	4.43	3.93	3.53	3.20
Reinforced Panels									
100	11	5.44	4.23	3.69	3.35	3.10	2.92	2.77	2.64
150	11	7.55	5.81	5.07	4.60	4.26	4.00	3.80	3.63
200	11	9.41	7.26	6.33	5.75	5.33	5.01	4.75	4.54



Roofs

Table 2
150mm - unreinforced horizontal single span roofs

Allowable span in metres for dead and live load combinations:

(ie horizontal distance between supports. Load in kN/m^2)

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
0.00	4.88	3.08	2.23	1.74	1.42	1.20	1.04	0.91
0.25	4.88	3.08	2.23	1.74	1.42	1.20	1.04	0.91
0.50	4.71	3.08	2.23	1.74	1.42	1.20	1.04	0.91
0.75	4.38	3.08	2.23	1.74	1.42	1.20	1.04	0.91
1.00	4.10	3.08	2.23	1.74	1.42	1.20	1.04	0.91
1.25	3.86	2.98	2.23	1.74	1.42	1.20	1.04	0.91
1.50	3.64	2.85	2.23	1.74	1.42	1.20	1.04	0.91
1.75	3.45	2.73	2.23	1.74	1.42	1.20	1.04	0.91
2.00	3.28	2.62	2.18	1.74	1.42	1.20	1.04	0.91
Slope DL.	**0.25**	**0.50**	**0.75**	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**

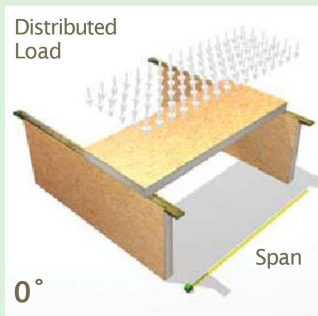


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Table 3

150mm - unreinforced 30˚ slope single span roofs

Allowable span in metres for dead and live load combinations:

(ie horizontal distance between supports. Load in kN/m^2)

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
0.00	4.60	2.96	2.17	1.71	1.40	1.19	1.03	0.91
0.25	4.60	2.96	2.17	1.71	1.40	1.19	1.03	0.91
0.50	4.40	2.96	2.17	1.71	1.40	1.19	1.03	0.91
0.75	4.11	2.96	2.17	1.71	1.40	1.19	1.03	0.91
1.00	3.85	2.96	2.17	1.71	1.40	1.19	1.03	0.91
1.25	3.63	2.84	2.17	1.71	1.40	1.19	1.03	0.91
1.50	3.44	2.72	2.17	1.71	1.40	1.19	1.03	0.91
1.75	3.26	2.61	2.17	1.71	1.40	1.19	1.03	0.91
2.00	3.11	2.51	2.11	1.71	1.40	1.19	1.03	0.91
Slope DL.	**0.22**	**0.43**	**0.65**	**0.87**	**1.08**	**1.30**	**1.52**	**1.73**

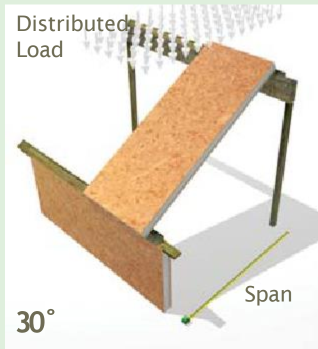

Table 4

150mm - unreinforced 45˚ slope single span roofs

Allowable span in metres for dead and live load combinations:

(ie horizontal distance between supports. Load in kN/m^2)

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
0.00	4.20	2.78	2.08	1.66	1.37	1.17	1.01	0.90
0.25	4.20	2.78	2.08	1.66	1.37	1.17	1.01	0.90
0.50	3.98	2.78	2.08	1.66	1.37	1.17	1.01	0.90
0.75	3.72	2.78	2.08	1.66	1.37	1.17	1.01	0.90
1.00	3.51	2.78	2.08	1.66	1.37	1.17	1.01	0.90
1.25	3.32	2.78	2.08	1.66	1.37	1.17	1.01	0.90
1.50	3.15	2.78	2.08	1.66	1.37	1.17	1.01	0.90
1.75	3.00	2.78	2.08	1.66	1.37	1.17	1.01	0.90
2.00	2.87	2.35	2.08	1.66	1.37	1.17	1.01	0.90
Slope DL.	**0.18**	**0.35**	**0.53**	**0.71**	**0.88**	**1.06**	**1.24**	**1.41**

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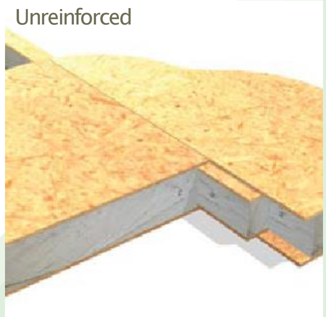
Table 5

150mm - unreinforced 60˚ slope single span roofs

Allowable span in metres for dead and live load combinations:

(ie horizontal distance between supports. Load in kN/m^2)

Dead Load	**0.25**	**0.50**	**0.75**	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**
Live load								
0.00	3.55	2.44	1.89	1.54	1.29	1.12	0.98	0.87
0.25	3.55	2.44	1.89	1.54	1.29	1.12	0.98	0.87
0.50	3.31	2.44	1.89	1.54	1.29	1.12	0.98	0.87
0.75	3.11	2.44	1.89	1.54	1.29	1.12	0.98	0.87
1.00	2.95	2.36	1.89	1.54	1.29	1.12	0.98	0.87
1.25	2.80	2.27	1.87	1.54	1.29	1.12	0.98	0.87
1.50	2.67	2.19	1.82	1.54	1.29	1.12	0.98	0.87
1.75	2.56	2.12	1.77	1.54	1.29	1.12	0.98	0.87
2.00	2.45	2.05	1.77	1.54	1.29	1.12	0.98	0.87
Slope DL.	**0.12**	**0.25**	**0.37**	**0.50**	**0.62**	**0.75**	**0.87**	**1.00**



Reinforced 150mm panels with 11mm face boards and 38mm thick grade C16 edge timbers

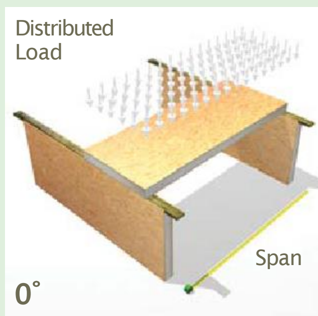
Table 6

150mm - reinforced **horizontal** single span roofs

Allowable span in metres for dead and live load combinations:

(ie horizontal distance between supports. Load in kN/m^2)

Dead Load	**0.25**	**0.50**	**0.75**	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**
Live load								
0.00	5.85	4.65	4.05	3.67	3.40	3.20	3.03	2.90
0.25	5.52	4.50	3.96	3.61	3.36	3.16	3.00	2.87
0.50	5.24	4.37	3.88	3.56	3.32	3.13	2.98	2.85
0.75	5.01	4.25	3.81	3.50	3.28	3.10	2.95	2.83
1.00	4.81	4.15	3.74	3.45	3.24	3.07	2.92	2.80
1.25	4.65	4.05	3.67	3.40	3.20	3.03	2.90	2.78
1.50	4.50	3.96	3.61	3.36	3.16	3.00	2.87	2.76
1.75	4.37	3.88	3.56	3.32	3.13	2.98	2.85	2.74
2.00	4.25	3.81	3.50	3.28	3.10	2.95	2.83	2.72
Slope DL.	**0.25**	**0.50**	**0.75**	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**



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Modernist house supplied by SIPBuild

Reinforced 150mm panels with 11mm face boards and 38mm thick grade C16 edge timbers

Table 7

150mm - reinforced 30° slope single span roofs

Allowable span in metres for dead and live load combinations:

(ie horizontal distance between supports. Load in kN/m^2)

Dead Load	**0.25**	**0.50**	**0.75**	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**
Live load								
0.00	5.33	4.22	3.68	3.34	3.10	2.91	2.76	2.64
0.25	5.01	4.09	3.60	3.29	3.06	2.88	2.73	2.62
0.50	4.76	3.97	3.53	3.23	3.02	2.85	2.71	2.59
0.75	4.55	3.86	3.46	3.19	2.98	2.82	2.68	2.57
1.00	3.82	3.77	3.40	3.14	2.94	2.79	2.66	2.55
1.25	4.22	3.68	3.34	3.10	2.91	2.76	2.64	2.53
1.50	4.09	3.60	3.29	3.06	2.88	2.73	2.62	2.51
1.75	3.97	3.53	3.23	3.02	2.85	2.71	2.59	2.50
2.00	3.86	3.46	3.19	2.98	2.82	2.68	2.57	2.48
Slope DL.	**0.22**	**0.43**	**0.65**	**0.87**	**1.08**	**1.30**	**1.52**	**1.73**

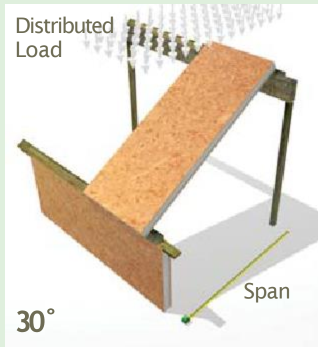


Table 8

150mm - reinforced 45° slope single span roofs

Allowable span in metres for dead and live load combinations:

(ie horizontal distance between supports. Load in kN/m^2)

Dead Load	**0.25**	**0.50**	**0.75**	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**
Live load								
0.00	4.65	3.69	3.22	2.92	2.71	2.55	2.42	2.31
0.25	4.38	3.57	3.15	2.87	2.67	2.52	2.39	2.29
0.50	4.16	3.47	3.09	2.83	2.64	2.49	2.37	2.27
0.75	3.98	3.38	3.03	2.79	2.61	2.46	2.35	2.25
1.00	3.82	3.30	2.97	2.75	2.58	2.44	2.33	2.23
1.25	3.69	3.22	2.92	2.71	2.55	2.42	2.31	2.21
1.50	3.57	3.15	2.87	2.67	2.52	2.39	2.29	2.20
1.75	3.47	3.09	2.83	2.64	2.49	2.37	2.27	2.18
2.00	3.38	3.03	2.79	2.61	2.46	2.35	2.25	2.17
Slope DL.	**0.18**	**0.35**	**0.53**	**0.71**	**0.88**	**1.06**	**1.24**	**1.41**

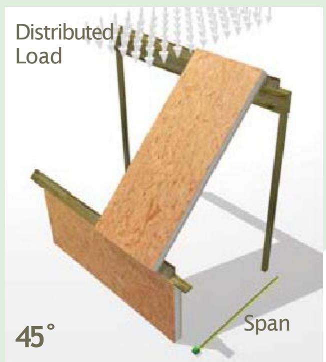


Table 9

150mm - reinforced 60° slope single span roofs

Allowable span in metres for dead and live load combinations:

(ie horizontal distance between supports. Load in kN/m^2)

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
0.00	3.69	2.93	2.56	2.32	2.12	1.96	1.81	1.71
0.25	3.48	2.84	2.50	2.28	2.08	1.92	1.78	1.69
0.50	3.31	2.76	2.45	2.25	2.05	1.89	1.76	1.67
0.75	3.16	2.69	2.40	2.22	2.02	1.86	1.74	1.65
1.00	3.04	2.62	2.36	2.17	1.99	1.84	1.72	1.63
1.25	2.93	2.56	2.32	2.13	1.95	1.82	1.69	1.60
1.50	2.84	2.50	2.28	2.10	1.92	1.80	1.67	1.58
1.75	2.76	2.45	2.25	2.06	1.89	1.79	1.65	1.56
2.00	2.69	2.40	2.22	2.02	1.87	1.78	1.63	1.55
Slope DL.	**0.12**	**0.25**	**0.37**	**0.50**	**0.62**	**0.75**	**0.87**	**1.00**

Two equally loaded equal spans continuous over central support plain unreinforced 150mm panels with 11mm face boards

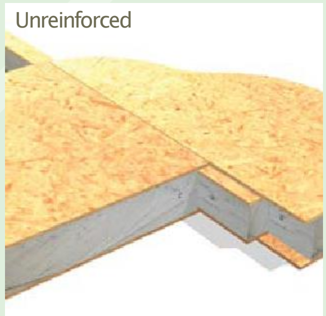
Table 10

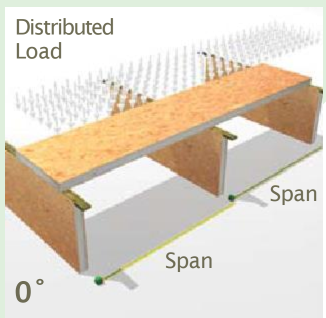
150mm - unreinforced horizontal two-span roofs

Allowable span in metres for dead and live load combinations:

(ie horizontal distance between supports. Load in kN/m^2)

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
0.00	5.42	3.20	2.28	1.77	1.44	1.21	1.05	0.92
0.25	5.42	3.20	2.28	1.77	1.44	1.21	1.05	0.92
0.50	5.40	3.20	2.28	1.77	1.44	1.21	1.05	0.92
0.75	4.95	3.20	2.28	1.77	1.44	1.21	1.05	0.92
1.00	4.58	3.33	2.28	1.77	1.44	1.21	1.05	0.92
1.25	4.25	3.16	2.28	1.77	1.44	1.21	1.05	0.92
1.50	3.97	3.00	2.28	1.77	1.44	1.21	1.05	0.92
1.75	3.73	2.86	2.28	1.77	1.44	1.21	1.05	0.92
2.00	3.52	2.74	2.24	1.77	1.44	1.21	1.05	0.92
Slope DL.	**0.25**	**0.50**	**0.75**	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**





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The BASF eco house built with SBS SIPs

Two equally loaded equal spans continuous over central support plain unreinforced 150mm panels with 11mm face boards

Table 11

150mm - unreinforced 30° two-span roofs

Allowable span in metres for dead and live load combinations:

(ie horizontal distance between supports. Load in kN/m^2)

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
0.00	5.18	3.12	2.23	1.74	1.42	1.20	1.04	0.92
0.25	5.18	3.12	2.23	1.74	1.42	1.20	1.04	0.92
0.50	5.18	3.12	2.23	1.74	1.42	1.20	1.04	0.92
0.75	4.71	3.12	2.23	1.74	1.42	1.20	1.04	0.92
1.00	4.36	3.21	2.23	1.74	1.42	1.20	1.04	0.92
1.25	4.07	3.05	2.23	1.74	1.42	1.20	1.04	0.92
1.50	3.81	2.90	2.23	1.74	1.42	1.20	1.04	0.92
1.75	3.59	2.77	2.27	1.74	1.42	1.20	1.04	0.92
2.00	3.38	2.66	2.19	1.74	1.42	1.20	1.04	0.92
Slope DL.	**0.22**	**0.43**	**0.65**	**0.87**	**1.08**	**1.30**	**1.52**	**1.73**

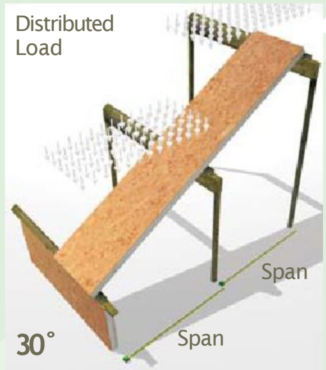


Table 12

150mm - unreinforced 45° two-span roofs

Allowable span in metres for dead and live load combinations:

(ie horizontal distance between supports. Load in kN/m^2)

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
0.00	4.84	2.97	2.16	1.70	1.39	1.18	1.03	0.91
0.25	4.84	2.97	2.16	1.70	1.39	1.18	1.03	0.91
0.50	4.84	2.97	2.16	1.70	1.39	1.18	1.03	0.91
0.75	4.35	2.97	2.16	1.70	1.39	1.18	1.03	0.91
1.00	4.06	2.95	2.16	1.70	1.39	1.18	1.03	0.91
1.25	3.79	2.89	2.16	1.70	1.39	1.18	1.03	0.91
1.50	3.57	2.75	2.16	1.70	1.39	1.18	1.03	0.91
1.75	3.37	2.64	2.16	1.70	1.39	1.18	1.03	0.91
2.00	3.19	2.53	2.10	1.70	1.39	1.18	1.03	0.91
Slope DL.	**0.18**	**0.35**	**0.53**	**0.71**	**0.88**	**1.06**	**1.24**	**1.41**

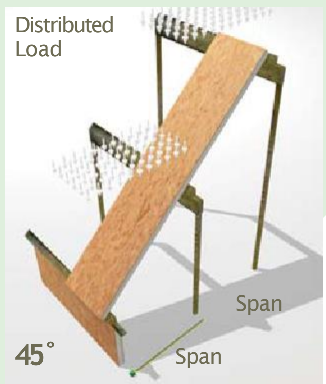


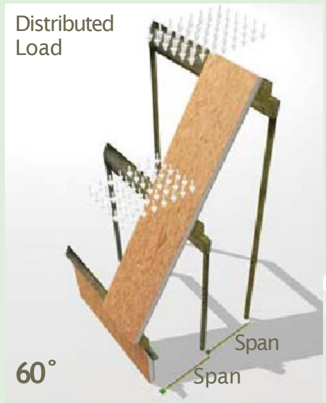
Table 13

150mm - unreinforced 60˚ two-span roofs

Allowable span in metres for dead and live load combinations:

(ie horizontal distance between supports. Load in kN/m^2)

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
0.00	4.21	2.71	2.01	1.60	1.33	1.14	1.00	0.88
0.25	4.21	2.71	2.01	1.60	1.33	1.14	1.00	0.88
0.50	4.04	2.71	2.01	1.60	1.33	1.14	1.00	0.88
0.75	3.76	2.71	2.01	1.60	1.33	1.14	1.00	0.88
1.00	3.52	2.70	2.01	1.60	1.33	1.14	1.00	0.88
1.25	3.31	2.58	2.01	1.60	1.33	1.14	1.00	0.88
1.50	3.13	2.48	2.05	1.60	1.33	1.14	1.00	0.88
1.75	2.97	2.38	1.99	1.60	1.33	1.14	1.00	0.88
2.00	2.83	2.23	1.93	1.60	1.33	1.14	1.00	0.88
Slope DL.	**0.13**	**0.35**	**0.53**	**0.71**	**0.88**	**1.06**	**1.24**	**1.41**



Reinforced 150mm panels with 11mm face boards and 38mm thick grade C16 edge timbers

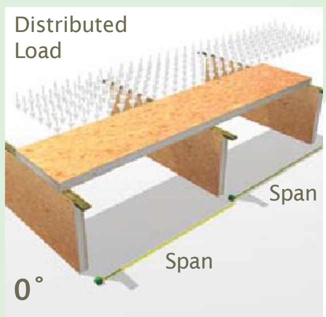
Table 14

150mm - reinforced **horizontal** two-span roofs

Allowable span in metres for dead and live load combinations:

(ie horizontal distance between supports. Load in kN/m^2)

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
0.00	7.93	6.26	5.45	4.94	4.57	4.29	4.06	3.87
0.25	7.45	6.07	5.34	4.86	4.51	4.24	4.02	3.84
0.50	7.08	5.89	5.22	4.78	4.45	4.19	3.98	3.81
0.75	6.76	5.73	5.12	4.70	4.40	4.15	3.95	3.78
1.00	6.50	5.58	5.03	4.64	4.34	4.10	3.91	3.75
1.25	6.26	5.45	4.94	4.57	4.29	4.06	3.87	3.71
1.50	6.08	5.34	4.86	4.51	4.24	4.02	3.84	3.69
1.75	5.89	5.22	4.78	4.45	4.19	3.98	3.81	3.66
2.00	5.73	5.12	4.70	4.40	4.15	3.95	3.78	3.63
Slope DL.	**0.25**	**0.50**	**0.75**	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**



Design guide

Part 1:
Structural Design

Roofs

Reinforced 150mm panels with 11mm face boards and 38mm thick grade C16 edge timbers

Table 15
150mm - reinforced 30˚ two-span roofs

Allowable span in metres for dead and live load combinations:
(ie horizontal distance between supports. Load in kN/m2)

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
0.00	7.21	5.70	4.96	4.50	4.16	3.91	3.70	3.53
0.25	6.78	5.52	4.85	4.42	4.10	3.86	3.67	3.50
0.50	6.44	5.36	4.75	4.35	4.05	3.82	3.63	3.47
0.75	6.15	5.21	4.66	4.28	4.00	3.78	3.60	3.44
1.00	5.91	5.08	4.58	4.22	3.95	3.74	3.56	3.41
1.25	5.70	4.96	4.50	4.16	3.91	3.70	3.53	3.39
1.50	5.52	4.85	4.42	4.10	3.86	3.67	3.50	3.36
1.75	5.36	4.75	4.35	4.05	3.82	3.63	3.47	3.34
2.00	5.21	4.66	4.28	4.00	3.78	3.60	0.44	3.31
Slope DL.	**0.22**	**0.35**	**0.53**	**0.71**	**3.60**	**1.06**	**1.24**	**1.41**

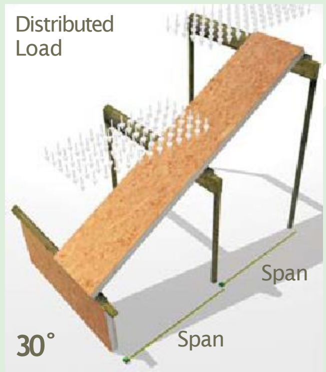


Table 16
150mm - reinforced 45˚ two-span roofs

Allowable span in metres for dead and live load combinations:
(ie horizontal distance between supports. Load in kN/m2)

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
0.00	6.31	4.99	4.34	3.94	3.65	3.42	3.24	3.10
0.25	5.93	4.83	4.25	3.87	3.60	3.38	3.21	3.07
0.50	5.63	4.69	4.16	3.81	3.55	3.34	3.18	3.04
0.75	5.38	4.56	4.08	3.75	3.51	3.31	3.15	3.02
1.00	5.17	4.45	4.01	3.70	3.46	3.28	3.12	2.99
1.25	4.99	4.34	3.94	3.65	3.42	3.24	3.10	2.97
1.50	4.83	4.25	3.87	3.55	3.38	3.21	3.07	2.95
1.75	4.69	4.16	3.81	3.55	3.34	3.18	3.04	2.93
2.00	4.56	4.08	3.75	3.51	3.31	3.15	3.02	2.90
Slope DL.	**0.18**	**0.35**	**0.53**	**0.71**	**0.88**	**1.06**	**1.24**	**1.41**

SBS SIP BUILDING SYSTEMS

Table 17

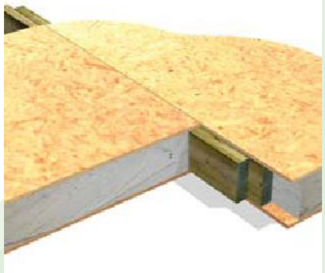
150mm - reinforced 60˚ two-span roofs

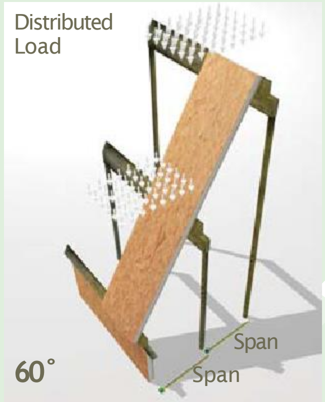
Allowable span in metres for dead and live load combinations:

(ie horizontal distance between supports. Load in kN/m2)

Dead Load	**0.25**	**0.50**	**0.75**	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**
Live load								
0.00	4.70	3.97	3.46	3.13	2.90	2.73	2.59	2.47
0.25	4.57	3.84	3.38	3.08	2.87	2.70	2.56	2.45
0.50	4.48	3.73	3.31	3.03	2.83	2.67	2.54	2.43
0.75	4.28	3.63	3.25	2.99	2.79	2.64	2.51	2.41
1.00	4.11	3.54	3.19	2.94	2.76	2.61	2.49	2.39
1.25	3.97	3.46	3.13	2.90	2.73	2.59	2.47	2.37
1.50	3.84	3.38	3.08	2.87	2.70	2.56	2.45	2.35
1.75	3.73	3.31	3.03	2.83	2.67	2.54	2.43	2.33
2.00	3.63	3.25	2.99	2.79	2.64	2.51	2.41	2.32
Slope DL.	**0.13**	**0.25**	**0.38**	**0.50**	**0.63**	**0.75**	**0.88**	**1.00**

Reinforced





Modernist town houses in Newcastle by SIPit (Scotland) Ltd

BBA BRITISH BOARD OF AGRÉMENT CERTIFICATE No 06/4312

Design guide

Part 1:
Structural Design

Floors

Unreinforced single span floors

Table 18
100mm thick with 11mm face boards

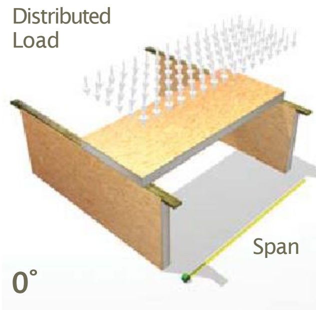
Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
1.50	1.50	1.14	0.92	0.76	0.66	0.57	0.51	0.46
2.00	1.26	1.00	0.82	0.70	0.60	0.53	0.48	0.43
2.50	1.09	0.88	0.74	0.64	0.56	0.50	0.45	0.41

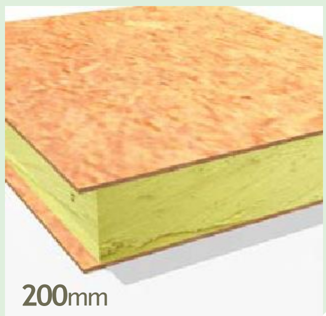
Table 19
150mm thick with 11mm face boards

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
1.50	2.36	1.82	1.47	1.24	1.42	0.93	0.83	0.75
2.00	2.01	1.60	1.32	1.13	0.98	0.87	0.78	0.71
2.50	1.74	1.42	1.20	1.04	0.91	0.81	0.73	0.67

Table 20
200mm thick with 11mm face boards

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
1.50	3.16	2.47	2.01	1.70	1.46	1.29	1.15	1.03
2.00	2.71	2.17	1.81	1.55	1.35	1.20	1.08	0.98
2.50	2.36	1.94	1.65	1.43	1.26	1.12	1.01	0.92





Man handling a panel

Reinforced single span floors

Table 21
100mm thick with 11mm face boards and 38mm C16 edge reinforcement

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
1.50	2.69	2.49	2.34	2.22	2.18	2.03	1.96	1.90
2.00	2.49	2.34	2.22	2.12	2.03	1.96	1.90	1.84
2.50	2.34	2.22	2.12	2.03	1.96	1.90	1.84	1.79

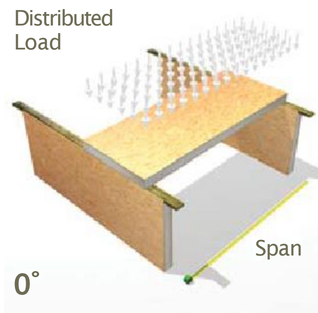
Table 22
150mm thick with 11mm face boards and 38mm C16 edge reinforcement

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
1.50	3.67	3.40	3.20	3.03	2.90	2.78	2.68	2.60
2.00	3.40	3.20	3.03	2.90	2.78	2.68	2.60	2.52
2.50	3.20	3.03	2.90	2.78	2.68	2.60	2.52	2.45

Table 23
200mm thick with 11mm face boards and 38mm C16 edge reinforcement

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
1.50	4.58	4.24	3.99	3.78	3.61	3.47	3.35	3.24
2.00	4.24	3.99	3.78	3.61	3.47	3.35	3.24	3.14
2.50	3.99	3.78	3.61	3.47	3.35	3.24	3.14	3.06

House near Perth by SIPit(Scotland) Ltd



Design guide

Part 1:
Structural Design

Floors

TWO equally loaded spans continuous over central support - unreinforced

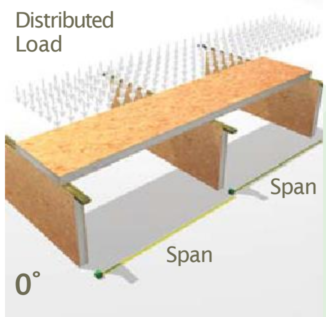


Table 24
100mm thick with 11mm face boards

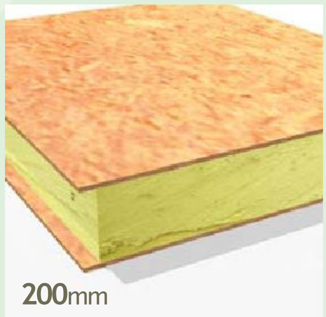
Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
1.50	1.53	1.15	0.93	0.76	0.65	0.57	0.52	0.45
2.00	1.28	1.01	0.82	0.69	0.61	0.54	0.48	0.41

Table 25
150mm thick with 11mm face boardst

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
1.50	2.42	1.85	1.49	1.25	1.08	0.94	0.84	0.75
2.00	2.04	1.62	1.34	1.14	0.99	0.88	0.78	0.70
2.50	1.77	1.44	1.21	1.05	0.92	0.81	0.73	0.66

Table 26
200mm thick with 11mm face boards

Dead Load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Live load								
1.50	3.27	2.52	2.05	1.72	2.05	1.30	1.16	1.04
2.00	2.77	2.21	1.83	1.57	1.37	1.21	1.09	0.99
2.50	2.41	1.97	1.67	1.44	1.27	1.14	1.03	0.93



SIP house in conservation area by Edward Halford Ltd

SIP cladding by SIPbuild

TWO equally loaded spans continuous over central support - reinforced

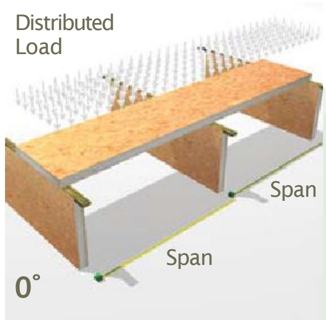


Table 27
100mm thick with 11mm face boards and 38mm thick grade C16 edge timbers

Dead Load Live load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
1.50	3.61	3.34	3.13	2.96	2.82	2.71	2.61	2.51
2.00	3.34	3.13	2.96	2.82	2.71	2.61	2.51	2.43
2.50	3.13	2.96	2.82	2.71	2.61	2.51	2.43	2.37

Table 28
150mm thick with 11mm face boards and 38mm thick grade C16 edge timbers

Dead Load Live load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
1.50	4.94	4.57	4.29	4.06	3.87	3.71	3.58	3.46
2.00	4.57	4.29	4.06	3.87	3.71	3.58	3.46	3.35
2.50	4.29	4.06	3.87	3.71	3.58	3.46	3.35	3.26

Table 29
200mm thick with 11mm face boards and 38mm thick grade C16 edge timbers

Dead Load Live load	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
1.50	6.16	5.70	5.35	5.07	4.84	4.64	4.47	4.32
2.00	5.70	5.35	5.07	4.84	4.64	4.47	4.32	4.19
2.50	5.35	5.07	4.84	4.64	4.47	4.32	4.19	4.07

Engineered floor joists in SIP house

Unreinforced Panel properties

(Note 1: panel properties are mean values)

(Note 2: these calculations have been prepared on 'Mathcad' using long variable names)

Panel thickness is	$D := 150\mathrm{mm}$	
Panel Face Board thickness is	$T := 11\mathrm{mm}$	
Core thickness is	$C := D - 2\cdot T$	$C = 0.128\,\mathrm{m}$
Core density (max)	$\rho c := 42\,\frac{\mathrm{kg}}{\mathrm{m}^3}$	
OSB 3 density	$\rho f := 665\,\frac{\mathrm{kg}}{\mathrm{m}^3}$	
Panel weight (max)	$wp := (T\cdot\rho f\cdot 2 + C\cdot\rho c)\cdot g$	$wp = 0.196\,\frac{\mathrm{kN}}{\mathrm{m}^2}$
Face board tensile strength	$\sigma tp := 3.2\,\frac{\mathrm{N}}{\mathrm{mm}^2}$	permissible
Face board shear strength	$\tau p := 0.67\,\frac{\mathrm{N}}{\mathrm{mm}^2}$	permissible
Width of panel considered is	$Bp := 1\mathrm{m}$	(All calculations based on 1m width)
Permissible axial load	$Ppx := 64\,\frac{\mathrm{kN}}{\mathrm{m}}$	From CERAM tests for all panels of 100mm thickness or more and up to 3m tall
Permissible eccentric load	$Ppe := 53\,\frac{\mathrm{kN}}{\mathrm{m}}$	up to 25mm eccentricity for all panels of 100mm thickness or more and up to 3m tall
Racking resistance	$Hr := 5.4\,\frac{\mathrm{kN}}{\mathrm{m}}$	(BS 5268 method, based on edge timber pulling out)
Face Board E value is	$Ef := 6800\,\frac{\mathrm{N}}{\mathrm{mm}^2}$	This is the very short term E value
Core shear modulus is	$Gc := 1.99\,\frac{\mathrm{N}}{\mathrm{mm}^2}$	Very short term value derived from test assuming above Ef
Panel effective depth is	$ep := D - T$	$ep = 139\,\mathrm{mm}$
Cross sect. area of face is	$Af := Bp\cdot T$	$Af = 1.1 \times 10^{4}\,\mathrm{mm}^2$
Face bending stiffness is	$Bst := Ef\cdot Af\cdot\frac{ep^2}{2}$	$Bst = 7.226 \times 10^{11}\,\mathrm{N}\cdot\mathrm{mm}^2$
Core area is	$Ac := Bp\cdot C$	$Ac = 0.128\,\mathrm{m}^2$
Shear stiffness	$Vst := Ac\cdot Gc$	$Vst = 254.72\,\mathrm{kN}$

Note: For domestic floors "¥ 1= 0.5 and "¥ 2 =0.3

Face I value	$Ip := Bp \cdot \frac{D^3 - C^3}{12}$	$Ip = 1.065 \times 10^8 \, mm^4$
Face Z value	$Zp := \frac{Ip \cdot 2}{D}$	$Zp = 1.42 \times 10^6 \, mm^3$
Panel bending resistance	$MRp := Zp \cdot \sigma tp$	$MRp = 4.543 \, kN \cdot m$

Creep coefficients:	**OSB face boards:**	**Foam core**	**Timber**
very short term (0 mins)	$\phi b0 := 0$	$\phi c0 := 0$	$\phi t0 := -0.43$
short term (200 hrs)	$\phi b200 := 0.6$	$\phi c200 := 0.46$	$\phi t200 := -0.33$
medium term (1000 hrs)	$\phi b1000 := 1.068$	$\phi c1000 := 0.896$	$\phi t1000 := -0.2$
long term (100000 hrs)	$\phi b100000 := 2.702$	$\phi c100000 := 4.21$	$\phi t100000 := 0$

(NB: BS 5268 E values are for long term loading. Shorter term values are higher – hence negative creep coeffs.)

Design Calculations – Typical example

Design of sloping roof panel - simply supported:

Assume the panel is subject to the following loads:

Span of panel horizontally is	$S := 2.4m$	In this example the following loads have been used	
Slope of panel	$\alpha := 30deg$	Roof dead load	$dl := 0.7 \frac{kN}{m^2}$
Roof dead load	$dl = 0.7 \frac{kN}{m^2}$	Roof live load	$ll := 0.6 \frac{kN}{m^2}$
Roof dead load	$ll = 0.6 \frac{kN}{m^2}$	including self weight	

Panel span and load:

Eurocode 1 gives guidance on deflection calculations taking creep into account. It postulates a quasi permanent load. This is defined (EC1 9,18) as IGkj+I\¥2i*Qki. The reversible seviceability limit state load is IGki+\¥1,1Qk1 + I\¥2,iQki (EC1 9,17)

Slope length of panel is $Ls := \frac{S}{\cos(\alpha)}$ $Ls = 2.771 \, m$

In the Eurocode 1:

$Gk := dl$	= IGkj above	
$Qk := l$	= IQki above	
$\psi 1 := 0.2$	= \¥2i for snow	medium term deflection load factor
$\psi 2 := 0$	= \¥2i for snow	long term deflection load factor

Applied load is:
Resolving normal to slope: ('N' suufix denotes normal to slope)

Roof DL is	$dlN := dl \cdot \cos(\alpha)$	$dlN = 0.606 \frac{kN}{m^2}$
Roof LL is	$llN := ll \cdot \cos(\alpha)$	$llN = 0.52 \frac{kN}{m^2}$
Medium term load is	$FumN := (dlN + \psi 1 \cdot llN) \cdot Bp \cdot Ls$	$FumN = 1.968\,kN$
	$MumN := FumN \cdot \frac{Ls}{8}$	$MumN = 0.682\,kN \cdot m$
Quasi permanent load	$FuqN := (dlN + \psi 2 \cdot llN) \cdot Bp \cdot Ls$	$FuqN = 1.68\,m^2 \frac{kN}{m^2}$
	$MuqN := FuqN \cdot \frac{Ls}{8}$	$MuqN = 0.582\,kN \cdot m$

Unreinforced Panel deflections:

Medium term (basic defl.)	$wbmN := 5 \cdot FumN \cdot \frac{Ls^3}{384 \cdot Bst}$	$wbmN = 0.755\,mm$
	$wvmN := FumN \cdot \frac{Ls}{8 \cdot Vst}$	$wvmN = 2.676\,mm$
Medium term (with creep)	$\delta cmN := [(1 + \phi b1000) \cdot wbmN + (1 + \phi c1000) \cdot wvmN]$	$\delta cmN = 6.753\,mm$
Quasi permanent (basic defl.)	$wbqN := 5 \cdot FuqN \cdot \frac{Ls^3}{384 \cdot Bst}$	$wbqN = 0.644\,mm$
	$wvqN := FuqN \cdot \frac{Ls}{8 \cdot Vst}$	$wvqN = 2.285\,mm$
Quasi permanent (with creep)	$\delta cqN := [(1 + \phi b100000) \cdot wbqN + (1 + \phi c100000) \cdot wvqN]$	$\delta cqN = 14.547\,mm$

Vertical component of deflection is

Medium term	$\delta cmV := \delta cmN \cdot \cos(\alpha)$	$\delta cmV = 5.848\,mm$
Medium term allowable deflection is	$\delta a\_m := \frac{S}{350}$	$\delta a\_m = 6.857\,mm$
Quasi permanent	$\delta cqV := \delta cqN \cdot \cos(\alpha)$	$\delta cqV = 12.598\,mm$
Quasi permanent allowable deflection	$\delta aq := \frac{S}{200}$	$\delta aq = 12\,mm$

SIP BUILDING SYSTEMS

Properties of reinforced panels:

(Note: panel properties are mean values)
Assume panel reinforced down both edges with timber fillet

Panel width	$Bp := 1.2m$	standard panel width
Take effective flange width as lesser of:		
	$be := 0.15 \cdot S$	$be = 0.36\ m$
	$Be := 30 \cdot T$	$Be = 0.33\ m$
	$Be := if(be < Be, be, Be)$	$Be = 0.33\ m$
Total flange width	$BfT := 2 \cdot Be$	$BfT = 0.66\ m$
Reinf Spacing	$sr := 1.2m$	
Reinf breadth	$br := 38mm$	
Total breadth reinf.	$Br := 2 \cdot br$	$Br = 76\,mm$
Reinforcement shear modulus	$Gr := 550 \frac{N}{mm^2}$	Grade C16 mean value
Reinforcement area is	$Ar := Br \cdot C$	$Ar = 9.728 \times 10^3\,mm^2$
Reinforcement shear stiffness	$Sgr := Ar \cdot Gr$	$Sgr = 5.35 \times 10^3\,kN$
Foam core shear stiffness is	$Sgc := Ac \cdot Gc$	(ignore)
Ignore foam core	$Sgc := 0 \cdot Sgc$	
Reinforcement	$\rho t := 5.9 \frac{kN}{m^3}$	timber density
Increased self weight	$wpR := wp + Ar \cdot \frac{\rho t}{Bp}$	$wpR = 0.244 \frac{kN}{m^2}$
$E\_C24min := 7200 \frac{N}{mm^2}$	$E\_C24mean := 10800 \frac{N}{mm^2}$	
$E\_C16min := 5800 \frac{N}{mm^2}$	$E\_C16mean := 8800 \frac{N}{mm^2}$	$Ef = 6.8 \times 10^3 \frac{N}{mm^2}$
Reinf E value is (long term)	$Erm := E\_C16mear$	$Erm = 8.8 \times 10^3 \frac{N}{mm^2}$ (at least 4 reinforcing fillets)

Reinf E value (very short term)
$Er0 := Erm\cdot\left(\frac{1}{1+\phi t0}\right)$
$Er0 = 1.544\times10^{4}\frac{N}{mm^{2}}$

medium term
$Er1000 := Erm\cdot\left(\frac{1}{1+\phi t1000}\right)$
$Er1000 = 1.1\times10^{4}\frac{N}{mm^{2}}$

long term
$Er100000 := Erm\cdot\left(\frac{1}{1+\phi t100000}\right)$
$Er100000 = 8.8\times10^{3}\frac{N}{mm^{2}}$

Effective width of reinf in bending
$brb1000 := Br\cdot\frac{Erm\cdot(1+\phi b1000)}{Ef\cdot(1+\phi t1000)}$
$brb1000 = 254.242\,mm$

$brb100000 := Br\cdot\frac{Erm\cdot(1+\phi b100000)}{Ef\cdot(1+\phi t100000)}$
$brb100000 = 364.103\,mm$

Effective I value is
$Ie1000 := \frac{BfT\cdot D^{3}}{12} - \frac{(BfT - brb1000)\cdot C^{3}}{12}$
$Ie1000 = 1.147\times10^{4}\,cm^{4}$

$Ie100000 := \frac{BfT\cdot D^{3}}{12} - \frac{(BfT - brb100000)\cdot C^{3}}{12}$
$Ie100000 = 1.339\times10^{4}\,cm^{4}$

Shear stiffness
$VsR := Ar\cdot Gr$
$VsR = 5.35\times10^{6}\,N$

Reinforced Panel Deflections - Typical calculation

Medium term:
$wbmN := 5\cdot FumN\cdot\frac{Ls^{3}}{384\cdot Ef\cdot Ie1000}$
$wbmN = 0.755\,mm$

$wvmN := FumN\cdot\frac{Ls}{8\cdot VsR}$
$wvmN = 2.676\,mm$

Medium term
$\delta cmN := \left[(1+\phi b1000)\cdot wbmN + (1+\phi t1000)\cdot wvmN\right]$
$\delta cmN = 6.753\,mm$

Quasi permanent
$wbqN := 5\cdot FuqN\cdot\frac{Ls^{3}}{384\cdot Ef\cdot Ie100000}$
$wbqN = 0.644\,mm$

$wvqN := FuqN\cdot\frac{Ls}{8\cdot VsR}$
$wvqN = 2.285\,mm$

$\delta cqN := \left[(1+\phi b100000)\cdot wbqN + (1+\phi t100000)\cdot wvqN\right]$
$\delta cqN = 14.547\,mm$

Note:The long term deflections derived from these calculations will give slightly longer spans than quoted in the tables. The creep coefficients are influence by many factors. The tables may be slightly conservative.

For domestic floors ¥1 = 0.5 and ¥2 =0.3

Vertical component of deflection is:

Medium term $\delta cmV := \delta cmN \cdot \cos(\alpha)$ $\delta cmV = 2.137mm$

Medium term allowable deflection is $\delta a\_m := \frac{S}{350}$ $\delta a\_m = 6.857mm$

Quasi permanent $\delta cqV := \delta cqN \cdot \cos(\alpha)$ $\delta cqV = 3.175mm$

Quasi permanent allowable deflection is $\delta aq := \frac{S}{200}$ $\delta aq = 12mm$

Racking resistance using BS 5268 method - Typical calculation

BS5268-6.1:1996 Structural use of timber - Part 6 Code of practice for timber frame walls – Section 6.1 Dwellings not exceeding four storeys. Sect 4.7.2b:

BBA Certificate quoted figure is from tests $Rb := Hr$ $Rb = 5.4 \frac{kN}{m}$

Wall length $Lwall := 11.183m$

Wall height $Hwall := 2.5m$ example values

Area of openings in wall $Aa := 4.37m^2$

Total area of wall $At := Lwall \cdot Hwall$ $At = 27.957\ m^2$

$p := \frac{Aa}{At}$ $p = 0.156$

$K100 := 0.66$ (see Table 1 BS5268-6.1:1996 - assistance from masonry)

$K104 := \frac{2.4m}{Hwall}$ $K104 = 0.96$

$K105a := \frac{Lwall}{2.4m}$ $K105a = 4.66$

$K105b := K105a^{0.4}$ $K105b = 1.851$

$K105c := 1.32$

$K105 := if(Lwall < 2.4m, K105a, if(Lwall < 4.8m, K105b, K105c))$ $K105 = 1.32$

$K106 := (1 - 1.3 \cdot p)^2$ $K106 = 0.635$

$K107 := 1$ No allowance made for vertical load in this case

$Kw := K104 \cdot K105 \cdot K106 \cdot K107$ $Kw = 0.805$

Racking resistance $Rrack := Rb \cdot Lwall \cdot Kw$ $Rrack = 48.584kN$

Racking force on panel $Fr := 70kN$

Racking load on SIPs $Fr\_res := K100 \cdot Fr$ $Fr\_res = \blacksquare kN$

SIPs as Beams

SIPs may be used as beams and lintels within walls by inserting timber flanges along the top and bottom edges. The Flanges must be glued with expanding polyurethane glue and screwed at not more than 200mm centre to centre. The end fixings must be sufficient to carry the shear loads. Their strength and stiffness may be calculated as follows:

Box Beam Calculation

Example Loadings: $S0 := 3m$ $BM0 := 4.3125kN \cdot m$ $W0 := 2.5\frac{kN}{m}$ $P0 := 2kN$

$V0 := 4.75kN$

Design as box beam: (comprising SIP with timber flanges inserted in edges to form beam)

Use 150 thick panel

$D := 150mm$ Panel thickness

$Db := 400mm$ Lintel depth (example)

$Tbf := 38mm$ Lintel timber flange thickness

$Tim\_grade := 16$ Timber grade C16 or C24

$$Ib\_fl := (D - 2 \cdot 11mm)\frac{Db^3 - (Db - 2 \cdot Tbf)^3}{12}$$

$Ib\_fl = 3.199 \times 10^8 mm^4$ I val .based on flanges only

$$Zb\_fl := \frac{Ib\_fl \cdot 2}{Db}$$

$Zb\_fl = 1.599 \times 10^6 mm^3$ Z val .based on flanges only

$\sigma tim\_t := \frac{BM0}{Zb\_fl}$ $\sigma tim\_allow = 3.2\frac{N}{mm^2}$

$$\sigma tim\_t = 2.696\frac{N}{mm^2}$$

$Etim = 5.6 \times 10^3 \frac{N}{mm^2}$ timber E value

$$\delta 0b := 5 \cdot (W0) \cdot \frac{S0^4}{384 \cdot Etim \cdot Ib\_fl} + P0 \cdot \frac{S0^3}{48 \cdot Etim \cdot Ib\_fl}$$

$$\delta 0b = 2.1\,mm$$

$$0.003 \cdot S0 = 9mm$$

Rolling Shear:

$$Ib\_box := Ib\_fl + 2 \cdot T \cdot \frac{Db^3}{12} \cdot \frac{Ef \cdot \phi b100000}{Etim}$$

$$Ib\_fl = 3.199 \times 10^8\,mm^4$$

$$ShearB := V0$$

$$ShearB = 4.75\,kN$$

$$Ab := (D - 2 \cdot T) \cdot Tbf$$

$$Ab = 4.864 \times 10^3\,mm^2$$

$$Roll\_sh := ShearB \cdot Ab \cdot \frac{Db - Tbf}{2 \cdot Ib\_fl \cdot 2}$$ per face

$$Roll\_sh = 6.537\,\frac{N}{mm}$$

C24 allowable shear is: $Stress\_allow = 0.67\,\frac{N}{mm^2}$

$$Roll\_stress := \frac{Roll\_sh}{Tbf}$$

$$Roll\_stress = 0.172\,\frac{N}{mm^2}$$

Moisture Movement

OSB expands by 0.03%/% (ie the board will expand by 0.03% of its length for every 1% rise in moisture content) Typical moisture contents are:

Heated building	7% – 9%
Intermittently heated building	9% – 12%
Unheated building	15%

Axial Load Capacity

The safe working load (actual not ultimate) for all panels of 100 mm thick or more and up to 3 m high is:

Axial Load 64 kN/m
Eccentric load 53 kN/m with up to 25 mm eccentricity.

Failure occurs locally at the top and bottom edges of the panel and not by over-all buckling.

SBS
SIP BUILDING SYSTEMS

Tel: +44(0)1744 747580
www.platinumpanelsystems.com
Email: info@platinumpanelsystems.com

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