SmartJoist Design Guide

Edition 1 2018

Introducing the SmartFloor®

Another first from SmartFrame

Now your SmartFrame floor system can be supplied precision docked*, with the web penetrations pre-cut to your specifications and even manufactured into cassette systems. Each cassette comes labelled with its identifying number to match the colour layout (up to A1) supplied as part of the order.

This provides the builder with an industry benchmark level of information to aid quick and correct installation, and allows for easy installation of services.

SmartFloor combines the speed and efficiency of SmartJoists with the flexibility of open webbed truss systems, without the need for the installation of strong- backs associated with open webbed trusses.

Table of contents

Scope of this publication

This Design Guide and Load Tables assists in the selection of SmartJoists for most of the common structural arrangements met in domestic construction. The Tilling Timber website (www.tilling.com.au) and SmartFrame software, in conjunction with this manual, provides an unparalleled level of design capacity for SmartFrame engineered timber products.

While specific details are given on suitable methods of developing lateral restraint, the methods of providing adequate support, adequate anchorage against wind uplift and overall structural stability are outside the scope of this publication.
Information on the above matters can be obtained from AS 1684 Residential timber-framed construction code or from a structural engineer experienced in timber construction.

Tilling Timber Pty Ltd has structural engineers on staff who can be contacted for advice on matters concerning the use of its engineered timber products in timber construction on the Tech support Helpline on 1300 668 690 or at techsupport@tilling.com.au.

Substitution of other products

All load tables in this document are designed using in-grade tested properties for SmartJoists as manufactured by Pacific Woodtech Corporation of Washington State, USA. Other manufacturers I-Joists may have different properties and, therefore, cannot be designed using these span tables.

Copyright

Certification

As a professional engineer, qualified and experienced in timber engineering, I certify that the use of the SmartJoist members as shown in these tables, and installed in accordance with the provisions of this Design Guide, will comply with the requirements of the Building Code of Australia. These span tables have been prepared in accordance with standard engineering principles, the relevant test reports and Australian standards, i.e. -

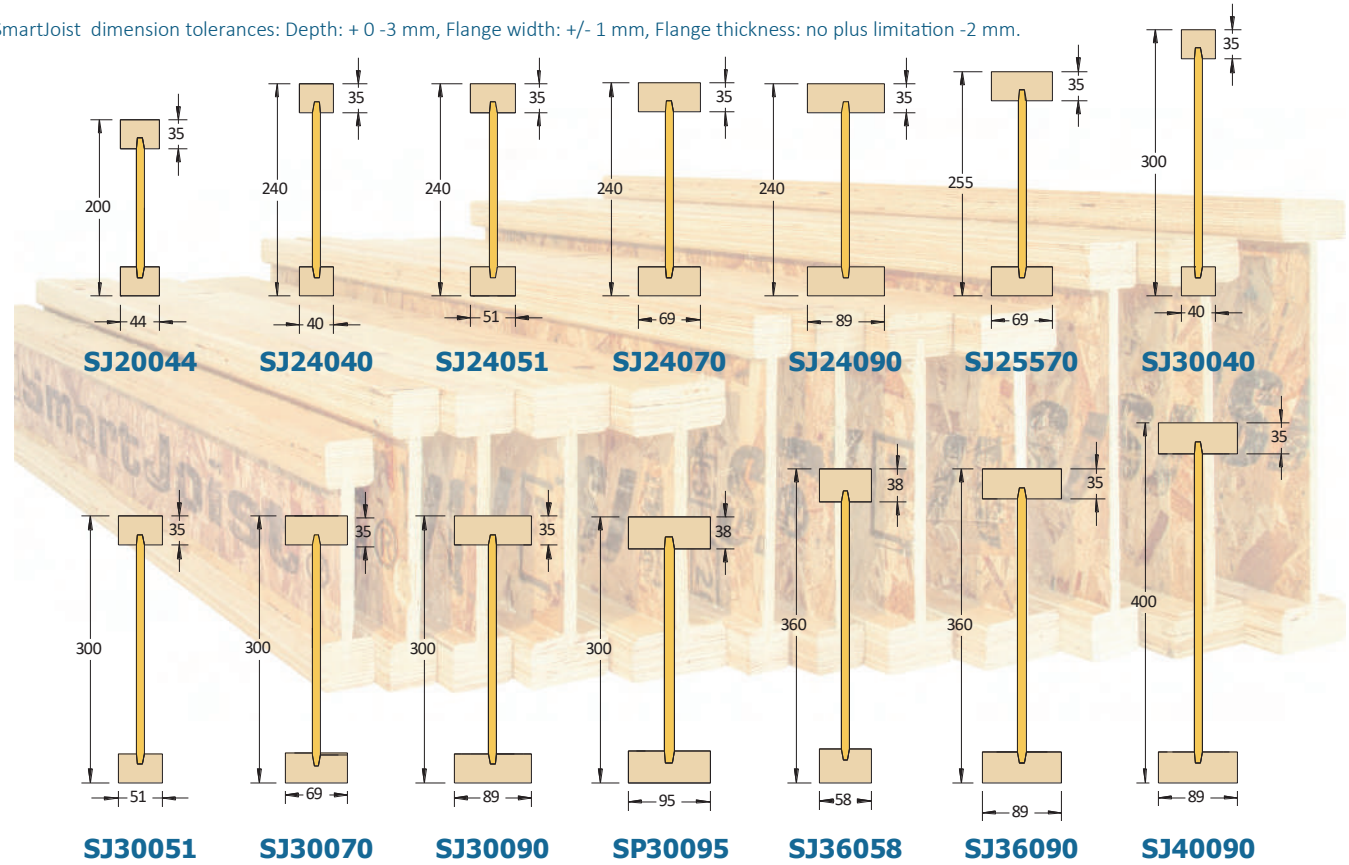
- AS 1720.3 Timber structures Part 3: Design criteria for timber-framed residential buildings
- AS 1720.1 Timber Structures - Design Methods
- AS 4055 Wind loads for Houses
- ASTM D 5055 Standard specification for establishing and monitoring structural capacities of prefabricated wood I-Joists

Craig Kay RPEng, EC-1961, RPEQ-5100, BPB0730, CC5635 C, NER
National Product Engineer

Flange width 40, 44, 51, 58, 70, 90 and 95 mm. Web thickness: 9.5 mm, for 40, 44, 51, 58 and 70 mm flanges: 11.5 mm for 90 and 95 mm flanges & SJ25570

SmartJoist sizes available in each state may vary from time to time. Check you local SmartFrame stockist before ordering

SmartJoist dimension tolerances: Depth: + 0 -3 mm, Flange width: +/- 1 mm, Flange thickness: no plus limitation -2 mm.



The information contained in this product brochure is current as at Jan 2016 and is based on data available to Tilling Timber Pty Ltd at the time of going to print. Tilling Timber Pty Ltd has used its reasonable endeavours to ensure the accuracy and reliability of the information contained in this document and, to the extent permitted by law, will not be liable for any inaccuracies, omissions or errors in this information nor for any actions taken in reliance on this information. Tilling Timber Pty Ltd reserves the right to change the information contained in this document without prior notice. It is important that you call the Tech Support Customer Helpline on 1300 668 690 to confirm that you have the most up to date information available.

SMARTFRAME®

SMART ENGINEERED SOLUTIONS

"The strength is in the engineering"

The SmartFrame Engineered Wood System is made up of:

- World class engineered timber products:
    1. SmartJoist
    2. SmartLVL
    3. SmartLam GLT
    4. Tecbeam
- Unique SmartFrame Structural Design, Detailing and Estimating Software
- Full engineering support and technical advice from experienced engineers and field staff free of charge on our unique Tech Support Customer Helpline 1300 668 690.

SmartJoists

The strength is in the engineering:- Strong. Stiff. Reliable. SmartJoists are engineered for heavy performance. We start with ultrasonically graded LVL, bonded with exterior adhesive for more load carrying capacity.

The webs are made from stable, strong Oriented Strand Board (OSB) for superior strength and consistent performance. SmartJoists are more uniform than solid sawn joists. They stay straighter and are manufactured with no camber, so there is no chance of crown down or upside down installation. They resist shrinking, twisting, warping and splitting for squeak resistant floors and quality roofs and ceilings.

Holes may be easily cut in the web according to the tables on page 30, allowing ducts and utilities to be run through the joists. Pre-punched 40 mm knockout holes are provided in the web for small diameter services or wiring.

Save Time and Money:- Because they weigh less than solid sawn joists, SmartJoists are easier to install, saving construction time and cost. Their greater load carrying capacity allows you to space them further apart, so it takes fewer to build the average floor or roof. And with five (5) depths from 200 to 400 mm, you will never have to compromise your design. So whether your plans call for cantilever beams in balconies, cathedral roofs or high pitched roof slopes, SmartJoists are the perfect choice.

An Environmentally Sound Choice:- In addition to being cost effective, SmartJoists are also an environmentally sound choice because they are made of a renewable resource – wood. So they are a better choice for building.

SmartJoists have a certified Chain of Custody system to PEFC.

SmartFrame Software:- Our unique SmartFrame design, detailing and estimating software offers you unparalleled design and estimating capabilities with engineered timber. You will get accurate designs for a wide variety of applications, printouts and joist layouts.

Limitations of use - SmartJoists:-SmartJoists are to be used in dry interior environments only, fully enclosed from exposure to exterior moisture. SmartJoists are suitable for subfloor applications provided that the subfloor space is ventilated as per the BCA requirements. This means that SmartJoists must not be exposed to environments where the equilibrium moisture content of the joist will exceed 18%. Tilling Timber will not guarantee SmartJoists that have been left exposed to the weather either prior to or during construction for more than 90 days.

Detailing such as cladding or lining must be used in moisture laden environments (commercial kitchens, bathrooms, wet industrial areas, saunas, swimming pool and spa rooms etc.) and constructed in such a way as to prevent exposure of the SmartJoist to moisture.

SmartJoists may be used in applications which are often exposed externally (gable ends, eaves, floor joists applications in elevated houses, cantilevered joists etc.) but must be sufficiently enclosed with a suitable cladding, lining etc. to completely prevent the exposure of the SmartJoist to moisture.

SmartFrame Consumer Product Warranty

Tilling Timber guarantees that SmartFrame Engineered Timber products have been manufactured to exacting standards and are free from defects in workmanship and materials.
At Tilling Timber, we take great pride in SmartFrame products, so if you bring to our attention problems such as squeaks that you believe are caused by our products, we guarantee that a technical representative will contact you promptly to evaluate the issues and provide advice to help solve the problem
Providing that any SmartFrame product is correctly designed, handled and installed, any problem caused by an unlikely defect will promptly be remedied at no cost to you.
This guarantee remains valid for the expected life of your home.

Tilling Timber Pty Ltd
31-45 Orchard Street
Kilsyth Vic 3137
Priority call: 1300 668 690 e-mail: techsupport@tilling.com.au

General information - about floor performance

The "feeling" that is identified when a person walks on a floor is very subjective. Some people want to feel a very stiff floor and others want some "give" so that it softens the footing. When people say the floor "bounces", it may be vibrating. This sensation is often caused by lack of dead load such as furniture, direct applied ceilings or other materials to absorb or dampen the vibration.

AS 1720.3 standard includes as an upper limit, a 1.0 kN static load applied at mid-span as a serviceability equation to simulate the foot force effect on the design of floor joists. The differential deflection caused by this 1 kN load is limited to 2 mm.

This criteria was developed for solid section floor joists up to 6 m spans, and in some cases, experience is now showing that at the 2 mm limit, the floor performance of lightweight I-Joist floors (especially without ceilings below e.g. subfloors) may be considered unfit for purpose by some people.

The two (2) alternative SmartJoist Span Table shown in this manual have been designed to meet the strength and serviceability criteria of:

- Table 1 - AS 1720.3—2016 In this table the strength and serviceability limits of AS 1720.3—2016 have been used along with the recommended dynamic requirements.
- Table 2 - SmartJoist Preferred Dynamics. In this table the strength and serviceability limits of AS 1720.3—2016 have been supplemented with a EN 1995-1-1-2004 serviceability equation to better model foot force effects on I-Joist floors. This approach has been demonstrated to produce stiffer floors for those wanting a firmer feel in their timber floor.

Both tables list MAXIMUM recommended joist spans, and therefore shorter spans in most cases should produce stiffer floors.

Factors that can affect floor dynamic performance

- The choice of flooring system
- The depth, stiffness and mass of the joists
- Spacing of joists
- Fixing of sheathing to joists
- Stiffness and mass of floor sheathing
- Mass and stiffness of ceiling materials
- Method of installation
- Location and type of internal partitions and furniture

Factors that can improve floor dynamic performance

- Glue/nailed and glue/screw floors will perform better than floors secured by nails alone.
- Deflection of the sheathing material between joists can be reduced by decreasing the joist spacing or using a thicker and/or stiffer sheathing.
- Proper installation is essential for dependable performance. Adequate and level support for the joists is necessary, as is correct fastening of the joists and sheathing.
- The installation of a ceiling to the bottom flange of the joists or a similar mass/loading sharing system.

While between joist blocking has been traditionally used to provide some improvement to floor dynamic performance of solid timber joists, both testing and long experience show limited if any improvement to the dynamic performance by mid-span blocking of I-Joist floor systems with simple blocking.

If floor dynamic performance is a concern to either the client, designer or contractor, then the above variables can be altered, or additional methods be incorporated to improve dynamic performance.

Further information on the dynamic performance of lightweight timber floors can be obtained by calling the Tech Support Customer Helpline on 1300 668 or at techsupport@tilling.com.au.

Large area ceramic tiled floors

The modern trend to large size ceramic tiles has introduced a new design challenge for all floor substrates. Smaller numbers of grouted joins between larger tiles means that any deflection of the floor has to be larger per grouted joint, thus increasing the probability of cracking.

AS 3958.1—2007 (incudes amendment 1-2010) Ceramic tiles Part 1: Guide to the installation of ceramic tiles limits the total deflection of the floor (Dead Load + Live Load) to L/360. This supplementary deflection limit is not one that is normally considered in the design of timber floors.

The spans listed within Tables 2-4 meets the additional AS 3958.1—2007 Ceramic tiles Part 1: Guide to the installation of ceramic tiles deflection limits.

Designing with SmartJoists®

The design information contained within this Design Guide is for the properties of SmartJoist® I-Joists only. Other manufacturers' I-Joists may have different properties and therefore cannot be designed using this information.

Dimensional tolerances:	Length	± 10 mm
	Depth	+0, -3 mm
	Flange width	± 10 mm
	Flange thickness	No plus limitation, -2
Treatment options:	H2s (standard) and H2 treatment to AS 1604.2 and AS 1604.4	

Characteristic properties

SmartJoist Code	Depth (mm)	Flange width (mm)	Flange Thickness (mm)	Web thickness (mm)	Self weight (kg/m)	Moment (kN.m)	Shear (kN)	EI x 10^6 (kN.mm^2)	GJ x 10^6 N.mm^2)	GA_w x 10^6 (N.mm^2)	End reaction (kN)	Max interior reactions	
												42 mm bearing (kN)	90 mm bearing (kN)
SJ20044	200	44	35	9.5	2.7	10.0	10.5	355	997	1.78	8.60	14.7	19.6
SJ24040	240	40	35	9.5	2.8	8.8	13.1	500	907	2.27	8.60	14.7	19.6
SJ24051	240	51	35	9.5	3.2	11.4	13.1	635	1156	2.27	9.5	17.0	22.4
SJ24070	240	69	35	9.5	4.0	15.3	13.1	852	1564	2.33	11.2	20.5	25.1
SJ24090	240	89	35	11.5	5.1	19.8	16.2	1097	2017	2.27	12.1	25.7	33.2
SJ25570	255	69	35	11.5	4.4	16.6	17.3	988	1154	2.46	11.2	20.5	25.1
SJ30040	300	40	35	9.5	3.1	11.3	17.0	844	907	3.01	8.6	14.7	19.6
SJ30051	300	51	35	9.5	3.6	14.7	17.0	1069	1156	3.01	9.5	17.0	22.4
SJ30070	300	69	35	9.5	4.4	19.7	17.0	1432	1564	3.01	11.2	20.5	25.1
SJ30090	300	89	35	11.5	5.6	26.0	20.7	1843	2017	3.01	12.1	25.7	33.2
SP30095	300	95	38	11.5	6.6	30.1	20.7	2087	2140	3.01	12.1	25.9	33.2
SJ36058	360	58	38	9.5	4.4	21.9	20.9	1953	1683	3.67	11.2	21.4	24.1
SJ36090	360	89	35	11.5	6.0	31.5	25.2	2791	2017	3.66	12.1	25.7	33.2
SJ40090	400	89	35	11.5	6.3	35.1	28.3	3537	2017	4.23	12.1	25.7	33.2

Strength reduction factors

The strength reduction factor for calculating the design capacities of structural members shall be taken from the table below, referenced from AS 1720.1 –2010

Application of SmartJoist as a structural member		
Category 1	**Category 2**	**Category 3**
Structural members for houses for which failure would be unlikely to affect an area greater than 25 m^2; OR secondary members in structures other than houses	Primary structural members in structures other than houses; OR elements in houses for which failure would be likely to affect an area* greater than 25 m^2	Primary structural members in structures intended to fulfil essential services or post disaster function
Strength reduction factor Ø *		
0.95	0.90	0.80

* AS 1720.1:2010 Table 2.1

Duration of load

The duration of load factor k_1 for strength is defined within clause 2.4 of AS 1720.1. The duration of load factor J_2 for deflection is defined below.

Duration of action	Bending and shear
Short term ≤ 1 day	1.0
Long term > 12 months	2.0

Deflection (Bending deflection + shear deflection)

Bending deflection—use standard engineering formula
Shear deflection - for a uniformly distributed load w, over a span L

$$y = j_2\left(\frac{5wL^4}{384EI_x} + \frac{wL^2}{8G_wA_w}\right)$$

Partial seasoning factor

SmartJoists are a seasoned timber product, generally k_4 equals 1. Where the SmartJoists are subjected to conditions in which the average moisture content for a 12 month period is expected to exceed 15%, the characteristic capacity shall be decreased. The value of k_4 shall be the greater of:

a. $k_4 = 1.0 - 0.3\frac{EMC - 15}{10}$

b. $k_4 = 0.7$

Where EMC is the highest value of the annual moisture content (percent) that the timber will attain in service.

Length and position of bearing

The k_7 bearing factor is defined is clause 2.4.4 of AS 1720.1

Load sharing

Because of the reduced variability of strength values of SmartJoist compared to solid timber , the load sharing factor k_9 = 1.0.

Stability

The stability factor k_{12} is defined within Appendix E of AS 1720.1

Temperature

For covered timber structures under ambient conditions, no modification for strength need be made for the effect of temperature (i.e., k_6 equals 1.0) except that where seasoned timber is used in structures erected in coastal regions of Queensland north of latitude 25°S, and all other regions of Australia north of latitude 16°S, the strength shall be modified by a factor k_6 of 0.9.

Recommended maximum spans for lightweight residential floors

General domestic - 1.5 kPa

Loadings: Permanent Loading G: self weight + 40 kg/m^2 + 0.5 kPa of live load permanently applied, live load Q: 1.5 kPa or 1.8 kN point live load

In compiling the span tables in this manual, the requirements of the relevant Australian standards and codes along with established Industry standard design guidelines for Residential Construction have been followed. In particular, the following codes and references have been used:

- AS 1720.3 Timber structures. Part 3: Design criteria for timber-framed residential buildings
- AS 1720.1 Timber Structures - design methods
- AS 4055 Wind loads for houses
- AS/NZS 4063 Characterisation of structural timber
- ASTM D 5055 Standard specification for establishing and monitoring structural capacities of prefabricated wood I-Joists

Serviceability criteria:

Max permanent load deflection - lesser of span / 300 or 15 mm ($j_2 = 2$)
Max live load deflection - lesser of span / 360 or 9 mm

Table 1 - AS 1720.3—2016 Floor dynamics criteria

1. Minimum floor Natural Frequency - 8 Hertz
2. Maximum differential deflection between joists of 2 mm under a concentrated load of 1.0 kN mid-span to simulate the foot force effect on the design of floor joists.

Joist spacing (mm)		300	400	450	600	300	400	450	600
SmartJoist code	Self weight (kg/m)	Maximum recommended floor joist span (mm)							
		Single span				Continuous span			
SJ20044	2.8	4750	4400	4150	3750	5400	5000	4800	4300
SJ24040	3.0	5150	4800	4650	4250	5900	5550	5300	4900
SJ24051	3.4	5450	5050	4900	4550	6200	5700	5600	5100
SJ24070	4.0	5850	5450	5250	4900	6600	6150	6000	5500
SJ24090	5.0	6200	5750	5600	5200	7000	6500	6350	5850
SJ25570	4.4	6100	5650	5450	5050	6900	6400	6200	5750
SJ30040	3.4	5900	5450	5300	4900	6650	6100	5900	5650
SJ30051	3.9	6250	5800	5600	5200	7000	6500	6250	5900
SJ30070	4.3	6650	6200	6000	5550	7500	6900	6700	6300
SJ30090	5.5	7000	6600	6350	5900	7950	7350	7100	6700
SP30095	6.6	7150	6700	6550	6050	8300	7650	7400	6850
SJ36058	4.8	7200	6700	6500	6000	8150	7500	7250	6900
SJ36090	5.9	7750	7250	7050	6550	8850	8150	7900	7500
SJ40090	6.2	8200	7700	7500	6950	9400	8650	8400	7800

Table 2 - SmartJoist Preferred floor dynamics criteria

1. Minimum floor Natural Frequency - 8 Hertz
2. Maximum differential deflection between joists of:
   - 1.8 mm for spans ≤ 4200 mm
   - 17,500/L$^{1.1}$ for span ≥ 4200 mm (for L in mm)

   under a concentrated load of 1.0 kN mid-span to simulate the foot force effect on the design of floor joists.

Joist spacing (mm)		300	400	450	600	300	400	450	600
SmartJoist code	Self weight (kg/m)	Maximum recommended floor joist span (mm)							
		Single span				Continuous span			
SJ20044	2.8	4750	4200	4050	3750	5400	4750	4500	4150
SJ24040	3.0	5150	4550	4500	4100	5900	5200	4900	4500
SJ24051	3.4	5400	4850	4650	4350	6200	5500	5200	4800
SJ24070	4.0	5850	5200	5000	4650	6700	5900	5600	5100
SJ24090	5.0	6200	5500	5300	4950	7150	6200	5950	5450
SJ25570	4.4	6100	5350	5150	4850	6900	6100	2800	5300
SJ30040	3.4	5900	5150	4950	4650	6700	5900	5600	5150
SJ30051	3.9	6250	5500	5250	4950	7100	6200	5900	5450
SJ30070	4.3	6650	5900	5650	5300	7650	6700	6350	5850
SJ30090	5.5	6950	6250	6000	5600	8100	7100	6750	6200
SP30095	6.6	7150	6450	6200	5800	8300	7300	6900	6400
SJ36058	4.8	7200	6350	6100	5700	8250	7200	6850	6300
SJ36090	5.9	7750	6900	6650	6200	9000	7850	7450	6850
SJ40090	6.2	8200	7300	7050	6600	9500	8300	7900	7250

Recommended maximum spans for residential floors with ceramic tiles

General domestic - 1.5 kPa

Table 3 - SmartJoist –65 kg/m^2 - grout and tiled floor

1. Minimum floor Natural Frequency - 8 Hertz
2. Maximum differential deflection between joists of:
   - 1.8 mm for spans ≤ 4200 mm
   - 17,500/L$^{1.1}$ for span ≥ 4200 mm

   under a concentrated load of 1.0 kN mid-span to simulate the foot force effect on the design of floor joists.
3. Total deflection of the floor (Dead Load + Live Load) to L/360 as per AS 3958.1—2007 (incudes amendment 1-2010) Ceramic tiles Part 1: Guide to the installation of ceramic tiles

Loadings: Permanent Loading G: self weight + 65kg/m^2 + 0.5 kPa of live load permanently applied, live load Q: 1.5 kPa or 1.8 kN point live load

Joist spacing (mm)		300	400	450	600	300	400	450	600
SmartJoist code	Self weight (kg/m)	Maximum recommended floor joist span (mm)							
		Single span				Continuous span			
SJ20044	2.8	4500	4200	3900	3500	5400	4700	4500	4100
SJ24040	3.0	4900	4550	4400	4000	5900	5200	4900	4500
SJ24051	3.4	5200	4800	4600	4300	6200	5500	5200	4800
SJ24070	4.0	5500	5200	5000	4650	6700	5900	5600	5100
SJ24090	5.0	5800	5450	5300	4900	7050	6250	5950	5450
SJ25570	4.4	5750	5350	5150	4850	6900	6100	5800	5350
SJ30040	3.4	5600	5100	4950	4650	6700	5900	5600	5150
SJ30051	3.9	5900	5500	5250	4950	7100	6200	5900	5450
SJ30070	4.3	6300	5900	5650	5300	7600	6700	6350	5850
SJ30090	5.5	6650	6200	6000	5600	8000	7100	6750	6200
SP30095	6.6	6800	6350	6200	5750	8200	7300	6950	6400
SJ36058	4.8	6800	6350	6100	5700	8200	7200	6850	6300
SJ36090	5.9	7350	6800	6650	6200	8850	7850	7450	6850
SJ40090	6.2	7800	7300	7050	6600	9400	8300	7900	7250

Table 4 - SmartJoist –135 kg/m^2 - 40 mm grout and tiled floor

1. Minimum floor Natural Frequency - 8 Hertz
2. Maximum differential deflection between joists of:
   - 1.8 mm for spans ≤ 4200 mm
   - 17,500/L$^{1.1}$ for span ≥ 4200 mm

   under a concentrated load of 1.0 kN mid-span to simulate the foot force effect on the design of floor joists.
3. Total deflection of the floor (Dead Load + Live Load) to L/360 as per AS 3958.1—2007 (incudes amendment 1-2010) Ceramic tiles Part 1: Guide to the installation of ceramic tiles

Loadings: Permanent Loading G: self weight + 135 kg/m^2 + 0.5 kPa of live load permanently applied, live load Q: 1.5 kPa or 1.8 kN point live load

Joist spacing (mm)		300	400	450	600	300	400	450	600
SmartJoist code	Self weight (kg/m)	Maximum recommended floor joist span (mm)							
		Single span				Continuous span			
SJ20044	2.8	4000	3700	3600	3250	4900	4500	4350	3950
SJ24040	3.0	4350	4050	3900	3650	5300	4950	4850	4500
SJ24051	3.4	4600	4300	4150	3900	5650	5250	5100	4750
SJ24070	4.0	4950	4550	4400	4100	6050	5650	5450	5050
SJ24090	5.0	5200	4800	4650	4350	6400	5920	5750	5350
SJ25570	4.4	5100	4750	4650	4300	6250	5850	5650	5250
SJ30040	3.4	5000	4600	4450	4100	5850	5400	5250	4800
SJ30051	3.9	5250	4850	4700	4300	6150	5750	5550	5150
SJ30070	4.3	5600	5200	5000	4650	6500	6100	5950	5500
SJ30090	5.5	5900	5500	5300	4950	6900	6400	6250	5800
SP30095	6.6	6100	5650	5500	5100	7450	6950	6750	6250
SJ36058	4.8	6050	5650	5450	5050	7100	6600	5450	5950
SJ36090	5.9	6500	6100	5900	5450	7600	7100	6900	6450
SJ40090	6.2	6950	6500	6250	5750	8100	7550	7300	6800

Recommended maximum spans for residential floors (cont'd)

Flooring:

Spans are suitable for solid timber, particle board and ply flooring. Floor sheathing glued and nailed to the joists will improve floor rigidity. Where a heavy overlay material is to be applied, such as thick mortar bed tiled or slate floors, the permanent load allowance should be increased to 1.2 kPa. A reduction of joist spacing can be used to accommodate this extra permanent load. A satisfactory result can be achieved by adopting the maximum spans for 600 mm and 450 mm spacing but installing the joists at 450 mm and 300 mm spacing respectively.

Continuous spans:

For beams which are continuous over two unequal spans, the design span and the "resultant span description" depend on the percentage difference between the two spans as shown below:

Span difference	Effective span	Resultant span description
10% max	main span	continuous
10 - 30%	1.1 x main span	continuous
above 30% diff	main span	single

$$\text{span difference} = \frac{(\text{main span} - \text{second span})}{(\text{main span} + \text{second span})} \times 100$$

SmartJoist Design /Effective span

Normal structural analysis uses the centreline representation of the member. The term "span" can be defined in a number of ways and these are defined as follows:

Clear Span. This is the distance between the faces of any support. It is generally the one easiest to measure and read from the drawings

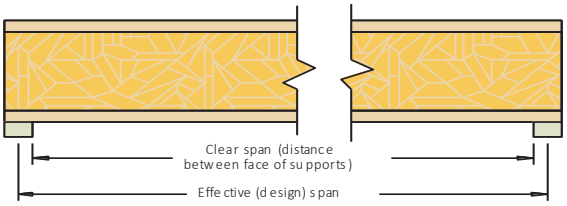
Nominal span/centre-line span. This is the distance between the centre of the supports. This span is used to determine bending moments and deflections for continuous spaning members

Design span/Effective span. This is the span used for single span members to determine the bending moment, the slenderness of bending members and the deflections. In AS 1720.1 this is the dimension referred to as "L", and is defined below.

Design span/effective span is the distance between -

- The centre of the bearing at each end of a beam where the bearing lengths have NOT been conservatively sized
- The centre of notional bearing that have been sized appropriately, where the size of the bearing IS conservative.

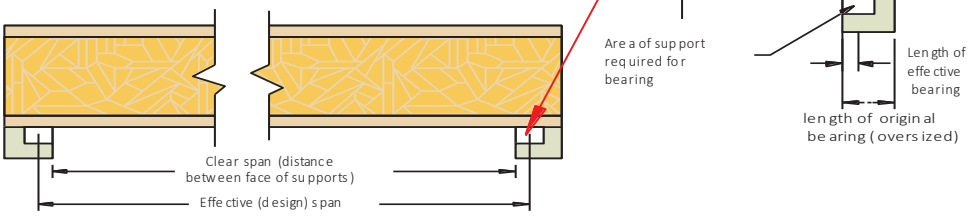
Diagram (a) shows beam where bearings have been designed appropriately. The effective span is taken as the distance between the centre of each bearing area



(a)

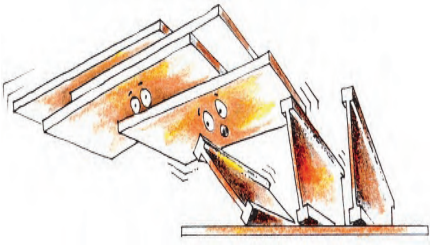
Diagram (b) shows beam where bearings at each end have been oversized. (This is frequently the case for beams that bear onto brickwork or concrete walls where the thickness of the wall is in excess of the area required to give the beam bearing capacity). To find the correct effective span:

1. Calculate the minimum bearing required to carry the loads satisfactorily
2. Add minimum bearing length to "clear span" distance



(b)

Safety Warning



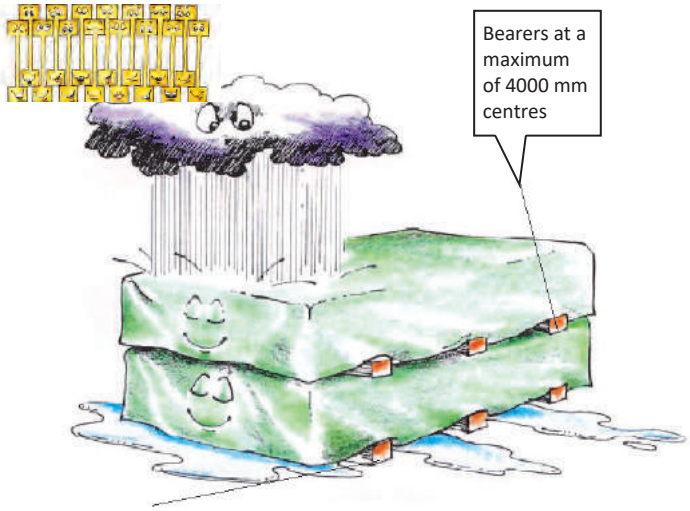
Do not allow workers or loads on SmartJoists until all blocking, hangers, rim joists, nailing and temporary bracing are installed as specified below. Serious accidents or injury can result from failure to follow these guidelines.

Accidents can be avoided under normal conditions by following these guidelines:

1. Brace each joist as it is erected. Joists must be nailed to supports and all hangers, blocking, rim joists. X - bridging at supports must be completely installed and properly nailed. (see general notes and details)
2. Brace the ends of cantilevers (overhangs) with closure panels, rim joist or x - bridging (see general notes and details)
3. Lateral brace the top flange of each joist, to prevent sideways buckling or rollover which may occur under light construction loads, such as a worker and/or a layer of unnailed sheathing. Fully installed permanent sheathing or temporary struts to the top flange of each joist (see 'Typical SmartJoist floor framing') can accomplish lateral bracing. Temporary struts must be nailed to a lateral restraint at the end of bay such as a braced wall or temporary (or permanent) sheathing nailed to the first 1200 mm of the joist at the end of the bay (see 'Typical floor or roof framing')
4. Permanent sheathing must be completely installed and properly nailed before additional loads can be placed on the system
5. **The integrity and safe use of these products can be seriously impaired if they are damaged. Do not install any damaged products. Contact your SmartFrame representative or the Tech Support Customer Helpline on 1300 668 690 if any product damage is noted.**

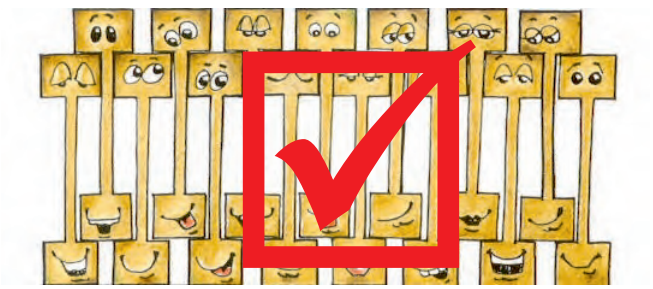
Handling and storage of SmartJoists

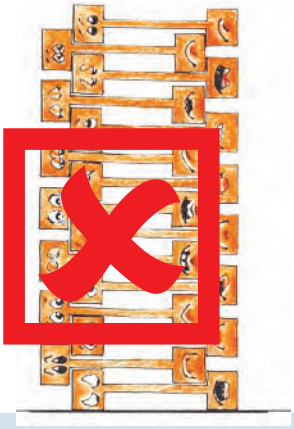
- Store SmartJoists flat on a hard, dry surface
- If surface isn't paved, the ground should be covered with a polythene film
- Keep covered with waterproof material that allows bundles to "breathe"
- Use bearers (bolsters) between the ground and the first bundle (4 metre max spacing)
- Use 100 x 50 timber flat between bundles at same spacing as bolsters
- Take great care to rewrap remaining material after opening bundles
- Wood "grows" in thickness and depth when allowed to get wet....KEEP DRY!
- Wood with high MC has short term reduction in Characteristic Strengths .... KEEP DRY!
- Under NO circumstances are stored SmartJoists to be in contact with the ground.



Use bearers to keep stacked material away from damp surfaces. Align bearer vertically

SmartJoists should be stacked in the upright position to avoid any damage during handling or storage.





Durability and exposure to moisture

SmartJoists are manufactured with Douglas Fir (Oregon) flanges with OSB webs, both having a durability rating of class 4, the equivalent rating as some Ash type Eucalypts. Untreated SmartJoists should therefore not be used where the equilibrium moisture content is likely to remain above 18 % for an extended period.

Untreated SmartJoists are suitable in the ***internal, fully protected, ventilated*** and the ***external above ground, protected*** zones of the structure as shown in appendix B of AS 1684. Untreated SmartJoist is not suitable for ***external above ground, exposed*** or humid indoor conditions, such as swimming pool enclosures.

Moisture effects on SmartJoists

SmartJoist is supplied WITHOUT any short term construction sealer, but once framed into a structure may be exposed to the weather for a limited time (not greater than 3 months) without negative affect, BUT, it may exhibit some effects of this exposure.

The wood fibre in SmartJoists, like all wood products, is hygroscopic, which means it has an affinity for water. The wood fibre in SmartJoist will readily take up and release moisture in response to changes in the local environment. Moisture exposure will lead to dimensional change. While the products will withstand normal exposure, excessive exposure during distribution, storage or construction may lead to dimensional changes that affect serviceability. These changes include twisting, bowing or expansion to dimensions to beyond the specified tolerance of the product in the "as-manufactured" condition.

As an organic material, mould and mildew may grow on untreated wood products if moisture is present. Prolonged periods of high moisture may also support the growth of wood decay fungi, which is another reason to follow proper methods of storage and handling of SmartJoists.

The table below shows the moisture content of SmartJoists as a function of humidity.

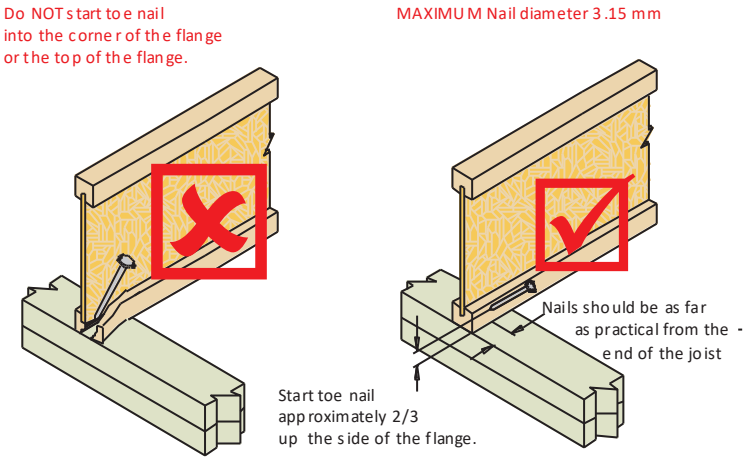
Moisture content of wood products %[1]		
Relative Humidity %	**LVL Flange MC**	**OSB web**
10	1.2	0.8
20	2.8	1.0
30	4.6	2.0
40	5.8	3.6
50	7.0	5.2
60	8.4	6.3
70	11.1	8.9
80	15.3	13.1
90	19.4	17.2

(1). Approximate moisture content at 21^{0}C

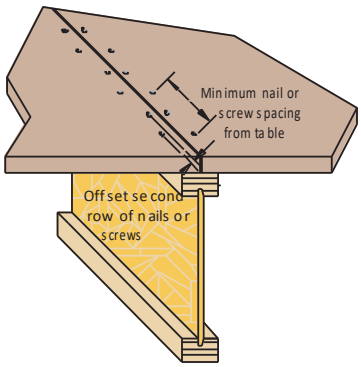
Wetting during construction may lead to temporary elevated moisture content and dimensional changes. Once covered, the SmartJoists will ultimately dry and re-equilibrate to the ambient humidity conditions, but some expansion or swelling may remain after drying.

SmartJoists - General information

1. Except where otherwise noted, 30 mm minimum bearing is required at joist ends and 42 mm minimum bearing is required at intermediate supports.
2. Nail joists at each bearing with 2 of 3.15 Φ x 65 nails, using one each side placed 30 mm from the end to avoid splitting as per detail below.



3. SmartJoist blocking or SmartRim - face nail to bearing plate with 3.15 Φ x 65 nails at 150 mm centres. Nail rim joist to the end of the top and bottom flange of each SmartJoist with 1 off 3.15 Φ x 65 nail, use 1 off 3.75 Φ x 75 nail top and bottom with joists with 58, 70 or 90 mm wide flanges.
4. 17-21 mm SmartRim - toe nail to bearing plate with 3.15 Φ x 65 nails at 150 centres or 4.5 Φ x 75 nails at 300 centres. Nail rim to the end of the top and bottom flanges of each SmartJoist with 1 3.15 Φ x 65 nails.
5. Sheathing nailing to top flange (Joists must be fully braced before sheathing is nailed or screwe.



Minimum single row fastener spacing into SmartJoist flanges					
Fastener type and size	**SmartJoist flange width**				
	40 mm flange	**44 mm flange**	**51 mm flange**	**58-70 mm flange**	**90 mm flange**
Nails					
2.8 x 60	75	75	50	50	50
3.15 x 60	100	90	75	75	75
Screws					
9g x 45	150	150	75	75	75
10g x 50	150	150	100	75	75

- Do not use nails or screws larger than those shown above when attaching sheathing to flanges of SmartJoists
- Minimum nail spacing is shown above, maximum nail spacing is set by the flooring manufacturer, in absence of manufacturers data, 300 mm centres

SmartJoists - General notes (Cont'd)

- Tighter effective nail spacing may be obtained by offsetting nail rows a minimum of 12 mm and maintaining a 10 mm minimum edge distance.

7. All joists require lateral support at end bearings using blocking or rim material.
8. The top flanges must be kept straight within 10 mm of the true alignment.
9. All roof details are valid to a maximum angle of 35° (as per AS 1684
10. All nails are steel nails complying with AS 2334 - 1980 Steel nails - Metric series. Nail gun nails of similar length and diameter may be substituted for the above provided that they are manufactured with properties equivalent to the nails in the above code.
11. Install all hangers to the manufacturers installation instructions, taking particular attention to the use of the correct nails. Never use clouts or brads.
12. Prescriptive code requirements for mid span blocking of solid timber joists are not applicable to SmartJoists.

Typical SmartJoist floor details

Blocking and lateral restraint

General notes:

SmartJoists designed and constructed as per this Design Guide do not require mid-span blocking. The exception to this is for lightweight subfloors where there is no lining to the underside of the joists. For more information on this topic, see page 3 'ABOUT FLOOR PERFORMANCE'.

Blocking within a structure falls within two (2) quite distinct stages:

Temporary or during construction blocking to prevent roll over of joists before the installation of floor sheeting.

Permanent blocking to provide resistance to racking loads through the floor diaphragm, transfer of vertical wall loads and to provide torsional resistance to the end of the joist.

The provision contained within AS1684 Residential timber-framed construction code dealing with blocking for deep joists, is "during construction" or "temporary" blocking, designed only to prevent the roll over of the deep joists prior to the floor sheeting being attached. This level of blocking can form a part of any overall blocking system, but was never intended to provide the total amount of racking resistance or vertical load transfer requirements within this floor diaphragm.

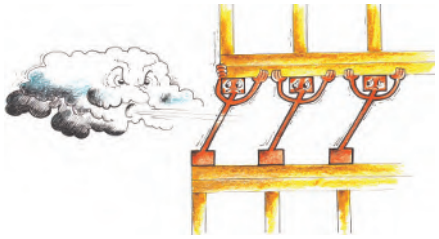
The lateral bracing requirements of the structure, unless there is full blocking of exterior walls, must be calculated in each individual case. Advice on this matter is obtainable from AS1684 Residential timber-framed construction code.

1.0 Joists bearing onto external walls

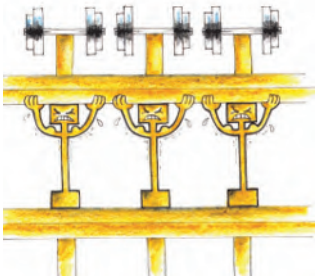
1.1 Loads at joist support connection

The ends of floor joists that bear onto a support experience external loads other than the floor dead and live loads, as shown. Any I-Joist, with it's small cross sectional area, needs to have its end bearing capacity considered as part of the design process.

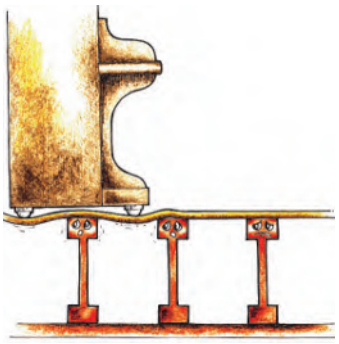
Further, as a holistic approach to the consideration of the lateral stability of the complete structure, it is necessary to consider the availability of racking and shear resistance through the floor diaphragm.



1. Racking and shear effects due to wind and earthquake loads



2. Vertical loads on joists due to upper wall, floors and roof



3. Unsightly deflections in the edges of unsupported sheet flooring may be experienced if heavy items of furniture are placed close to sheet edges.

Typical SmartJoist Floor details (Cont'd)

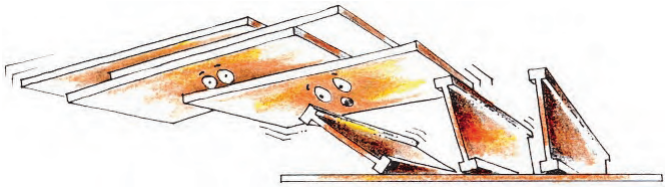
1.2 Stages of blocking/bracing

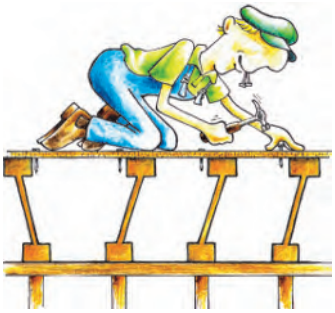
1.2.1 Temporary (during construction) end blocking

Temporary or during construction blocking of the ends of joists over external wall must comply with the requirements as shown in the "SAFETY WARNING" on page 6 and as shown in the "TYPICAL SmartJoist FLOOR FRAMING" diagram on page 14.

This is summarised as:

- Temporary struts, fastened to top of SmartJoist, connected back to braced supports.
- Temporary floor sheeting nailed to the first 1200 mm of joists at the end of the bay, in combination with struts, if no connection to a braced wall can be made.



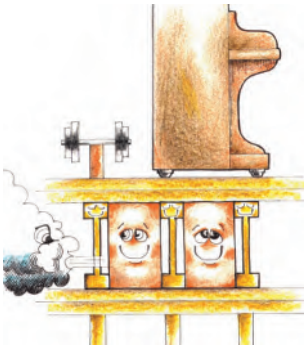


1.2.2 Permanent end blocking/bracing

Permanent blocking (bracing) to be effective in providing adequate transfer of racking and shear loads through the floor diaphragm must comply with the details as shown in "TYPICAL SmartJoist FRAMING" diagram on page 17. In essence, fully block the ends of all joists at their bearing point on external walls, as per one of the options shown in details F1- F4.

This permanent blocking/bracing provides:

1. A satisfactory mechanism to transfer racking loads through the floor diaphragm.
2. Vertical load transfer independent of the floor joist.
3. Support to the end of the floor sheeting (Platform floors only). Heavily loaded furniture legs have been known to cause large deflections and even failures at the edges of sheet flooring.
4. Torsional restraint to the end of floor joists, improving the joists structural performance.



2.0 Interior supports

2.1 Ends of simple spans

Where SmartJoists are discontinuous over interior supports, install the temporary strut bracing as per "SAFETY WARNING" on page 8.

2.2 Continuous spans

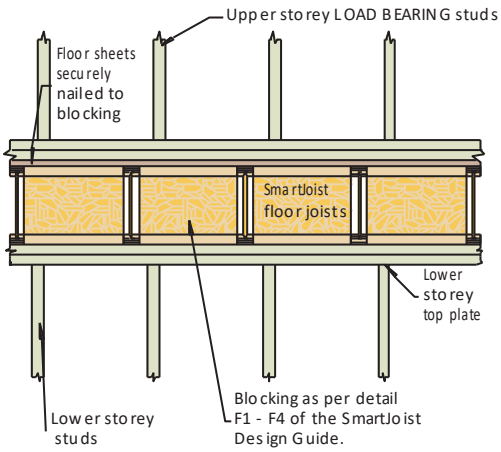
Continuous joists over internal supports do not require blocking, other than the temporary top flange struts as shown in the "SAFETY WARNING" on page 8, except in the following circumstances:

- Load bearing walls bear onto the joists at their support. (Details F7 or F8 apply)
- Shear resistance is required in internal walls (This is a function of shear resistance, and is not related to the structural adequacy of the joist itself.)

3.0 Blocking and wall plates

Wall plates in the frame are required to transfer vertical loads into the support structure below. These wall plates may be supported at 450 or 600 mm ctrs, thus acting as a beam between supports, bending about its weaker axis. When concentrated loads act at the centre of this wall plate, the bending and deflection effects can be quite significant. The full blocking of external and load bearing walls, as shown in details F1-F4, can act as a beam transferring these loads to the support structure below, thus reducing the beam effect of the wall plates.

Unless there is a requirement for double wall plates for a reason OTHER than the beam effect between supports, walls blocked as per detail F1-F4 and general notes #2, #3, and #4 provide sufficient beam action to allow single wall plates.



SmartJoist/SmartRim® Characteristic blocking capacities

SmartRim®

SmartRim rimboard is an alternative solution to blocking with SmartJoists (either long length of cut to length) to support vertical and lateral wall loads as part of a floor or roof framing system.

SmartRim is a 19 or 21 mm LVL (2 veneers are cross laminated for stability) and is sold in 3.6 m lengths, precision ripped to match the height of the SmartJoist range up to and including 360 mm. (400 mm SmartRim in QLD only). Fixing of rimboard is described in detail in SmartJoist—GENERAL NOTES item 3 on page 8 of this Design Guide.

SmartRim has a joint strength group of JD4 on the wide face for nails, screws and bolts.

SmartJoist/SmartRim Characteristic capacity (see notes below)		
Vertical load capacity (kN/m) (1) (2)		Horizontal load transfer capacity (kN/m) (3) (4)
SmartJoist	SmartRim	6.9
29	21	6.9

1. Vertical load capacity above is for instantaneous load conditions and must be multiplied by the appropriate k_1 factor for load condition under consideration
2. Vertical load capacity above already includes the k_{12} factor for up to 400 mm depth as per clause I2.3 of AS 1720.1
3. Horizontal load capacity above is an instantaneous load condition, with the k_1 for lateral bracing loads usually 1.0
4. The above horizontal load capacity is limited by the fixing of the SmartJoist / SmartRim to the frame and can ONLY be achieve if the fixing detail on page 8 of this SmartJoist Design Guide is strictly adhered to.

Penetrations within SmartJoist and SmartRim blocking

The maximum allowable hole size for a SmartJoist/SmartRim shall be ⅔ of the rim board depth as shown below.

The length of the SmartJoist/SmartRim segment containing a hole shall be at least 8 times the hole size.

SmartJoist hole sizes and corresponding minimum length		
SmartJoist/SmartRim Depth (mm)	Maximum allowable hole size (a) (b) (mm)	Minimum length of SmartJoist/SmartRim board segment (c) for the maximum allowable hole size (mm)
200	130	1050
240	160	1280
300	200	1600
360	235	1900
400	265	2100

(a) These hole provisions do not apply to SmartJoist/SmartRim installed over openings such as doors or windows
(b) The diameter of the round hole or the longer dimension of the rectangular hole
(c) The lengths of the SmartJoist/SmartRim segment per wall line. For multiple holes, the minimum length of SmartJoist/SmartRim segment shall be 8 times the sum of all hole sizes

Application Notes

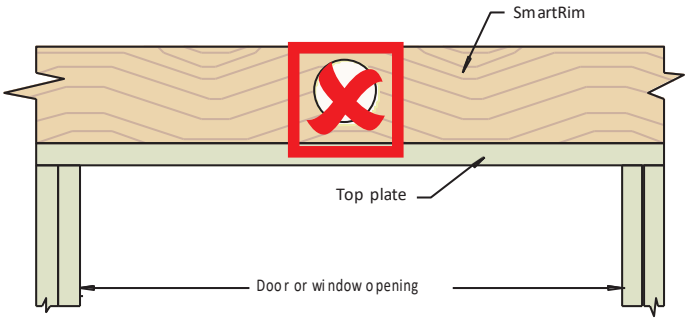
1. Do not cut holes in SmartRim installed over openings, such as doors or windows, where the SmartRim is not fully supported, except that holes of 40 mm or less in size are permitted provided they are positioned at the middle depth and in the middle ⅓ of the span (see note 5 for minimum hole spacing).

2. Field-cut holes should be vertically centred in SmartRim and at least one hole diameter or 150 mm whichever is less, clear distance away from the end of the wall line. Holes should never be placed such that they interfere with the attachment of the rim board to the ends of the floor joist, or any other code-required nailing.

3. While round holes are preferred, rectangular holes may be used providing the corners are not over-cut. Slightly rounding corners or pre-drilled corners with a 25 mm diameter bit is recommended.

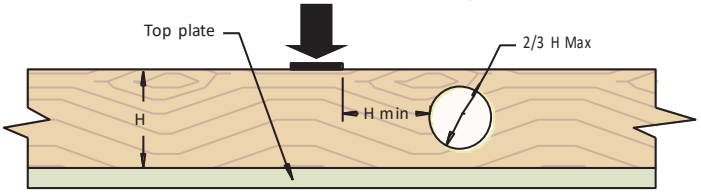
SmartRim over an opening

Do not cut holes in SmartRim over an opening except for holes of 40 mm or less in size (see note 1).



SmartJoist/SmartRim near concentrated vertical load

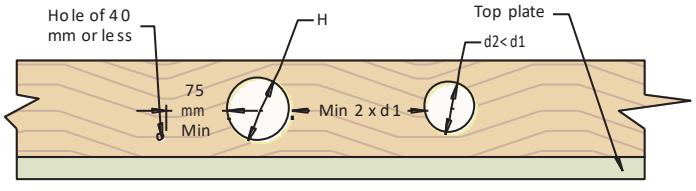
4. When concentrated loads are present on the SmartJoist/SmartRim (loads not supported by any other vertical-load-carrying members such as squash blocks), holes should not be placed in the SmartJoist/SmartRim within a distance equal to the depth of the SmartJoist/SmartRim from the area of loading.



5. For multiple holes, the clear spacing between holes shall be at least two times the diameter of the larger hole, or twice the length of the longest rectangular hole. This minimum hole spacing does not apply to holes of 40 mm or less in diameter, which can be placed anywhere in the rim board (see note 1 for holes over opening) except that the clear distance to the adjacent hole shall be 75 mm minimum.

Multiple holes for SmartJoist/SmartRim

6. All holes shall be cut in a workman-like manner in accordance with the limitations listed above.



SmartJoist hangers

Joist hanger selection

The joist hangers below have been developed specifically for the flange widths for SmartJoists are manufactured using Z275 light-gauge steel, having zinc coating of 275 gsm (total weight). AS1684.2-2010 and AS1684.3-2010-Australian Standards for Residential Timber Frame Construction stipulates a minimum Z275 steel for all sheet metal products used in an internal environment.

Other joist hangers may be used with SmartJoists but it is the responsibility of the specifier of these alternative joists hangers to ensure that:

i. they suit the SmartJoist flange widths and do not require any cutting or packing of the flanges
ii. they are manufacturer from Z275 light-gauge steel
iii. they have the adequate capacity for the anticipated end reaction

Fixing of joist hangers

1. **Hand driven nails -** The joist hangers in the table below are supplied by Tilling Timber as part of a SmartFrame order with the manufacturer recommended nails. All holes are to be filled with the specified nails in order to achieve the stated hanger capacity.
2. **Gun nails** - While the use of gun nails may be common, unless the gun nails are of a minimum 40 x 3.33 diameter, the hanger capacities listed cannot be assumed
3. **Screws -** The equivalent number of 35 x 6 gauge bugle-head or wafer-head wood screws may be used in lieu of the supplied nails. Increased capacities can be achieved by using screws. Advice on the capacities of the joist hangers listed below with screws replacing the nails can be obtained by contacting the Tech Support Customer Helpline on 1300 668 690.

Corrosion protection

The standard range of joist hangers made from Z275 light-gauge steel, having zinc coating of 275 gsm is adequate only for INTERNAL applications in most corrosion environments, except areas that are classified as heavy industrial or those subject to high humidity (e.g. enclosed swimming pools) etc. Under these circumstances, seek advice from experts as special protection will be required.

Note: INTERNAL areas are those within the building envelope that are kept permanently dry. In areas outside the building envelope that are exposed to repeated wetting (EXTERNAL areas), stainless steel products or equivalent should be considered. Some alternatives include hot dip galvanised or powder coated steel, which are not Tilling Timber stock items.

For more detailed information contact the Tech Support Customer Helpline on 1300 668 690 or at techsupport@tilling.com.au.

SmartJoist	Face mount code	Down hanger capacity ΦkN *	No of face nails	Nail size (mm)	Top mount code	Down hanger capacity ΦkN *	No of face nails to support	No of top nails	No of nails to joist	Nail size (mm)
	Single joist face mounts				Single joist top mount					
SJ20044	20044F	6.2	8	3.75 x 40	20044T	5.7	2	6	2	3.75 x 40
SJ24040	24040F	7.8	10	3.75 x 40	24040T	5.7	2	6	2	3.75 x 40
SJ24051	24051F	7.8	10	3.75 x 40	24051T	5.7	2	6	2	3.75 x 40
SJ24070	24070F	7.8	10	3.75 x 40	24070T	5.7	2	6	2	3.75 x 40
SJ24090	24090F	7.8	10	3.75 x 40	24090T	5.7	2	6	2	3.75 x 40
SJ25570	25570F	7.8	10	3.75 X 40	N/A					
SJ30040	30040F	9.3	12	3.75 x 40	30040T	5.7	2	6	2	3.75 x 40
SJ30051	30051F	9.3	12	3.75 x 40	30051T	5.7	2	6	2	3.75 x 40
SJ30070	30070F	9.3	12	3.75 x 40	30070T	5.7	2	6	2	3.75 x 40
SJ30090	30090F	9.3	12	3.75 x 40	30090T	5.7	2	6	2	3.75 x 40
SP30095	30095F	9.3	12	3.75 X 40	N/A					
SJ36058	36058F	10.9	14	3.75 x 40	36058T	5.7	2	6	2	3.75 x 40
SJ36090	36090F	10.9	14	3.75 x 40	36090T	5.7	2	6	2	3.75 x 40
SJ40090	40090F	10.9	14	3.75 x 40	40090T	5.7	2	6	2	3.75 x 40
	Double joist face mounts				Double joist top mounts					
2/SJ20044	20044DF	6.2	8	3.75 x 40	N/A					
2/SJ24040	N/A				24040DT					
2/SJ24051	24051DF	6.2	8	3.75 x 40	24051DT	5.7	2	2	6	3.75 x 40
2/SJ24070	24070DF	7.8	10	3.75 x 40	24070DT	5.7	2	2	6	3.75 x 40
2/SJ24090	24090DF	7.8	10	3.75x40	Pryda BBT	15		3(1)	2	3.75 x 40
2/SJ25570	N/A				N/A					
2/SJ30040	N/A				N/A					
2/SJ30051	30051DF(2)	6.2	8	3.75 x 40	30051DT	5.7	2	2	4	3.75 x 40
2/SJ30070	30070DF	9.3	12	3.75 x 40	30070DT	5.7	2	2	4	3.75 x 40
2/SJ30090	30090DF(2)	7.8	10	3.75 x 40	Pryda BBT	15		3(1)	2	3.75 x 40
2/SP30095	N/A				N/A					
2/SJ36058	N/A				36058DT	4.8	2	4	2	3.75 x 40
2/SJ36090	N/A				Pryda BBT	15		3(1)	2	3.75 x 40

(1) M10 x 75 mm gal coach screws or 75 x 3.75 mm flat head nails or a combination of both (2) Requires web stiffeners see detail F13

SmartJoist hangers

Specialised joist hangers

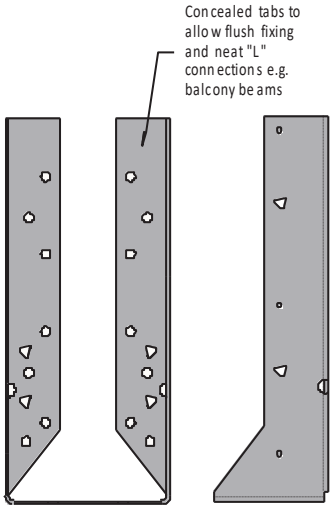
A range of more specialised joist hangers are available from Tilling Timber, some will be stock items and others will have a lead time before they could be supplied.

Specifiers of these more specialised brackets should contact Tilling Timber during the design phase of the project to ascertain:

1. What brackets are available that would best suit the proposed application
2. The lead time before selected joist hangers could be supplied
3. Whether SmartFrame engineers are required to design individual member connections

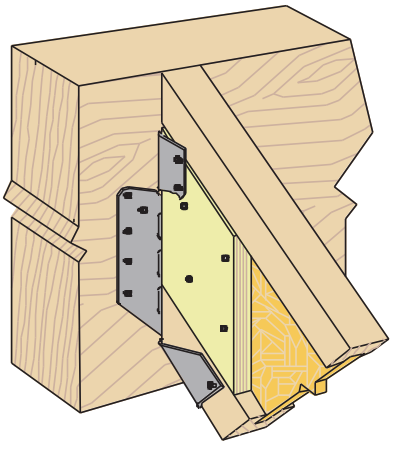
Example specialised brackets/connectors

Internal Flange Hangers - A range of internal flange hanger is available to suit 'L' shape connections and the edge joist in SmartJoist cassette floors



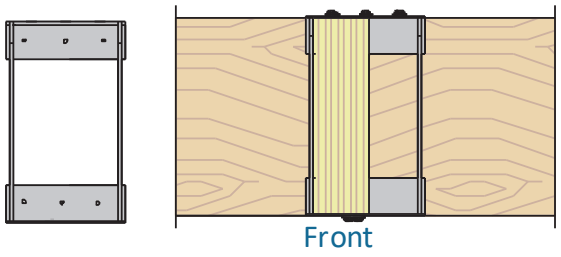
SmartJoist rafter brackets - Access is available to a range of rafter brackets especially designed to make use of the exceptional strength to weight ratio of SmartJoists and apply it to roof member applications. Rafter brackets available include:

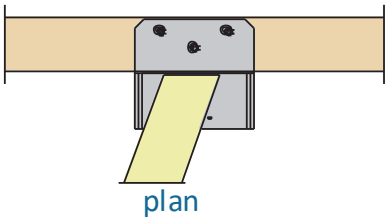
1. Variable slope rafter connectors
2. Variable slope and skew rafter connectors
3. Variable ridge connectors



Heavy duty roof beam supports - Tilling Timber has access to a range of heavy duty support brackets for all applications including brackets especially designed to cater for supported beam at a wide range of angles.

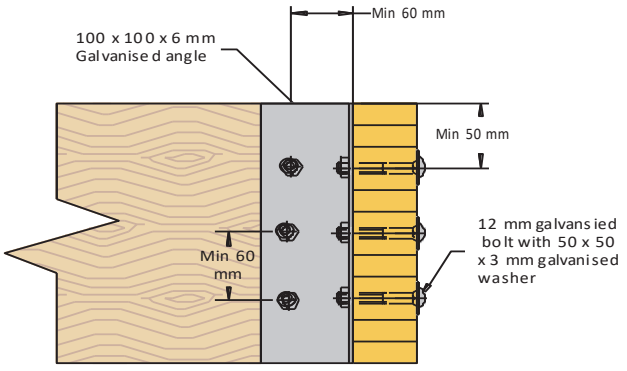
An example is the Pryda® BBT125240 shown below





Individual designs - There are occasions where a generic off the shelf bracket is available for a particular application.

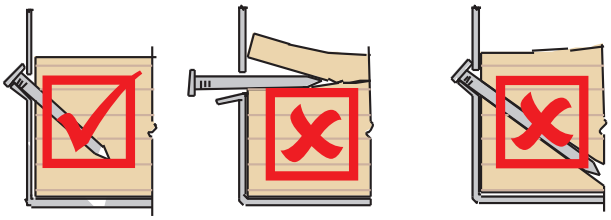
In certain circumstances, SmartFrame engineers may be available to provide individual designs on a fee for service basis for users of SmartFrame product. (conditions apply)



For more detailed information contact the Tech Support Customer Helpline on 1300 668 690 or at techsupport@tilling.com.au.

General connector installation details

Positive angle nailing

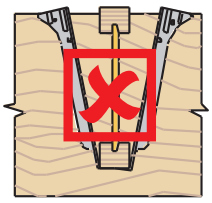


Correct nailing

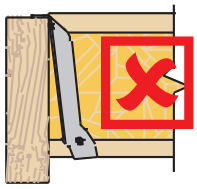
Nail at wrong angle

Nail too long

Top mount hangers



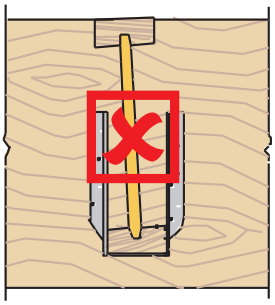
Hanger overspread
If hanger is overspread, I-Joist may be raised above header, also, NO support for top flange.



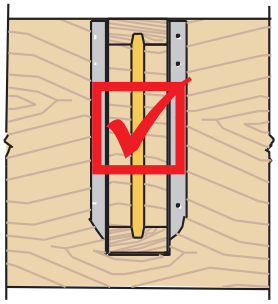
Hanger not plumb
A hanger kicked out from the header can cause uneven surfaces.

Prevent rotation

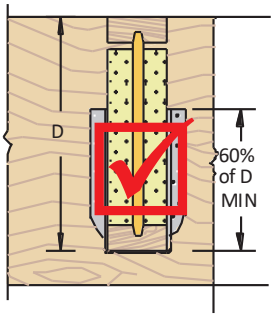
Hangers provide some joist rotation resistance; however, additional lateral restraint may be required for deep joists.



No web resistance
Results in rotation



No web stiffener required
Hanger side flange supports joist top flange.



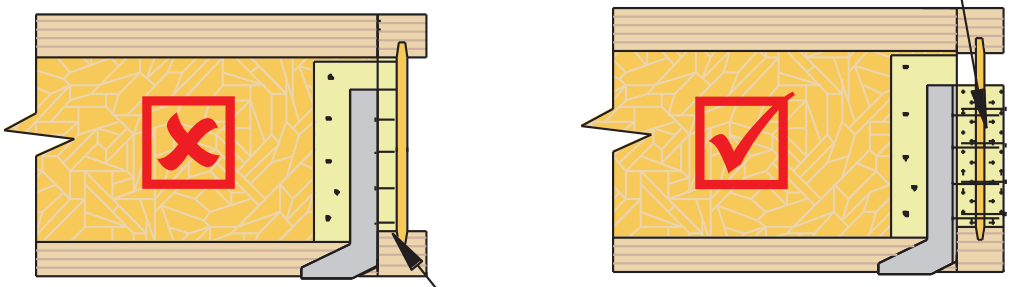
Web stiffener required
Hanger side flange should be at least 60% of joist depth or potential joist rotation must be addressed.

Correct fasteners

Bracket capacities are based upon using the correct bracket nail as per the table on page 11. Bracket nails have special heads to provide strength. Clouts, brads etc. are NOT suitable as bracket nails

SmartJoist headers

Backer blocking each side, hanger nails must extend past the supporting joist's web member into the backer blocking.

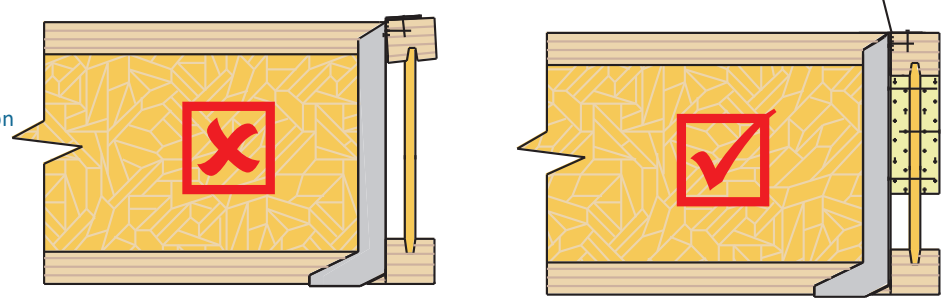


Face mount connection to web

Bottom flange pulling off when Backer block on one side only.

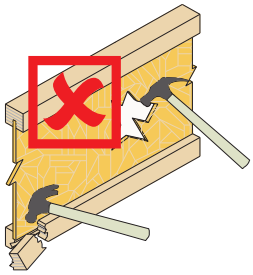
The top flange of the supporting joist must be supported by backer blocks to prevent cross grain bending and rotation.

Top mount connection

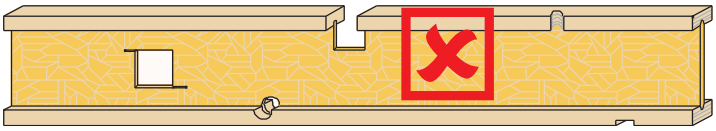


Field repair to damaged SmartJoists

Don' make holes with a hammer other than tapping out pre-punched knockouts



Don't hammer on flanges and damage joist



Do not cut or notch flanges
Do not overcut holes in web

SmartJoists are sophisticated Engineered Timber products, and must be treated accordingly. Damage to key components, while affecting only a small percentage of the cross section may be sufficient to render the SmartJoist unsuitable for the purpose.
It is therefore recommended that damage to joists and the possibility of repair be referred to the Tech Support Customer Helpline on 1300 668 690 or at techsupport@tilling.com.au for advice.

Flange damage

- Flange damage becomes more critical the nearer it is to mid-span or an interior support. Flange damage is less critical in close proximity to an end support.
- How much flange damage is acceptable? A rule of thumb is "If you have to ask, it's too much". A saw kerf that knicks the corner of a flange on one lightly-loaded joist could well be acceptable.
- A joist with unacceptable flange damage cannot be repaired, rather a new joist must be added to take it's place. The damaged joist does not have to be removed. Consult SmartJoist and SmartLVL tables to find an acceptable new joist that is shallower than the damaged joist so installation is easier. Consider double and triple joists. If the damaged joist is multi-span, the new joist only needs to go across the span(s) where the damage occurs.
- A single damaged joist can sometimes be trimmed off of adjacent undamaged joists (run a calculation within the SmartFrame software).

Web damage

- Web damage becomes more critical the nearer a support. Web damage is less critical near mid-span.
- Web holes can be too big to repair. A flange-to-flange rectangular hole longer than 450 mm located at mid-span probably warrants a new joist. A 150 mm round hole located right by a support probably warrants a new joist. Consult SmartJoist and SmartLVL tables to find an acceptable new joist that is shallower than the damaged joist so installation is easier. Consider double and triple joists. If the damaged joist is multi-span, the new joist only needs to go across the span(s) where the damage occurs.
- A single damaged joist can sometimes be trimmed off of adjacent undamaged joists (run a calculation within the SmartFrame software)
- Damage that could be confidently repaired in a single, isolated joist, might be judged too severe to repair if several, adjacent joists are involved
- If several small holes violate the 2x diameter proximity rule, but would fit inside a single acceptable hole, then the group of small holes is OK
- Hole repairs generally require a reinforcement that covers the full depth of the web and extends at least 300 mm past each side of the hole.

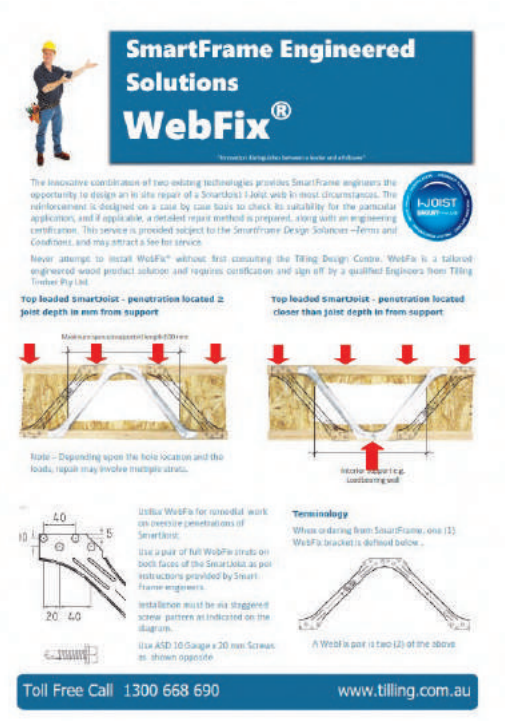
Damage report information required

1. In order to design a repair, the SmartFrame engineer will have to know all of the design information that is required to run SmartFrame software.
2. Provide a sketch of the damage showing it's size, shape and location on the joist.
3. Indicate whether a pipe, duct, conduit, etc. must remain and be accommodated.
4. Indicate how many adjacent joists are affected in each case.

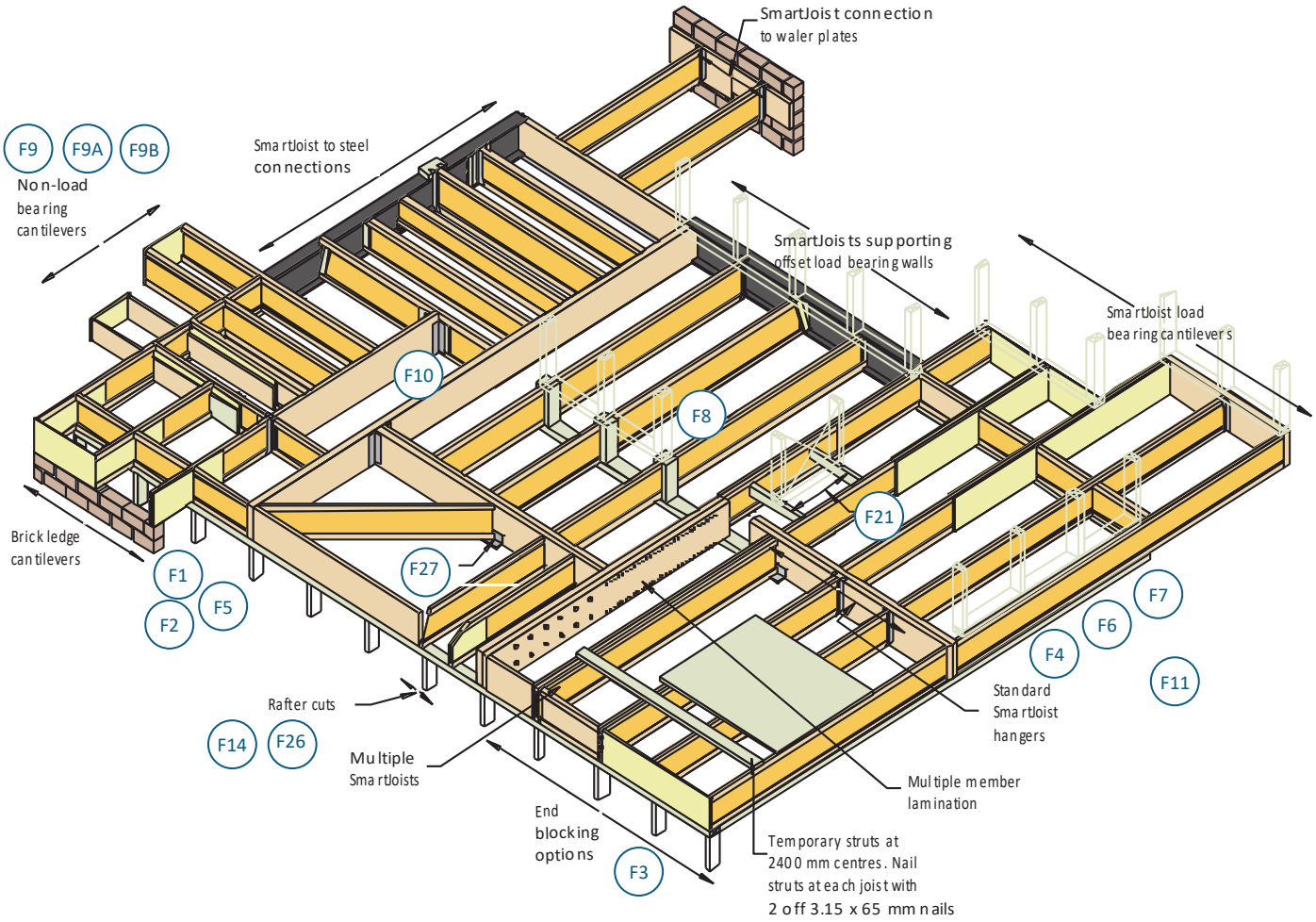
The SmartFrame system now includes the WebFix® (web reinforcement) developed to be a rapid "repair" to webs where penetrations have been placed at inappropriate locations, penetrations too large or other web damage which diminishes the strength of the member. This repair system is unique to SmartJoist applications.

Tilling Timber is the SOLE Australian distributor of this PATENTED system, which in most cases can be fixed around services that have been installed through the web penetrations.

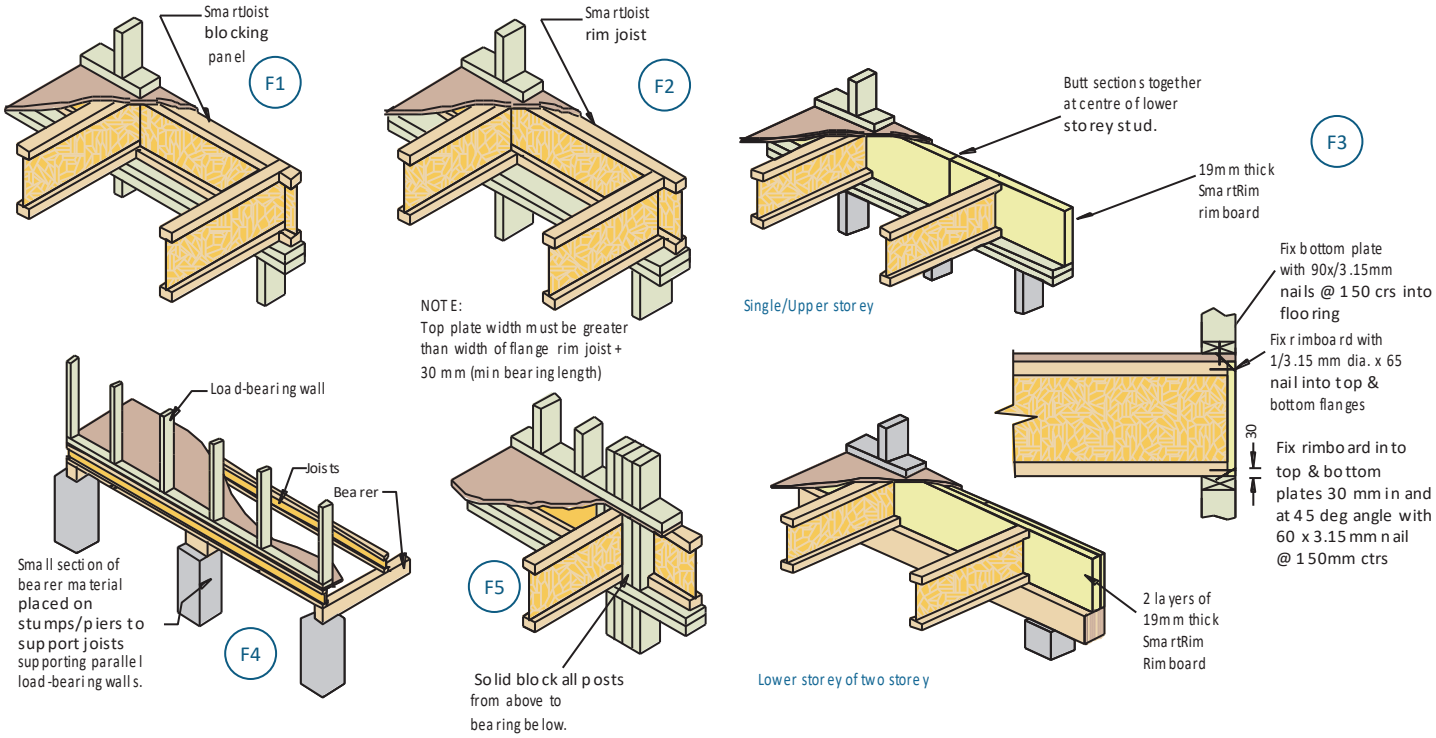
The WebFix® does need to be designed into each situation by SmartFrame engineers and can ONLY be purchased from Tilling offices after the structural design is completed. Where the web damage is not the result of an error or omission by Tilling Timber Pty Ltd, an engineering fee commensurate with the time taken to design the repair will be charged



Typical SmartJoist floor framing



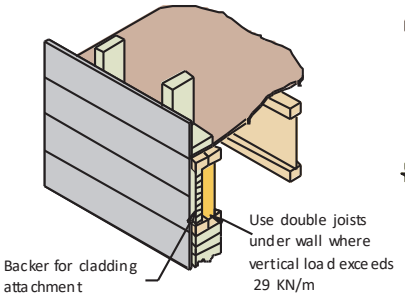
Typical SmartJoist floor construction details

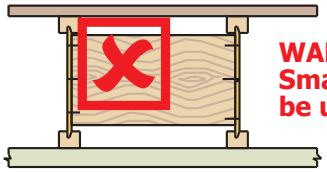


Note:
To achieve the necessary racking resistance through the floor diaphragm, it is important that the nailing provisions of the floor sheeting to the joists as described in AS 1684 (AS 1869 for particle board) be adopted to nail the floor sheeting to the Rim Joist or SmartRim in details F1-F3

Typical SmartJoist floor construction details (cont'd)

F6



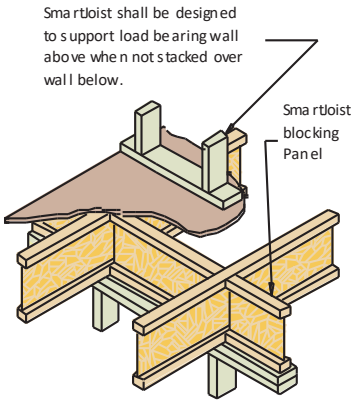


WARNING - Correct blocking for SmartJoists. Green timber shall not be used under any circumstance

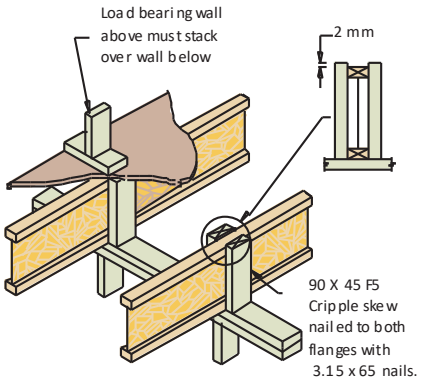
All blocking shall be carried out as per details F1-F3, with blocking to extend to both flanges and skew nailed with 3.15 Φ x 65 nails, one each side of top and bottom flange.

Interior loading bearing and bracing walls

F7



F8



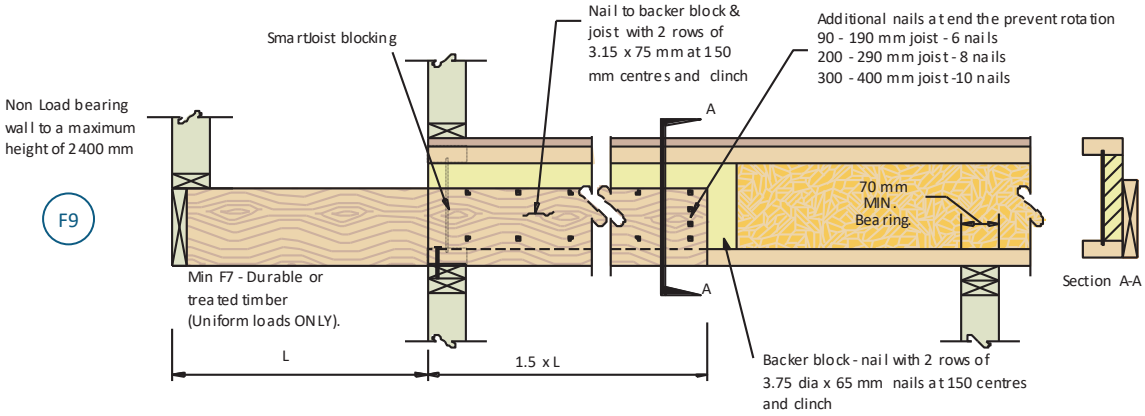
NOTE: Detail F7 with blocking panel is required for bracing walls.

Non load bearing cantilevers (balconies)

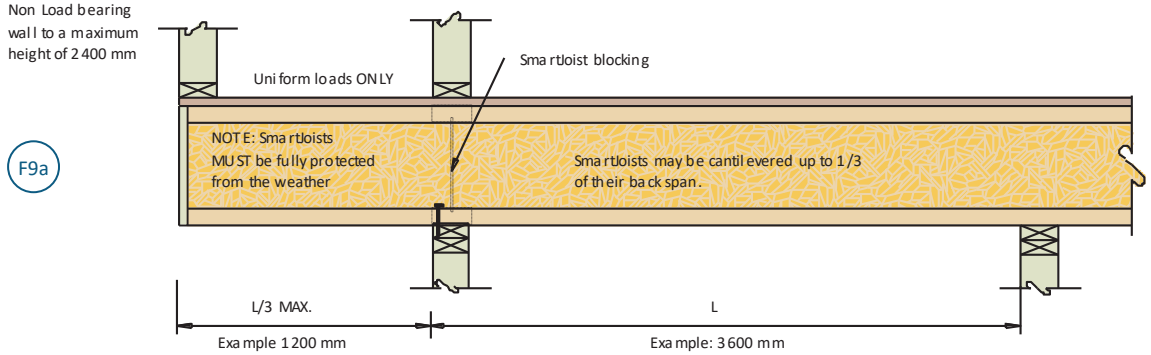
Example cantilever spans and minimum back spans for this detail are shown in the table on the next page

1. Adjacent cantilevers joists

F9



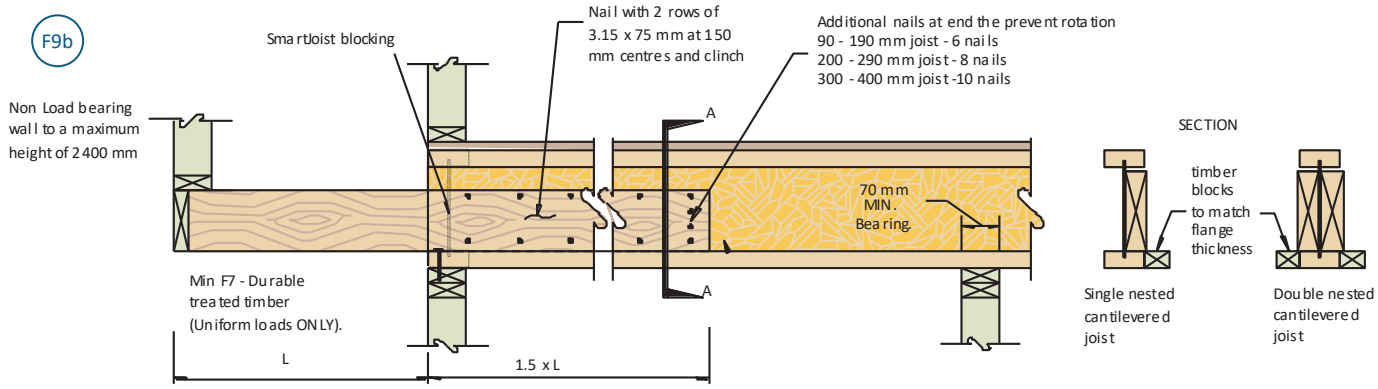
F9a



For cantilevered joists supporting load bearing walls see details C1-C4

Cantilevered balconies

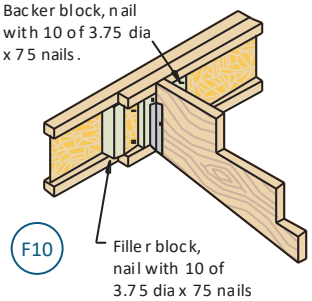
2. Nested cantilevers joists

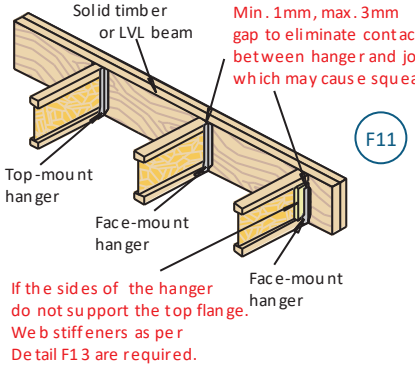


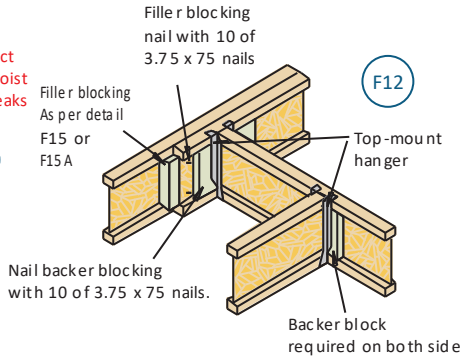
Loadings: Permanent Loading G: self weight + 40 kg/m^2 + 0.6 kPa of live load permanently applied, live load Q: 2.0 kPa or 1.8 kN point live load, 1.5 kN/m acting at end of cantilever

Cantilever material	Joist spacing (mm)	300		400		450		600	
	Cantilever material	Cantilever	Back span	Cantilever	Back span	Cantilever	Back span	Cantilever	Back span
H3 SmartLVL 15	120 x 42	1000	1500	900	1400	900	1400	800	1200
	150 x 42	1300	2000	1200	1800	1100	1700	1000	1500
	170 x 42	1400	2100	1300	2000	1300	2000	1100	1700
	200 x 42	1600	2400	1500	2300	1500	2300	1300	2000
	240 x 42	1900	2900	1800	2700	1700	2600	1600	2400
	300 x 42	2200	3300	2100	3200	2000	3000	1900	2900
	2/120 x 42	1300	2000	1200	1800	1100	1700	1000	1500
	2/150 x 42	1600	2400	1500	2300	1400	2100	1300	2000
	2/170 x 42	1700	2600	1600	2400	1600	2400	1400	2100
	2/200 x 42	2000	3000	1800	2700	1800	2700	1600	2400
	2/240 x 42	2300	3500	2100	3200	2000	3000	1900	2900
	2/300 x 42	2700	4100	2500	3800	2400	3600	2200	3300
H3 MGP 10	120 x 42	900	1400	800	1200	800	1200	700	1100
	140 x 45	1100	1700	1000	1500	900	1400	800	1200
	190 x 45	1400	2100	1300	2000	1300	2000	1100	1700
	240 x 45	1700	2600	1600	2400	1600	2400	1400	2100
	2/120 x 42	1100	1700	1000	1500	1000	1500	900	1400
	2/140 x 45	1300	2000	1200	1800	1200	1800	1100	1700
	2/190 x 45	1700	2600	1600	2400	1600	2400	1400	2100
	2/240 x 45	2100	3200	1900	2900	1900	2900	1700	2600

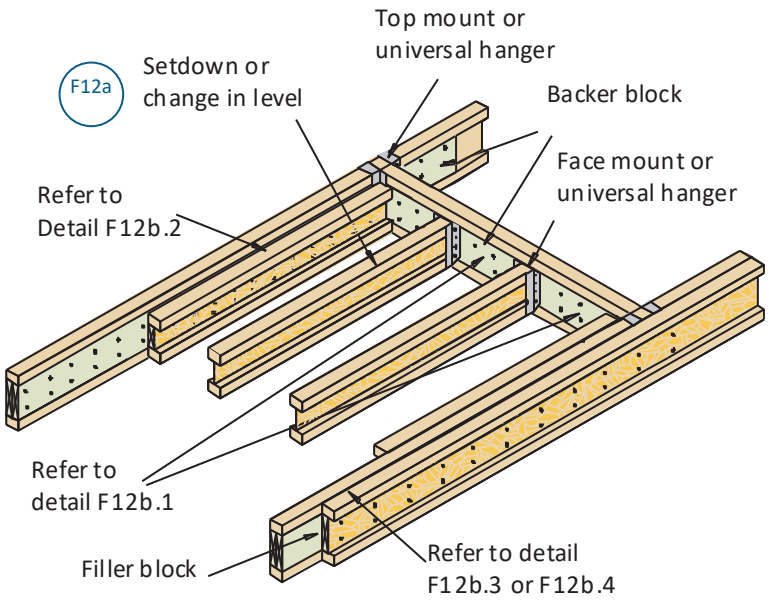
Backer and filler blocks

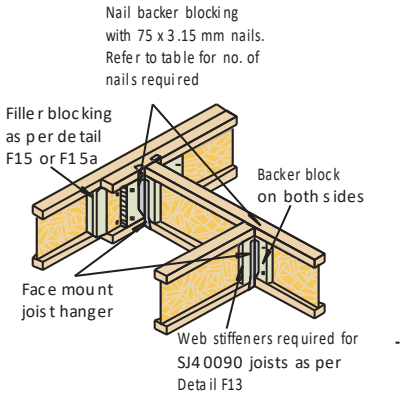






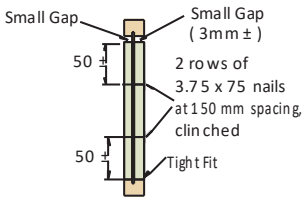
Backer and filler blocks (cont'd)



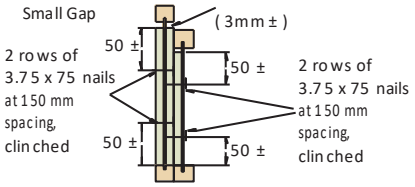


F12c

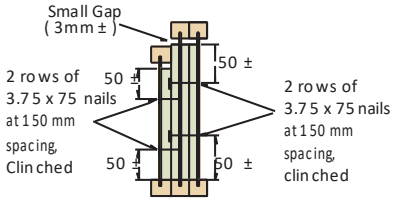
F12b



F12b.1

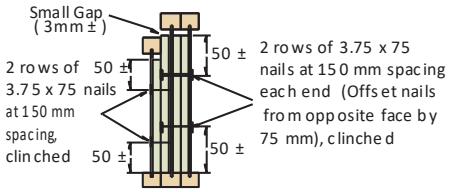


F12b.2



F12b.3

For 2/51mm 2/70mm 2/90mm & 3/SJs with 1/setdown joist attached



F12b.4

For 2/40mm & 2/44mm SJs with 1/setdown joist attached

Recommended filler blocks and web stiffeners

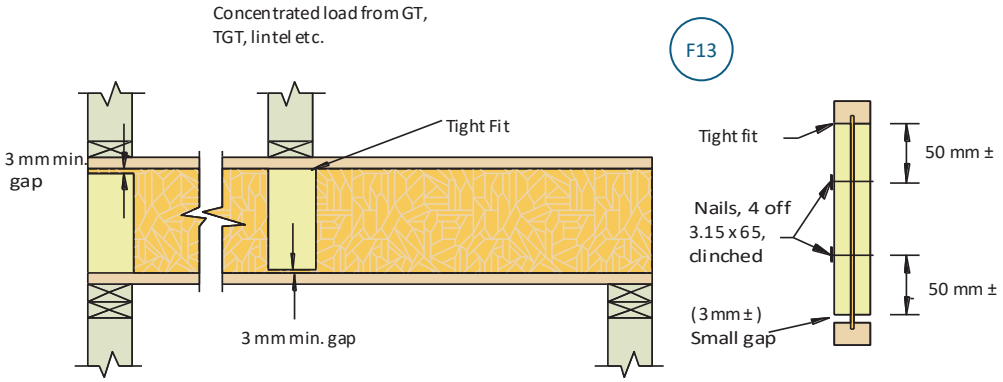
SmartJoist code	Recommended filler block	Web stiffener material	
		stiffener	nails
SJ20044	120 x 35	15 x 60 mm ply	4-3.15 x 65
SJ24040	140 x 35	15 x 60 mm ply	4-3.15 x 65
SJ24051	140 x 45	19 x 60 mm ply	4-3.15 x 65
SJ24070	150 x 58 LVL	2/15 x 60 mm ply	4-3.15 x 65
SJ24090	2/140 x 45	2/19 x 60 mm ply	5-3.15 x 65
SJ25570	170 x 58 LVL	2/15 x 60 mm ply	4-3.15 x 65
SJ30040	190 x 35	15 x 60 mm ply	4-3.15 x 65
SJ30051	190 x 45	19 x 60 mm ply	4-3.15 x 65
SJ30070	150 x 58 LVL	2/15 x 60 mm ply	4-3.15 x 65
SJ30090	2/190 x 42 LVL	2/19 x 60 mm ply	5-3.15 x 65
SP30095	2/190 x 42 LVL	2/21 X 60 mm SmartRim	5-3.15 x 65
SJ36058	250 x 50	2/12 x 60 mm ply	5-3.15 x 65
SJ36090	2/240 x 45	2/19 x 60 mm ply	5-3.15 x 65
SJ40090	2/240 x 45	2/ 19 x 60 mm ply	5-3.15 x 65

NOTES:

1. Use plywood sheathing for web stiffener with face grain parallel to long axis of the stiffener.
2. Filler blocks noted are for the general requirements of the details within this Design Guide.
3. Leave 3 mm gap between top of filler blocks and bottom of top flange.

Concentrated loads on SmartJoists

Web stiffeners under concentrated loads are required as shown below for concentrated loads that exceed 6.5 kN ONLY.



F13

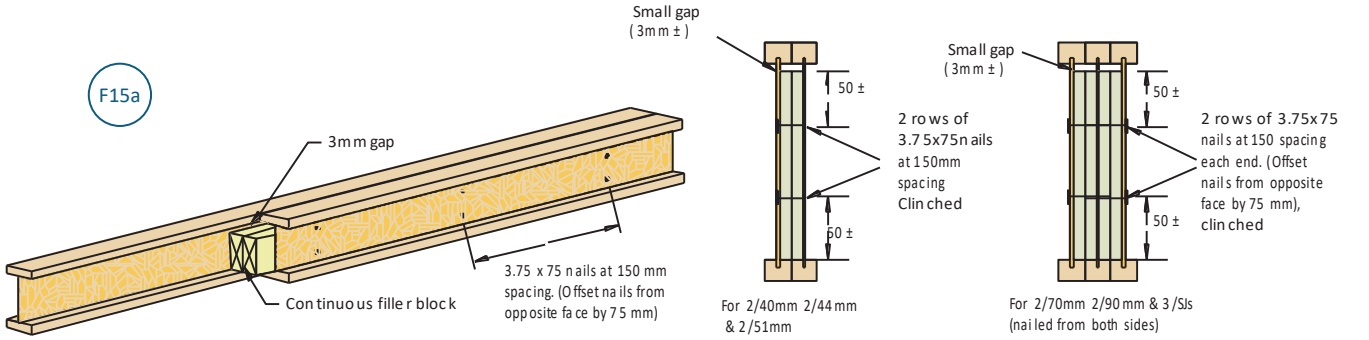
NOTE:

1. Web stiffeners are NOT required at end bearing supports when span length are taken from the SmartJoist Design Guide, except where they are required to prevent rotation if the joist hanger dos not laterally restrain the top flange
2. Web stiffeners may be required at inner supports under concentrated loads. Consult the appropriate tables.

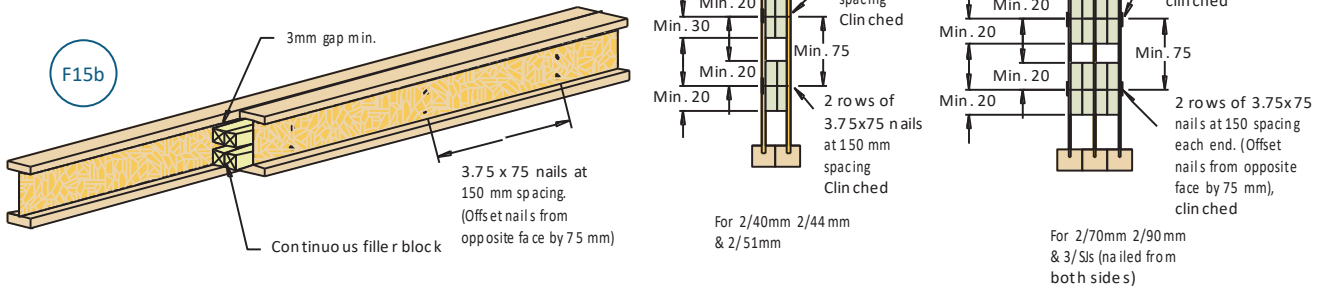
Multiple SmartJoist members

(a) filler blocks

F15a



F15b



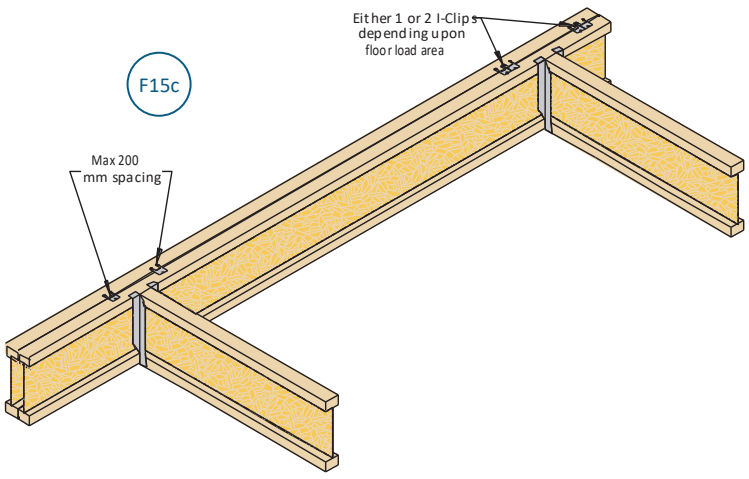
(b) SmartJoist Multi Joist clips (MJC)

The SmartFrame MJC is Australia's first backer and filler free solution to join multiple SmartJoist members

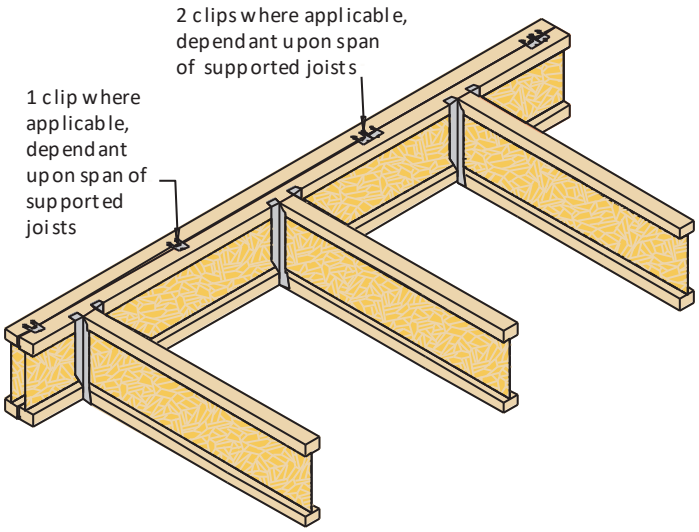
2 ply SmartJoist supporting concentrated loads

SmartJoist Applications - Characteristic Concentrated loads (kN)	
No of MJC's	**Max incoming Concentrated Load**
4	16.4
8	24.6

F15c



(b) SmartJoist MJC (cont'd)



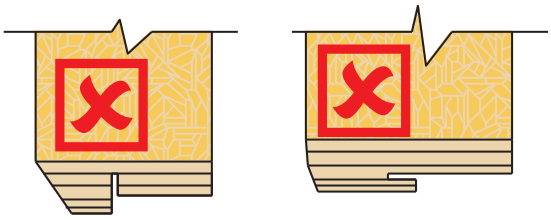
2 ply SmartJoist supporting regular loads

SmartJoist Applications - Characteristic Regular loads (kN)	
No of MJC's	**Max incoming regular Load**
2	8.2
4	12.3

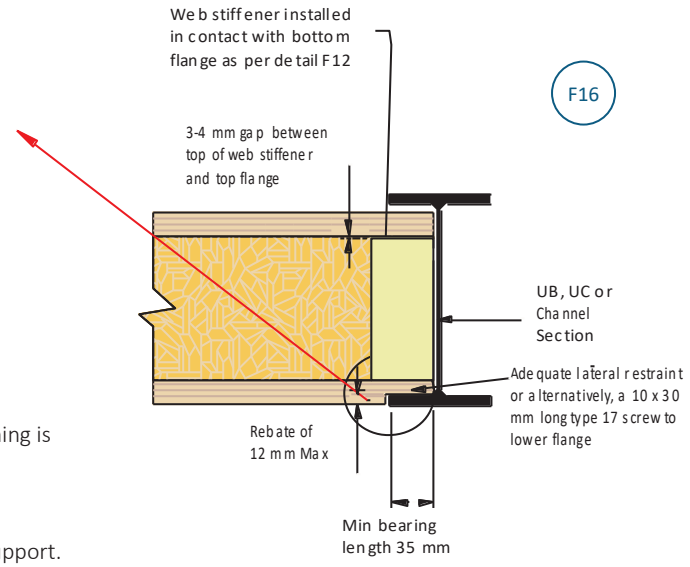
Limited end notching at supports

The cutting of notches in the ends of joists may reduce the allowable end reactions of the SmartJoists. The amended end reaction capacities of SmartJoists with a 12 mm notch are as follows:

- Without web stiffeners - 80% of allowable end reaction
- With added web stiffeners (as per detail F13) - Full end reaction capacity.



Do not over cut flanges. Substantial reductions in capacity may occur if flanges are over cut.

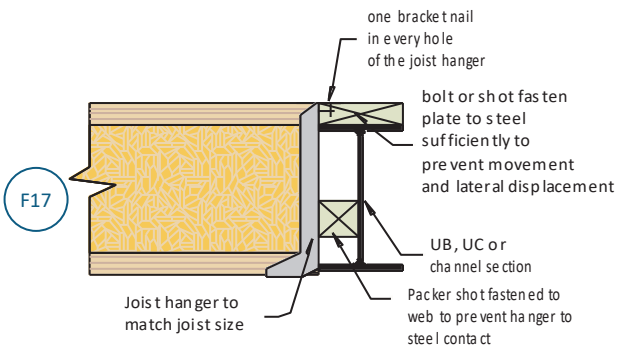


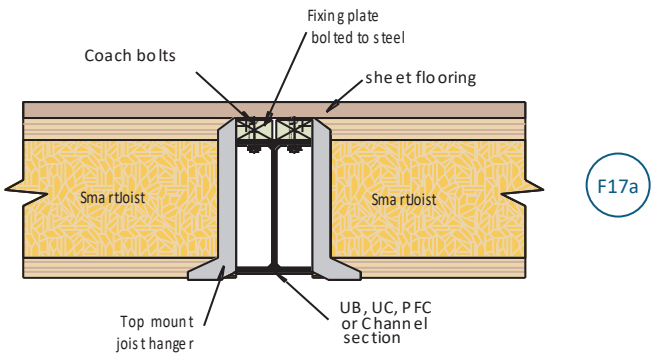
To maintain the end reaction capacities above, end flange notching is strictly limited to:

1. Notch depths NOT greater than 12 mm
2. Notches cleanly cut - NO over cutting
3. Notch length not to exceed more than 5 mm past the support.

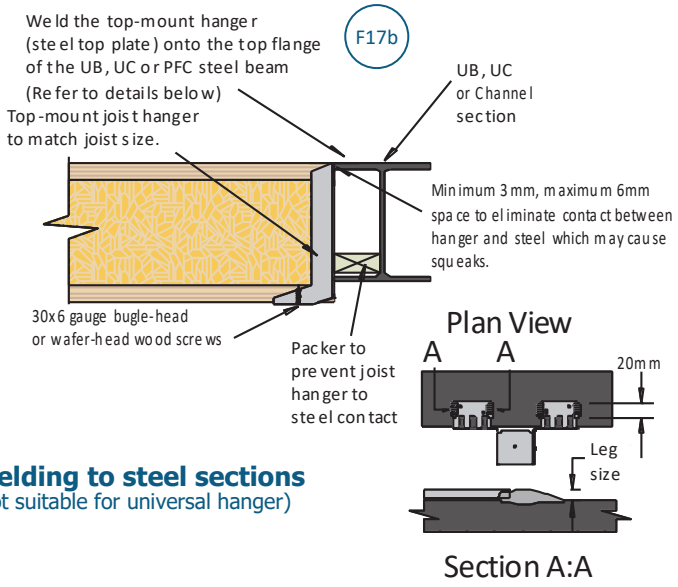
Example fixing of SmartJoists to steel beams

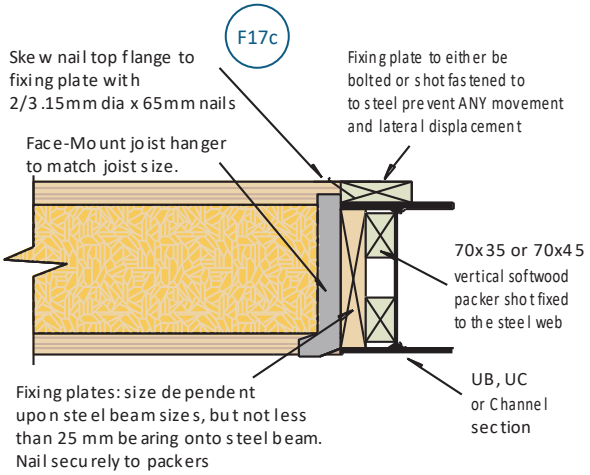
(a) Top mount or universal hangers





Example fixing of SmartJoists to steel beams



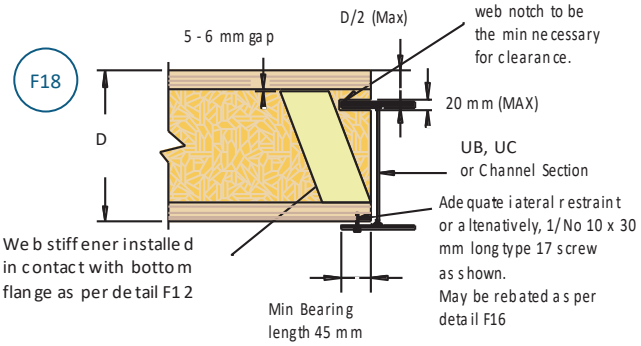


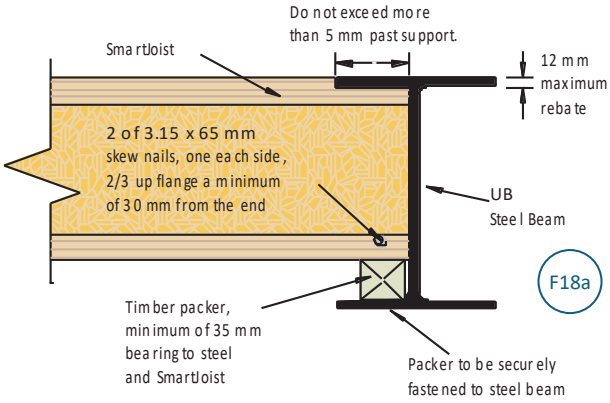
Welding to steel sections
(not suitable for universal hanger)

The welding of top mount SmartJoist hangers to common steel sections (UB, UC etc. must be carried out strictly as follows:

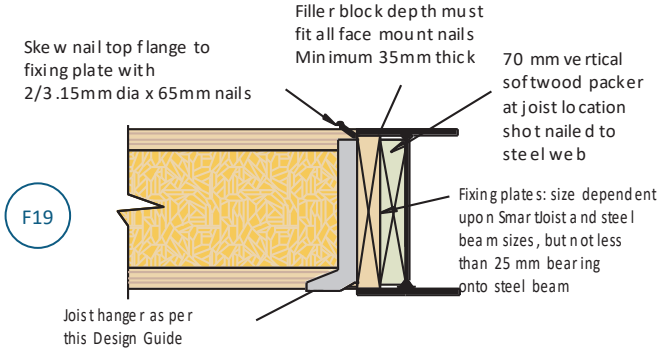
1. Supporting steel section must be thoroughly cleaned to remove black scale, rust, paint etc.
2. Clamp top flange of bracket hard up against steel section
3. Apply fillet weld to lap joint with the minimum weld length of 20 mm with a leg size at least the thickness of the metal hanger (see diagram above)
4. Commence weld pool away from the hanger steel to ensure penetration into supporting steel prior to penetration into hanger tab
5. Finish connections with anti-corrosive paint to achieve appropriate corrosion resistance
6. It is essential that welding is conducted under the guidance of an experienced welder

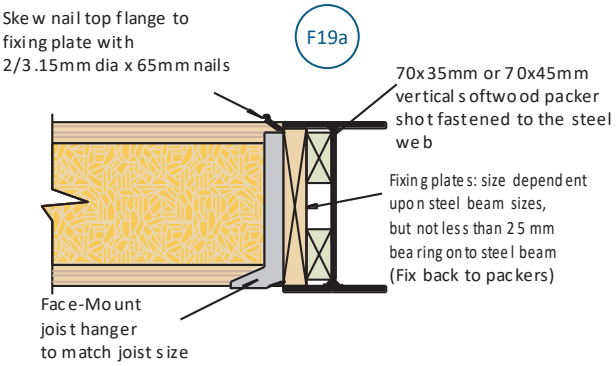
(b) Rebated into steel beam



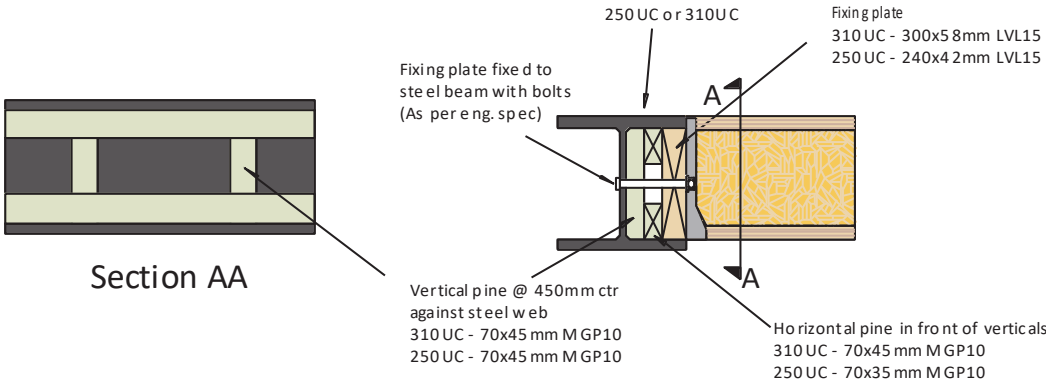


(c) Face mounting to steel



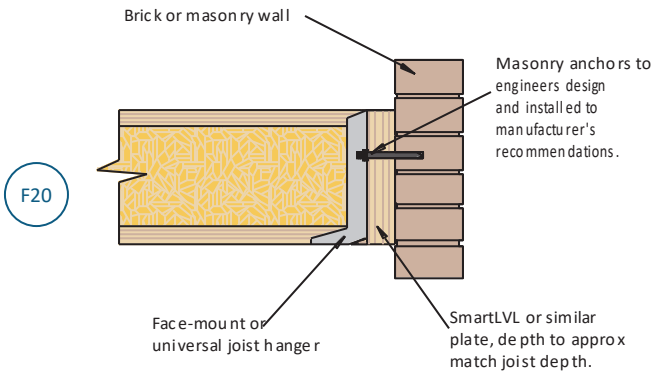


Example fixing of SmartJoists to steel beams (cont'd)

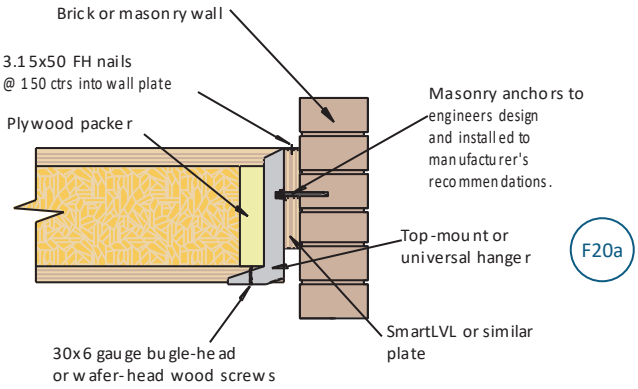


F19b

(c) Fixing to masonry walls



F20



F20a

Tie down and bracing wall support details

The tie-down needs of the structure are related to the applied wind loads and the effect of bracing walls either parallel or perpendicular to the supporting member. Reference should be made to AS 1684 for further guidance on this issue.

Floor systems are integral in the transfer of all vertical and horizontal loads to the footing system. Methods to transfer both uplifts and bracing loads to the floor system will vary dependent upon:

1. Loads are applied into a structural element that is running parallel to the bracing/tie-down panel
2. Loads are applied into a structural element that is running perpendicular to the bracing/tie-down panel

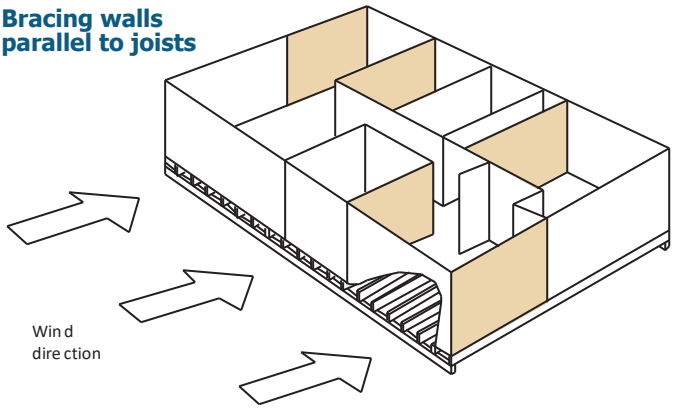
AS 1684 requires bracing to be approximately evenly distributed and provided in both directions as shown below. Care must be taken with tie down to resist bracing loads because the applied load could be either up or down, whereas the wind uplift forces are always vertically up.

Where the bracing walls are parallel to a floor joist, the joist involved must be designed to resist the applied forces imposed, over and above any gravity and normal live loads associated with the floor system

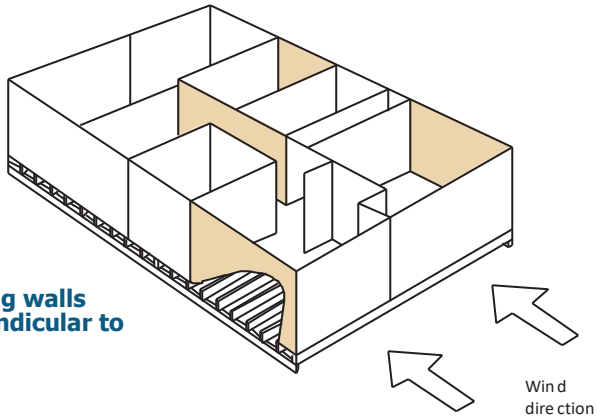
The general details relating to the tie-down provisions of solid end section timber may be adopted for SmartJoists, except that under NO circumstances is it permitted to bolt through either the top or bottom flange, except when the joist is fully supported upon a wall plate or similar as shown below. Care must also be taken to ensure that any bolts etc. drilled through solid timber joists do not compromise the structural integrity of that member.

A conservative solution to bracing walls directly above parallel joists is to adopt a double joist at that location, with the tie down connection bolt running down between the two joists.

Bracing walls parallel to joists



Bracing walls Perpendicular to joists



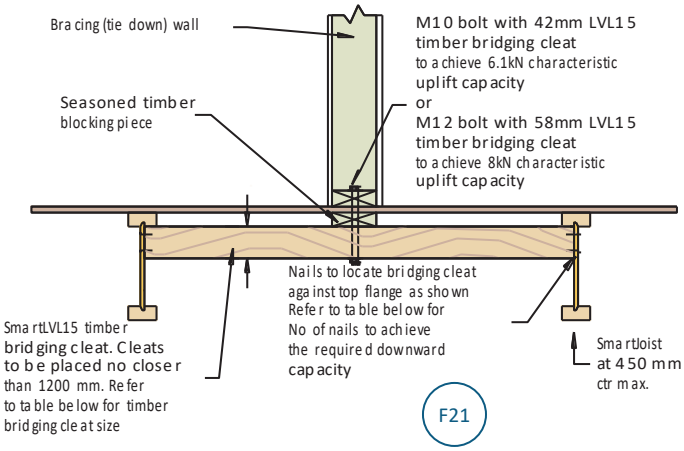
Tie down and bracing wall support details (cont'd)

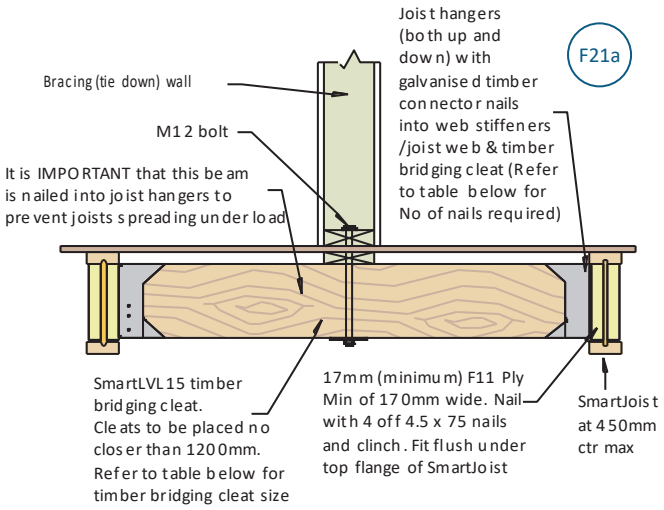
The tie-down and bracing of any structure is or critical importance to its robustness. While some general guidance on this topic is given in AS 1684 sections 8 and 9 including some specific examples, very little information is provided to designers where the bracing or tie down forces act within a floor diaphragm, or how to transfer the design loads specified in table 8.18 to supporting members.

Below are some examples that may be helpful to designers utilising SmartJoist floor joists but these examples must in no way be a substitute for expert engineering advice from an experienced structural engineer.

Any member, especially tall slender sections typical of floor joists experience significant reduction in strength at the location of a vertical hole. Typically a vertical hole is deemed to have an effect of 1.5 times the diameter of the hole.

Bracing walls between parallel joists





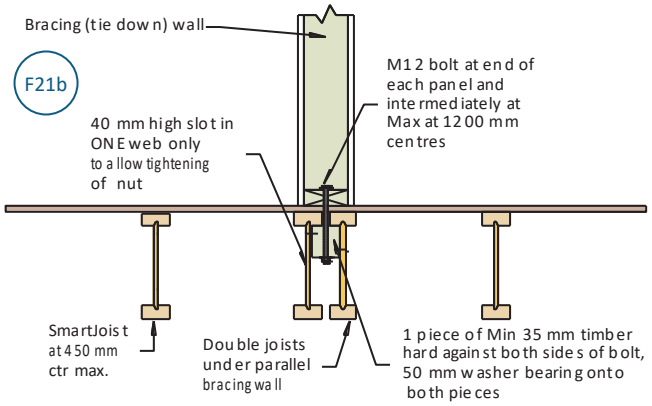
Downward force capacities

Timber bridging size (DxB mm)	No of nails through SmartJoist web to bridging	Characteristic capacity (kN) $1.2G + W_{dn}$
90x42/58 SmartLVL 15	2	4.0
130x42/58 SmartLVL 15	3	4.9
170x42/58 SmartLVL 15	4	5.8

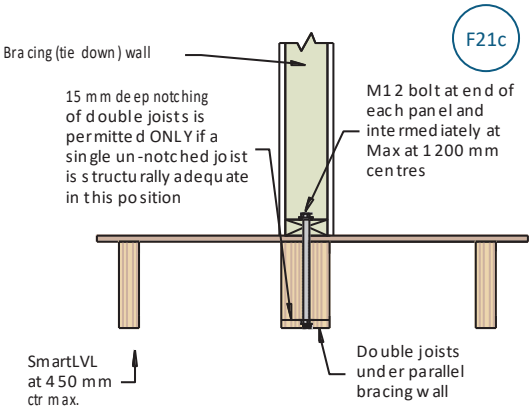
Timber bridging size (DxB mm)	Hanger code	No of hanger nails into joist	No of hanger nails into bridging	Characteristic uplift and downward capacity (kN)
90x58 SmartLVL 15	FB5890	8	4	9.6
130X58 SmartLVL 15	FB58120	12	6	13.6
170X58 SmartLVL15	FB58170	20	10	20.0

Bracing walls vertically above parallel joists

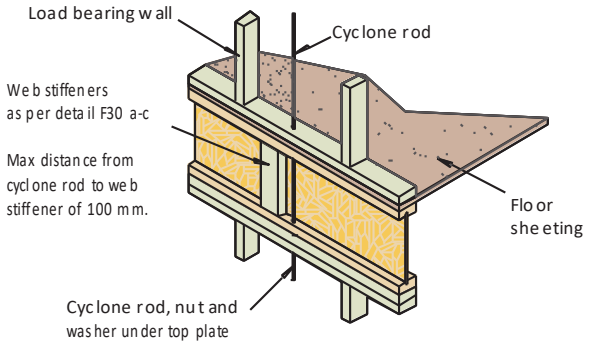
Do not drill through either flange of SmartJoists unless they are fully supported on wall plate or similar



Do not drill through single members unless the whole member is re-analysed with a reduced cross section at the hole location

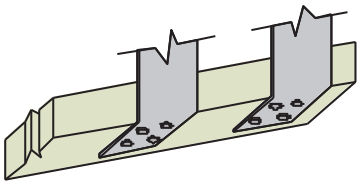


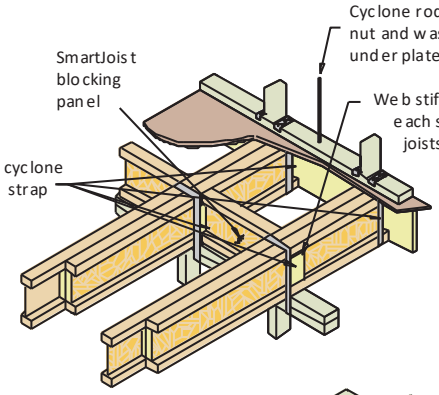
Cyclone rod tie down for cantilevered SmartJoist floors

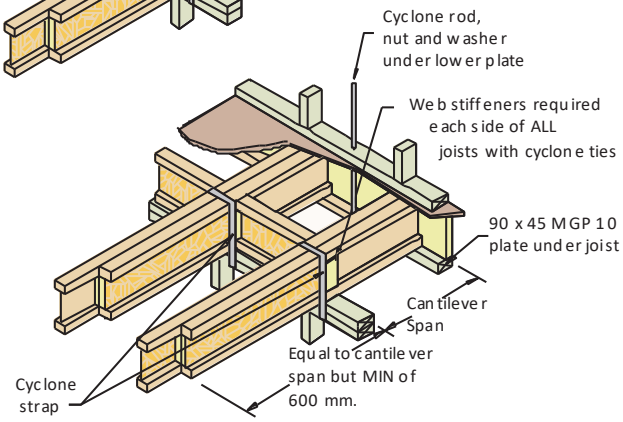


Cyclone strap capacities

Where the strap ends of the cyclone strap are wrapped around the wall plate or other timber member and are fixed with 4 of 3.15 Ø x 35 nails, the design capacity $ØN_j$ of 15.3 kN is applicable, regardless of the timber joint group. Tests have proven that bending the legs of cyclone straps around the timber increases the ultimate load capacity.



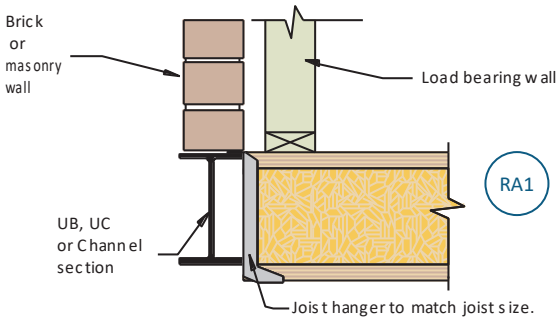


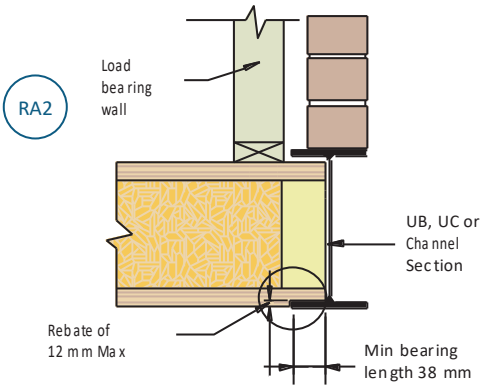


While double joists shown in the above diagram, it is only necessary when loads exceed the capacities of single joist cantilevers.

Joist/beam connections supporting offset load bearing walls

Modern building designs frequently call for the upper storey of a two storey dwelling to be set back from the lower wall to allow sufficient light access to all areas of the building. Provided that the SmartJoists have been designed to support this offset load, no special provisions need to be made for their support EXCEPT in the following support conditions:





Maximum roof area supported (m^2)

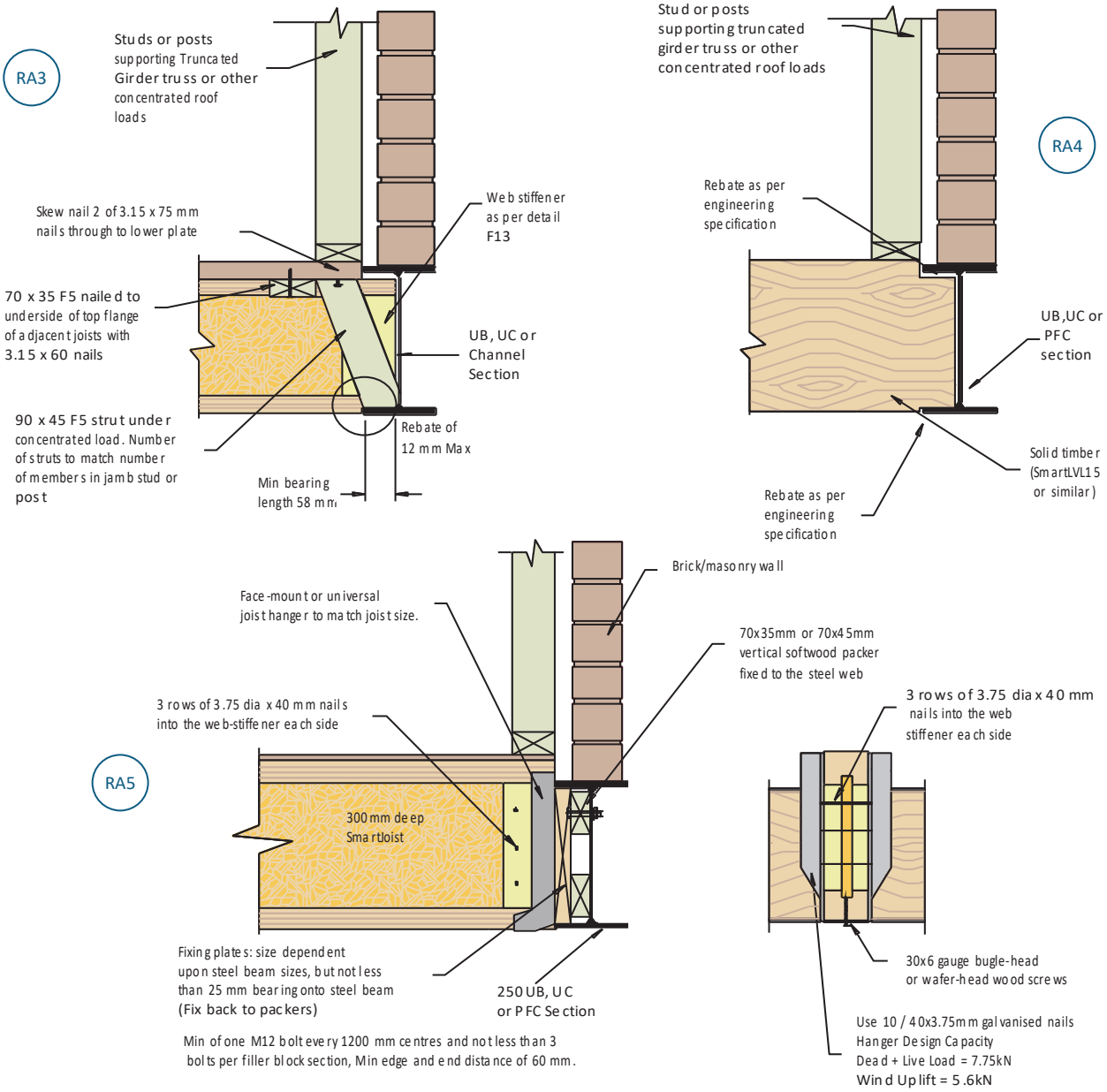
- based upon worst case of 40 mm flange width (conservative for wider flanged joists)

	Joist supported on joist hanger RA1								Lower flange bearing RA2							
Joist spacing (mm)	300	400	450	600	300	400	450	600	300	400	450	600	300	400	450	600
Joist span (mm)	Sheet				Tile				Sheet				Tile			
3500	21.7	15.0	12.8	8.2	9.6	6.7	5.7	3.6	6.9	6.4	6.2	5.3	3.1	2.9	2.8	2.4
4000	21.1	14.5	12.3	6.9	9.4	6.4	5.5	3.1	6.7	6.2	6.0	4.6	3.0	2.8	2.7	2.0
4500	20.5	13.9	11.7	5.7	9.1	6.2	5.2	2.5	6.6	6.0	5.7	3.9	2.9	2.7	2.5	1.7
5000	20.0	13.4	10.4	4.4	8.9	5.9	4.6	2.0	6.4	5.8	5.1	3.1	2.9	2.6	2.3	1.4
5500	19.4	12.1	9.1	3.2	8.6	5.4	4.1	1.4	6.3	5.3	4.6	2.4	2.8	2.4	2.0	1.1

Support for Concentrated loads - Joist/beam connection supporting offset load bearing walls

Concentrated loads from any source such as girder trusses MUST be transferred through the floor space WITHOUT adding extra vertical loads to the ends of the SmartJoist at its bearing support.

Examples of transferring these loads are shown below RA3 involves the use of inclined timber struts as shown in the detail opposite. Struts must be a tight fit and at a minimum angle of 60º to the horizontal. RA4 uses a solid member in lieu of SmartJoist under large concentrated loads. RA5 involves a face fixing to blocked out steel beam.



Beams supporting SmartJoists – Multiple member laminations

Vertical laminations may be achieved by adopting the procedures described in clause 2.3 of AS1684, however these procedures should be considered as the minimum requirements to achieve the desired effect.

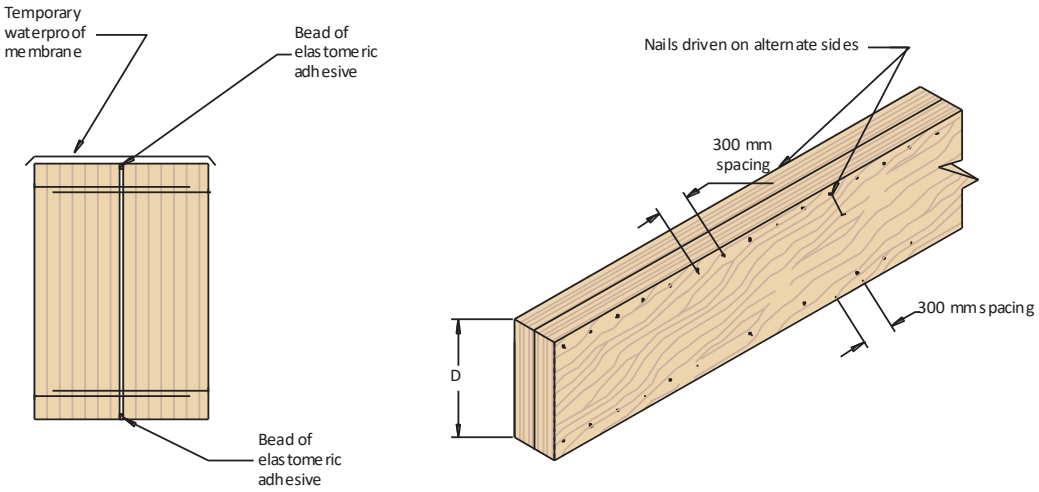
Experience with SmartLVL beams indicates that this degree of fixing may not satisfactorily prevent cupping of individual components as a result of the ingress of moisture between laminates during construction. The suggested method of vertical lamination below provides a greater level of fixity between individual components, and with the use of an elastomeric adhesive, also prevents moisture penetration between the laminates.

Multiple member laminating of top loaded beams (Symmetrical loading)

The edges of the individual sections must be carefully aligned to each other so that the composite beam is flat, allowing the applied loads to be equally shared.

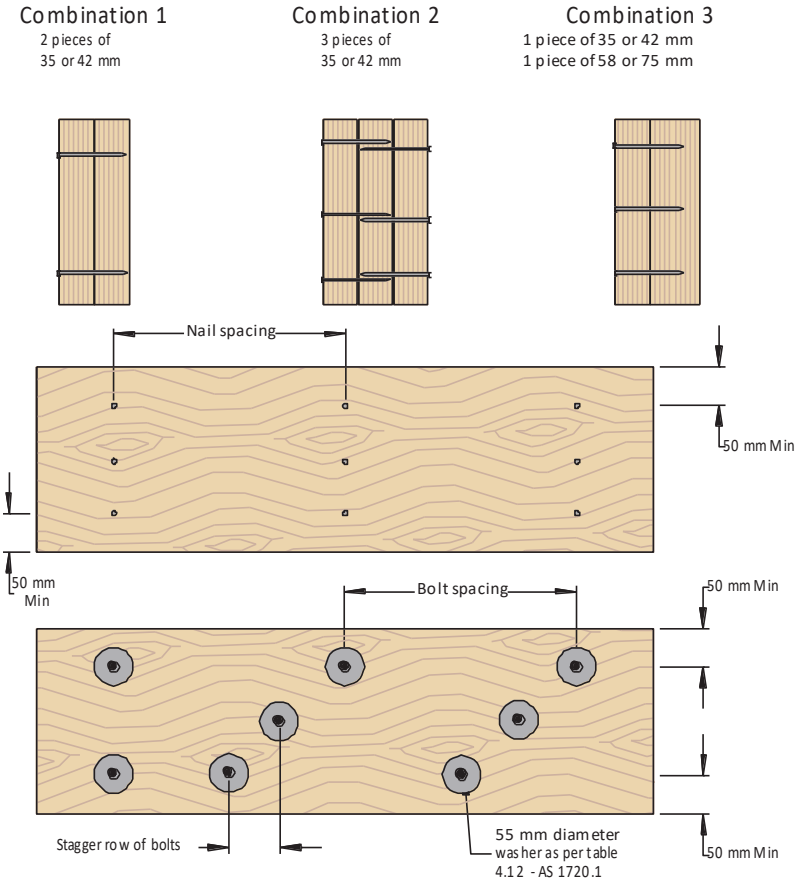
- Depths up to and including 300 mm: 2 rows of nails as shown above at 300 mm centre
- Depths in excess of 300 mm: 3 rows of nails as shown above at 300 mm centres.

Beams supporting SmartJoists – Multiple member laminations (Cont'd)



LB2

Multiple member lamination of side loaded beams (Non– symmetrical loading)



LB1

Maximum floor load width supported by either outside member (mm)

Combination (see details above)	3.75Φ x 90 mm nails		12 mm Φ bolts	
	2 rows at 300 ctrs	3 rows at 300 ctrs	2 rows at 600 ctrs	2 rows at 300 ctrs
Combination 1	3400	5100	7500	15000
Combination 2	2900	4000	5600	11000
Combination 3	2900	4000	4500	11000

Notes:

1. Table values are for 40 kg/m^2 floors.
2. The table values for nails may be doubled for nails at 150 mm centres, and tripled for nails at 100 mm centres

Multiple member lamination of side loaded beams (Non– symmetrical loading) (cont'd)

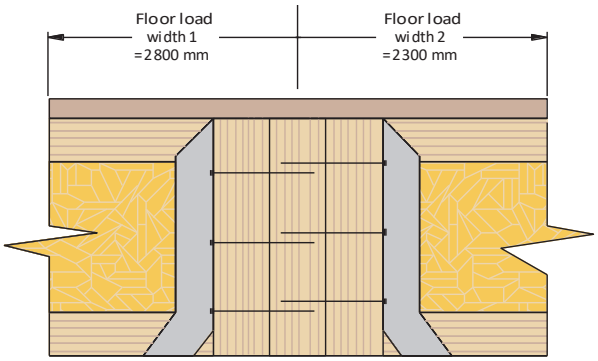
3. The nail schedules shown apply to both sides of a three (3) piece beam
4. Bolts are to be grade 4.6 commercial bolts conforming to AS 1111. Bolt holes are to be a maximum of 13 mm diameter and are to be located NOT less than 50 mm from either edge.
5. All bolts shall be fitted with a washer at each end, of a size NOT less than that given in AS 1720.1 table 4.11.

How to use the maximum uniform side load table

Example: see diagram opposite

Beam of 2 SmartLVL loaded on both side (Combination 1)
FLW 1 = 2800 mm, FLW 2 = 2300 mm
Total FLW = 2800 + 2300 = 5100 mm.

1. Use SmartFrame software or SmartLVL safe load tables to size the two member section to support the FLW of 5100 mm.
2. Choose the larger of the side FLW's carried by the beam, in this case 2800 mm.
3. Enter the table at the "Combination 1" row and scan across to a table value greater than 2800 mm. The first value in the row at 3600 mm is greater than the 2800 mm required.
4. Thus adopt 2 rows of 3.75Φ x 90 mm nails at 300 mm centres



Rafter cuts for SmartJoist floor joists

SmartJoists can be "rafter cut" but only within the limitation shown below.

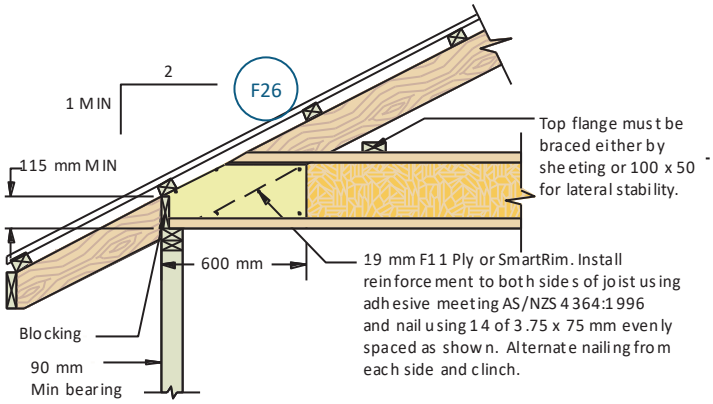
Rafter cuts are limited to:

1. 115 mm MINIMUM end height
2. MINIMUM Roof Slopes of 1 in 2 (approximately 26.5^0),

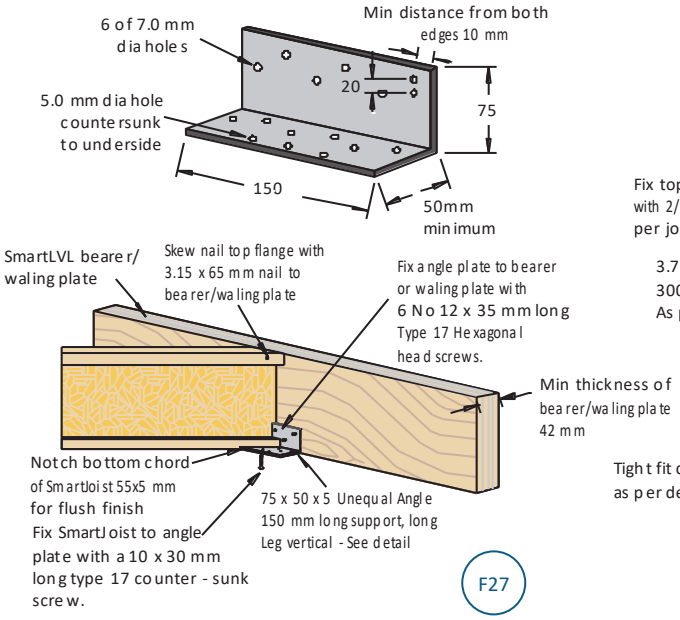
and

3. Must be blocked at the end to prevent rotation of the joist.

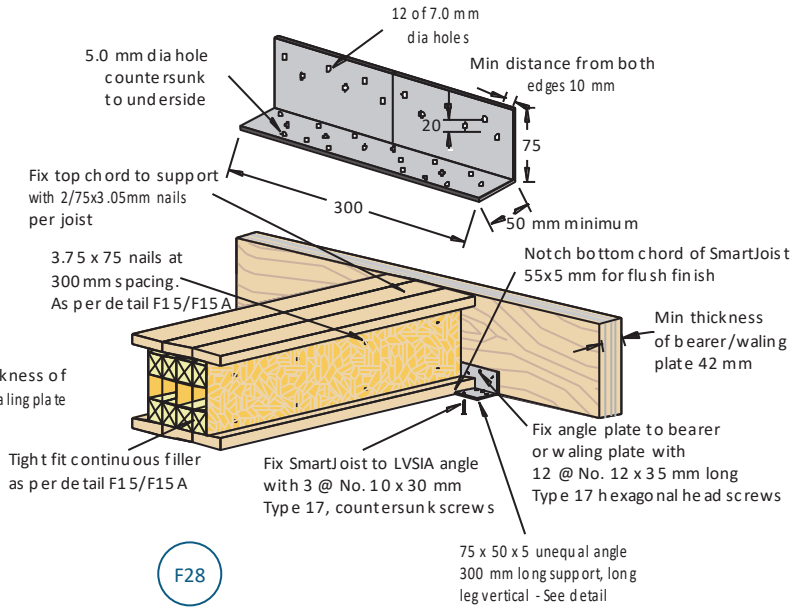
Joists without reinforcement are limited to design shear and end reactions up to 6.5 kN Ply reinforcement can be added to joists with rafter cuts to increase the shear and end reaction capacity of the joist. The detail below shows the proper installation of the reinforcement. With the reinforcement added, the end reaction and shear capacity increase to 12.7 kN. Duration of load increases are permitted as per AS1720.1.



Oblique connection options



F27



F28

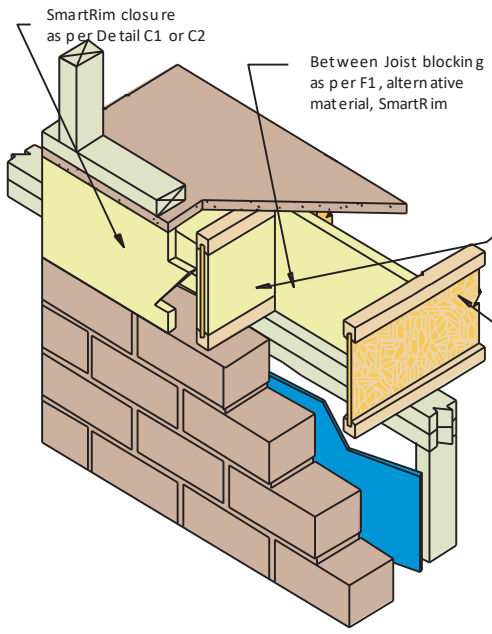
Brick ledge cantilevers construction details

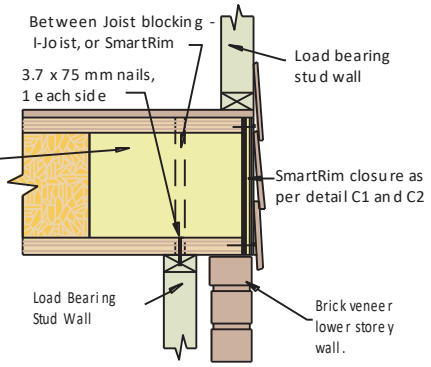
Cantilevered SmartJoists as "brick ledge cantilevers" (Max of 160 mm cantilever) to suit upper storey clad frames DO NOT usually require any special modification (other than the necessary timber or ply/LVL closure member attached to the outer edge as shown in details C1 or C2. The exceptions to this are where concentrated floor loads (e.g. truncated girders, jamb studs) are supported on an Individual cantilevered joist such that the concentrated roof load area supported exceeds that as shown below for an un-reinforced SmartJoist.

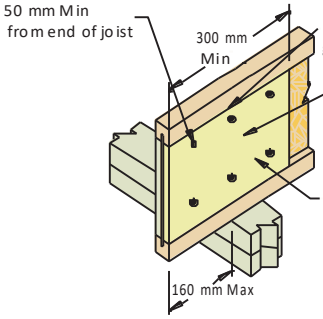
Individual joists may be reinforced, if required, as per details F23 or F24 to support a roof load area (measured in square metres) as shown below.

Joist spacing (mm)	Un-reinforced SmartJoist						Web Filler (F23)						Reinforcing one side (F24)					
	Sheet Roof			Tiled Roof			Sheet Roof			Tiled Roof			Sheet Roof			Tiled Roof		
	300	450	600	300	450	600	300	450	600	300	450	600	300	450	600	300	450	600
SmartJoist	Roof area supported (m^2)																	
SJ20044	7.8	6.9	6.0	4.6	4.0	3.5	9.3	8.3	7.5	5.4	4.9	4.4	11.2	10.3	9.4	6.4	5.7	5.2
SJ24040	7.6	6.5	5.5	4.5	3.8	3.2	9.1	8.0	7.0	5.3	4.7	4.1	11.0	9.9	8.9	6.2	5.5	4.9
SJ24051	9.1	8.0	6.9	5.3	4.7	4.0	10.6	9.4	8.3	6.2	5.5	4.9	12.6	11.4	10.3	7.1	6.4	5.7
SJ24070	11.4	10.2	9.1	6.7	6.0	5.3	12.9	11.7	10.5	7.5	6.9	6.2	14.9	13.7	12.5	8.5	7.7	7.0
SJ24090	15.0	13.7	12.5	8.8	8.2	7.3	16.4	15.2	14.0	9.6	8.9	8.2	18.4	17.1	15.9	10.5	9.7	9.0
SJ25570	11.3	10.0	8.9	6.6	6.1	5.2	12.7	11.5	10.4	7.5	6.7	6.1	14.7	13.5	12.3	8.4	7.6	6.8
SJ30040	7.2	6.0	4.9	4.2	3.5	2.9	8.7	7.5	6.3	5.1	4.5	3.7	10.7	9.4	8.3	6.0	5.3	4.5
SJ30051	8.7	7.4	6.2	5.1	4.4	3.7	10.2	8.9	7.7	6.0	5.2	4.5	12.2	10.9	9.7	6.9	6.1	5.3
SJ30070	11.0	9.6	8.4	6.4	5.8	4.9	12.5	11.1	9.9	7.3	6.5	5.8	14.4	13.1	12.3	8.2	7.4	6.5
SJ30090	14.6	13.0	11.8	8.5	7.7	6.9	16.0	14.6	13.3	9.4	8.6	7.8	18.0	16.5	15.2	10.2	9.4	8.4
SP30095	14.6	13.1	11.7	8.5	7.9	6.9	16.0	14.5	13.2	9.4	8.5	7.7	18.0	16.5	15.2	10.2	9.3	8.4
SJ36058	11.4	9.9	8.6	6.7	5.8	5.0	12.8	11.4	10.1	7.5	6.7	5.9	14.8	13.4	12.0	8.4	7.5	6.5
SJ36090	14.1	12.5	11.1	8.3	7.4	6.5	15.6	14.0	12.6	9.1	8.2	7.4	17.6	16.0	14.6	9.9	9.0	8.0
SJ40090	13.9	12.2	10.7	8.1	7.1	6.3	15.3	13.7	12.2	9.0	8.0	7.1	17.3	15.6	14.1	9.8	8.8	7.8

F22



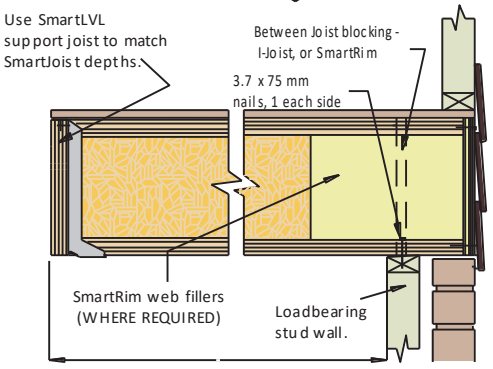




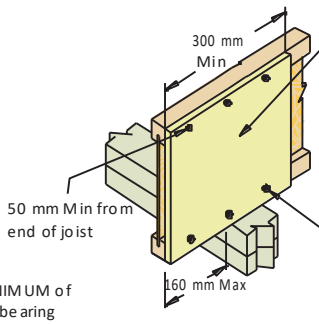
Web filler reinforcement

F23

F25



Trimmer joists where main joist are parallel to brick ledge cantilever wall



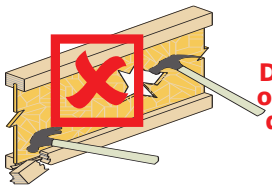
F24

Full depth Reinforcement one side

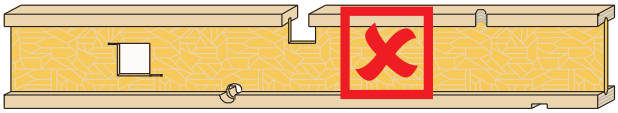
Trimmer Joists to be MINIMUM of 600 mm from inside of bearing plate to support LVL floor Joist.

SmartJoist hole and duct charts

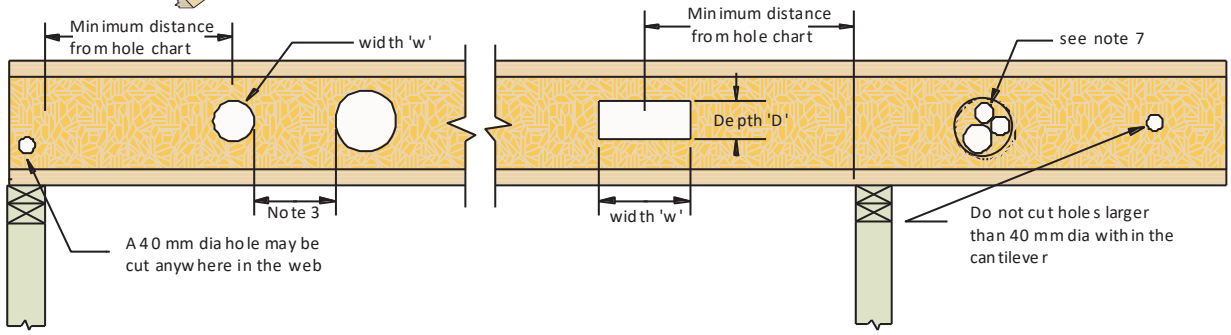
Don't make holes with hammer other than pre-punched knockouts



Don't hammer on flanges and damage joint



Do not cut or notch flanges
Do not over cut holes in web



Note: The most accurate method to design the allowable web penetration size and distance from support for SmartJoists is to use the Smart-Frame software. The table below will give conservative results in some instances. Also, advice on hole size and location may be obtained by contacting the Tech Support Customer Helpline on 1300 668 690 or at techsupport@tilling.com.au.

Assumed loading (DL = 62 kg/m^2, FLL = 2 kPa, FPL = 1.8 kN)

Joist code	Joist span* (mm)	Joist spacing (mm)	Circular/square holes								Rectangular holes			
			Hole diameter/square hole width (mm)								Depth x wdth (mm)			
			75	100	125	150	175	200	225	250	125x150	150x300	175x350	200x400
			Minimum distance from any support to the centre of the hole (mm)											
SJ20044	600-999	300 to 600	300	300	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
	1000-1499		300	300	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
	1500-1999		300	300	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
	2000-2499		300	600	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
	2500-2999		300	800	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
	3000-3300		300	900	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
SJ24040	600-999	300 to 600	300	300	300	ns	ns	ns	ns	ns	ns	ns	ns	ns
	1000-1499		300	300	300	ns	ns	ns	ns	ns	ns	ns	ns	ns
	1500-1999		300	300	300	Span/2	ns	ns	ns	ns	750	Span/2	ns	ns
	2000-2499		300	300	300	Span/2	ns	ns	ns	ns	1000	Span/2	ns	ns
	2500-2999		300	300	500	Span/2	ns	ns	ns	ns	Span/2	Span/2	ns	ns
	3000-3500		300	300	800	Span/2	ns	ns	ns	ns	Span/2	Span/2	ns	ns
SJ24051	600-999	300 to 600	300	300	300	ns	ns	ns	ns	ns	ns	ns	ns	ns
	1000-1499		300	300	300	ns	ns	ns	ns	ns	ns	ns	ns	ns
	1500-1999		300	300	300	Span/2	ns	ns	ns	ns	750	Span/2	ns	ns
	2000-2499		300	300	300	Span/2	ns	ns	ns	ns	1000	Span/2	ns	ns
	2500-2999		300	300	500	Span/2	ns	ns	ns	ns	Span/2	Span/2	ns	ns
	3000-3499		300	300	800	Span/2	ns	ns	ns	ns	Span/2	Span/2	ns	ns
	3500-3800		300	300	1000	Span/2	ns	ns	ns	ns	Span/2	Span/2	ns	ns
SJ24070	600-999	300 to 600	300	300	300	ns	ns	ns	ns	ns	ns	ns	ns	ns
	1000-1499		300	300	300	ns	ns	ns	ns	ns	300	ns	ns	ns
	1500-1999		300	300	300	Span/2	ns	ns	ns	ns	600	Span/2	ns	ns
	2000-2499		300	300	300	Span/2	ns	ns	ns	ns	900	Span/2	ns	ns
	2500-2999		300	300	500	Span/2	ns	ns	ns	ns	1250	Span/2	ns	ns
	3000-3499		300	300	800	Span/2	ns	ns	ns	ns	1500	Span/2	ns	ns
	3500-3999		300	300	1000	Span/2	ns	ns	ns	ns	Span/2	Span/2	ns	ns
	4000-4100		300	450	1100	Span/2	ns	ns	ns	ns	Span/2	Span/2	ns	ns

SmartJoist hole charts (Cont'd)

Assumed load (DL = 62 kg/m^2, FLL = 2 kPa, FPL = 1.8 kN)

Joist code	Joist span* (mm)	Joist spacing (mm)	Circular/square holes								Rectangular holes			
			Hole diameter/square hole width (mm)								Depth x width (mm)			
			75	100	125	150	175	200	225	250	125x150	150x300	175x350	200x400
			Minimum distance from any support to the centre of the hole (mm)											
SJ24090	600-999	300 to 600	300	300	300	ns	ns	ns	ns	ns	ns	ns	ns	ns
	1000-1499		300	300	300	ns	ns	ns	ns	ns	300	ns	ns	ns
	1500-1999		300	300	300	700	ns	ns	ns	ns	500	750	ns	ns
	2000-2499		300	300	300	1000	ns	ns	ns	ns	800	1000	ns	ns
	2500-2999		300	300	400	1150	ns	ns	ns	ns	1100	Span/2	ns	ns
	3000-3499		300	300	700	1400	ns	ns	ns	ns	1400	Span/2	ns	ns
	3500-3999		300	300	800	1550	ns	ns	ns	ns	1700	Span/2	ns	ns
	4000-4100		300	300	900	1600	ns	ns	ns	ns	1800	Span/2	ns	ns
SJ25570	600-999	300 to 600	300	300	300	300	ns	ns	ns	ns	300	300	ns	ns
	1000-1499		300	300	300	300	ns	ns	ns	ns	300	500	ns	ns
	1500-1999		300	300	300	span/2	ns	ns	ns	ns	400	800	ns	ns
	2000-2499		300	300	600	span/2	ns	ns	ns	ns	700	1000	ns	ns
	2500-2999		300	300	900	span/2	ns	ns	ns	ns	1000	1300	ns	ns
	3000-3499		300	700	1300	span/2	ns	ns	ns	ns	1300	1600	ns	ns
	3500-3999		300	1100	1600	span/2	ns	ns	ns	ns	1700	1900	ns	ns
	4000-4300		300	1400	1800	span/2	ns	ns	ns	ns	1900	span/2	ns	ns
SJ30040	600-999	300 to 600	300	300	300	300	300	300	ns	ns	300	300	ns	ns
	1000-1499		300	300	300	300	300	300	ns	ns	300	500	Span/2	ns
	1500-1999		300	300	300	300	300	500	ns	ns	300	Span/2	Span/2	Span/2
	2000-2499		300	300	300	300	300	700	ns	ns	500	Span/2	Span/2	Span/2
	2500-2999		300	300	300	300	400	1000	ns	ns	900	Span/2	Span/2	Span/2
	3000-3499		300	300	300	300	600	1200	ns	ns	1300	Span/2	Span/2	Span/2
	3500-3999		300	300	300	300	900	1450	ns	ns	1750	Span/2	Span/2	Span/2
	4000-4100		300	300	300	400	1000	1500	ns	ns	Span/2	Span/2	Span/2	ns
SJ30051	600-999	300 to 600	300	300	300	300	300	300	ns	ns	300	300	ns	ns
	1000-1499		300	300	300	300	300	300	ns	ns	300	500	Span/2	ns
	1500-1999		300	300	300	300	300	500	ns	ns	300	750	Span/2	Span/2
	2000-2499		300	300	300	300	300	700	ns	ns	400	Span/2	Span/2	Span/2
	2500-2999		300	300	300	300	400	1000	ns	ns	800	Span/2	Span/2	Span/2
	3000-3499		300	300	300	300	600	1200	ns	ns	1200	Span/2	Span/2	Span/2
	3500-3999		300	300	300	300	900	1450	ns	ns	1600	Span/2	Span/2	Span/2
	4000-4300		300	300	300	400	1000	1600	ns	ns	1800	Span/2	Span/2	ns
SJ30070	600-999	300 to 600	300	300	300	300	300	300	ns	ns	300	300	ns	ns
	1000-1499		300	300	300	300	300	300	ns	ns	300	500	Span/2	ns
	1500-1999		300	300	300	300	300	500	ns	ns	300	750	Span/2	Span/2
	2000-2499		300	300	300	300	300	700	ns	ns	400	1000	Span/2	Span/2
	2500-2999		300	300	300	300	400	950	ns	ns	700	1250	Span/2	Span/2
	3000-3499		300	300	300	300	600	1200	ns	ns	1000	Span/2	Span/2	Span/2
	3500-3999		300	300	300	300	900	1450	ns	ns	1400	Span/2	Span/2	Span/2
	4000-4499		300	300	300	500	1100	1700	ns	ns	1800	Span/2	Span/2	Span/2
	4500-4600		300	300	300	700	1200	1800	ns	ns	1900	Span/2	Span/2	Span/2
SJ30090	600-999	300 to 600	300	300	300	300	300	300	ns	ns	300	300	ns	ns
	1000-1499		300	300	300	300	300	300	ns	ns	300	400	Span/2	ns
	1500-1999		300	300	300	300	300	300	ns	ns	300	750	Span/2	Span/2
	2000-2499		300	300	300	300	300	600	ns	ns	300	950	Span/2	Span/2
	2500-2999		300	300	300	300	300	800	ns	ns	500	1200	Span/2	Span/2
	3000-3499		300	300	300	300	400	1100	ns	ns	800	1500	Span/2	Span/2
	3500-3999		300	300	300	300	700	1300	ns	ns	1200	1750	Span/2	Span/2
	4000-4499		300	300	300	300	950	1600	ns	ns	1600	Span/2	Span/2	Span/2
	4500-4900		300	300	300	500	1100	1800	ns	ns	1800	Span/2	Span/2	Span/2

SmartJoist hole charts (Cont'd)

Assumed load (DL = 62 kg/m^2, FLL = 2 kPa, FPL = 1.8 kN)

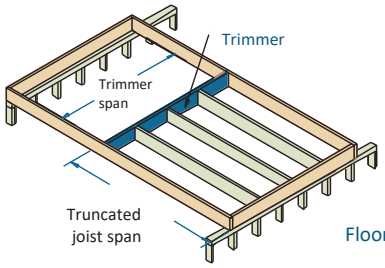
Joist code	Joist span (mm)	Joist* spacing (mm)	Circular/square holes								Rectangular holes			
			Hole diameter/square hole width (mm)								Depth x width (mm)			
			75	100	125	150	175	200	225	250	125x150	150x300	175x350	200x400
			Minimum distance from any support to the centre of the hole (mm)											
SP30095	600-999	300 to 600	300	300	300	300	300	300	ns	ns	300	300	300	300
	1000-1499		300	300	300	300	300	300	ns	ns	300	300	400	400
	1500-1999		300	300	300	300	300	400	ns	ns	300	500	700	700
	2000-2499		300	300	300	400	600	700	ns	ns	300	800	900	1000
	2500-2999		300	300	300	700	900	1000	ns	ns	300	1000	1200	span/2
	3000-3499		300	300	400	1000	1200	1300	ns	ns	600	1300	1500	span/2
	3500-3999		300	300	700	1300	1500	1600	ns	ns	1000	1600	1700	span/2
	4000-4499		300	300	1100	1600	1800	1900	ns	ns	1300	1900	2000	span/2
	4500-4999		300	300	1500	2000	2200	2200	ns	ns	1700	2200	2300	span/2
	5000-5499		300	300	1900	2300	2500	span/2	ns	ns	2100	span/2	span/2	span/2
SJ36058	1000-1499	300 to 600	300	300	300	300	300	300	300	300	300	300	400	ns
	1500-1999		300	300	300	300	300	300	300	400	300	300	700	span/2
	2000-2499		300	300	300	300	300	300	300	700	300	550	900	span/2
	2500-2999		300	300	300	300	300	300	400	900	300	850	1200	span/2
	3000-3499		300	300	300	300	300	300	650	1200	300	1200	1500	span/2
	3500-3999		300	300	300	300	300	400	900	1400	300	1500	1750	span/2
	4000-4499		300	300	300	300	300	600	1100	1700	300	1800	span/2	span/2
	4500-5000		300	300	300	300	300	800	1400	1900	300	2200	span/2	span/2
SJ36090	600-999	300 to 600	300	300	300	300	300	300	300	300	300	300	ns	ns
	1000-1499		300	300	300	300	300	300	300	300	300	300	300	ns
	1500-1999		300	300	300	300	300	300	300	300	300	300	450	700
	2000-2499		300	300	300	300	300	300	300	400	300	300	750	1000
	2500-2999		300	300	300	300	300	300	300	650	300	450	1000	1250
	3000-3499		300	300	300	300	300	300	300	900	300	800	1300	1500
	3500-3999		300	300	300	300	300	300	500	1150	300	1100	1600	span/2
	4000-4499		300	300	300	300	300	300	750	1400	300	1450	1900	span/2
	4500-4999		300	300	300	300	300	400	1000	1650	300	1800	2200	span/2
	5000-5400		300	300	300	300	300	600	1200	1800	300	2100	2500	span/2
SJ40090	600-999	300 to 600	300	300	300	300	300	300	300	300	300	300	ns	ns
	1000-1499		300	300	300	300	300	300	300	300	300	300	300	ns
	1500-1999		300	300	300	300	300	300	300	300	300	300	300	400
	2000-2499		300	300	300	300	300	300	300	300	300	300	300	600
	2500-2999		300	300	300	300	300	300	300	300	300	300	300	900
	3000-3499		300	300	300	300	300	300	300	300	300	300	600	1200
	3500-3999		300	300	300	300	300	300	300	400	300	300	1000	1500
	4000-4499		300	300	300	300	300	300	300	600	300	300	1300	1800
	4500-4999		300	300	300	300	300	300	300	800	300	500	1700	2100
	5000-5499		300	300	300	300	300	300	400	900	300	1000	2000	2500
	5500-5700		300	300	300	300	300	300	500	1100	300	1200	2200	2750

Notes:

1. The hole chart is generated for single span joists with a maximum floor dead load of 62 kg/m^2 with no wall or roof loads. It therefore does not apply for joists supporting either parallel or perpendicular load bearing walls. These scenarios can be analysed by using the appropriate model within the SmartFrame software. Help can be obtained for continuous spans by contacting the Tech Support Helpline on 1300 668 690 or at techsupport@tilling.com.au
2. Hole locations are suitable for joist spacings up to 600 mm centres. Holes may be permitted closer to supports for some member when spacings of 450 or 300 mm are used
3. The clear distance between holes must equal or exceed twice the diameter of the largest hole, or twice the longest side of a rectangular hole and no more than 3 holes in excess of 75 mm are allowed in any span
4. Do not cut or damage flanges under any circumstances
5. Except as noted in 1 and 2 above, a 40 mm hole at a minimum of 450 mm centres is allowed to be drilled anywhere in the web EXCEPT in cantilevered spans
6. If possible, holes in web should be positioned mid height, minimum edge clearance from any flange is 6 mm A group of round holes at approximately the same location shall be permitted if they meet the requirements for a single round hole circumscribed around them.

Openings within SmartFrame floors

Opening trimmer



The tables below are for trimmer members of SmartJoists and LVL. Other SmartFrame engineered timber products may also be used for this member, the designs for each of these other material types can be simply calculated by using the SmartFrame software or by contacting the Tech Support Customer Helpline on 1300 668 690 or at techsupport@tilling.com.au.

Floor live load 1.5 kPa

SmartJoist	Maximum trimmer span (mm) Truncated joist span (mm)				
	1.5	3.0	4.5	6.0	7.2
SJ20044	3700	3000	2600	2300	2100
SJ24040	4000	3300	2900	2600	2400
SJ24051	4300	3500	3100	2800	2500
SJ24070	4600	3800	3400	3000	2800
SJ24090	4800	4000	3500	3300	3000
SJ30040	4600	3800	3400	3100	2800
SJ25570	4700	3900	3500	3100	2500
SJ30051	4900	3900	3600	3300	3100
SJ30070	5200	4300	3800	3500	3300
SJ30090	5500	4500	4000	3700	3500
SP30095	5700	4700	4200	3700	3500
SJ36058	5600	4700	4200	3800	3600
SJ36090	6100	5000	4500	4100	3900
SJ40090	6500	5400	4800	4400	4100

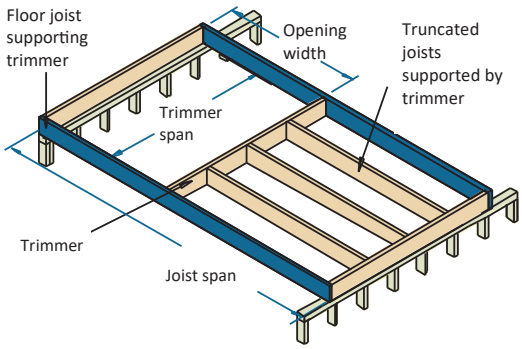
Floor live load 1.5 kPa

SmartLVL 15	Maximum trimmer span (mm) Truncated joist span (mm)				
	1.5	3.0	4.5	6.0	7.2
200x42	3900	3200	2800	2500	2300
240x42	4500	3800	3300	3000	2800
300x42	5300	4500	4000	3700	3500
360x42	6100	5100	4600	4300	4100
200x58	4300	3600	3100	2800	2600
240x58	4900	4100	3700	3400	3100
300x58	5800	4900	4400	4100	3900
360x58	6600	5600	5000	4700	4400
400x58	7100	6000	5400	5000	4800

Trimmer Joists

Trimming joists at floor opening often support the loads from stair stringers, as well as the concentrated load from the trimmer. The table below has been set up to allow a load from stairs equally supported from the floor below (or above) and the trimmer joists. In many cases this will provide a conservative result. Alternative designs can be readily obtained by using the SmartFrame software or by contacting the Tech Support Customer Helpline on 1300 668 690 or at techsupport@tilling.com.au

Floor live load 1.5 kPa



Note: Based on spacing of 600 mm and maximum of 10 mm DL deflection

	SmartFrame engineered timber	Maximum trimming joist span (m)											
		Opening width 900 (mm) Trimmer span (mm)				Opening width 1800 (mm) Trimmer span (mm)				Opening width 2700 (mm) Trimmer span (mm)			
		2	3	4	5	2	3	4	5	2	3	4	5
SmartJoists	SJ20044	3300	3100	2800	2600	3400	3200	3100	3000	3700	3600	3600	3500
	SJ24040	3700	3400	3200	3000	3600	3400	3100	3000	4000	3800	3700	3700
	SJ24051	3900	3600	3400	3200	3800	3600	3400	3300	4100	4000	3900	3800
	SJ24070	4200	3900	3700	3500	4100	3800	3600	3500	4400	4200	4000	4000
	SJ24090	4500	4100	3900	3700	4300	4000	3800	3600	4500	4300	4200	4000
	SJ25570	4800	4500	4200	4000	4600	4300	4100	3900	4800	4600	4400	4300
	SJ30040	4300	4000	3700	3500	4100	3900	3700	3500	4400	4200	4100	3900
	SJ30051	4500	4200	3900	3700	4300	4000	3800	3700	4600	4400	4200	4100
	SJ30070	4900	4500	4200	4000	4600	4300	4100	3900	4800	4600	4400	4300
	SJ30090	5100	4800	4500	4200	4900	4500	4300	4100	5100	4700	4500	4400
	SP30095	5700	5500	5100	4900	5500	5100	4800	4600	5500	5200	5000	4800
	SJ36058	5300	4900	4700	4400	5000	4600	4400	4200	5200	4800	4600	4400
	SJ36090	5700	5300	5000	4800	5400	5000	4800	4400	5500	5100	4900	4700
	SJ40090	6100	5800	5500	5200	5800	5300	5000	4800	5800	5400	5100	4900
SmartLVL 15	200x42	3600	3200	2900	2700	3600	3300	3100	3000	4000	3900	3700	3600
	240x42	4200	3800	3500	3300	4100	3800	3600	3400	4400	4200	4000	3900
	300x42	5100	4600	4300	4100	4800	4400	4100	4000	5000	4700	4500	4300
	360x42	6000	5400	5100	4800	5500	5000	4700	4500	5600	5200	5000	4800
	200x58	3900	3600	3300	3000	3900	3600	3400	3200	4200	4000	3900	3900
	240x58	4600	4200	3900	3700	4400	4100	3800	3700	4700	4400	4200	4100
	300x58	5600	5100	4800	4500	5200	1800	4500	4300	5300	5000	4800	4600
	360x58	6600	6000	5600	5300	6000	5500	5100	4900	6000	5600	5300	5100
	400x58	7200	6600	6200	5700	6500	6000	5600	5300	6500	6000	5700	5400

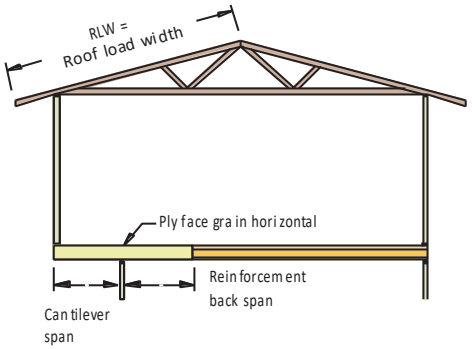
SmartJoist cantilevers supporting load bearing walls

SmartJoist cantilevers may need to be reinforced to support load bearing walls at the end of the cantilever. The table below lists the allowable roof load widths with un-reinforced and reinforced SmartJoists.

Reinforcement Description:

- 0 - Reinforcement not required
- 1 - Install 15 mm F11 x 1200 mm min structural ply on one side of joist
- 2 - Install 15 mm F11 x 1200 mm min structural ply on both sides of joist or double joist at cantilever
- x - Not suitable

Tables assume a 0.8 kN/m wall dead load, sheet roof dead load of 40 kg/m^2 and tiled roof dead load of 90 kg/m^2.
Serviceability limits on Cantilever - DL: 6.0 mm Maximum - LL: 4.5 mm Max



Reinforcement requirements for cantilevered floor joists supporting load bearing walls

***Important : See notes on next page on the use of this table**

NOTE - Total length cantilever reinforcement must be a minimum of 1200 mm but NEVER be less than twice the cantilever span. i.e. Reinforcement back span ≥ cantilever span.

Max Cantilever (mm)		Sheet roof 40 kg/m^2									Tiled roof 90 kg/m^2											
	RLW (m)	4.0			6.0			8.0			2.0			4.0			6.0			8.0		
	SmartJoist	300	450	600	300	450	600	300	450	600	300	450	600	300	450	600	300	450	600	300	450	600
300	SJ20044	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
	SJ24040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
	SJ24051	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
	SJ24070	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
	SJ24090	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
	SJ25570	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
	SJ30040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SJ30051	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SJ30070	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SJ30090	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SP30095	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SJ36058	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SJ36090	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SJ40090	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
600	SJ20044	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	2
	SJ24040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	SJ24051	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	x
	SJ24070	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	x
	SJ24090	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	x
	SJ25570	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	x
	SJ30040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SJ30051	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SJ30070	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SJ30090	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SP30095	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SJ36058	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SJ36090	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SJ40090	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
900	SJ20044	0	0	1	0	0	1	1	1	x	0	0	0	0	2	x	1	x	x	x	x	x
	SJ24040	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	2	x	1	x	x
	SJ24051	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	2	x	1	x	x
	SJ24070	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	x	x	x	x
	SJ24090	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	x	0	1	x
	SJ25570	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	x	1	1	x
	SJ30040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	x
	SJ30051	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	x
	SJ30070	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
	SJ30090	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SP30095	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SJ36058	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SJ36090	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SJ40090	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

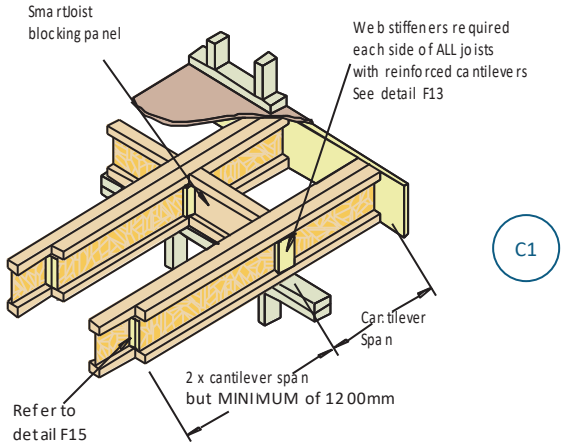
SmartJoist cantilevers supporting load bearing walls (Cont'd)

NOTE:

Spans in the preceding table are based upon a uniform roof load width at the cantilever end of each joist. The presence of large windows or openings within the load bearing wall supported by these cantilevered joists create concentrated loads at the edges of such openings. The joists supporting the concentrated loads will require special engineering consideration to avoid excess loads and differential deflections between adjacent joists. It is strongly recommended that where concentrated loads occur on cantilevered joists that advice be sought from the Tech Support Customer Helpline on 1300 668 690 or at techsupport@tilling.com.au.

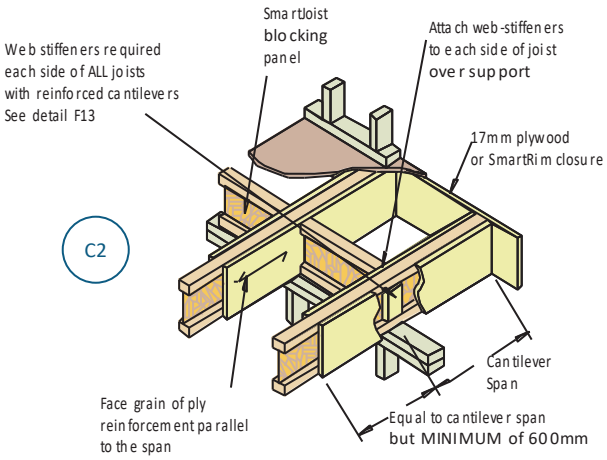
Example construction details for load-bearing cantilevers

Note: Option 1 with cantilever reinforced with an extra SmartJoist is equivalent to option 2 with 2 sheets of ply reinforcement.



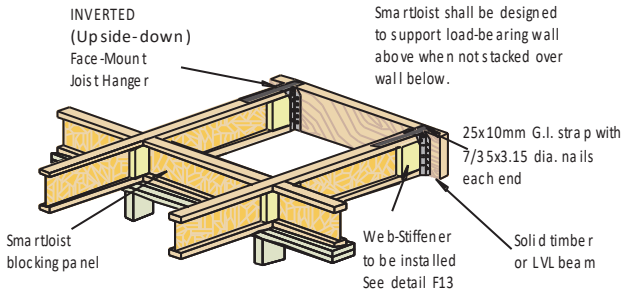
C1

NOTE:
Block together full length with filler blocks as per detail F15 of the SmartJoist Design Guide

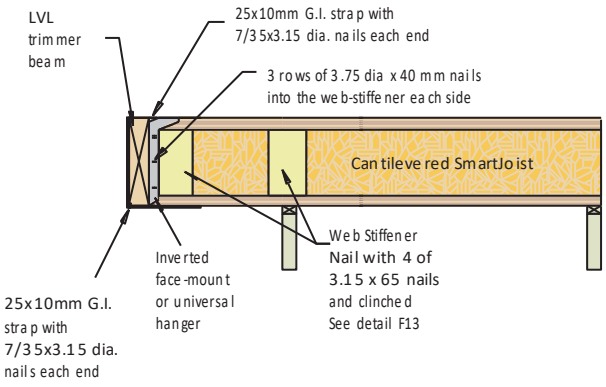


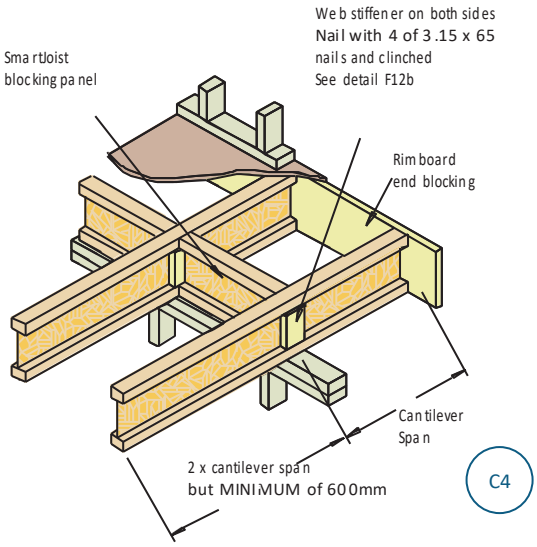
C2

NOTE:
15mm F11 structural ply is required on one or both sides of the joist (See Tables). Depth shall match the full height of the Smartjoist. Nail with 3.15 x 65 nails at 100mm ctrs in a staggered pattern.



C3



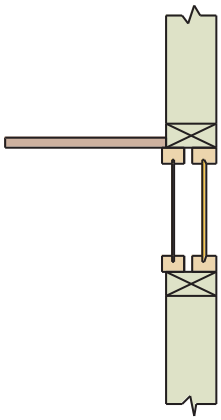


C4

SmartJoists supporting parallel load-bearing walls

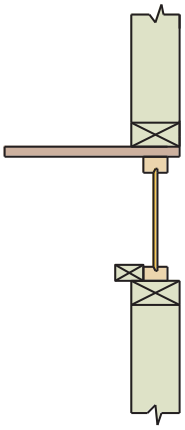
Fitted floors

Double SmartJoists required for fixing of floor and ceiling, and when required by table below
AND
for SmartJoists with 40 mm wide flanges

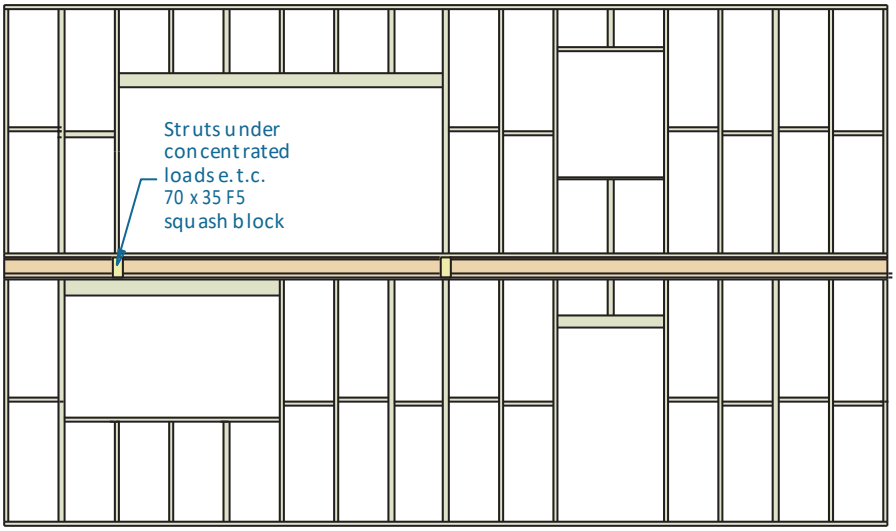


Platform floors

Single SmartJoist with flange > 50 mm may be used, but requires alternative fixing for ceiling.
NOT suitable for SmartJoists with 40 mm wide flanges e.g SJ24040

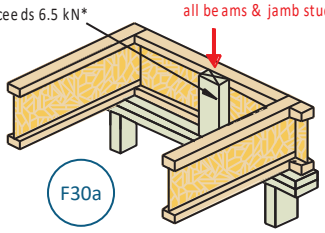


Joists continuously supported by lower walls



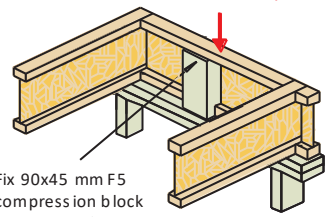
Fix 90x45 mm F5 compression block to SmartJoist where load exceeds 6.5 kN*

Concentrated point loads (eg, girder trusses, TG's all beams & jamb studs)



Single SmartJoists with flange width < plate width

Concentrated point loads (eg, girder trusses, TG's all beams & jamb studs)

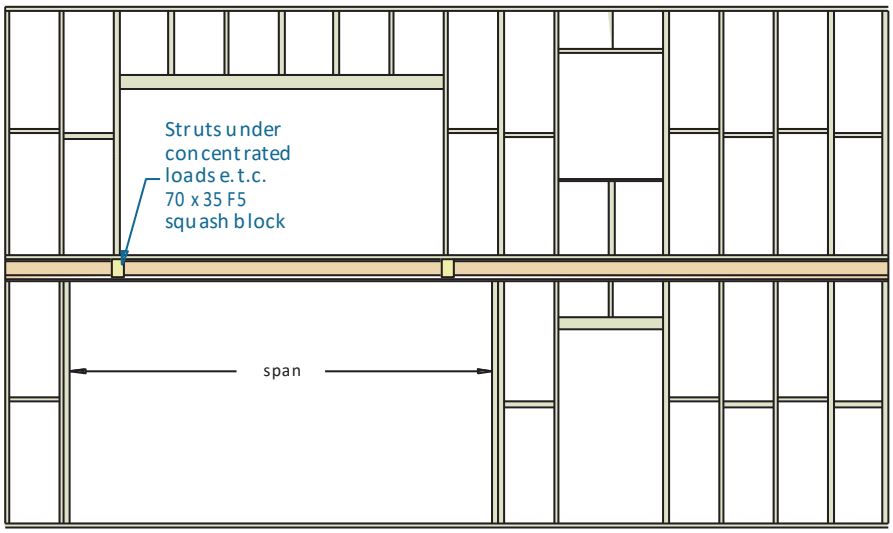


Fix 90x45 mm F5 compression block to SmartJoist where load exceeds 6.5 kN*

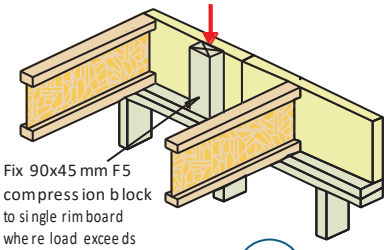
F30b

Single SmartJoists with flange width >= plate width

Joist non-continuously supported by lower wall



Concentrated point loads (eg, girder trusses, TG's all beams & jamb studs)



Fix 90x45 mm F5 compression block to single rim board where load exceeds 26.0 kN*

F30c

Single SmartRim

Single (and double) SmartJoists are adequate to transfer uniformly distributed compression loads up to 29 kN/m per joist from loadbearing walls to a continuous rigid support below. Detail F5 and F8 are used to transfer concentrated loads where walls are perpendicular to the joists. Details F30a, F30b and F30c above must be used to transfer concentrated loads through parallel SmartJoists where the instantaneous reaction exceeds 6.5 kN and exceeds 26.0 kN for single SmartRim (reaction needs to be factored for load duration)

The table below gives allowable spans for single and double joists NOT continuously supported by a parallel wall. Care must always be taken to adequately support the web of the joists from concentrated point loads from above by adopting details F13.

Single SmartJoists supporting parallel load bearing walls

Floor load width (mm)		600			600		
Roof load width (mm)		1500	3000	5000	1500	3000	5000
SmartJoist code	Roof mass (kg/m^2)	Maximum recommended SmartJoist span (mm)					
		Single Span			Continuous Span		
SJ20044	40	2450	2250	2050	3450	2900	2400
	90	2200	1900	1400	2800	2100	1600
SJ24040	40	2800	2550	2300	3550	3150	2800
	90	2500	2150	1750	3100	2550	2000
SJ24051	40	3000	2750	2500	4050	3600	2950
	90	2700	2300	1750	3450	2550	2000
SJ24070	40	3300	3000	2700	4300	3600	2950
	90	2950	2450	1750	3450	2550	2000
SJ24090	40	3550	3200	2900	4550	4250	3500
	90	3150	2700	2150	4100	3050	2300
SJ25570	40	3450	3150	2850	4450	4200	3750
	90	3100	2650	2300	4100	3250	2450
SJ30040	40	3350	3100	2800	4050	3600	3150
	90	3000	2600	2250	3500	2900	2450
SJ30051	40	3600	3300	3000	4600	4100	3600
	90	3250	2800	2250	4000	3300	2550
SJ30070	40	3850	3600	3250	4900	4600	3800
	90	3550	3050	2250	4450	3300	2550
SJ30090	40	4050	3800	3500	5200	4850	4450
	90	3750	3250	2750	4800	3850	2950
SP30095	40	4150	3900	3600	5300	5000	4400
	90	3850	3400	2750	4900	3850	2950
SJ36058	40	4150	3900	3650	5300	5000	4400
	90	3850	3400	2800	4850	4000	3100
SJ36090	40	4500	4200	3900	5750	5400	5000
	90	4150	3700	3250	5300	4650	3550
SJ40090	40	4750	4450	4150	6100	5700	5350
	90	4400	3950	3550	5650	5100	4000

Double SmartJoists supporting parallel load bearing walls

Floor load width (mm)		600			600		
Roof load width (mm)		1500	3000	5000	1500	3000	5000
SmartJoist code	Roof mass (kg/m^2)	Maximum recommended SmartJoist span (mm)					
		Single Span			Continuous Span		
2/SJ20044	40	3200	2950	2700	4200	3950	3700
	90	2900	2500	2200	3900	3500	2750
2/SJ24040	40	3650	3350	3050	4600	4300	3950
	90	3300	2850	2500	4250	3600	3050
2/SJ24051	40	3850	3600	3300	4850	4550	4250
	90	3550	3100	2700	4500	4100	3400
2/SJ24070	40	4100	3850	3600	5200	4900	4550
	90	3800	3350	2950	4800	4350	3400
2/SJ24090	40	4350	4050	3800	5500	5150	4850
	90	4000	3600	3150	5100	4600	4050
2/SJ25570	40	4250	4000	3750	5400	5050	4750
	90	3950	3550	3100	5000	4500	4100
2/SJ30040	40	4150	3900	3650	5250	4950	4500
	90	3850	3450	3000	4850	4100	3450
2/SJ30051	40	4350	4100	3850	5550	5200	4850
	90	4050	3650	3250	5150	4650	3950
2/SJ30070	40	4650	4400	4100	5950	5550	5200
	90	4300	3900	3500	5500	4950	4350
2/SJ30090	40	4950	4650	4350	6250	5900	5500
	90	4550	4100	3750	5800	5250	4750
2/SP30095	40	5050	4750	4450	6450	6050	5650
	90	4700	4250	3850	5950	5400	4900
2/SJ36058	40	5050	4750	4450	6400	6050	5650
	90	4700	4250	3850	5950	5400	4800
2/SJ36090	40	5450	5150	4800	6950	6550	6100
	90	5050	4550	4150	6450	5800	5300
2/SJ40090	40	5800	5450	5100	7400	6950	6500
	90	5350	4850	4400	6850	6200	5600

NOTES:

1. Bearing lengths - minimum of 30 mm
2. Wall loads assumed 0.37 kPa
3. Floor load loads 1.5 kPa or 1.8 kN point live load
4. Upper floor dead load 40 kg/m^2 .
5. deflection limits: permanent load - span/300 or 12 mm max LL - span/360 or 9 mm max.

SmartJoist as rafters

About roofs

Roof members are subject to dead and live loads as well as wind loads. These wind loads can act either down onto the roof, or can create an uplift effect. For roofs of light construction, the uplift loads generally control the maximum span, whereas it is usual for dead and live loads to be the controlling factors for heavier roofs (e.g. tiles). SmartJoists, by their large depth to width ratio, perform well in roof situations providing that their upper and lower flanges have adequate lateral support provided by battens and/or ceiling materials . Due to this fact, the spans in the table below only apply for roofs which meet the following criteria:

1. - Enclosed building

SmartJoist as rafters (Cont'd)

2. Ceiling fastened to the underside of bottom flange or adequate lateral supports to bottom flange at a minimum of 600 mm centres
3. Roofs are constructed as per details R1 to R9 of this manual
4. Batten spacing at a maximum of 1200 centres.

1. Tie downs

Wind loadings on light roofs can produce net uplift pressures. The same requirements and methods of tie down apply to SmartJoists as for solid timber roof members except that any tie down system must extend over the top flange. Guidance for tie down requirements are provided in AS 1684 series.

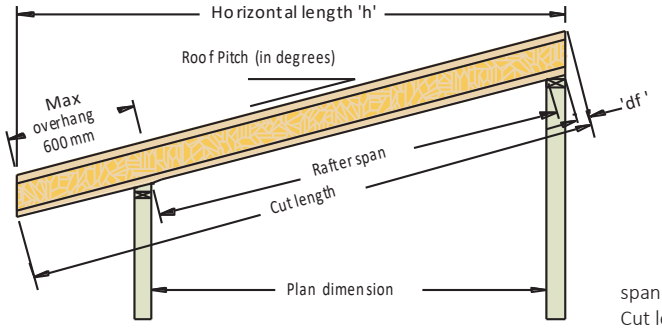
Wind Classification N1 - N3

Max Deflections DL: Span/300 LL: Span/250 WL: Span/150. Max Slope = 25°.

Joist Code	Roof mass (kg/m²)	Single span @ 25° pitch				Continuous 2 span @ 25° pitch			
		Rafter/roof beam spacing (mm)							
		450	600	900	1200	450	600	900	1200
		Recommended maximum rafter span - Plan dimension (mm)							
SJ20044	40	5400	5000	4400	4100	N/A(1)	N/A(1)	N/A(1)	4550
	90	3850	3500	3050	2750	N/A(1)	4900	4250	3800
SJ24040	40	5600	5150	4500	4100	N/A(1)	N/A(1)	4850	4300
	90	4350	3950	3450	3100	N/A(1)	4750	4050	3550
SJ24051	40	6000	5550	4850	4450	N/A(1)	N/A(1)	N/A(1)	5200
	90	4700	4250	3700	3350	N/A(1)	N/A(1)	4950	4350
SJ24070	40	6600	6050	5350	4850	N/A(1)	N/A(1)	N/A(1)	N/A(1)
	90	5100	4650	4050	3650	N/A(1)	N/A(1)	N/A(1)	N/A(1)
SJ24090	40	7000	6500	5750	5250	N/A(1)	N/A(1)	N/A(1)	N/A(1)
	90	5500	5050	4400	3950	N/A(1)	N/A(1)	N/A(1)	N/A(1)
SJ25570	40	6800	6400	5800	5400	N/A(1)	N/A(1)	N/A(1)	N/A(1)
	90	5700	5300	4600	4100	N/A(1)	N/A(1)	6000	N/A(1)
SJ30040	40	6600	6100	5400	4850	N/A(1)	N/A(1)	N/A(1)	N/A(1)
	90	5200	4700	4100	3700	N/A(1)	N/A(1)	N/A(1)	N/A(1)
SJ30051	40	7100	6550	5800	5300	N/A(1)	N/A(1)	N/A(1)	N/A(1)
	90	5600	5050	4450	4000	N/A(1)	N/A(1)	N/A(1)	N/A(1)
SJ30070	40	7800	7200	6350	5800	N/A(1)	N/A(1)	N/A(1)	N/A(1)
	90	6100	5550	4850	4400	N/A(1)	N/A(1)	N/A(1)	N/A(1)
SJ30090	40	8250	7700	6800	6250	N/A(1)	N/A(1)	N/A(1)	N/A(1)
	90	6550	6000	5200	4700	N/A(1)	N/A(1)	N/A(1)	N/A(1)
SP30095	40	8000	7500	6900	6500	N/A(1)	N/A(1)	N/A(1)	N/A(1)
	90	6700	6300	5700	5300	N/A(1)	N/A(1)	N/A(1)	N/A(1)
SJ36058	40	8450	7950	7000	6400	N/A(1)	N/A(1)	N/A(1)	N/A(1)
	90	6750	6150	5400	4850	N/A(1)	N/A(1)	N/A(1)	N/A(1)
SJ36090	40	9150	8650	7800	7150	N/A(1)	N/A(1)	N/A(1)	N/A(1)
	90	7550	6900	6000	5450	N/A(1)	N/A(1)	N/A(1)	N/A(1)
SJ40090	40	9650	9150	8350	7750	N/A(1)	N/A(1)	N/A(1)	N/A(1)
	90	8150	7450	6500	5900	N/A(1)	N/A(1)	N/A(1)	N/A(1)

NOTE: (1) Maximum Continuous spans exceed the maximum available length of the SmartJoist

Sloped roof span and cut lengths



Roof slope degrees	Slope factor 's_f'	Depth factor 'd_f'				
		Joist depth (mm)				
		200	240	300	360	400
15.0	1.04	54	64	80	96	107
17.5	1.05	63	76	95	113	126
20.0	1.06	73	88	109	131	146
22.5	1.08	83	99	124	149	166
25.0	1.10	93	112	140	168	187
27.5	1.13	104	125	156	187	208
30.0	1.15	115	139	173	208	231
35.0	1.22	140	168	210	252	280

span (mm) = plan dimension x slope factor (s_f)
Cut length (mm) = horizontal length (h) x slope factor (s_f) + depth factor (d_f) = h x s_f + d_f

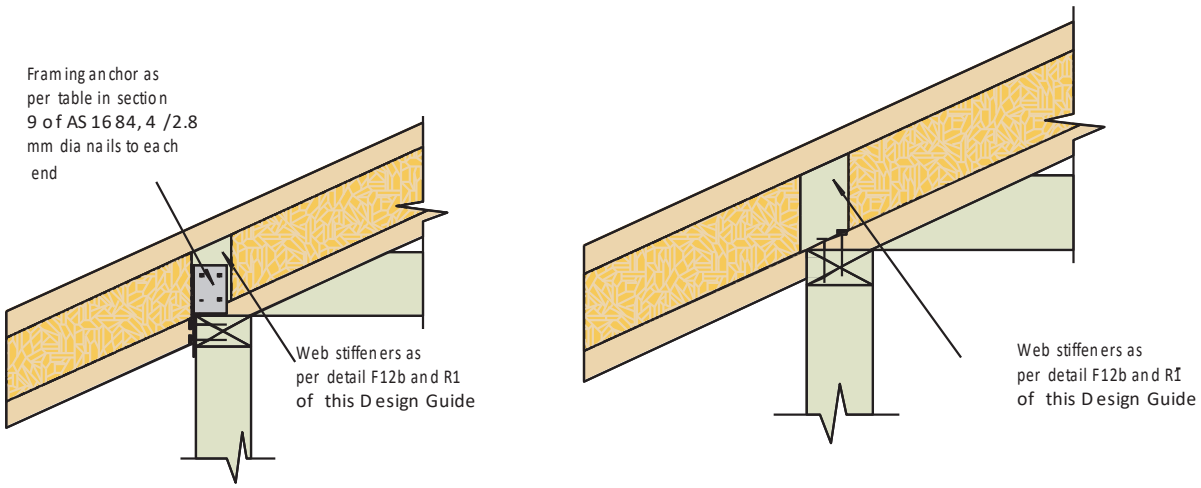
SmartJoist rafter tie-down

SmartJoist rafters need to be tied down in wind uplift situations in a similar manner to solid timber as shown in section 9 of AS 1684. it is beyond the scope of this document to show tie down requirements for every case.

The examples shown in this section are equally applicable to SmartJoists except that web stiffeners as per detail F12a and R1 must be installed to the SmartJoists where either skewed nails or framing anchors are chosen as the tie down method before the uplift capacities in the tables in section 9 of AS 1684 can be adopted.

All tie down types that involve a strap over the top of the SmartJoist rafters, or involving the bolting down of a member above the rafter running in the perpendicular direction, require no modification to the SmartJoist and therefore uplift capacities in the tables in section 9 of AS 1684 may be used.

The SmartFrame software has a tie-down module in which the development of tie down systems complying with section 9 of AS 1684 can be easily designed.



Typical SmartJoist rafter box gutter details

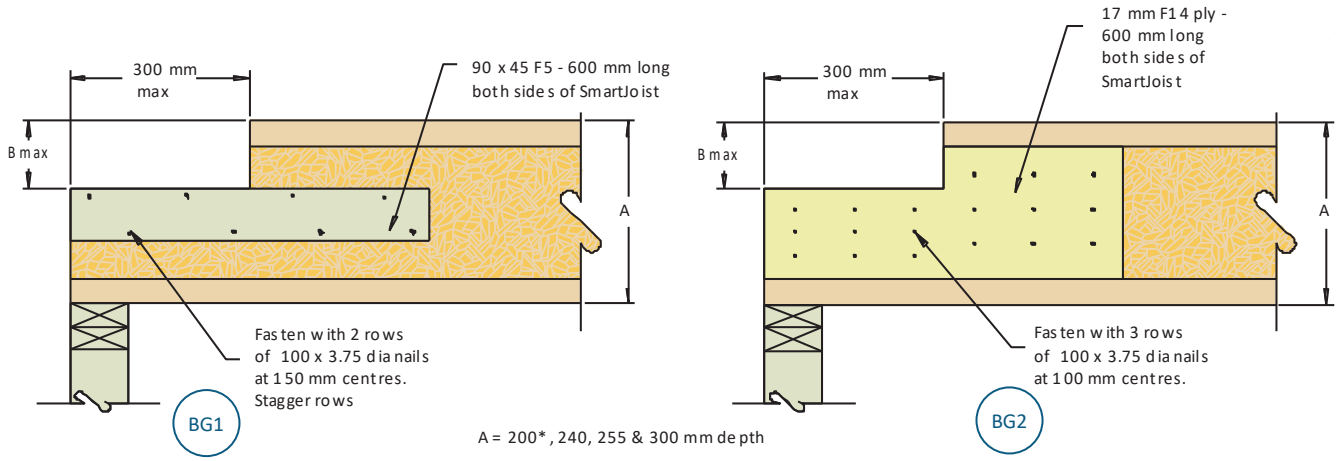
Box gutter details

Rebates for box gutters are permissible within a roof constructed with SmartJoist rafters to the MAXIMUM rebate limits as shown below.

- Fig BG1 with 2 pieces of 90 x 45 nailed to the web reduces shear capacity by 40%
- Fig BG2 with 2 pieces of 17 mm F14 ply nailed to the web maintains full shear capacity

Given that the design shear values at the end of rafters with lightweight roofs are usually very low compared to the allowable shear, in most instances figure BG1 is satisfactory to provide a box gutter rebate within the SmartJoist rafters, however the remaining shear capacity MUST be checked.

It is recommended that designers wishing to cut box gutter rebates in SmartJoist rafter contact the Tech Support Customer Helpline on 1300 668 690 or at techsupport@tilling.com.au for further advice on this issue.



A = 200*, 240, 255 & 300 mm depth

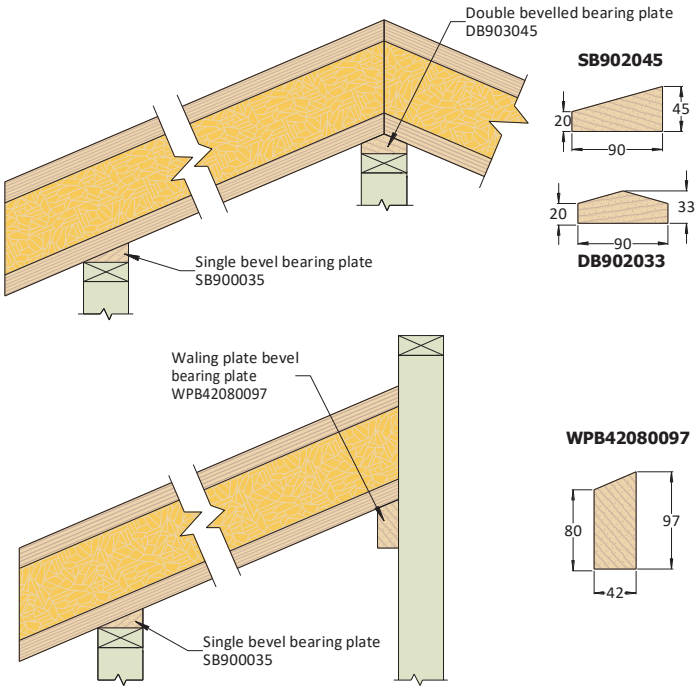
B = 50 mm when A = 240 and 255 mm
B = 100 mm when A = 300 mm

200 mm - Requires ply infil, 90 x 45 solid timber reinforcement is not suitable

SmartFrame bevelled bearing plates

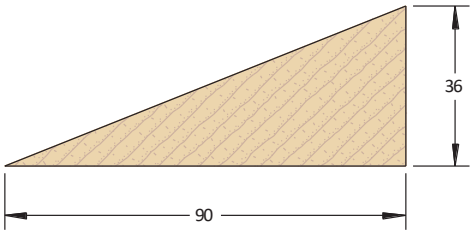
The use of beveled bearing plates makes the use of lightweight SmartJoists as rafters even more attractive, removing the need for most, if not all joist hangers. From its sophisticated wood working equipment such as CNC cutting and machining tools, Tilling Timber can supply ancillary components to further revolutionise the rapid and cost effective installation of SmartJoist roof systems

- Single and double bevel plates for rafter angles from 6° to 24° slope from 90 mm wide seasoned softwood can be supplied as an integral part of a long span lightweight SmartJoist roof layout
- SmartJoist rafters can on request, be supplied plumb cut on either one or both ends
- Waler bevel plate for rafter angles 6° to 45° slope from either SmartLVL or seasoned softwood can be supplied as an integral part of a SmartJoist roof layout.



Example single bevel bearing plate

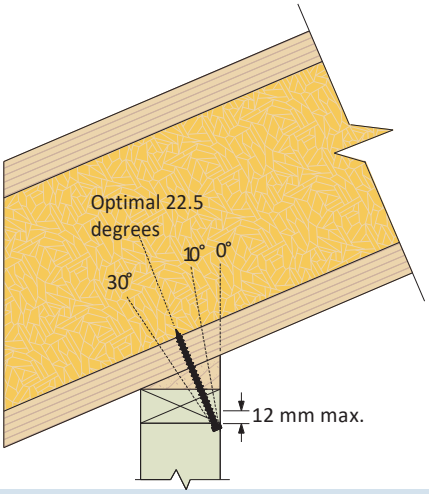
Example SmartFrame bevel plate sizes for 90 mm wide plate, nil front upstand			
Roof slope°	Height (mm)	Roof slope°	Height (mm)
6	9	16	26
8	13	18	29
10	16	20	33
12	19	22	36
14	22	24	40



Notes:

- SmartFrame bevelled bearing plates, where requested, are designed by the Design Centre into a SmartJoist roof system layout. They are not sold individually as they are custom made only for the associated SmartFrame roof system and are not a stocked item
- SmartFrame bevelled bearing plates can be supplied in seasoned softwood or Smart LVL, depending upon the application
- Allow five (5) working days from placement of order for non-retreated members, allow 10 working days for bevelled bearing plates requiring H2f treatment of cut face
- Bevelled bearing plates with a nil front upstand (triangular shape) for roof slopes less that 6° are not available because of the difficulty of cutting and small wood volume likely to split when nailed. It is recommended for low slope rafters that a 20 mm front upstand be used

Strong-Drive® SDWC Truss screw



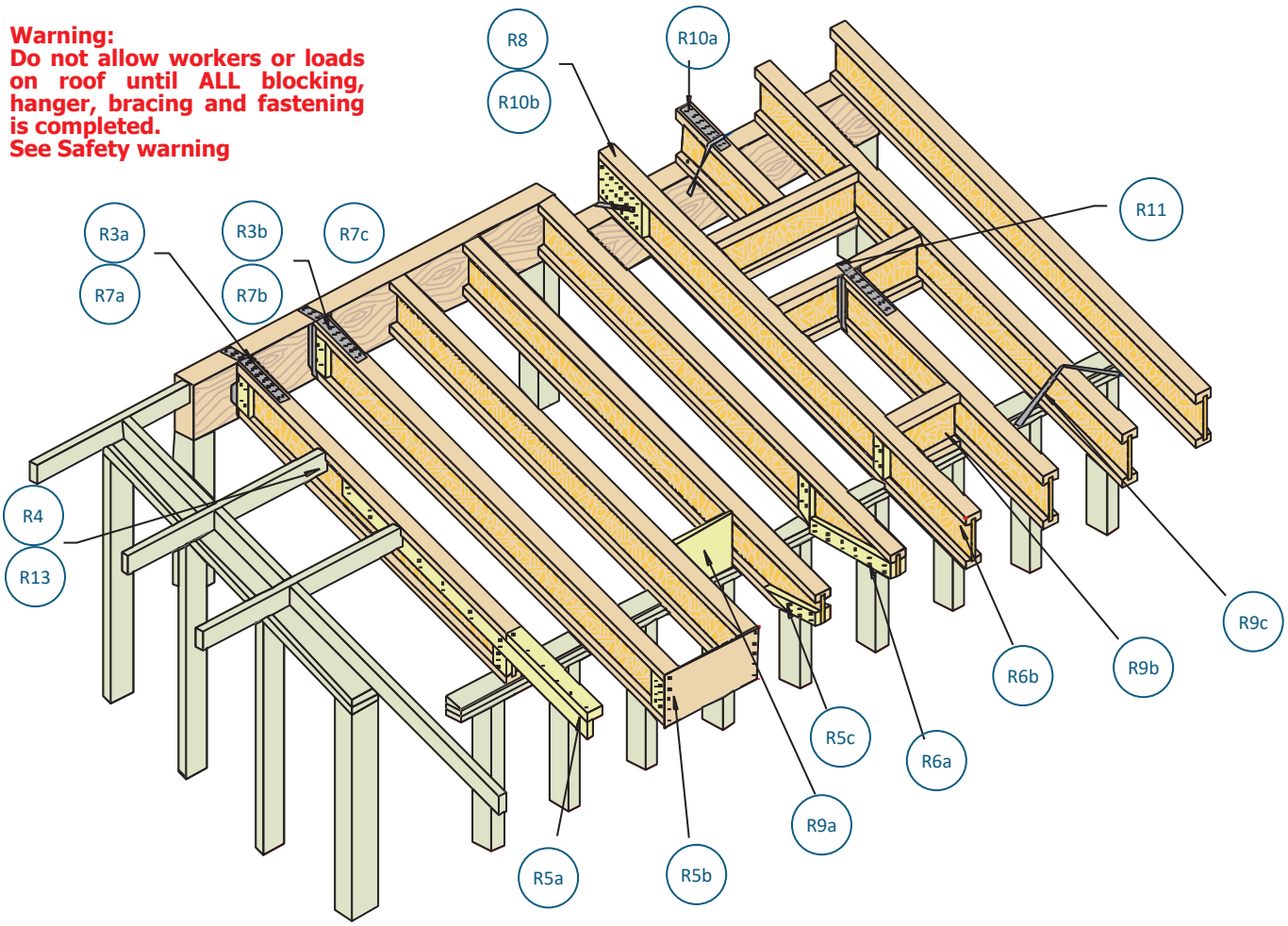
A clean, neat screw system that connects both the SmartJoist rafter and SmartFrame bevelled bearing plate to the wall top plate.

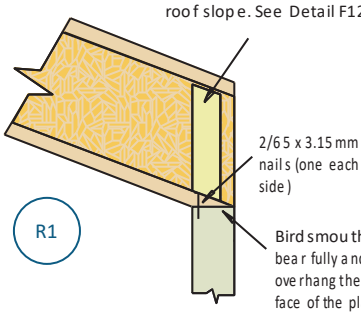
The SDWC Truss screw is tested for uplift and lateral loads between wall plates and vertical wall framing and between the top plate and the roof rafters or trusses. The SDWC screw is recognised for use in chemically treated timber.

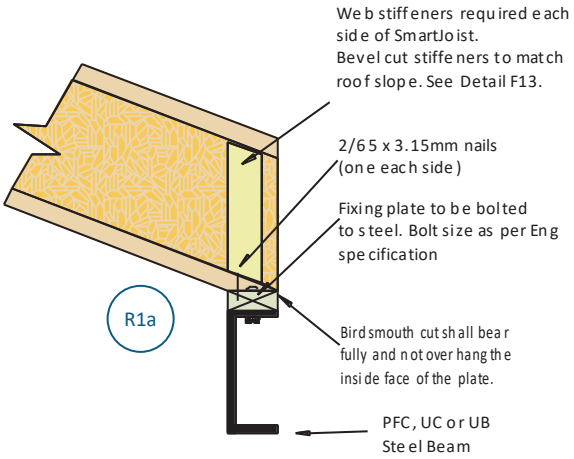
Installation Guides and Capacity tables for the SDWC system are available from www.strongtie.com.au.

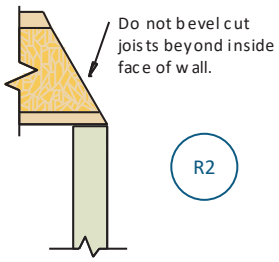
Typical SmartJoist Roof details

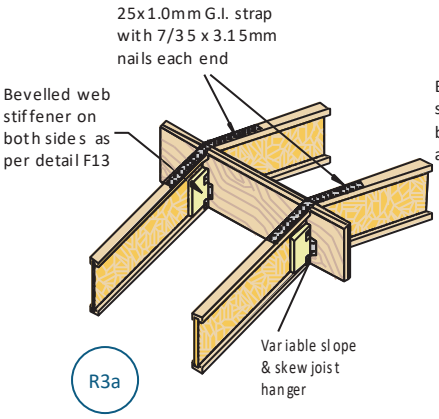
Warning:
Do not allow workers or loads on roof until ALL blocking, hanger, bracing and fastening is completed.
See Safety warning

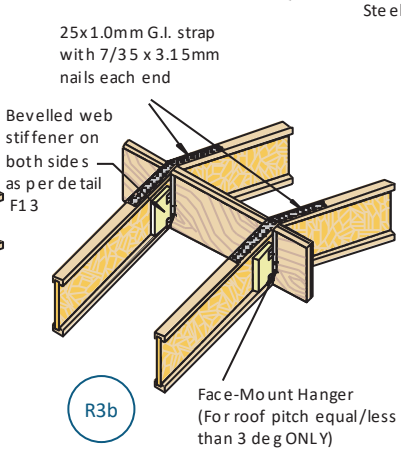


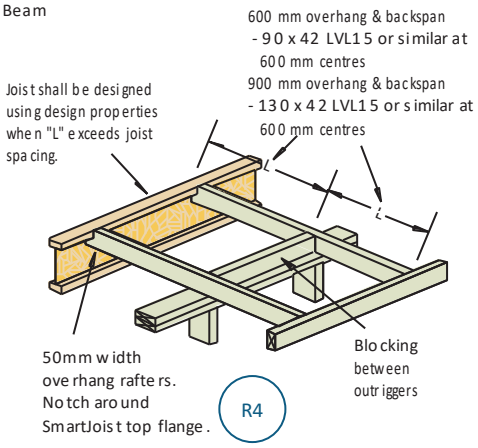






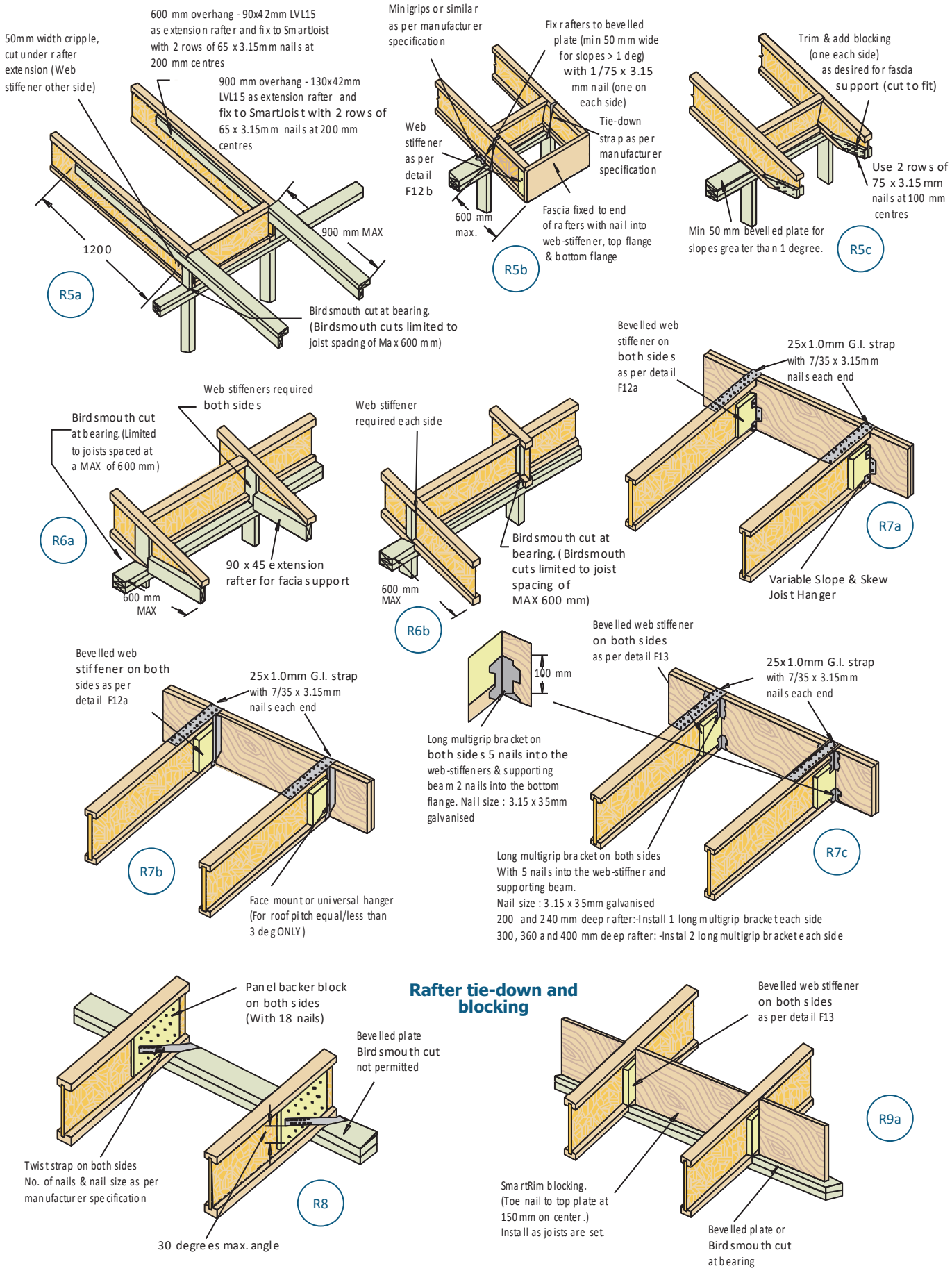




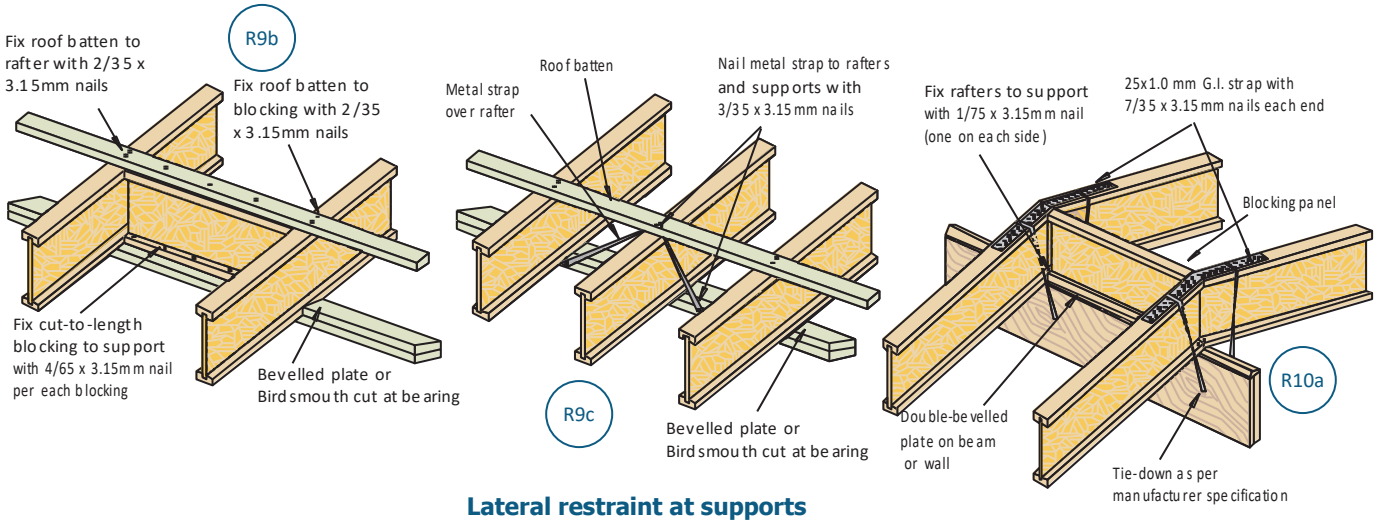


Note: Tiedown details to be designed to AS 1684.2 for the respective wind loads with the SmartFrame software

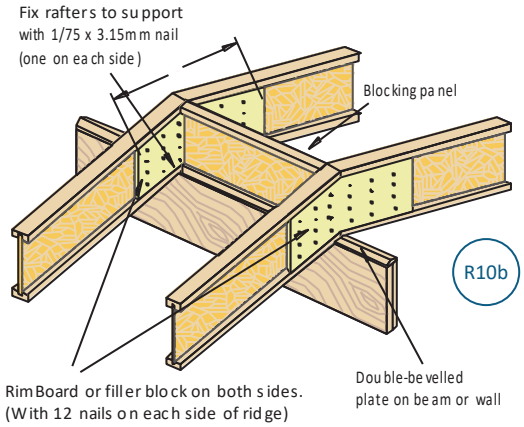
Typical SmartJoist Roof details (cont'd)

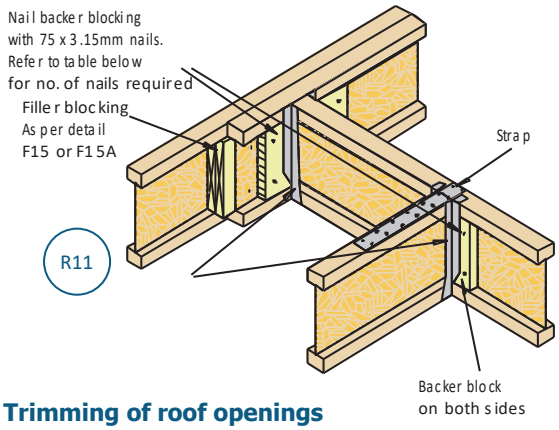


Typical SmartJoist Roof details (cont'd)

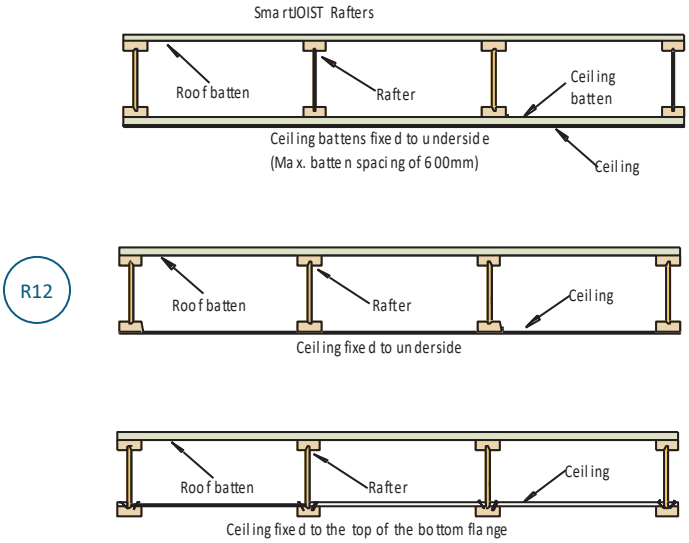


Lateral restraint at supports

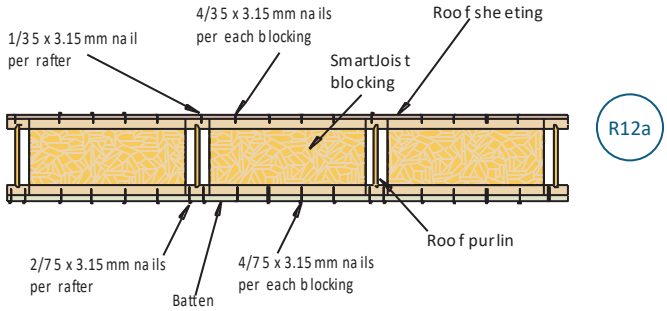




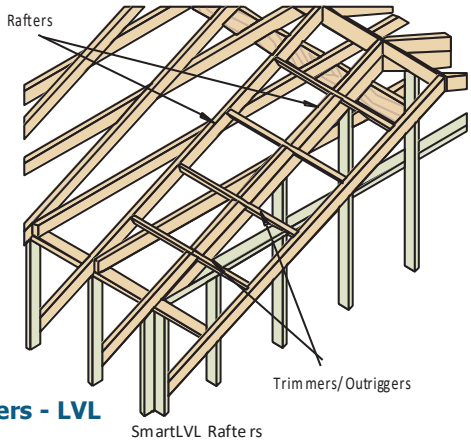
Trimming of roof openings



Lateral restraint for rafters - Use of ceiling options to provide lateral support



Lateral restraint - SmartJoist blocking fixing



Outrigger rafters - LVL

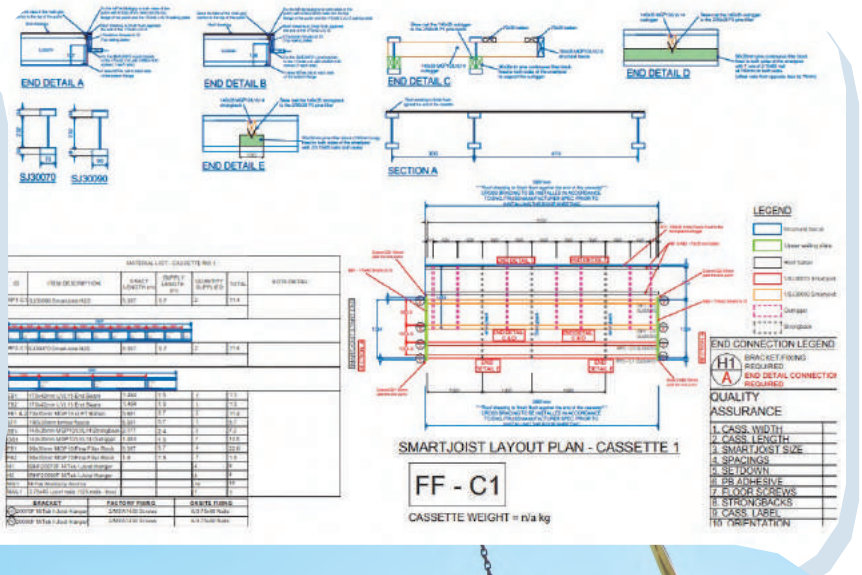
SmartJoist roof cassettes

The lightweight long spanning SmartJoists are ideal roof components for mono-slope and pitched roof applications, both parallel and perpendicular to the roof slope.

Sophisticated CAD design systems and CNC manufacturing processes adopted by Tilling Timber nationally has meant that the benefits of offsite manufacture of SmartJoist roof cassettes using SmartJoists and other products from the SmartFrame family of EWP where necessary, had rapidly become mainstream in the Australian market.

Since designing and building the approx. 3600 m^2 floor cassettes for the inaugural five (5) storey lightweight framed class 2 building in Australia in 2014, the SmartFrame Design Centre has continued to expand a well experienced dedicated cassette team that specialises in the design and production of shop drawing for sophisticated cassettes.

For further information about the application of offsite manufactured SmartFrame cassettes in your project pleased contact Tech support Helpline on 1300 668 690 or at techsupport@tilling.com.au.



SMARTFRAME
Powered by Innovation

Building envelope watertightness - decks

Deck ledger attachments

Many houses have decks attached to them. They are usually attached by first installing a deck ledger to the side of a house. The ledger carries the load for one end of the floor joists of the deck. The ledger and its attachment points penetrate the exterior cladding and must be flashed to protect the wall from rain water running down the cladding.

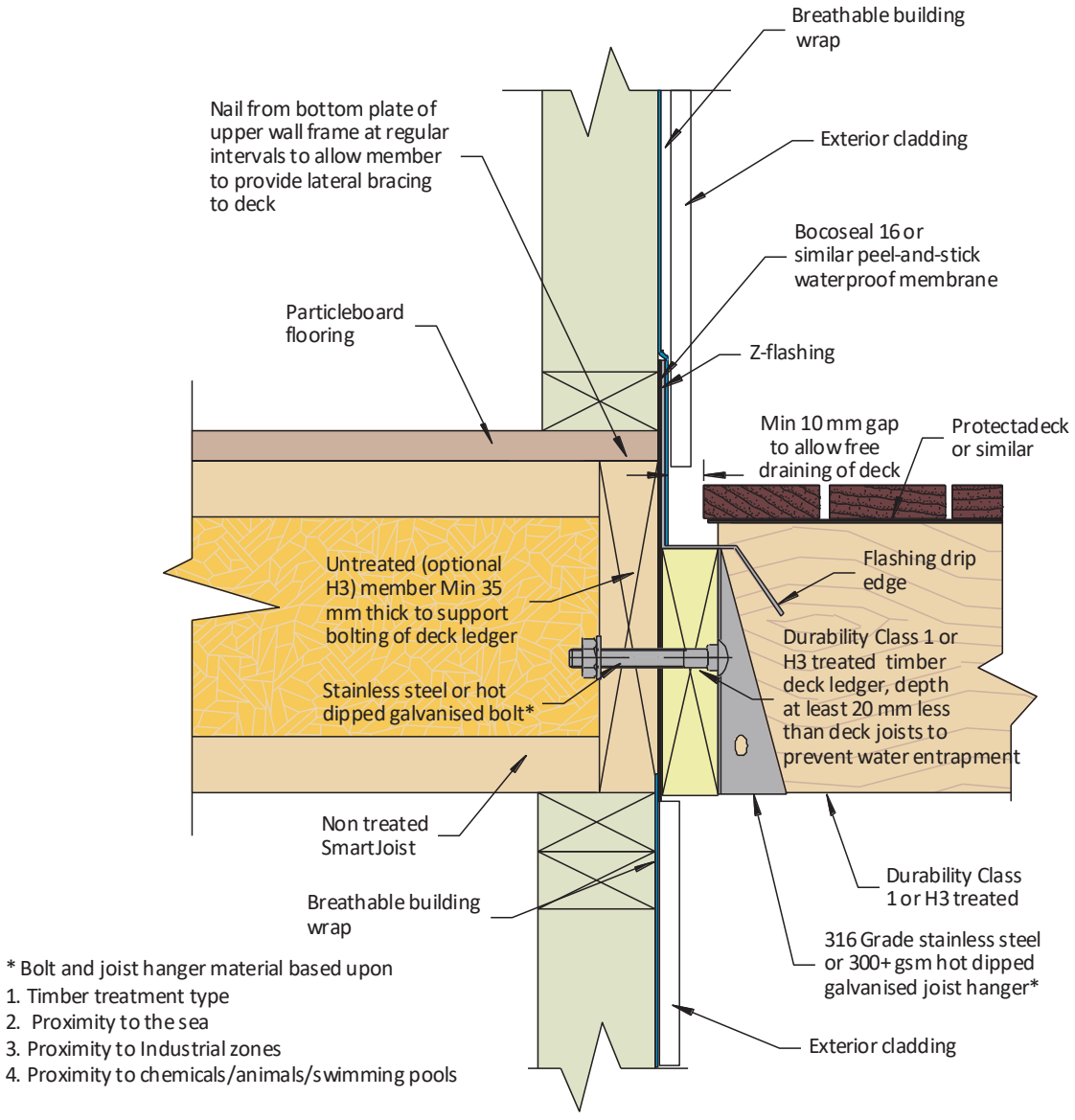
This area of the wall experiences more rain exposure than most others because rain hitting the deck next to the wall splashes against the wall. "Free-standing" decks avoid this problem because they do not penetrate the cladding envelope.

As with window and door installations in walls, paying careful attention to flashing details is critical to avoid potential rot and mould of inner non treated wall frames and floor systems. Water from direct rainfall, splash from decks and runoff from incorrectly sloped deck surfaces can leak into the exterior wall where the deck attaches to the house.

Several conditions contribute to the water problem:

- The ledger board is simply attached to the house with numerous lag screws or other hardware that penetrate the wall's cladding and drainage plane, but no flashing has been installed to protect these areas
- Water is often trapped behind the ledger board
- Upward splashing of rain from the deck adds significant wetting to the cladding, and inadequate flashing results in wetting and rot in the wall's framing and other internal elements.
- Integrating the attachment of the ledger board with the drainage plane behind the wall's cladding and adding proper flashing will maintain the integrity of the drainage plane and channel water away from the wall's surface.

Example flashing of deck ledger connection to un-treated house frame



* Bolt and joist hanger material based upon
1. Timber treatment type
2. Proximity to the sea
3. Proximity to Industrial zones
4. Proximity to chemicals/animals/swimming pools

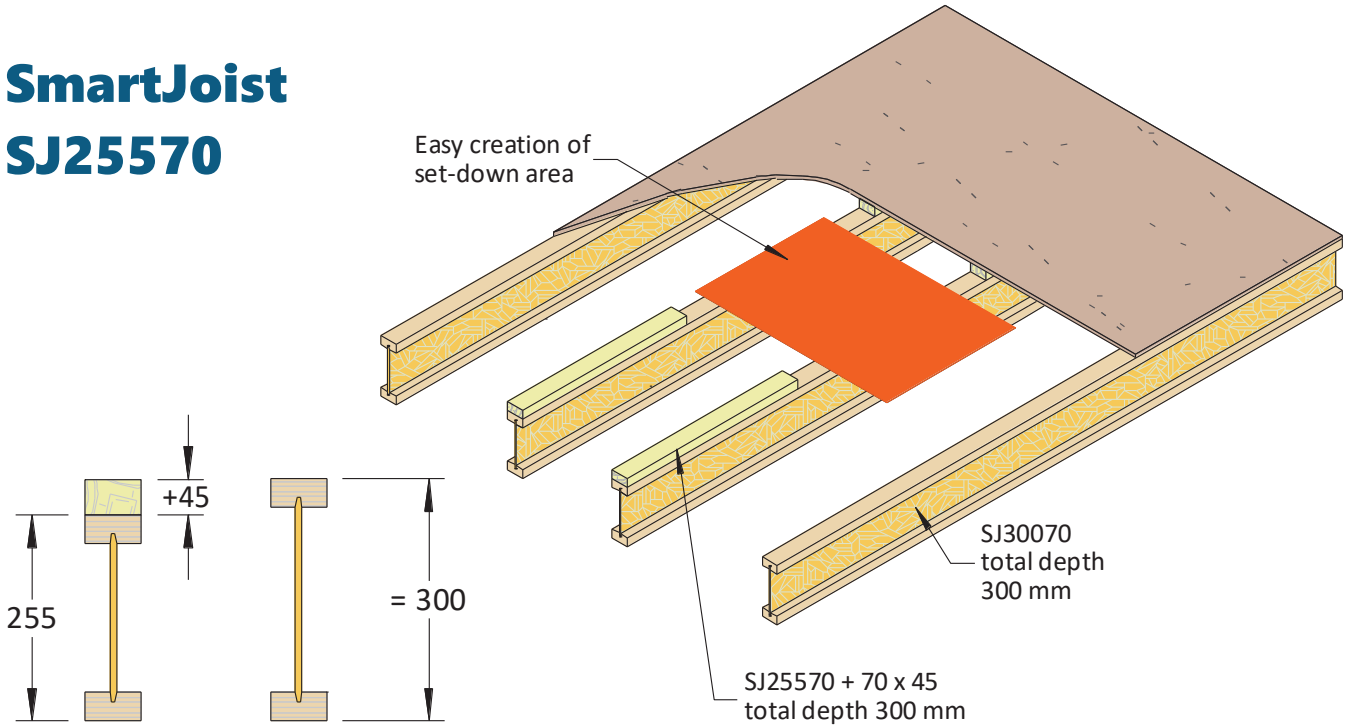
SmartJoist floor set-downs

Floor set-downs

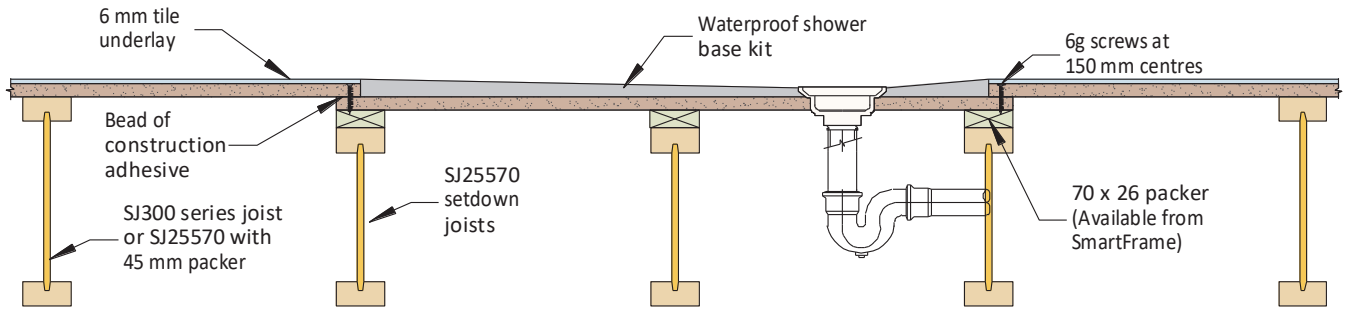
In recent years accessibility considerations are mandated for house construction. This has resulted in the growing use of set-downs to create a "wet room" or "open bathroom" where the edge of shower base is at the same level as the floor, with a small fall to the shower outlet. Typically the entire floor including the shower base is seamlessly tiled.

The different depths and flange width of joists within the SmartJoist range make the creation of set-down areas a simple exercise by adding shallower joists in the set down area, these shallower joists either being supported on internal/external walls or off trimmers between the deeper joist.

SmartFrame innovation has further simplified the set-down of areas within the most common floor depth 300 mm floor depth by introducing a 255 mm deep set-down joist, the SJ25570. The SJ25570 joist offers a 45 mm set-down from the 300 mm deep joists, BUT, may also be packed up to 300 mm with stock standard 45 mm framing timber.



Example "wet room" shower detail



Notes:

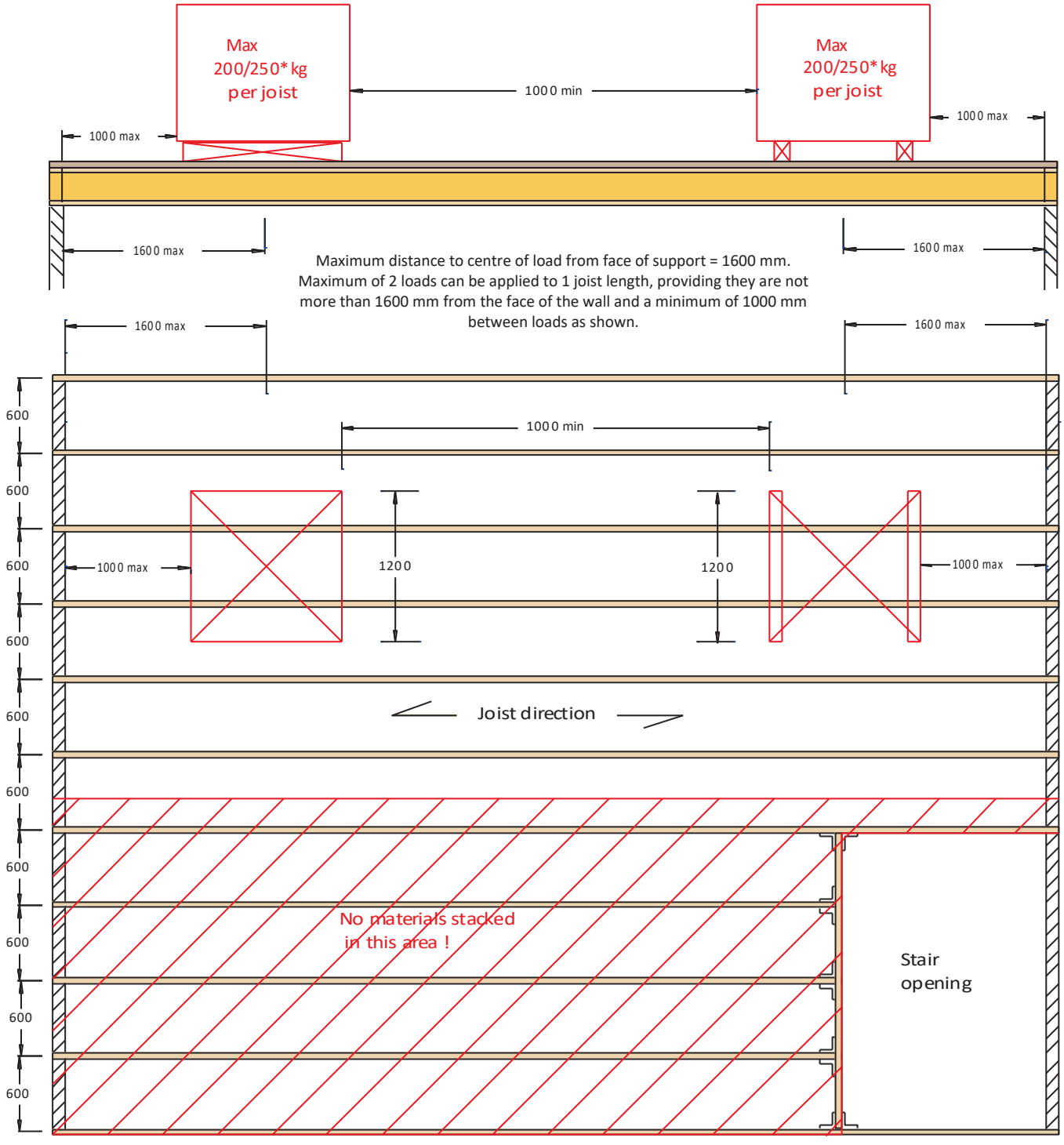
1. In the above detail, wet are waterproofing in accordance with NCC volume 2 Part 3.8.1 has been omitted for clarity. It is the users responsibility to ensure that any areas subject to moisture are correctly detailed as per NCC and /or local authority requirements

2. This is an example using a proprietary waterproof shower base kit with an exterior rim height of 25 mm. Given the prevalence of this size, lengths of 70 x 26 mm packers are available in conjunction with SJ25570 joist orders. These packers are available only with SJ25570 order, and are not a separate stock item

Safe loading of materials on a SmartJoist working platform

IMPORTANT!! Joists must be fully braced of have floor sheeting installed before applying any of the following loads.

* 200 kg per joist for joists less than 240 mm deep
* 250 kg per joist for joists 240 mm and greater



Notes:

1. Deflection limit is taken as span/200
2. All timber must be kept dry when applying maximum temporary loading
3. Loads are to be spread equally over a minimum of 2 joists, using timber bearers at a minimum of 1200 mm in length or a standard 1200 x 1200 pallet
4. NO loads are to be stacked over any part of the lengths of the joists fixed to an opening header or trimmer joist such as a stair trimmer
5. If no plasterboard is in place under the joists, the bottom flange requires temporary bracing
6. Joists on hangers may require propping
7. If unsure about stacking concentrated loads on SmartJoist working platforms, please contact the SmartFrame Design Centre on 1300 668 690.

Fire safety and sound transmission

Fire safety

The Building code of Australia became a performance-based code in 1996 (BCA96). The introduction of the BCA along with the changes to AS 1530.4 has seen Australia brought into line with international standards for fire resistance testing. The principle modification has been to express the test result in terms of the performance of the specimen Fire Resistance Level (FRL) rather than to assign a single rating as had been the established practice. The outcome of the test is expressed as the number of minutes for which the specimen fulfils the requirements of each of the three criteria, being:

i. Structural adequacy
ii. Integrity; and
iii. Insulation, and expressed in that order

The performance of a specimen is then given as the actual time for which the specimen satisfied these criteria, but rounded down to the nearest regulatory requirements. E.g. 60/60/60.

Ceiling systems may also be required to provide "Resistance to the Incipient Spread of fire" for a given period of time. This requires the ceiling system to prevent the spread of fire within a roof/ceiling or floor/ceiling cavity by providing adequate thermal insulation to combustibles in this area, avoiding the danger of them igniting. To coincide with the changes, the FWPA produced a set of Wood Solutions manuals *"Design and construction guide for BCA compliant fire-rated construction"* which outlined the BCA requirements for all classes of buildings, design criteria and construction details which were designed to satisfy the BCA requirements.

Fire rated floors/ceilings

The best information available at this time concludes that the fire resistance for ceiling and floor/ceilings is achieved by the lining material and that alternative joist sizes and material can be substituted in the various certified systems, providing they are designed to support the full loads. The thickness of the fire grade ceiling lining for the relevant FRL is the same as required in the tested systems using solid timber joists.

Additional testing have concluded that the following layers of fire rated plasterboard can achieve the FRL and incipient spread of fire as listed in the following table:

Fire grade plasterboard	FRL	Incipient spread of fire
1 x 13 mm	30/30/30	0
1 x 16 mm	60/60/60	30
2 x 13 mm	60/60/60	30
2 x 16 mm	90/90/90	60
3 x 16 mm	120/120/120	60

The above ratings can be achieved using standard fire grade plasterboard from some sheet manufacturers. Other manufacturers may however require the use of special fire rated board or may still require the number of layers outlined in the Wood Solutions Design and construction guide for BCA compliant fire-rated construction.

For further details on the various certified systems, see the Wood Solution website www.woodsolutions.com.au or contact the engineers on the Tech Support Customer Helpline on 1300 668 690.

Sound transmission

The ability of walls and floors to reduce noise is measured over the most important part of the hearing range (from 125 to 4000 cycles per second), and the results reduced to a "weighted sound reduction index" or R_w value. In 2004, the BCA introduced the addition of a Spectrum Adaption factor. This C_{tr} factor takes into account lower frequency level sounds, and has been chosen in large part, in recognition of the problem of the high bass frequency outputs of modern home theatre systems and amplified music systems. Therefore, both the C_{tr} and the R_w of the building element will now need to be considered.

In addition to being rated for airborne sound transmission, floors are also rated by "Impact sound pressure level" or $L'_{n,w}$ plus the spectrum adaption factor C_I values that rate the capacity of floor assemblies to control impact noise such as footfalls. The lower the $L'_{n,w}+C_I$ of the floor, the better the performance of the floor in terms of impact sound insulation

The BCA now requires a R_w+C_{tr} of 50 in floors between sole occupancy units and between dwellings and a plant room, lift shaft, stairway, public corridor, public lobby or similar.

In 2004, the BCA introduced Deemed-to-satisfy provisions which require the $L'_{n,w}+C_I$ of a floor to be determined by testing in the laboratory. The impact sound insulation requirements for floors in the BCA is $L'_{n,w}+C_I$ not more than 62 for floor separating dwellings and floor separating dwellings from a plant room, lift shaft, stairway, public corridor, public lobby or similar.

The use of light-frame construction systems challenges designers to insulate against noise rather than simply relying on the massiveness of heavy walls and floors. Excellent levels of noise control can be achieved with good acoustics in wood framed structures surfaced with wood structural panels. Sound control can be achieved by applying floor and wall materials over isolated air spaces that absorb sound. The addition of resilient channels to support the ceiling system independently increases the R_w+C_{tr} and $L'_{n,w}+C_I$ ratings.

The best current understanding indicates that the systems – walls, floors and ceiling" as detailed in the Wood Solutions manuals "*Design and construction guide for BCA compliant fire-rated construction* can be used to closely approximate the R_w+C_{tr} and $L'_{n,w}+C_I$ rating of floor/ceiling systems with SmartJoist floor joists. Work is under way to further investigate the link between joist types and impact sound insulation.

Some example systems are shown on the next page as an indication of Fire and Acoustic rated SmartJoist systems.

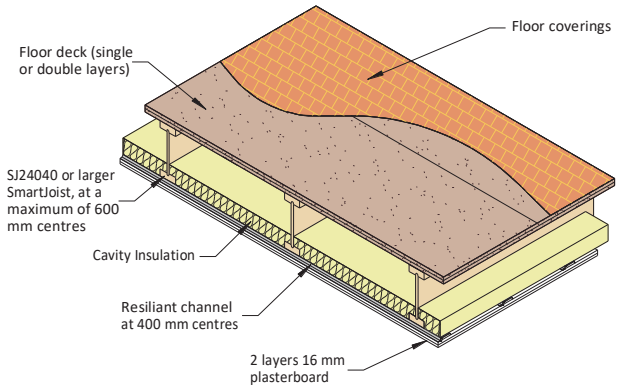
For further details on the various certified systems see www.woodsolutions.com.au or contact the engineers on the Tech Support Customer Helpline on 1300 668 690 or at techsupport@tilling.com.au

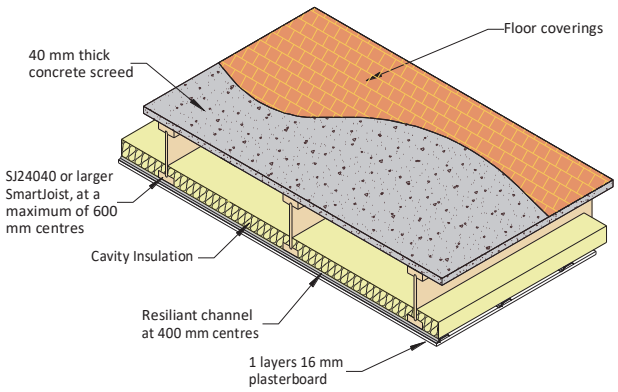
Examples of fire and/or acoustic rated SmartFrame floor assemblies

Lightweight concrete toppings are frequently installed over engineered wood floor systems in multi -residential and commercial construction. Such composite floor systems are typically constructed as fire-rated assemblies with code-compliant fire and acoustic performance.

However, In recent years, the wood structural panel industry has developed all-wood floor systems that use single or double-layer floor sheathing meeting both fire and acoustic performance requirements without the use of concrete topping.

The diagrams below detail an All-Wood floor system that has been tested to ASTM International. *Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.* ASTME90 (2016) and ASTM International. *Standard Classification for Determination of Impact Insulation Class* (IIC). ASTME989-06 (2012). Tests to these standard test methods demonstrate that the two systems shown below give very similar airborne sound resistance (STC*) and Impact resistance (IIC*) values. (similar Acoustic performance)

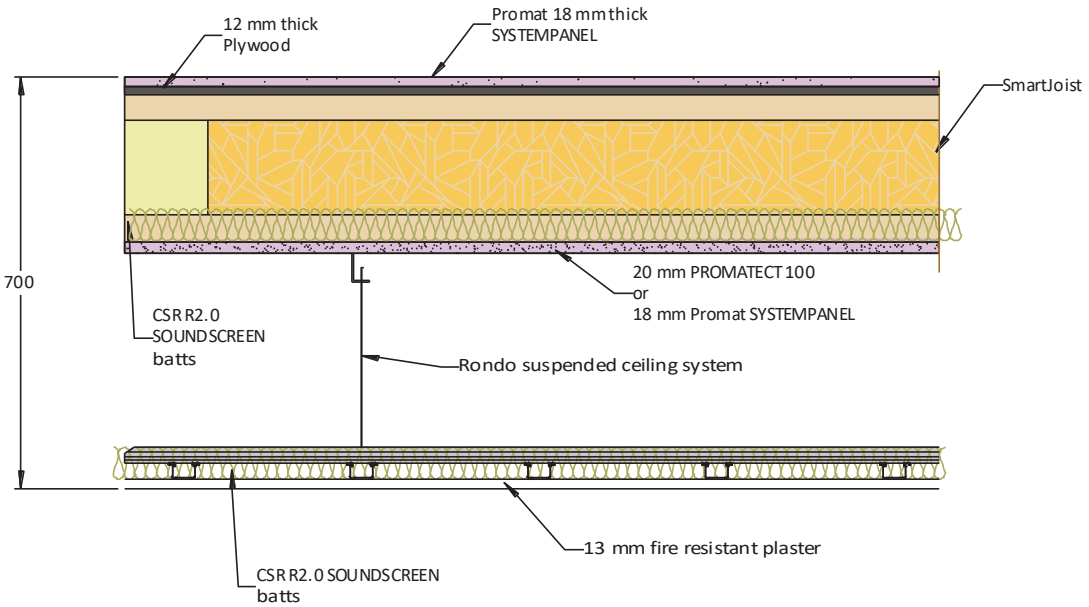




Note: STC and IIC values are US scales and in this example are used to compare systems only. Approximate conversions to R_w and $L_{n,w}$ scales are available.

For more information about Acoustic rated All -Wood floor systems, contact SmartFrame Tech Support on 1300 668 690

FRL 60/60/60



NOTE:

The examples above are included to demonstrate that SmartFrame lightweight floor systems can easily be designed to provide both acoustic and fire properties that meet the requirement's of the NCC, however, these examples are not to be specified without further expert advice from acoustic and fire experts and /or the inclusion of SmartFrame product into tested and certified proprietary systems, where applicable.

Preservative treatment

The treatment of timber to extend its service life is covered by AS/NZS 1604. This code identifies the various biological hazards by a hazard class number, with hazard class numbers from H1 - H6. The higher the hazard class number, the greater the severity of the biological hazard. A complete table listing the 6 hazard classes is contained within AS/NZS 1604.1.

All SmartJoists are supplied H2s treated per the table below, or alternatively may be after-market H2 treated by an experienced and approved timber preserver.

Water borne treatments are NOT suitable for SmartJoists.

It is also NOT recommended that SmartJoists be specified for use outside above ground, even if H3 treated. This is predominately due to the geometric shape of the I-Joist which will not shed water effectively.

Further information on treated I-Joists can be obtained on 1300 668 690 or at techsupport@tilling.com.au

Hazard Class	Exposure	Specific service conditions	Biological hazard	Typical uses
H1*	inside, above ground	Completely protected from the weather and well ventilated, and protected from termites	Lyctid borers	Interior beams, stair cases, stringers
H2s	inside, above ground	South of the Tropic of Capricorn ONLY Protected from weather, Nil leaching	Borers and termites	Interior joists, rafters and roof beams
H2	inside, above ground	Protected from weather, Nil leaching	Borers and termites	Interior joists, rafters and roof beams

* All SmartJoists are manufactured from materials not susceptible to Lyctid attack

Adhesive and formaldehyde emission facts sheet

Q. Are the glues used in SmartFrame Engineered Wood Products safe?

A. Yes, they are safe, Phenolic resins used in our Engineered Wood Products are stable, polymerised materials. The polymerisation reaction is non-reversible (i.e. once the polymer is formed, it doesn't break down). A wood dust warning label is provided for all SmartFrame wood products to alert our customers that wood dust can be generated by sawing, sanding, or machining wood and wood products.

Q. What is the level of formaldehyde emission from our phenolic-bonded Engineered Wood Products?

A. Independent third party testing has confirmed that formaldehyde emissions from our phenolic-bonded products (i.e. OSB, LVL, and I-Joists) are below 0.5 mg/L under reasonably foreseeable conditions of use, which meets or exceeds the E_0 Formaldehyde Emission Class

In short, all available information indicates that formaldehyde levels associated with phenolic resin-bonded wood products are similar to those of the dimension lumber veneer or other forms of wood used to make the products.

Q. How much formaldehyde is in our phenolic-bonded, Engineered Wood Products?

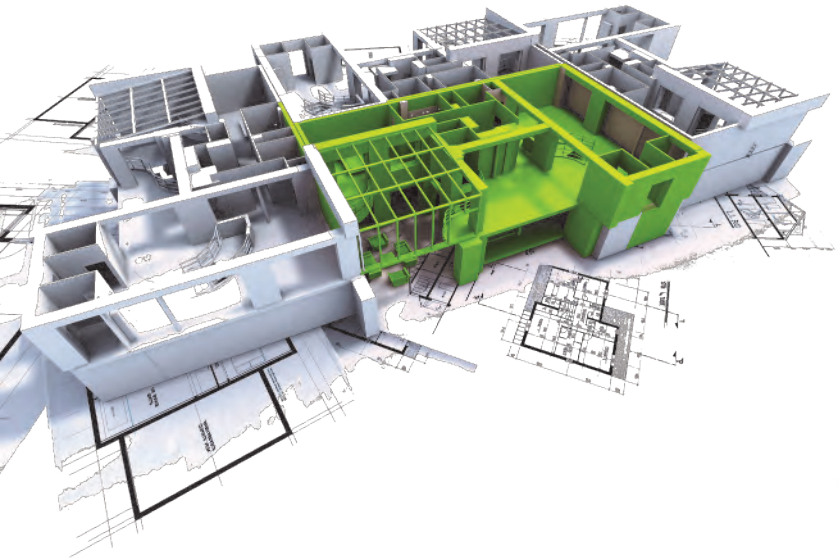
A. The amount of formaldehyde in our Engineered Wood Products is less than 0.1 percent of the dry weight.

Q. What is being done to reduce the exposure to formaldehyde?

A. Formaldehyde is normally present at low levels, usually lower than 0.03 ppm, in both outdoor and indoor air. Efforts have been made by both government and industry to reduce exposure to formaldehyde. A 1985 regulation by the US Department of Housing and Urban Development (HUD), covering the use of manufactured pressed wood products in housing was designed to ensure that indoor levels were below 0.4 ppm. Product standards established for plywood and particleboard led to significant reductions in formaldehyde emissions from those products. Furthermore, HUD acknowledged that phenolic resin bonded wood products emitted such small quantities of formaldehyde that these products were exempted from all the testing and certification requirements of the standards. In Germany, the German Hazardous Materials regulation, better known as the "E1" Standard, sets a limit of 1.0 mg/L for formaldehyde emissions from some wood-based composite products. All available data indicates that our phenolic bonded Engineered Wood Products meet the more stringent E_0 level.

Q. What affects formaldehyde levels in a home?

A. Formaldehyde levels in the indoor air depend mainly on what is releasing the formaldehyde, the temperature, the humidity, and the air exchange rate (i.e. the amount of outdoor air entering or leaving the indoor area) Levels of formaldehyde decrease with increasing air exchange rate, decreasing temperature, and decreasing humidity.



SMARTFRAME Design Compendium

Design Compendium Contents	Interactive	Printable	PC
Specifications software	✓	✓	✓
Technical Support	✓		✓
Design Guides (PDF)		✓	✓
Technical Illustrations		✓	✓
Fixing Details		✓	✓
Software Tutorial	✓		✓

Never before has so much user-friendly computer power you been unleashed into the hands of building industry professionals to allow the design and detailing of engineered timber products. This software, in conjunction with the SmartFrame Design Centre and SmartFrame Engineered Wood products themselves, combines to form the most sophisticated structural timber option ever available to the Australian market.

The Smart Frame Engineered Timber Solution represents an entirely new and revolutionary concept in the delivery of the 21st century technology and service to the building industry.

Available from:

Head Office

Victoria
31-45 Orchard Street,
Kilsyth Vic 3137
email: sales@tilling.com.au
Phone +61 3 9725 0222
Fax +61 3 9725 3045

New South Wales
109 Kurrajong Avenue,
Mt Druitt, NSW 2770
email: nswsales@tilling.com.au
Phone +61 2 9677 2600
Fax +61 2 9677 2500

Queensland
84 Magnesium Drive,
Crestmead QLD 4132
email: qldsales@tilling.com.au
Phone +61 7 3440 5400
Fax +61 7 3440 5444

Western Australia
10 Cartwright Drive
Forrestdale WA 6112
email: wasales@tilling.com.au
Phone +61 8 9399 1609
Fax +61 8 9399 1065

South Australia
5-9 Woomera Ave
Edinburgh SA 5111
email: sasales@tilling.com.au
Phone +61 8 8345 1966
Fax +61 8 8345 1977

Sales 1800 33 77 03

Technical support 1300 668 690