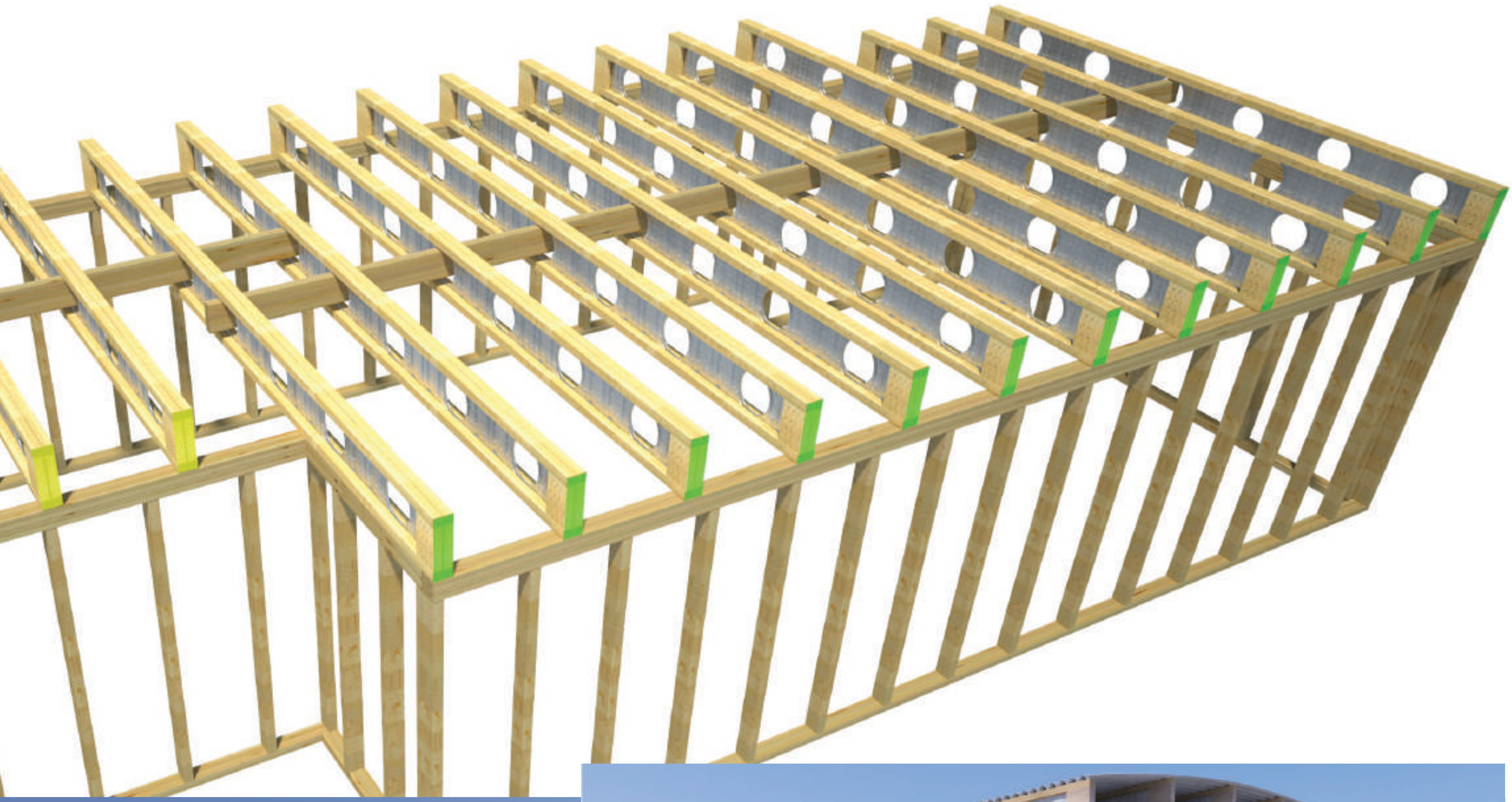
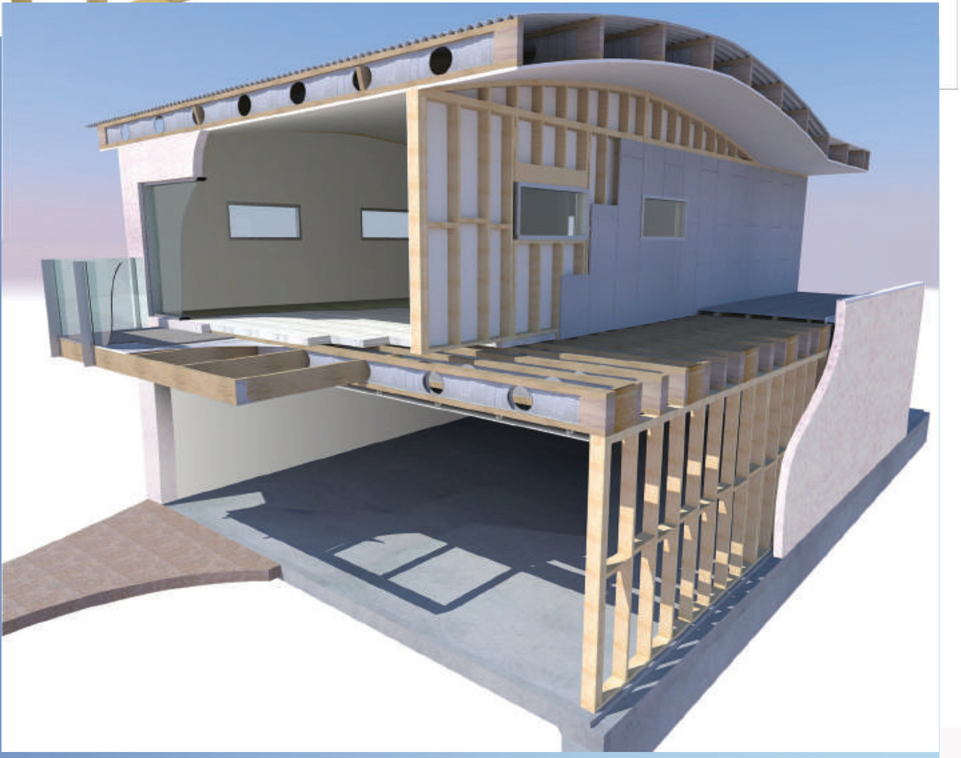
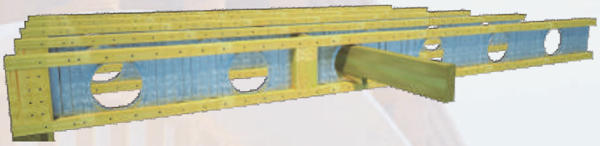
Tecbeam®
Design Guide





Edition 1 2016

TECBEAM



TECBEAM® - A patented light weight composite timber and steel 'I' beam with timber flanges and a continuous pressed steel web which transforms it's structural behaviour into a beam with exceptional features; functioning more like a steel beam.

Tecbeam characteristics

Stiffness - the continuous steel web enhances beam stiffness, **reducing creep by over 60%** compared with a seasoned timber beam, trussed joist or plywood 'I' beam, and over 80% for an unseasoned timber beam. No other timber engineered beams achieve this.

Shear capacity - the engineered and patented Tecbeam steel web has a **high shear capacity** and reliable performance in comparison with solid timber, which can be relatively low in shear strength and prone to brittle failure.

Strength - the continuous steel web **enhances beam strength by up to 20%**, floors can be designed for loads exceeding 15 kPa. (A quick solution for a short span bridge!)

Ductility - at the ultimate load capacity, testing shows that web tensile yielding and shear buckling generally occurs before flange stresses reach the timber capacity. Web yielding occurs at the point of maximum bending moment, this action forms a local mechanism which is analogous to the ductile action in a steel beam. The Tecbeam joist undergoes an **increased deflection but continues to carry significant load**; this is an important safety feature in the structural integrity of a floor. In comparison, solid timber, open web truss type joists, and plywood 'I' beams, all undergo catastrophic collapse at their ultimate strength limit states.

Creep factor - long term load testing has established the creep or duration factor to be in the order of 1.4. In comparison, for solid seasoned timber the creep factor is 2.0, and for unseasoned timber it is 3.0. This lower creep factor means **Tecbeam joists can often be used to replace steel beams, with significant savings.**

Point loads - high concentrated loads can be **placed anywhere along the flange** because of the continuous steel web support. (Open web truss joists can have excessive local bending stresses where point loads occur between the nodes). Tecbeam joists are ideally suited to residential, commercial, industrial and car park structures where there are high point loads.

Vibration - in long spans, all light weight joists exhibit vibration; in a Tecbeam floor this is easily controlled by using secondary beams installed at right angles to the joists, e.g. strongbacks, placed through the holes and securely fixed with wedges. The timber and steel web combination in Tecbeam joists provides **better dampening characteristics than floor trusses, plywood 'I' beams, steel purlin sections and lightweight all-steel joists.**

Load Sharing - where point or line loads occur, several Tecbeam joists in the immediate area can be connected by a short load spreading beam, or strongback, passing through the web holes. This provides a **load sharing feature which often eliminates the need for a separate beam**.

Stability - the wide timber flanges provide excellent **stability eliminating the need for blocking.**

Overload - testing and site experience has proven that Tecbeam joists have **excellent recovery from overloads**. Where visible web buckling is in the elastic range, full recovery is possible, without permanent set; the beam will continue to function normally.

Safety -Tecbeam joists provide greater safety due to their ductile behaviour, and no potential shear splitting as in a solid timber beam. They can **remain serviceable after an overload**, support high point and shear loads, and exhibit much lower creep compared with solid timber, plywood I beams and truss type joists. Use of secondary beams (strongbacks) provides additional safety margins through load sharing, as well as evening-out floor deflections and controlling floor vibration.

Analysis - Tecbeam joists are a typical 'I' beam, therefore standard beam design principles and formulas can be used for analysis. Shear deformation of the pressed metal web is significant in shorter spans and should be included in the analysis. It is recommended that the **free SmartFrame software be used to design Tecbeam** elements because it uses a sophisticated algorithm to calculate both the bending and shear deflections components of the total deflection.

Design bending capacity (ΦM_x) is determined from the first moment of area of the transformed section 'Z_x' and the characteristic strength values for the timber flanges. The design capacity in shear (ΦV_x) is provided by the cold formed steel web; the tabulated values are based on test results. Timber modification factors do not apply to the shear capacity of Tecbeam joists, this significantly simplifies the analysis.

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Characteristic strength properties

Note: Custom sized Tecbeams can be designed and manufactured to order from Tilling Timber Pty Ltd

Tecbeam CODE[1]	depth (mm)	Timber flange		Steel web			Self weight (kg/m)	Resistive moment[2,3] M_x (kN.m)	Vertical shear[3] V_x (kN)	Z_x x 10^3 (mm^3)	EI_x[4,5] x 10^9 (Nmm^2)	GJ x 10^6 (Nmm^2)	GA_w[6] x 10^6 (N)	Maximum reactions[3] (kN)		
					Hole									End[7]	Internal[8]	
		Depth (mm)	Width (mm)	Size (mm)	Dia (mm)	Spacing (mm)								Min 35 mm bearing	Without web stiffener	With web stiffener
T259aL15	246	43	85	242x0.8	160	450	5.9	3.57 L_c	7.4	734	1409	2461	1.9	7.4	7.4	15.1
T259bL15		43	85	242x1.0	160	450	6.3	4.47 L_c	10.2	756	1454	2461	2.4	10.2	9.3	16.9
T309bL15	300	43	85	295x1.0	214	600	6.3	5.66 L_c	10.2	955	2209	2461	2.4	10.2	8.9	16.6
T309cL15		43	85	295x1.2	214	600	6.7	6.78 L_c	14	983	2257	2461	2.9	12.0	8.9	16.6
T367bL15	360	73	71	295x1.0	214	600	8.5	6.31 L_c	11.6	1340	3906	5956	2.0	11.6	11.6	19.3
T367cL15		73	71	295x1.2	214	600	9.0	7.58 L_c	14	1369	3987	5956	2.3	14.0	14.0	21.7
T407bL15	400	93	71	295x1.0	214	600	10.3	6.74 L_c	11.6	1712	5553	9319	2.0	11.6	11.6	19.3
T407cL15		93	71	295x1.2	214	600	10.7	8.10 L_c	14	1738	5634	9319	2.3	14.0	14.0	21.7

NOTES:

1. Beam code: T25, T30, T36, T40 - joist depth (cm); 7 or 9 - nominal joist width (cm); a, b, c - galvanized steel web thickness 0.8, 1.0, 1.2 mm respectively; grade G300 Z275; L15 - SmartLVL 15 flange grade
2. L_c = distance in metres between points of contraflexure (zero moment). For a single span, this distance can be taken as the full span
3. The applicable capacity reduction factor Ø as defined within Table 2.1 of AS 1720.1 needs to be applied to the tabulated value. For domestic houses for which failure would be unlikely to affect an area greater than 25 m^2, use Ø =0.95
4. Tabulated values are based upon the short duration modulus of elasticity for LVL 15 with the True E instead of Apparent E used in AS 1720.1. i.e. $E_T = 1.05E_A$.
5. Total deflection of a thin webbed I-Joist is made up of bending deflection and shear deflection, with the shear deflection a significant proportion of the total deflection. For Uniformly Distributed Load w, over span L, the total deflection is calculated with the following formula, however the SmartFrame software will give the most accurate solution for the serviceability of Tecbeams

   $$\Delta = j_2\left(\frac{5wL^4}{384EI_x}+\frac{wL^2}{8GA_w}\right)$$ For permanent loads adopt $j_2 = 1.4$

6. GA_w— tabulated value of shear rigidity (mainly of the steel web) are based upon test results and interpolation
7. End reactions are based upon the assumption that the ends of all Tecbeams have standard web stiffeners correctly installed and a minimum bearing length of 35 mm
8. Capacities are based upon an internal support greater or equal to 58 mm.

Designing with TECBEAM

Span Tables

Loadings are in accordance with AS/NZS 1170.0:2002 and AS/NZS 1170.1:2002 ; spans are based on limit state design to AS 1720.1-2010.

Serviceability Limit State

Deflection (y) criteria controls for the smaller live loads and single spans (L). Dead Load (G), Live Load (Q)

Residential - houses, townhouses, boarding houses, Class 1 buildings AS 1684.1

Short-term Ψ_s = 1.0

y_s ≤ L/360, or maximum 9.0 mm

Long-term Ψ_l = 0.33

y_l ≤ L/300, or maximum 15.0 mm as joist, or max. 12.0 mm as beam under load bearing walls

$y_l = (y_G + \Psi_l y_Q) j_2$

Residential - multi-units, apartments, aged accommodation, hostels, Class 2 & 3 buildings AS/NZS 1170.0 Spans based on AS 1684.1 criteria are less than for residential, compared to AS1170.0 criteria; where applicable he smaller house spans have been adopted to ensure similar dynamics.

Commercial - to AS/NZS 1170.0

Ψ_s = 0.7

y_s ≤ L/480

Ψ_l = 0.4 except storage, libraries, etc (Ψ_s = 1.0, Ψ_l = 0.6)

y_l ≤ L/300, or maximum 15.0 mm

$y_l = (y_G + \Psi_l y_Q) j_2$

Strength Limit State

Timber flanges, designated L15, are sourced from SmartLVL 15 H2s treated material. Other timber materials can be built into Tecbeams on request as special orders. For Tecbeam timber flanges, the nominal moment capacity is based a characteristic bending capacity of 59 MPa.

The characteristic bending capacity (M_x), is also based on the computed transformed section properties and the transfer of stress at the web flange interface and is therefore dependant upon the length of web/flange interface available to resist the applied loads. The capacity is expressed as (constant) x L_c where L_c in metres is the distance between points of contraflexure in a continuous span or may be taken as 1.0 x span for single spans.

Steel web, design shear capacity is based on AS 4600, ($\Phi_v V_b$ -web buckling limit state, Φv = 0.9, capacity factor for cold formed steel in shear). The tabulated values have been derived from testing. Note the capacity factors for timber do not apply to shear in Tecbeam joists.

Strength reduction factor

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. Note strength reduction factors do NOT apply to shear.

Duration of load factor

The duration of load factor k_1 for strength are defined within Table 2.3 and clause 1.2.4.1.1 of AS 1720.1

The duration of load factors j_2 for stiffness for permanent loads on Tecbeam is 1.4. (J_2 = 1 for short term actions)

Moisture effects

Application of Tecbeam 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

When used in dry conditions where the moisture content remains below 15%, no modification for moisture content is required. Where Tecbeam is subjected to conditions, such that the average moisture content for a 12 month period with exceed 15%, the modification factors for strength k_4 and for stiffness j_6 in the following table.

Temperature

The modification factor for temperature K_6 is described in clause 2.4.3 of AS 1720.1

Load sharing

Because of the reduced variability of strength values of Tecbeams compared to solid timber, the load sharing factors k_9 within clause 2.4.5 of AS 1720.1 do not apply and therefore k_9 = 1.0.

Stability

Property	Equilibrium moisture content *(EMC)*		
	≤15%	15% to 25%	≥25%
Bending	k_4 = 1	k_4 = 1.45 - 0.03 *EMC*	k_4 = 0.7
Modulus of elasticity	J_6 = 1	j_6 = 1.30 - 0.02 *EMC*	J_6 = 0.8

The stability factor k_{12} is defined within clause 3.2.4 and 3.3.3 of AS 1720.1 for dry timber except that the material constant (ρ_b) for beams shall be calculated as per clause 8.4.7 of AS 1720.1.

Steel web, design shear capacity is based on AS 4600, ($\Phi_v V_b$ -web buckling limit state, Φv = 0.9, capacity factor for cold formed steel in shear). The tabulated values have been derived from testing. Note the capacity factors for timber do not apply to shear in Tecbeam joists.

Section Properties

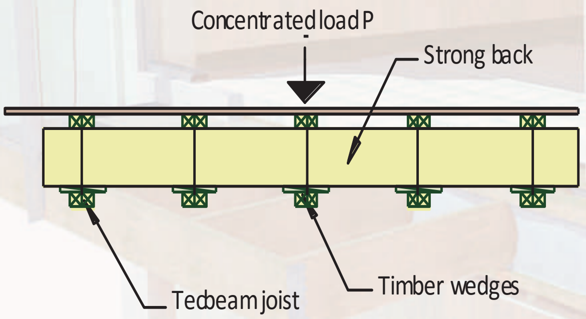
The first moment of area (Z_x) and the second moment of area (I_x) are based on the theoretical values for the transformed sections. The flexural stiffness parameter (EI) uses the short duration modulus without the shear reduction of 5%, i.e. 1.05 x E. The shear rigidity parameter (GA) is included because shear deformation is a significant component of total deflection in shorter spans; this should be included in deflection calculations and in moment distribution for continuous spans. The (GA) values have been derived from testing. (These are lower than the theoretical values due the web stiffening ribs, holes, etc.)

Load Sharing

Tecbeam joists can be linked by a secondary beam or strongback, fitted through the joist web holes, to provide simple and effective load sharing. Significantly larger point or parallel line loads can be supported.

Joists that are partially loaded, or spanning less than their Span Table capacity, can be utilized to carry extra loading. It is recommended that deflection in the secondary beam is limited to 3 mm at the second joist each side of the load point. The load distribution depends on the continuity of the strongback; a conservative design would be to assume a short cantilever each side of the load point.

The following diagram gives a worst case load distribution for a short secondary beam centred about the load point. A continuous strongback results in lower distribution values.



Suggested Load Distribution for:

single joists

0.15P 0.22P 0.26P 0.22P 0.15P

double joists under load

0.13P 0.17P 0.40P 0.17P 0.13P

Notes:

1) Distribution values applicable to 450 and 600 mm joist spacing

2) For a permanent point load, double the number of strongbacks to keep the long-term deflection under 3.0 mm.

Setback Load bearing walls

Tecbeam joists have proven performance in supporting large permanent loads such as tiled roofs, aerated concrete walls and floors. The design can take advantage of this feature by eliminating beams that would normally be used under load bearing walls.

There are advantages for the builder such as:

1. continuity of holes for installing services
2. cost and time savings and a continuous ceiling frame which avoids a potential crack line

It is recommended to limit long-term deflection to 12 mm, even though AS1684.1 allows 15 mm.

Vibration Control

Tecbeam joists have good dampening characteristics due to their unique composite design. Vibration control becomes critical for light weight floor joists in long spans, particularly over 6.0 m, unless very stiff floor joists are used. A simple and more economical way to control vibration in a Tecbeam floor is to introduce one or two rows of secondary beams (strongbacks), fitted normal to the direction of the floor joists. The holes in Tecbeam joists allow easy installation of secondary beams or strongbacks; these should be securely wedged in place at each joist. The strongbacks have an added advantage in replacing blocking which is less effective.

If a higher comfort level is required in long spanning open floors (it is recommended to check this with the client), then stiffness in the secondary beams needs to be increased above the minimum recommended (refer to the Installation Guidelines). Suggested methods are to either; increase the number of strongbacks, or substitute the solid pine (MGP10) strongback with LVL or a small steel section with higher EI_x.

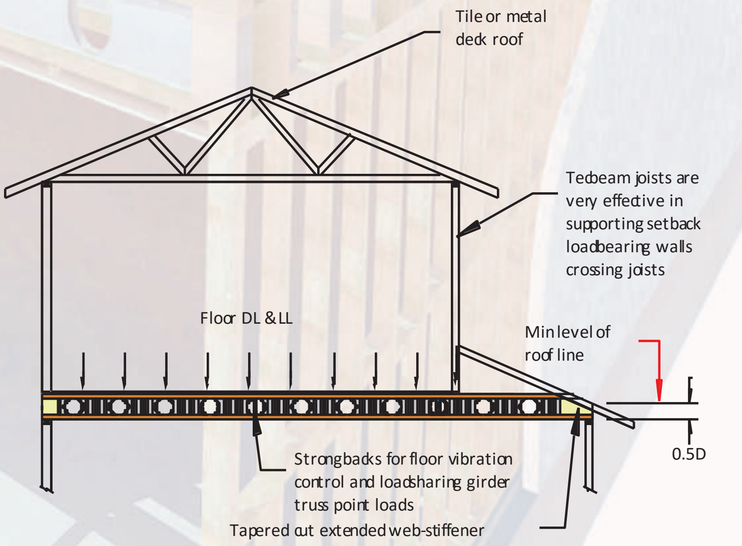
There are a number of technical references on this subject; some practical guidance can be found in AS2327, Part 1-1980, cl. 6.4.

Concealed Beams

Where a flush ceiling and continuous joists are required, such as, at a cantilevered stair landing, the web holes in Tecbeam joists can be used to fit a concealed beam between supports. Internal support at each hole is possible due to the shear capacity of the continuous steel web in the flange area; limit joist shear to $0.5\Phi V_x$ each side of the support.

First floor roofline for set-back upper walls

In order to gain maximum benefit from a Tecbeam floor, and make cost savings, the joist layout should allow spanning to the outside walls. The designer will need to keep the first floor roof line above the outside wall plate, by at least half the joist depth.



Tecbeam joists spanning to outside supporting wall

Strongbacks to control vibration

Strong backs, or secondary beams, are an effective method of controlling floor vibration. The greater the strongback stiffness the more solid the floor will feel, even at the maximum tabulated spans.

Residential light-weight floors

For residential floors fitted with lightweight sheet or strip flooring and a single layer of plaster board ceiling, it is recommended to specify at least one row of strongbacks near mid span, where joist spans are within 750 to1500 mm of their tabulated spans. Where joists are within 750 mm of their tabulated spans, two rows of strongbacks are recommended, placed near the one-third points of the span.

NOTE: For higher comfort levels in long spans, an increase in the secondary beam stiffness is required. This can be achieved by either: adding an extra row of strongbacks, or substituting the normal MGP10 grade strongbacks with LVL15 or a small steel section of higher EI_x.

Heavier Residential and Commercial floors

Where the floor construction is heavier, such as floors with acoustic and FRL ceilings, and/or where a concrete topping or aerated concrete floor panels are installed, the added mass lowers the natural frequency of the floor and may result in noticeable vibration. For joist spans within 750 to 1500 mm of their tabulated spans, it is recommended to specify at least one row of SmartLVL 15 strongbacks near the mid span. Where joists are within 750 mm of their tabulated spans, two rows of SmartLVL 15 strongbacks are recommended positioned near the one-third points of the span

Maximum Joist spans

Designers can confidently specify Tecbeam joists up to the maximum spans as listed in the span tables. Specifying strongbacks in accordance with the manufacturer's recommendations ensures comfort levels exceed the Australian Standards*, even at the maximum spans. If a more solid floor is required, ensure additional strongbacks are installed during the construction phase.

* 1.8 mm up to 4000 mm span or $16500/span^{1.1}$ for a 1.0 kN load midspan

Floor framing designs

(a) To minimize the use of steel beams

The high shear and bending strength and low creep factor in Tecbeam joists can be utilized to support upper level load bearing walls, and concentrated loads, replacing the traditional method of placing steel beams and columns under load bearing walls.

(b) Layout detail

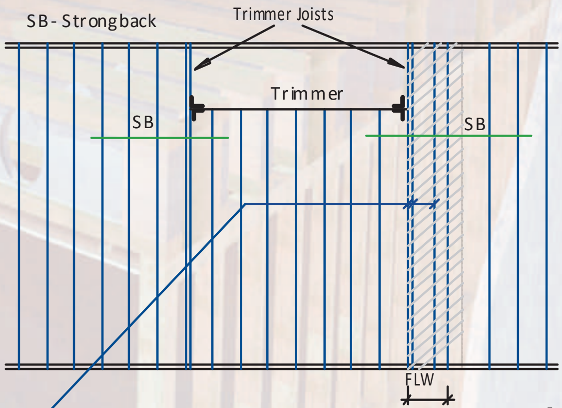
1. Look for the shortest spans between support lines, try to keep joists in one direction (to simplify the flooring installation), this however can change if better economy is achieved by spanning some areas in the other direction.
2. Aim to layout joists with the set-back load bearing walls (carrying the higher load) crossing the joists. Add a strongback near a roof girder truss point load to avoid a double joist; the load spreading action simplifies the joist design and evens-out deflections.

- Where possible, use Tecbeam joists under parallel load bearing walls to enable use of the holes for installing services. To minimize the number of parallel joists, install at least two strongbacks to load share with the adjacent joists, and where possible, extend to the lower outside wall (up to 1.5 m)
- Where Tecbeam joists are parallel to an outside wall, balconies can be conveniently added by cantilevering solid timber or steel joists through the web holes. Provide a back span of at least twice the cantilever span; check the edge Tecbeam joist for the balcony reaction load
- On external walls, where joists and studs are not in line, instead of double top plates or wall frame blocking, specify a plywood load spreader or rim board, of the same depth as the joists, these also act as bracing in the plane of the floor, and replaces solid blocking or cross bracing. See illustration below:

Framing stair voids

A combination of Tecbeam joists and strongbacks acting as load sharing beams simplifies the design and construction of floors around stair landing areas. Strongbacks, positioned behind the stair trimmer, share the trimmer floor loads over a minimum of three Tecbeam joists; this can eliminate the requirement for a solid support beam, and enables services to continue through the web holes.

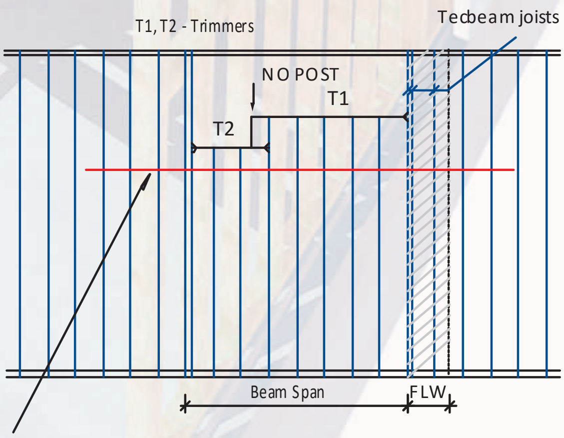
Case 1—Load-sharing at Trimmer joist



Joists share the trimmer load, either as single, double or triple joists. eg, 2,3,4,5 or 6 joists can share the load.

See following illustration for how a corner post can be eliminated.

Case 2—No corner post



Beam concealed in Tecbeam web holes, continue past stair void for load sharing. For longer spans or higher loading, a steel section will be required.

Designing with TECBEAM (cont'd)

Connection to steel beams

For steel beam depths within 50 mm of the joist depth, a simple method is to notch the Tecbeam joist ends so the joist bears on the beam flange. To gain maximum benefit from this method, the steel beams sizes selected should be similar in depth to the joists in order to minimize the notching required.

Recommend for: T25 joists –250PFC or 250UB, and
T30 joists – 300PFC or 310UB
T36 joists – 360UB or similar

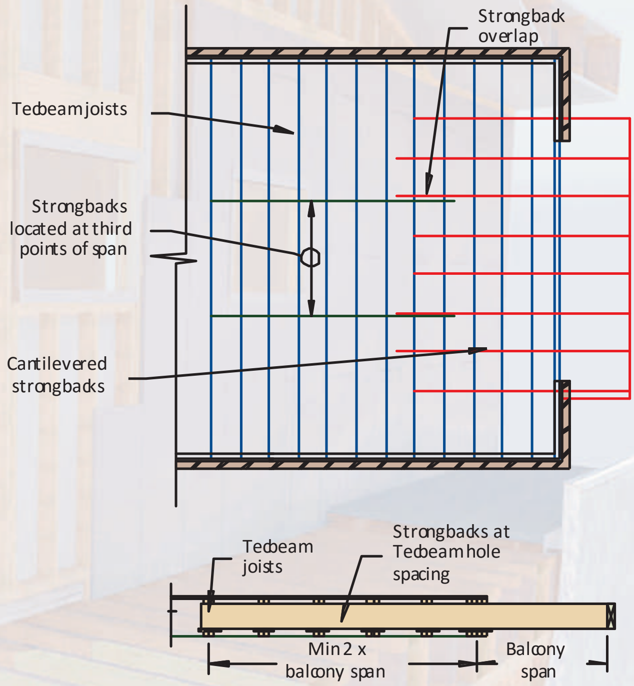
Refer to the Installation Guidelines for details.

Where Tecbeam joists are more than 50 mm deeper than the steel beam, timber packing fixed to the steel web is recommended, joist hangers can be installed to complete the connection. Note if joists are fixed on one side only, restraint against beam rotation should be checked .

Tecbeam perpendicular cantilevered members

A Tecbeam floor or roof system provides unparalleled opportunity to facilitate cantilevers in two (2) directions. Conventional systems require the need to install a trimmer and to reverse the direction of the joists at the trimming member. With Tecbeams, strongbacks hidden within the Tecbeam joists can be extended perpendicular to the main joists to become cantilevered load bearing joists for balconies or upper rooms.

Contact the Tilling Timber Pty Ltd Design Centre at smartdata@tilling.com.au or the SmartData customer helpline on 1300 668 690 for further advice on the design of perpendicular cantilevered members supported by a Tecbeam floor system



Tecbeam 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 NZS 3603 this is the dimension referred to as "L", and is defined below.

Design span/Effective span is the distance between -

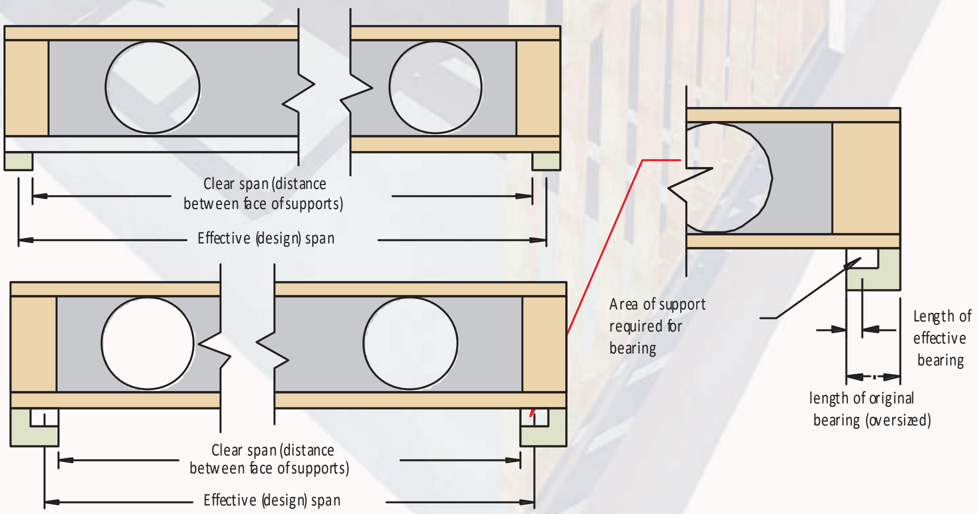
- The centre of the bearing at each end of a beam where the bearing lengths have NOT been conservatively sized
- The centre of notional bearing that have been sized appropriately, where the size of the bearing IS conservative.

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

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



Recommended maximum spans for residential floors

- Lightweight floors

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

Tecbeam depth (mm)	Joist spacing (mm)	300	338	360	400	450	600	300	338	360	400	450	600
	Code	Single span						Continuous span					
246	T259aL15	6650	6350	6250	6050	5900	5450	7600	7400	7250	7050	6850	5850
	T259bL15	6650	6450	6350	6150	6000	5500	7750	7500	7350	7150	6950	6400
300	T309bL15	7350	7100	7000	6800	6600	6100	8550	8250	8150	7900	7650	7050
	T309cL15	7450	7200	7100	6900	6650	6150	8650	8350	8200	8000	7750	7150
360	T367bL15	8300	8000	7850	7650	7400	6800	9650	9300	9150	8900	8600	7900
	T367cL15	8400	8100	8000	7750	7500	6900	9750	9450	9300	9000	8700	8050
400	T407bL15	8950	8650	8500	8250	7950	7300	10400	10050	9900	9600	9250	8500
	T407cL15	9050	8750	8600	8350	8050	7400	10550	10200	10000	9700	9400	8650

- Heavy weight floors

Loadings: Permanent G: self weight + 100 kg/m^2 + 0.6 kPa of live load permanently applied, live load Q: 2.0 kPa or 1.8 kN point live load

Tecbeam depth (mm)	Joist spacing (mm)	300	338	360	400	450	600	300	338	360	400	450	600
	code	Single span						Continuous span					
246	T259aL15	6050	5900	5800	5600	5400	4100	7050	6600	6250	5700	5200	4050
	T259bL15	6150	6000	5900	5700	5500	5100	7150	6950	6800	6650	6400	5350
300	T309bL15	6800	6600	6450	6300	6100	5600	7900	7650	7500	7300	7000	5500
	T309cL15	6900	6650	6550	6350	6150	5700	8000	7750	7600	7400	7150	6600
360	T367bL15	7650	7400	7250	7050	6800	6250	8900	8600	8450	8200	7900	6250
	T367cL15	7750	7500	7350	7150	6900	6350	9000	8700	8550	8300	8050	7350
400	T407bL15	8250	7950	7800	7550	7300	6300	9600	9250	9100	8750	7950	6300
	T407cL15	8350	8050	7900	7700	7400	6800	9700	9400	9200	8950	8650	7400

Continuous spans:

For beams subject to lightweight floor loadings 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

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

NOTES to Span Tables for RESIDENTIAL floors

1. End bearing lengths = 35 mm at end supports and 58 mm at internal supports for continuous members
2. Adopted Serviceability (deflections) limits accordance with AS 1684.1:1999
3. Floor Dynamic performance criteria:
   - Minimum natural frequency - 8 Hz
   - Maximum differential deflection with a 1 KN load midspan - 1.8 mm for span < 4000 mm, 16500/span $^{1.1}$ for spans ≥ 4000 mm
4. Spacing, nominal average, i.e.
   - 300crs is equivalent to 450crs plus an extra joist @ 900crs
   - 338crs " " " 450crs " " " " 1350crs
   - 360crs " " " 450crs " " " " 1800crs

   NB If extra joists are installed, at least one row of strongbacks are required for uniform support
5. Strongbacks are recommended to improve floor vibration effects in long spans. Where joists are within 750 —1500 mm of their max. span, install one row midspan; where joists are within 1000 mm of the maximum span install two rows of strongbacks. If lower vibration is required increase the strongback stiffness, e.g. use MGP12 or SmartLVL 15 instead of MGP10
6. Section properties and structural design guidelines are available from TECBEAM Australasia Pty Ltd, Tilling Timber Pty Ltd or can be downloaded from www.tecbeam.com.au or www.tilling.com.au.

Recommended maximum spans for non-residential floors

3.0 kPa (Offices, classrooms, laboratories, etc. - EXCLUDES car parks)

Loadings: Permanent G: self weight + 100 kg/m^2 , live load Q: 3.0 kPa or 2.7 kN point live load

Tecbeam depth (mm)	Joist spacing (mm)	300	338	360	400	450	600
	code	Maximum floor joist span (mm)					
246	T259aL15	5400	5200	5100	4800	4300	3200
	T259bL15	5600	5400	5200	5000	4800	4300
300	T309bL15	6300	6100	6000	5700	5500	4500
	T309cL15	6500	6200	6100	5800	5600	5000
360	T367bL15	7400	7100	6900	6600	6300	5000
	T367cL15	7500	7200	7000	6800	6500	5800
400	T407bL15	8100	7800	7600	7300	6600	5000
	T407cL15	8200	7900	7700	7400	7100	6000

Recommended maximum spans for non-residential floors (Cont'd)

4.0 KPa (Public space, shops, corridors, landings etc. - EXCLUDES car parks)

Loadings: Permanent G: self weight + 100 kg/m^2 , live load Q: 4.0 kPa or 4.5 kN point live load

Tecbeam depth (mm)	Joist spacing (mm)	300	338	360	400	450	600
	code	Maximum floor joist span (mm)					
246	T259aL15	5100	4500	4200	3800	3400	2500
	T259bL15	5200	5000	4900	4700	4500	3500
300	T309bL15	6000	5700	5600	5300	4700	3500
	T309cL15	6100	5800	5700	5500	5200	4700
360	T367bL15	6900	6600	6400	5900	5300	4000
	T367cL15	7000	6700	6600	6300	6000	4800
400	T407bL15	7500	6900	6500	5900	5300	4000
	T407cL15	7700	7400	7200	6900	6300	4800

5.0 KPa (Public assembly area, workshops, gymnasiums etc.)

Loadings: Permanent G: self weight + 100 kg/m^2 , live load Q: 5.0 kPa or 4.5 kN point live load

Tecbeam depth (mm)	Joist spacing (mm)	300	338	360	400	450	600
	code	Maximum floor joist span (mm)					
246	T259aL15	4200	3700	3500	3200	2800	2100
	T259bL15	4900	4700	4600	4400	3900	2900
300	T309bL15	5600	5200	4800	4400	3900	2900
	T309cL15	5700	5500	5400	5200	5000	4000
360	T367bL15	6500	5800	5500	4900	4400	3300
	T367cL15	6600	6300	6200	5900	5300	4000
360	T407bL15	6500	5800	5400	4900	4400	3300
	T407cL15	7300	6900	6500	5900	5300	4000

NOTES Span Tables (3,4 & 5 KPa FLL)

1. Maximum Dead Load for tabled spans is 1.0 kPa -TECslab® (Hebel). For higher dead loads check shear, bending and long-term deflection*
2. For continuous spans, no increase in span is recommended for higher loads because joist shear increases at the intermediate support. It is recommended that shear is checked*
3. Live Loads - refer to AS1170.1 for the relevant activity loading. These tables are NOT applicable to storage loads where long term deflection may exceed span/300 or 15 mm*

4. Deflection or serviceability criteria adopted:

   – Short-term loading ψ_s = 0.7 - (excluding storage where ψ_s = 1.0, ψ_l = 0.6)

     Max deflection = span/480

   – Long-term loading ψ_l = 0.4

     Max deflection = span/300, max 15 mm

5. Strongbacks are required to control floor vibration in long spans. Where joists are within 750 —1500 m of their max. span, install one row midspan; where joists are within 750 mm of the maximum span install two rows of strongbacks. To control vibration in spans over 6000 mm, two rows of strongbacks are recommended. For spans over 7000 mm, an increase in the strongback stiffness is recommended, e.g.. use two rows of MGP12 or SmartLVL15 or use three rows of MGP10 strongbacks

6. Where a concentrated load exceeds 5.0 kN add a pair of web stiffeners under the point load and check that there is a strongback (min. 2400 mmm long) within 1000 mm, closer to the mid span. Concentrated loads over 7.5 kN should be specified on the drawings

7. Spacing, nominal average, i.e.:

   – 300crs is equivalent to 450crs plus an extra joist @ 900crs

   – 338crs “ “ “ 450crs “ “ “ “ 1350crs

   – 360crs “ “ “ 450crs “ “ “ “ 1800crs

   NB If extra joists are installed, at least one row of strongbacks are required for uniform support

8. Beam code: T25, T30, T36, T40 - joist depth (cm); 7 or 9 - nominal joist width (cm); a, b, c - galvanized steel web thickness 0.8, 1.0, 1.2 mm respectively; grade G300 Z275; L15 - SmartLVL 15 flange grade

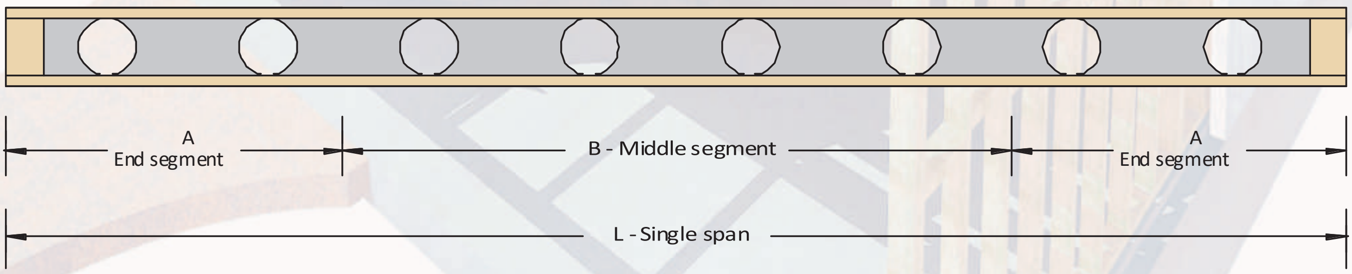
- Further Engineering advice is available from Tilling Timber at smartdata@tilling.com.au, toll free on 1300 668 690, or TECBEAM Australasia Pty Ltd.

Extra web holes

If extra web holes are required, the following are guidelines for permissible on-site modifications:

- Conditions:

  1. For uniform **RESIDENTIAL** floor loads only*
  2. Maximum Dead Load 0.7 KPa (including internal partitions)
  3. Maximum Live Load 2.0 KPa
  4. No load bearing walls (LBWs) on the span
  5. Cutting flanges is NOT allowed
  6. Flange size overall 90 x 45 (for flanges 70 x 45, the rectangular hole length is reduced, refer to Tilling Timber Pty Ltd, Tecbeam Australasia P/L, or a structural engineer)
  7. Cut holes neatly, square and rectangular holes to have rounded corners (Pre-drill minimum: 10 mm dia.)

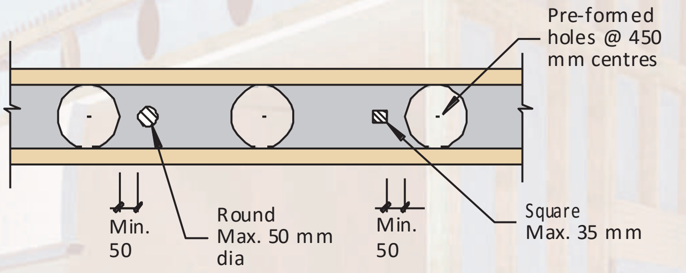


Where:

- Single span “L” is the TECBEAM tabulated span for 1.5 & 2.0 KPa loading
- Middle segment “B” is 0.5 x half MAX. span L

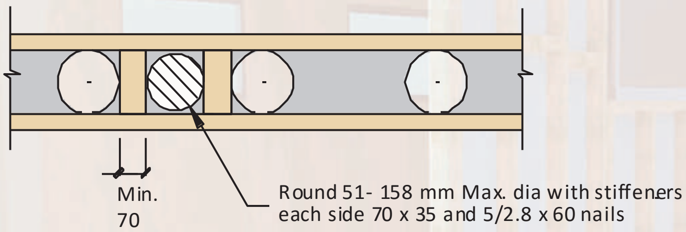
Extra web holes (Cont'd)

Tecbeam T250 series

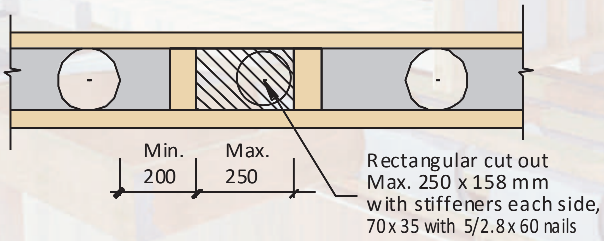


Segment A&B

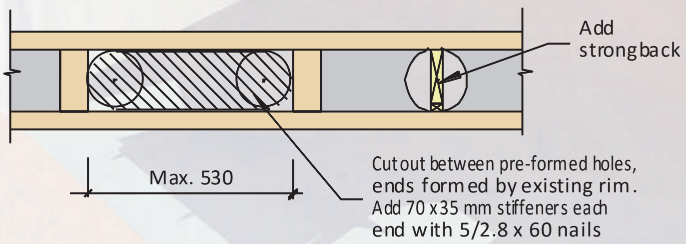
No stiffening



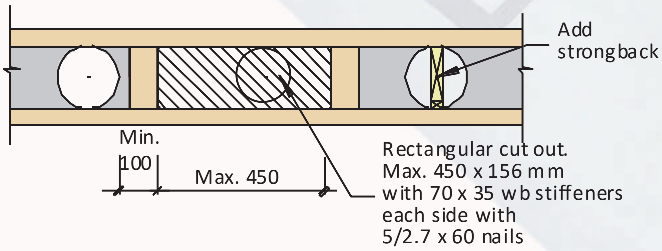
Segment A&B



Segment A



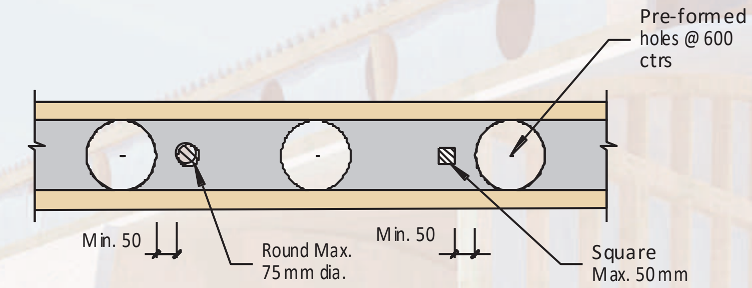
Segment B



Segment B

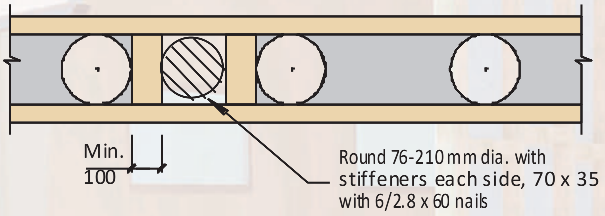
Extra web holes (Cont'd)

Tecbeam T300 series

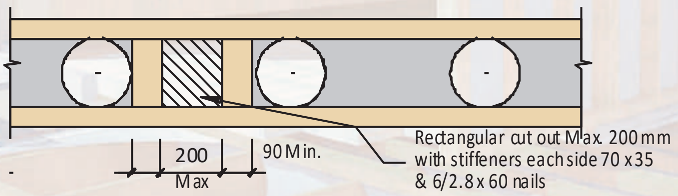


Segment A&B

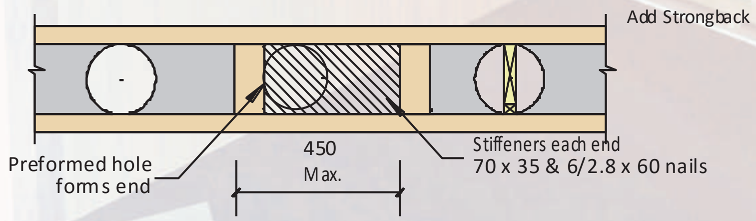
No stiffening



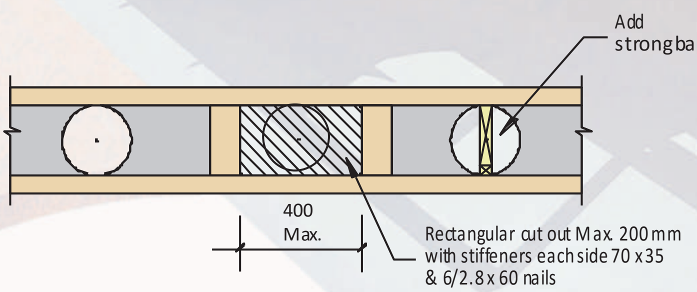
Segment A&B



Segment A



Segment B



Segment B

For T36 and T40 series, setback LBWs, continuous spans, and higher floor loading, refer to Tilling Timber Pty Ltd , Tecbeam Australasia or a structural engineer.

Rafter Cuts

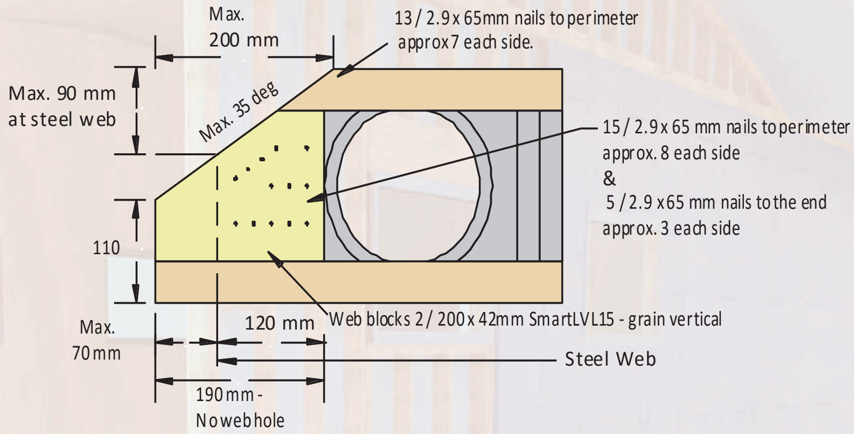
Tecbeams may have rafter cuts detailed. While it is possible to create the rafter cuts on site it is preferred that any rafter cuts are detailed and created into the Tecbeam at the time of manufacture by Tilling Timber . Some example rafter cuts are shown below .

Contact the Tilling Timber Pty Ltd Design Centre at smartdata@tilling.com.au or the SmartData customer helpline on 1300 668 690 for further advice on the design of rafter cuts Tecbeam members.

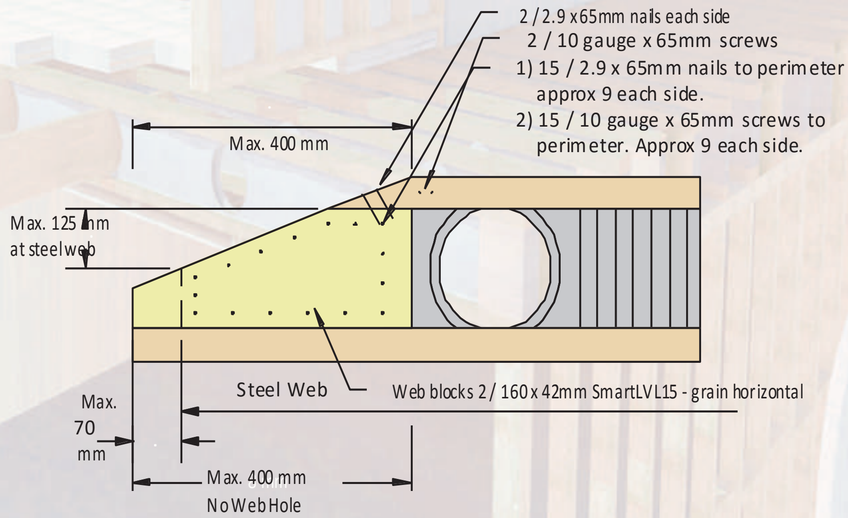
T250 series

Characteristic end reactions

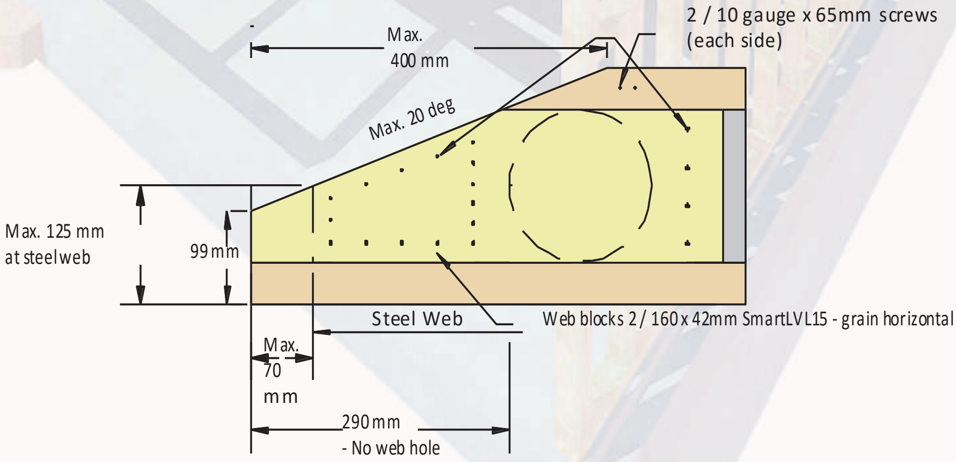
4.3 kN



5.5 kN



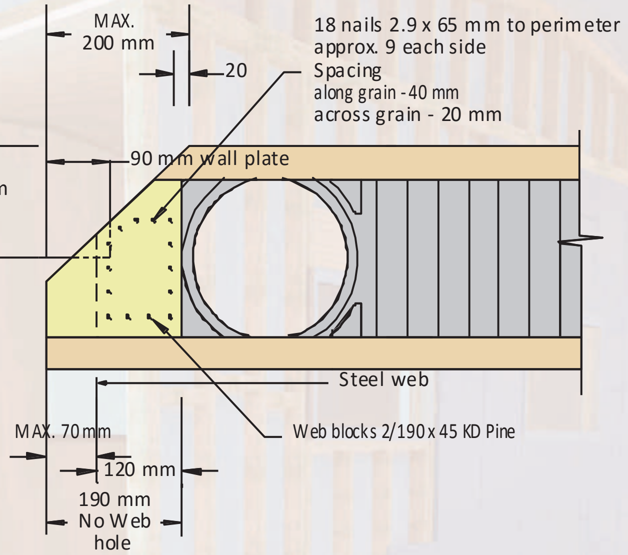
5.2 kN



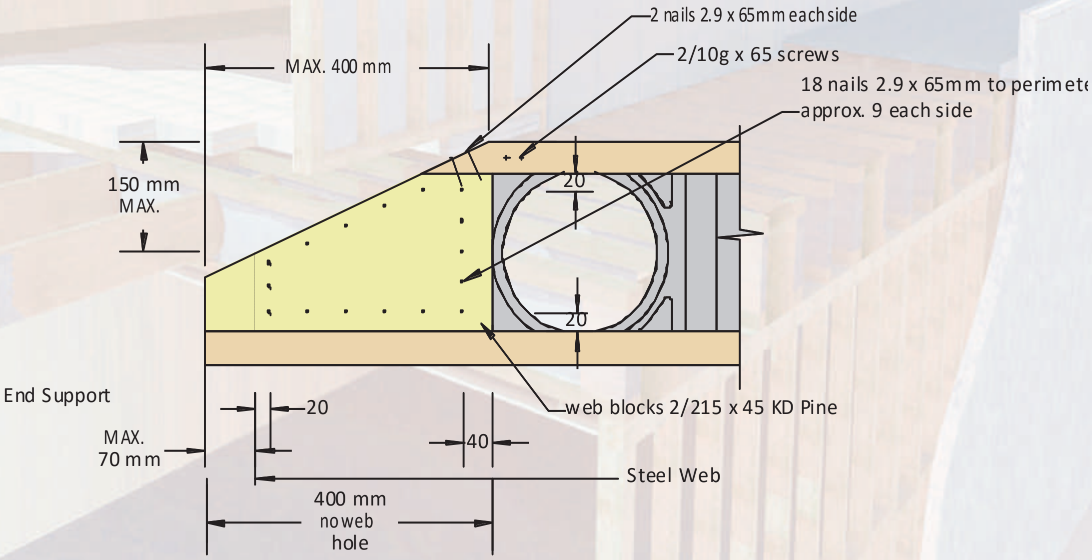
Characteristic end reactions

T300 series

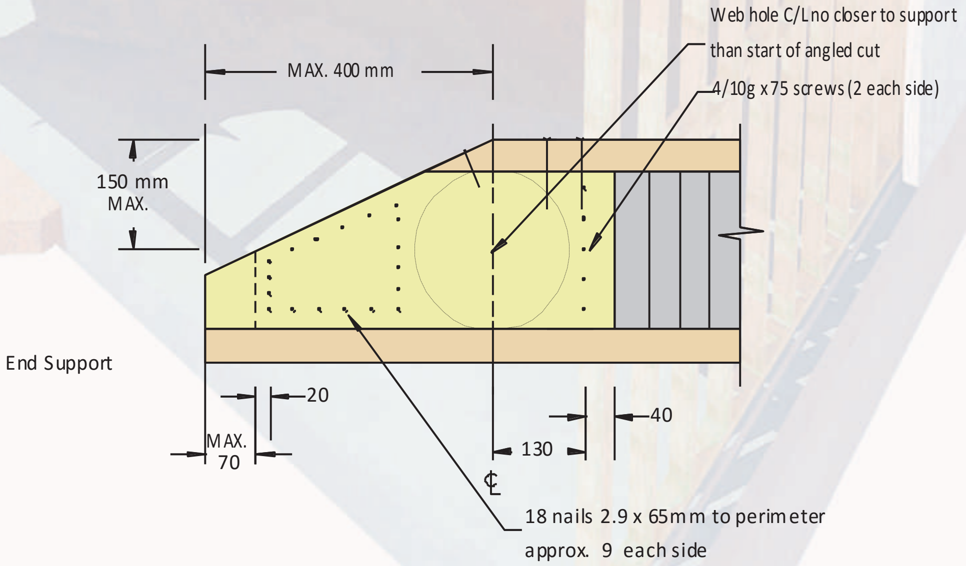
6.5 kN

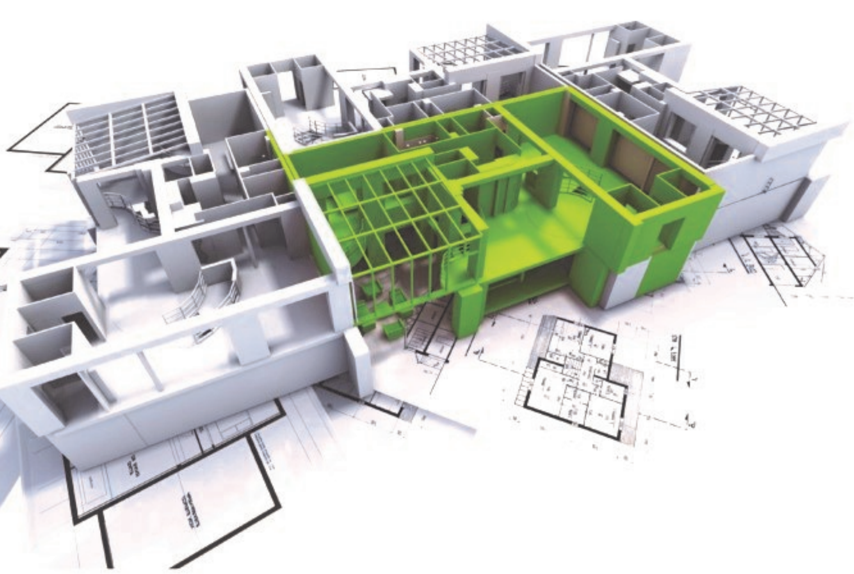


6.5 kN



6.5 kN





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