DESIGN GUIDELINES:

DG02. GENERAL INFORMATION

TECBEAM

2.1 Span Tables

Loadings are in accordance with AS/NZS 1170.0 and AS/NZS 1170.1-2002; spans are based on limit state design to AS 1720.1-1997.

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	$\leq$ L/360, or maximum 9.0 mm
Long-term	ψ_l	$= 0.33$
	j_2	$= 1.4$
	y_l	$\leq$ 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, to AS1170.0 criteria; the smaller house spans have been adopted to ensure similar dynamics.

Commercial – to AS/NZS 1170.0

ψ_s	$= 0.7$
y_s	$\leq$ L/480
ψ_l	$= 0.4$ except storage, libraries, etc ($\psi_s = 1.0$, $\psi_l = 0.6$)
y_l	$\leq$ L/300, or maximum 15.0 mm
y_l	$= (y_G + \psi_l y_Q)\, j_2$

Strength Limit State

Timber flanges, designated as P10, P12 and L13, are sourced, respectively, from MGP10, MGP12 and LVL13 graded material. For Tecbeam timber flanges, the nominal moment capacity is based on the following modified characteristic bending stresses:

Flange Type:	P10	$f'_b = 15.5$ MPa
	P12	$f'_b = 24.0$ MPa
	L13	$f'_b = 42.8$ MPa

The nominal bending capacity (M_x), is also based on the computed transformed section properties and the parameters from AS 1720.1-1997.

$$M_x = k_1\, k_4\, k_6\, k_9\, k_{11}\, k_{12}\, [f'_b\, Z_x]$$

where $k_1, k_4, k_6, k_9, k_{11}, k_{12} = 1.0$

Design bending capacity (ΦM_x)

Capacity factor (Φ) typical residential $\Phi = 0.9$, and $k_1 = 0.8$
non residential applications, $\Phi = 0.75$ (MGP), $\Phi = 0.85$ (LVL)
(For duration of load factor (k_1) refer to AS 1720.1, Table 2.7 & G1).

Steel web, design shear capacity is based on AS 4600, ($\Phi_v V_b$ –web buckling limit state, $\Phi_v = 0.9$, 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.

2.2 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%, ie 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.)

Design software programs that ignore web shear deformation can still be used by substituting (I_x) with (I_e), an equivalent second moment of area that is a combination of the flexural and shear parameters for a particular span. These are plotted in convenient curves for quick selection. For details refer to the graphs 'I_e vs Span' and the table 'Composite Section Properties'.

2.3 Design / Analysis

The structural engineer can either; design the Tecbeam floor using standard beam design principles or readily available software programs; or they can specify the design certification to be "by the manufacturer".

In designing Tecbeam floors, using standard beam design formulas, the following adjustments are required:

(1) Where shear deformation is not calculated separately, select Ie that corresponds with the appropriate span from the curves of Ie vs Span. For continuous beams with different spans, Ie will also vary for each span. Note for cantilevers select 'I' based on a span which is double the cantilever span.

(2) Deformation duration factor (or long-term creep) $j_2 = 1.4$

(3) Strength duration factor (k_1), applies only to the timber flanges. For capacity factors (Φ) refer to AS 1720.1, Table 2.5

(4) Where a single beam is to be used and deflection is critical, AS 1720.1, Table B1, Note 3 requires a reduced value for the modulus of elasticity, MGP grades 0.7 E, and LVL 0.85 E.

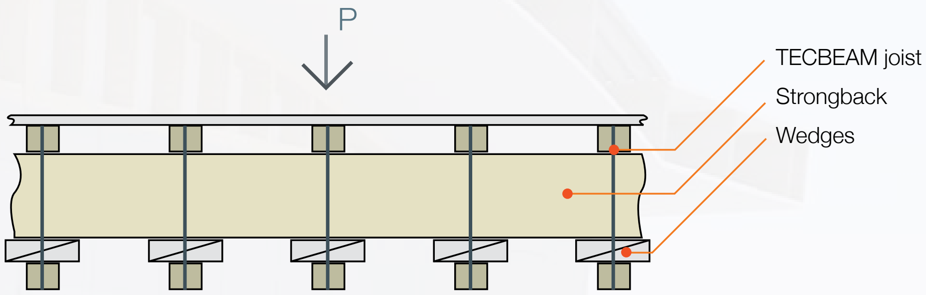
If loading is higher than the published span tables, deflection, shear and bending moment should be checked. Note, for shear the capacity factor in cold formed steel applies; for bending, the timber parameters apply, refer to the values listed in AS1720.1.

2.4 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: continuity of holes for installing services, cost and time savings and a continuous ceiling frame which avoids a potential crack line. It is recommended to limit long-term deflection to 12mm, even though AS1684.1 allows 15mm.

2.5 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 3mm 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) Refer to comments on the grid factor g_{42} in Section 3.2 Note 3.
2) Distribution values applicable to 450 and 600 mm joist spacings.
3) For a permanent point load, double the number of strongbacks to keep the long-term deflection under 3.0 mm.

2.6 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 6m, 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 EIx.

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

2.7 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.

2.8 Design Recommendations

To gain the maximum benefit from using Tecbeam joists including floor layout design, please refer to DG06.