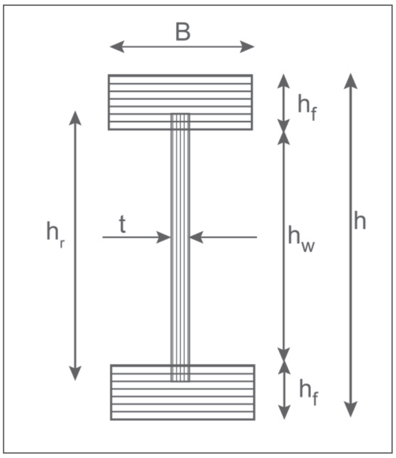
INFORMATION SHEET
STRUCTURAL MATERIALS

PLYWOOD
SPECIFIC DESIGN OF ENGINEERED I-JOISTS

The information provided below has been taken from the New Zealand Timber Design Guide 2007, published by the Timber Industry Federation and edited by Professor A H Buchanan. To purchase a copy of the Timber Design Guide, visit www.nztif.co.nz

The method is conservative compared to published information in manufacturers' literature and software, but it allows engineers to carry out specific design for situations outside the scope of software.



SERVICEABILITY

The deflection of any flexural member is a combination of bending deflection and shear deflection. While shear deflection is usually a small percentage of total deflection for a solid section, it is likely to be significant (15-20%) in the design of an I-joist, and must be taken into account.

I-joists have different flange and web materials. These materials have different properties which can be incorporated in the following formulae to derive section properties for bending deflection:

$I_{web} = k_{34} t h_r^3/12$

$I_{flange} = [B(h^3 - hw^3) / 12] - I_{web}$

$EI_x = E_{flange} I_{flange} + E_{web} I_{web}$

where:

E_{flange} and E_{web} are obtained from manufacturers' literature

k_{34} = parallel ply factor = 0.33 for 9mm ply and 0.50 for 12 mm ply

Bending deflection is obtained from standard formulae.

Shear deflection may be calculated as:

$\Delta = M_0 / (G_w A_w)$

where:

M_0 = the bending moment at mid-span

G_w = web modulus of rigidity, obtained from manufacturers' literature

A_w = web area = t h_r

Total deflection is then the sum of the bending and shear deflections:

$\Delta_{total} = k_2 (\Delta_{bending} + \Delta_{shear})$

where:

k_2 = duration of load factor from NZS 3603

STRENGTH

Bending Capacity

The usual method (slightly conservative) to determine the maximum bending stress is to assume that the web makes no contribution to the bending strength.

$$M^* \leq \phi M_{bx}$$

$$M_{bx} = k_1 k_8 f_t A_f D_1 \text{ x } 10\text{-}6 \text{ kNm}$$

where:

- ϕ = strength reduction factor
- k_1 = load duration factor
- k_8 = stability factor
- f_t = flange characteristic tension stress (from manufacturers' literature)
- A_f = net area of flange = $B h_f - 0.5(h_r - h_w) t$
- D_1 = distance between flange centroids = $h - h_f$

Note that for values of k_8 less than the ratio of (flange characteristic tension stress) / (flange characteristic compression stress), use

$M_{bx} = k_1 k_8 f_c A_f D_1 \times 10^{-6}$ kNm, where

f_c = flange characteristic compression stress (from manufacturers' literature).

Shear Capacity

The shear capacity of an I-joist section is usually determined by calculating the panel shear in the web. This may also be limited by the capacity of the web-web joint, or the web-flange joint. Refer to manufacturers' literature for guidance.

Panel shear

$$V^* \leq \phi V_x$$

$$V_x = k_1 f_{ps} t (D_1 - 40) \text{ N}$$

where:

- ϕ = strength reduction factor
- k_1 = load duration factor
- f_{ps} = characteristic web panel shear stress (from manufacturers' literature)
- t = web thickness
- $(D1 - 40)$ = effective shear depth, with allowance for 40 mm hole in web for standard web penetrations.