Prolam
Engineered Laminated Timber

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How does the placement of steel in a composite beam affect its performance?

I-beams optimise material usage by positioning large flanges far from the neutral axis and connecting them with a relatively thin web. Similarly, PLX20 beams employ this concept to maximise the effectiveness of steel reinforcements, thereby significantly increasing bending stiffness. In PLX20 beams, the steel bars serve a similar function to the flanges of an I-beam, while the timber acts as the web.

Bending stiffness, aka flexural rigidity, is directly related to the second moment of inertia ***I*** of a beam's cross-section.

The second moment of inertia for a rectangular beam is calculated using this equation

$$I = \frac{bh^3}{12} + Ad^2$$

where

b is the width of the beam

h is the depth of the beam

A is the area of the beam equal to ***b*** × ***h***

d is the distance between the geometric centre and neutral axis (for a rectangular beam, the geometric centre and neutral axis are the same location, so this distance is zero)

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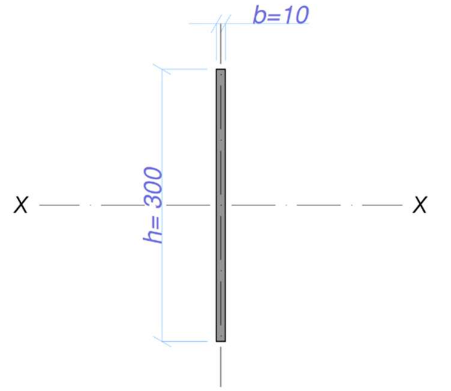
Consider a ***300* × *10*** rectangular section bending about its major (strong) axis *X-X*. This means



b = 10

h = 300

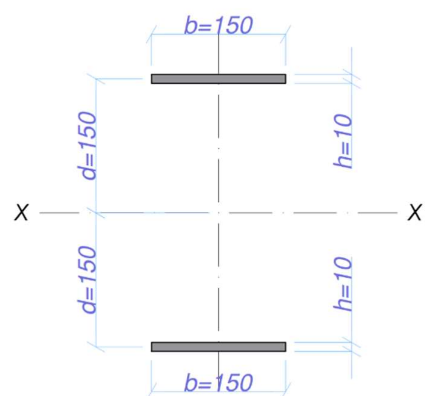
A = 10 × 300 = 3000

d = 0

The second moment of inertia for this beam is

$$I = \frac{bh^3}{12} + Ad^2 = \frac{10 \times 300^3}{12} + 3000 \times 0^2 = 22.5 \times 10^6$$

Now imagine the same rectangular section is broken into two pieces and placed ***300*** apart from each other. For each piece in the new configuration, it means



b = 150

h = 10

A = 10 × 150 = 1500

d=150 (geometric centre for each piece is 150 from the neutral axis, which has a significant impact on the second moment of inertia)

The second moment of inertia for each piece is

$$I = \frac{bh^3}{12} + Ad^2 = \frac{150 \times 10^3}{12} + 1500 \times 150^2 = 33.8 \times 10^6$$

The total second moment of inertia for both pieces is

$2 \times (33.8 \times 10^6) = 67.5 \times 10^6$

Comparing the second moment of inertia for two configurations

$$\frac{67.5 \times 10^6}{22.5 \times 10^6} = 3.0$$

This means, in this example, the second configuration has ***three*** times the bending stiffness while using the same amount of material.