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Bending strength of I-beams with webs of wood-fibre board and flanges of star-sawn triangular profiles.

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Subject

To determine some bending strength parameters of I-beams with triangular flanges and wood-fiber board webs.

Material and methods

Twenty three beams with wood-fiber board webs K-board K40 (BFS 1993) and triangular flanges of pine (*Pinus silvestris* L) prepared by star-sawing (Sandberg 1996) were prepared and loaded in bending to failure (Fig 1). The flanges were considered to be a structural lumber K24 or lower (BFS 1993). The cross-sectional dimensions of the beams are given in Fig 2. The flanges and webs were glued using a resorcinol-formaldehyde adhesive (Cascosinol 1711, hardener 2520). The beams were loaded to failure using a four-point loading technique (Nordtest-standard 1987), and the failure load, modulus of elasticity and ultimate moment to failure were determined. During the experiment, the mean moisture content and the density of the flanges were 10.3 % and 417 Kg/m³ respectively.

Results

Table 1 shows the mean values for 23 beams loaded in bending to failure. The results obtained are equivalent to an I-beam with a rectangular cross section flange having the same section modulus as the triangular flange.

Compared to solid cross-section beams, an I-beam has the advantage of providing the greatest moment of inertia for the amount of material employed. Using an I-beam with a triangular flange rather than a rectangular flange, it is possible to achieve additional advantages such as:

- A better material utilization, where a 7% small volume of wood is needed in a triangular flange to give the same section modulus as a rectangular flange.
- Since it is free from the undesirable juvenile wood, a beam with a triangular flange can offer a high density structure with a better shape and dimensional stability
- The beam can offer a better shape stability if the triangular flange is glued to the web, since the position of the annual ring orientation is maintained as shown in Fig 2.

References

- BFS 1993:** Boverkets konstruktionsregler 94, Boverket 1993:58, ISSN 1100-0856 (in Swedish)
- Nordtest method 1987:** Light-weight beams of wood, NT Build 327
- Sandberg, D. 1996:** Radially sawn timber. Star-sawing - a new method for producing timber with vertical annual rings. Holz als Roh- und Werkstoff 54(1996) 145-151

Table 1. Strength values in bending for the beams in the test (mean values of 23 beams at 10.3 % moisture content)

Property	Mean value	Standard deviation
Momentkapacitet (kNm)	11,2	3,3
Bending resistance (kNm ²)	392	66,9
Kantböjhållfasthet (MPa)	35,7	10,5
Modulus of elasticity (GPa)	10,9	1,7
Failure load (kN)	16,9	5,0

Fig. 1. Cross-section of a conventional light-weight beam (left) and a light-weight beam with triangular flanges (right)

Fig. 2. Cross-section dimension for the beam in the investigation. The length of the beams was 4.2 m