Transverse Prestressing of Prestressed Laminated Wood Bridge Decks

B. deV. BATCHELOR
Prof. of Civil Eng.
Queen's Univ.
Kingston, ON, Canada

K. Van DALEN
Prof. of Civil Eng.
Queen's Univ.
Kingston, ON, Canada

R.J. TAYLOR
Res. Eng.
Ontario MTC
Downsview, ON, Canada

A form of construction which is well suited to short span bridges is the nailed-laminated wood deck. However, experience has shown the load distribution of this type of deck is severely impaired with time due to rusting and ultimate failure of the nails. A method (1) has been developed for the rehabilitation of nailed laminated wood decks which involves introduction of transverse prestressing. This method has also been successfully applied to new construction. Initially, no standard method of design existed for such an application of prestress to wood systems and studies have been undertaken (1) to assess the behaviour of such systems and to determine the appropriate values of structural parameters for use in analysis and design. As shown in the figure, the details of the prestressing system vary depending on whether it is applied to rehabilitation of existing structures or to new construction. Typical details are provided in the Ontario Highway Bridge Design Code (2) which includes a section on prestressed wood systems.

Laboratory and field studies have been conducted on the system (1). The objective of the laboratory studies was the determination of orthotropc plate parameters and prestress losses. The main variables were type of wood (hem-fir, white pine and red pine), type of wood treatment and level of initial prestress. Tests were conducted on laminated beams and plates and on axially loaded prisms formed from laminates. The results of these investigations have also been reflected in the provisions of Reference (2).

The prestressed laminated wood deck lends itself to prefabrication. Its superior load distribution over that of existing conventional nailed laminated decks has been demonstrated (1) as shown in the figure. The Hebert Creek Bridge which was rehabilitated in 1976, has been monitored regularly, and has confirmed that the system is feasible and economical. This has also been confirmed at other sites in Ontario.

REFERENCES

1. Taylor, R.J., Batchelor, B.deV. and Van Dalen, K., "Prestressed Wood Bridges", Procs. International Conference on Short and Medium Span Bridges", Vol. 2, August 8-12, Toronto, Ontario, pp: 203-218.

2. Ontario Highway Bridge Design Code, Ontario Ministry of Transportation and Communications, Downsview, Ontario, 1983.

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TRANSVERSE PRESTRESSING OF LAMINATED WOOD BRIDGE DECKS

Existing Nailed Decks

Longitudinal Deck

Transverse Deck

Problems - Nails are susceptible to repeated loads causing delamination. This reduces load carrying capacity & life expectancy, and increases maintenance costs.

Typical X-section

Typical Delamination

Solution - Transverse Prestressing

KABAIGON R.(1981) Rehabilitation

SIOUX NARROWS(1982) Deck Replacement

RESEARCH AND CONSTRUCTION

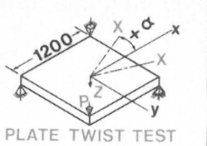
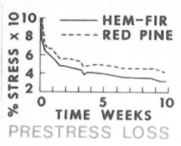
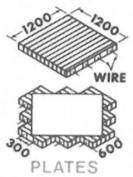


PLATE TWIST TEST

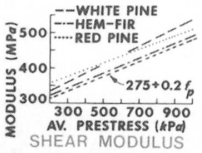
TEST RIG



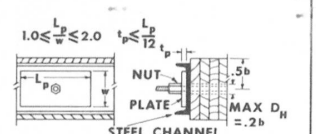
PRESTRESS LOSS

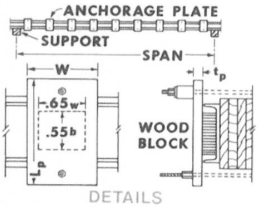


PLATES



SHEAR MODULUS





DETAILS

CONCLUSION – PRESTRESSED WOOD DECKS FEASIBLE

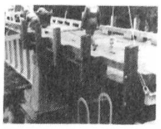
Load Testing

Herbert Crk. (1976) Vertical Deflections
Results - 100% Increase in Capacity

Other Applications

FOX LAKE Bridge New prestressed laminated wood rigid frame. Built 1981, Sudbury, Ontario.

AGUASABON R. Bridge New transversly laminated, prestressed wood. Segmental Construction. Terrace Bay, Ontario 1983.



VICTORIA ISLAND Bridge. Deck replacement with prestressed wood panels. Ontario Hydro Ottawa, 1984.