DISCUSSION

The Importance of Tension Chord Bracing

Paper by JAMES M. FISHER
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Discussion by **Cedric Marsh**

It is of interest to observe that in the summary to this paper, the true action of columns in a truss is described, and shows why lateral bracing is *not* required.

If a cable is passed through a tubular column, anchored to the column ends and tensioned, causing compression on the tube, the buckling length is always the actual length. Place the cable outside the column, as in Fig. 1 of the paper, and it is seen that, as the end of the column is displaced, the direction of the axial force remains along the column. There is no loss of potential energy, hence no destabilizing force.

Given that point A is restrained and force *P* remains vertical, then the lateral displacement of B will cause an increase in the force in the strut, AB, (Fig. 13) to $P/\cos\theta$, but it is still in neutral equilibrium, and the strut can only buckle as a column of length AB.

Even if the column is fixed at the end A, due to the freedom of B to move laterally, the effective length *K* is still 1 for out-of-plane buckling. In this case, lateral bracing may be desirable in order to reduce *K*.

Were the arguments for bracing tension chords valid, then a pony truss, with the compression chord stabilized laterally only by the rigidity of the web members, would be subject to a similar analysis.

Cedric Marsh is a Professor at the Centre for Building Studies, Concordia University, Montreal, Canada.

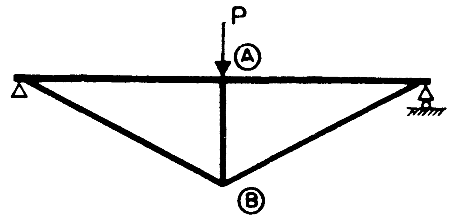


Figure 1

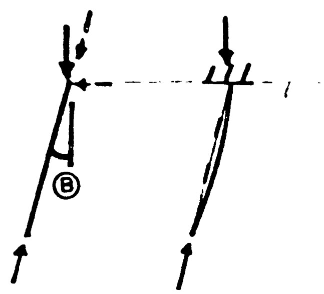


Figure 13

Discussion by **Carl Erik Broms**

The author describes a method to estimate the bracing requirements for the tension chord of a truss.

This writer shares the opinion that a tension chord needs bracing, but does not agree with the author's arguments.

In a normal roof truss, both the load (the purlins) and the top chord are laterally braced. Then the author's Fig. 12 is wrong, since the force transmitted to the diagonals is passing through the end-points of the diagonals. (The bracing force at the top chord is missing in Fig. 12.)

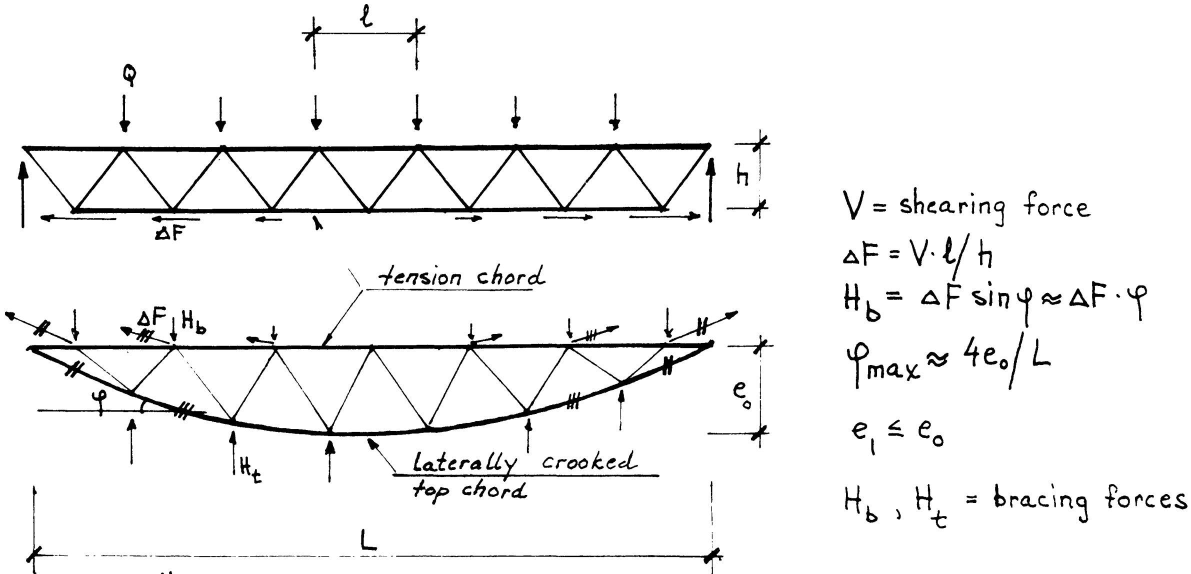
But the tension chord still needs to be braced *if the top chord is laterally crooked*, as in Fig A. The forces $\triangle F$, which are delivered to the tension chord by pairs of diagonals, will be situated in the plane through the three end points of the pair of diagonals involved. Thus the $\triangle F$ forces delivered to the tension chord are laterally parallel to the top chord, and subsequently the $\triangle F$ forces delivered to the top chord are parallel to the tension chord.

Only strength requirements are necessary for the tension chord bracing, since a deflection in the direction of the bracing will not affect the magnitude of the bracing forces (as long as the top chord bracing can be considered infinitely stiff).

The bracing forces at the top chord due to a crooked tension chord shall be added to the easily derivable forces

$$H_t = \frac{Qe_1}{h}$$

As the top chord is in compression these forces shall be enlarged due to second order effects—the enlargement depending on the stiffness of the top chord bracing.



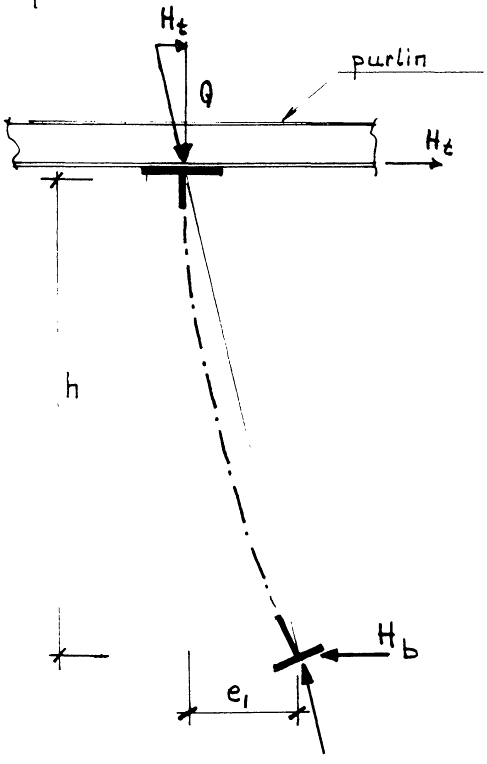


Figure A

Carl Erik Broms is a Consulting Structural Engineer with AB Jacobson & Widmark, Industrial Division, Lidingö, Sweden.

Closing Discussion by **James M. Fisher**

The author appreciates the comments made by Mr. Marsh relative to the subject paper. His comments relative to the cable analogy are theoretically and mathematically correct. However, if the cable ends are not located *exactly* in the same plane with the column, or if one cable end is slightly higher in elevation than the other end, the structure is then inherently unstable. Until such time that experimental research has shown the cable analogy will work for real structures (with their inherent eccentricities and tolerances) the author prefers to base calculations on the more conservative approach described in the paper.

James M. Fisher is Vice President, Computerized Structural Design, Inc., Milwaukee, Wisconsin.