Abstract:

In modern timber constructions there is a tendency to larger span and greater slenderness of glulam beams. Due to their slenderness the timber beams are in risk of lateral torsional buckling and have to be supported at their compression chord. An easy analytical solution in accordance with 2^{nd} order theory is not possible because of the coupling of the beam and the horizontal bracing. Using lateral rigid supports enables a simplified solution with the equivalent member method. For the dimensioning of the horizontal bracing a deflection criterion of L/500 has to be taken into account and the influence of a horizontal equivalent load q_d has to be considered.

Within this research project a separation of the timber beam and the horizontal bracing was performed for the calculation of the occurring forces and deflections. In this process the internal forces of the beam in accordance with 2^{nd} order theory were calculated with the program *constantialigni* developed at the Institute of Structural Design (University of Stuttgart). In addition, the deflections of the horizontal bracing were determined with RSTAB using the forces calculated in *constantialigni*. In turn the deflections of the horizontal bracing were added to the precamber of the beam in *constantialigni* and the spring stiffness of the bracing was considered. This iterative procedure was performed until a convergence of the horizontal deflection occurred.

The results of *constantialigni* have been validated by comparative calculations. Within this research project an extension of the existing program has been realized so that parallel-chord beams with three flexible supports at the upper chord can now be analyzed.

In the scope of a parametric study the cross section of the beam was varied to determine the influence on the necessary stiffness of the lateral supports. Furthermore parameters of the horizontal bracing were varied to gain knowledge of its necessary supporting stiffness. Thereby the variation of the beam length shows the greatest influence on the bracing stiffness. The supporting stiffness decreases with increasing beam length and therefore increasing slenderness of the beam. By increasing the distance between the beams or the diameter of the diagonals of the bracing the supporting stiffness increases significantly. In each of the cases examined the deflection criterion of L/500 according to DIN EN 1995 has been observed under pure stabilization forces. For very slender beams or large precambers however the maximum deflection according to the standard is only nearly reached. Additional deformations by horizontal loadings such as wind loading will then lead to an exceeding.

Due to the sinusoidal horizontal precamber of the beam the occurring supporting forces in the middle of the beam are much higher than the forces in the beam´s outer quarter points. This effect can´t be taken into account using the constant distributed load q_d according to DIN EN 1995. For a better consideration of the realistic distribution of the stabilization forces within the scope of this research project a simplified method was derived. Depending on the slenderness, the height and the length of the beam the constant load according to the standard is redistributed with the help of the factor K_V. Using the factor K_V enables a more realistic assumption of the distribution of the occurring stabilization forces even for system with more than three supports (up to a slenderness of 19).
However, no detailed calculations for beams with more than three horizontal supports were carried out yet. For a simplified design model for beams with more than three horizontal supports or varying chords further research is necessary. In addition no simplified approach can be given for beams with varying height