COMPARISON OF NON-LINEAR STATICAL ANALYSIS OF TRUSS WITH LINEAR AND ROTATIONAL SIDE SUPPORTS AND 3D ROOF MODEL

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1. Introduction

The present research is devoted to study lateral buckling of truss with linear and rotational elastic side-supports. In the paper geometrically non-linear analysis of example truss with linear and rotational elastic side supports is compared with geometrically non-linear analysis of part of the roof construction with purlins and truss-bracing. The problem of bracing stiffness required to provide lateral stability of compression members is present in design codes [1], [2]. To the best of the author knowledge similar problem for trusses with elastic side supports have been investigated only in few studies as for example in experimental investigations [1] or in studies [4], [5].

2. Model description

In the present parametric study a roof truss shown in *Fig. 1* is considered. The height of the truss in the middle is 1.61 m and 0.9 m near supports. The truss is made of steel of f_d = 305 MPa. The connections between truss elements are stiff. It is assumed that the load is applied in the top chord joints. The top chord is laterally braced every 2.4m in joints by linear and rotational elastic side – supports and built-up top chord section is battened every 0.6m. The compressed chord of the truss is sized according code [1] for design value of axial force 700 kN, and the plastic resistance to normal force is 945 kN. The stiffness of linear elastic side supports is 50-1000 kN/m. The range of stiffness of supports has been approximated according codes [1], [2] as relation between force and limited support displacement. The stiffness of rotational side-supports is 20 kNm/deg. The part of the roof with truss bracing and purlins is also considered. The case of stiff and hinged truss-purlin connection is considered. It was assumed that upper and lower truss chord are bent in out of truss plane direction, and that the shape of imperfection is parabolic with maximal value of $L/500$, opposite in upper and lower truss chord.

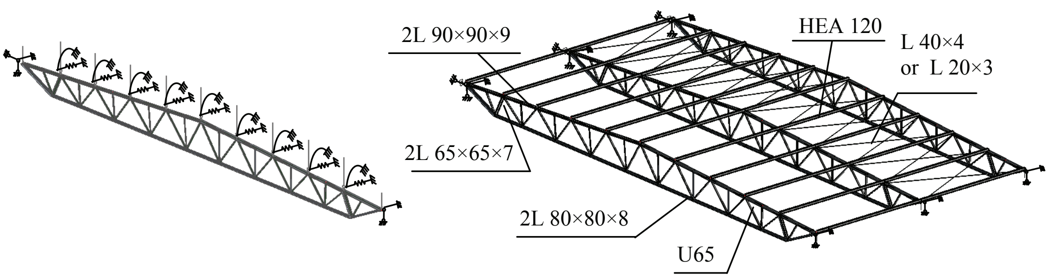

Figure 1. Truss with linear and rotational elastic side – supports and part of roof construction.

3. Results of numerical simulations, conclusions

For different stiffness of side-supports a non linear relation between normal force in compressed chord due to out of truss plane displacement has been calculated (*Fig. 2*). The limit normal force increases with increase of side support stiffness. For all of considered stiffness of linear supports excepting 50 kN/m the limit normal force of truss chord is greater than design value of normal force. The additional rotational supports causes about 77% increase of limit normal force for support of stiffness 50 kN/m and about 20% for supports of stiffness 1000 kN/m. In the case of roof model with purlins and truss bracing, increase of limit normal force caused by stiff connection between truss and purlin is 87% for bracing of L20×3 and 104% for L40×4. Moment in rotational supports is lower than bending design moment of purlins, caused be typical gravity loads, so it is possible to consider purlins as rotational supports of the truss on condition that the connectors between the purlins and the truss are designed to carry arising moment.

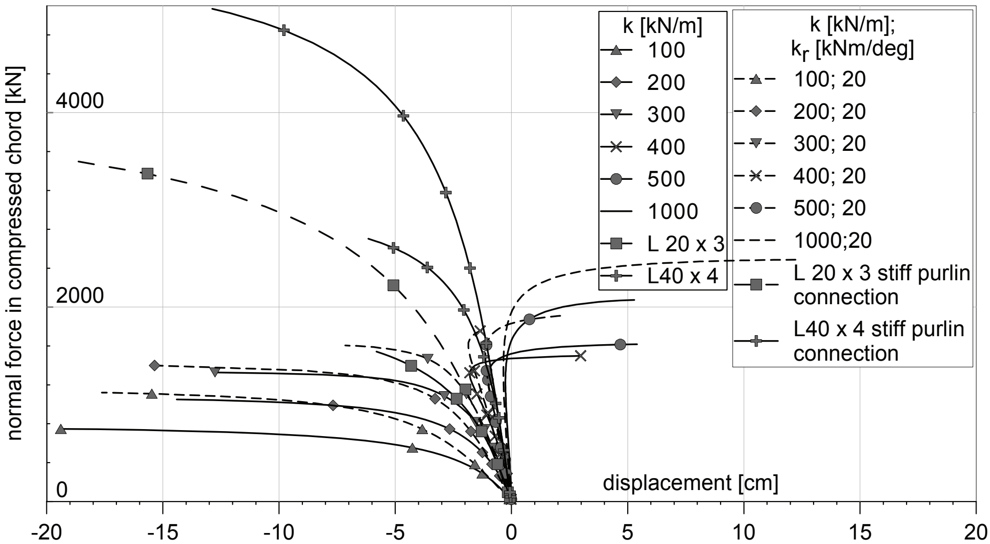

Fig.2. Normal force in compressed chord due to out of plane displacement for different stiffness of side supports

For all of side support stiffness, excepting truss bracing of L40×4 with stiff truss-purlin connection, the buckling length related to side – support distance is greater than value of relative buckling length described in code [1], so code [1] requirements are not precise and in fact predict higher critical force in compressed chord than calculated in example truss.

Relation between side supports reaction and normal force in compressed chord is non-linear. For force level corresponding to design load of the truss side support reaction is about two times lower than described by code [1].

6. References

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