Load-bearing behaviour of halls with stays

In the study three global numerical model were created to simulate the lateral-torsional buckling of steel frames. The models include imperfections, material non-linearity and geometric non-linearity. The way of the modelling makes the change of the details of the frames possible, so more parameters could be examined.

First the numerical model of the global structure is presented. Two kinds of shell models are developed: a Simplified Spring Model and a Model With Purlins. The feature of the models, the imperfection study are written in this part of the study. For the followings study the most important results come from the examination of the imperfections. Some of them are inessential and some of them very important. For accurate results the proposed maximum element size is different for the examined frames.

After the simulations, these observations can be taken:

- The effect of out of verticality and the deformations of the frame in its plane imperfections are negligible.
- The eigenmode imperfections: member buckling form, plates form have significant influence on the frame's load capacity, especially when the frame is not sensitve for global buckling.
- The stiffness of the springs influences the maximum load capacity, if it is reduced to 25% of the original stiffness. Until that time the bottom flange of the rafter is supported stiff enough, so global buckling can work out only between two spring. The influence of the stay stiffness is the same as the spring's.
- The influence of the stiffness of the cladding is negligible, but it is necessary to model them. They prevent the horizontal deformation of the purlins.
- The position of the stays has one of the most important effect on the load capacity, especial in those cases where global buckling can easy be formed. By the distribution of the purlins it can be verified that the first and the second stay position (from the column) is the most important. Consecutively higher resistant was given when the first purlin was used to give support to the bottom flange.
- The support condition of the purlin, so the presumed deformation of the purlins is also a quite important factor. The calculations show that the symmetric shape can earlier formed then the asymmetric one. The difference between the load capacity is about 4-5 %.
- The used purlin cross-sections have enough bending stiffness to brace the frame and to give support for the stays. It is necessarry to take considaration the support of the cladding because it gives to the purlin more stabillity.
- Stays: If the connections of the stays are real hinge (so they don t get any bending moment) then their cross-section can be reduced. The area of the stay's cross-section hasn't got much influence on the load capacity of the frame.
- The distance between the purlins is neglectable but not the position of the stays.

The executed calculations show, that the stays are able to ensure the stability of the frame against deformations out of the frames plane, even in case of disadvantageous imperfections. However, the reserve of the bearing capacity is partially extreme slight.