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COMPARISON OF DIFFERENT CONSTRUCTION HOIST MASTS BY FEM ANALYSIS

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Abstract
The article compares three variants of construction hoist masts. All three masts were calculated by FEM analysis and results discussed.

Key words: *construction hoist; FEM analysis; mast.*

INTRODUCTION

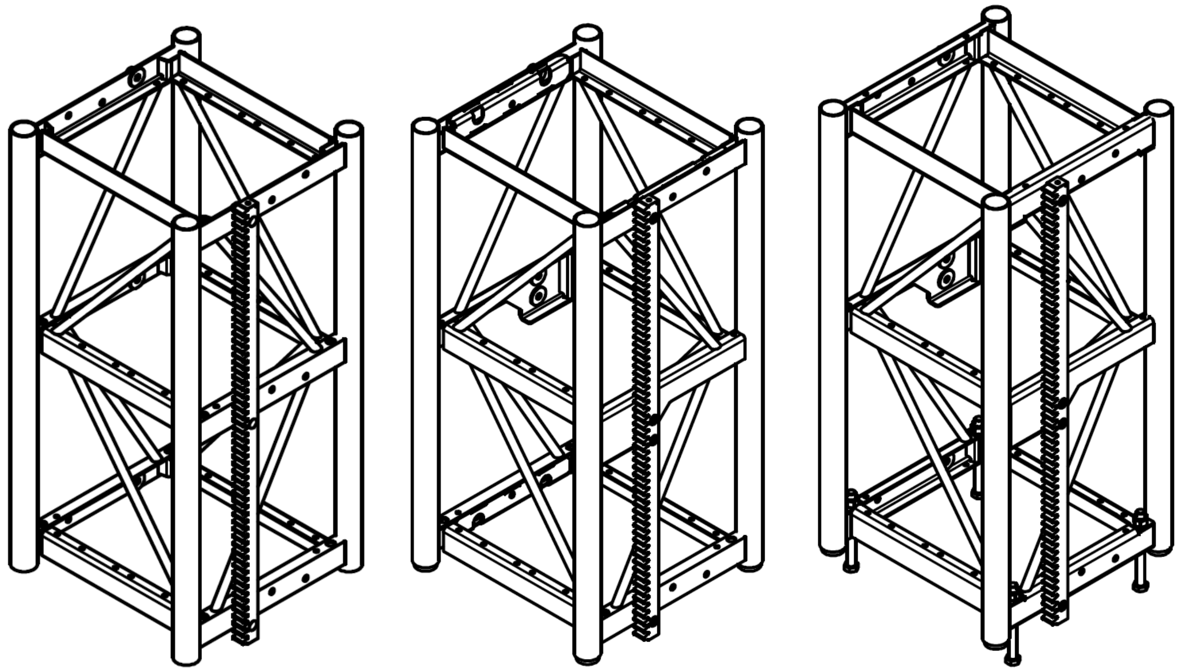
There is a demand on higher load capacity of construction hoists due to increasing productivity of construction work. Manufacturers of hoists want to satisfy this demand by innovation of masts, but they are limited by connection dimensions of nowadays used masts so the old and new masts could work together. Usage of construction hoists is shown on Fig. 1.

Fig. 1 Photos of construction hoists.

MATERIALS AND METHODS

The variant marked as A is original construction which started to lose its reliability due to increased load capacity of construction hoist. There is 3D model shown in Fig. 2. Detail of middle crossbeam is shown in Fig. 3. All three crossbeams are made from rolled L profiles.

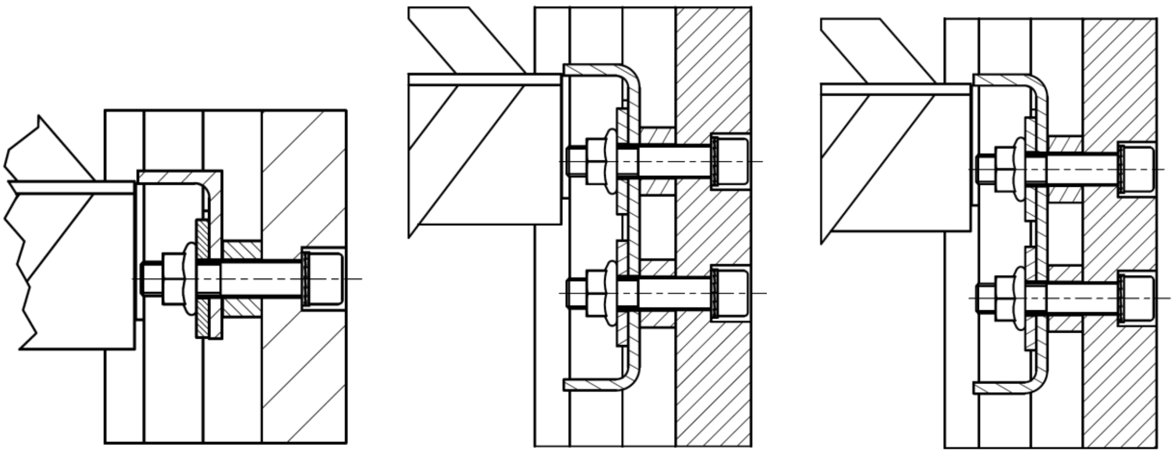
The variant marked as B is based on variant A. Middle crossbeam shape was changed from half of its length to C profile and from half to L profile and it is made from bent sheet metal. Top and bottom crossbeam closed by a second L profile from bent sheet metal a welded to original rolled L profile. There is 3D model shown in Fig. 2. Detail of middle crossbeam is shown in Fig. 3.



A B C

Fig. 2 3D model of mast variants (A – original, B – closed profile from two L – profiles, C – C profile).

The variant marked as C is based on variant B. Top and bottom crossbeam has been changed from closed shape to C profile from bent sheet metal. Middle crossbeam is same as in the variant B. There is 3D model shown in Fig 2. Detail of middle crossbeam is shown in Fig. 3.



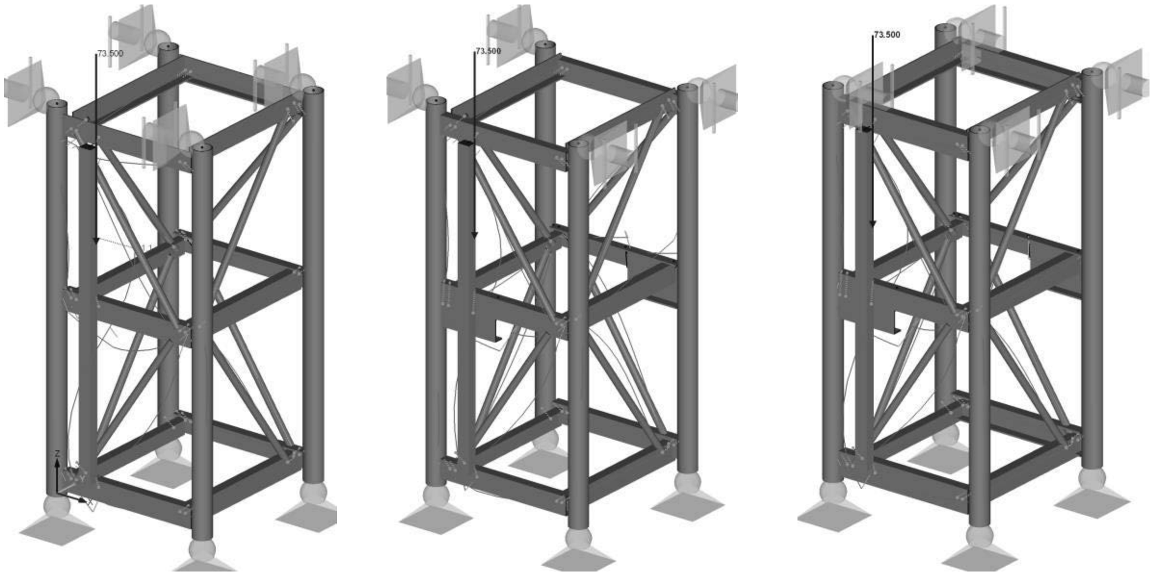
A B C

Fig. 3 Detail of middle crossbeam for variants A, B and C.

Maximal mast load capacity is 7 360 kg (cage + transported material in cage). Maximal speed of cage is up to 90 meters per minute. Cage is driven by three pinions distant 494 mm from each other. Cage is guided by vertical tubular profiles via side pulleys distant 2.1 meters from each other and three pulleys placed on the opposite side of rack (against pinions) with distance 123 mm from each other.

FEM analysis of mast was made in software RFEM from company Dlubal Software ltd. [1]. Calculations were made as 3D variant with 1D elements at whole part of mast and as 3D variant with 2D elements (shell elements) [2].
Model with 1D elements was created in two versions. First version was without rack (this version is not described in this article). Second version was with rack and it is shown in Fig. 4 for all three variants.

Model is created as a beam construction with assigned cross-sectional. Axes of beams are joint according to production drawings.



A B C

Fig. 4 1D model of masts with rack. From left to right variant A, B and C.

RESULTS AND DISCUSSION

In Fig. 5 there is shown comparison of von Mises stress at middle crossbeam for variants A, B and C, which are sorted from top to bottom and has the same color scale. Variants B a C has the same stress distribution and against variant A are crossbeams less stressed.

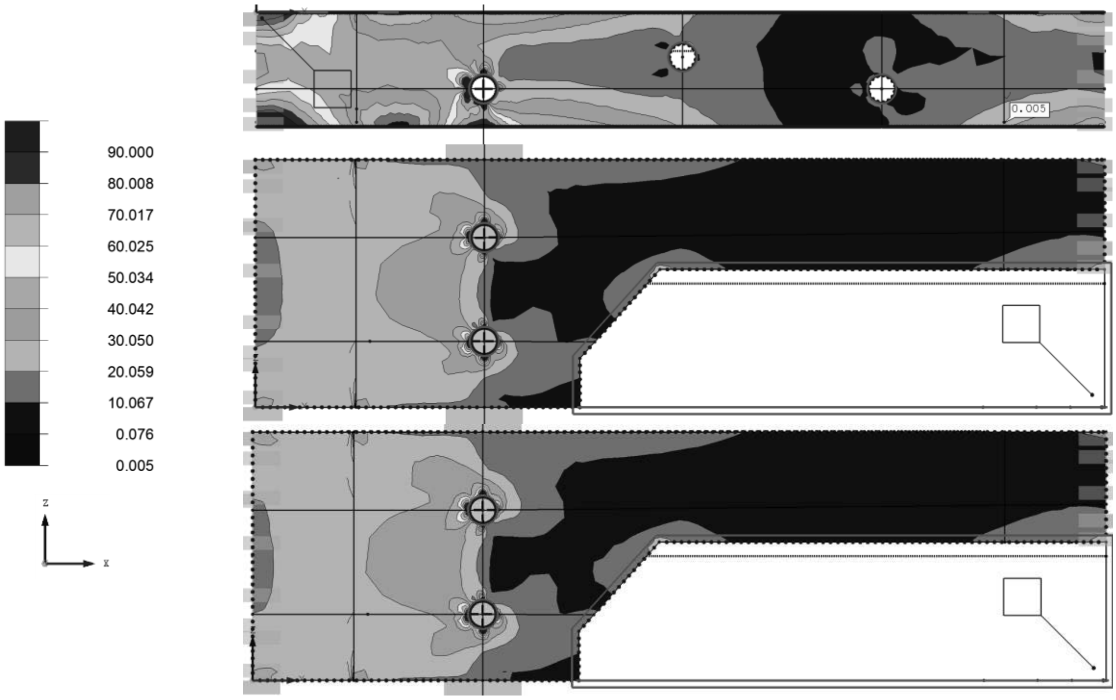


Fig. 5 Von Mises stress at middle crossbeam – variant A, B, C (from top to bottom) – color scale is united

In Fig. 6 there is made comparison of von Mises stress on top (bottom) crossbeam for variants A, B and C, which are sorted from top to bottom and has same color scale. The lowest values of stress is at variant B, where closed profile is used.

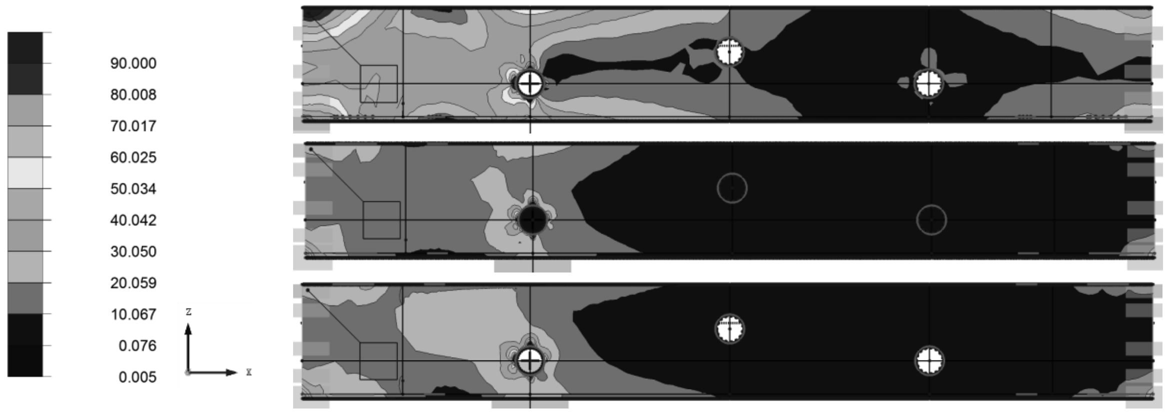


Fig. 6 Von Mises stress at top crossbeam – variant A, B, C (from top to bottom) – color scale is united

CONCLUSIONS

The results shows that closed profile is a best solution to lower maximal stress in construction. Thus the best solution for top and bottom crossbeam is to use shape of crossbeam from variant B. Variant B is however worse to productivity. Variant C has good productivity so closing this shape with another sheet of metal would significantly increase its toughness.

For middle crossbeam is suitable to use variant B (C). The von Mises stress was lowered by 15 Nmm^{-2} which is about 30% better than at variant A.

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