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EXPERIMENTAL METHODS FOR MEASURE REPRESENTATIVE CONDITIONS OF THE CARRYING ROLLERS

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Abstrakt: On the basis of the specification requirements, a stress and deformation analysis of the carrying roller has been performed. As a result, maximum stresses and deformations have been found out and necessary conclusions made. Hereafter, alternatives of further research were outlined, in particular in the area of extreme conditions.

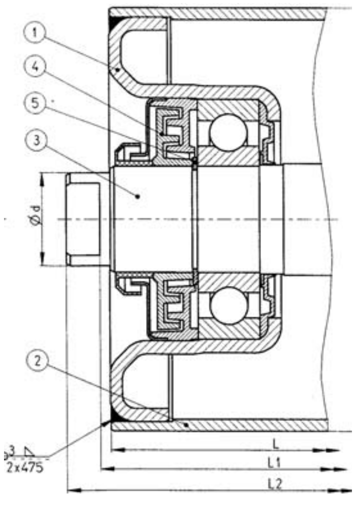
Key words: carrying rollers, FEM

1. INTRODUCTION

Work in lignite open-pit mines is arranged in two phases: removal of overlying rock and coal mining. Removal of overlying rock to the depth of 250 meters presents earthwork of a large extent. These works are done through technological units, consisting of winding machine, long-distance conveyance and overburden dumping machine. On overburden areas in gigant coal open casts, high-capacity digging-wheel and bucket-ladder excavators are used, output of which reaches approx. 10.000m^3/hour. These quantities have to be placed into the outside and inside hoppers by a long-distance belt transport and overburden dumping machines. This results in an enormous consumption of rollers. Therefore, the biggest home-manufacturer of rollers Tranza a.s. came to perform the stress and deformation analysis.

2. SPECIFICATION PARAMETERS

For calculation, plain rollers have been selected. (fig.1), designed for belt transport and manufactured by Tranza a.s. Břeclav.



1 … face (mat. 11.315.50)
2 … jacket (mat. 11 523.0)
3 … shaft (mat. 11.500.0)
4 … block gasket
5 … safety ring

Fig.1 Plain roller

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The roller loading is shown in the figure 2, where q is continuous load consisting of weight of the transported material and weight of belt corresponding to one roller. Loading falling to one central roller:
q = 6.220 Nm^{-1}
Transport speed of the belt v = $5ms^{-1}$
The roller seating is atypical for the standard design. Cylindrical shaft ends are firmly fixed in the head frame and no axis rotation is possible.

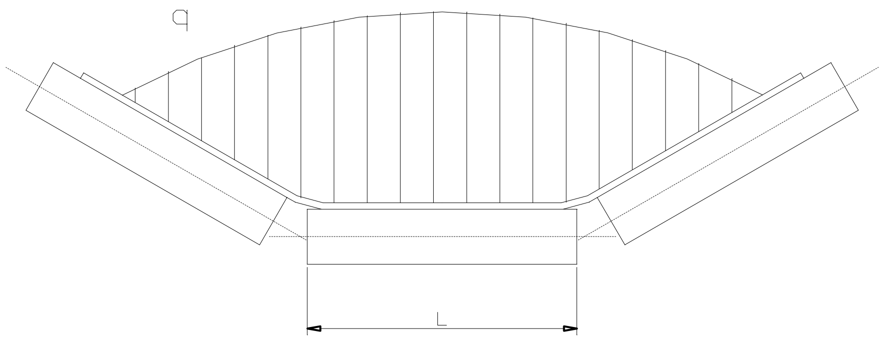


Fig. 2 Loading of transport head frame

Specification requested to perform the stress and deformation analysis of the jacket and shaft, determine the face stiffness impact onto the jacket deformation and specifying the angle of the mutual turning of the bearing rings as well as defining the limit load, when the bearing is seized due to exceeding the permissible turning limit.

3. SOLUTION AND RESULTS

The stress and deformation analysis of the roller has been calculated by the method of final elements. The seating was performed in accordance with the specification requirements as fixing. The bearing has been resolved as a contact problem, which made possible monitoring of the rings turning. Elements having no impact on the roller strength have been disregarded in the calculation model (block gasket safety ring).

The results of the stress analysis are shown in the figure 3. The stress peaks appear due to fixing at the end of the shaft. The decisive maximum is, however, on the jacket and represents 90 MPa. The stress pattern along the jacket is shown in the chart of the figure 4.

Deformations in the direction of load (y axis) are visible in the figure 5. The expected maximum is again in the center of the jacket under load, having value of 0,52 mm. Charts of the deformation dependence on the jacket length are for the jacket and shaft shown in the fig. 6 and 7.

It was found out during the analysis of the mutual turning of bearing rings, that due to seating only minimum angle difference of turning appears, which consequently means that no load limit has to be sought.

Calculations have been performed by software Marc, provided by the company MSC.software s.r.o. Brno.

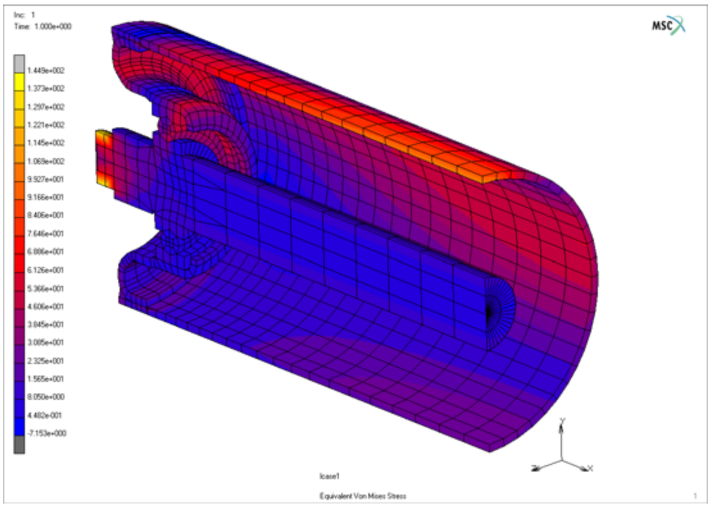


Fig.3 Stress pattern Von Mises

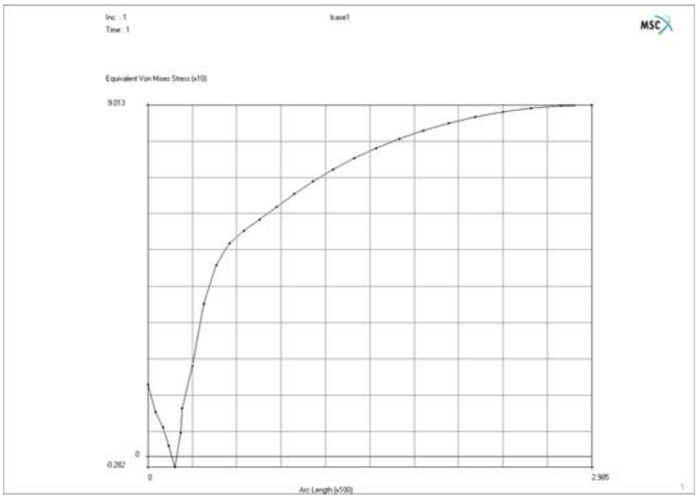


Fig.4 Stress pattern Von Mises in dependence on jacket length

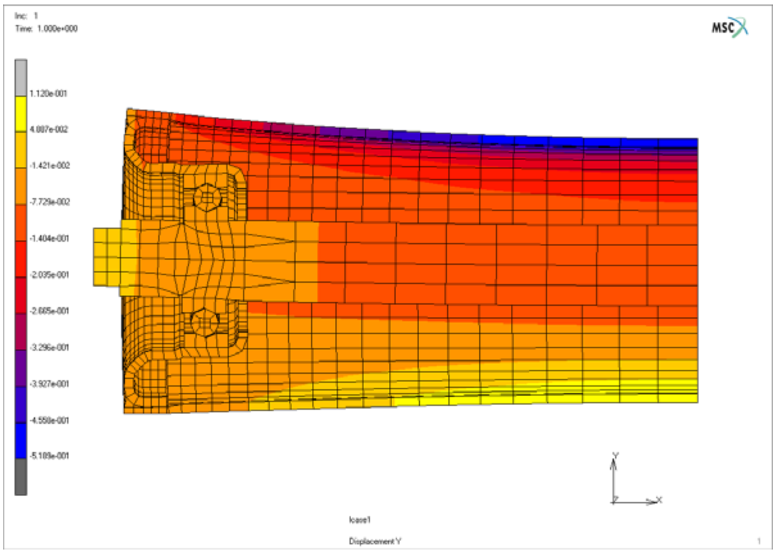
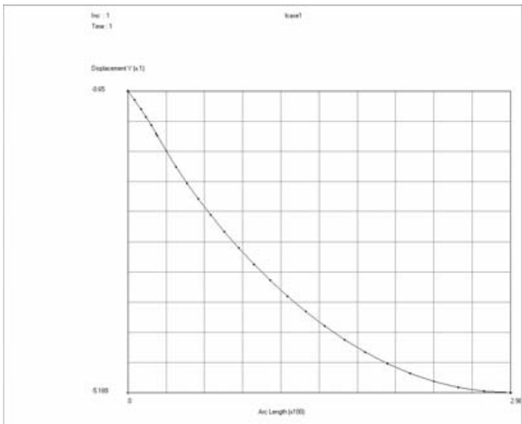


Fig.5 Deformations pattern in direction of y-axis



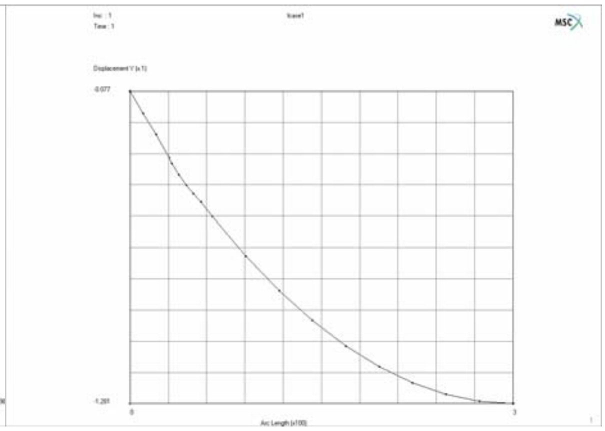


Fig.6 Deformation dependence on jacket length   Fig.7 Deformation dependence on shaft length

4. CONCLUSION (CLOSING REMARKS, ACKNOWLEDGEMENT)

Results demonstrated the stress and deformation patterns on the carrying roller. The maximum stress Von Mises is, as expected, in the center of the jacket below the limit load. Its value is 90,13 MP, which is deeply below the yield point of the material class 11 500.

The maximum deformation was found at the same place as the maximum stress, showing value of 0,52 mm. This value has no impact on the belt guiding. However, the roller vibration may obviously happen not only for reasons of loading, but also due to manufacture inaccuracy and belt vibration. It is recommendable to pay attention to the issue of load dynamics in the next calculation.

The danger of the bearings seizing due to inadmissible turning of rings has been found out as inappropriate. This was mainly due to the required seating which did not make possible turning of the shaft end . By virtue of this kind of seating, the face has been more loaded. However, results have shown, that its strength is adequate even in such a case. Furthermore, its analysis has shown that in case of a joint seating it has due to its deformation (Fig. 5) a positive impact on an alignment of the bearing rings turning.

In further phase of research, it shall be essential to take into account the dynamic load and various kinds of seating. An impact of extreme temperatures also significantly affects the strength properties; therefore it will be necessary to handle this issue also in future.

5. REFERENCE

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