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# STRENGTH ANALYSIS OF THE REASON OF INITIATION OF FATIGUE DEFECTS IN WINDING DRUMS

Рассматриваются причины возникновения поломок барабанных лебедок лифтового оборудования, вызванных усталостью материала. Для проведения анализа прочности конструкций использованы дефектоскопия и анализ напряженно-деформированного состояния с применением пакета программного обеспечения NE/Nastran 8.3 для Windows. Результаты расчетов могут быть использованы для модернизации барабанных лебедок лифтового оборудования.

The article studies causes of fatigue defects in winding drums of lifting equipment. Non-destructive tests and stress-and-strain analysis with application of the NE/Nastran 8.3 software package for Windows. Results of the computations may be used in modernization of winding drums.

In currently used drums (fig.1) appear many defects of fatigue nature. Periodically made repairs of these defects don't eliminate repetition of their appearance in the same areas, what has significant influence on the safety of exploitation of lifting machines.

To explain the reasons of these drums defects underwent certain nondamaging tests and stress and strain analysis of which results were verified by tensometric measurements. Stress and strain analysis of these drums was made using the NE/Nastran 8.3 for Windows software package.

FEM (Finite Element Method) models of the winding drums were developed. These models fully reflects the geometry of the analyzed construction and were made of plate and solid elements.

Load of the construction caused by the forces in steel cords was appropriately distributed along the contact area of the cords and the cylinder's flange (fig.2).

Fig.2*a* shows load scheme of frictional type drum. On the A-B arc the load was applied, caused by the press of the cord on the flange and the friction force. On the B-C arc, however, the load is caused by the force comes only from the press force of the cord.

Fig.2*b* shows load scheme of rolling type drum. This type of drum rolls the cord so three variant of load were considered: beginning of rolling (pressure only on short width); half rolled cord (pressure on half width); fully rolled cord (pressure on whole width).

So prepared numeric models were used in the strength analysis of both kinds of winding drums. As an effect of the conducted computer simulations, full set of data about stress and strain in analyzed constructions was gathered.

Selected results of the computations for each drum were shown in the form of contour plots, showing von Mises stresses in particular area of the drums model.

Executed nondamaging tests using magnetic powder method showed fatigue crack in the stress concentration area near U-type stiffeners-axle connection.

The analyses of the results of the MES computations showed that the most significant influence on the level of frictional type drum stresses hasn't the value of the summarical force in cords but the bend of the shaft of the lifting machine caused by this load. Performed calculations also showed that the value of the transferred torque has a secondary importance on the state of the stresses in these areas.

Further detailed analysis of the MES computation results showed that stresses of critical values are located in stiffeners in their connec-

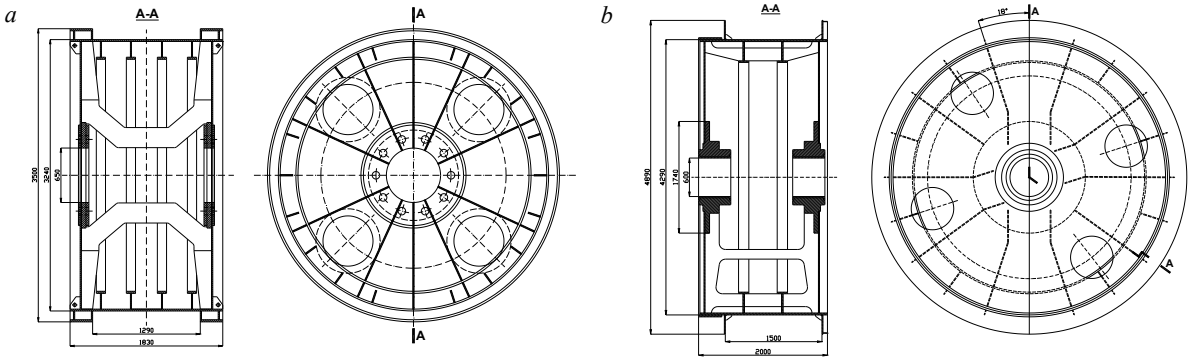


Fig.1. Drums drafts: *a* – frictional type; *b* – rolling type

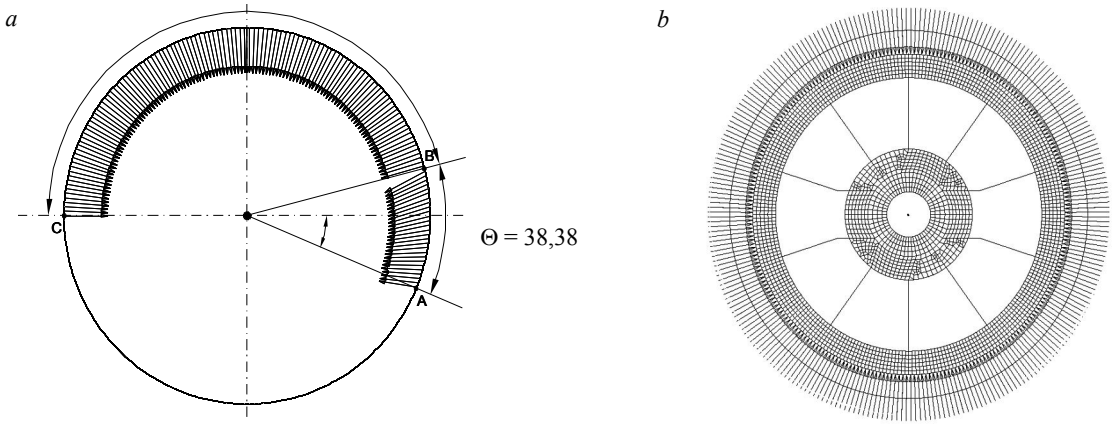


Fig.2. Loads scheme: *a* – frictional type; *b* – rolling type

tion point with shaft's axle, i.e. there, where appearance of the fatigue defects is observed.

Von Mises stress distribution for rolling drum were obtained.

The analyses of the results showed that the level of stress located in outer flange is very high, especially when whole cord is rolled on drum. During nondamaging tests explored many fatigue cracks located in this area. Tensometric tests verified the level of computed stress.

Results of the conducted computer simulations and tensometric measurements indicate that the reason of the fatigue defects of the frictional type drum is overstiffness of the construction caused by the use of the stiffeners connecting side shields of the cylinder. To resolve this problem is suggested to remove middle part of U-type stiffeners to reduce stiffness.

Otherwise in rolling drum fatigue crack is caused by a low stiffness of outer flange. In this case adding a longitudinal T-type stiffeners, which constrained outer flange in more points reduced stresses to acceptable level.

Effects of the computations may become the basis to compilation of the technical documentation allowing the modernization of the discussed drums.