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УКРАЇНСЬКИЙ ДЕРЖАВНИЙ УНІВЕРСИТЕТ
ЗАЛІЗНИЧНОГО ТРАНСПОРТУ

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«ПРОБЛЕМИ НАДІЙНОСТІ ТА ДОВГОВІЧНОСТІ ІНЖЕНЕРНИХ СПОРУД І БУДІВЕЛЬ НА ЗАЛІЗНИЧНОМУ ТРАНСПОРТІ»

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UKRAINIAN STATE UNIVERSITY OF RAILWAY TRANSPORT

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Збірник містить тези доповідей науковців вищих навчальних закладів України та інших країн, підприємств транспортної та будівельної галузі за трьома напрямками: залізниці, автомобільні дороги, промисловий транспорт і геодезичне забезпечення; будівельні конструкції, будівлі та споруди; будівельні матеріали, захист і ремонт конструкцій та споруд.

10th International Scientific and Technical Conference "Reliability and durability of railway transport engineering structures and buildings" Kharkiv, November 20-22, 2024: Abstracts. - Kharkiv: UkrSURT, 2024. - 225 p.

The proceedings include abstracts of presentations by researchers from higher education institutions in Ukraine and other countries, as well as representatives of enterprises in the transport and construction industries. The topics are organized into three main areas: railways, highways, industrial transport, and geodetic support; building structures, buildings, and facilities; and construction materials, including the protection and repair of structures and facilities.

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DETERMINATION OF RATIONAL GEOMETRIC PARAMETERS OF ROPE DRUM

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A double-ended lifting is widely used in the Ukraine's mining industry. Hoists with a single split drum are more compact and less material intensive in comparison to two-drum hoists, which use a separate drum for each of the ropes.

In this mine hoist, the drum consists of two parts – a wide jammed part and a narrow adjustable part, with a clearance of 3 to 5 mm between them. The jammed part of the drum is used for winding and unwinding both ropes. This design allows a significant reduction of the physical dimensions and the metal capacity of the mine hoist.

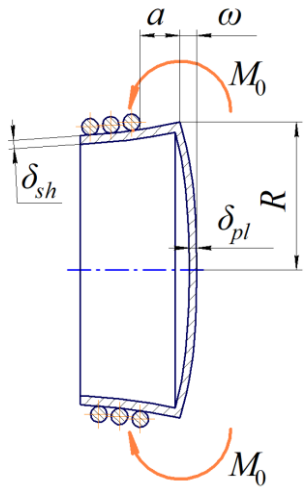
A split drum comprises two essential parts – a wide one, which is rigidly fixed onto the shaft, and a narrow part, which is mounted on bearings and can be connected to the shaft using the decoupling device. This design allows changing the hosting height by varying the length of the rope. In operation, one of the ropes passes the split while being winded onto the drum. According to the technical specifications, the clearance between two drum parts must be 3 to 5 mm wide. However, the drum's deformation due to the forces caused by the wounded rope may increase the clearance beyond the defined limit [1].

There are other problems related to the operation of mine hoists' drums. Algorithms for determining their stress-strain state have been previously developed. In particular, for the drum's shell, which is reinforced with stiffening elements, considering the specific placement of the stiffeners [2].

Using a mathematical model, we determined the dynamic response factors for oscillations at the starting stage of lifting, which ranged between 1.71 and 2.12 for the ropes. Oscillations are caused by the instantaneous application of external moments to the motor rotor and the end loads [3].

Based on the computational scheme (Fig. 1), we built the analytical model using the theory of elasticity. The model allows us to determine the plate flexure depending on the load of the coiled rope. The linear bending moment takes the dynamic response factors into account [3].

The result of modeling is presented on graphs (Fig. 2, 3). By analyzing these graphs we found that a 100% increase in the shell thickness reduces the plate flexure by 30% and increases the overall mass of the drum by 52%.



R – drum radius, R = 3,1 m;
δ_{sh} – shell thickness, m;
δ_{pl} – plate thickness, m;
a – distance between plate and nearest coil of rope, m;
ω – plate flexure, m;
M_0 – linear bending moment, N·m/m

Fig. 1. Computational scheme for building of the analytical model

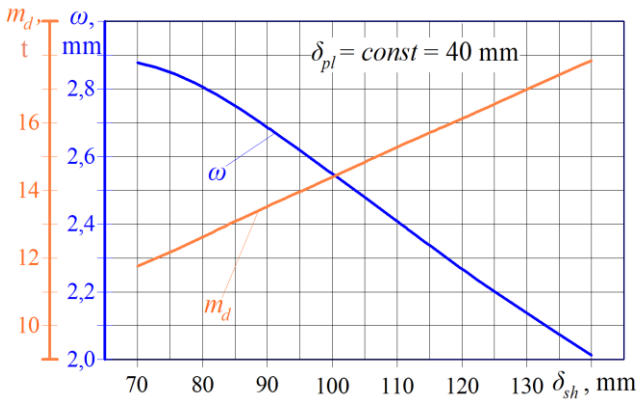


Fig. 2. Relationship between plate flexure ω, drum's mass m_d, and shell's thickness δ_{sh}

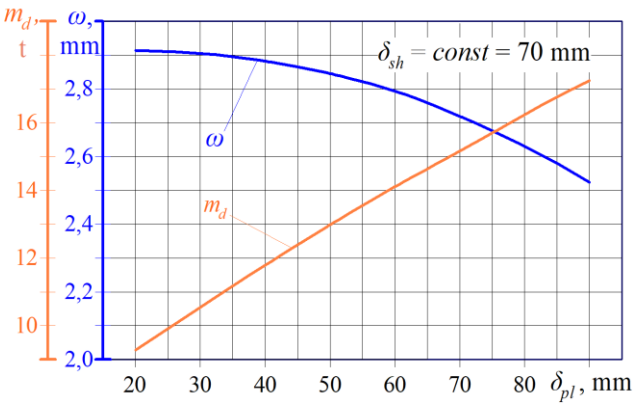


Fig. 3. Relationship between plate flexure ω, drum's mass m_d , and plate's thickness δ_{pl}

On the other hand, increasing the thickness of the plate to the value that corresponds to equal mass growth decreases the plate flexure by only 16%. Therefore, the thickness of the plate is a major factor affecting the plate flexure caused by the load of the coiled rope. This has to be considered in the design of rope drums.

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