OPERATIONAL IMPROVEMENTS IN MUD EVACUATION INSTALLATIONS FROM WATER COLLECTING POOLS IN LUPENI MINE NO. 12 AUXILIARY SHAFT PUMP STATION

Daniel BRÂNZAN, Iosif DUMITRESCU**, Vilhelm ITU***, Mihai-Carmelo RIDZI***

Abstract: *In general, water evacuation schemes are determined by the seam development method used When underground water cannot be evacuate by flow galleries, pumping stations will have to be arranged.*

Collecting pools next to water deposits also play the role of decanting, in view of separating mechanical impurities in water, before pumping. Pools should be placed so that they could be cleaned from the mud from the floor, at least once every 6 months.

In Lupeni Mine, mine water collecting pools afferent to the main water evacuating station at shaft 12, level 400 are cleaned with the help of the mud evacuating installation. The area where the installation is placed is made up of a 50 meter transversal gallery under the pool level land a vertical 30 m mining working

The paper presents certain operational improvements brought about to this installation.

Keywords*:* *mud evacuating installation, operational improvement*

1. Introduction

The mud evacuating installation (Fig. 1) is made up of the following main parts and subassemblies: the traction installation; the balancing equipment of the evacuation vessel; the evacuation vessel; the guidance system of the evacuation vessel.

The traction installation, in its turn, is made up of electrical mine trolley, deviation drum of the traction cable cord, traction cable guiding device.

The electrical mine trolley (Fig. 2) used for traction is type TPe - 1 x 2000 and is part of the category with drums, one or two, and depending on their intent of use, can be for horizontal traction or on inclined plans.

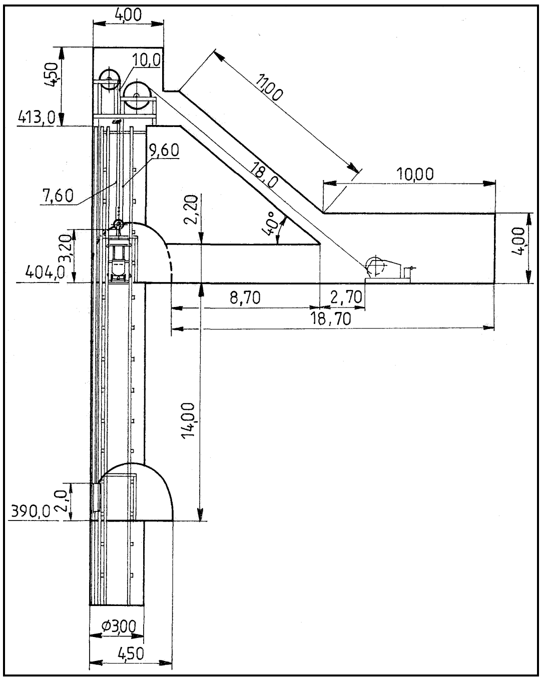

Fig. 1 *Mud evacuation installation in Lupeni Mine*

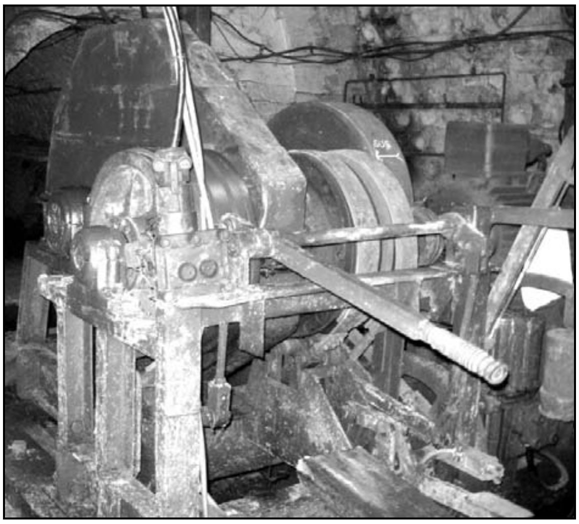

Fig. 2 *TPe - 1 x 2000 type electrical mine trolley*

Deviation drum of the traction cable cord (Fig. 3) is placed in front of the electrical mine trolley, in view of deviating the traction cable cord, so that it would wind or unwind on the trolley drum parallel to the trolley platform and its foundation.

The deviation drum of the traction cable cord is a drum for stretching for the underground transportation belt, with 800 mm conveyor belt width.

* *Eng. C.N.H. S.A Petroşani, E.M. Lupeni*
** *Assoc.prof. eng. Ph.D University of Petroşani, Romania*
*** *Lect. eng. Ph.D University of Petroşani, Romania*

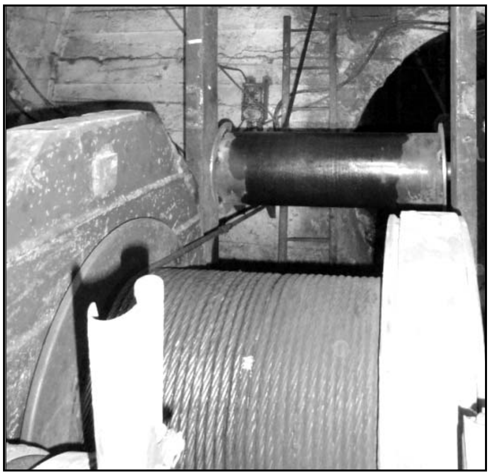

Fig. 3 *Deviation drum of the traction cable cord*

The device for directing traction cable is made up of Φ1530mm cable deviation or directing winch (Fig. 4)and a Φ 450 mm mobile pulley (Fig. 5), to reduce traction force, over which the traction cable is passed over.

Fig. 4 *Deviation winch of the traction cable directing device*

Fig. 5 *Mobile pulley to reduce traction force*

The mobile pulley is connected to the evacuation vessel rod by means of a bolt and junction plates. One end of the traction cable is stable and is fixed to a beam, and the other end to the trolley drum.

The deviation winch is fixed to transversal steel beams, their ends being embedded in the mining working and cemented.

The balancing equipment of the vessel is made of counterweights, the connecting cable between the counterweight and the evacuation vessel, the deviation winch and the fixing clams.

The connecting cable between the counterweight and the evacuation vessel is made of steel, and one of its ends is mounted to the evacuation vessel, and the other is mounted to the counterweight.

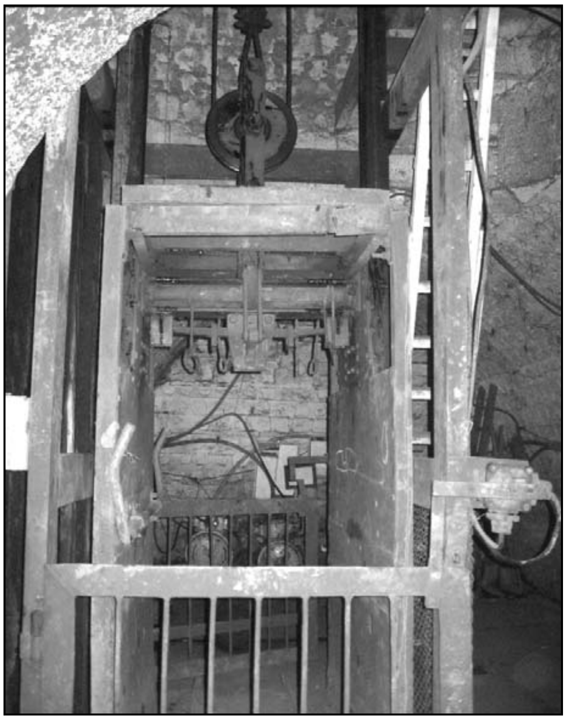

Fig. 6 *Evacuation vessel*

The evacuation vessel (fig. 6) is an extraction cage type vessel, with one level and a wagon on the level. It is a parallelepiped metal construction, intended only to transport wagons, as well as to let down and bring up various materials.

To avoid transversal oscillations during the travel, the evacuation vessel moves along wooden guides. The guides are fixed and supported by transversal beams (ties) made of metal profiles, embedded in concreted walls. The evacuation vessel (cage) is laterally guided.

2. Improving the trolley's exploitation conditions

Due to the provisions in the technical manual of the trolley to be used in galleries and inclined planes, and in the case of mud removing installation in Lupeni Mine it played the role of winding installation with the machine on the soil, placing a cable deviation drum that would take over the vertical component given by the cable was required.

Fig. 7 shows the constructive solution of the deviation drum, where: 1 – metal support frame; 2 – deviation drum; 3 – spacing ring; 4 – collar; 5 – M20x50 screw.

The metal support frame is made of two U20 profiles, which are fixed by two L100x100x8 mm traverse bars, and in the lower part it has two distance pieces of L100x100x8 for the positioning against the support frame of the trolley.

In the upper part there are two cams in the bar L100x100x8x200mm for leaning against a p Φ 160 mm tube.

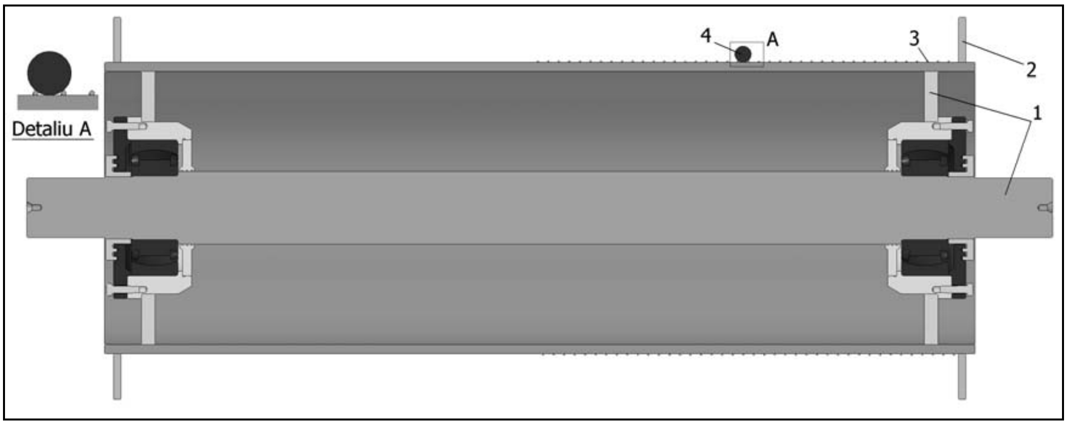

Fig. 7 *Deviation drum*

Fig. 8 shows the drum design, where: 1 –TMB 800 free drum; 2 – stoppage flange; 3 –Φ2 mm wire spiral; 4 – wire spiral positioning calibrating device.

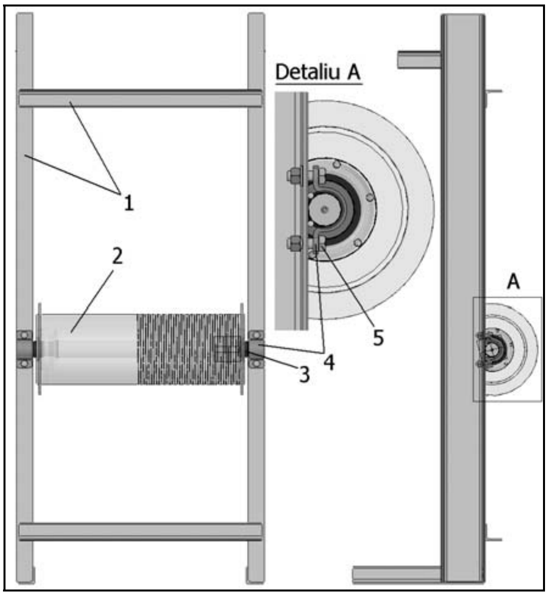

Fig. 8 *Deviation drum design*

Due to the different diameters of the 500 mm trolley drum and of the 320 mm deviation drum, the number of turns of the two drums during the cable being wound and unwound, differ by the ratio 518/338 = 1,5325, a ratio by which the pitch of the wire spiral should be reduced, p=11,75 mm, compared to the winding pitch of the cable over the trolley drum of 18 mm.

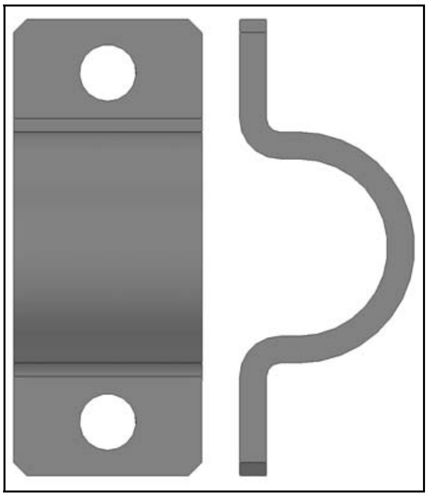

Fig. 9 *Collar*

Fig. 9 shows the collar design, by which the deviation drum shaft is fixed to the metal support frame.

3. Improving the functioning of the safety catch device

Fig. 10 shows the 3D model of the extraction vessel, one level cage, with one wagon on the level, made up of: 1 – cable for cage balancing counterweight; 2 – installation with pulley to pull the cage; 3 – assembly (rod); 4 – cage roof; 5 – slides; 6 – wooden guides; 7 – cage body; size 1700x1120x2400 mm; 8 – wagon route; 10 – cage support beam; 11 – ends supports; 12 – plate spring; 13 – inclined wedge; 14 – transversal rod; 15 – vertical rod; 16 – arm; 17 – shaft; 18 – bearing; 10 – safety catch; 20 – assembly with mining chain for counterweight.

The safety catch device is shown in Fig. 10 a, in normal functioning conditions, when the cage weight deforms the plate spring 12, and the latter is supported by rod 3, and the safety catch claws are in the position in Detail A.

Fig. 10 b shows the situation when there is no more traction force on rod 3, the spring extends, and by the transversal rod 14, fixed to the rod by wedge 13, the vertical rods 15 and the arm 16 rotation of shaft 17 takes place in bearings 18 and the safety catch 19 claws in the guide body 6 (Detail B).

Initially, the counterweight was fixed by a bolt to the junction plates of the traction pulley, as in Fig. 11, but it does not allow the safety catch device to be triggered when the traction force is annulled.

To eliminate this shortcoming of the device, the assembly was designed and made with 20 mining chain, fixed to 10 cage support, as in Fig. 10.

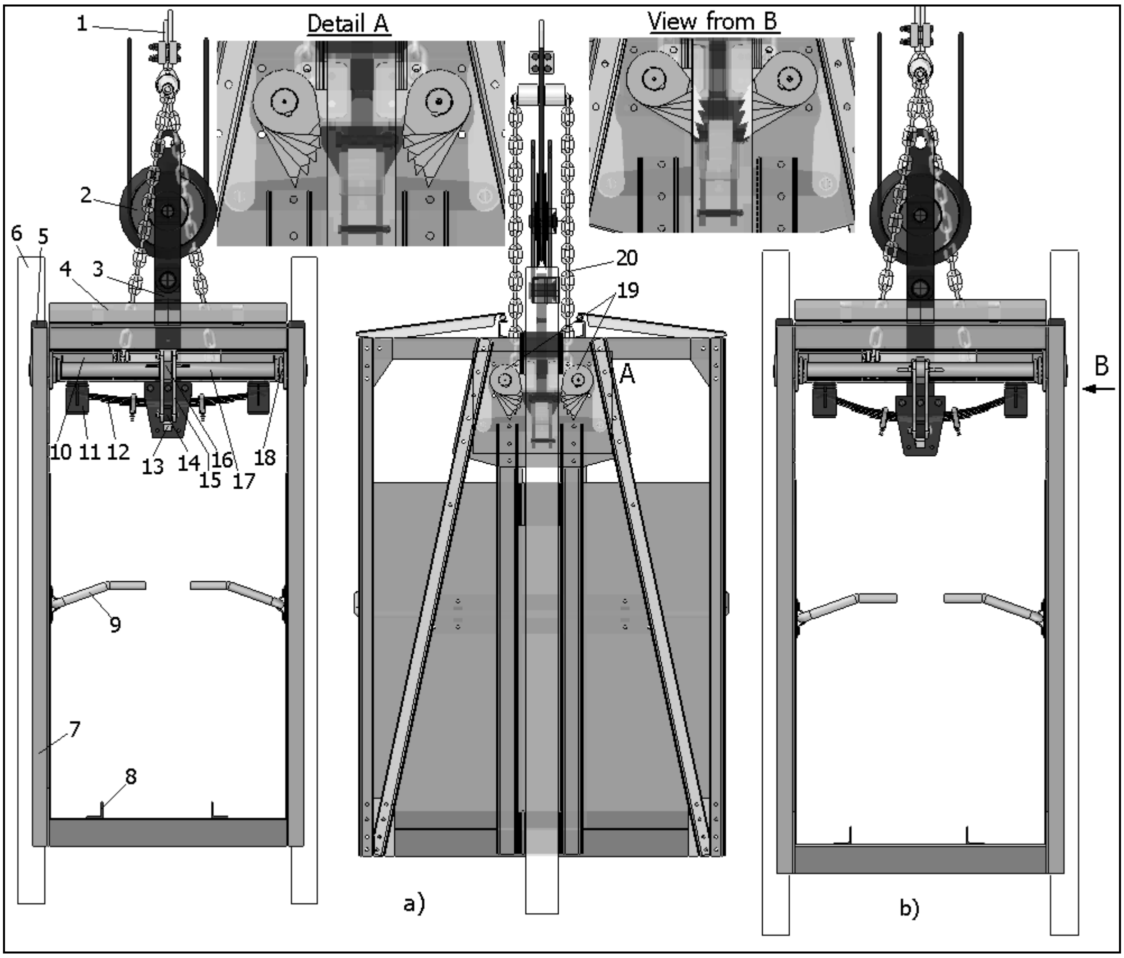

Fig. 10 *3D model of the mud evacuation installation*

Fig. 11 *How to fix the counterweight cable*

Based on a 3D modelling of the mud evacuation installation with the help of Solid Edge software, the functioning of the safety catch device was studied next.

Fig. 12 shows the construction and operation of the safety catch device. Rod 2 connects the 3 cage support beam and 1 bolt, connecting the cage traction junction plates of the pulley. The 4 plate spring is entered between the support plates of 2 rod, and is fixed with the 5 transversal beam, which is pressed by the 6 inclined wedge introduced between the rod and the piece positioned in the grooves of the spring support rod plates.

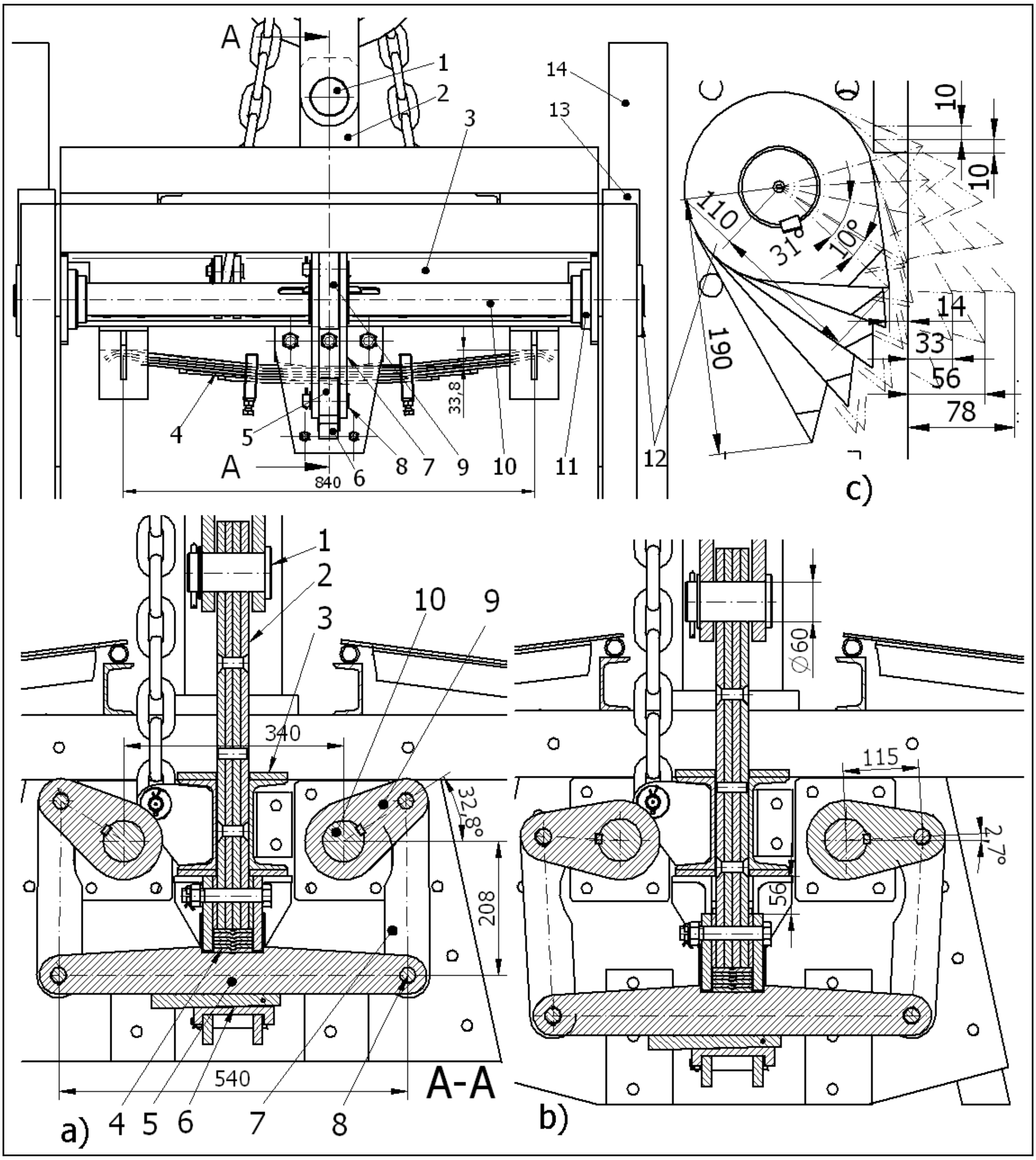

Fig. 12 *Safety catch device*

With the help of 8 bolts and 7 vertical rods, the connection is made between the transversal rod and the 9 arms, which are mounted by wedges to 10 shafts. Shaft 10 is supported and positioned by two 11 gliding bearings that are fixed in the lateral walls of the cage, and on the ends of the shaft 12 claws of the safety catch device are mounted.

Fig. 12 a shows the rod system of the safety catch device with dimensions and angle made by the arm with the horizontal and arrow of the spring, 33,8 mm, for normal functioning conditions, the cage beam leaning to the rod. Fig. 12 b shows the situation of triggering the safety device, when the rod moves by 56 mm and the claws enter in the 14 wooden guides.

Fig. 12 c studies the way in which the claw teeth enter in the guide, depending on the rotation angle. At a 10˚ rotation, the second tooth comes into contact with the guide surface, and at a 31˚ rotation, the safety catch claw teeth enter in the guide 33 mm deep, blocking it in 13 slide.

In the existing installation, the claw teeth were of 12 mm sheet, as in Fig. 14, which made entering the teeth into the guide wood difficult.

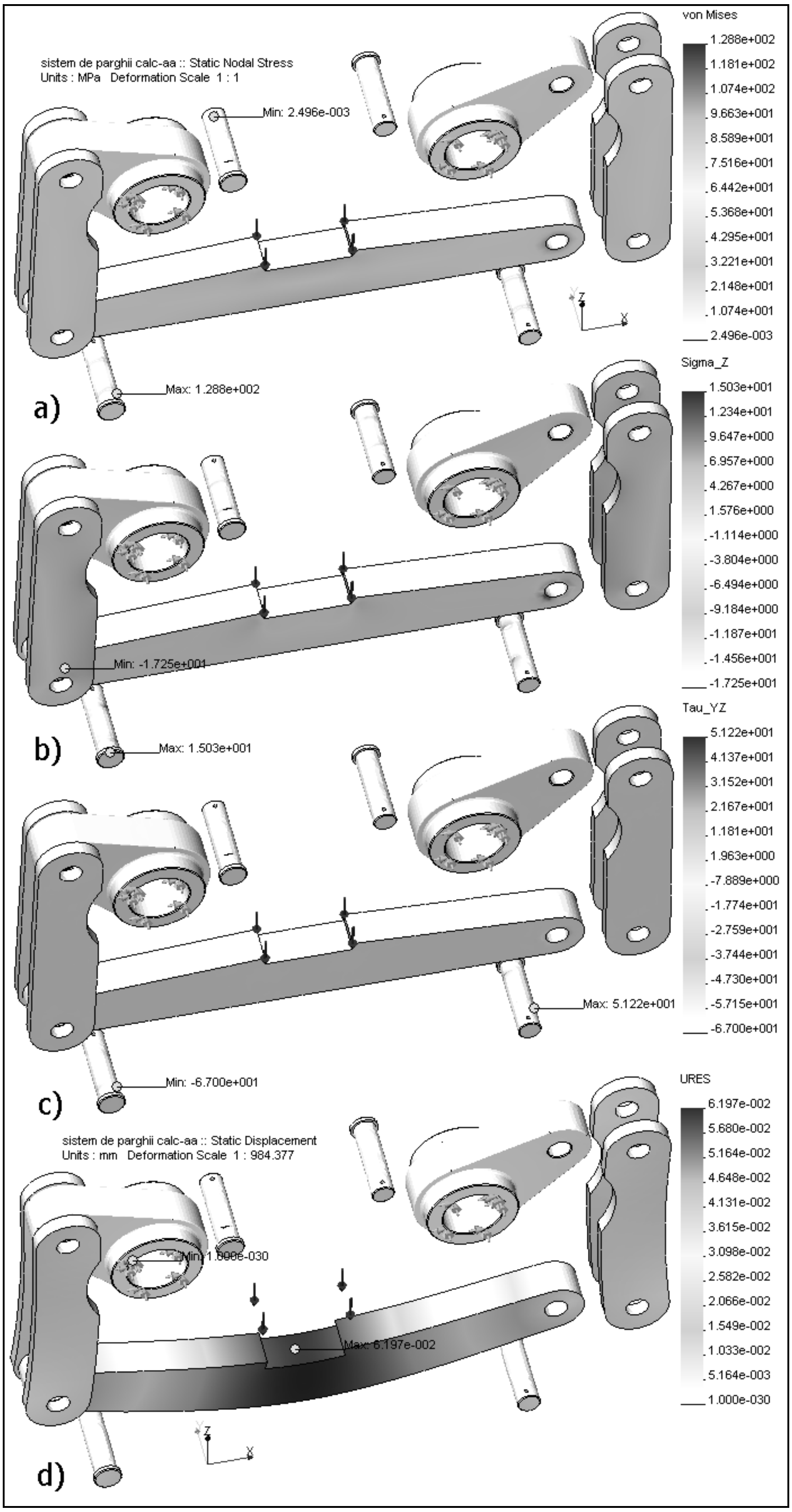

Fig. 13 *Analysis with finite elements of the rod system of the safety catch device*

With the help of Cosmos Design Star software, an analysis with finite elements of the device rod system was made in Fig. 13, where:

a –Von Mises equivalent tension; b – normal tension after axis Z; c – shear tension in plane YZ; YZ; d – sum of deformations. It is noticed that the maximum equivalent tension is 128,8 MPa and is in the bolt in the separation plane between the transversal and vertical rod.

With the help of Cosmos Design Star software, an analysis with finite element was made, Fig. 15 a for the existing tooth and Fig. 15 b for the proposed tooth, laterally sharpened. In both cases, the 15 mm contact length was taken, due to the elastic deformation of the wood. With the help of Cosmos Design Star software a finite element analysis was made, Fig. 15 a for the existing tooth and Fig. 15 b for the proposed, laterally sharpened tooth.

Fig. 14 *Existing safety catch device in the mud evacuating installation*

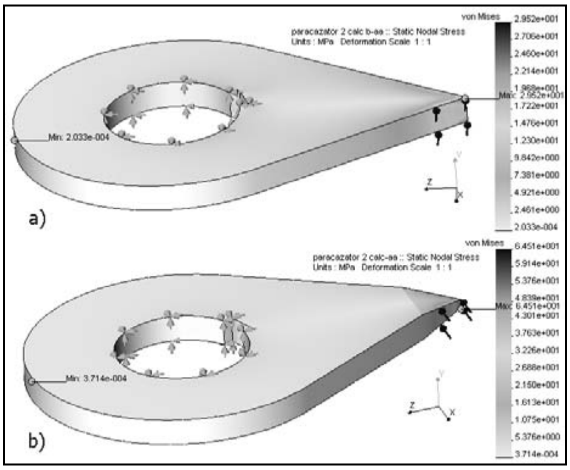

Fig. 15 *Analysis with finite elements of the contact between the safety catch device claw tooth and the wooden guide*

If the guiding is wooden of fir tree with 40 MPa resistance to compression along the fibre 54 MPa for oak, it its noticed that the blunt tooth makes a 29,5 MPa contact tension, lower than the resistance to compression of the wood.

4. Conclusions

As a result of the safety device of the mud evacuation installation in Lupeni Mining Plant, the following resulted:
- improvement of the device by linking the counterweight to the cage;
- sharpening of the teeth of the device claws;
- correlation of the sizes of the lever system with the rotation angle and depth of intrusion of the claw teeth in the guidance wood;
- dimensional verification and establishing the necessary materials for the component materials of the device.

References

1. Blaer, P. and others
Processing foreman's guide, vol.1, Ed. Tehnică, Bucureşti, 1989

2. Bolunduţ, I.L.
Metal materials, Ed. AGIR, Bucureşti, 2004

3. Buzdugan, Gh.
Material resistance, Ed. Tehnică, Bucureşti, 1979

4. Carţiş, I. Gh
Thermal handling – technology and tools, Ed. Facla, Timişoara, 1982

5. Găfiţeanu, M. and others
Machine pieces, vol. I and II, Ed. Tehnică, Bucureşti, 1981 and 1983

6. Itu, V., Dumitrescu, I.
Execution of documentation for mud evacuation installation. Order 871/01.11.2011 E.M.Lupeni, 2011

7. Magyari, A.
Mining mechanical installations, Ed. Tehnică, Bucureşti, 1990

8. Mănescu, T. Şt. and others
Structural analysis through the finite element method, Ed. Orizonturi Universitare, Timişoara, 2005

9. Muscă G.
Assisted projection using Solid Edge, Ed. Junimea, Iaşi, 2006

10. Rădulescu, Gh. and others
Projection guide for machines construction, vol. III, Ed. Tehnică, Bucureşti, 1986