EQUIPMENT DESIGNING FOR THE CAROL SHAFT REHABILITATION FROM SLĂNIC PRAHOVA SALINA

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Abstract: In order to rehabilitate the wooden support of Carol shaft ventilation from Slănic Prahova Salina there have been suggested four variants, from the consolidation of the existing support to its replacing with wood or support or reinforcement with concrete. These mining works can be done only with the help of special equipment that is encased on the wellhead. The designed equipment for the rehabilitation can be used with minor adjustments for those four technological variants of shaft recovery. When it comes to recovering the support of the concrete shaft, the equipment is used to support and move the sliding shuttering. The construction of the equipment is simple, easy to transport, handle and fit, having a low-cost price.

Key-words: ventilation shaft, support, rehabilitation equipment

1. INTRODUCTION

In order to rehabilitate the wooden support of Carol shaft ventilation from Slănic Prahova Salina there have been suggested the following technological variants:

V1 – Replacing the current support with another similar one, made up of oak wood, with strengthening and waterproofing rock around the well by injecting behind the old support a mixture of cement and slag thermal power plant;

V2 – Lining the old support with oak wood, strengthening and waterproofing rock around the well by injecting behind the old support a mixture of cement and slag thermal power plant;

V3 – Replacing the old wooden support with another one, made of concrete;

V4 – Replacing the current support with a similar one made of wood oak, with rock excavation in advance of canopy gaps and filling and sealing with clay.

Making an analysis of the four suggested variants, in terms of technical and economic, here are the conclusions:

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- *Variant V1* is close to variant *V2*, economically speaking, (the cost price being higher with approx. 10%), having the advantage compared to the second one that the full support shaft is replaced with oak, raising the support durability. Compared to variant *V4*, that is more expensive, with approx. 20%, variant *V1* has the deficiency that the filling of the holes cannot be completely controlled.

- *Variant V2* has the advantage of being the cheapest, having the disadvantage of the impossibility of the control on filling the holes behind the support and also the disadvantage of keeping the old support.

- *Variant V3* is the most expensive variant, with approx.50% more expensive than the cheapest variant *V2*. This one has the advantage of the durability of the support and complete filling of the holes with concrete.

- *Variant V4* is the second variant, in economical terms, of the execution expenses being with approx. 30% more expensive than the reference variant *V2*. Compared t the other variants of support in wood, it has the advantage of the durability support, that is completely replaced and full filling the holes with clay.

2. CONSTRUCTION AND OPERATION OF THE INSTALLATION

In figure 1 is presented the constructive solution of the Carol shaft rehabilitated plant from Slănic Prahova Salina, that is made up of: 1 – supporting metal frame; 2 – work platforms; 3 – cart to transport materials; 4 – 4t manual winch; 5 – bridge work; 6 – roof.

The Carol shaft from Slănic Prahova Salina is used to air the salina, having a rectangular section with two compartments of 2000x1300 mm. The wooden armature shaft is broken and must be remade, and so was suggested the constructive solution of the installation presented in figure 1. This one is made up of a metallic supporting frame, see 1, that is on the wellhead and it rests on a bridge work, see 5. On top of the metal frame beams supporting pulleys are mounted on one end for supporting cables and shift work platforms, see 2.

The working platform is moved inside a compartment shaft with a manual winch of 4t, see 4, and it is guided from the superior and inferior part by the wooden rails that glide on the guide's compartment shaft.

While positioning in the interior of the shaft to operate the armature rehabilitation, this one blocks itself supplementary by those four ear dumps that are caught in nails against the rebuilt shaft armature. The platform roof is with two 45° slopes and one is mobile, fixed in hinges and clasps, in order to allow the transportation of the materials from the surface of the working platform with the help of the cart, see 3. The maximum load that a working platform can meet is 7.50 kN.

It was used in order to handle the platform a 4t manual winch (40 kN) because the maximum load is 10 kN, and the platform moving is done with low speed, below 1 m/min, and with large intervals. The cart to transport materials is trailed by an electric winch PRO-CP500, made by PROLIFT Constanţa, that can elevate a mass of 500 kg on a height of 58 m and with the speed of 10 or 15 m/min. The winch PRO-CP500 is

fixed with the help of a plate on the cross of the superior half of the metal frame, and at the other end, opposite to the pulley for the bridge work, and has a cable of 6 m for the box with control buttons.

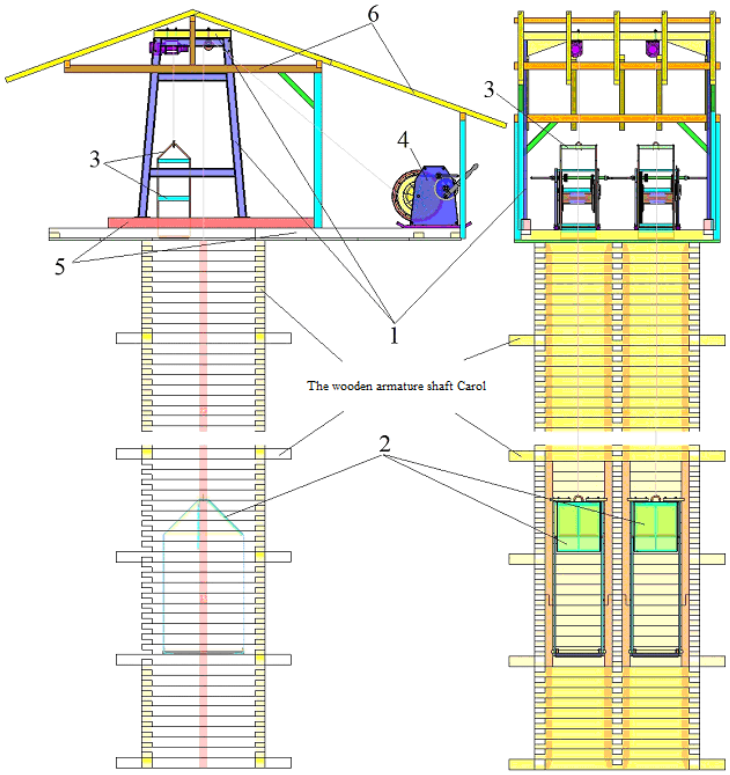

Fig. 1. The equipment for the Carol shaft rehabilitation from the Slănic Prahova Salina.

Since the length of the operation of rehabilitation of the shaft is long, the entire equipment and the wellhead is protected by a roof, see 6.

The construction of the metallic frame support is presented in figure 2, with the annotations: 1 – standing support; 2 – upper frame; 3 – electric winch PRO-CP500; 4 – pulley Φ200; 5 – screw M16x40; 5 – washer Grower N16; 6 – nut M16.

The metallic frame is made up of two standing supports, see 1, where a metallic frame is supported and fixed by eight screws M16x40, and see 2. This one has two sleepers, on the symmetry planes of the two compartments, at a 1500 mm distance, where there are fixed the winches PRO-CP500, see 3, in order to raise and lower the carts for materials and trolleys transport, see 4, for the towing cables of the work platforms.

The standing support of the metallic frame has a trapezoidal shape, being made up of rolled profiles U16, with two vertical longerons and two horizontal pulleys, and

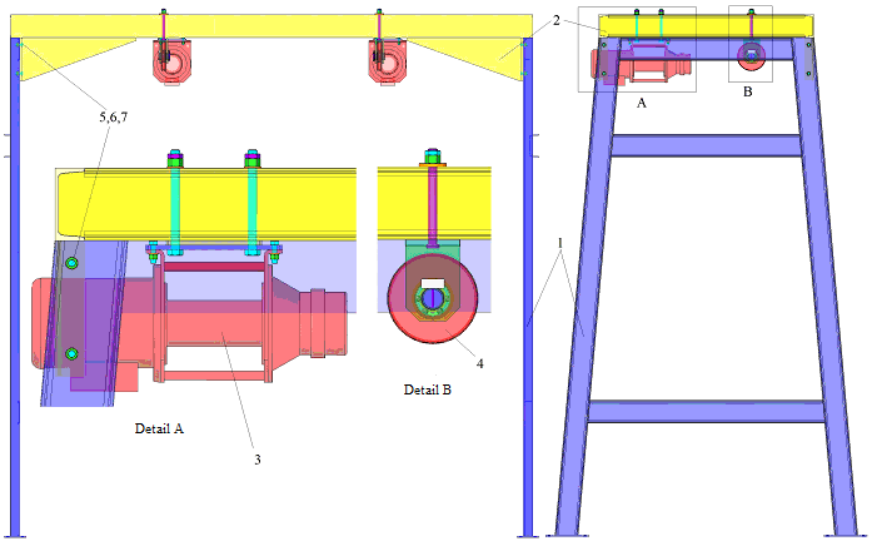

Fig. 2. The constructive solution of the supporting metal frame.

at the lower base of the longerons there are two outsole plates of 10 mm, with a surface of 300x150 mm.

They have four holes of Φ11 to fix them with clamps on the wooden beam. At the upper part, it has four holes Φ 18 mm, to fix it against the upper frame. Also, under the upper beam there is a U16 beam, sticking with 45mm outside the standing support, to sustain the roof. The upper frame is made up of two beams of rolled profile U16 with its wings to the inside, with the length of 3630 mm, between them there are fixed four beams of U16. These beams are positioned in twos, back to back, with a distance of 22 mm in order to allow go through them the threaded rod of the shaft and the screws of M20x220 of the winch plate. At the sides of the upper frame beams the fixing standing supports are mounted by welding, made of sheet of 10 mm, that have a distance from the beam edge of 65 mm and between their interior there must be a distance of 3500 mm. These sheets are stiffened against the frame beam through a gusset plate of 10 mm. The resistance construction of the supporting metallic frame, standing supports and the upper frame has been made demountable in order to be executed and transported easily.

3. HOW TO USE THE EQUIPMENT OF THE CAROL SHAFT REHABILITATION

The way in which the equipment of the Carol shaft rehabilitation is used in order to concrete the reinforcement shaft, stage 1, is presented in figure3a, with the annotations: 1 – salt block; 2 – the wooden armature shaft; 3 – working platform; 4 – reprofiling cylindrical shaft; 5 – concrete platform on the ridge of salt; 6 – concrete

reinforcement of the well to the surface; 7 – earth filling; 8 – concrete platform surface; 9 – rehabilitation equipment; 10 – cart to transport materials.

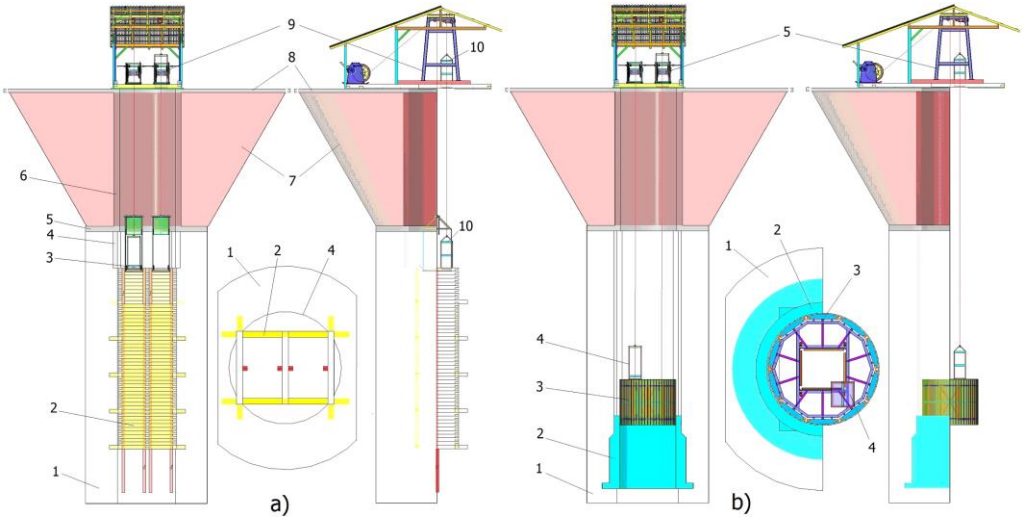

Fig. 3. The usage method of the equipment for the rehabilitation of the shaft by concreting, stage 1 and 2.

In figure 3b is presented the usage method of the equipment for the rehabilitation of the shaft by concreting, stage 2, with the annotations: 1 – salt block; 2 – standing support concrete reinforcement of the pit of salt; 3 – interior sliding formwork; 4 – cart to transport materials; 5 – rehabilitation equipment.

After demounting the wooden armature and the reconversion of the salt pit with the help of the standing support of the concrete armature of the pit, follows its casting.

The working platforms are removed and instead the sliding metal frame formwork is caught (3). They slide down to the level of the ramp of the cost gallery, where there was arranged a working bridge over the shaft opening and those ten segments of the sheathing are mounted.

The interior sliding formwork was presented in subchapter 3.2, the mounting of the formwork segments is done sort of conically, with a difference between diameters of 10 … 20 mm and the large base to the upper side in order to ease the formwork mold release after casting.

Pouring concrete surface is achieved using a flexible hose and its handling for filling the space between the casing and salt is made by a worker being lowered material transport basket .

If the transport basket is used to transport workers, the material is mounted by welding two pieces of sheet with dimensions of 690x450 mm 2 mm between the support arms to provide a protective roof.

Lifting the slide inside the mold is 2000 mm, leaving a collar of 500 mm over the previously cast section.

In figure 4a is presented the way of using the equipment for the Carol shaft rehabilitation, by changing the wooden armature with excavation, variant IV, stage 1, with the annotations: 1 – salt block; 2 – the wooden armature shaft; 3 – working platform; 4 –the rectangular profile of the salt pit; 5 – cart to transport materials; 6 – new wooden reinforcement of the well to the surface; 7 – earth filling; 8 – concrete platform surface; 9 – rehabilitation equipment; 10 – ramp pit gallery +400.

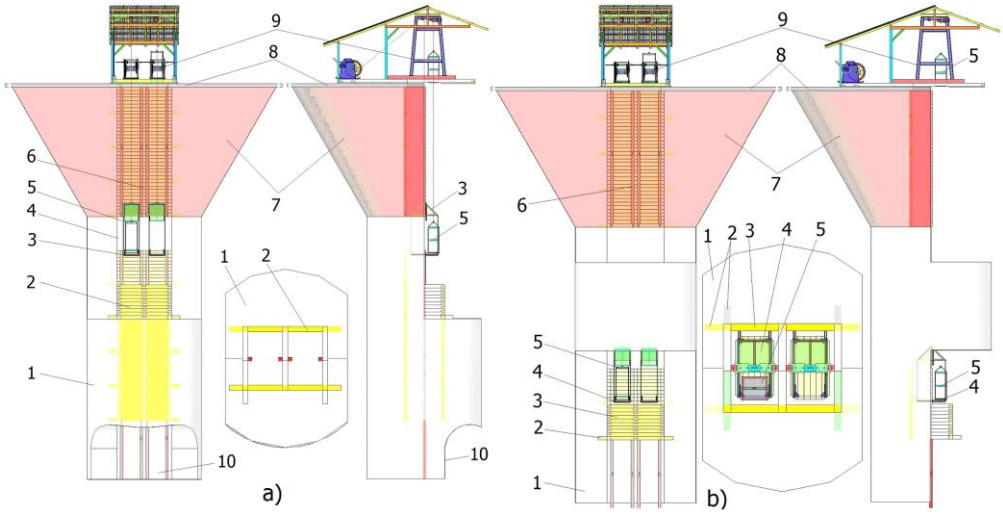

Fig. 4. The way of using the equipment for the Carol shaft rehabilitation, by changing the wooden armature with excavation, variant IV, stage 1 and 2.

After conducting excavation in the ground to ridge reinforcement wooden salt and execution of the well to the surface （6), of the earth filling of the excavation cone (7) and of the concrete platform surface (8) there is mounted the equipment for shaft rehabilitation.

The positioning system is such that the plane of symmetry channel pulley wheel to be in the plane of symmetry of the compartment shaft and the plane of symmetry of the wood guides to be tangential to the pulley block.

The workings platforms are lowered (3) to the reinforcement of old wood ridge in salt and make removing it and fill with clay and reinforcement block of salt. The demounted armature and the clay are transported to the surface with the two carts to transport materials (5).

In figure 4b is presented the way of using the equipment for the shaft rehabilitation by concreting, stage 2, with the annotations: 1 – salt block; 2 – frame support; 3 – new wooden armature; 4 – working platform; 5 – cart to transport materials; 6 – new wooden reinforcement of the well to the surface; 7 – earth filling; 8

– concrete platform surface; 9 – rehabilitation equipment.

After removing the valve from the timber and cleaning of the salt is carried out, the shaft supporting profiles of the frame support the pockets (2) in the ramp of the shaft we go on to its mounting. The working platforms are lowered (4) until the bridge thing of the ramp pit and then these people and materials are picked up and raised to the support frame. Next, the new armature (3) is carried out, filling the gaps between valve and block salt clay beaten. The transport of the reinforcement elements and of the clay packed in bags is made from surface with baskets to carry materials (5). If the cart to transport materials is used to transport workers, two pieces of sheet of 2 mm are mounted by welding, with their dimensions of 690x450 mm between the standing supports to make up a protection roof.

For the equipment for the Carol shaft rehabilitation from the Slănic Prahova Salina, there has been done an estimated cost regarding the design of the metallic construction, of the pulley and of the products bought commercially. As well, the estimated cost has been done for the case of the design of only one working platform, one cart to transport materials and one trolley. The total value for the equipment design for the Carol shaft rehabilitation under those two circumstances:

- of working on only one good compartment – 21 318,4 lei;
- of simultaneously working on both good compartments – 30 026,2 lei.

In the cost of the Carol shaft rehabilitation I haven't included those two 4t manual winches that are found in the Slănic Prahova Salina endowment.

4. CONCLUSIONS

The equipment for the Carol shaft rehabilitation from the Slănic Prahova Salina can be used with small adaptations for those four technological variants of shaft support recovery. When it comes to the recovery of the reinforced concrete shaft, the equipment is used for the sustenance and displacement of the sliding shuttering.

The construction of the equipment is easy, easy to transport, maneuver and mount, having a low cost. This cost is low because of the possibility of using those two 40 kN manual winches that exist in the Slănic Prahova Salina endowment. Moving the working platform is done using the manual winch 40 kN. Also, it can be anchored to the wooden shaft support through four ears dump. The platform is equipped with two roof slopes at 45 °, of which one is mobile, with fixing hinges and locks, to allow the transport of materials from the area of the working platform using the transportation cart. The operation of the materials cart moving winch can be manually done from the switchboard or by remote controller from the working platform.

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