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TRANSPORT OF CONVEYOR BELTS UNDER HOISTING CAGE

PŘEPRAVA DOPRAVNÍKOVÝCH PÁSŮ POD KLECÍ

Abstract

The article describes possibilities of partial decrease costs during conveyor belts replacement of mucking on mine Lazy, with using hot vulcanisation of jointed conveyor belt parts. Professional firms at the scope, concern by making and completing or vulcanisation of jointed relatively long belt parts, give on the joints guarantee up to four years. Despite of make the joints underground in mine conditions, moreover at areas with fire explosion dangerous. In this case, conveyors have to be keep in adequate operational conditions.

When we carry out the joints like was describe mentioned, we don't need exchange them like steel joints, we don't need stop the belt, decrease downtime of whole mucking, because one conveyor is in line with other one, etc. Furthermore we increase work productivity and decrease operational costs of whole mucking complex.

We must to do basic economical calculation of any project, decrease joints number to minimum, what bring to us time and cost saving of the don't joints. But joints number is given by shaft proportions where the belts will be transported.

Abstrakt

Článek se zabývá možností částečného snížení nákladů na výměnu dopravníkového pásu odtěžení na Dole Lazy, o.z. s využitím teplé vulkanizace spojů jednotlivých částí dopravního pásu. Zkušené firmy v daném oboru, zabývající se výrobou a kompletizací respektive vulkanizací spojů relativně dlouhých pásů, dávají na spoje takto vytvořené až čtyřletou záruku, a to i v případě jejich provedení v důlních podmínkách v prostorách s nebezpečím výbuchu metanu (SNM2), ale za patřičného udržování dopravníku v adekvátních provozních podmínkách.

Takto provedené spoje není nutno obměňovat jako například spoje mechanické, není nutno pás zastavovat, tím se sníží prostoje celého odtěžení, neboť jeden dopravník navazuje na druhý atd., zvýší se produktivita práce a sníží patřičné náklady na provoz tohoto strojního komplexu.

Je však nutno provést alespoň základní ekonomickou kalkulaci daného projektu, snížit počet spojů na minimum, což přinese časové a finanční úspory neprováděných spojů, avšak jejich počet je dán především technickými parametry jámy, kterou budou pásy do dolu dopravovány.

1 INTRODUCTION

During first half of 2002 on main mucking of the mine Lazy was needful to replace old belt on conveyor no. 9 kind 39990 Sch 800 type, by belt Fenaplast FRSR 9000 form Fenner firm. At the same time, the firm proposed hot vulcanisation of jointed belt parts in underground mine conditions, at areas with fire explosion danger. First time, we needed 13 joints. We had to do economic balance of the project and compare with possibilities to used steel connecting devices.

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2 ECONOMIC BALANCE

- *Present condition* – The conveyor Sch 800 has speed transport 3,8 $m.s^{-1}$ and length 1760 m. Conveyor belt has 23 mechanical joints of type MATO U 38 with average replacement 8,2 joints per month, it is 35,6%. To compare, other one (conveyor no. 18) has speed transport 2,5 $m.s^{-1}$, 9 same mechanical joints and their average replacement is 2,2 joints per month. We can see, that conveyor no. 9 has 1,5x higher transport speed and at the same time abrasion too, joints replacement respectively (correlation speed and joints abrasion).
- *Proposed condition* – Upon using mechanical joints on new completed conveyor belt, which will has 13 joints with 35,6% joints replacement per month, it is 56 joints per year, have to replace them. Price of the one mechanical joint MATO U 38 type is 6.554 CZK, plus steel wire 250 CZK, in sum 6.804 CZK. Start costs of 13 mechanical joints are 88.452 CZK. Firm Fenner give three years guarantee on vulcanising joints. Replacement costs of mechanical joints during three years would be 3 x 56 x 6.804 CZK, what is in sum 1,143.072 CZK. Including start costs – buying mechanical devices, whole costs of the joints would be 1,231.524 CZK. Whole price of the vulcanised joints, arranged with Fenner firm was 1,561.548 CZK. But at margin of both prices (330.024 CZK) against vulcanisation, don't include other costs, such us bigger rolls usage, bigger demands of maintenance and dust treatment, bigger downtimes etc.

It is evident, even joint vulcanisation is more expensive, for long time usage (3 to 5 yers) is cheaper than mechanical joints of belt conveyors. That is why, we must to study the shaft technical design and to do analyse of possibilities of belts transport to underground of the mine, and decrease number of joints between conveyor belt parts (increase conveyor belt parts length).

3 VARIANT SOLVING

When I wrote mentioned, we had to do analyse of transport possibilities to decrease costs and increase length of the belt pieces. From the analyse follow final transport method, which is transport of the two-roll belt piece under hoisting cage in pit no. 5. The pit has guides along cage sides, across if we compare it with new – modern cages. Just this fact allows transport two-rolls belt, which is relatively too width (1200 mm), hung up under hoisting cage on/in special device.

Was designed and solved three variants:

3.1 **Carriage with fixed truss**

The device compose from support frame; bench and triangular truss. Advantage of the device is possibility to transport two-rolls or simple roll of belt from surface loading station to underground place of destination without additional material handling. Maximal rolls diameter can be 1500 mm and minimal cca 900 mm (roll with less diameter we must not to transport under cage). Device is showed on Figure 1 and including proposed, designed and solved profiles on Figure 2.

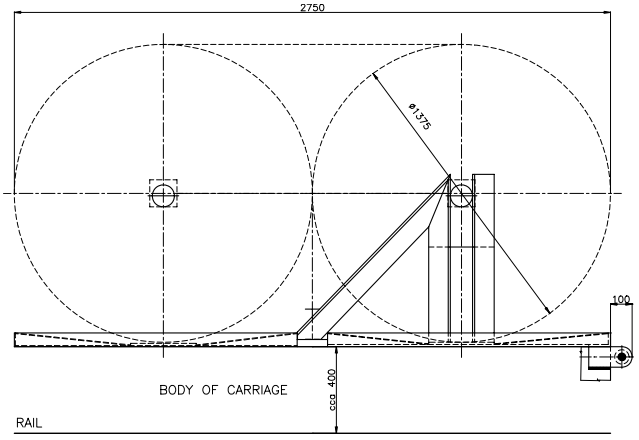

Fig. 1 Construction of carriage with fixed truss

Device was solved in detail without software, used only human possibility. Upon solving of triangular steel truss I was solving with only one constraint to speed up the solving, what is showed on Figure 3.

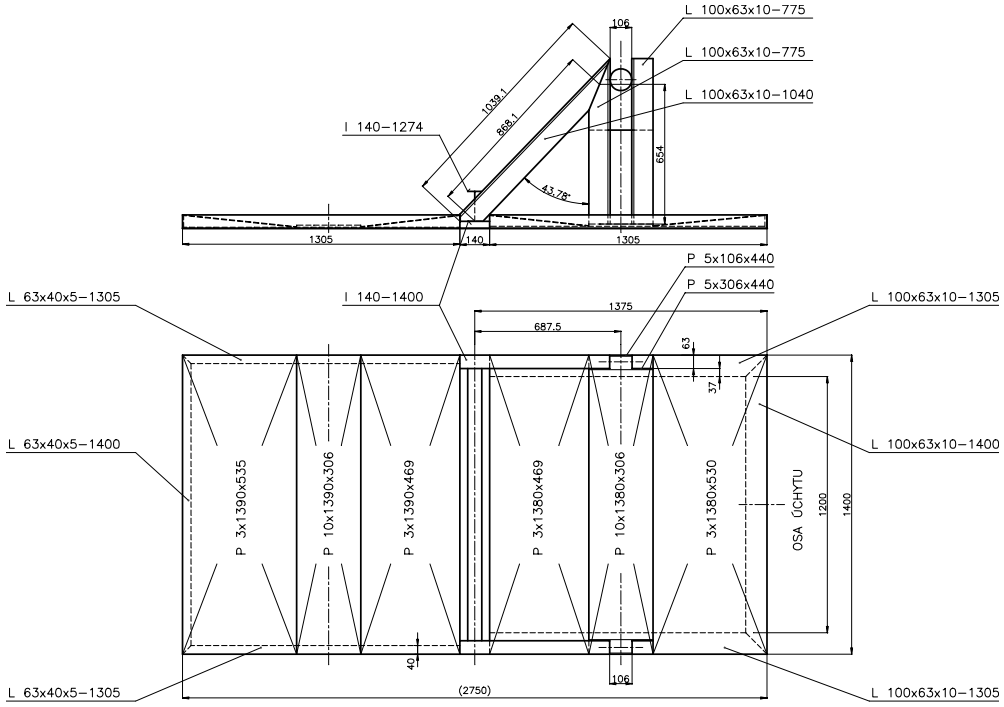

Fig. 2 Designed and solved profiles of the device

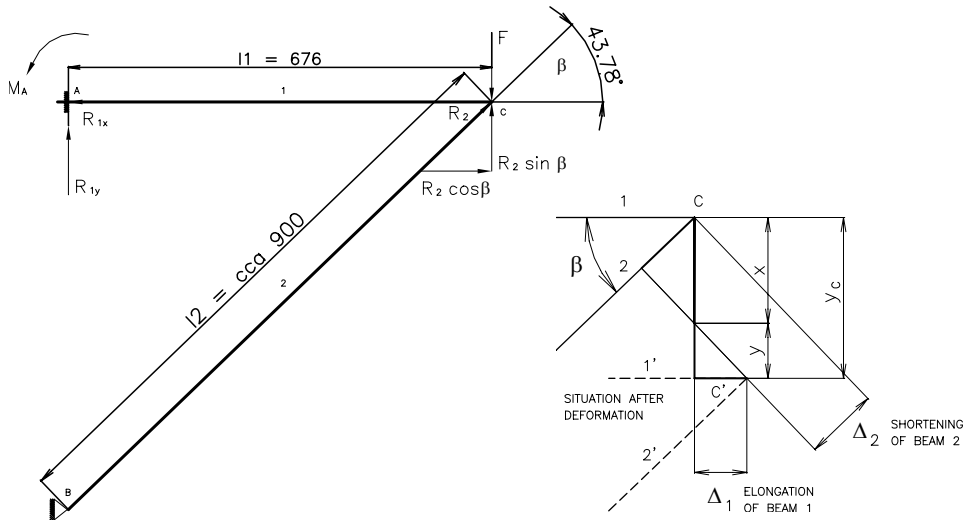

Fig. 3 Triangular steel truss

Upon solving I started from deformity criterion. (Figure 3):

$$y_c = x + y = \frac{\Delta_2}{\cos(90° - \beta)} + \Delta_1 \cdot tg(90° - \beta), \tag{1}$$

where after putting conditions of equilibrium of forces:

$$\frac{(F - R_2 \cdot \sin\beta) \cdot l_1^3}{3 \cdot E \cdot J} = \frac{R_2 \cdot l_2}{E \cdot S \cdot \cos(90° - \beta)} + \frac{R_{1x} \cdot l_1}{E \cdot S} \cdot tg\cos(90° - \beta), \tag{2}$$

is solved.

Separate designed pieces of constructional accommodate even without influence of plates which are built up to basic frame.

3.2 **Carriage with chain**

This device is similar to the device from 4.1 chapter, it hasn't the steel triangular truss, but hoisting chain (Figure 4). This structural design is simple and cheaper that other one.

Landing gear to the mentioned two devices we can used from dead carriage, which are on scrap heap. Advantage of the chain device compared to device from 4.3 chapter is, that we can transport rolls or roll of belt from surface loading station to underground place of destination without additional material handling too. Disadvantage is lowered structural - transport height, in virtue of don't used height of the landing gear. This fact is done by necessity carriage to going through air breaks and caging devices on each filling station of the shaft.

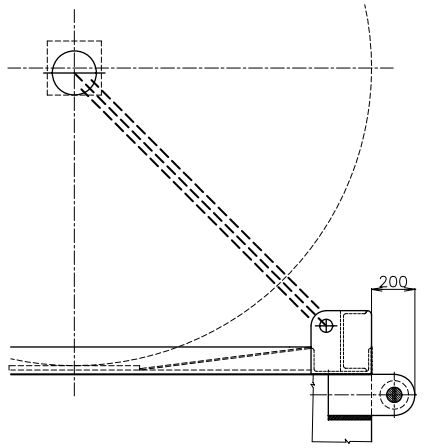

Fig. 4 Design of carriage with chain

3.3 **Container**

Another device for belt transport was container, which thanks to specific reasons was selects to realization. Container is intricate to solving them by human forces, but I did only simple calculations of the body and more precise solving of connecting through tenon, which joined two pieces of container and rope coupling, which is connecting device between container and steel shaft rope. Solving of the container could have been solved by software with Finite elements method, but I hadn't a lot of time to realisation.

Disadvantage of the container is its weight, which decrease weight of transporting material. Whole weight of hinged load is limited and closely watched. Another disadvantage is its no very good manipulation, because he isn't on wheels, for it we must to displace him or draw on footwall.

Advantage is full covered - protected of the belt rolls or other transported materials and relatively lower transport height - we can transport bigger material, belt rolls with relatively bigger diameter. Therefore we save bigger money, because belt pieces are longer what decrease number of joints and reduce costs.

On lower mentioned figures (Figure 5 to 8) are showed basic procedures of two-rolls conveyor belt transport from surface to underground places, to shaft no. 5 respectively.

4 CONCLUSION

From mentioned text is evident, that it is more important to establish new technology, which can increase work productivity and effectiveness. For example hot vulcanisation, which was too expensive is cheaper then mechanical connecting belt parts, if we do adequate analysis. Thank to detail solving and study shaft technical documentations, we reduced belt joints from 13 to 9 and decrease operational costs. Saved money we spent to hot vulcanising, which warrant operational long time without downtimes of whole conveyor belt or mucking respectively.

Fig. 5 Fill up and covering two-rolls of transport belt

Fig. 6 Blocking of two container parts

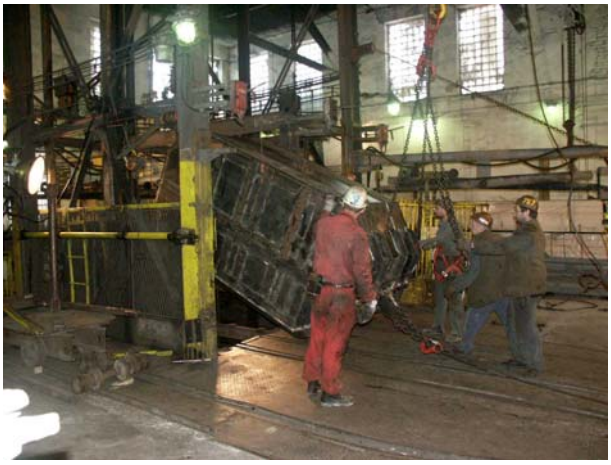

Fig. 7 Container guidance to shaft no. 5

Fig. 8 Container lowering in shaft to adequate filling place

5 LITERATURE

In the article was used personal material only.

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