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CALCULUS OF LOADS TRANSMITTED TO THE EXTRACTING TOWERS WITH THE HOISTING INSTALLATIONS OF WINDING MACHINES WITH MULTICABLE DRIVING WHEELS ON IN THE CASE OF THE APPLICATION OF THE SAFETY BRAKE

In the paper there are presented certain aspects concerning the determination of loads transmitted through the bearings of the extracting pulleys of the structure of the metallic towers of the extracting installations in the case of the application of the safety brake. The exemplification of the determination of the loads transmitted to the metallic tower in the case of the application of the emergency brake has been done by taking into study the extracting installation „Puț nou cu schip" belonging to E.M. Lonea

1. Introduction

The normal development of the schedule of the movement of the extracting vessels or the stopping of the machine in a certain position of the vessels (maneuver braking) and the automated stopping of the machine (safety brake), independent of the will of the operator in one of the cases considered perturbations or distress, is insured by a braking device supplied with every extracting machine. Cases considered perturbations or distress are: lack of tension, a decrease in fluid pressure required for acting the brake, over-height of the extracting vessels, passing the max. speed limit overweight etc.

In the paper there are presented certain aspects concerning the determination of loads transmitted through the bearings of the extracting pulleys of the structure of the metallic towers of the extracting installations in the case when the emergency brake is applied due to an overcome of the max speed allowed. In order to study the loads from the extracting cables transmitted to the structure of the metallic towers of the extracting installations through the extracting pulleys in the case when the emergency brake is applied it has been taken into study the tower of the extracting installation „Skip Shaft" from Lonea Mining Plant. The general and exploitation data of the installation taken into study are presented as follow.

2. The extracting installation taken into study

The extracting installation that operates on the new skip well from Mining Plant Lonea, is destined [7] for the extraction from the underground of minerals. The extraction is done from the horizons +169,40; +203,3 and 403,45 to the surface (the surface level is +704,5m; and the skip unloading level is +715,5m).

The installation (fig.1) is ballanced and has an extracting machine type MK 5x2 (fig.2) equipped with two motors type M2M-1000-213-4YXP/1986, of 1000 kW power and a nominal rpm of 54 rot/min (fig.3).

The cables are wrapped around a moving wheel of F 5000 mm (fig.4).

The extracting cables with diameters of F 46,5 mm and a mass (on a linear meter) of 8,049 kg/m are wrapped around the two extracting pulleys of F 5000 mm with a

Fig.1. Extracting installation

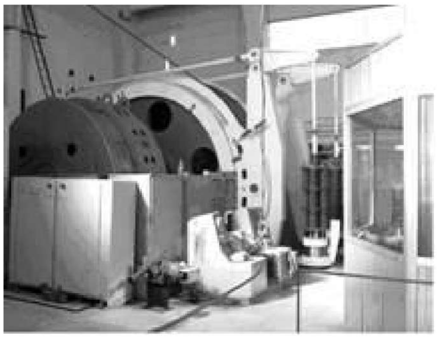

Fig.2. Extracting machine

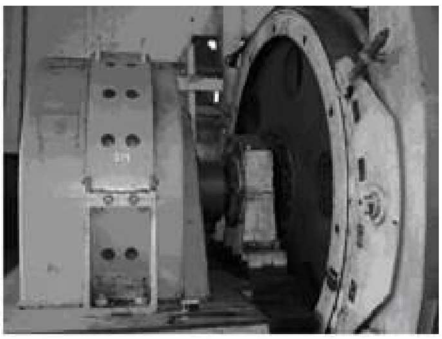

Fig.3. The motor

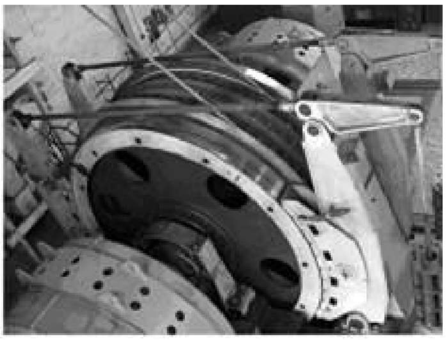

Fig.4. Wrapping organ

 

Fig.5. Extracting pulleys Fig.6. Metallic tower

mass (the pulley, the axel of the pulley and the bearing of the axel) of 12.108,84 kg for the top and 11,948,3 kg for the bottom (fig.5), laying on the tower at a height of 47 m (pulley axel) the top and 40 m the bottom. The ballanced cables have a section of 135×20 mm and a mass (on a linear meter) of 9,062 kg. The extracting vessels are skips having a mass (own mass, plus D.L.C., plus D.E.C. and suplimentary mass) of 24.120kg (19.276kg+2x557kg+1230kg+2500kg) from Petrila branch and 21.620kg (19.276kg+2x557kg+1230kg) from Cimpa branch.

The effective load is 7000-8000 kg/skip. Another main component of the extracting installation is the metallic tower (fig.6) with a height until the pulley axel of 47 m. The structure of the tower is composed of the extracting pulley platform sustained by the leading component and the one abutment set up as a frustum pyramid.

The extracting machine lies on the ground (at a height of 6,45 m to the 0 level of the well (well collar), sideways from the tower (well tower), at a distance (of the wheel axel), towards the vertical portion of the extracting cables which enter the well of 45,06 m.

The length of the cable chord (the distance between the tangent points of the cable to the deviating pulley from the tower and the wheel of the extracting machine, in the central position of the chord (perpendicular on the wheel axel)), is for the bottom branch L_{ci}=52,54m, and L_{cs}=58,78m for the top branch.

The incline angles of the cables chords are $b_i = 45^0\ 08'\ 24''$ for the bottom branch and $b_s = 43^0\ 36'\ 52''$, for the top branch [7].

3. Determination of loads

For the determination of the loads(efforts) which act upon the installation taken into consideration it has been taken into study the case when one of the skips is descending (ascending) on one of the branches.

On the calculation of loads it has been considered the fact that their variation is determined not only by the kinematics of the installation (kinematical parameters) but also by certain geometrical elements which define the position of the extracting machine towards the well geometrical elements regarding only the installations where the extracting machine lies on the ground.([1],[3],[4],[5],[6]).

For this purpose it has been taken into analysis the case when the skip is descending on the top branch (case 1, the skip of the bottom branch is climbing and the top one is descending) and the case when the skip is descending on the bottom branch (case 2, the skip of the bottom branch is descending and the top one is climbing). The diagrams for the space, speed, and acceleration for the two cases taken into analysis are presented into fig 7 case 1 and in fig 8 case 2. The variations of acceleration and space have been used for the calculation of the loads applied to the tower. The determination of the loads acting upon the tower through the deviating pulleys has been done using the d'Alembert principle (the kinetics-static method [2]) taking into consideration the static forces (the weight of the extracting cable, the cage the trolley the pulley and the load), the friction forces (multiple friction and aero-dynamic resistances which for installations with cages is approximated with a coefficient of k'=0,2 from the useful load [1]) and the dynamic forces (which intervene only in the acceleration and deceleration periods, fig. 7 and fig. 8)).

The variation of the components of the forces from the bearings of the extracting pulleys for the two cases taken into consideration in the case of the application of the security brake on the surpassing of the max admitted speed is presented in fig 9 and fig 10,case 1 and fig 11 and fig 12, case 2.

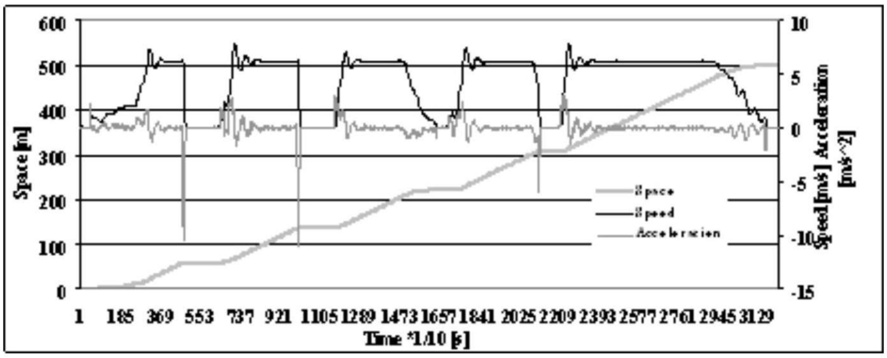

Fig.7. Speed acceleration and space for case 1

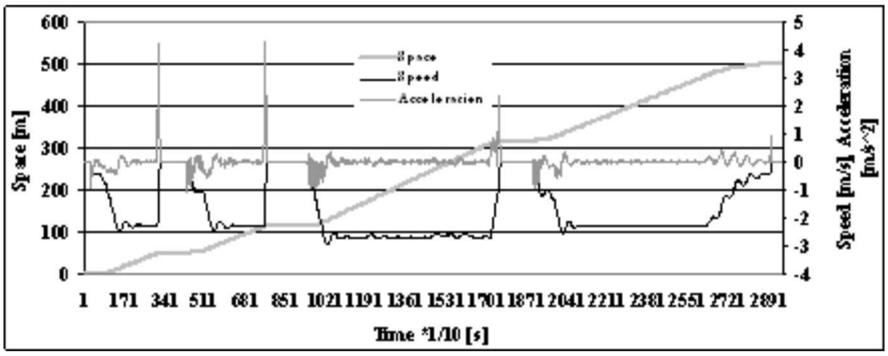

Fig.8. Speed acceleration and space for case 2

The variation of the resultant forces from the bearings of the extracting pulleys for the two considered cases in the case of the application of the safety brake on the surpassing the max admitted speed is presented in fig 13, for case 1,

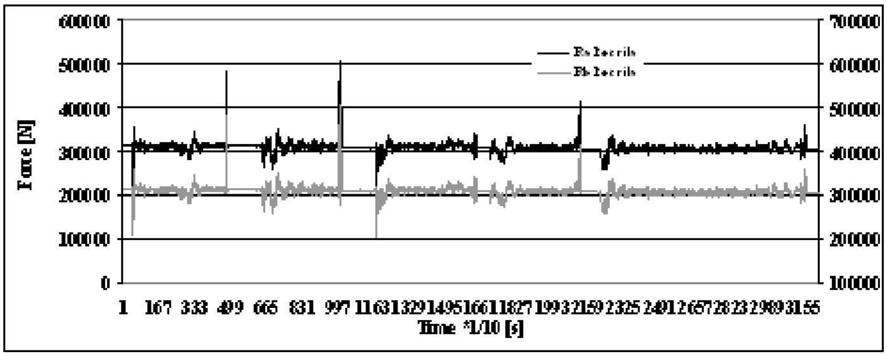

Fig.9. Forces on the bearings of the top pulley for case 1

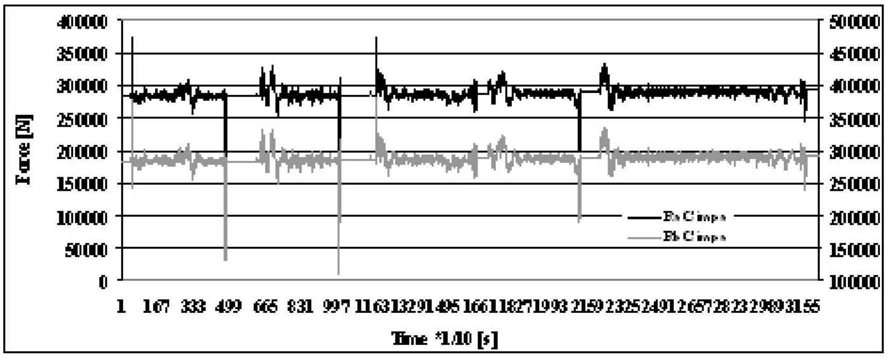

Fig.10. Forces on the bearings of the bottom pulley for case 1

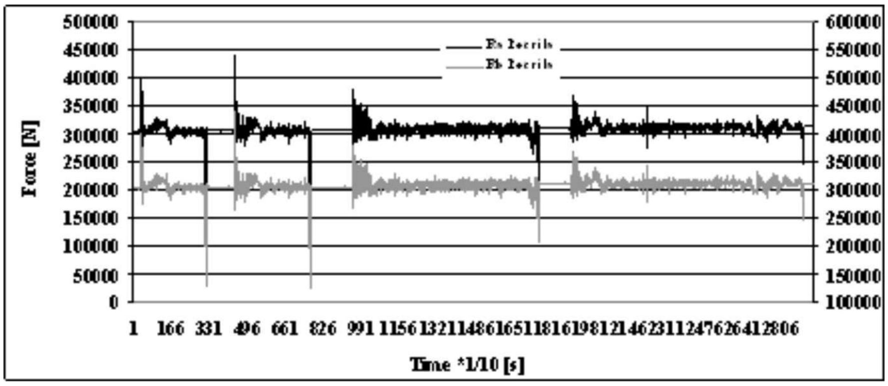

Fig.11. Forces on the bearings of the top pulley for case 2

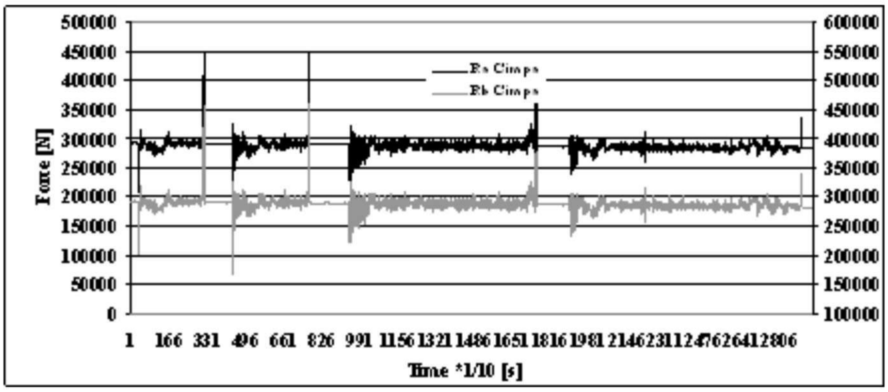

Fig.12. Forces on the bearings of the bottom pulley for case 2

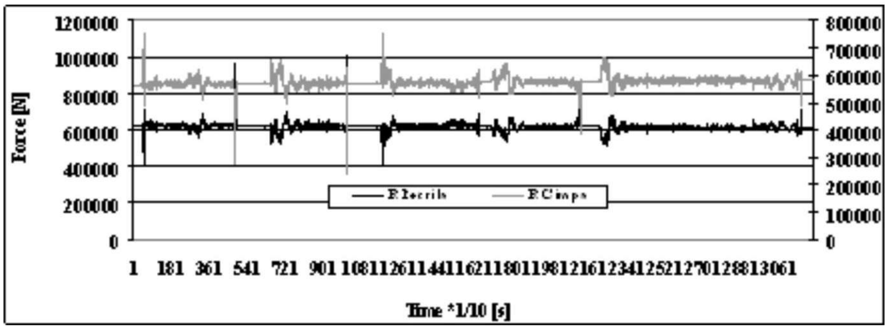

Fig. 13. Reactions from the bearing of the top and bottom pulley when the top cage descends and the bottom one climbs, case 1

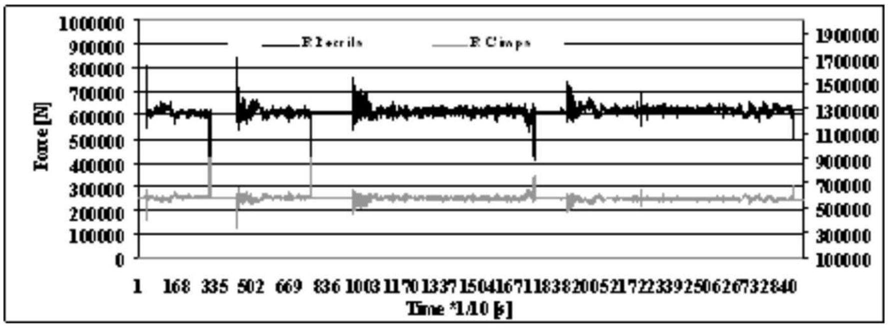

Fig.14. Reactions from the bearing of the top and bottom pulley when the top cage climbs and the bottom one descends, case 2

for the top and bottom pulley and fig 14, for case 2, also for the top and bottom pulley.

The variation of the total resultants (reactions) the forces from the extracting pulleys for the two cases taken into consideration in the case of the appliance of the safety brake on the surpassing of the max speed is presented in fig15 case 1, loads when the top cage descends and the bottom one climbs and fig 16, loads when the top cage climbs and the bottom one descends case 2, for both pulleys.

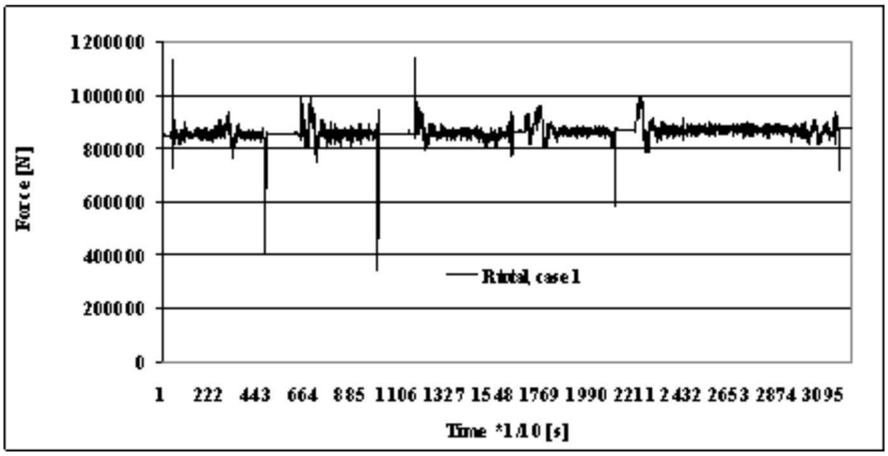

Fig. 15. Total loads when the top cage descends and the bottom one climbs case 1

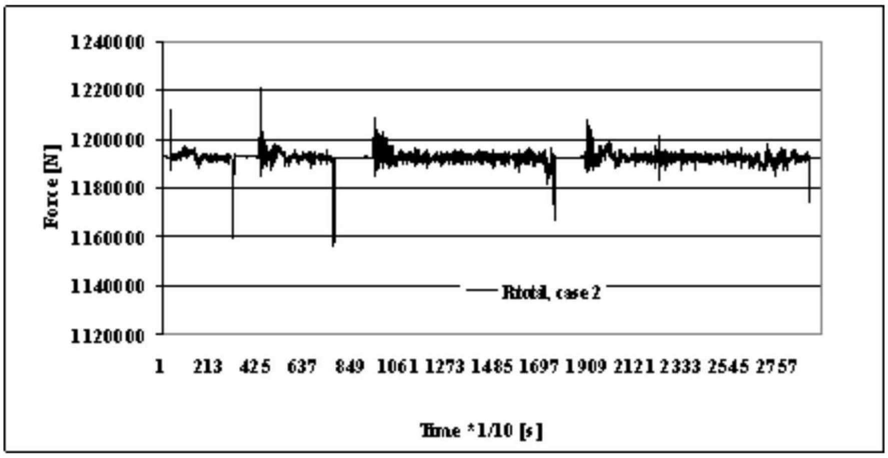

Fig. 16. Total loads when the top cage climbs and the bottom one descends case 2

4.Conclusions

The calculation the structure of the mining extracting towers is done taking into consideration all the unfavorable combinations practically possible of the different loads called groups of loads.

Following the classification and grouping of the loads transmitted to the extracting mining towers in the paper there are presented certain aspects concerning the establishing of the exceptional short term loads due to the extracting cycle in the case of the appliance of the safety brake which are transmitted to the structure skip and the wrapping organ of the extracting machine is moving wheel.

The loads transmitted to the tower through the bearings of the extracting pulleys from the tower due to the efforts from the extracting cables have been considered in the case when the emergency brake is applied due to an overcome of the max speed allowed when the skip are climbing and descending on one of the two extracting branches.

The variation of loads is due both for the cinematic parameters as well as for thegeometric parameters of the extracting installation.

As noticed from the variation of the total loads which act upon the tower during an extracting cycle in the case of the appliance of the safety brake the maximum values are in case 1 of the cycle and in case 2 at the beginning of the cycle (fig 15 and fig 16).

The maximum values of the loads determined are further used to determine the values of mechanical stress and strain from the elements of the structure of the metallic tower of the installation in order to verify its resistance.

References: 1. *Magyari A.* Instalaţii mecanice miniere, Editura tehnică, Bucureşti, 1990; **2.** *Ripianu A., ş.a.* Mecanica tehnica, Editura Didactică şi Pedagogică, Bucureşti, 1982; **3.** *Vlad P. C.* Prescripţii de calcul pentru instalaţii de extracţie mono şi multicablu, Vol. I, O.D.P.T., Bucureşti, 1972; **4.** *Vlad P. C.* Prescripţii de calcul pentru instalaţii de extracţie mono şi multicablu Vol. II, O.D.P.T., Bucureşti, 1973; **5** *Itu, V.,* Variaţia sarcinilor ce se transmit în timpul unui ciclu de extracţie turnurilor instalaţiilor de extracţie cu colivii nebasculante şi maşină de extracţie cu tobă dublă şi acţionare asincronă, Revista Minelor, vol 168, nr. 6/2005, pag.34-40; **6** *Itu, V.,* Influenţa elementelor geometrice ce definesc poziţia maşinii de extracţie faţă de puţ asupra sarcinilor de funcţionare instalaţiilor de extracţie transmise structurii turnurilor Revista Minelor, vol 172, nr. 10/2005, pag.21-31.

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