ACTA TECHNICA CORVINIENSIS
BULLETIN OF ENGINEERING

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CALCULUS METHOD OF THE TECHNOLOGICAL LOADS TRANSMITTED TO THE EXTRACTING TOWERS WITH THE HOISTING INSTALLATIONS OF WINDING MACHINES WITH MULTICABLE DRIVING WHEELS ON

Abstract:

In the paper there are presented certain aspects concerning the calculus of technological loads transmitted through the bearings of the extracting pulleys of the structure of the towers of the extracting installations in the case of functioning loads.

In the case of the extracting installations which have the extracting machine on the ground, having as a wrapping organ of the cables friction driving wheels, or a moving wheel the variation of the loads is determined not only by the kinematics of the installation (kinematics parameters), the dynamic (friction and inertia forces), but also by certain geometrical elements which define the position of the extracting machine towards the well geometrical elements that refer only to these type of installations.

These geometrical elements are the incline angles of the extracting cable chords. These aspects were showed on the installation ,,Skip Shaft" belonging to Mining Plant Lonea.

Keywords:

calculus method, technological loads, extracting tower

INTRODUCTION

In the case of the extracting installations which have the extracting machine on the ground, having as a wrapping organ of the cables double cylindrical wheels, or a moving wheel the variation of the loads is determined not only by the kinematics of the installation (kinematics parameters), ther dynamic (friction and inertia forces), but also by certain geometrical elements which define the position of the extracting machine towards the well geometrical elements that refer only to these type of installations.

These aspects were showed on the installation ,, Skip well " Lonea Mining Plant (Fig.1). The installation taken into study has benn described as follows.

Figure 1. Extracting installation

THE INSTALLATION TAKEN INTO STUDY

The extracting installation that operates on the new skip well from Lonea Mining Plant, 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). he cables are wrapped around a moving wheel of ϕ 5000 mm (Fig.4).

The extracting cables with diameters of ϕ 46,5 mm and a mass (on a linear meter) of 8,049 kg/m are wrapped around the two extracting pulleys of ϕ 5000 mm with a mass (the pulley, the axel of the pulley and the bearing of the axel) of 12.108,83 kg (Fig.5), laying on the tower at a height of 51 m (pulley axel).

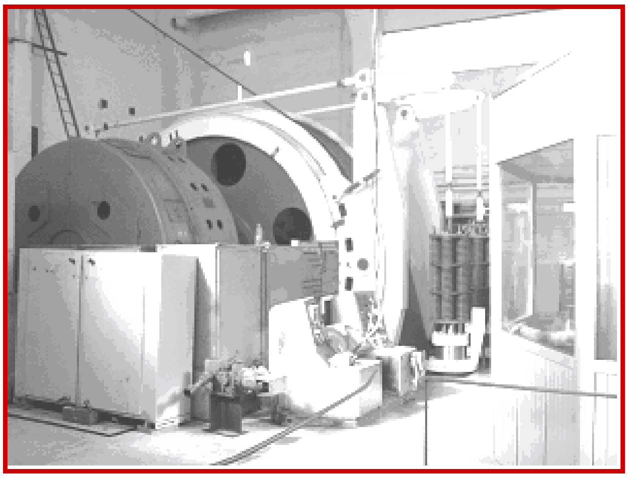

Figure 2. Extracting machine

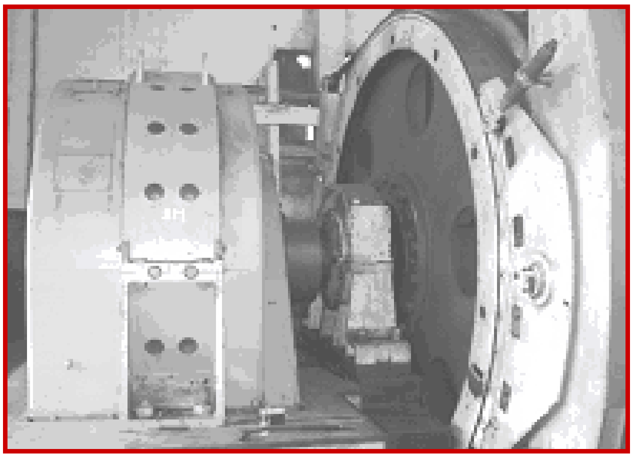

Figure 3. The motor

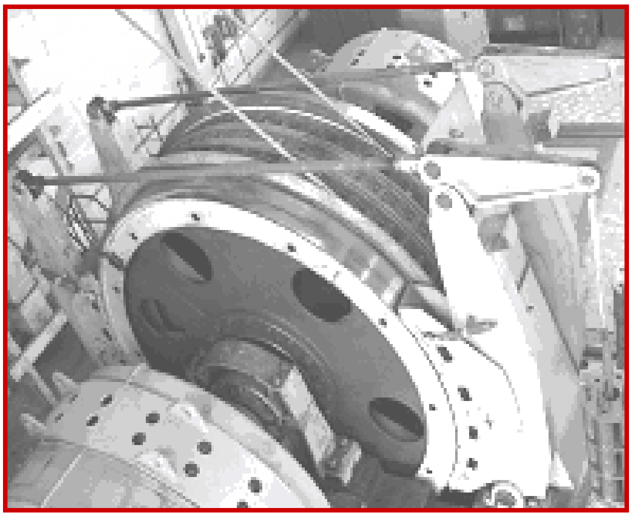

Figure 4. Wrapping organ

Figure 5. Extracting pulleys

Figure 6. Metallic tower

The ballanced cables have a section of 135x20 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 21600 kg and 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 51 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 7,5 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 44m. 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 Lci=52,78253595m, and Lcs=58,78482883m for the top branch. The incline angles of the cables chords are $\beta i = 48^0$ 43' 37" for the bottom branch and $\beta s = 44^0$ 37' 07", for the top branch [7].

LOADS TRANSMITED TO THE TOWER

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).

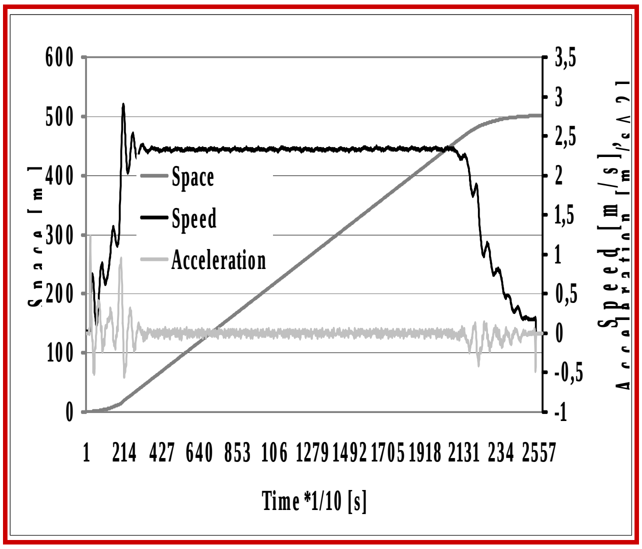

Figure 7. Speed acceleration and space for case 1

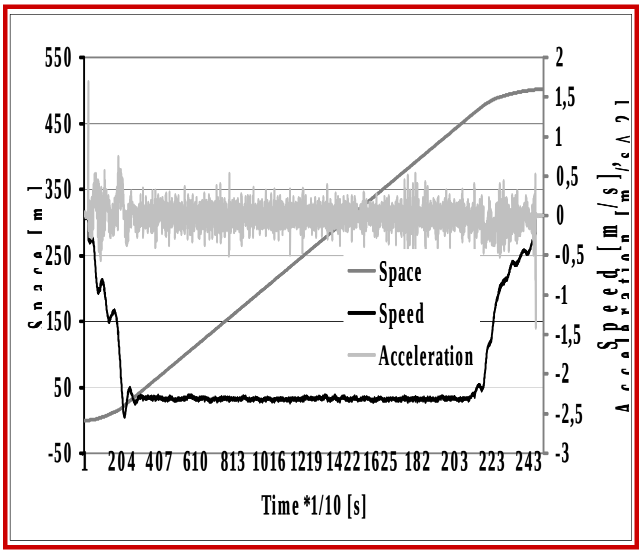

Figure 8. Speed acceleration and space for case 2

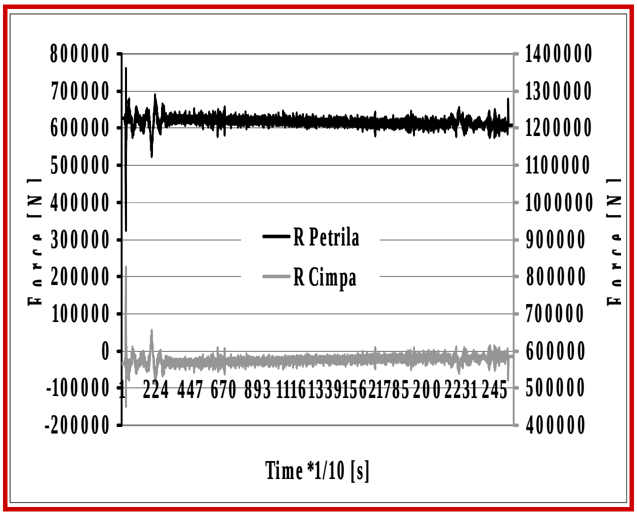

Figure 9. Reactions from the bearing of the top and bottom pulley when the top cage descends and the bottom one climbs, case 1

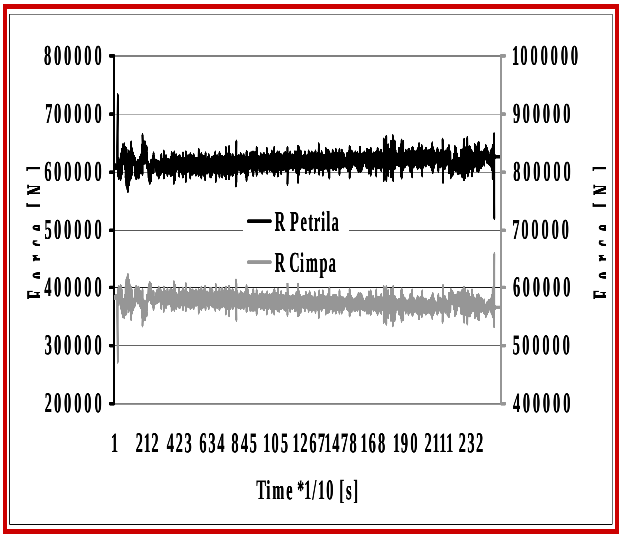

Figure 10. Reactions from the bearing of the top and bottom pulley when the top cage climbs and the bottom one descends, case 2

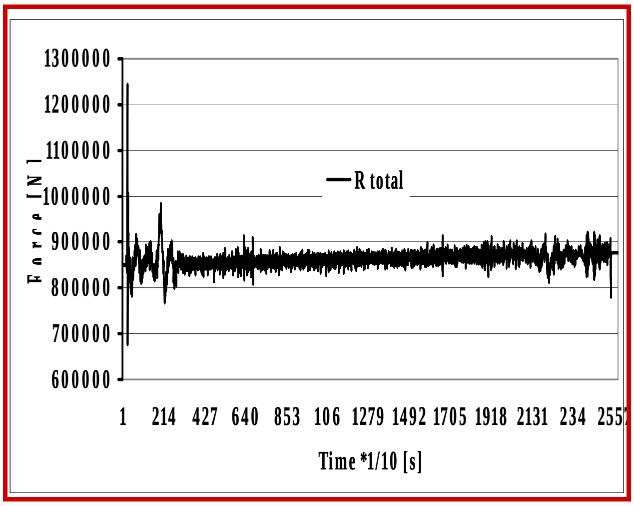

Figure 11. Total loads when the top cage descends and the bottom one climbs case 1

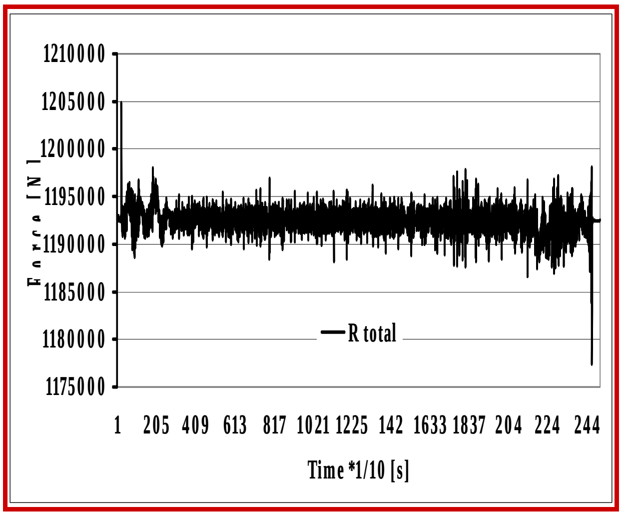

Fig. 12. Total loads when the top cage climbs and the bottom one descends case 2

The variation of the resultant forces from the bearings of the extracting pulleys for the two cases taken into consideration is presented in Fig 9, for case 1, for the top and bottom pulley and Fig 10, for case 2, also for the top and bottom pulley.

CONCLUSION

The calculation the structure of the mining extracting towers is done taking into consideration all the unfavourable 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.

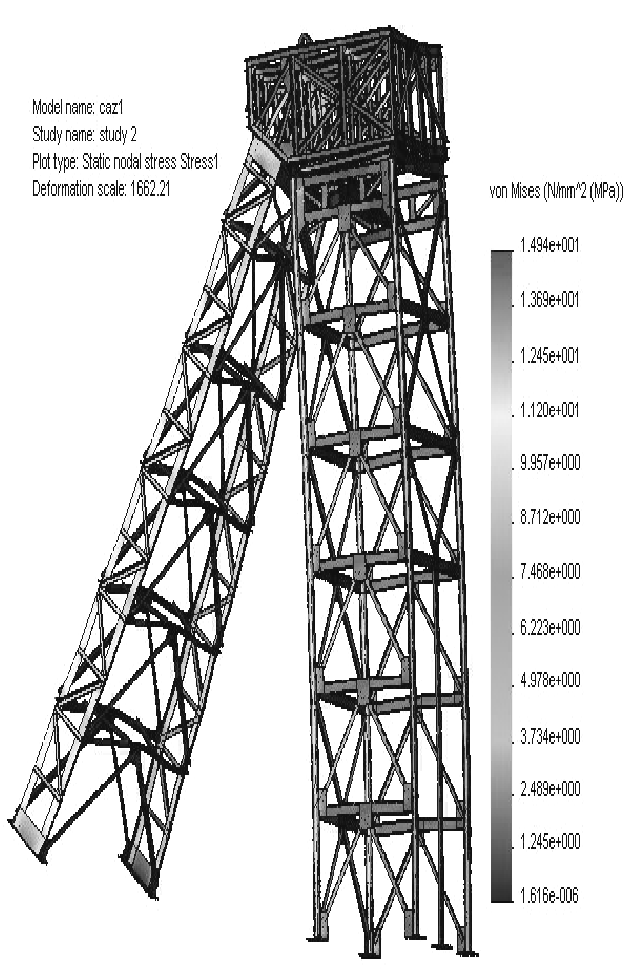

Figure 13. Stress on the tower

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

As noticed from the variation of the total loads which act upon the tower during an extracting cycle the maximum values are in case 1 of the cycle and in case 2 at the beginning of the cycle (Fig 11 and Fig 12).

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, like in Valea Arsului tower case, from Lonea Mining Plant. (Fig. 13).

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FACULTY OF ENGINEERING HUNEDOARA
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Scientific supplement of
ANNALS of FACULTY
ENGINEERING HUNEDOARA
– INTERNATIONAL
JOURNAL of ENGINEERING
ISSN: 1584-2665 [print]
ISSN: 1584-2673 [CD-Rom]

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