THE STATE OF STRAIN AND DISPLACEMENTS FROM THE STRUCTURE OF THE TOWERS OF THE EXTRACTING INSTALLATIONS WITH WESSELS AND DOUBLE PULLEYS IN THE CASE OF THE APPLYANCE OF THE EMERGENCY BRAKE

Vilhelm Itu, Iosif Dumitrescu, Mihai Ridzi,
University of Petroşani, University Street, number 20, zip code 332006

Abstract: *In the paper there are presented certain aspects concerning the determination of the state of strain and displacements from the structure of the towers of the extracting installations due to the loads transmitted through the bearings of the extracting pulleys in the case of the application of the emergency brake, on the increase of speed above the maximum admitted, a case considered perturbation or emergency.*
Key words*: Strains, displacements, tower, extracting installation.*

1.INTRODUCTION

It has been taken into consideration the tower (fig.1) of the extracting installation (fig.2) of „Auxiliary well no.2“ from Bărbăteni, E.M. Lupeni. The extracting installation is unbalanced. The wrapping organ of the extracting installation is a double wheel with the wrapping of the extracting cable onto one layer. The extracting vessels are untipping cages with one level, with two carts per floor. The machine of the extracting installation operates asynchronous. The tower of the installation is made out of reinforced concrete. The study method of the strain displacement state is that of the finite element. In the paper it is also studied if the maximum values of the stress and strain from the elements composing the structure of the tower in the considered cases are within the admissible limits and the establishing of the measuring points in order to verify the values obtained numerically through experimental measurements.

2. THE INSTALLATION TAKEN INTO STUDY

The extracting installation which works on auxiliary well no.2, from E.M. Bărbăteni, which is destined [3] for the underground supply with materials and tools as well as for transporting personal among levels 580, 650, şi700 the surface level being 783. The extracting installation that supplies the well (fig.2) is unbalanced and has an extracting machine type 2T-3,5 $\times$ 1,7 (fig.3) equipped with one asynchronous motor type AKH -14 - 46 -10, of 600 kW

Fig.1. . Installation tower „ Auxiliary well no. 2 "

Fig.2. Extracting installation „ Auxiliary well no. 2 "

Fig.3 Extracting machine type 2T-3,5 $\times$ 1,7

power and a nominal rpm of 585 rpm. The reducer of the machine is of type TD-170 having the transmittance ratio of 11,5. The extracting cables with diameters of Φ 42 mm and a mass (on a linear meter) of 6,9 kg/m on the left branch (from the extracting machine to the well) and Φ 40 mm and a mass 6,17 kg/m on the right branch are wrapped around the two extracting pulleys of Φ 3500 mm with a mass (the pulley, the axel of the pulley and the bearing of the axel) of 3050 kg (fig.3), laying on the tower at a height of 23,7 m (pulley axel). The cables are wrapped in a single layer (row) on each of the two wheels of the machine, from which one is fixed and one is mobile and which are hooked at one end by the exterior end (side) of them. The other end of the cables going through the extracting pulleys is hooked to the extracting vessel through the cable tie device DLC. The extracting vessels are untipping cages with one level, with two trolleys per level having a mass (own mass plus D.L.C.) of 4661 kg. The mass of a trolley is of 650 kg, and the effective load is 1800 kg /

Fig.4. Pulley platform

Fig.5. Leading component

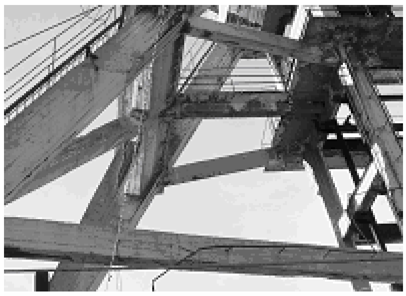


Fig.6. Abutment

trolley. The tower (fig.1) with a height until the pulley axel of 23,7 m. The structure of the tower is composed of the extracting pulley platform (fig.4) sustained by the leading component (fig 5) and the abutment (fig 6). The extracting machine lies on the ground (at a height of 0.7 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 42m. 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 left branch L_{cs}=46,226m, and L_{cd}=46,358m for the right branch.

The incline angles of the cables chords are $\beta_s = 34^0\ 04'\ 29''$for the left branch and $\beta_d = 29^0\ 44'\ 41''$, for the right branch, and the deviating angles (which are formed in the limit positions of the cable chord towards the interior side(interior angle) or exterior (exterior angle) of the wheel, over the central position of the chord) are: α_e st =$19'29''$ and α_i st=$45'21''$ For the left branch and $\alpha_e$dr=$31'53''$ and α_i dr=$32'46''$ for the right branch.

3. LOADS TRANSMITTED TO THE TOWER

For the determination of stress and displacements in the structure of the tower of the installation taken into study there have been calculated the loads transmitted to the tower considering the cases when one of the two cases loaded is climbing on one of the two branches.

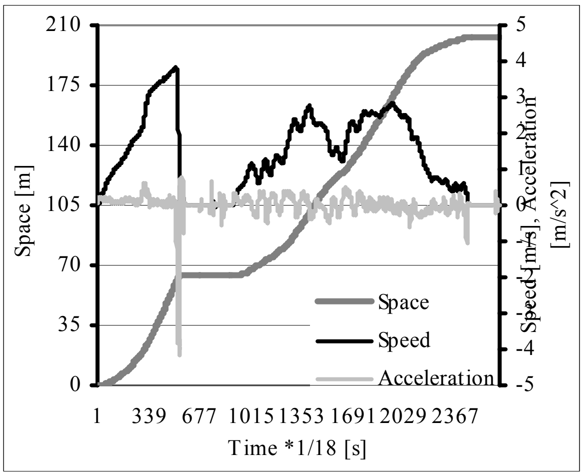


Fig.7. Left case climbing, .case 1

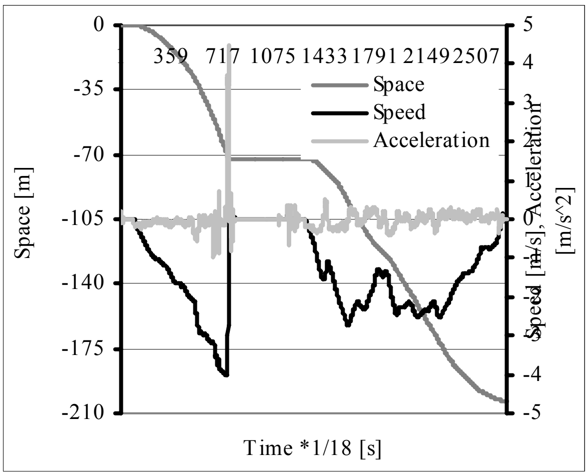


Fig.8. Right case climbing, case 2

For this purpose it has been taken into analysis the case 1, left case is climbing and the right one is descending and the case 2, the right case is climbing and the left one is descending. The tahograms for the two cases taken into analysis are presented into fig 7 case 1 and in fig 8 case 2. The speed diagrams have been interpoled in order to smoothen them (to eliminate brum) and then through their derivation numerically there have been determined the accelerations and decelerations.

The calculation of the loads [1], [2] which act on the tower through the deviating pulleys has been made, taking into consideration the static forces, the friction forces and the dynamic forces (which intervene only in the acceleration and deceleration period).

In the case of the loads it has been used the d'Alembert principle (the cineto-static method [3], [4]) decomposing the efforts from the cable chords, in the tangent points of the chords to the pulleys (fig.7), into components over the three perpendicular directions which are the same with the axis system used in the discretisation of the structure of the installation tower. Therefore the z axis has been chosen horizontal, over the pulleys axel, and axis x and y perpendicular onto z, horizontally and vertically. The components ([1], [2], [3], [4], [5], [6]) of the efforts in the cable chords change due to the incline angles of the chords as well as over the deviating angles of them. Following the facts exposed before and taking into consideration that the component parallel to the z axis of efforts, creates momentum to the bearings of the pulleys (considered support (bindings) of type axel bearing with shoulders), and have been determined the forces that act upon the metallic tower through the bearings, forces decomposed after the directions of the axis x, y and z.

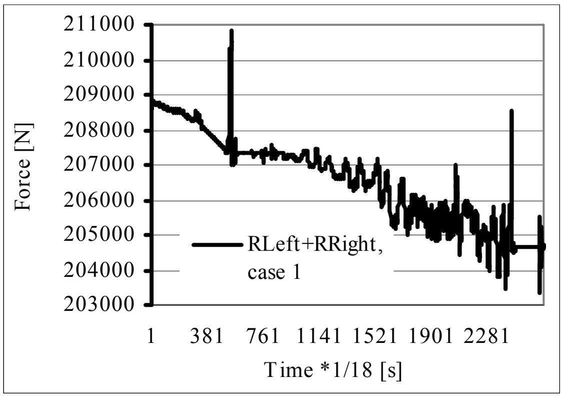


Fig. 9. Forces in the bearing of the pulleys left and right when the left case is climbing and the right one is descending

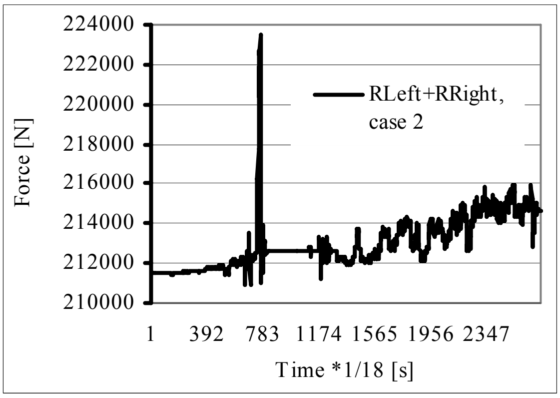
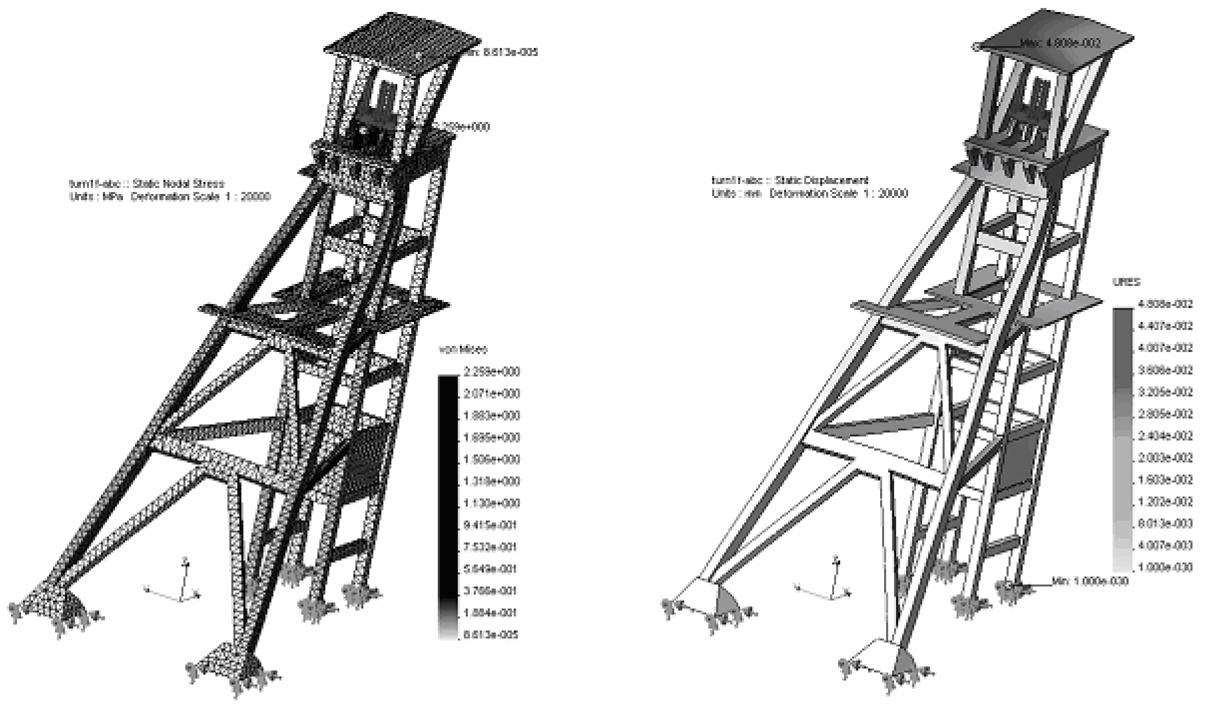


Fig. 10. Forces in the bearing of the pulleys left and right when the left case is descending and the right one is climbing

4. STRAINS AND DISPLACEMENTS

Due to the complexity of the resistance structure of the extracting tower, the most adequate method to study the state of stress and displacements is the finite element method. In order to analyze the state of stress and displacement with the finite element the structure of the tower has been discretised adequate for each component in the structure of the tower the geometrical and mechanical characteristics of every element which enters the structure of the tower and they have been introduced into the calculation software. In the cases taken into discussion it has been taken into consideration also the mass of the structure of the entire tower calculated with the software.

In fig11 a) and b) there are presented the displacements and stress for case 1 and in fig 12 a) and b) for case 2.



a) b)

Fig. 11 Deceleration left climbing right descending (x 149)

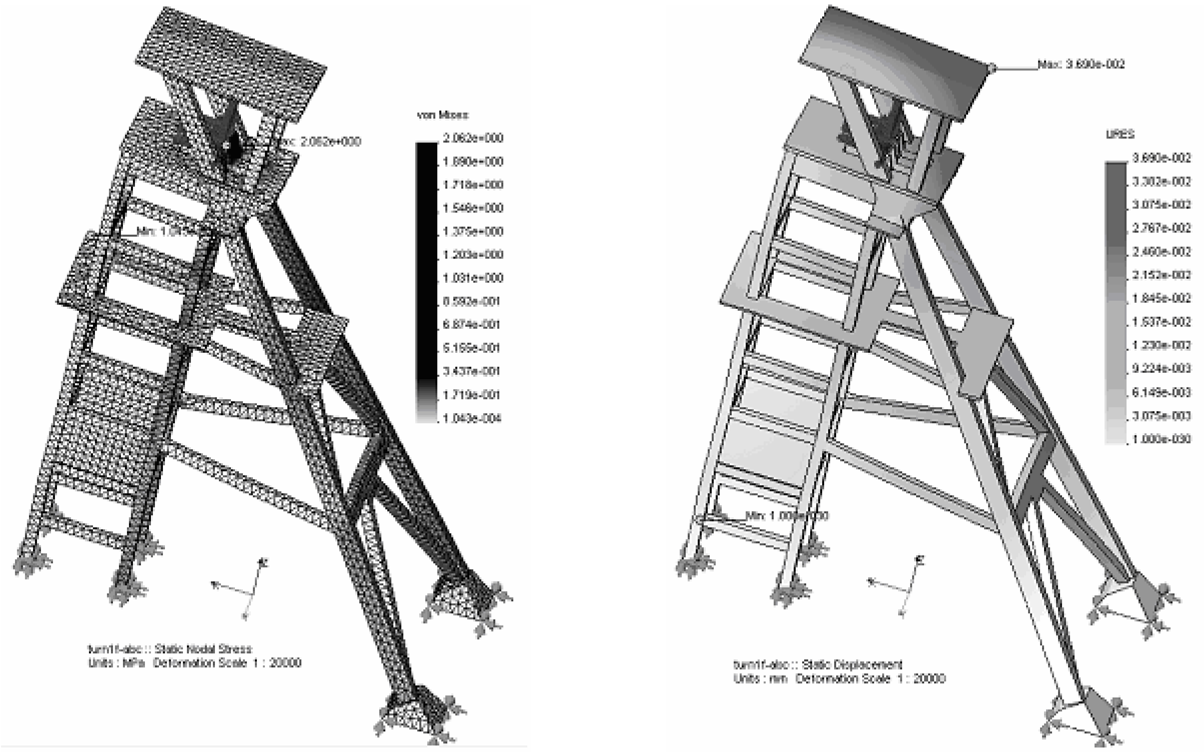
a) displacements; b)mechanical strain.

5. CONCLUSIONS

Strain and displacements in the cases considered are within the admittable limits

Following the results obtained it has been found that the elements that have the biggest stress and the biggest displacements, compared to the rest of the elements of the tower structure, are the feet of the abutment the pulley's platform, and the props situated on the side of the leading way.

There have been determined and located the maximum values of the stress and displacements from the elements from the tower structure in order to establish the measuring points in order to match the results obtained through numerical calculations by experimental values.



a) b)

Fig. 12 Deceleration, left descending right climbing (x 435)

a) displacements ; b) mechanical strains.

6. REFERENCES

1. Brădeanu, N. Instalații de extracție miniere, Editura Didactică şi Pedagogică, Bucureşti, 1965;
2. Maghyari A. Instalații mecanice miniere, Editura tehnică, Bucureşti, 1990;
3. Ripianu A., Mecanica tehnica, Editura Didactică şi Pedagogică, Bucureşti, 1982;
4. Popescu P., Balan B.,Sarian, M., ş.a. Probleme de mecanică, Editura Didactică şi Pedagogică, Bucureşti, 1983;
5. Vlad P. C. Prescripții de calcul pentru instalații de extracție mono şi multicablu, Vol. I, O.D.P.T., Bucureşti, 1972;
6. Vlad P. C. Prescripții de calcul pentru instalații de extracție mono şi multicablu, Vol. II, O.D.P.T., Bucureşti, 1973;
7. * * * Documentație tehnică, E.M. Lupeni, mina Bărbăteni.