CONTROL OF THE LOW ROTOR STABILITY

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Abstract The paper addresses an important and timely issue in the area of improving and modernising methods and equipment to ensure the efficient operation of the machinery for the extraction of high-capacity by improving the functioning of the time, concerned by increasing usability. The drafting of the paper were undertaken both in actual conditions research of quarries in Oltenia, in general and of quarries in the Stall, in particular, as well as in specialized technical literature in the field, from which it resulted that the weighing operations, methodologies for the determination of the Centre of gravity and the counter weight size and stability tests shall be performed on the machine working careers (rotor excavator haldat, machines, etc.) for a long time with the aid of means and methods which have become classics that can be upgraded and improved so that the balance, stability, functioning condition to improve and to increase the performance of the ruling mainly machinery and technological system in general.

Keywords Transport, Optimization, Mechanics

1. Introduction

Working machines from the quarries, the general and particular rotor backhoes have a relatively small support surface, and constructive parts on which large forces act, extends far outside. Such structures, the issue is of particular importance to stability, because the resultant of all forces acting on the structure, is not allowed to hit or exceed the contour of the surface, because that would lead to the instability of the structure. The problem is even more difficult because the center of gravity of the mass of the rotor excavator sits much higher than the support structure, as well as the point at which the external forces acting on the rotor excavator.

In Figure 1. is presented schematically on top of a rotor excavator. Limits the stroke support symbolized by figures 1 and 2 are located at the distance of 0.5 × from the axis of rotation of the upper face of the z-axis of the reference system. The distance between the two strokes, "is small in relation to the position defined by the rotor, (b)", and the inverse weight, defined, c. "

The Centre of gravity of the mass of the upper QR is moved with the size, it's "in the direction of the arm, the front of the z axis, and the height, h," toward the outline of the support surface. These two sizes, "and" h "are not constant, but depends on the height at which it's high rotor, thus," is minimal when the impeller arm is horizontal, and increases the rise or descent, and rotor, h ' is minimal when the arm is down and increases with raising rotor arm. Horizontal position of the machine working, i.e. rotor excavator, base support is horizontal, and the resultant mass forces support surface it stings too remote, "towards the z-axis when machine is tilted, the point at which the resultant mass forces support surface it stings, and depending on the direction of tilt, the distance to the axis may be higher or lower than the "e".

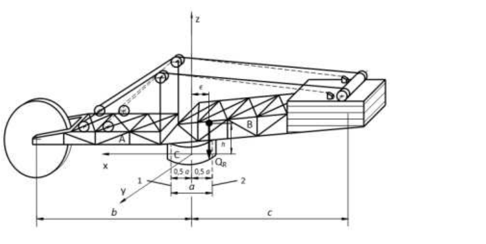

Fig. 1. Defining elements of balance and stability of the upper deck rotating rotor: the backhoes-arm rotor; B- counter weight arm; D-rotate the Crown to the top; 1 and 2-stroke limits the upper support

Vertical forces acting on the rotor in the direction of the axis (z) moves the point of intersection of rezultantei of all forces towards supporting 1, outline and horizontal forces acting on the rotor in the direction of the axis (-x), if it is below the surface of the support plan, produce the same effect. The forces acting on the rotor's axis direction (+x), respectively from counter weight arm forces in the direction of the axis (z), moves the point of intersection of the resultant of all forces towards supporting 2 contour, and horizontal forces acting on the rotor's axis direction (+x), acts under the surface support, plan and forces in the direction of the axis (-x), whether it can act above the support surface produces the same effect. Safe operation of the excavator is possible only if the point of intersection of the resultant of all the forces acting, is located inside the support surface bounded by 1 and 2. Even in the most adverse situations of external forces that may occur during operation, the intersection point of the resultant is not allowed to exceed the outline of the support, because otherwise the machine sideways, which could result in the destruction of the excavator, but might be in danger the lives of human operators. To treat the issue of stability, in the alternative, to balance the forces acting on the rotor excavator can be divided into two groups: the first group belong all the forces acting on the continuous and constant construction; the second group are all forces not acting continually (all external forces) but also the forces caused by the inclination of the masses.

First group forces are forces due to the mass of each component, in the direction of the axis (z). For they can calculate the position of the center of mass, masses of component parts from constructive. In this case some errors may occur due to the large number of parts, the mass of which cannot be considered to be very accurate. For this reason it is recommended that the position of the center of mass due to their masses determined after mounting of all components by weighing and then to lay the necessary mass of counter weight, because that is interdependent with the position of the Centre of gravity of the masses. To make it possible to modify the counter weight mass since the construction should be taken into account as early as the design stage of a variation of domain (10% for mass balancing determined theoretically. *As the size of mass balancing has a great importance for the functioning of the excavator, this must be clearly stated in the technical documentation. Its size must be entered clearly and prominently on the outside and construction. Forces in Group 1 are the forces that give stability, because it doesn't change size and position and acts in the direction (z). Due to these forces in supporting surface stability moments occur* M_{S1} and M_{S2}.

The second group forces are forces that are trying to overthrow the equipment, developing around the areas they support moments M_{r1} and M_{r2}, that can be calculated theoretically from the individual forces. Here enters and forces that arise due to the massive rotor blocking or support its embankment. In the case of supporting the upper deck on a ball bearing support are clear contours, which are given by the centre line of route of the bowls. A substantial improvement in safety to roll over can be obtained with the help of hooks (Spurs), between the Raceway of the upper and lower bowls. In the case of special platforms rotation can take over and thrust forces, support surfaces, edges are located outside of the centre line of route of the bowls and is oriented so that it can retrieve the moment in turning platform.

If it is necessary to provide conditions similar to normal turning platforms, this can only be done with the help of a construction with fastening hooks that can retrieve and transmit large thrust forces, rotating between the upper and lower part. Such constructions with hooks (Spurs) grip only works after turning platform was sloped, so her action must be limited to combinations of tasks at which it no longer held any movement of its rotation.

The equipment, the structure of the upper rotary switch is fixed on the plate rotating (turntable) by means of spherical joints which permit tilting, it is necessary to obtain a certificate for the stability of the joints. Due to the fact that joints of inclination in most cases is located closer to the axis of rotation than the outer edge of the route of balls, you no longer need the stability plan certificate link. Support for the plan of construction points lower on the system running with paver, there may be various forms of contours, for the different variants of the running system. In figures 2 and 3 are given various forms of support variants.

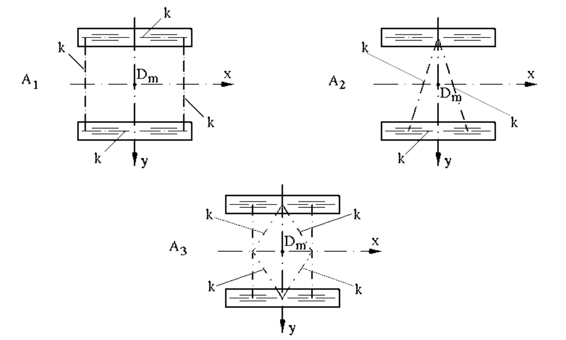

Fig. 2. Figures of support for systems running with 2 tracks. k-the contour support; A1-2 system running track; guiding rollers with tilt; A2-2 paver with tread; a reconditioning fixed and one swivel; A3-running system with 2 swivel wheels; guiding rolls balanced (offset).

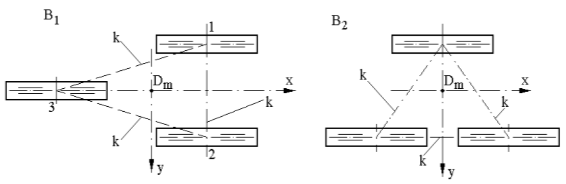

Fig. 3. The figures support for systems running with 3 tracks. B1-3 system running track with a reconditioning conducted; guiding rolls offset; B2-runtime system with three tracks, with two tracks dirigibles; guiding rolls offset.

To determine the timing of MS, lower construction provides a constant value, while the upper part has to be analysed the various positions of rotation. And for moments of Mr. must be considered the most unfavorable position of rotating towards the contour of the lower support. Because the support plan is set out below, under the Centre of gravity of the masses, the rotating platform, tilting forces have a more pronounced effect overturning. In principle, the Overview of constructive paver weights should not be used for the determination of safety to overthrow at the point of support of the bottom, because in most cases the construction points of the lower support cannot retrieve large thrust forces. It can be a stabilizing force to the fulcrum of the bottom, which can transfer by stretching from the construction point of support to the construction wheel.

Since the masses located on the rotor arm and arm counter weight very strongly influences the position of the center of mass, it should be borne in mind that heavy objects, which are not part of the construction of the excavator, but required the renovation works, not to remain there during operation excavator, but should be removed after the completion of these works. If functional reasons certain items should be fitted at a later stage on the arm of the impeller, then the weight should be balanced by a corresponding correction. Such corrections of counter weight shall be noted in the technical documentation of the machine. In the case of repair work, remove the larger masses, such as removing the influence of impeller, measures must be taken to ensure the stability of the machine (e.g. removal of part of the counterweight, or by riding it).

The machines deposit or transfer, shall be made of similar stability as well as backhoes rotor. For both the demolition and rotor for transhipment facility must be taken into account both the horizontal momentum, as well as additional vertical load in the calculation of stability.

2. Methods of Weighing Machines Working in Careers

For control values and mass center of mass position of upper deck, theoretically determined the actual quantities by weighing, and thus must be checked and counter weight. Weighing can be done in different ways, depending on the method used results in a more or less accurate. The simplest method of weighing, consists in lifting the upper deck on the lower part by means of hydraulic cylinders. Points of action of hydraulic cylinders are provided for use in structure and strain relief upper deck and at change of the rotation Crown or controlling it. By measuring the pressure in the hydraulic cylinders for lifting points in place, measure the forces acting on these points and determine the total mass of the upper rotating structure and the position of the center of mass lies within the propulsion points of hydraulic cylinders.

It should be borne in mind that the upper deck to be detensionată and all to be taken over by means of hydraulic cylinders. To remove as much influence of parasitic drag of the Pistons and cylinders, the pressures they will be determined several times, both lifting and lowering the average of these values. This method is not very accurate, however, it is sufficient in the case of smaller, with a mass of up to 600 tons. Hydraulic cylinders for lifting the upper deck are typically owned career can be use for other purposes. Best results are obtained if between hydraulic cylinders and their lift from the upper deck, force transducers are mounted, with which it can be determined much more precisely the forces developed at the point of action. And this method must be rotating link It's not tense and complete the task developed by upper deck to be taken only in lifting points. Also it is recommended that the measurement several times and pressures used in subsequent calculations of the mean values of the measurements. Force transducers must be calibrated before making measurements to ensure that the values obtained are as small as errors. If you are doing measurements in different positions on the working height of the rotor arm, can be determined and the mass and centre of gravity position. Such weighing starts from the premise that the right actuator cylinders points, between upper and lower platform there is enough space to mount the rollers and force transducers. As in most careers no such force transducers are used, they must be purchased or leased small quarries, from specialized companies. This method is in most cases sufficient, even for large machines, for calculating theoretical stability. However, neither in this case are not excluded errors due to uncertainty in the measurements using the force transducer.

If you need more precise measurements and then measuring the forces must take place with the bridge crane control, which is mounted on a special measuring elements, mounted at the point of removal of the upper deck, and whose particulars are recorded and processed with special devices. For this method of weighing, whereby they can be determined and the masses and positions of centre of each component of the structure, it requires a specialized team and who has the necessary experience to carry out such measurements and is provided with adequate facilities and equipment. Processing of the results requires more time, so that they are not readily available, as opposed to other methods. The particulars should be linked with morphometric decks loads acting on the measuring elements, yet before weighing. This can be done through a calibration method of a certain size set at a fixed distance toward the centerline of rotation. With this you can accurately determine the request from lifting points. In order to achieve the purpose of weighing, measurement equipment should be as horizontally and must not beat the wind, because the influence of these factors would greatly distort the weighing results. If the results of weighing differ by more than 5% of the results of the theoretical calculation of stability, then the calculations to be checked, and weighing must be repeated. After weighing, on the basis of the results obtained, if necessary, be amended so that the table counter weight for the resultant position in the lifting points correspond to the values laid down.

3. Determination of Center of Gravity by Weighing

The classical method of determining the center of gravity through, weighing "practised so far consists in lifting the upper deck by means of hydraulic cylinders, static for several distinct situations. For this demolition must lie on the ground horizontally, with the appropriate gear position handle and safe over time. The difference between the rates for the three points as necessary is up to 15 mm (measured with theodolite). In addition the machine has drained of tape conveyors. Grinding wheel arm material bucket wheel and bucket (including the interior). It cleans stairs, walkways, metal constructions, mechanisms, etc. and remove any parts, tools, etc. by dropping could cause accidents. Disconnected power supply to the equipment by spacer 6 kV from cofretul cable drum, possibly from the cell. Measures shall be taken to prevent accidental voltage coupling. Excavator superstructure rotates toward the basic structure (fig. 4) that points on the chassis and platform rotating (fig. 5), marked for mounting of hydraulic cylinders, to overlap.

Duplication of these points will be made as accurately. Bucket rotor positioned approximately 0.5 m above the hearth of the plan.

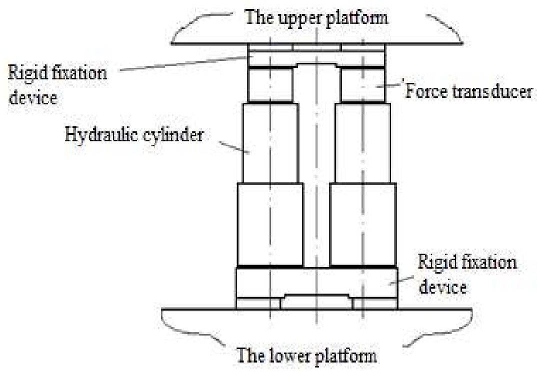

Fig. 4. *Basic structure.*

Fig. 5. *The point of lifting the upper deck.*

Crane service, located on the upper arm, is moored near the hoist, lifting-lowering arm wheel bucket. Location of superstructure, mounting position of hydraulic cylinders, the distances between them and toward the center of rotation of the upper deck shall be indicated in the documentation. Six cylinders are used 2000 kN each. The groups of hydraulic cylinders (fig. 6) for the purposes of uniform distribution of forces, from the lower part of them, shall be inserted between sections and groups of cylinders one rigid clamping device (beam), and at the top of the force transducers are followed by another rigid fixation device. Hydraulic cylinders shall be placed symmetrically against lifting points marked on the lower deck. Each group of hydraulic cylinder plugs among themselves for running uniform and to be able to measure their position during lifting. After exhausting a lifting force shall be measured by means of force transducer and pressure transducer.

For measurements shall be removed under more added stop hooks (fig. 7 th and fig. 8) to realize the possibility of lifting the superior turning platform (superstructure). In certain situations where it removed the head hooks. Also make sure it is sufficient distance between the upper surface of the support of the bridge and washer upper platform. The need is to dismantle the top cover of the support. It removed the brushes from collecting rings to allow the lifting of the (height).

Fig. 6. *Mounting position of a group of hydraulic cylinders.*

Fig. 7. *Filler metal for a hook latch Fig. 8. Latch hook.*

Fig. 8. *Latch hook.*

For an additional verification of the lifting force and position the center of gravity of the upper deck excavator (measuring system functionality), each group of hydraulic cylinders to mount a pressure gauge.

References

[1] Baron, T., Isaic-Maniu, A., Tövissi, L., Niculescu, D., Baron, C., Antonescu, V., Roman, I., *Calitate şi fiabilitate. Manual practic, Vol. I-II*, Editura

Tehnică, Bucureşti, 1988.

[2] Buzdugan, Gh., ş. a., *Rezistenţa Materialelor*, Editura Tehnică, Bucureşti, 1979.

[3] Constantinescu, M., *Protecţia anticorosivă a metalelor*, Editura Tehnică, Bucureşti, 1975.

[4] Elczner, G., Tigae, I., *Mecanică şi rezistenţa materialelor*, Litografia I. M. Petroşani, 1979.

[5] Faur, N., Dumitru, I, *Metode numerice în rezistenţa materialelor*, Editura Universităţii Timişoara, 1995.

[6] Fodor, D., *Exploatarea zăcămintelor de minerale şi roci utile prin lucrări la zi*, Vol. I. Editura Tehnică, Bucureşti, 1995.

[7] Fodor, D., Iliaş, N., *Mecanizarea în exploatările miniere la zi*, Editura Tehnică, Bucureşti, 1978.

[8] Iliaş, N., Kovacs, I., Gruneanţu, I., *Maşini miniere – curs – vol. II*, Litografia I. M. P., 1989.

[9] Jescu, I., *Extracţia lignitului prin exploatări la zi în România*, Editura Tehnică, Bucureşti, 1981.

[10] Jevtović, B., Mataušek, M., *Modeling of Bucket Wheel Excavator: Theory and Experimental Results*, Facta Universitatis, Series: Working and Living Environmental Protection Vol. 2, No. 4, 2004, pp. 335-343.

[11] Kovacs, I., *Studiul regimului de lucru al combinelor de abataj*, Teză de doctorat, I. M. Petroşani, 1980.

[12] Kovacs, I., Iliaş, N., Nan, M. S., *Regimul de lucru al combinelor miniere*, Editura Universitas, Petroşani, 2000.

[13] Kovacs, I., Jula, D., Nan, M. S., Kovacs, A., *Berechnungsverfahren der notwendigen Antriebleistung der drehbaren Gewinnungsteile der Verschiedenen Bergbaumaschinen*, High Technologies of Machine-building Kharkov, 1999.

[14] Kovacs, I., Nan, M. S., Andraş, I., Jula, D., *Stabilirea regimului extrem de funcţionare a excavatoarelor cu roată portcupe*, Lucrările ştiinţifice ale Simpozionului Internaţional „Universitaria ROPET 2002" 17-19 oct. 2002, Petroşani – Inginerie mecanică.

[15] Kramadibrata, S., *The Influence of Rock Mass and Intact Rock Proporties on the Design of Surface Mines with Particular Reference to the Excavatability of Rock*, Thesis of doctor of philosiphy. Curtin University of Technology, U. S. A., 2003.

[16] Mihăilescu, S., *Utilaje de transport pe calea ferată pentru subteran*, Editura UNIVERSITAS, Petroşani, 2006.

[17] Mihăilescu, S., Praporgescu, G., *Analyzing the Operation of the Extraction System in the E. M. C. Jilt Open Casts*, Annals of the University of Petroşani, Mechanical Engineering, vol. 8, Petroşani, 2006.

[18] Nan, M. S., *Studiul organelor de tăiere ale combinelor de înaintare cu atac parţial în vederea creşterii performanţelor acestora la săparea galeriilor în cărbune*, Teză de doctorat, Universitatea Tehnică Petroşani, 1993.

[19] Nan, M. S., *Parametrii procesului de excavare la excavatoarele cu rotor*, Editura Universitas, Petroşani, 2007.

[20] Nan, M. S., Jula, D., *Capacitatea sistemelor de transport*, Editura Universitas, Petroşani, 2000.

[21] Oprean, A., ş. a., *Acţionări hidraulice. Elemente şi sisteme*, Editura Tehnică, Bucureşti, 1982.

[22] Pavovlic, V., *Continuous Mining Reliability and Capacity*, Min.res.eng. vol 2, no 3, 1989.

[23] Pătraşcu, P., Vătavu, S., *Hidraulica maşinilor miniere. Elemente de acţionări hidraulice,* Editura Universitas, Petroşani, 2006.

[24] Pătraşcu, P., Vătavu, S., *Îndrumător de laborator pentru acţionări hidraulice şi pneumatic,* Litografia Universităţii din Petroşani, Petroşani, 1998.

[25] Popescu, Fl., *Programarea şi utilizarea calculatoarelor*, Editura SIGMA PLUS, Deva, 2002.

[26] Raaz, V., *Optimierung der maschinen-mid Verfahrenrechnischen Parameter von Schaufelradbaggem für einen abbau von harteren Materialen ím Tagebau*, Braunkohle in Europa: Innovationen für die Zukunfl; 1. Internationale Konferennnz, 29 Marz bis 1. Aprili 2000, in Freiberg, Tagungsband.

[27] Ridzi, M. C., *Analiza experimentală a tensiunilor*, Editura UNIVERSITAS Petroşani, 2004.

[28] Ridzi, M. C., *Metoda elementului finit*, Editura UNIVERSITAS Petroşani, 2004.

[29] Rumşiski, L. Z., *Prelucrarea matematică a datelor experimentale*. Traducere din limba rusă, Editura Tehnică, Bucureşti, 1974.

[30] Sümegi, I., *Külfejtési marótárcoás kotrógépek jövesztő szerkezetének*

elméleti vizsgàlata és fejlesztése, Doktori értekezés, Universitatea din Miskolc, 2002.

[31] Şerban, D., Zene, M., *Îndrumător pentru utilizarea fontelor, oţelurilor şi aliajelor neferoase*, Editura Tehnică, Bucureşti, 1981.

[32] Ungureanu, N. S., *Fiabilitate şi diagnoză*, Editura RISOPRINT, Cluj-Napoca, 2003.

[33] Vasiliu, N., Vasiliu, D., *Acţionări hidraulice şi pneumatice, vol. 1*, Editura Tehnică, Bucureşti, 2005.