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Equations for Changing the Centers of Gravity of Mass Goods in the Unloading Process in Trailers

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ABSTRACT: The article present the equations for changing the centers of gravity of mass goods in the unloading process in trailers.

I. INTRODUCTION

The working proses of unloading device changes the mass of loads and relative to the horizontal plane, the load shedding and the rigidity of the platform relative to the frame.
This process, in turn, leads to a change in its center of gravity to the current. As a result, a change in the forces of gravity falling on the bases of the gidrosilindr shaft and Raman occurs. In the calculation of these forces, the determination of the coordinates of the center of gravity of the load is of great importance.

Determination of the coordinates of the load center of gravity relative to the tilt angle of the platform is the main objective of this work.

II. RELATED WORKS

Available technical literature, published scientific papers and internet data analysis this issue has not been thoroughly researched [1, 2, 3, 4, 5, 6] shows.

III. METHODS

In the implementation of the set goal, it is necessary to develop the coordinates of the change of the load center of gravity, the equations of change in the angle of inclination, which are the main parameters of the working process of the device. In this position, in the case when the body's internal volume is full of cargo, the broad and the length of the load are equal to the broad and the length of the platform and do not change during the process, it is assumed that in the case only the height of the load and the geometrical shape of the side surface change.

So, that the center of gravity of the load is in the middle on the length of the platform, and it only changes according to the *x* and *y* coordinate axes.

The change of the center of gravity of the loads will depend on the characteristics of their spilling.

The process of pouring loads is basically two different:

1. Parts of the loads slip between themselves (crumbly loads - grain, sand, etc.).

In this type of pouring, the loads are poured evenly without interruption, during the process its side surface and mass change.

2. The cargo will slip along the base surface of the platform (cotton, the stem of different crops, etc.).

The side surface and mass of this type of cargo are poured holistically while practically unchanged during the process. In the process of pouring, the part of the load coming out of the platform can be disconnected from the load.

The analysis of the load shedding process shows that in the first type of load shedding, the load is in the form of a lateral trapezoid (initial stage) and a triangle (final stage), changing the shape of the side surface (Figure 1). In order to facilitate the work of accounts, the coordinates are taken from the lower end of the platform rolled over so as to head.

So, having determined the centers of gravity of the forms of the side surface of the load, with the help of which it is possible to find the total center of gravity of the load.

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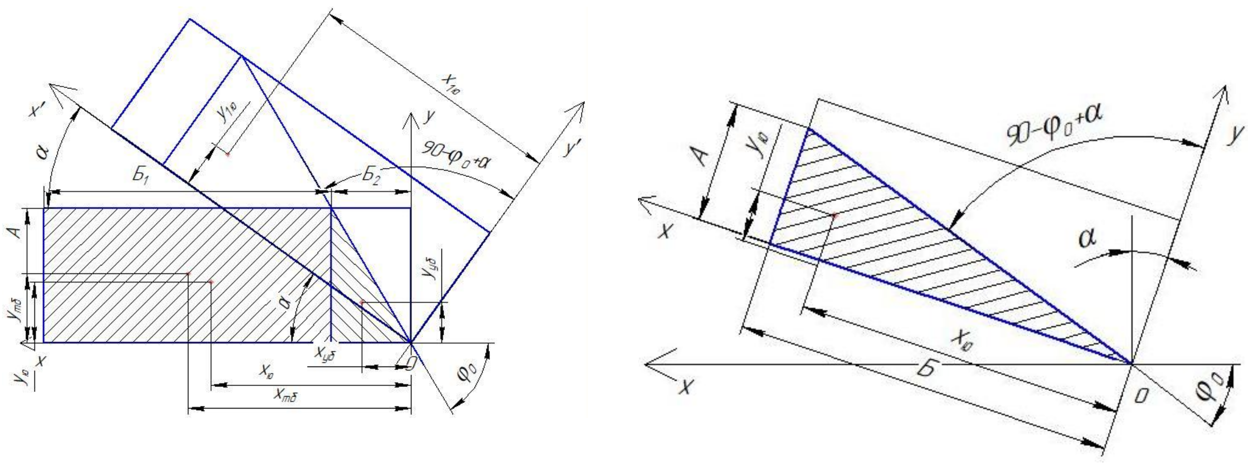

Figure1. Side surface one side trapezoid (on the left) and triangle (on the right) case.

Determination of the center of gravity of a lateral trapezoid. Such trapezoids consist of rectangular and triangular shapes, the work of which is carried out according to the equations of theoretical mechanics for determining the centers of gravity of the body volume (figure 1). The coordinates of the center of gravity of the surface for the trapezoidal shape can be determined in the following form:

$$x_{tp} = \frac{S_{rg} \cdot x_{qd} + S_{tg} \cdot x_{tg}}{S_{rg} + S_{tg}} (1), y_{tp} = \frac{S_{rg} \cdot y_{qd} + S_{tg} \cdot y_{tg}}{S_{rg} + S_{tg}} \ (2)$$

here: S_{rg}, S_{tg} – rectangular and triangular surfaces, x_{tp}, y_{tp}, x_{rg}, y_{rg}, x_{tg}, y_{tg} –respectively the coordinates of the centers of gravity on the x and y axes of the trapeziod, rectangle and triangular surfaces.

According to the rules of geometry surfaces: $S_{rg} = \text{А} \cdot \text{Б}_1$ and $S_{tg} = \frac{\text{А} \cdot \text{Б}_2}{2}$ as for the expression and the centers of gravity:$x_{rg} = \frac{\text{Б}_1}{2} + \text{Б}_2$, $y_{rg} = \frac{\text{А}}{2}$, $x_{tg} = \frac{2 \cdot \text{Б}_2}{3}$, $y_{tg} = \frac{\text{А}}{3}$ will be determined (picture 1).

If we put these expressions (1) and (2), the coordinates of the center of gravity of the trapezoid surface will be as follows:

$$x_{tp} = \frac{A \cdot \text{Б}_1 \cdot \left(\frac{\text{Б}_1 + 2 \cdot \text{Б}_2}{2}\right) + \frac{\text{А} \cdot \text{Б}_2}{2} \cdot \frac{2 \cdot \text{Б}_2}{3}}{\frac{\text{А} \cdot (2 \cdot \text{Б}_1 + \text{Б}_2)}{2}} = \frac{3 \cdot \text{Б}_1^2 + 6 \cdot \text{Б}_1 \cdot \text{Б}_2 + 2 \cdot \text{Б}_2^2}{6 \cdot \text{Б}_1 + 3 \cdot \text{Б}_2} \ (3)$$

$$y_{tp} = \frac{A \cdot \text{Б}_1 \cdot \frac{A}{2} + \frac{\text{А} \cdot \text{Б}_2}{2} \cdot \frac{A}{3}}{\frac{\text{А} \cdot (2 \cdot \text{Б}_1 + \text{Б}_2)}{2}} = \frac{A \cdot (3 \cdot \text{Б}_1 + \text{Б}_2)}{6 \cdot \text{Б}_1 + 3 \cdot \text{Б}_2} \ (4)$$

From the pigure 1 $\text{Б}_1 = \text{Б} - \text{Б}_2$, $\text{Б}_2 = A \cdot tg(90° - \varphi_0 + \alpha)$, $x_{tp} = x_l$ and $y_{tp} = y_l$ (x_l and y_l – is the coordinates of the centers of gravity on the x and y axes of the loud) if we make the necessary simplifications in the expressions (3) and (4), taking into account the fact that the load center of gravity coordinates for the initial state of the load shedding can be written in the following form the change in the position related to the angle of platform deflection:

$$\begin{cases} x_l = \dfrac{3 \cdot \text{Б}^2 - 3 \cdot \text{А}^2 \cdot tg^2(90° - \varphi_0 + \alpha) + 2 \cdot \text{А} \cdot tg(90° - \varphi_0 + \alpha)}{[6 \cdot \text{Б} - 3 \cdot tg(90° - \varphi_0 + \alpha)] \cdot cos\alpha}, 0 \leq \propto < \varphi_0 - arctg\dfrac{\text{А}}{\text{Б}} \\ y_l = \dfrac{\text{А} \cdot [3 \cdot \text{Б} - 2 \cdot \text{А} \cdot tg(90° - \varphi_0 + \alpha)]}{6 \cdot \text{Б} - 3 \cdot tg(90° - \varphi_0 + \alpha)}, \qquad 0 \leq \propto < \varphi_0 - arctg\dfrac{\text{А}}{\text{Б}} \end{cases} \ (5)$$

here: φ_0- is a natural slope angle, α - is the slope angle of the platform, which will be dressed when the loads are poured into the pile.

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Determine the center of gravity of the triangle.Coordinates of the center of gravity of the triangular surface are: $x_{tg} = \frac{2 \cdot Б}{3}$ and $y_{tg} = \frac{A}{3}$ figure 1. To these expressions, we put the value of *B*, as above concentration $x_{tp} = x_l$ and $y_{tp} = y_l$ if we take into account that the load loss can be recorded in the following form, the change in the case of the load center coordinates depends on the angle of rotation of the platform for the latter case:

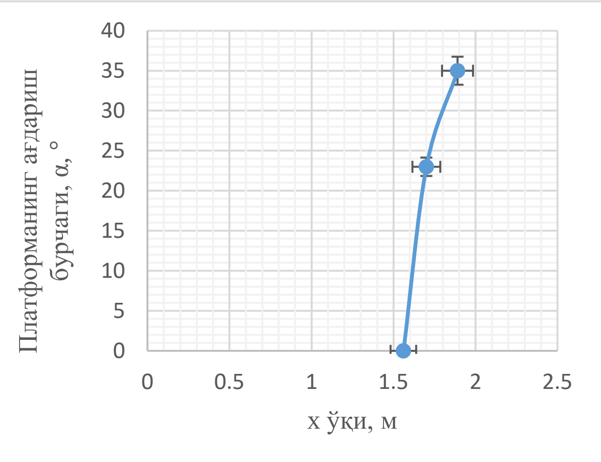
$$\begin{cases} x_l = \dfrac{2 \cdot Б}{3 \cdot cos\alpha}, & 45° > \propto > \varphi_0 - arctg\dfrac{А}{Б} \\ y_l = \dfrac{Б}{3 \cdot tg(90° - \varphi_0 + \alpha)}, & 45° > \propto > \varphi_0 - arctg\dfrac{А}{Б} \end{cases} \quad (6)$$

III. RESULTS 1

By combining (5) and (6) expressions, we will dressing the following expression:

$$\begin{cases} x_l = \dfrac{3 \cdot Б^2 - 3 \cdot А^2 \cdot tg^2(90° - \varphi_0 + \alpha) + 2 \cdot А \cdot tg(90° - \varphi_0 + \alpha)}{[6 \cdot Б - 3 \cdot tg(90° - \varphi_0 + \alpha)] \cdot cos\alpha}, & 0 \leq \propto < \varphi_0 - arctg\dfrac{А}{Б} \\ x_l = \dfrac{2 \cdot Б}{3 \cdot cos\alpha}, & 45° > \propto > \varphi_0 - arctg\dfrac{А}{Б} \\ y_l = \dfrac{А \cdot [3 \cdot Б - 2 \cdot А \cdot tg(90° - \varphi_0 + \alpha)]}{6 \cdot Б - 3 \cdot tg(90° - \varphi_0 + \alpha)}, & 0 \leq \propto < \varphi_0 - arctg\dfrac{А}{Б} \\ y_l = \dfrac{Б}{3 \cdot tg(90° - \varphi_0 + \alpha)}, & 45° > \propto > \varphi_0 - arctg\dfrac{А}{Б} \end{cases}$$

This system of equations is a mathematical expression of the centers of gravity of the loads that slip between the change in α angles.



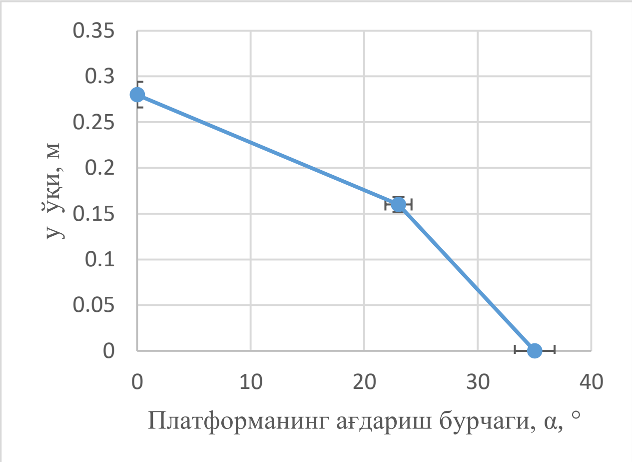


Figure2. Diagram of the change in the centers of gravity and angles of the loads with which they slip (ex. of crop)

<u>Change of load center of gravity in the process of gliding on the base surface.</u>

In this type of pouring process, the condition that the louds maintain their equilibrium position is used to determine the change in the center of gravity.

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In order for the force of loud (F_l) inherent in the load to be in full equilibrium when the displacement angle is $\propto = 0$, the coordinates of its center of gravity are $x_{l\,0} = \frac{Б}{2}$ and $y_{l\,0} = \frac{A}{2}$ as follows.

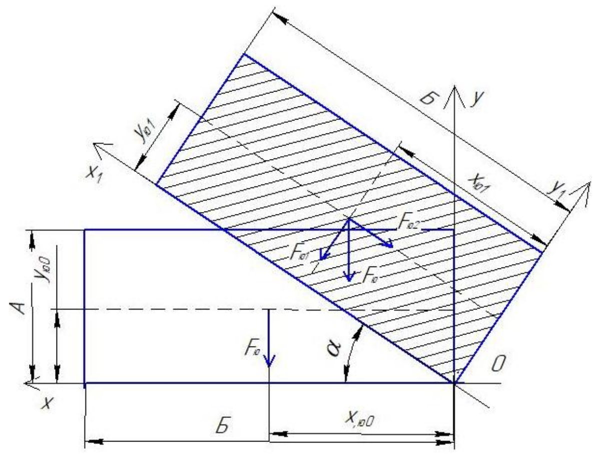

Figure 3. Slip spilling on the base surface.

When the tilt angle is $\propto > 0$, the force F_l is divided: the force F_{l1} (perpendicular to the platform) and the force F_{l2} (directed along the surface of the platform). Of these, the force F_{l1} tries to return the load in its original condition and is determined as follows:

$$F_{l1} = F_l \cdot cos\alpha$$

In the case of the load incline, in order for it to be in balance, its center of gravity coordinates, the angle of inclination must fulfill the following condition in relation to the center of gravity in $\propto = 0$:

$$x_{l0} \cdot F_l = x_{l1} \cdot F_{l1}$$

using this condition, they are determined as follows:

$$x_{l0} \cdot F_l = x_{l1} \cdot F_l \cdot cos\alpha, \;\; x_{l1} = \frac{x_{l\,0}}{cos\propto} \text{ ёки } x_{l1} = \frac{Б}{2 \cdot cos\propto} \; (7)$$

$$y_{l1} = y_{l0} \text{ ёки } y_{l1} = \frac{A}{2} \; (8)$$

III. RESULTS 2

Combining the expressions (7) and (8), we put the boundary conditions and dressing the system of the following equations:

$$\begin{cases} x_{l1} = \dfrac{Б}{2 \cdot cos \propto}, & \propto \leq 45° \\ y_{l1} = \dfrac{A}{2}, & \propto \leq 45° \end{cases}$$

This system of equations is a mathematical expression of the change in the center of gravity $\propto$ angle dependent states of the loads that slip on the base surfaces.

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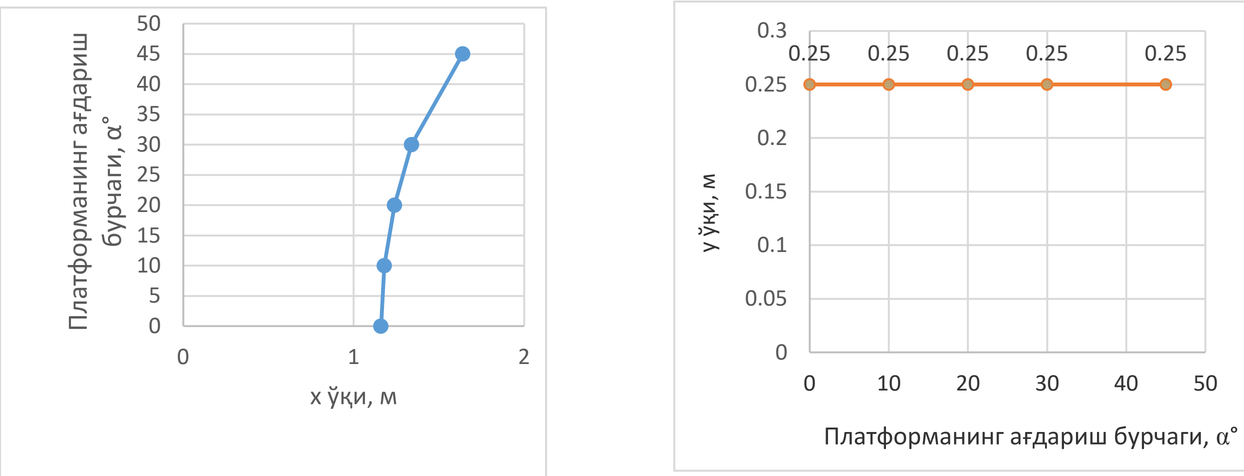

Figure 3. Change diagram of the centers of gravity of sliding loads dependent ∝ angle on the base surfaces (ex. of cotton)

IV. CONCLUSION

The analysis of the developed mathematical expressions shows that the centers of gravity of loads in the process of overturning, from the centers of gravity in its horizontal position, are shaken to the side of the growth of the x axis. This condition can be explained by the fact that the volume of the load is higher on the upper side of the slope than on the lower side, and the load tends to maintain its equilibrium in the slope.

In this research, the equations of change in the weight center of the load on the trailer platform, which is an important component of the mathematical modeling of the lifting-tilting process on the trailer, were taken up by the coordinates of the change-tilting device on the turning angle, which is the main parameter of the working process.

REFERENCES

1. A.A.Shermukhamedov, Kh.R. Baynazarov. Mathematical modeling of the change in the mass of goods in the processes of work lifting - rejecting the device trailers .SCIENTIFIC – TECHNICAL JOURNAL of FerPI 2019, №4 (No.4), Uzbekistan
2. F. U. Yuldashev Development of method for calculating the unloading mechanism vehicles. Disertation for kandidate of technical sciences, Tashkent, 2015y.
3. A.A.Shermukhammedov,I. I. Usmanov,R. T Salimjanov, A.A.TogayevMethods for calculation and tasting of auto traktor trailers in domestic production. Monograph, Tashkent, Fan, 2011.
4. P. R. Bartosh, I. G. Selevonchic.Dinamic calculation of the hudraulic drive the unloading mechanism of the tipper vehicles platform.. Avtomobilniy transport, vol.29, Moscow, 2011y.
5. F. M. MatmurodovJustification of the dinamic parametrs of the unloading device of the body of the tipper vehicles . Disertation for kandidate of technical sciences.Tashkent 2002 y.
6. A.A. Shermukhammedov Development of scientific foundation of modeling working processess in hudraulic drivers of cargo mobile machine in explatition of exteme conditions. Disertation for Doctor. of science.Tashkent.2000 y.

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