Technological basis of rotation of body with polygon

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Abstract. Front-end plows are promising and carry out smooth plowing. A significant disadvantage of the front plow is that the housings do not completely rotate the layers within their own furrow and have a large traction resistance since they work in conditions of blocked cutting. The study aims to substantiate the technology of turnover of a polygonal formation in conditions of non-blocked cutting. The basic principles and methods of classical mechanics, mathematical analysis, and statistics were used in this study. The parameters of the polygonal formation formed by the angle beam and the body of the plow have been studied. Analytical dependences for determining the coordinate of the center of gravity of the formation and the displacement of its center of gravity along the ordinate axis are obtained. It was found that the displacement of the center of gravity of the formation along the ordinate with a formation width of 45-52.5 cm and a gripping width of the angle of 4-10 cm is 4-10 cm.

1 Introduction

The main conditions of the new technology of flat plowing are the cross-silencing of the center of gravity of this plast and the autonomy of the grinding process. These conditions make this process complicated enough and aggravate its implementation [1]. This method of flat plowing is also proved by the absence of visible and high-level results in autumn in world practice. Research carried out abroad on flat plowing without cultivation outside the Russian Federation is mainly of a constructive-experimental and practical nature [2].

Sh.Kurbanov [1-3], F. Mamatov [3-40], N.Aldoshin [4, 15, 32-33], Sh.Ravshanov [1, 3, 15, 19, 24, 27, 39], B. Mirzaev [5-8, 11-12, 15-16, 18, 20-21, 25, 30, 33-40], I.Ismailov [4, 14], I. Temirov [19, 31] and other scientists were engaged.

In the study of theoretical issues of the character of the Palahsa movement, its kinematics is considered one of the most important aspects since it is possible to carry out the process on its basis.

In a theoretical review of the cinematics of plast by Y.Lobachevsky [41], The model of the soil plast was adopted as a holistic elastic medium. It is known that such a theoretical model can not be made in the ideal form. This process can be carried out only if there is a volumetric compression deformation of the collapsible pellet.

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The theoretical model of the rotating plast was built, considering the shape of the cross-section, which changes due to the deformation of its edges. In this case, the kinematic model of the rotation of the compression plast was adopted. To theoretically see the model of the rotating plast, only the non-compression part of it was adopted.

Proposes a model of an incompressible parallelogram. This model is implemented only in linear constructions of plugs. The main disadvantage of this plug is that its first body works in closed enclosure conditions. In addition, the linear plug has a higher metal volume than the frontal plug.

The working surfaces of the bodies and joints, Y.Lobachevsky [42], do not provide symmetrical rotation or deformation of the slab. This, in turn, leads to increased energy consumption in flat plowing and negatively affects the reliability of the tillage process.

The results of the above research show that the creation of angle cutters and the justification of their parameters, which ensure the formation of a semi-open edge during the operation of the front plug, is an important topical issue.

Selu's research is the rationale for the technology of turning a polygonal seam under conditions of non-blocking cutting.

2 Methods

When machined with front plows, the edges of the sheet are deformed by rotating 180º at the boundary of its edge, i.e., their edges touch and compress each other. When the angle plug is installed on the front plug, the shape of the blade changes. Its shape is non-rectangular, with the edges cut at a certain angle - hexagonal (Fig. 1). We assume the soil cut with an angle grinder is spread evenly over the slab. The rotation of the resulting hexagon AB_1CDE_1F at the boundary of its axis is radically different from the rotation of a rectangular quadrilateral.

Determine the dimensions of the hexagonal plate AB_1CDE_1F and the coordinates of the center of gravity. The right and left edges of a rectangular slab with angles are cut at depth a_b and width b_p and then spread evenly over the slab, increasing its height by h_3.

Since the resulting hexagonal plate AB_1CDE_1F is symmetrical, its coordinate of the center of gravity on the X-axis is.

$$X_0 = \frac{1}{2} b_p \tag{1}$$

To determine the coordinate of the center of gravity Z_0 of the hexagonal plate AB_1CDE_1F on the Z axis, we divide its surface into two parts: a rectangular rectangle AB_1E_1F and a trapezoid B_1CDE_1.

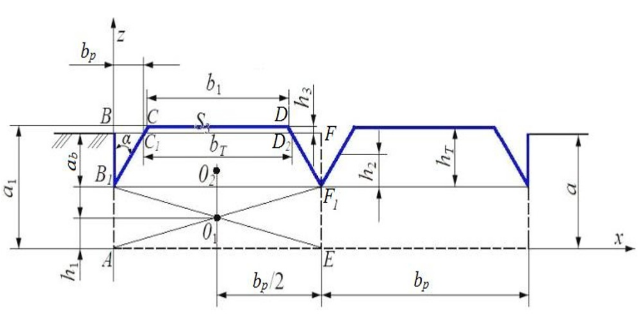

Fig. 1. Scheme for determining dimensions of pelvis and the coordinates of center of gravity

Determine the coordinate of the center of gravity Z_0 on the Z axis of AB_1CDE_1F by the following formula:

$$Z_0 = \frac{Z_1 S_1 + Z_2 S_2}{S}, \quad (2)$$

where Z_1, Z_2 are the coordinates of the centers of gravity of the rectangle AB_1E_1F and trapezoid B_1CDE_1 on the Z axis, respectively, cm; S_1, S_2 are surface of rectangular AB_1E_1F and trapezoidal B_1CDE_1, respectively, cm^2; S_r is the surface area of the AB_1CDE_1F plate, cm^2.

From Figure 1, we determine the coordinates and surfaces of the center of gravity of the rectangle AB_1E_1F and trapezoid B_1CDE_1 on the Z-axis.

$$Z_1 = \frac{1}{2}(a - a_b) \quad (3)$$

$$Z_2 = (a - a_b) + h_2 = (a - a_b) + \frac{(b_1 + 2b_p)h_T}{3(b_1 + b_p)} \quad (4)$$

$$S_1 = b_p (a - a_b) \quad (5)$$

$$S_2 = \frac{1}{2}(b_p + b_1)h_T \quad (6)$$

where b_1 and h_T are the width of the upper part of the trapezoid B_1CDE_1 and its height, respectively, cm.
From Figure 1.

$$b_1 = b_T - \frac{2a_b h_3}{b_b} \quad (7)$$

In that case

$$Z_2 = (a - a_b) + \frac{(b_1 + 2b_p)h_T}{3(b_1 + b_p)} \quad (8)$$

The height of the trapezoid B_1CDE_1

$$h_T = a_b + h_3 \quad (9)$$

where h_3 is the height of the trapezoid C_1CDD_1.
Substituting the value of b_1 (7) into expression (6), we obtain:

$$S_2 = (b_p + b_p - \frac{a_b h_3}{b_b})h_T. \quad (10)$$

Since the soil cut by the angle cutters is assumed to be evenly distributed over the slab, the surfaces S_3 and S_4 of the triangles B_1BC_1 and E_1ED_1 are equal to the surface of the trapezoid C_1CDD_1 i.e.,

$$S_3 + S_4 = S_5, \tag{11}$$

$$S_3 = S_4 = \frac{1}{2} a_b b_b \tag{12}$$

$$S_5 = \frac{(b_T + b_1)}{2} h_3 = \frac{(b_p - 2b_b + b_1)}{2} h_3. \tag{13}$$

To simplify the calculations, we assume that b_1 is equal to b_T. Then we set the values of S_3, S_4, and S_5 to (11) by expressions (12) and (13), and after certain modifications, we obtain the following expression to determine h_3.

$$h_3 = \frac{a_b b_b}{b_p - 2b_b} \tag{14}$$

Substituting the value of h_3 (14) into the expression (9), we obtain:

$$h_T = a_b + \frac{a_b b_b}{b_p - 2b_b}. \tag{15}$$

Substituting the values of h_3 and h_T into expressions (10) for expressions (14) and (15), we obtain:

$$S_2 = (b_p + b_b - \frac{a_b{}^2}{b_p - 2b_b})(a_b + \frac{a_b b_b}{b_p - 2b_b}). \tag{16}$$

AB_1CDE_1F is the total surface area of the slab

$$S_r = S_1 + S_2 \tag{17}$$

Substituting the values of S_1 and S_2 into expressions (5) and (16), we obtain:

$$S = b_p(a - a_b) + (b_p + b_b - \frac{a_b{}^2}{b_p - 2b_b})(a_b + \frac{a_b b_b}{b_p - 2b_b}). \tag{18}$$

Substituting the values of Z_1, Z_2, S_1, S_2, and S_p into (2) for expressions (3), (8), (5), (16), and (17), we obtain the following expression to determine Z_0.

$$Z_0 = \frac{\frac{1}{2}(a-a_b)^2 b_p + Z_2(b_p + b_b - \frac{a_b^{\ 2}}{b_p - 2b_b})(a_b + \frac{a_b b_b}{b_p - 2b_b})}{b_p(a-a_b) + (b_p + b_b - \frac{a_b^{\ 2}}{b_p - 2b_b})(a_b + \frac{a_b b_b}{b_p - 2b_b})} \quad (19)$$

$$Z_2 = (a-a_b) + \frac{(b_1 + 2b_p)h_T}{3(b_1 + b_p)} \quad (20)$$

$$b_1 = b_T - \frac{2a_b h_3}{b_b} \quad (21)$$

We determine the displacement of the center of gravity of the rod AB_1CDE_1F along the Z-axis by the following expression

$$e = Z_o - Z_T, \quad (22)$$

where Z_T, Z_o are the coordinates of the rectangle and the polygon on the Z-axis.
We can subtract the values of Z_T and Z_o from (19) to (20)

$$e = \frac{\frac{1}{2}(a-a_b)^2 b_p + Z_2(b_p + b_b - \frac{a_b^{\ 2}}{b_p - 2b_b})(a_b + \frac{a_b b_b}{b_p - 2b_b})}{b_p(a-a_b) + (b_p + b_b - \frac{a_b^{\ 2}}{b_p - 2b_b})(a_b + \frac{a_b b_b}{b_p - 2b_b})} - \frac{a}{2} \quad (23)$$

(23) shows that the displacement of the center of gravity along the Z-axis varies with the dimensions of the axis and its cut edge.

3 Results and discussion

The graph of the center displacement of gravity on the beam along the Z-axis depends on the width of the beam b_b and the width of the edge cut by the angle cutter bb in Fig. 2.

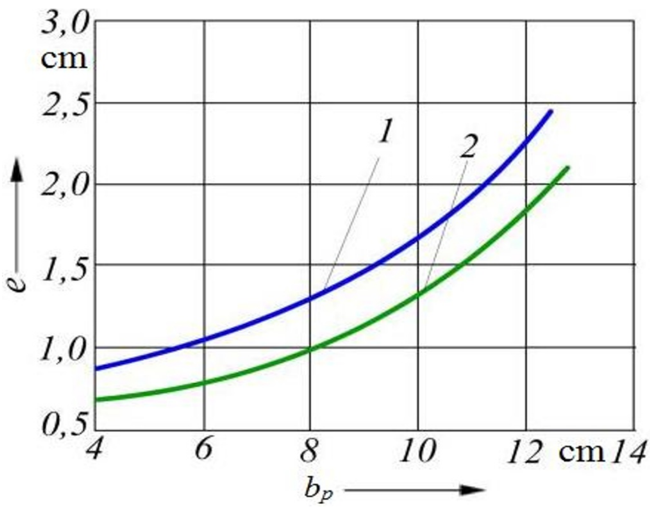

Fig. 2. Graph of center displacement of gravity on beam along Z-axis (e) depending on the width of the cut edge of the beam (b_b): 1 – b_p = 52, cm; 2 – b_b = 45 cm.

(23) Calculations and graphs show that when the width of the slab is 45 and 52.5 cm, the displacement of the center of gravity of the slab along the Z axis, respectively, is the width of the cut edge of the slab increases sharply according to the laws of the sunken parabola.

However, in both cases, the b_b values range from 4 to 10 cm and range from 0.59 to 1.56 cm. Therefore, the coordinates of the center of rotation of a polygonal sphere can be assumed to be equal to the coordinates of the center of gravity of a rectangular sphere.

4 Conclusion

Analytical dependencies have been obtained to determine the coordinate of the center of gravity of the reservoir and the displacement of its center of gravity along the ordinate axis. It has been established that the displacement of the gravity center of the seam along the ordinate with a seam width of 45-52.5 cm and an angle capture width of 4-10 cm is 4-10 cm.

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