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ANALYSIS OF WORKS DEVOTED TO THE STUDY OF THE SHAPE OF THE TRANSVERSE PROFILE OF THE WORKING BODIES OF THE MOLDBOARD TYPE

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ABSTRACT

The article is devoted to the analysis of works devoted to the study of the shape of the transverse profile of earth-moving machines, in particular, bulldozers. On the basis of the in-depth analysis of studies devoted to the substantiation of the basic parameters concerning the shape of the cross profile the conclusion is made that, despite the numerous works on the substantiation of the basic parameters of the blade, the issues of influence of the shape of the cross profile of the blade on the energy intensity of digging the ground are insufficiently considered.

Keywords: dozer blade, working body, transverse profile, curvature radius.

INTRODUCTION

Bulldozers of the nonrotating and rotating types are the most common types of earthmoving equipment. The bulldozer blade digging process is as follows:

-The soil shavings separating from the massif move upwards along the moldboard surface, then collapse down the slope of the formed soil prism (this is typical for cohesive soils);

- The soil chips separating from the massif are directed inside the prism thickness, thus increasing it (this process is typical for low-cohesive soils).

In addition to physical and mechanical properties of soil, the size of the prism, the geometry of the shape of the profile of the blade has a significant influence on the nature of the digging process. Therefore, the study of the shape of the transverse profile of the blade are devoted to the works of many scientists.

The main parameters of the bulldozer's non-swiveling blade are: blade width B, blade height H, cutting angle α (angle between blade plane and horizontal), blade slope angle ε (angle between the line connecting the cutting edge of blade and the upper blade surface), tipping angle δ, length of straight section l (blade height), radius of blade cylindrical surface R (Fig.1.).

Experimental studies performed by A.I. Anokhin [1] can be referred to the study of the optimal shape of the blade working surface.

He recommended the shape of dozer blade profile with flat bottom part, considering that deformation of chips in this case will be the least.

Foreign researches on this issue include the works of G. Kühn and G. Dress.

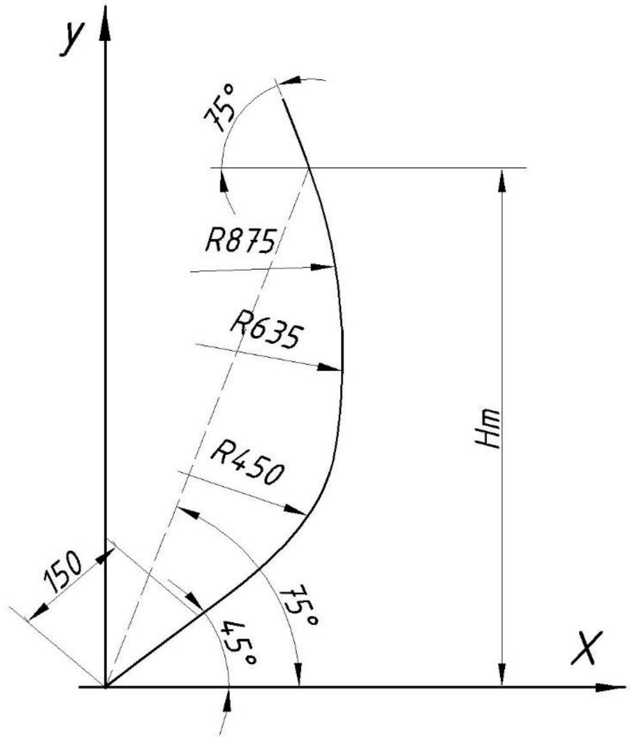

Fig.1.Parameters of the bulldozer blade profile

G. Kuhn [2] conducted experimental research with different blade profiles. He believes that the shape of the bulldozer blade should provide the maximum possible filling with the soil with minimal resistance to filling. In Kühn's research, soil was treated as a highly viscous fluid. Therefore, the profile of the dozer blade should be parabolic, so that the soil flow does not break away from the surface, and the surface itself should have a smoother shape. The type of curvature of the blade, especially at the top, has a significant influence.

G. Kuhn recommends the following values of parameters of the profile of the non-reversible moldboard 6; the angle of tilt in the range of - 0-50; the optimum cutting angle of 30-55^0.

From the researches of G. Dress [3] follows, that the rational form of the dozer blade profile is an involute of a circle with smoothly decreasing curvature in the direction of the top edge and with more curvature at the bottom. This profile will have the lowest coefficient of friction between the ground and the blade surface material.

In the work of A.M. Zavyalov [4] it is proved that less energy-consuming in comparison with the traditional profile of a nonrotating dozer blade is a profile, which is a section of a logarithmic spiral, given in polar coordinates by the equation

$$r = me^{k\varphi}, \qquad (1)$$

where $0 \le \varphi \le \varphi_k$, m,k - parameters depending on the dump height and physical and mechanical properties of the soil.

The purpose of the experimental research of D.I. Fedorov and I.A. Nedorezov [5] was to determine the optimal shapes of scoop dumps having the minimum number of kinks (in the plan), which eliminates the interaction between the soil flows rising on the surfaces of the dump. Such a moldboard consists of two side sections set obliquely in the plan and the middle section between them, moving in the vertical plane and eliminating jamming of soil flows and sticking of the moldboard (Fig.2).

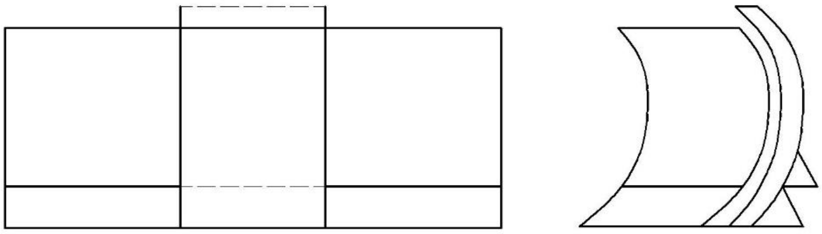

Fig.2.Rational constructive form of a shovel blade

The profile of the blade sections is made on an arc of a circle, the radius of which can be determined by the formula

$$r = \frac{H_0}{(\sin\delta + \cos\alpha)}, \qquad (2)$$

where H_0- height of the curvilinear part of the blade; $\omega = \pi/2 - \alpha + \delta$- central angle of the profile; α- cutting angle; δ- angle of the blade tipping.

Studies of the bulldozer's nonrotating blade were carried out by A.A. Yarkin [6]. From the point of view of ensuring minimum energy intensity of digging at the largest volume of the accumulated soil optimal for bulldozers of general purpose A.A. Yarkin recommends the following values of profile parameters: slope angle- $\varepsilon = 75^0$; roll angle-$\beta_0 = 75^0$; cutting angle-$\gamma_0 = 55^0$; radius of curvature of dozer blade-R=0.99H(Fig.3 .)

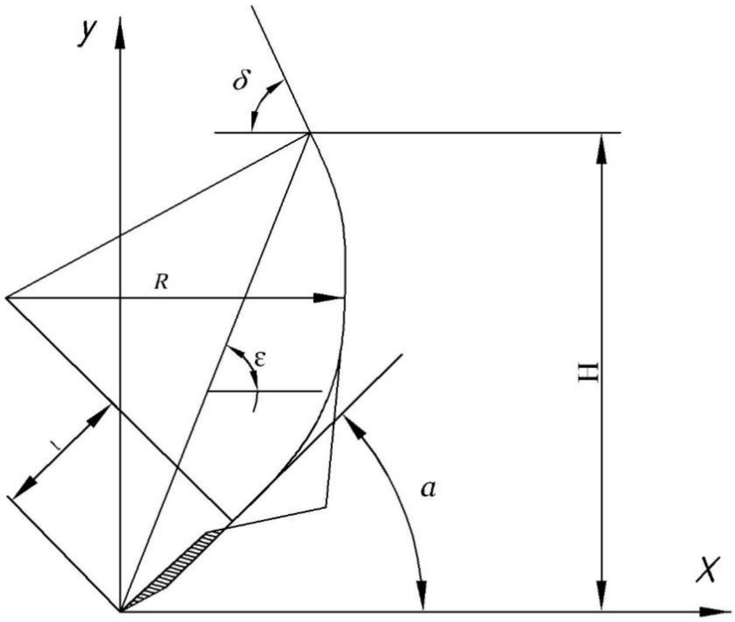

Fig.3. Profile of the blade recommended in the works of A.A. Yarkin.

V.I. Balovnev [7] proposes to calculate the basic parameters of dozer blades on the basis of the statics of a loose medium possessing traction. He notes that the blade curvature radius must satisfy the following ratio

$$R \geq (0.9 \div 1.1)H, \qquad (3)$$

where H is the height of the working body's moldboard, m.

In this case, the influence of curvature on the horizontal component of the resistance to digging decreases. Also, V.I. Balovnev comes to the conclusion that the influence of curvature falls with decreasing blade height.

In the Moscow automobile and road institute under the direction of I.A. Nedorezov [1], there were conducted researches of mouldboards with the purpose of definition of their optimum profile and an optimum angle of installation in the plan.

During experimental studies the values of resistance to cutting the soil, movement of the drag prism and movement of chips on the moldboard under the drag prism for moldboards of three different types were determined (Fig.4.)

1) with a constant radius of curvature;

2) with a variable radius of curvature with greater curvature at the bottom;

3) with a variable radius of curvature with greater curvature at the top.

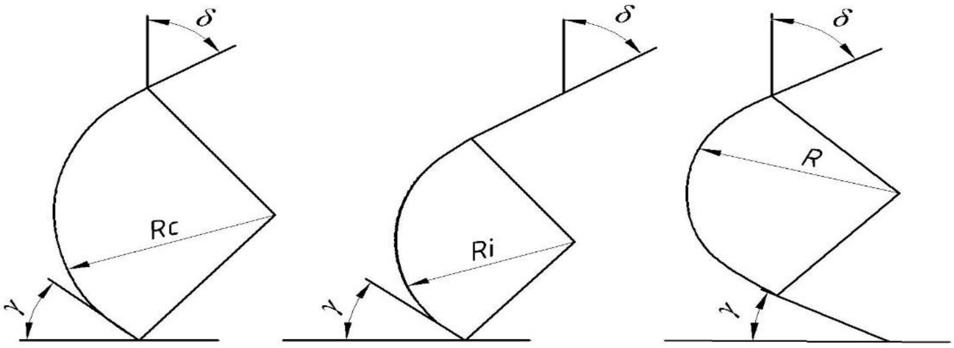

Fig.4. Shapes of experimental dumps profiles

Experimental dumps had the same height, length and equal tipping angles δ with equal cutting angles γ.

All experiments were conducted on dusty soil with a density of 1.75 g/cm^3 and humidity of 18-22%. For the given type of the ground at a constant thickness of the cut chips, resistance to cutting depends only on angles of capture and cutting, and resistance to movement of a dragging prism and movement of chips on the blade depend on the radius of curvature and height of the blade.

On the basis of the carried out research it is possible to draw the following conclusions:

1. The optimal profile of the rotary motor grader and universal dozer blade is a profile with a constant radius of curvature.

2. The optimal profile for the bulldozer blade is one with a variable radius of curvature with more curvature at the bottom.

LITERATURE USED

1. 1.Болдовская Т.Е. Обоснование рациональной формы поперечного профиля неповоротного отвала бульозера: Дис. ... кандю.техн.наук. Омск, 2006-152 с.
2. 2.Kuhn G. Form der Sehelde vou Planier raupen rum Erzielen madliechst kleiner Fullurderstande// V.D.Y.Bd.96,№29.1994.
3. Завьялов А.М.. Исследование рабочего процесса бульдозерного скрепера: Дис. ... кандю.техн.наук. Омск, 1980-252 с.

4. Dress G.Untersungen uber das Kraftespielen Flachbagger-Ychneld-werzeugen in Mitelsand und Ychwahindien, Sandigem Ychuff.Baumaschine und Bau-Rechnichnick,1997,№2.
5. 5.Недорезов И.А., Федоров Д.И. Исследование и создание новқх вқсокоэффективнқх совковқх отвалов для бульдозеров.//Машины для земляных работ.Иып.79.-М.:Транспорт, 1983.-с.93-101.
6. Яркин А.А. Исследование параметров неповоротного отвала бульдозера.//Исследование дорожных машин/ВНИИкоммунмаш-1985.
7. Баловнев В.И. Методика определения основных параметров отвала бульдозеров//Строительное и дорожное машиностроение.-1980.-№1.-с.20-25.