USE OF SOLIDWORKS FOR DETERMINATION OF WORKING DEVICE FOR INSTALLATION AND DISASSEMBLY OF BRAKE DRUMS

Rudyk Oleksandr Yuhymovych
Ph.D., Associate Professors
yuhymovych@gmail.com
Ziabkin Artem Olegovych
undergraduate
ziabkintam@gmail.com
Khmelnytsky National University
Khmelnitsky, Ukraine

Введение./Introductions. The drum system works as follows: the driver, pressing the brake pedal, creates pressure in the working fluid system. Brake fluid "presses" on the pistons of the brake cylinder. Overcoming the force of the coupling springs, the pistons actuate the brake pads, which diverge on the sides, tightly adhering to the working surface of the drum, slowing down the rotation speed of the drum together with the rim [1].

One of the main advantages of these mechanisms is that they are securely closed from any environmental influences. This brake system is ideal for operation in difficult or even extreme conditions [2].

The pads are practically free of dust and moisture, which significantly increases the life of parts. Also in the process of braking, such a system emits less heat. This makes it possible to use cheaper entry-level liquids with a low boiling point.

Another advantage is that the braking force can be increased not only due to the larger diameter of the brake drum, but also due to its width. Thus, the contact spot

of the pad with the surface of the element becomes larger, which significantly improves the braking properties [2].

The brake drum is the main element of the drum brake system. It is affected by drum brake pads in the direct braking process. The stop of the car is caused by the friction of the brake pads on the surface of the brake drum [1].

During use, the drums are subjected to severe mechanical and thermal loads, which can lead to wear and damage. The wear of the working surface of these parts can be uniform or uneven.

In the first case, there is an increase in the diameter of the drum, and the pads are forced to cover a greater distance to the contact with the friction surface. In the second case, the friction surface becomes uneven, furrows appear on it, etc. Also, the inner part of the drum may become oval, which adversely affects the quality of braking. In any situation, the drum requires boring or must be replaced [3, 4].

Цель работы/Aim. The purpose of the work - with the help of SolidWorks to determine the efficiency of the crossbar of the device for mounting and dismounting brake drums.

Материалы и методы/Materials and methods. After a long stay on the axle shaft, the brake drum is difficult to remove due to the presence of its oxidation products (in the axle-drum connection, instead of landing with a gap, an interference is obtained). Therefore, a device for mounting and dismounting the brake drums of trucks [5] has been proposed.

The proposed device (fig. 1) refers to garage equipment. The purpose of its creation is to increase the reliability of holding brake drums, to accelerate and ensure the safety of assembly and dismantling [5].

The device contains a U-shaped frame on wheels with racks, bearing brackets and a puller. In this case, the puller is equipped with a spacer power cylinder installed in the middle of the U-shaped frame (with a rod passing through the gripper to act with the vehicle axle).

The risk of safety violations when using this device is due to jamming of the crossbar 8 (fig. 1). Therefore, it is necessary to anticipate such developments and make the necessary calculations. This formed the purpose of the study: to determine the maximum force that can be applied to the crossbar. At the same time, we started from the allowable safety factor [n] = 2.5 [6, 7].

Результаты и обсуждение./Results and discussion. The CAE / CAD automated SolidWorks complex was used for the study [8, 9]). The application of this program (SolidWorks Simulation) uses a geometric model of the part to form a computational model [6].

During modeling, SolidWorks created a geometric cross-section model, and SolidWorks Simulation assigned the material from which it is made (steel 20L GOST 4543-71), fixed (fig. 2) and set the load area. Two cases were studied: symmetrical load on both rods 5 (fig. 3, a) and skew with a clamp of the right crossbar (fig. 3, b).

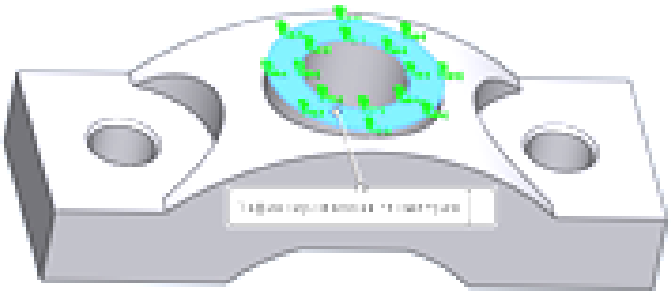
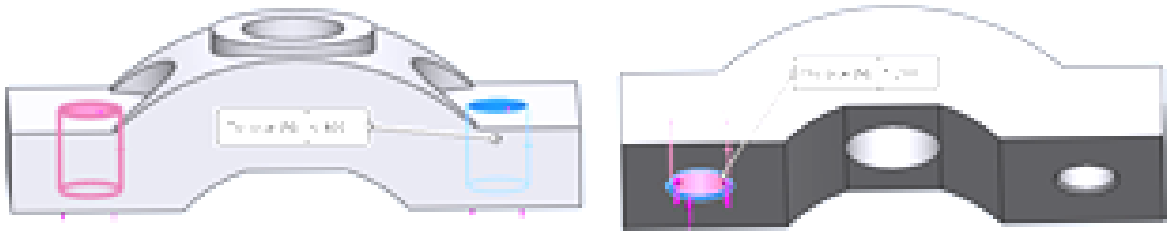


Fig. 2. Fixing in static analysis of the crossbar



a b

Fig. 3. Application of loads in static analysis of the crossbar: a – symmetrical load on both rods; b – skew with a clamp of the right crossbar

The next steps are to determine the contact interactions and create a finite element model of the crossbar (fig. 4).

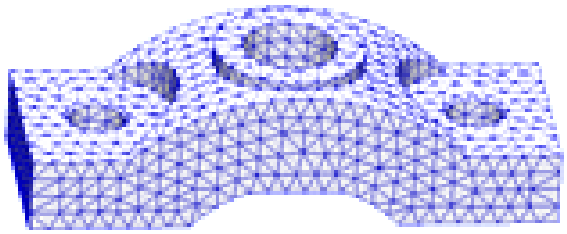
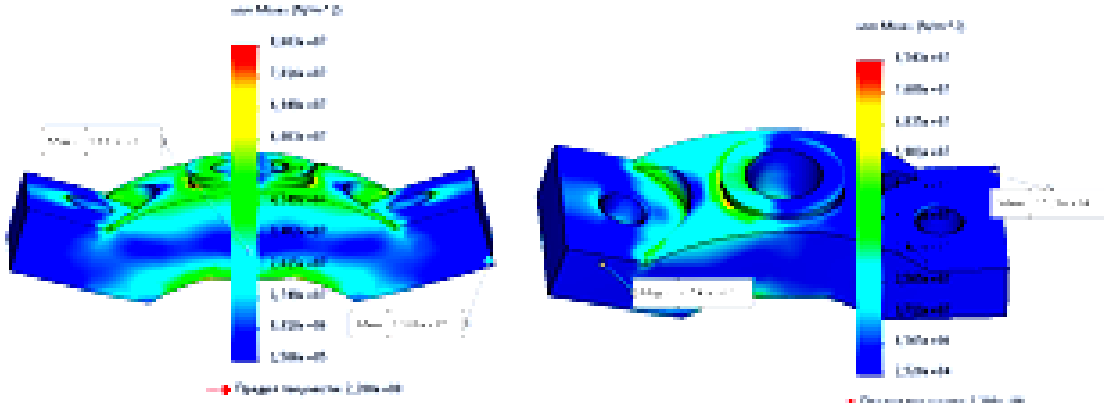


Fig. 4. Parameters of the finite element grid of the crossbar (a) and its reflection on the solid (b)

SolidWorks Simulation software creates algebraic equations based on the connections between elements. They associate the reaction with the property's properties, limitations, and loads. After arranging the equations in a large common system are unknown [6].

The results of static analysis are depicted in the form of a color gradient, which shows the change in color distribution of the calculated parameters: stress fields (fig. 5), displacement, deformation, margin of safety, the limit values of which are given in table. 1.



а б

Fig. 5. The resulting nodal stresses Von Mises crossbars: a – symmetrical load on both rods; b – skew with a clamp of the right rod

Table 1

The results of static analysis of the crossbar at [n] = 2,5

Maximum	Symmetrical load on both rods	Skew with a clamp of the right rod
VON: Tension Von Mises	8,683e+07N/m^2 Node: 13403	8,543e+07N/m^2 Node: 13383
URES: Resulting displacement	4,148e-0 2 mm Node: 357	3,938e-02 mm Node: 401
ESTRN: Equivalent deformation	3,233e-04 Element : 7918	3,035e-04 Element : 3061
Effort	6400 H	5200 H

Выводы/Conclusions. Therefore, for the designed device for installation and dismantling of brake drums the maximum effort on a crossbeam which will not lead to safety violations (at the minimum admissible safety margin [n] = 2,5) will make 5200 N.

Список літератури / List of references

1. Rear brake drums: removal and replacement // Access mode: https://starimpex.ru/razmoe/tormoznoj-baraban.html

2. Rear brake drums: removal and replacement // Access mode: com.ua/transport/zadni-galmivni-barabani-znyattya-i-zamina.html

3. Brake drum: features and tips on operation // Access mode: https://drossel.ua/ua/article/07_2020/340.html

4. Do-it-yourself brake drum repair // Access mode: https://сделано-сам.рф/remont-tormoznyh-barabanov-svoimi-rukami/

5. Device for mounting and dismounting brake drums for trucks // Access mode: https://vmasshtabe.ru/transport/autoservis/stend-dlya-remonta-tormozov.html

6. Rudyk O. Yu. Using SolidWorks to calculate of a tractors bearing puller / O. Yu. Rudyk, M. O. Homich, V. V. Seredyuk // Achievements and prospects of modern scientific research. Abstracts of the 4th International scientific and practical conference. Editorial EDULCP. Buenos Aires, Argentina. 2021. – Pp. 21-27. – URL: https://sci-conf.com.ua/iv-mezhdunarodnaya-nauchno-prakticheskaya-konferentsiya-achievements-and-prospects-of-modern-scientific-research-7-9-marta-2021-goda-buenos-ajres-argentina-arhiv/

7. Rudyk O. Yu. Computer simulation of the electrohydraulic lift with the help SolidWorks Simulation / O. Yu. Rudyk, O. V. Shepilo // The world of science and innovation. Proceedings of the 10th International scientific and practical conference. Cognum Publishing House. London, United Kingdom. 2021. Pp. 160-167. – URL: https://sci-conf.com.ua/x-mezhdunarodnaya-nauchno-prakticheskaya-konferentsiya-the-world-of-science-and-innovation-5-7-maya-2021-goda-london-velikobritaniya-arhiv/

8. Psol S. V. Using SolidWorks to ensure passability of automotive equipment / S. V. Psol, Y. Leshchak, O. Yu. Rudyk // Achievements and prospects of modern scientific research. Abstracts of the 2nd International scientific and practical conference. Editorial EDULCP. – Buenos Aires, Argentina. 2021. – Pp. 140-146. – URL: https://sci-conf.com.ua/ii-mezhdunarodnaya-nauchno-prakticheskaya-konferentsiya-achievements-and-prospects-of-modern-scientific-research-11-13-yanvarya-2021-goda-buenos-ajres-argentina-arhiv/.

9. Rudyk O. Yu. CAD/CAE-systems in the research of motor vehicle details / O. Yu. Rudyk, V. O. Fasolia // Interdisciplinary research: scientific horizons and perspectives: collection of scientific papers «SCIENTIA» with Proceedings of the I International Scientific and Theoretical Conference (Vol. 2), March 12, 2021. – Vilnius, Republic of Lithuania: European Scientific Platform. – Pp. 51-53. – URL: https://ojs.ukrlogos.in.ua/index.php/scientia/issue/view/12.03.2021/471