SIMULATION OF THE STRENGTH OF A FRAME OF A NEW DESIGN ACM GIN MACHINE UNDER THE INFLUENCE OF EXTERNAL FORCES

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https://doi.org/10.5281/zenodo.8197508

Abstract. *The forces acting on the frame of a new design by two saw cylinders are analyzed. Using the values of these forces, simulations of allowable stresses, displacements and deformations were obtained in the Solidworks Simulation program. Based on the results, it has been proven that a frame designed according to this is resistant to external forces.*
Keywords: *frame of a new design, two saw cylinders, resistant, forces, simulations of allowable stresses, displacements, deformations.*

Introduction.

To test the strength of the new genie design, we will test the strength of the new saw cylinder body in the SolidWorks program. We calculate the saw cylinder mass, the weight of the raw material and the torque force.[1] Material density of saw cylinder shaft - $\rho_{steel} = 7800 kg/m^3$

The diameter of the working surface of the saw cylinder shaft – d_{axis}=0.06m

Weight of one saw Gsaw=0.5kg - figure 2.4.1 a)

Gasket weight Gp=0.3 kg Figure 2.4.1 b)

Distance between saws – **Δ,**

The number of saws is -n

Determine the length of the working part of the saw cylinder [2]

$$l = n \cdot \Delta + 2 \cdot \Delta; \;\; mm$$

Determine the volume of the saw cylinder shaft using the following formula:

$$V = S \cdot l = \frac{\pi \cdot d_{axis}^2}{4} \cdot l \; ; \; m^3$$

a)

b)

Figure 1. Determination of the mass of working bodies using scales

a) saw weight b) gasket weight

The weight of the saw cylinder shaft is determined by: [3]

$G_{axis} = \rho_{steel} \cdot V; \ \ kg$

$$G_{axis} = 36{,}5kg$$

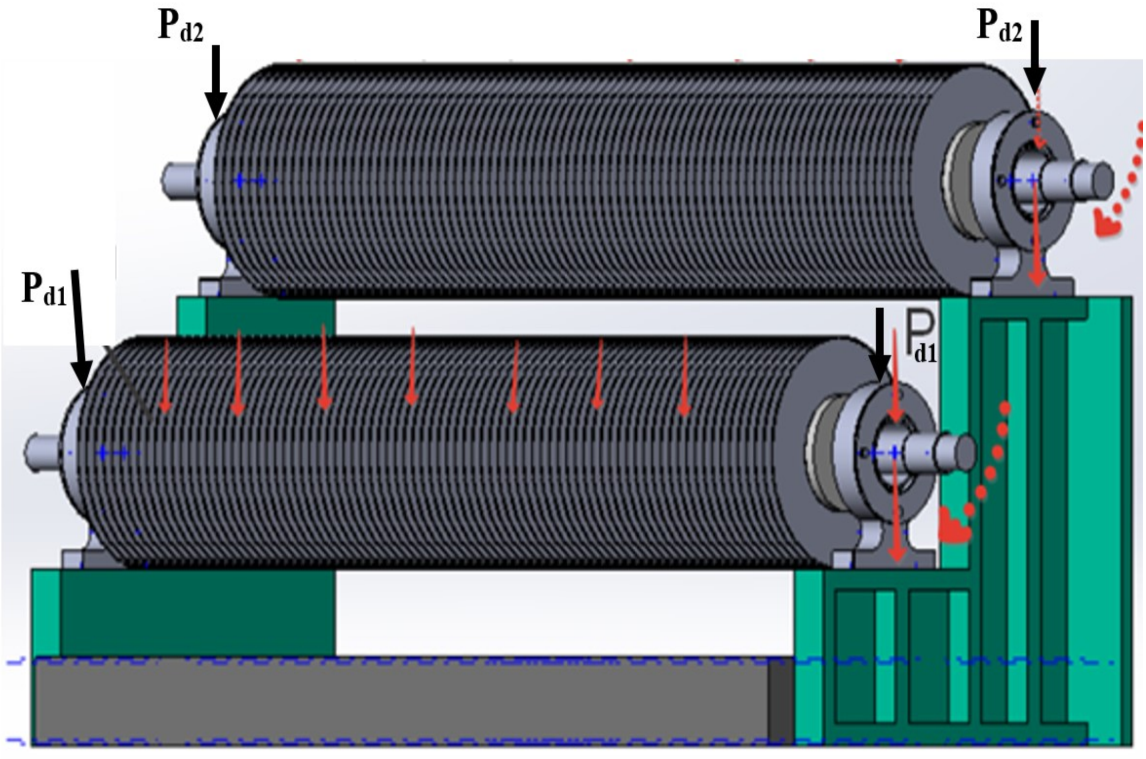

Figure 2. Scheme of the distribution of forces on the frame

The total weight of the saws is determined as follows:

$$G_{\Sigma saw} = n \cdot G_{saw}; \quad (kg)$$

$G_{\Sigma saw} = 90 \cdot 0{,}55 = 49{,}5kg$

The total weight of the gaskets is determined as follows:

$$G_{\Sigma p} = n \cdot G_p; \quad (kg) \quad (5)$$

$G_{\Sigma p} = 91 \cdot 0{,}3 = 27{,}3kg$

The total weight of the saw cylinder is determined as follows: [4]

$$G_{\Sigma} = G_{axis} + G_{saw} + G_p; \quad (kg) \quad (6)$$

Table 1

№	N	Δ l [m]	L [m]	V [m3]	Gaxis [kg]	GΣsaw + GΣp [kg]	GΣ [kg]
1	90	0,018	1,656	0,00468	36,5	76,8	113,3
2	130	0,018	2,838	0,0185	165,11	104	269,11

Methods and research

Given that the density of cotton is 325-340 kg/m3, the diameter of our working gin chamber is 360 mm and the length is 1650 mm. In this case, we determine the volume of the raw roller according to the following formula [5]

$V = \pi r^2 h = 3{,}14 \cdot 18^2 \cdot 165 sm = 167864{,}4\ sm^3$

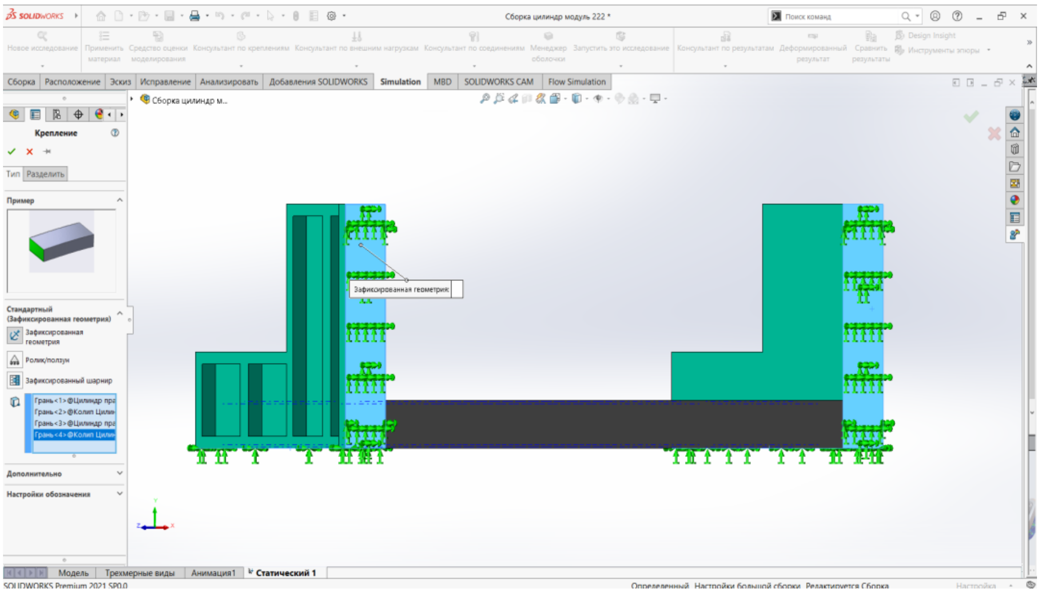

Figure 3. Designation of basic fastening points in the Solid Works program

Then, with a working chamber diameter of 360 mm and a chamber length of 1650, the weight of cotton in the working chamber is 60.43 kg**.**

$m = \rho V = 0{,}00036 \cdot 167864{,}4 = 60{,}43 kg$

Now we find the dynamic coefficient: $K_d = 1 + \sqrt{1 + \frac{2h}{\Delta_{St}}}$;

h-dynamic force is the height affected by this force h=0

Δ_{St} – static deformation

$$K_d = 1 + \sqrt{1 + 0} = 2\,;$$

$$P_{d1} = (m \cdot 0{,}6 + G_\Sigma) \cdot K_d = (60{,}43 \cdot 0{,}6 + 113{,}3) \cdot 2 = 299{,}11 kg$$

$$P_{d2} = (m \cdot 0{,}4 + G_\Sigma) \cdot K_d = (60{,}43 \cdot 0{,}4 + 113{,}3) \cdot 2 = 274{,}94 kg$$

$$P_{mod1} = \frac{P_{d1}}{2} = \frac{299{,}11}{2} = 149{,}542 kg$$

$$P_{mod2} = \frac{P_{d2}}{2} = \frac{274{,}94}{2} = 137{,}47 \text{kg}$$

SCIENCE AND INNOVATION
INTERNATIONAL SCIENTIFIC JOURNAL VOLUME 2 ISSUE 7 JULY 2023
UIF-2022: 8.2 | ISSN: 2181-3337 | SCIENTISTS.UZ

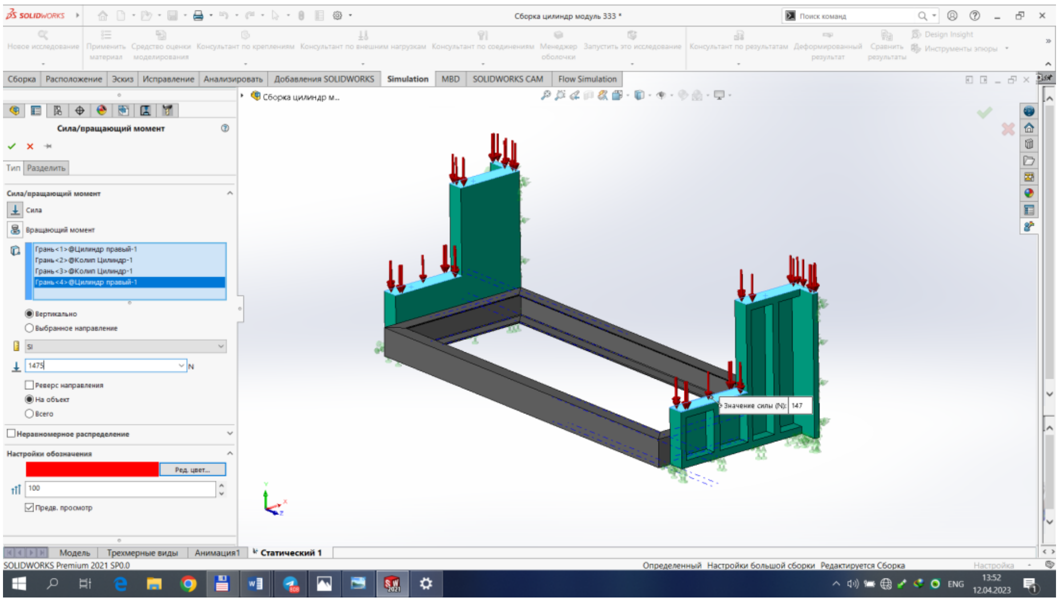

Figure 4. Specifying parameters affecting force in the Solid Works program

Stress is a product of the interaction between its particles when a body is loaded. External forces tend to change the relative positions of particles, while tension opposes the movement of particles. According to the hypothesis of the unity of matter, each particle of the body is covered by many particles with different directions. Particles located at a certain point do not have the same interaction with particles around their axis. That is why the voltages at a certain point are different.[6]

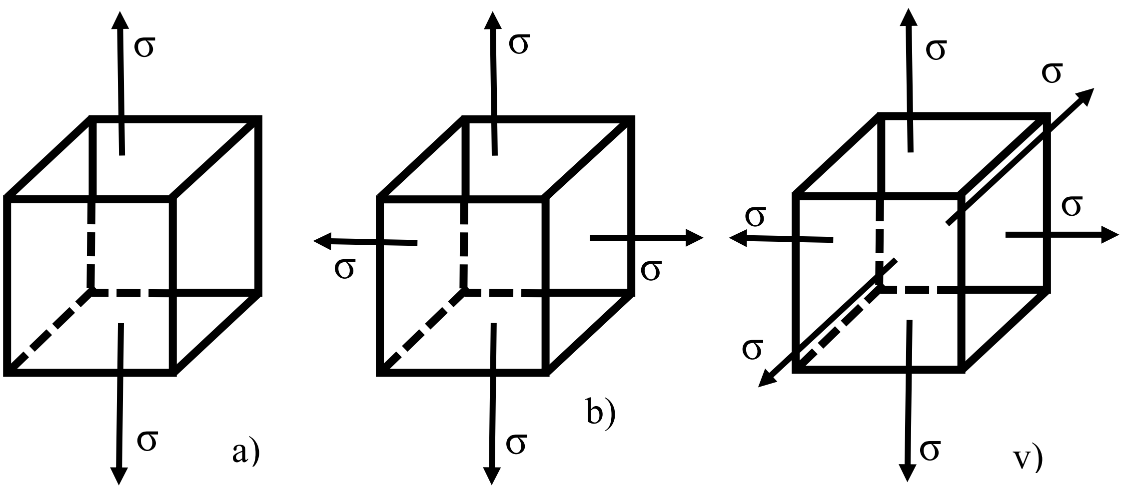

Figure 5. Types of stress force

Results

If the two principal stresses are equal to zero, then the stresses are linear or uniaxial (Fig. 5, a).

If one of the principal stresses is equal to zero, such stresses are considered to be flat or biaxial stresses (Fig. 5, b).

If none of the principal stresses is equal to zero, then such stresses are volumetric or triaxial

(Fig. 5,v).

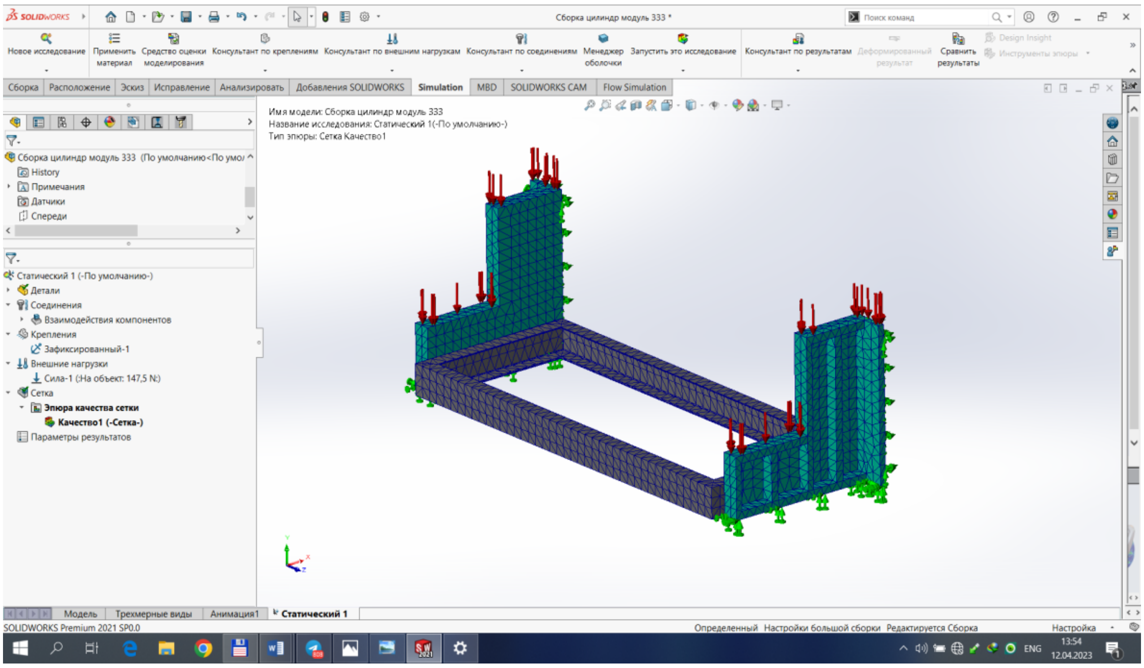

Figure 6. Solid Works meshes the object to determine stresses, strains, and displacements.

So, since our newly designed frame is under bulk stress, we will cover the entire body with a mesh in SolidWorks (Figure 6).

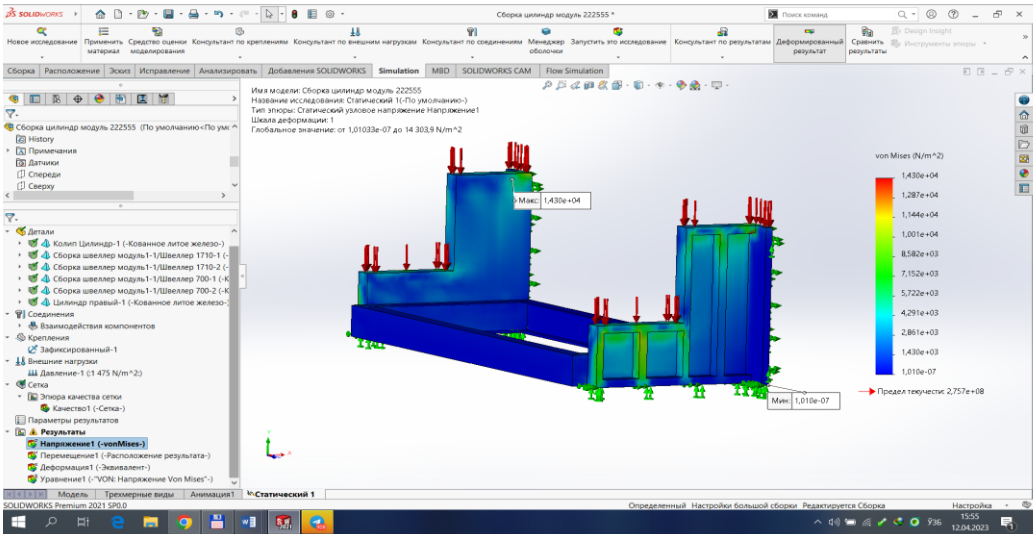

Figure 7. Graph of the distribution of stresses in the structure

As can be seen from the stress distribution graph shown in Figure 7, the maximum stress is 1.430e $^{+4}$ (N/meter^2), taking into account the geometric characteristics of our body, the yield strength, i.e. The allowable stress equal to the material we have chosen is 27.5742e^{+7}(N/meter^2). The strength of the material of our design, compared with the results obtained, has a high level of reliability and is resistant to the forces and loads inherent in our design.

Свойство	Значение	Единицы измерения
Модуль упругости	1.9e+11	Н/м^2
Коэффициент Пуассона	0.27	Не применимо
Модуль сдвига	8.6e+10	Н/м^2
Массовая плотность	7300	кг/м^3
Предел прочности при растяжении	413613000	Н/м^2
Предел прочности при сжатии		Н/м^2
Предел текучести	275742000	Н/м^2
Коэффициент теплового расширения	1.2e-05	/K
Теплопроводность	47	W/(м·K)
Удельная теплоемкость	510	J/(кг·K)
Коэффициент демпфирования материала		Не применимо

Figure 8. Technical specifications of frame material

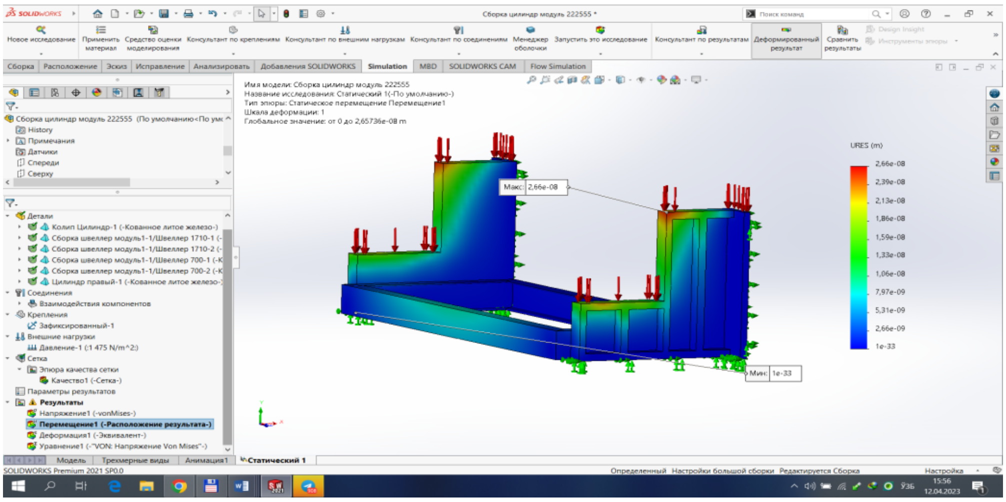

Figure 9. A graph of the displacement distribution in the structure

As can be seen from the displacement modulus distribution graph shown in Figure 9, the maximum displacement modulus value after simulation is equal to 2.66e+8(meter), which is the permissible displacement modulus value for our material, taking into account the geometric characteristics of our body. Since it is equal to 8.6 e+10(N/meter2), we prioritize the forces and loading on our structure, and due to the high value of the modulus of strength of our structure, there are no cases f failure of the case or failure during operation, and vibration is eliminated.

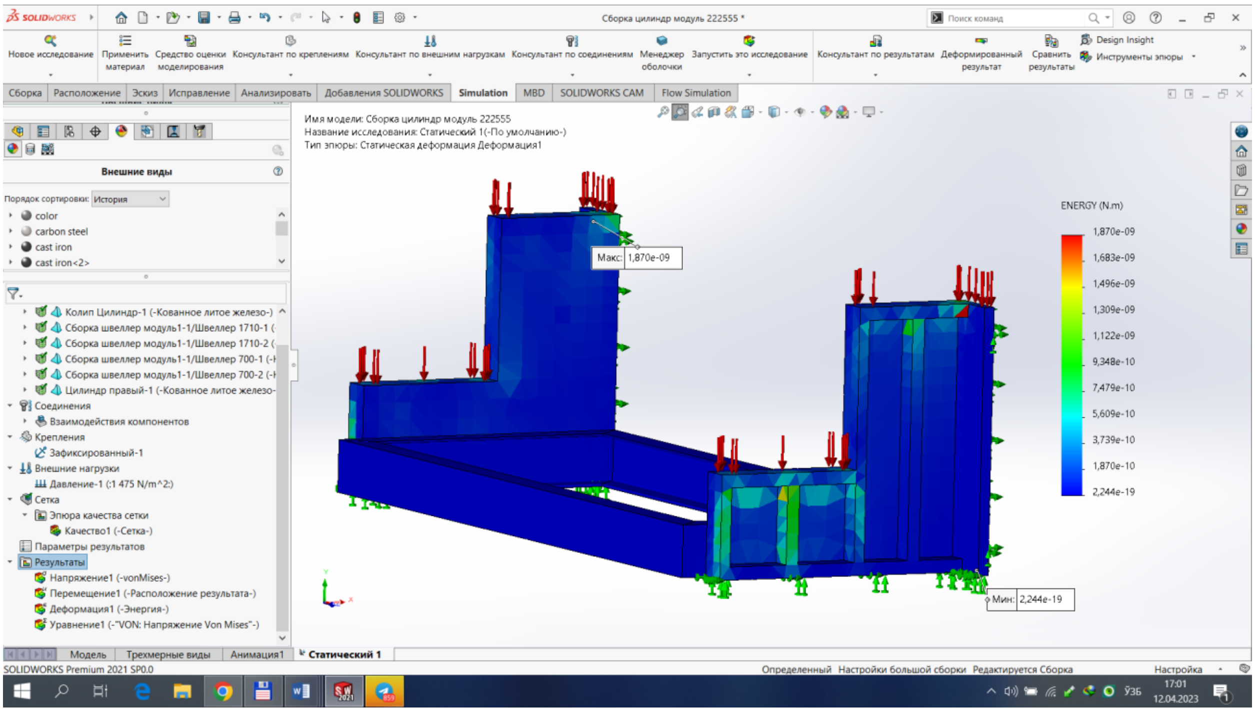

Figure 10. Frame deformation distribution graph

As can be seen from the deformation distribution graph shown in Figure 10, the maximum deformation value after the simulation is equal to 1.870e-9(N meter), so the forces and loading applied to our structure are prioritized and no deformation is observed.

Conclusion

Mounted on a newly designed gin machine, with two saw cylinder supports and a stair-shaped body. The Solidworks simulation program was used to determine the scheme of distribution of the forces acting on the support of the upper saw cylinder and lower saw cylinder on the body of the gin. In comparison with the saw cylinders used in production, the loading condition is reduced by 40% on the lower cylinder and 60% on the upper cylinder. As can be seen from the stress distribution graph, the maximum stress is equal to 1.430e+4(N/meter2) (Fig. 7), taking into account the geometric characteristics of our body, the yield limit, i.e., the permissible stress is 27.5742e+7(N/meter2)) is equal to (Fig. 8), the forces and loads put on our structure will be prioritized. As can be seen from the displacement distribution graph in the structure, the maximum displacement modulus value after simulation is equal to 2.66e+8(meters) (Figure 9), the permissible displacement modulus value for our material, taking into account the geometric characteristics of our body Since it is equal to 8.6 e+10(N/meter2) (Fig. 8), we prioritize the forces and loading on our structure, and because of the large value of the modulus of strength of our structure, there are no cases of hull strain or failure during operation and vibration is eliminated. As it can be seen from the deformation distribution graph, the maximum deformation value after simulation is equal to 1.870e-9(N meters) (Fig. 10), so the limit value of the material chosen for our construction is 4.13613 e+9(N meters). (Fig. 8), the applied forces and loading take priority and the deformation is not observed. applied forces and loading are prioritized and deformation is not observed.

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