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CHECKING DETAILS FOR HEAT AND IMPACT FORCES USING KOMPAS 3D SOFTWARE

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Annotation. We can't imagine today without computers. Especially when it comes to helping people do what they need to do. Computers have become an integral part of human beings because they save human time and precision in the work they do. In addition to many engineering programs, KOMPAS 3D software is one of them. In addition to drawings and 3D design, it is possible to conduct various tests on the details and components created in it. For example, we can perform strength, temperature, compression, elongation, torsion, and other calculations.

Keywords: KOMPAS 3D, consistency, temperature, pressure, test, piston.

Аннотация. Сегодня мы не можем представить себе жизнь без компьютеров. Особенно когда речь идет о помощи людям в выполнении необходимых им задач. Компьютеры стали неотъемлемой частью человеческой жизни, поскольку они экономят время и повышают точность работы. Помимо множества инженерных программ, программное обеспечение KOMPAS 3D является одной из них. Помимо чертежей и 3D-проектирования, в нем можно проводить различные испытания деталей и компонентов, созданных в программе. Например, можно выполнять расчеты прочности, температуры, сжатия, удлинения, кручения и другие.

Ключевые слова: KOMPAS 3D, консистенция, температура, давление, испытание, поршень.

Annotatsiya. Bugungi kunda kompyuterlarsiz tasavvur qila olmaymiz. Ayniqsa, odamlarga kerakli ishlarni bajarishda yordam berish haqida gap ketganda. Kompyuterlar inson vaqtini va bajaradigan ishlarida aniqlikni tejaganligi sababli inson hayotining ajralmas qismiga aylandi. Ko'plab muhandislik dasturlaridan tashqari, KOMPAS 3D dasturi ham ulardan biridir. Chizmalar va 3D dizayndan tashqari, unda yaratilgan detallar va komponentlar bo'yicha turli sinovlarni o'tkazish mumkin. Masalan, biz mustahkamlik, harorat, siqish, cho'zilish, burish va boshqa hisob-kitoblarni amalga oshirishimiz mumkin.

Kalit so'zlar: KOMPAS 3D, konsistentsiya, harorat, bosim, sinov, piston.

INTRODUCTION.

The 21st century is the age of computer-based development and organization of new techniques and technologies. Therefore, the use of computers in engineering

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design, as in all fields, is one of the main tasks of today. Nowadays, three-dimensional computer modeling tools are in the spotlight, and it's no coincidence. Their use allows for high-quality design work, as well as fast, high-quality, high-precision drawings for the user, testing and printing. Experts in each field choose a graphics program that is convenient for their work. The scope of the program will also be focused on a specific area. So, when choosing a graphics program, you must first take into account its capabilities. In this article, the authors demonstrate how to conduct tests using the KOMPAS 3D software. As an example, a piston, which is a basic part of a car engine, was taken and tested for the pressures and temperatures that affect it.

MATERIAL AND METHOD. The function of the piston is to participate in the formation of a closed volume for the combustion chamber and to carry out the working processes inside the cylinder. It also transfers the pressure of the combustion gases to the connecting rod through the piston finger, absorbs the temperature of the combustion gases and transfers them to the cylinder walls through itself and the rings. The piston is not cooled directly by water or air in the cooling system. Instead, it is surrounded by hot parts (cylinder, cylinder head). Therefore, the piston is always under mechanical stress and heat stress. The most important of these is heat stress. Its value varies depending on the use of the engine and the degree of forcing. The piston is selected according to this symbol. The basis for selection is the conditional unit of heat stress - q_p. Its threshold values for different types of pistons are as follows:

-for non-cooled cast iron pistons…… 4,0

- thermal conductivity 120 ... 150 kcal / m.h. For non-cooled, light alloy pistons at ° C ……. 6,0

- for rib-cooled pistons …….. 6,6-6,8

- for oil-spilled cooler ……... 8,0

- for oil-sprinkled cooler ……. 10,0

We know that the maximum temperature and pressure are given to the piston during combustion. As the combustion process approaches the piston upper edge point, a spark is emitted through the ignition spark plug. As a result, the

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combustible mixture, which is ready to heat up, burns, and the pressure inside the cylinder rises to 30 ... 35 kg / cm^2, and the temperature rises to 2300 ... 2500 ° C.[1]

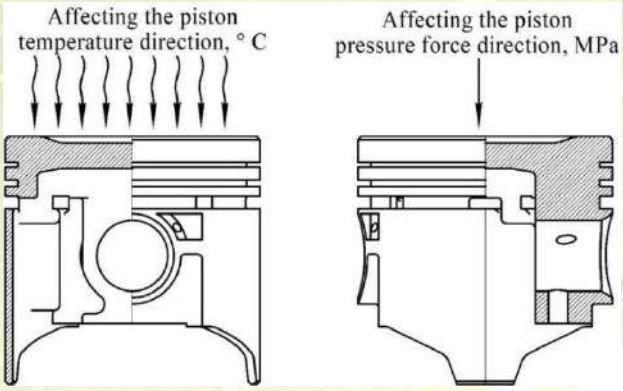


Figure 1. Pressure and temperature directions of the piston and the gases acting on it.

The piston is made of durable aluminum alloy with high thermal conductivity and low coefficient of friction. Aluminum alloys are based on alumina and contain molten copper (6 ... 12%) or silicon (up to 23%). It is 2.6 times lighter than cast iron, has a thermal conductivity of 3 to 4 times, and has good abrasion resistance. [2]

RESULTS AND DISCUSSIONS. We have already considered the values and directions of the pressure and temperature acting on the piston. Now let's look at how to determine and calculate these forces using KOMPAS 3D. To do this, we used the 2018 version of the program KMPAS 3D, developed by the company ASCON of the Russian Federation. It is up to the user to decide which version to use, as the calculation commands are the same for all versions. To get started, we need a computer with KOMPAS 3D software and a 3D view of the piston.

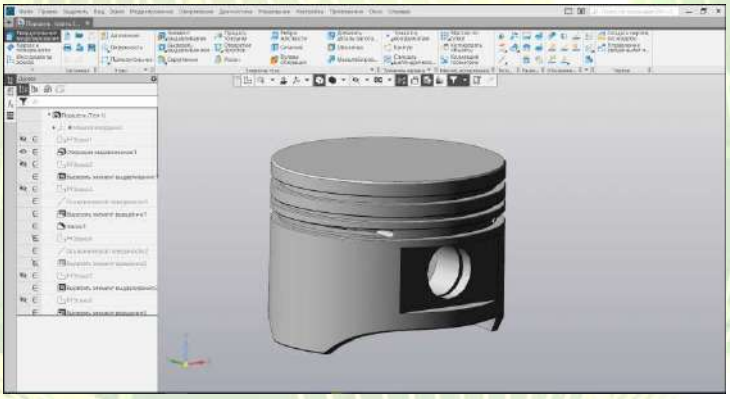


Figure 2. KOMPAS is a car engine piston created in a 3D environment

First of all, we need to choose the material for the created detail. To do this, go to the material section from the details (model of the model) and go to the selection of material from the list (select material from the list). There are many

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different types of materials, such as ferrous metals or non-ferrous metals, and we can choose the aluminum alloy D16 that suits us. (Figure 3)

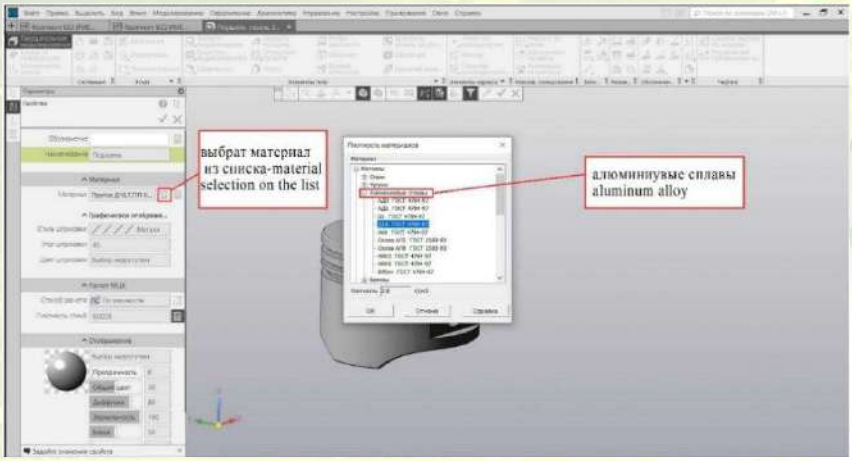


Figure 3. Material Sequence Sequence in KOMPAS 3D

After selecting the material, we check whether the existing KOMPAS program has a section APM FEM to perform calculations. If such a section does not exist, we can create it in this sequence: Приложения »Добавить приложения» APM FEM »открыть. At the end of the practice, it looks like this to us (Figure 4).

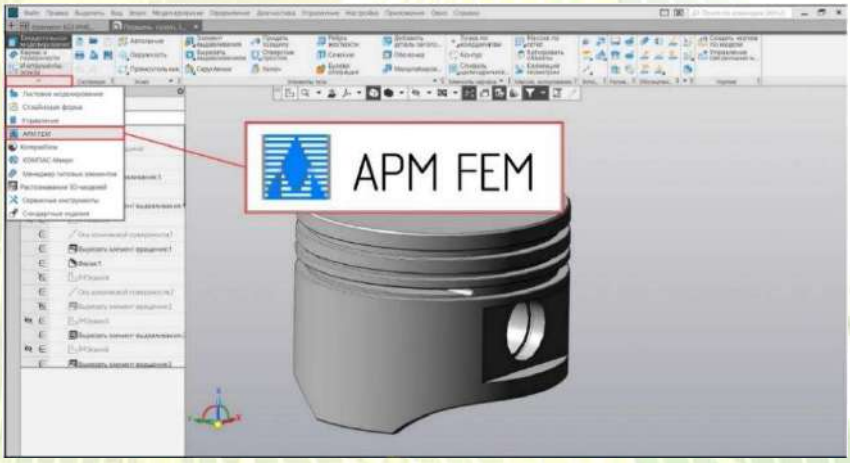


Figure 4. Location of KOMPAS 3D software computing department

By selecting the APM FEM panel, we can view the available commands in it.(Figure5)

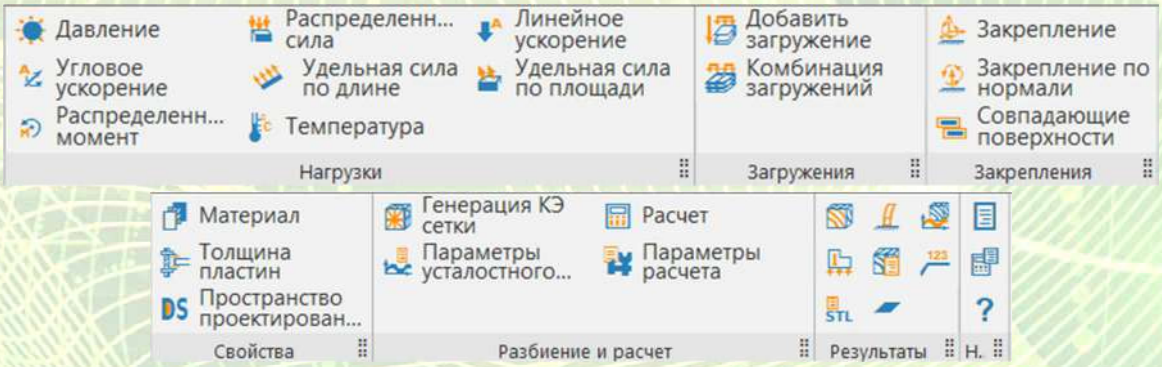


Figure 5. APM FEM panel commands

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From the resulting panel, first select the fastening command (закрепление) and select the fastening part of the piston. As a fastening part of the piston, we can take a hole for plugging the piston finger. Use the mouse to mark the surface of the hole for the piston finger to be plugged, and it will appear to us in red. When we're done, press Enter to save the changes. (Figure 6)



Figure 6. Setting the piston fastener

Once the piston is tightened, we can determine the values and direction of the pressure and temperature acting on it. The highest temperature that affects it is, as mentioned above, during combustion, and its value in gasoline engines is 2500˚C. We enter the same value using the temperature (температура) command, and keep the direction set by the top of the piston. (Figure 7)

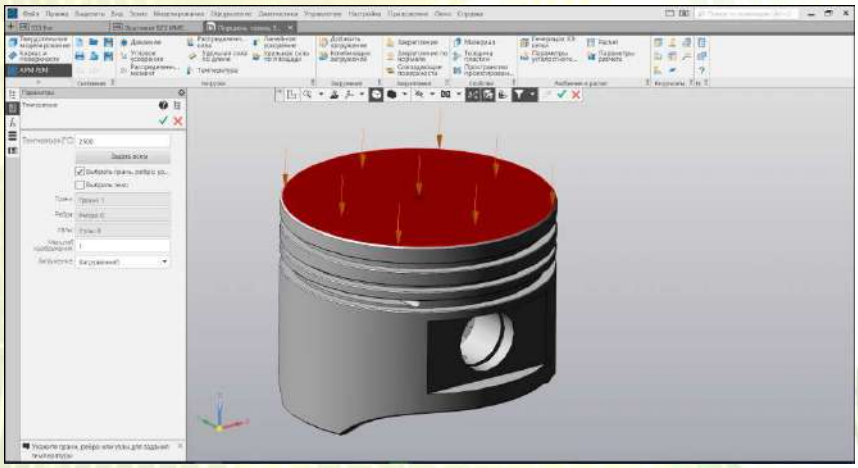


Figure 7. The value and direction of the temperature acting on the piston

The pressure acting on the piston can be applied by the pressure (давление, Fig. 5) command. Its direction is the same as the temperature. The pressure force of the heaviest gases is given to the piston during combustion and its value can reach 30 ... 35 kg / cm^2. We're going to take the largest of these values and change the unit to Newton. 35 kg / cm^2 = 3500 N. Now we enter this value 3500 in the давление part.

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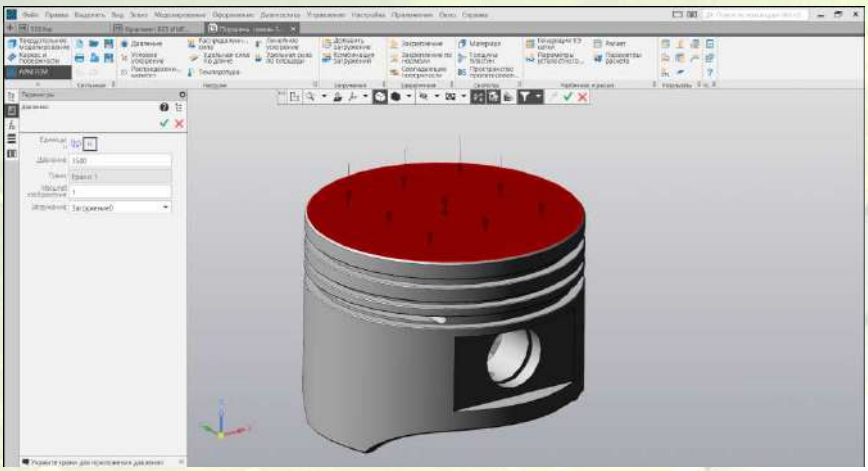


Figure 8. The pressure of the gases acting on the piston

Once we have determined the forces acting on the piston, we can break the piston into smaller pieces using the Generation KE grid (Генерация КЭ сетки) command.

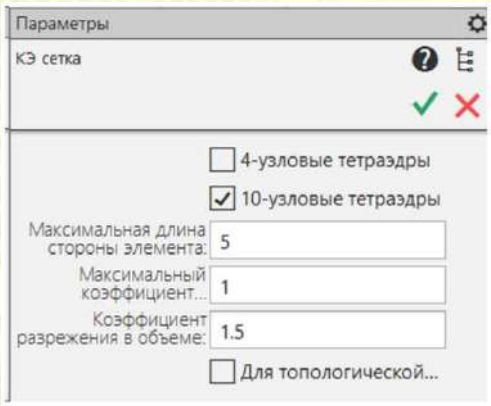


Figure 9. Generation KE grid window

When the command icon is clicked, the following window will appear (Figure 9). In the window, you can enter the value of the maximum length of the side element (Максимальная длина стороны элемента). When entering a value, pay attention to the size of the item you want to calculate. If the detail is large, we need to add a larger value. Maximum coefficient of compaction on the surface (Максимальный коэффициент сгущения на поверхности) and the coefficient of friction on the volume (коэффициент разрежения в объеме) - it is recommended to leave the values of volume reduction unchanged. Then press enter, the process may take some time. When the process is complete, the detail will look like this (Figure 10)

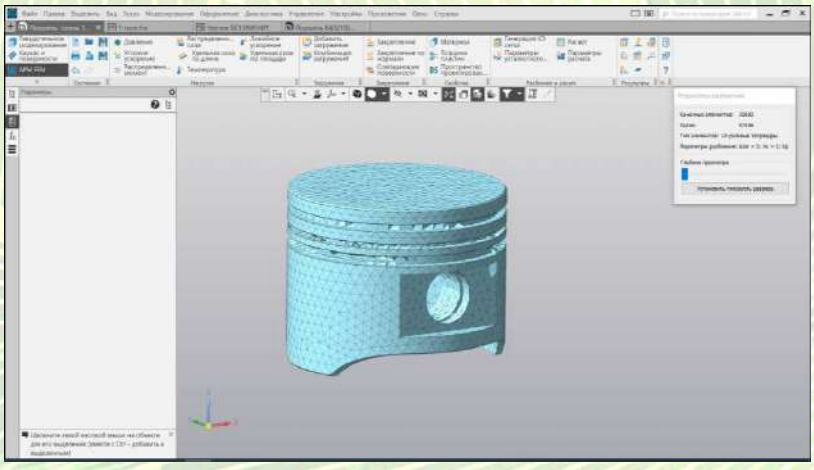
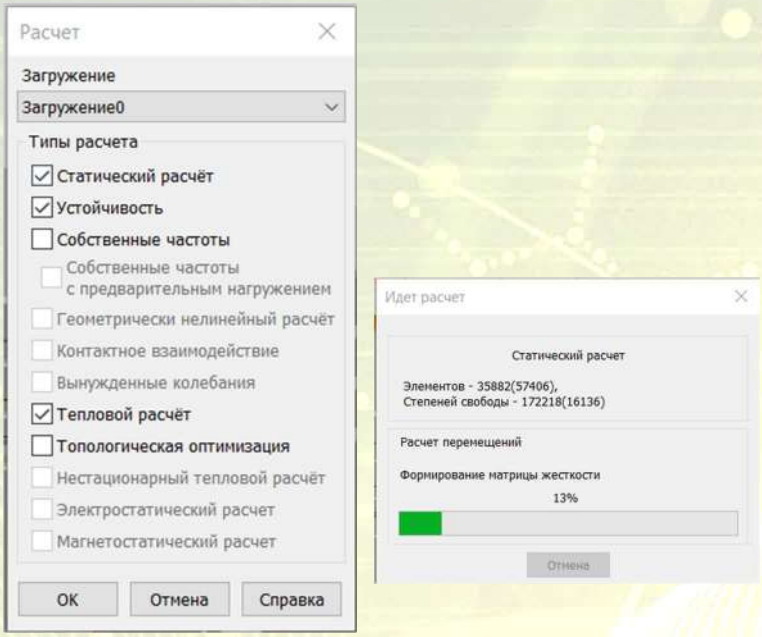


Figure 10. The result of the Генерация КЭ сетки command

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To start the test, go to the Calculation (Расчет) command. The resulting window will select the sections we need. (Figure 11)



From the list of sections shown in the picture, we can select the tests we need. We need to define the static calculation (статический расчёт), Stability (Устойчивость) and temperature calculation (Тепловой расчёт) and click OK. As a result, the calculations begin as shown in Figure 11 (b). This process also takes some time.

a **b**

Figure 11. Calculation (Расчет) command window (a) and start of calculations (b)

When the calculations are completed, you will be able to get the necessary analysis using the card results (карта результатов) command. The results of the analysis are displayed on the screen as follows (Figure 12).

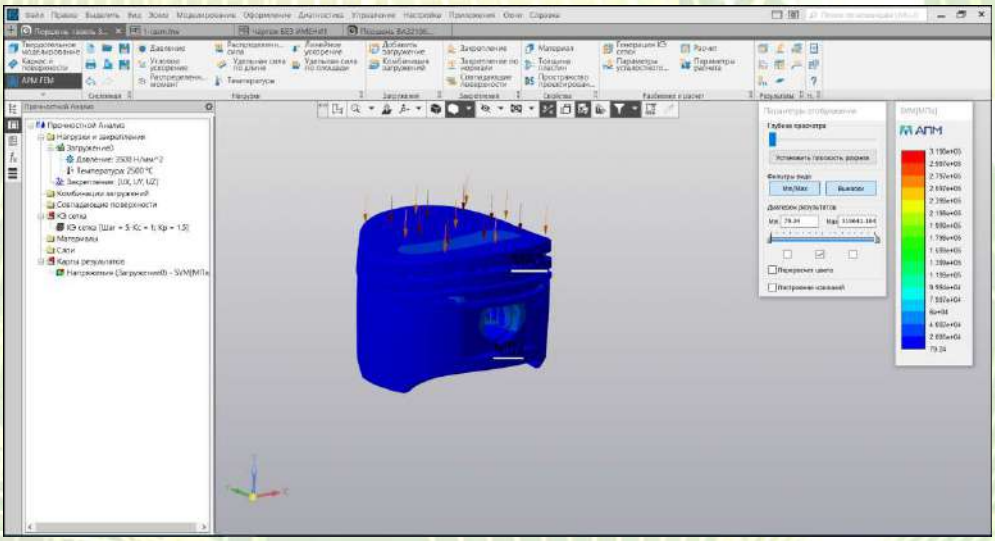


Figure 12. Final test results.

By calculating the piston of a car engine, we also get the maximum and minimum values of the forces acting on it, and we can determine how much more power we can put on it. As you can see in the picture, we can see the level of tension

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through the colors, while the blue colors turn into a safe and red towards the danger zone (Figure 12). The result of our tests is absolutely positive, that is, we can see bruises almost everywhere on the piston.

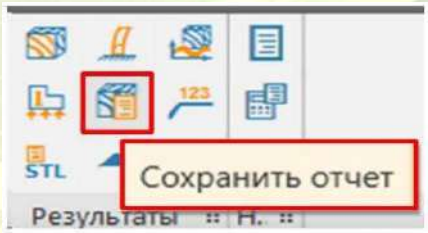


Figure 13. Save the file

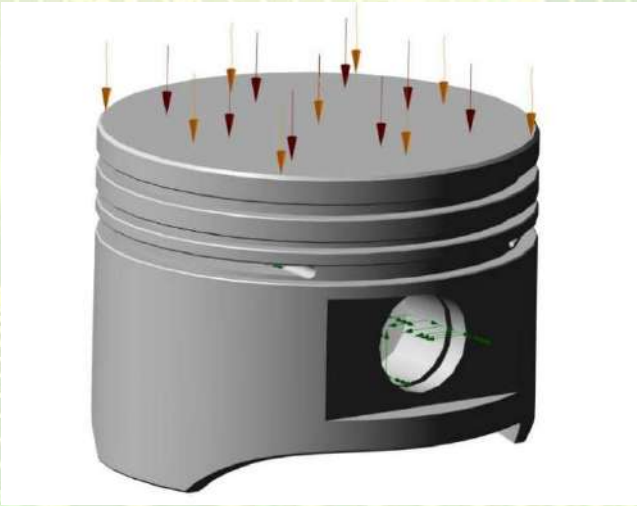
Now we can save the calculations as a file or print them out. To do this, we perform sohranit report-calculations by clicking on the save icon. In the file html version, the results of calculations are stored in Russian.

Project information

Organization	Termez institute of Engineering and technology
author	Jurayev Davron
Report creation date	15.09.2022; 19:52:06
Program used	APM FEM for KOMPAS-3D v18.1 (LLC STC "APM")
The path to the file	D:\TMTI\Maqolalar\Kompas 3D\Поршень 3D.m3d

Content

1. Introduction
2. Model
3. Information about materials
4. Load Information
5. Reinforcement Information
6. Finite element mesh
7. Results
8. Conclusion



3) Information about materials

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N	Part name	Material	Plate thickness [mm]
1	D:\TMTI\Maqolalar\Kompas 3D\Поршень газель 3D.m3d	Д16.Т.ПП КВ50П ГОСТ 21488-97	

Material name**: Д16.Т.ПП КВ50П ГОСТ 21488-97**

Yield strength [MPa]	350	
Modulus of elasticity normal [MPa]	71000	
Poisson's Coefficient	0.33	
Density [kg/m^3]	2800	
Temperature coefficient of linear expansion [1/C]	0.000023	
Thermal conductivity [W/(m*C)]	177	
Compressive strength [MPa]	410	Default
Tensile endurance limit [MPa]	209	Default
Torsional endurance limit [MPa]	139	Default

4) Load Information

Name	Selected objects	Load parameters	Loading
Pressure:	Edges: 1	Value: 3500 H/mm^2	Loading0
Temperature:	Edges: 1	2500 degrees Celsius	Loading0

5) Pinning Information

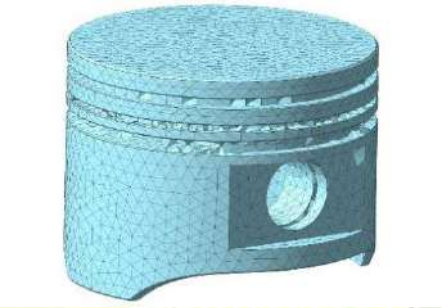
Name	Selected objects	X [mm]	Y [mm]	Z [mm]	Rot. X [deg]	Rot. Y [deg]	Rot. Z [deg]
Fixing:	Edges: 4	Prohibited	Prohibited	Prohibited	-	-	-

6) Finite element mesh

Partitioning parameters and results

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Name	Meaning
Item type	10-knot tetrahedra
Maximum element side length [mm]	5
Maximum thickening factor on the surface	1
Dilution coefficient in the volume	1.5
Number of Finite Elements	35882
Number of nodes	57406



7) Results

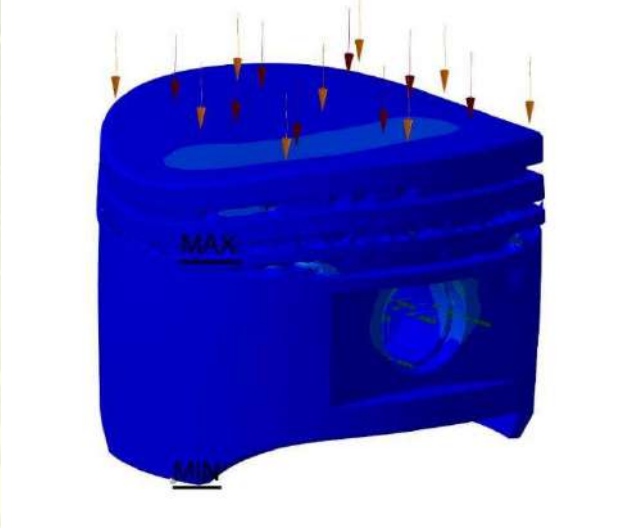
Static calculation results

Инерционные характеристики модели

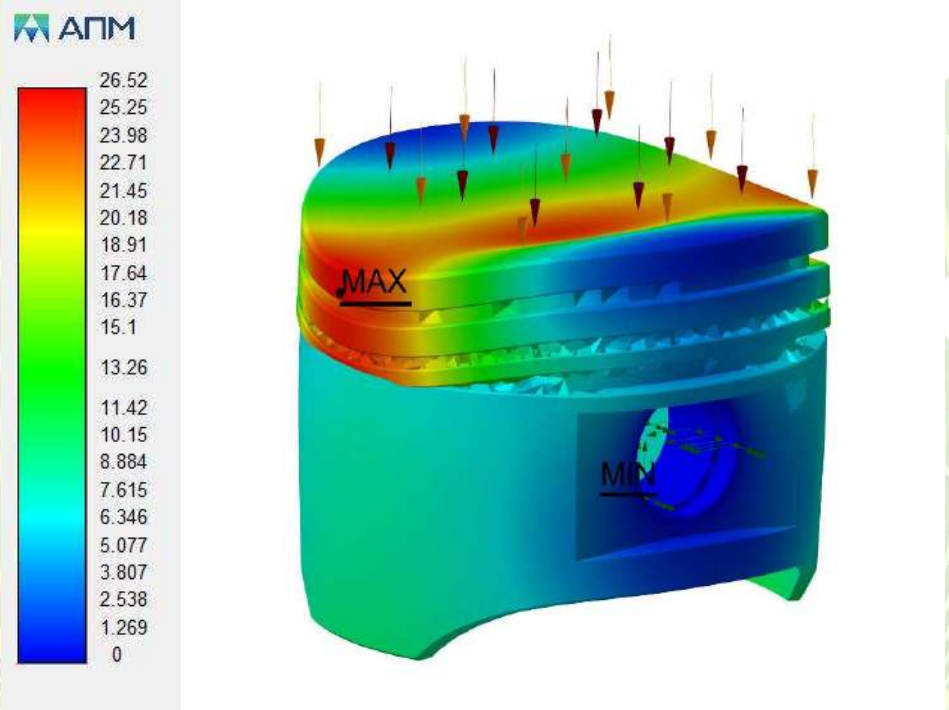
Name	Meaning
Model weight [kg]	0.556478
Model center of gravity [m]	(-0.000011 ; -0.000009 ; -0.024359)
Moments of inertia of the model relative to the center of mass [kg*m^2]	(0.000566 ; 0.000548 ; 0.000729)
Reaction moment relative to the center of mass [N*m]	(-408.919736 ; 1003.269917 ; 712.445253)
Total reaction of supports [N]	(-84774.060621 ; -37646.472423 ; 22508417.077715)
Absolute reaction value [N]	22508608.203143
Absolute torque value [Nm]	1296.66654

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Name	Type	Minimum value	Maximum value
von Mises equivalent voltage	SVM [[MPa]	48.373	315473.874

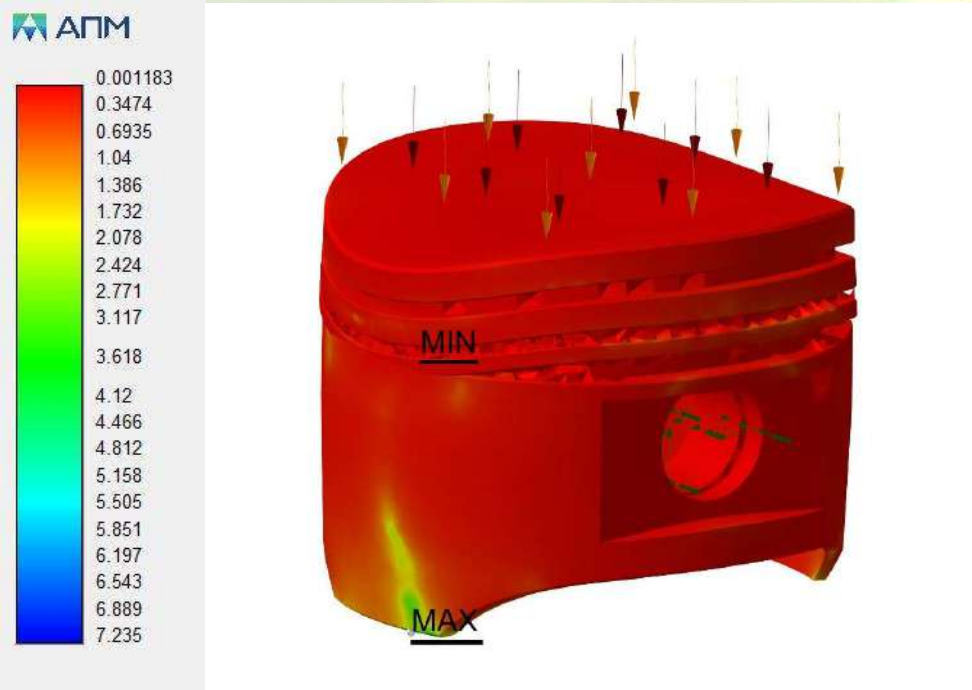


Name	Type	Minimum value	Maximum value
Total linear displacement	USUM [мм]	0	26.522272



Name	Type	Minimum value	Maximum value
Yield safety factor		0.001183	7.235425

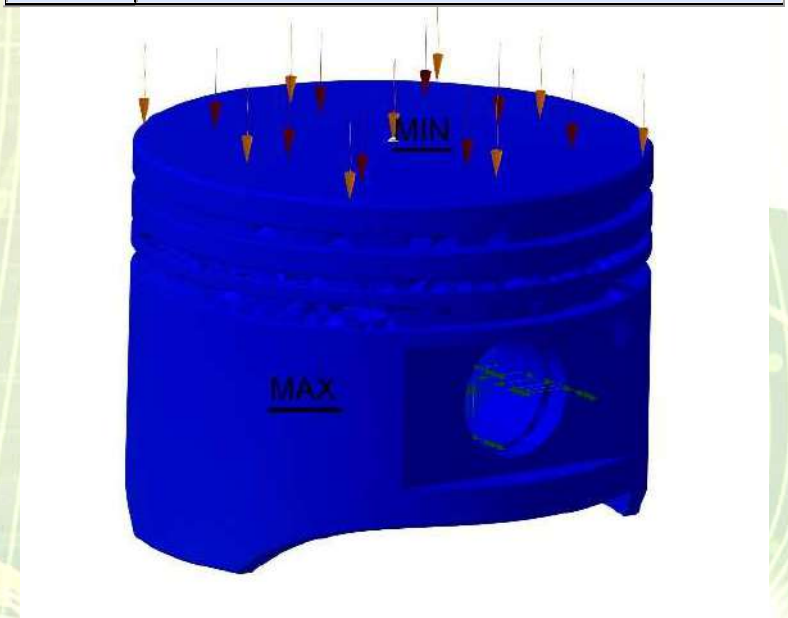
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Результаты расчета устойчивости

Name	Type	Minimum value	Maximum value
safety factor		0.001385	8.475784

N	Buckling safety factor
1	0.000305



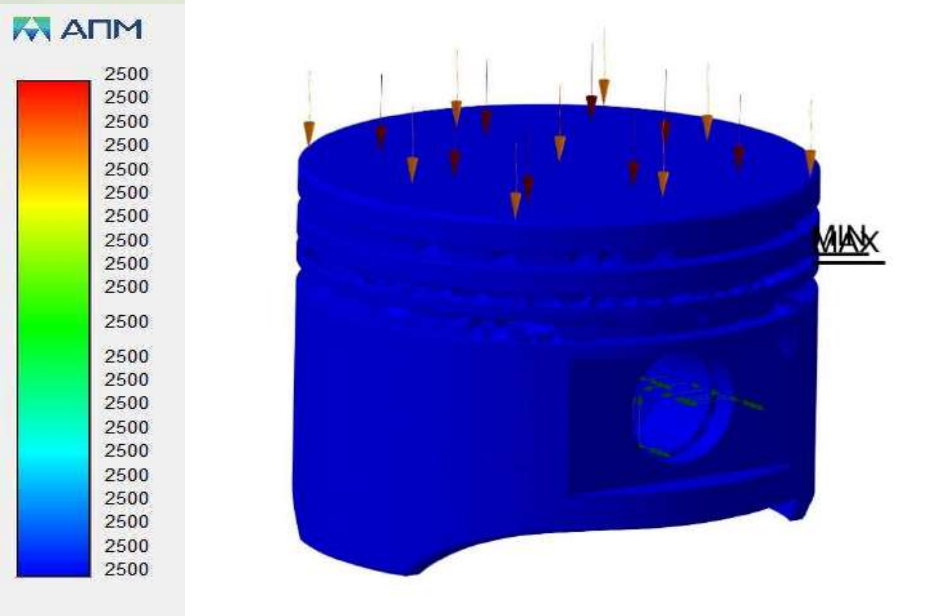
1st form of buckling

Thermal calculation results

Name	Type	Minimum value	Maximum value

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Temperature	Temperature [deg. Celsius]	2499.999902	2499.999902



CONCLUSION

In conclusion, we can say that the calculations we have studied above are very much in line with modern methods. Because a world of calculations using paper, formulas and drawings using the human brain is now considered obsolete. It is also worth noting that when you calculate with the help of KOMPAS 3D software, the detail you are testing will appear in front of your eyes and will greatly enrich your imagination. We think that by reading this article, KOMPAS 3D users will have another novelty for themselves and save valuable time using it in their work.

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