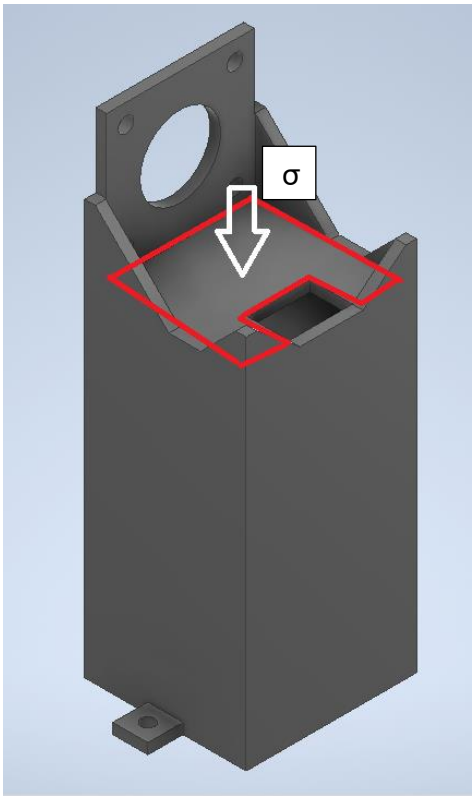
Motor Tower

Pressure applied

The pressure applied to the base of the bridge will be the result of the division between the weight of the Nema 17 motor in Newtons and the contact surface between it and its support base. Knowing that the motor weighs 300g and the contact surface neglecting the hole is 42x40mm:



$$\sigma = \frac{F}{S}$$

$$\sigma = \frac{0.3 * 9.807}{0.042 * 0.04}$$

$$\sigma = 1751.25Pa = 0.002MPa$$

Restrictions

To carry out the stress analysis, a series of restrictions had to be applied to different faces of the tower, such as the lower face, which will be glued with screws and the front face where the motor is glued. These fixings can be seen in the sections of strains and displacements.

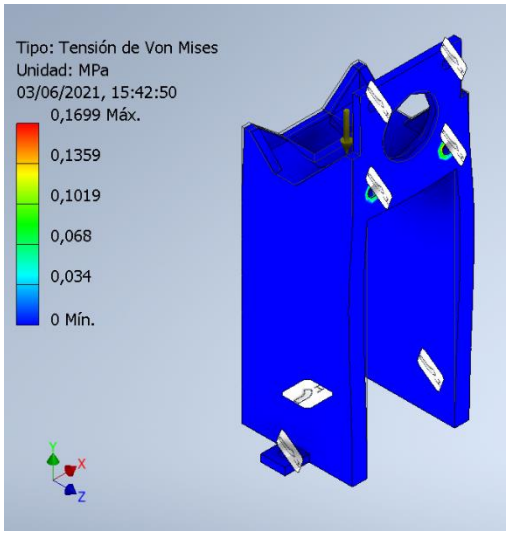
Material Characteristics

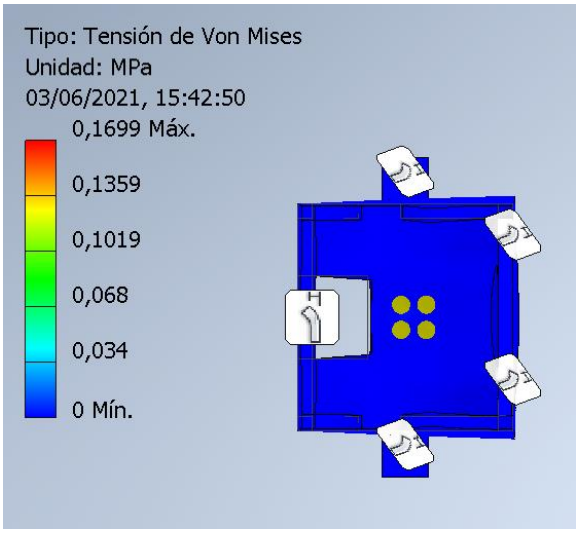
The material used in the structure is PLA, as the parts have been printed with a 3D printer, so to determine the behaviour of the structure towards the pressure applied to its surface, the stresses will be compared with the elastic limit of the material (PLA), to take into account the permanent deformations of the structure and whether it will withstand the applied stress.

The elastic limit of PLA is 55MPa.

Von Misses' Strain

The Von Misses' theory, determine the absolute values of the strains in every point of the solid analysed, to be able to determine the admissible tension in every point of the surface. So, knowing those strains, we'll be able to compare those strains with the elastic limit of the material used in the structure to know if the structure is going to break or being deformed.



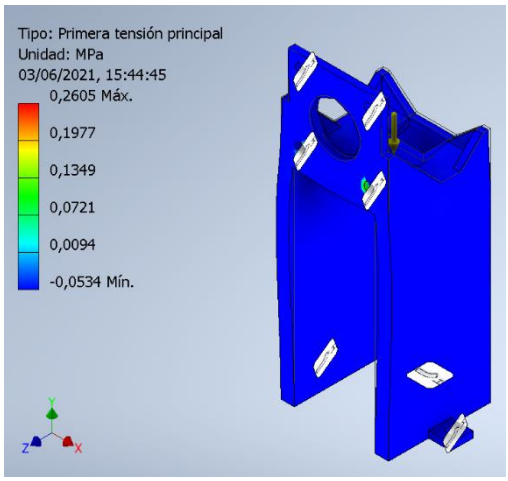


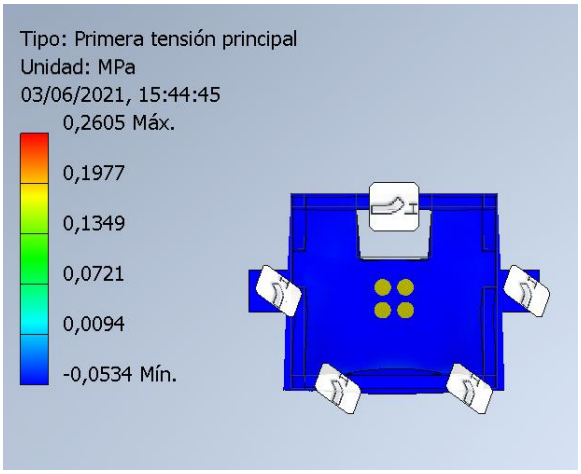
As can be seen in the previous images, the maximum stresses in the structure are almost all 0MPa, except for the points where the screws are glued with the motor. The maximum stress of the most affected area is 0.1359MPa, with the elastic limit being 55MPa, so the structure will not suffer any permanent deformation or breakage.

Main Strain 1

In the following images we can see the maximum strains in the Z axis, which is about -0.0534MPa in the main part of the surface.

The maximum value is about 0.1977MPa and the minimum is about -0.0534MPa. We also can see that where the screws are glued, the tension is about from 0.094MPa to 0.1349MPa.

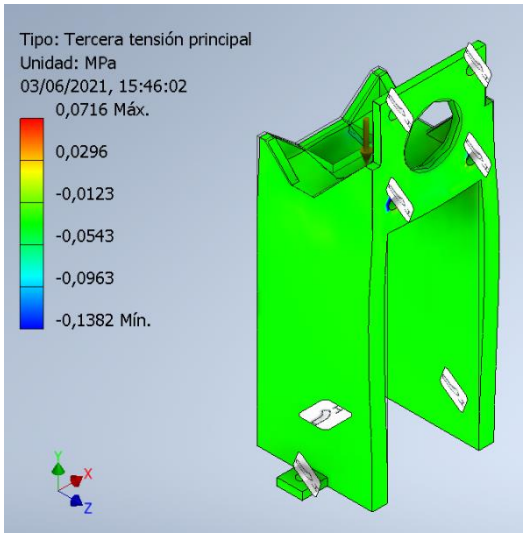


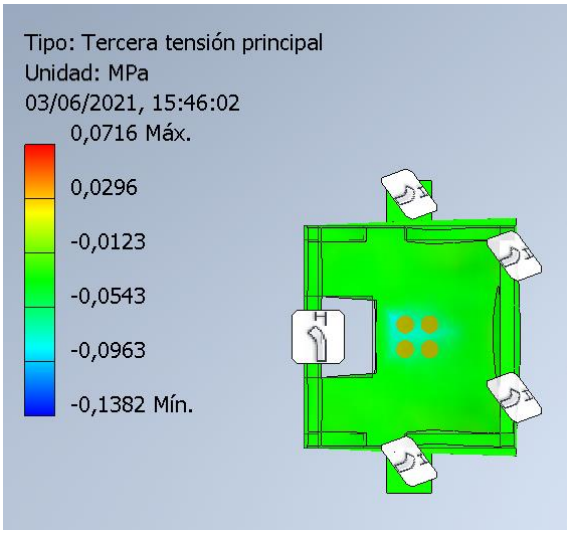


Main Strain 3

Here we can see the maximum strains in the Y axis, which is about -0.0543MPa in the main part of the surface.

The maximum value is about 0.0296MPa, which is situated where the screws are glued, and the minimum value is about -0.1382MPa, which is also situated where the screws are glued.



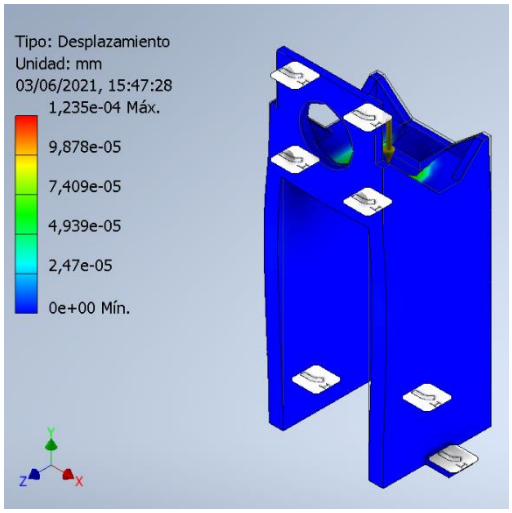


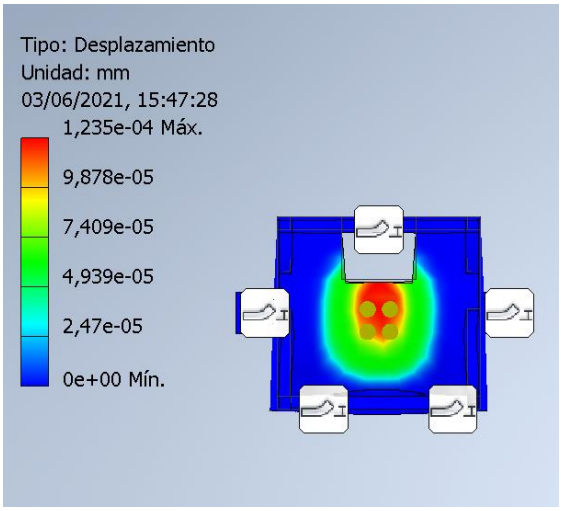
Also, we can see that in the base there is a little change in the strains, where in a very little area, it can be seen a strain with a value of -0.0963MPa.

Displacements

Finally, observing the displacements of the structure, it can be seen that the maximum value is about 9.878e^-5mm, being applied at the centre of the base where the motor will be situated, being it an insignificant displacement comparing it with the dimensions of the tower.

Finally we can also highlight that there will not be any displacement on the main surface of the structure.





Conclusion

As a final conclusion, we can say that the structure will be able to support the strains produced by the Nema 17 motor, being the most conflictive zone where the screws are glued, although the structure is not going to be deformed or broken. So finally, we can say that the structure is easily going to support the 300g of a Nema 17 motor.