<table>
<tr><td colspan="4">Warsaw University of Technology
Faculty of Electrical Engineering

1DA1213 - Mechanical Engineering</td></tr>
<tr><td colspan="2">Completed by:

Borys Kovba</td><td colspan="2">Project:

Creation and simulation of a head of an USB-A plug in SolidWorks</td></tr>
<tr><td>Academic Year:
2019/2020</td><td>Date:
May 2020</td><td>Checked by:
dr inż. Łukasz Kolimas</td><td>Mark:</td></tr>
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1. Abstract

During the completion of the project, the 3D-model of a head of an USB-A plug (marked as USB CABLE E467715 AWM STYLE 2725 VW-1) I had at home was designed and simulated statically in SolidWorks.

2. Specifications

Technical specifications were taken from the USB 3.1 Legacy Cable and Connector Specification (September 22, 2017)[1], while the most recent specifications are likely to be found in the IEC 62680-1-6:2019 document (September 19, 2019).

The choice of the materials for the simulation (Figure 4 below) was based on the information from the abovementioned sources:

Component	Materials
Cable	Conductor: copper with tin or silver plating
	SDP shield: AL foil of AL/Mylar foil
	Coaxial shield: copper strand
	Braid: Tin plated copper or aluminum
	Jacket: PVC or halogen-free substitute material
Cable Overmold	Thermoset or thermoplastic
Connector Shell	Copper alloy or stainless steel, depending on durability requirement
Housing	Thermoplastics capable of withstanding lead-free soldering temperature.

The “Cable Pull-Out (EIA 364-38, Condition A): No physical damage to the cable assembly shall occur when it is subjected to a 40 N axial load for a minimum of 1

[1] https://www.usb.org/document-library/usb-31-legacy-cable-and-connector-revision-10

minute while clamping one end of the cable plug" condition was simulated (see "Static Simulation" below).

3. Results

Model Design

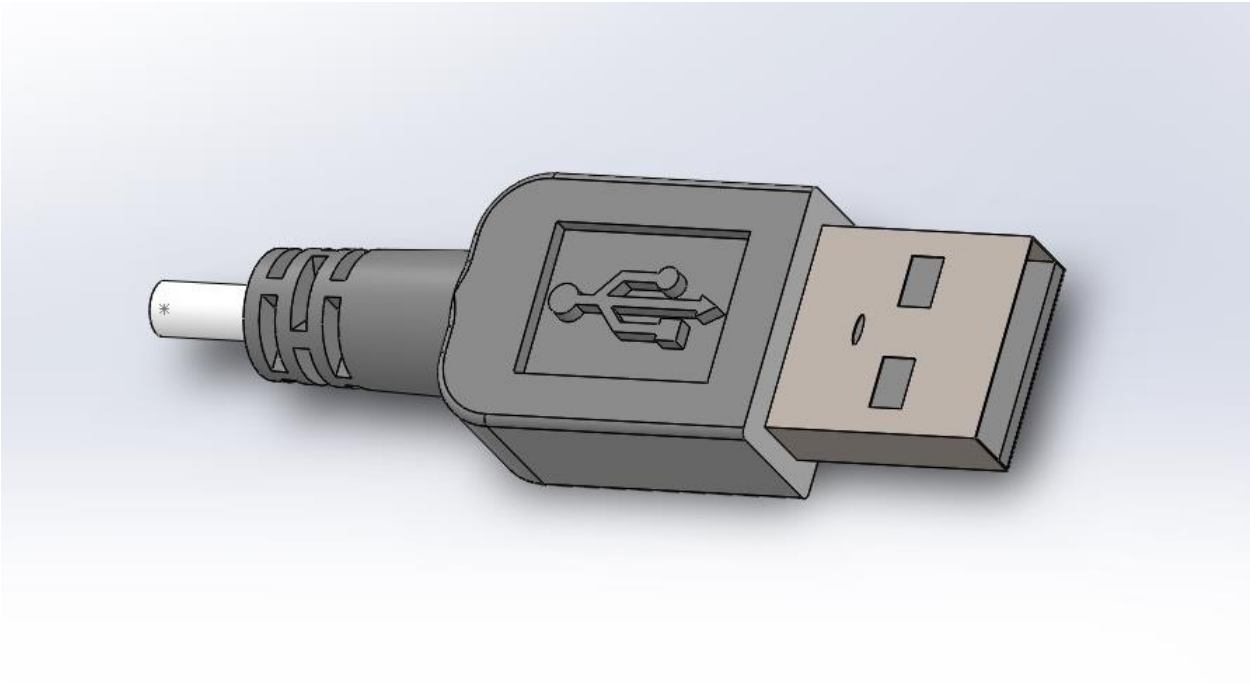

Figure 1 - general view of the model

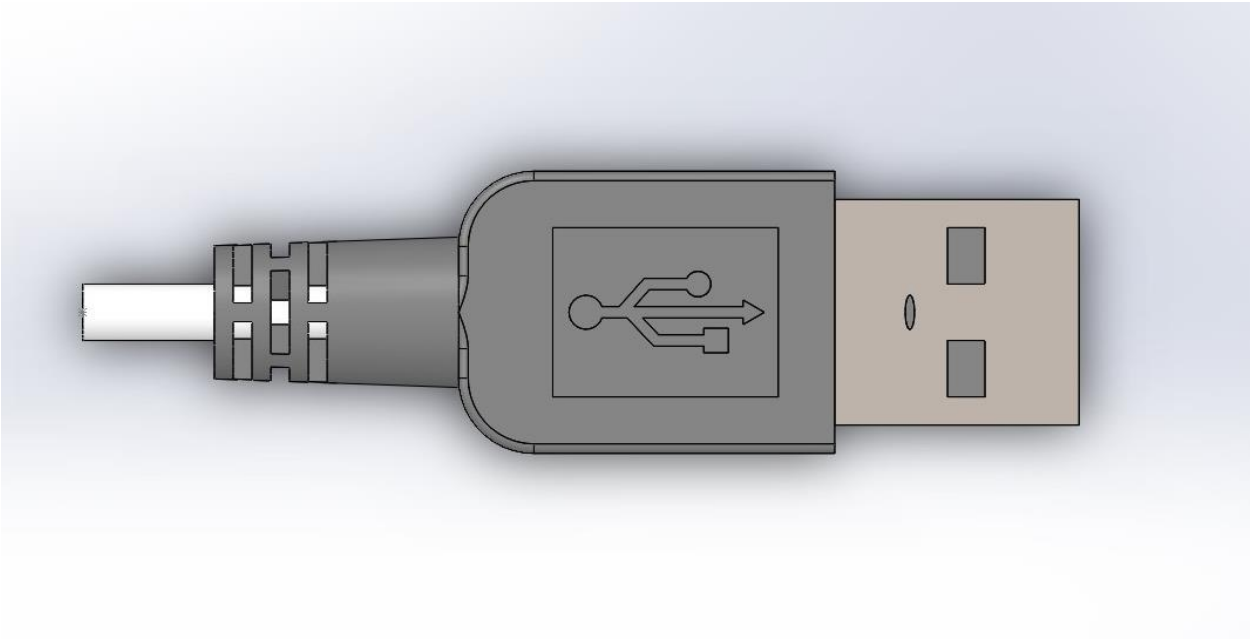

Figure 2 - top view of the model

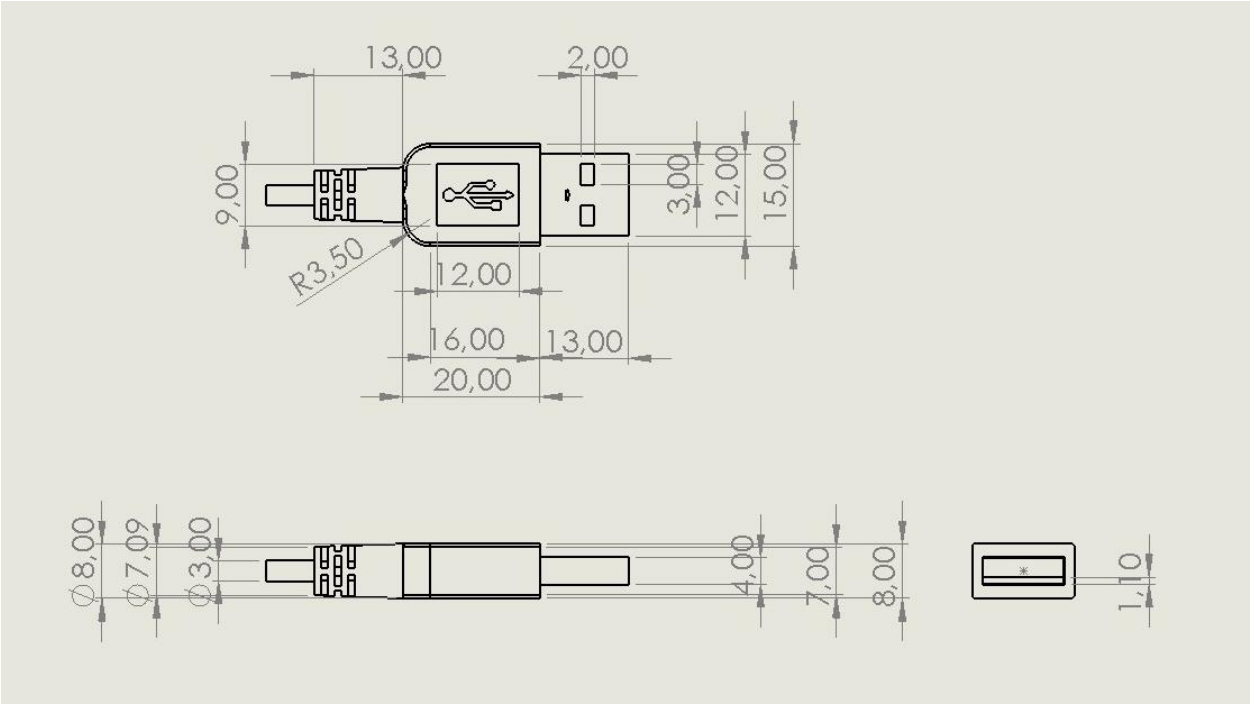

Figure 3 - dimensions of the model

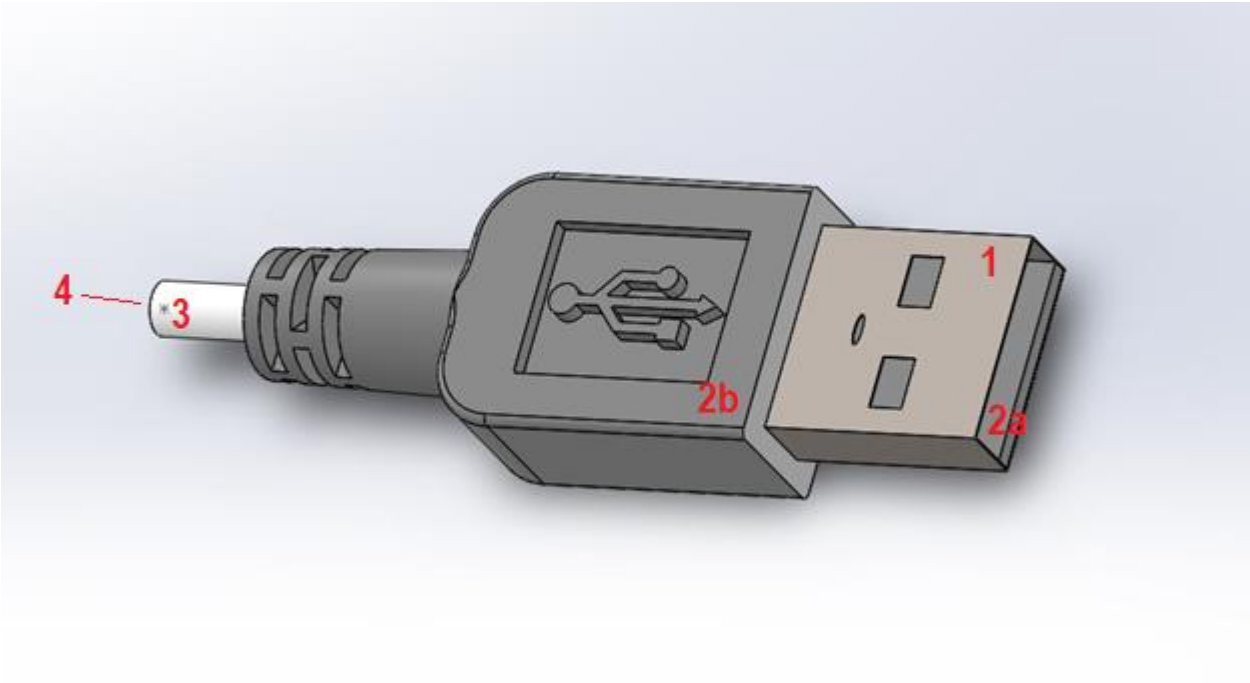

Figure 4 - list of materials used in simulation(definition below)

1 – AISI Type 316 Stainless Steel
2a(inner part of the connector), b – PBT General Purpose
3 (cable isolation) – PVC Rigid
4 (material of the cable, not shown) – Copper

Static Simulation

Applied Force – 40N

1. Stress (von Mises)

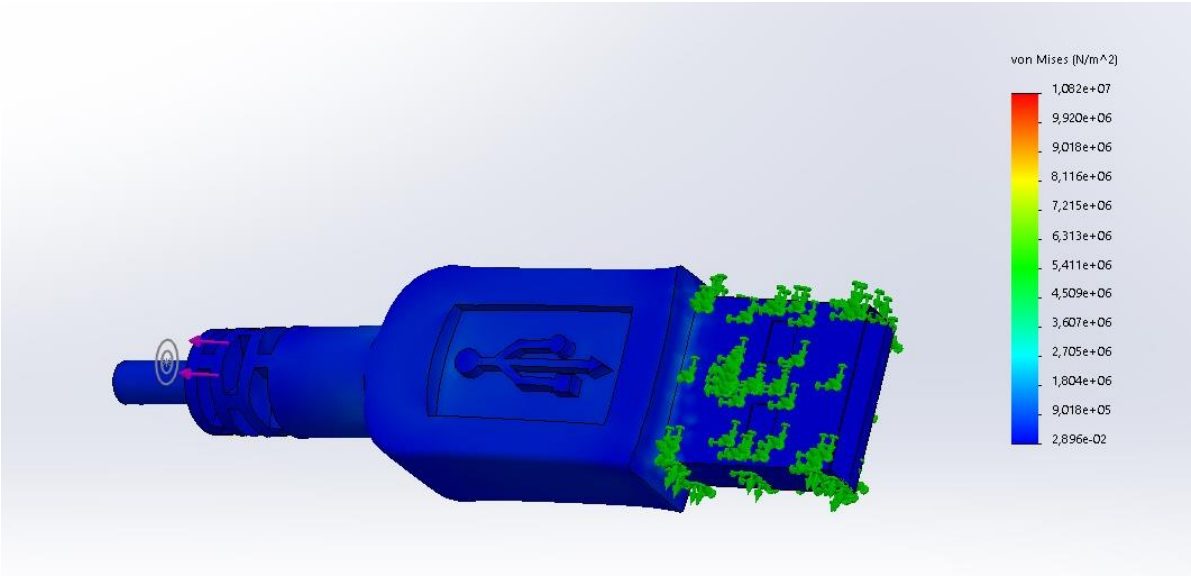

Figure 5 - side view

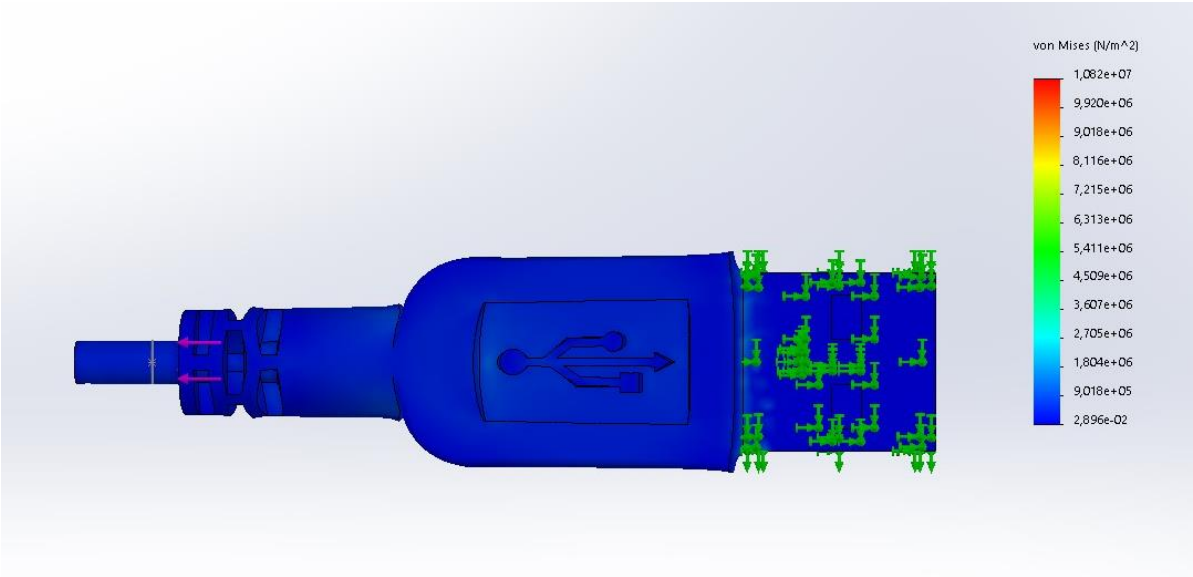

Figure 6 - top view

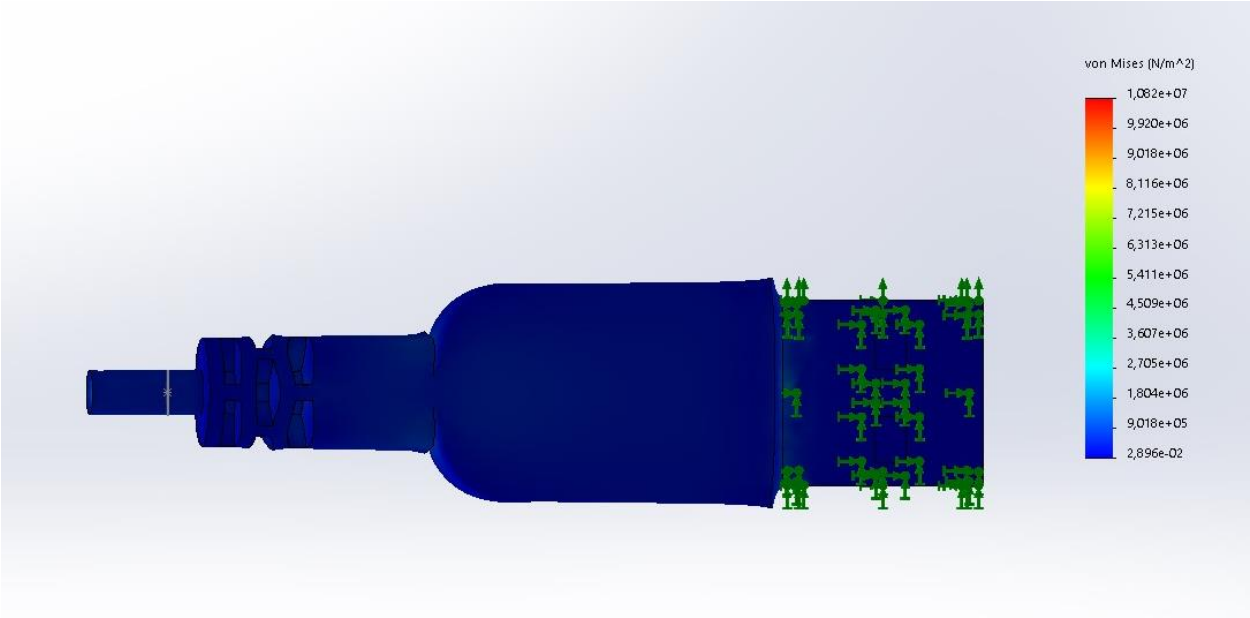

Figure 7 - bottom view

2. Displacement

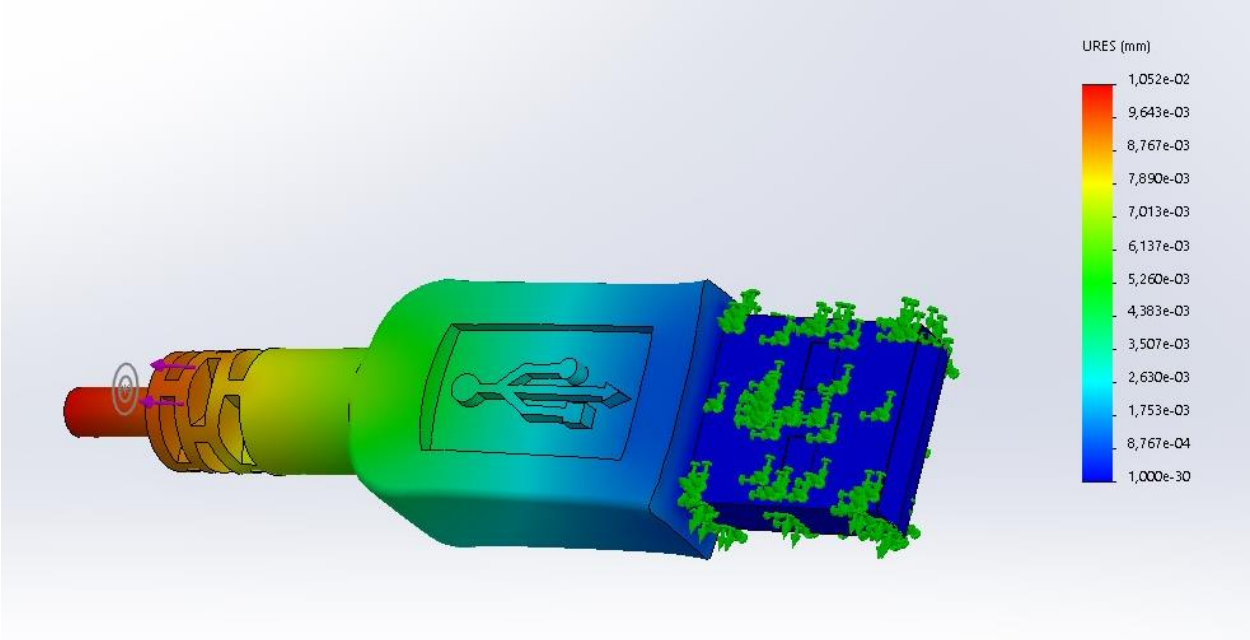

Figure 8 - side view

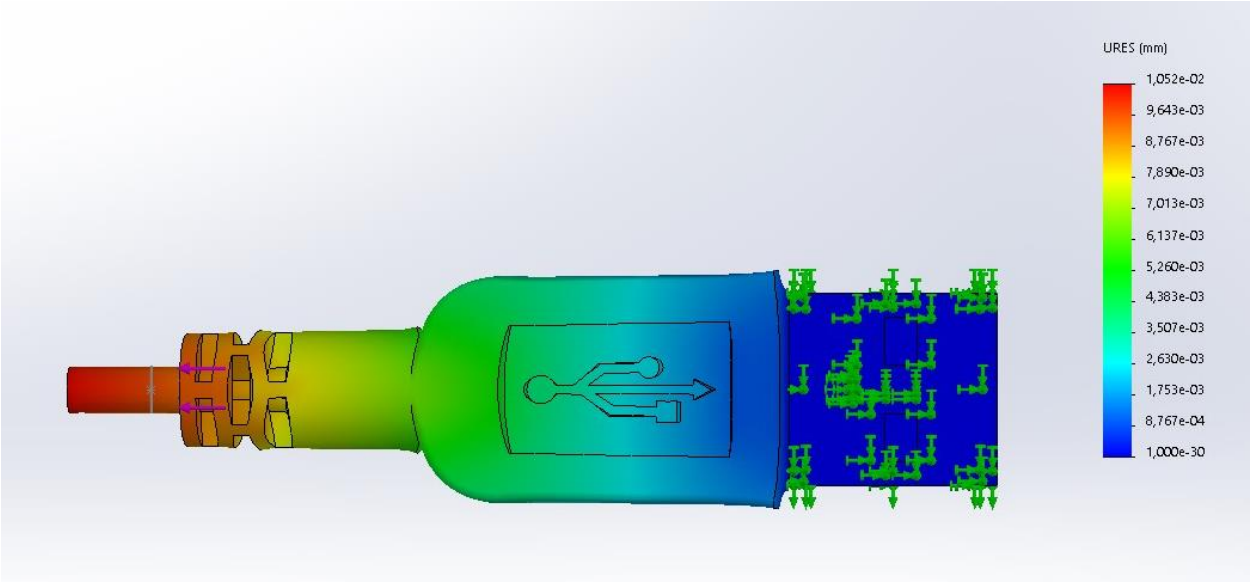

Figure 9 - top view

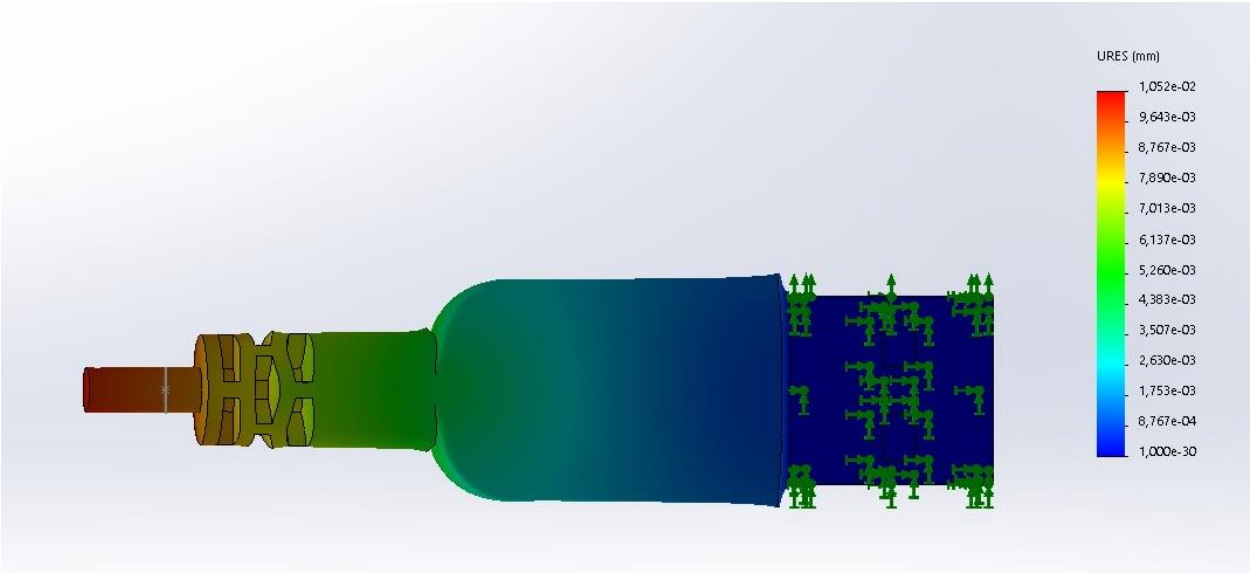

Figure 10 - bottom view

3. Strain

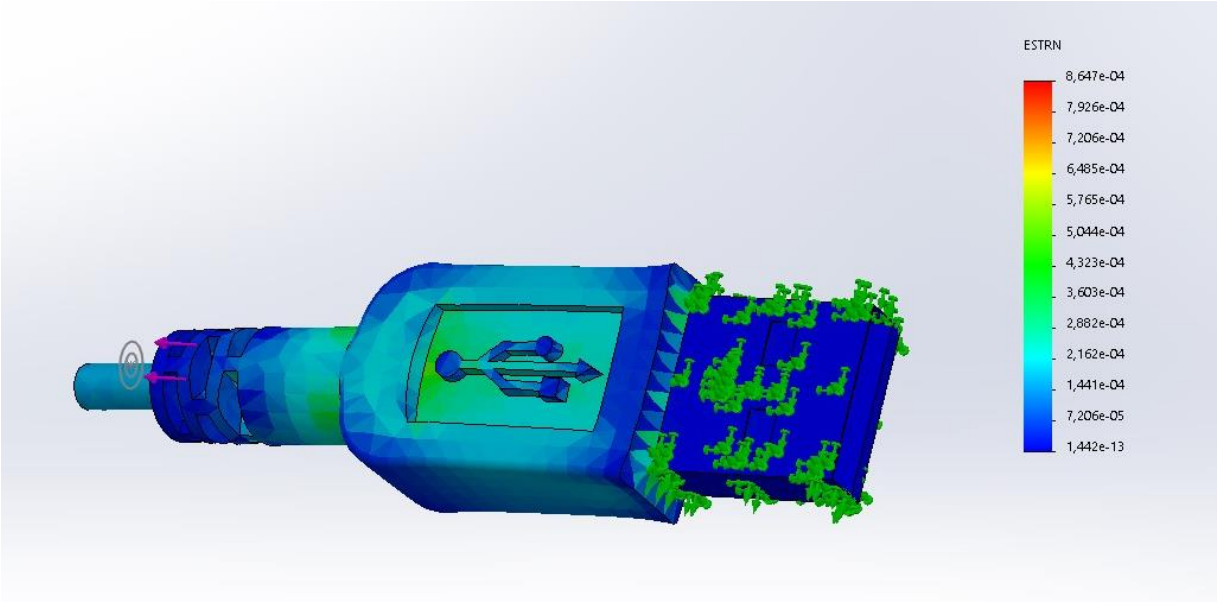

Figure 11 - side view

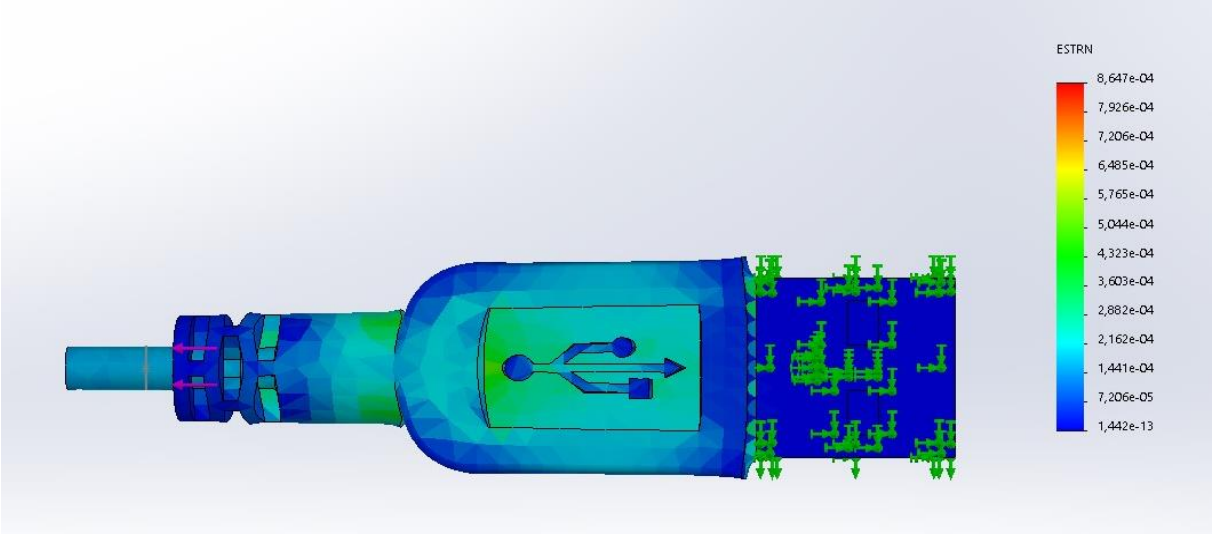

Figure 12 - top view

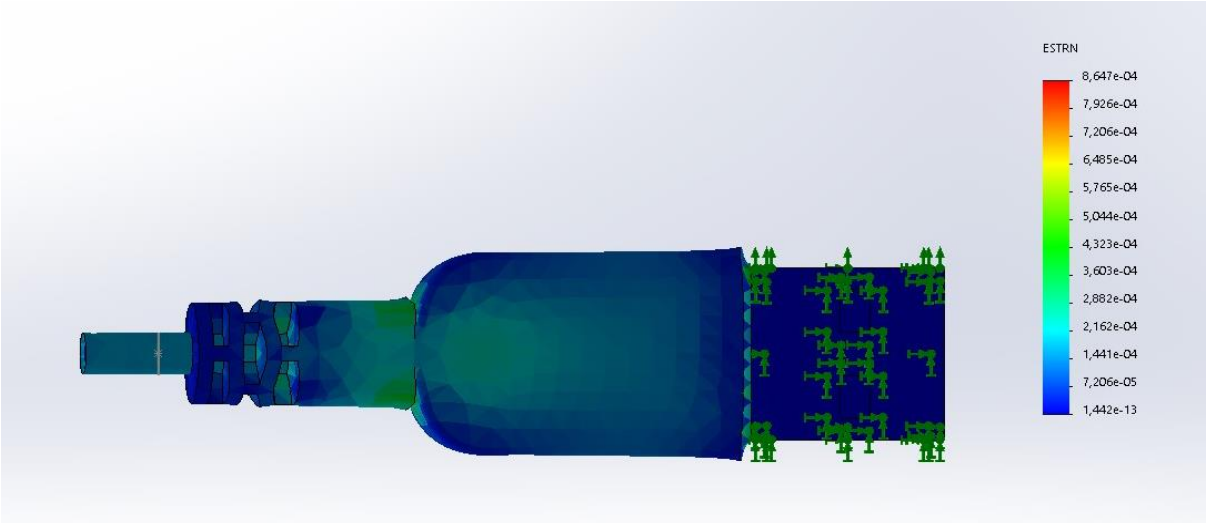

Figure 13 - bottom view

4. Conclusion

According to the simulation, the greatest displacement of the model was 10^{-2}mm, which allows to conclude that there is no destruction of the cable structure as expected. Therefore, the created model is a plausible substitution of a real cable, which in turn means that the goal of the project was completed successfully.

5. References

1. https://www.usb.org/document-library/usb-31-legacy-cable-and-connector-revision-10
2. https://en.wikipedia.org/wiki/USB