

# BiOM Text Fixture

Summary

## Device Description

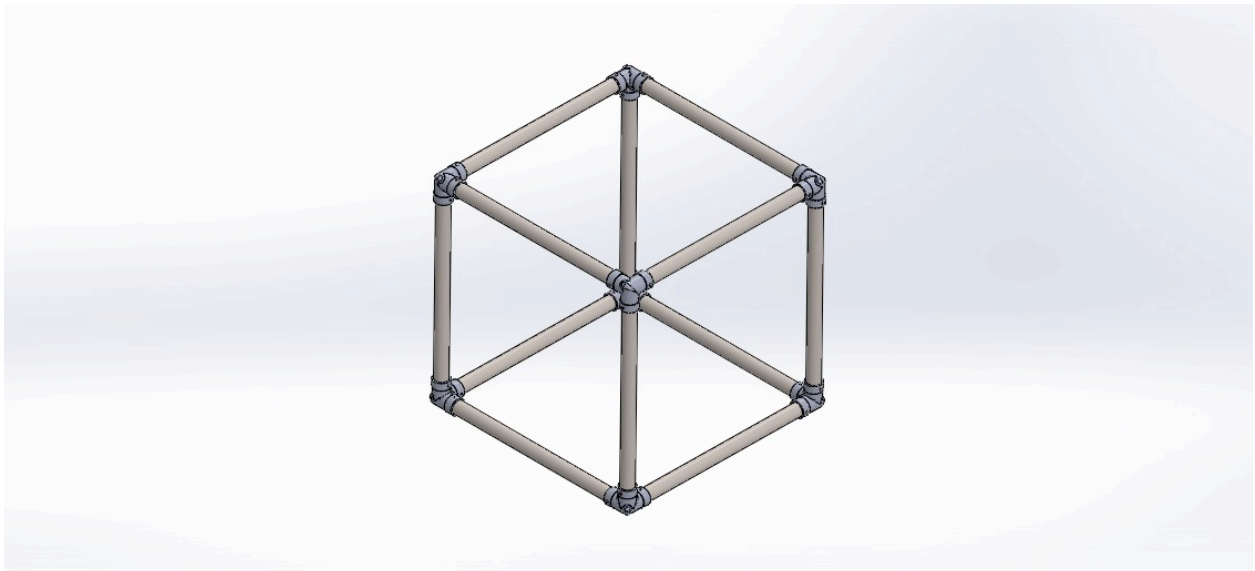
The BiOM Text Fixture is designed to test the BiOM device's behavior under the action of force and weight of the person. The device is designed to support a weight of 130 kg. The testing BiOM Text Fixture is designed such that it can apply a net force equivalent to 130 kg on the device. The device comprises a battery connected to a motor or centrifugal pump. The pump/ motor will drive the hydraulic cylinder that will exert the pressure on the device. The end of the device, which acts as a foot, is attached with the hydraulic cylinder assembly. The other end of the device is fixed at the other end of the BiOM Text Fixture so the proper force can be applied on the BiOM Text Fixture.

## BiOM Text Fixture Assembly

The Text Fixture's assembly is simple. The main components of BiOM Text Fixture are

- Connectors
- Rods
- Battery Plate
- Battery
- Motor
- Hydraulic assembly

The BiOM Text Fixture is designed to be cubic in structure where the device would be attached diagonally. There are 12 rods connected with 8 connectors, assembled in a cubic shape. Three rods are attached with the single connector. The battery plate is attached at the bottom of the cubic the BiOM Text Fixture one which battery and motor is attached. The hydraulic cylinder is then attached with the motor.



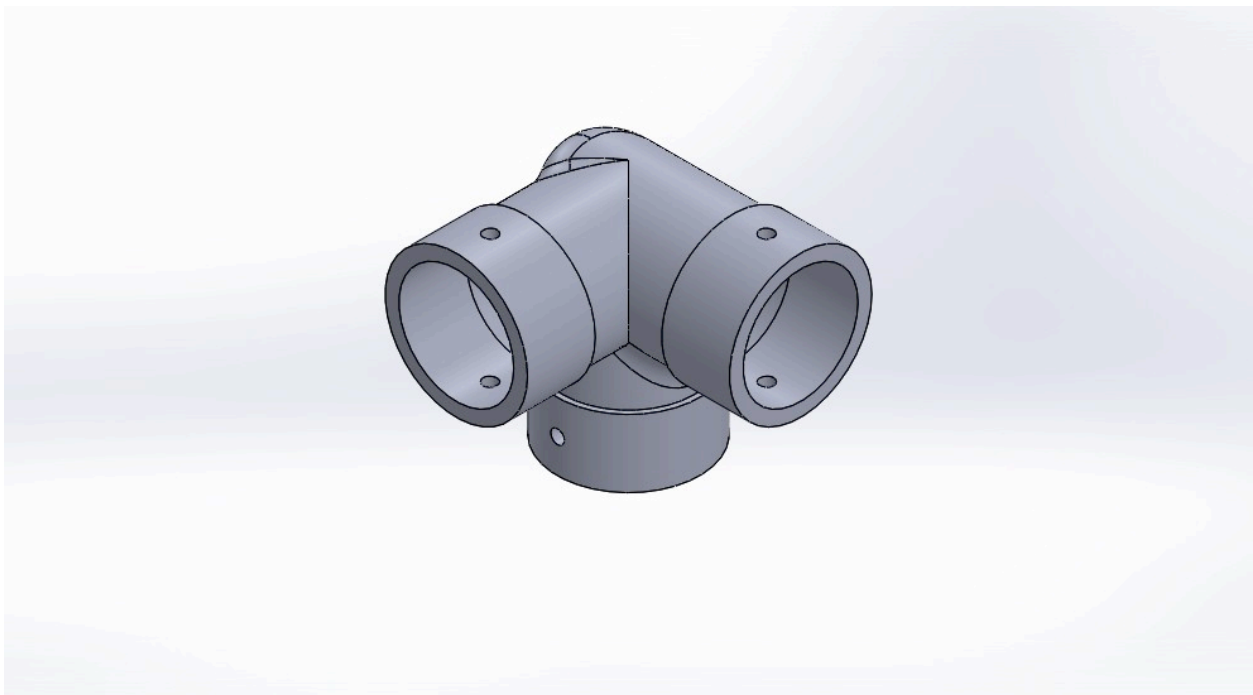
*Figure 1: Assembly's 3D CAD model*

## Testing BiOM Text Fixture Analysis

The BiOM Text Fixture is capable of exerting a force of 1.3kN. Behavior of each component is analyzed and simulated in the software Ansys 16. The parts are simulated separately and then behavior of whole BiOM Text Fixture assembly is studied.

### Connector

The connector is fixed from the places where rods are attached. The net reaction force of 1.3kN is applied to the connector. The von-Mises equivalent stress of 1.2 MPa is observed at the places where rods are attached with the connector. The proper contouring of the connector, distributes the stress concentration and a safety factor of 15 is achieved. Safety of factor of 3 is enough for any device. The connector is properly designed to hold the rods. The simulation results are given below:



*Figure 2: Connector 3D CAD Model*

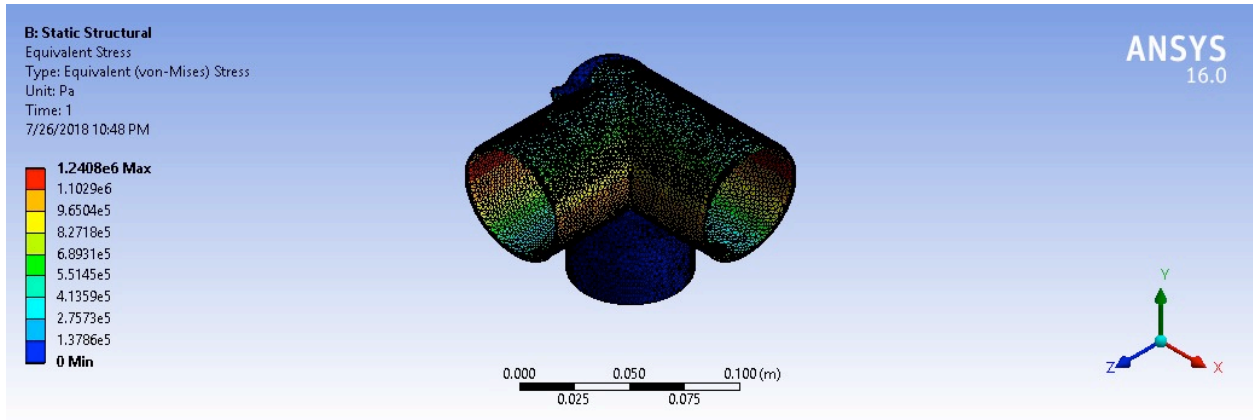


Figure 3: Equivalent Stress in the Connector

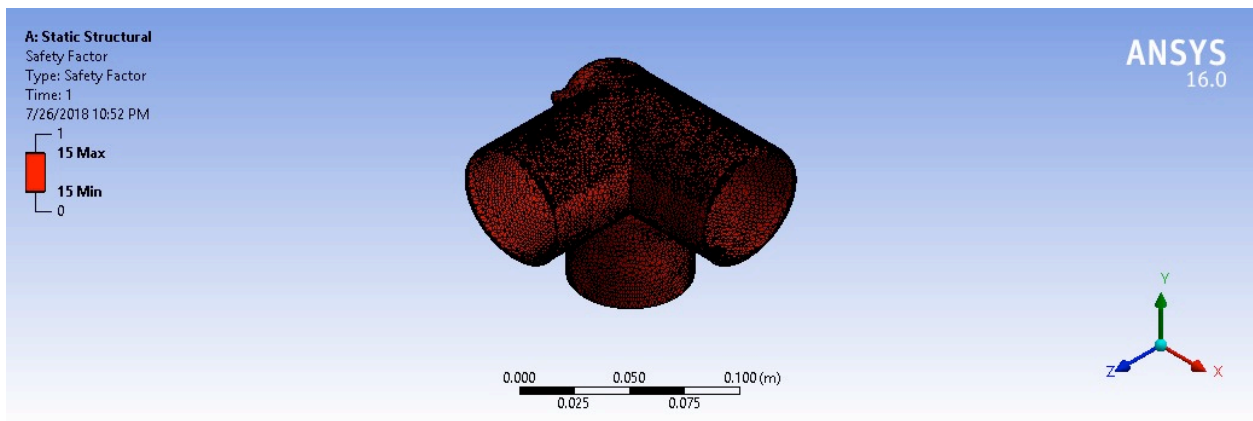


Figure 4: Safety factor of Connector

## Links

The main force that acts on the link is the force due to its dropping from a certain height. The net force of 400N is applied at the outer surface. The circular faces of the links are fixed. The minimum safety factor of 9.675 is achieved which is good for the design. The analysis showed that the links are appropriate for the BiOM Text Fixture operation. The analysis results are presented below:

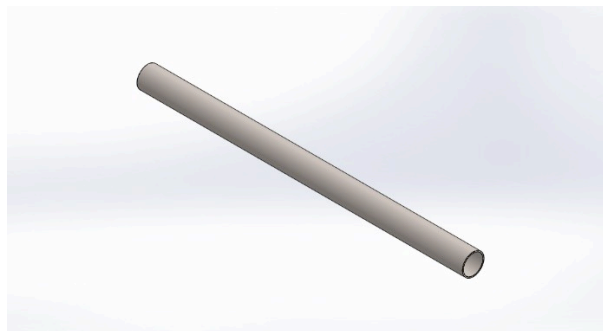


Figure 5: Link's 3D CAD Model

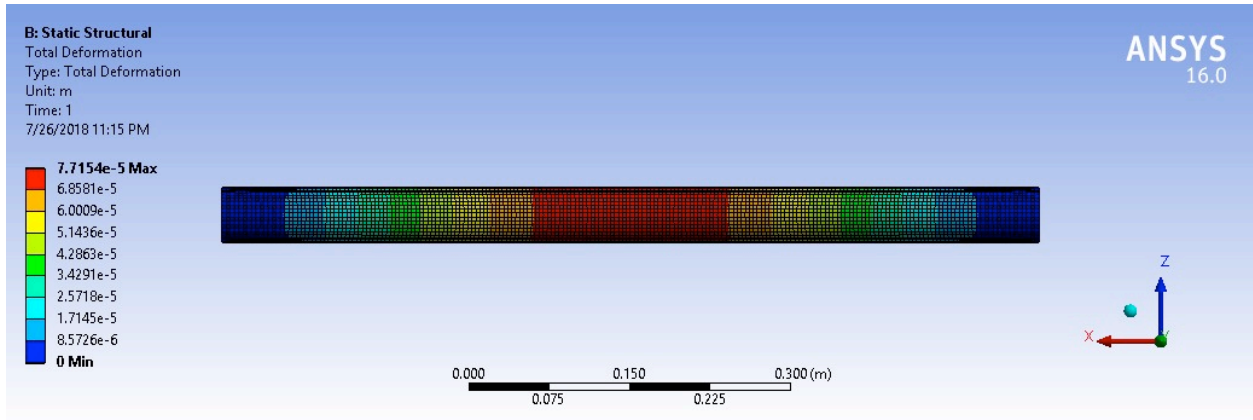


Figure 6: Total Deformation in the Link

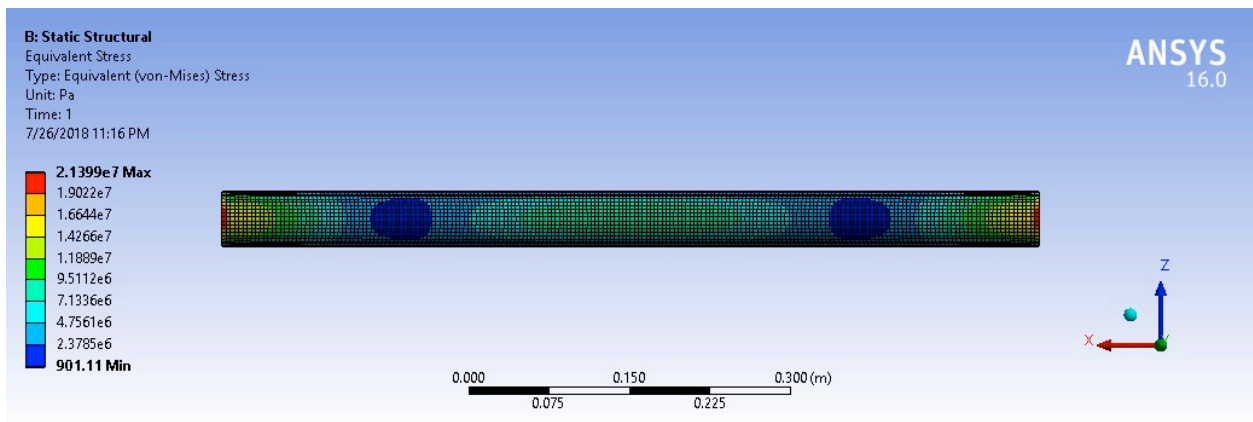


Figure 7: Equivalent stress in the Link

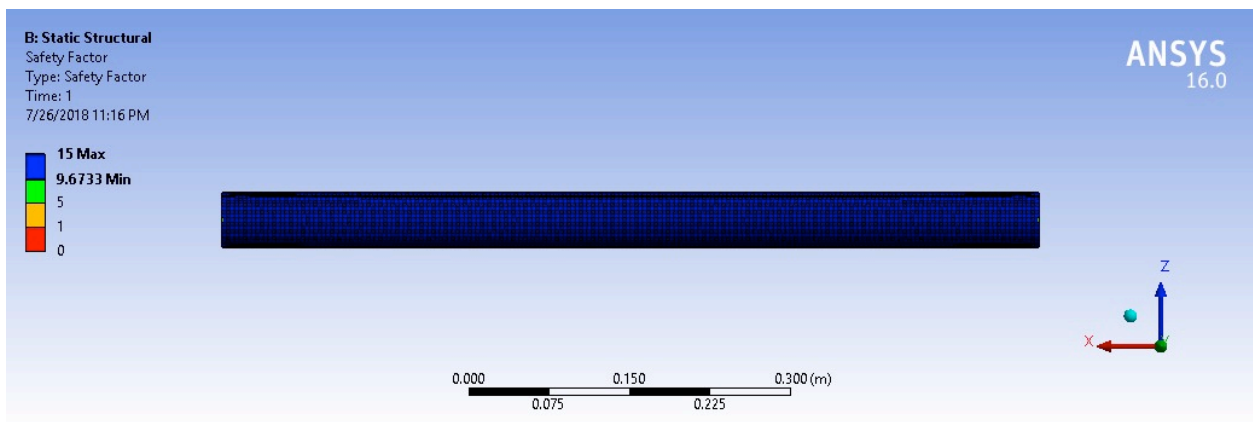


Figure 8: Safety factor of Link

### Assembly:

The analysis on the whole assembly is carried out, in order to check whether the assembly is sustainable or not. The net reaction force of 1.3kN is applied at the ends where the device is attached with the BiOM Text Fixture. The results are not in the favor of the design. The minimum safety factor of 0.00079

is observed at the connectors where force is applied which is not safe for BiOM Text Fixture operation. More work is needed to be done the assembly so we can achieve a minimum safety factor of 3. The results are previewed below:

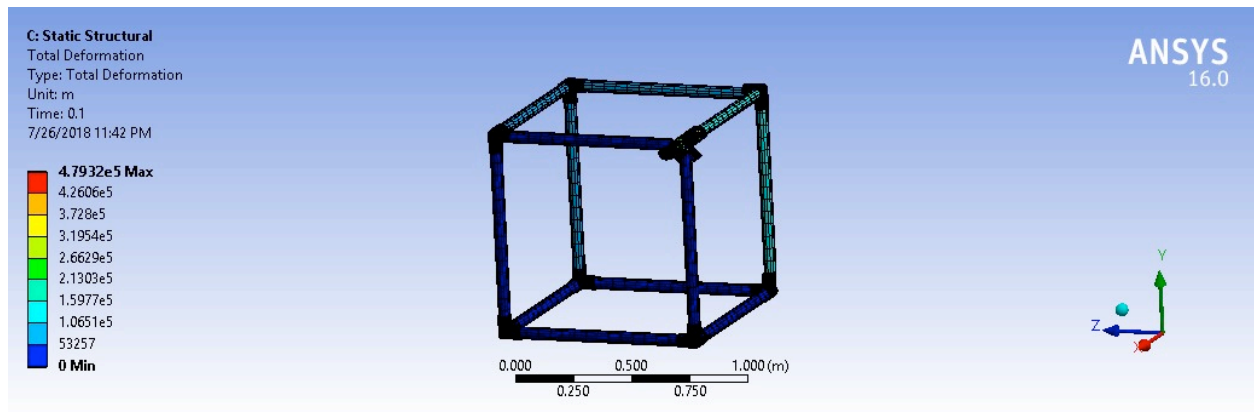


Figure 9: Deformation in the Assembly

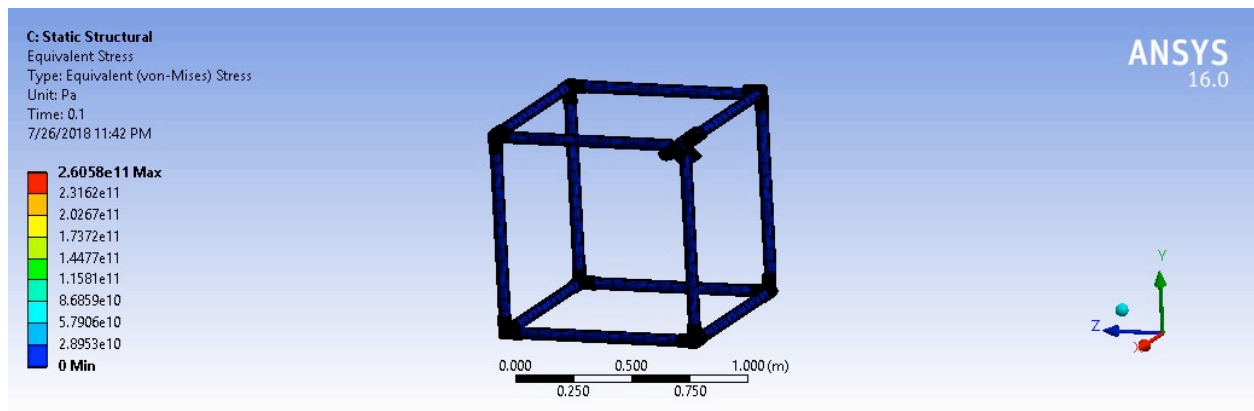


Figure 10: Equivalent Stress in the Assembly

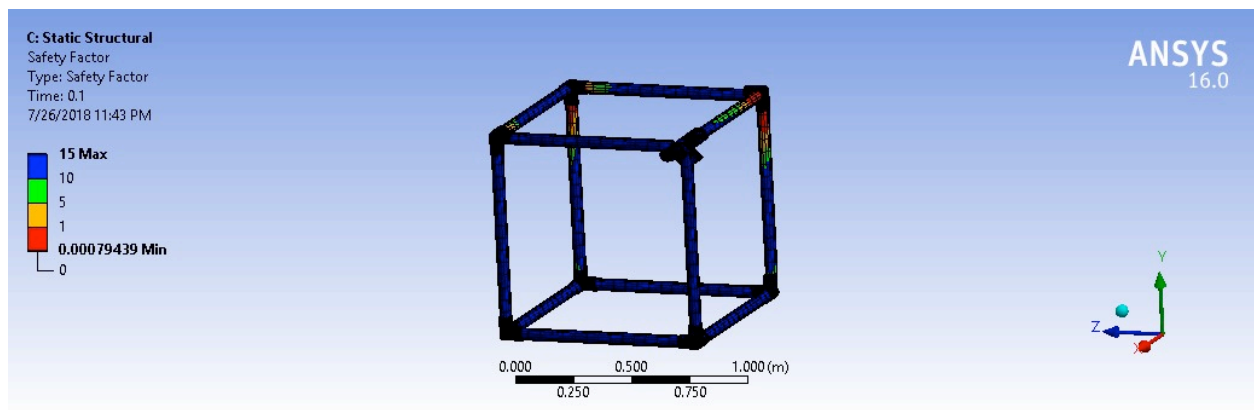


Figure 11: Safety factor distribution of the assembly

# Engineering Requirement Testing Proof

The engineering requirements for the testing machine along with its testing proof is given below:

- The project requirement is to design a BiOM Test Fixture capable of applying 1.3 kN force on the device in order to test its behavior. The 12 V battery powers the motor which drives the hydraulic cylinder, the specifications are mentioned in the bill of materials. The specifications of motor and battery are also attached with the bill of materials. The specifications meet the requirements of generating 1.3 kN force on the BiOM device.
- The other requirement of the BiOM Test Fixture is it should be strong enough to apply the force on the device. The FEA of the rods and connectors were carried out. The results satisfy the engineering requirement of safety factor of above 2. The safety factor of the BiOM Test Fixture is in safe range to be operated. The BiOM Test Fixture is capable of withstanding a reaction force imparted on it during operation. The battery and motor carrier is attached at the bottom of the Test Fixture on a thin metal sheet. The sheet gives excellent strength to bear motor and battery's weight.
- The battery used is 12 V Lithium ion battery. The battery operates at low voltage and low current. The safety requirement of Test fixture is met. Since, the copper wires are properly insulated with a no shock threat.
- The structure demands a strong connector that holds the rods of the test Fixture firmly. The FEA of the connector shows that the connectors are firm enough to hold the rods of the machine under operation.
- The BiOM Test Fixture should firmly hold the BiOM device in order to test it. The hydraulic cylinder at one end grips the device while the other end is diagonally fixed at the other opposite end. The diagonal fixing of the device firmly holds and make sure that the device will remain fix at its place during operation.
- The separate analysis is carried out on rods and connectors to check their strengths and a combine machine analysis proved the rods and connectors strength while whole machine operation.
- The size of the Test Fixture device is under 80 cm x 40 cm x 35 cm. The machine's dimensions are measured using measuring tape and the engineering requirement is fulfilled.
- The time for testing the BiOM device is under 20 minutes. The hydraulic cylinder will exert force of 1.3 kN in for 15-20 minutes to test the device. The stop watch measures the time.
- The weight of the Test Fixture device is under 15 kg. The weight of the machine is measured using newton meter.
- The FEA of the Test Fixture tests the strength of the device and approves the material selection for the device. The brinell hardness test will test the hardness of the device.
- The pressure sensor attached with the hydraulic cylinder tests the pressure generated by the hydraulic system. The motor and battery check is also measured using pressure sensors. The battery and motor should have enough power to able hydraulic cylinder to launch 90 psi pressure.