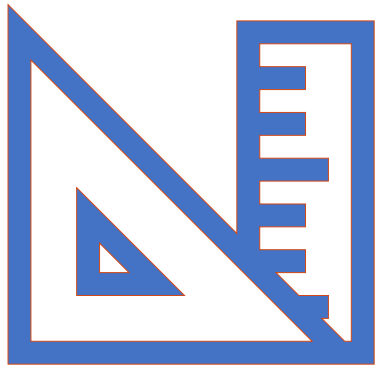


INFILL AND STRUCTURAL DESIGNS IN FDM

Group 4

Israt Zarin Era

Faujia Islam

Ryan Mitchell

CONTENT

- Introduction to AM and FDM
- Goal of the Project
- Inspiration of the designs
- 3D model Development
- Experiment Results
- Summery & Conclusion

INTRODUCTION TO ADDITIVE MANUFACTURING

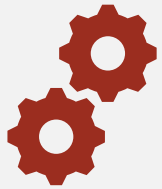
- Additive manufacturing is "*The process of joining materials to make objects from 3D model data, usually layer upon layer*" **[ASTM (2010) F2792-10e1].**

FUSED DEPOSITION MANUFACTURING

- "*A material extrusion process used to make thermoplastic parts through heated extrusion and deposition of materials layer by layer*" (**ASTM Intl F2792-12a).**

  - Material: Thermoplastics
  - Cost: Cheapest of all other AM processes
  - Next Day Delivery Lead time

GOAL OF THE PROJECT



Two Parts:

Part 1: Infill Pattern Design of a compressive testing block

Part 2 : Structural Design of a load bearing bridge specimen

To study Stress/Ductility/Load-weight ratios resulted from the tests on respective infill pattern designs.

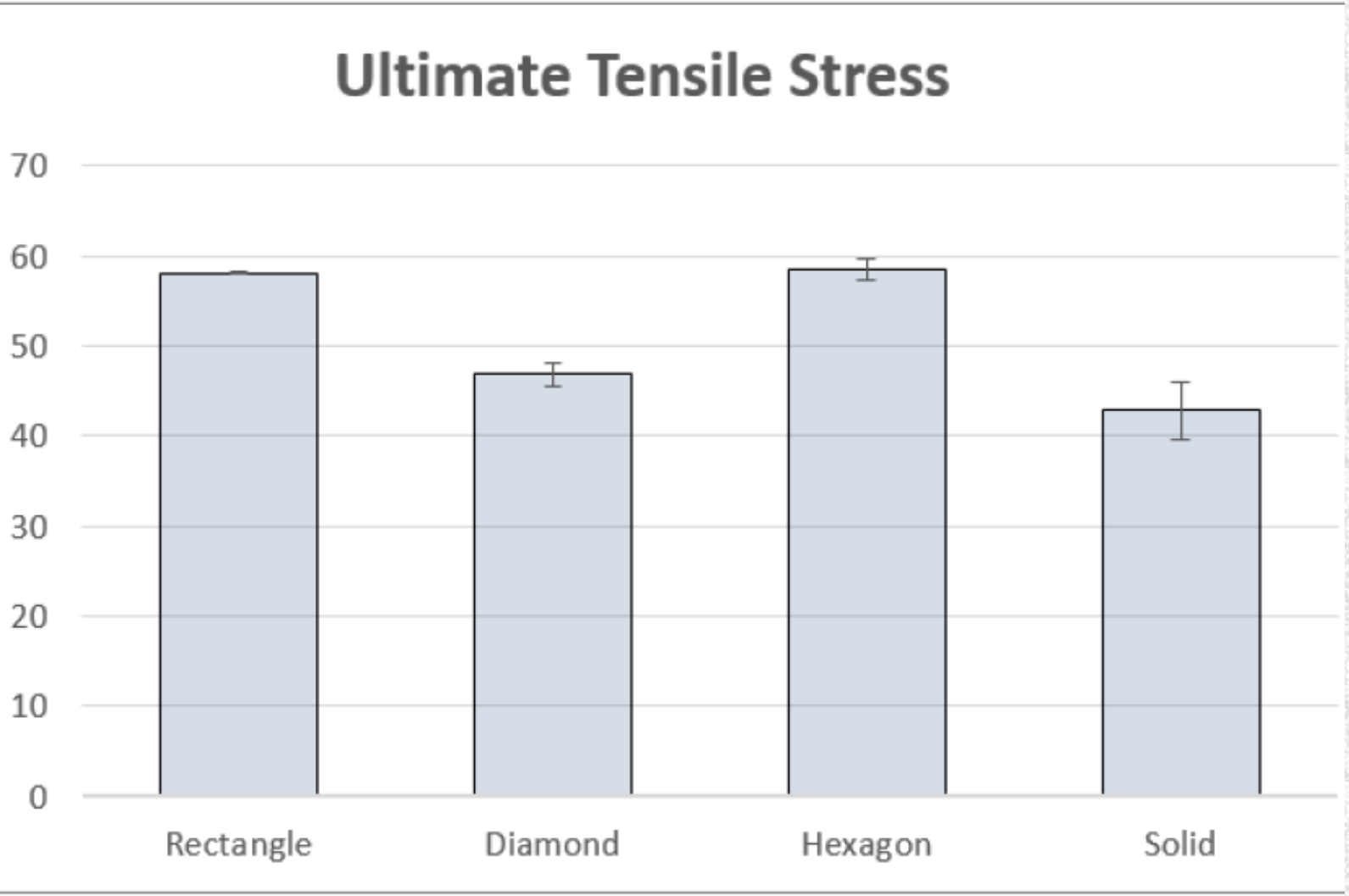


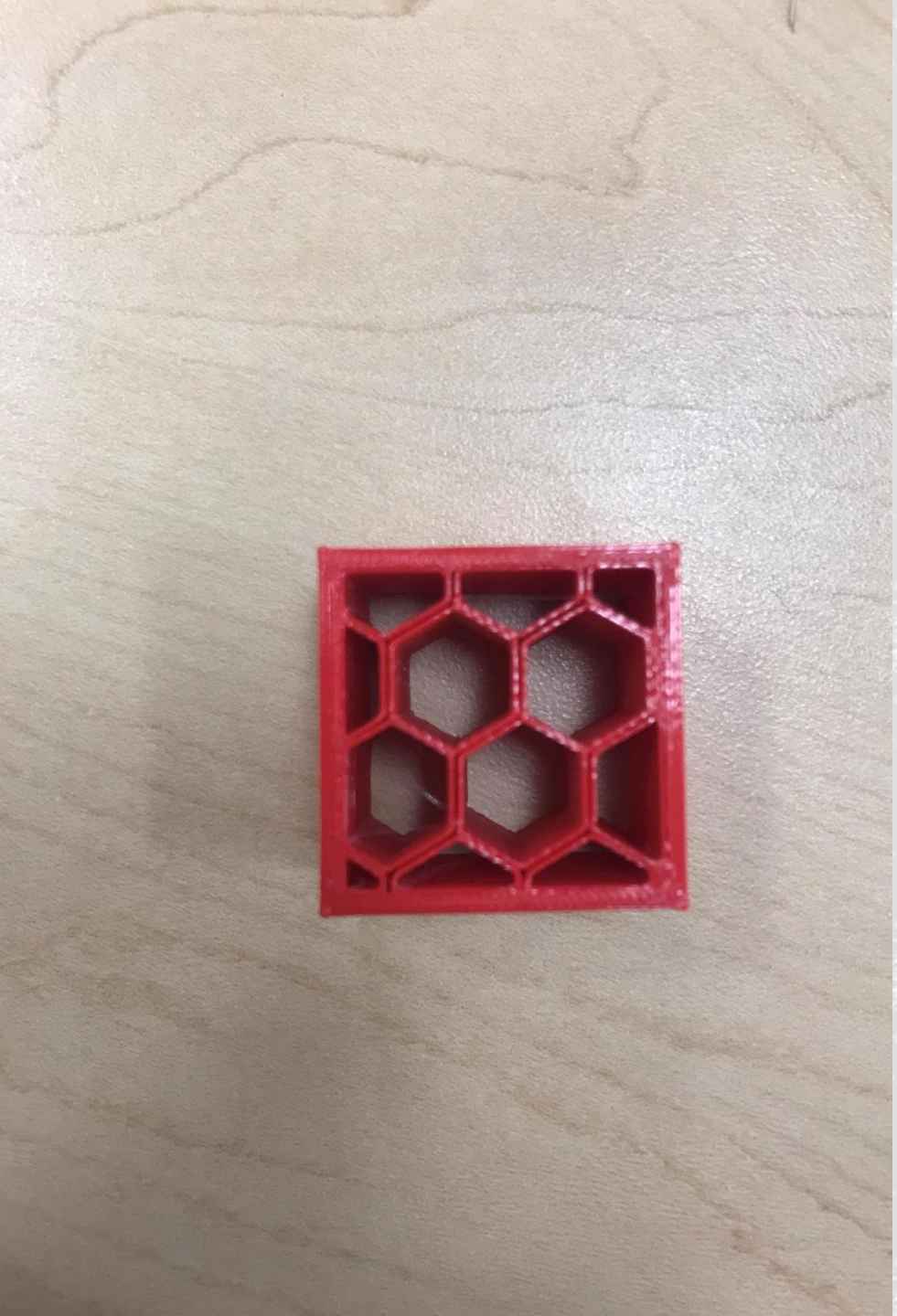
Figure 44. Column chart of calculated Ultimate Tensile Strength values

PART 1: INFILL PATTERN DESIGN OF A COMPRESSIVE TESTING BLOCK

Inspiration:

To get the maximum compressive strength-weight ratio.

Tanner David Harpool, 2014, studied how the infill pattern affects the mechanical properties, particularly tensile strength of a given part fabricated by Fused Filament Fabrication (FFF) by PLA.



3D MODEL DEVELOPMENT: DIMENSIONS

Drawing 30 × 30 × 20 mm

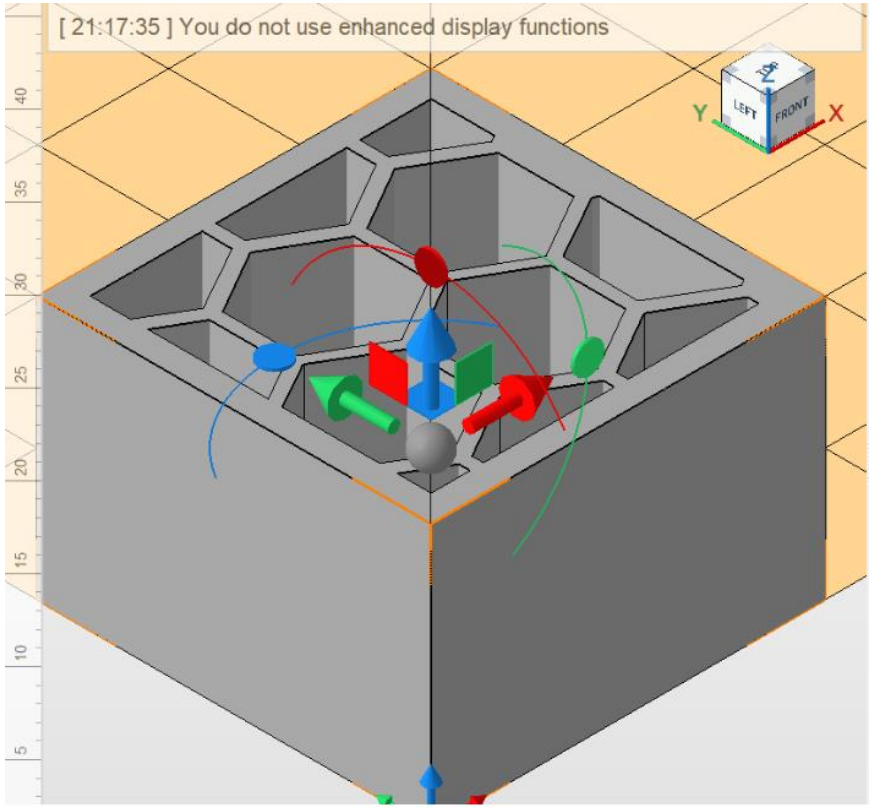
Infill Thickness : 1 mm

Shell Thickness: 2 mm

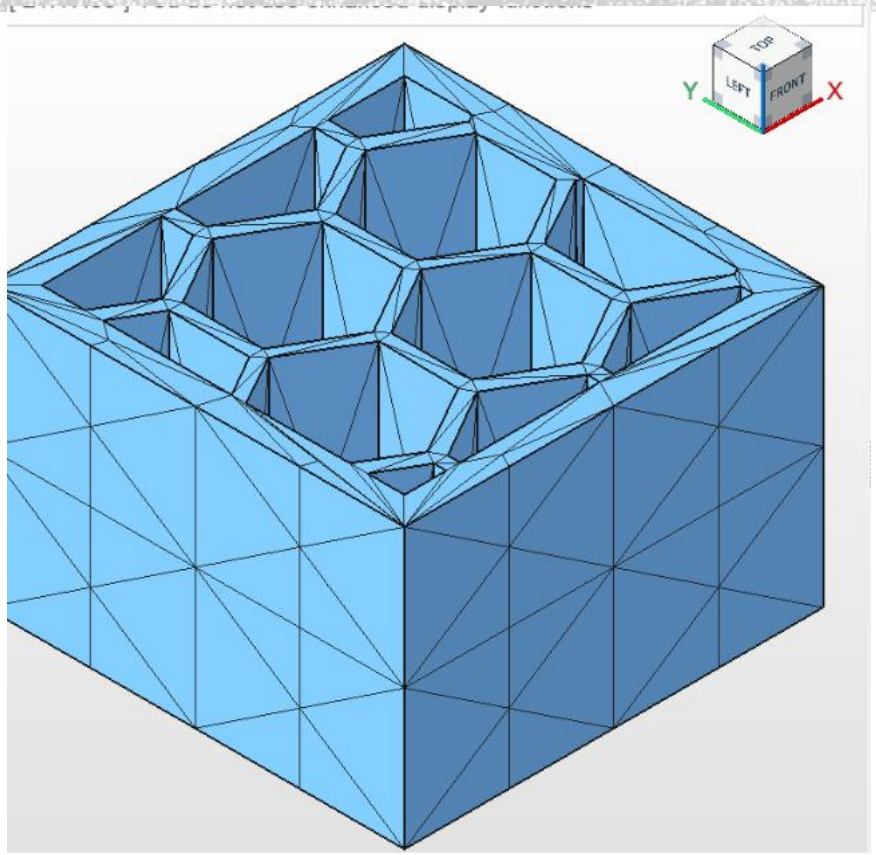
Cross Sectional Area: 349.388 mm^2

Infill Density: 38.88%

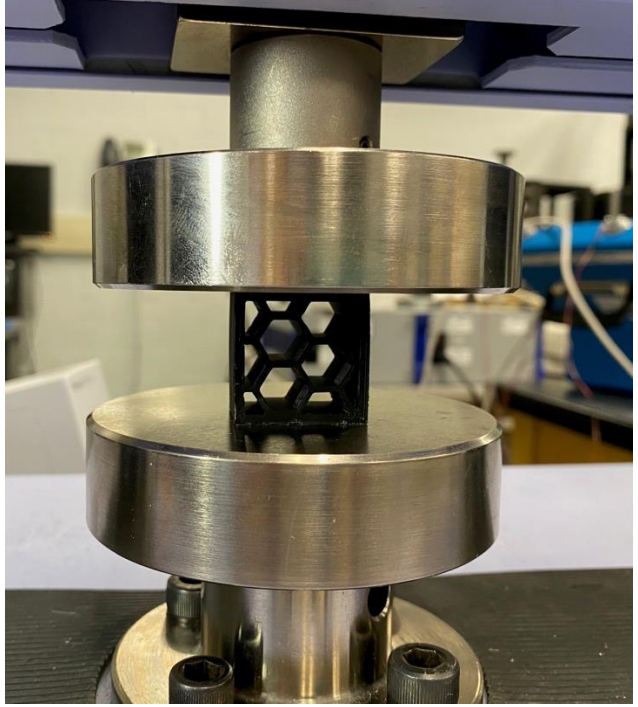
REPAIR: AUTODESK NETFABB

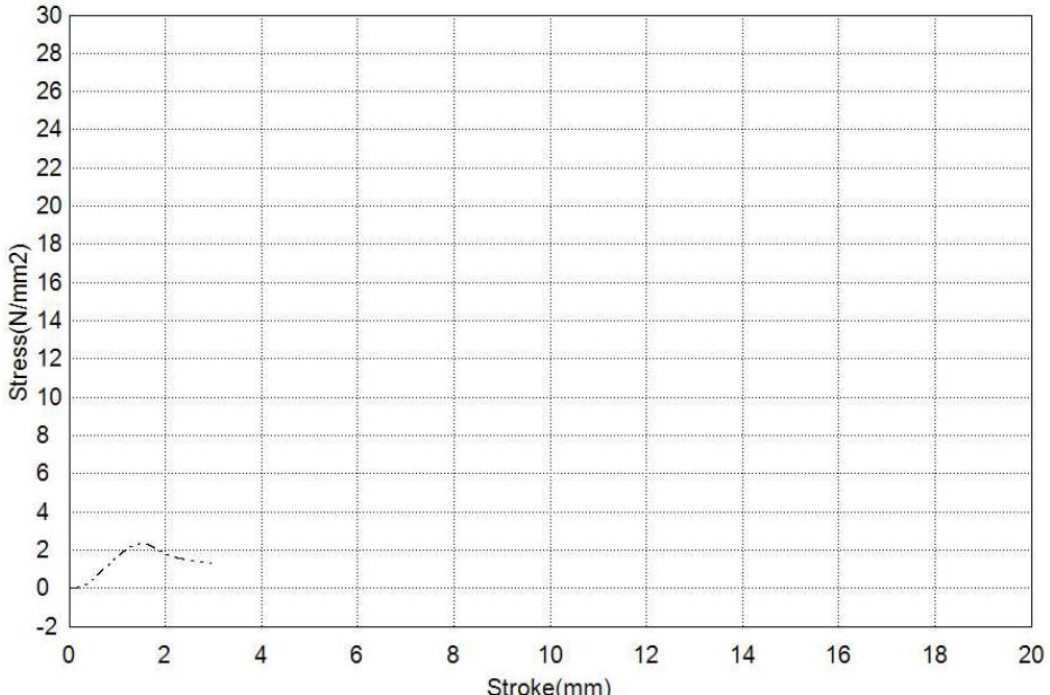


Before Repair: 327 Triangles



Before Repair: 700 Triangles





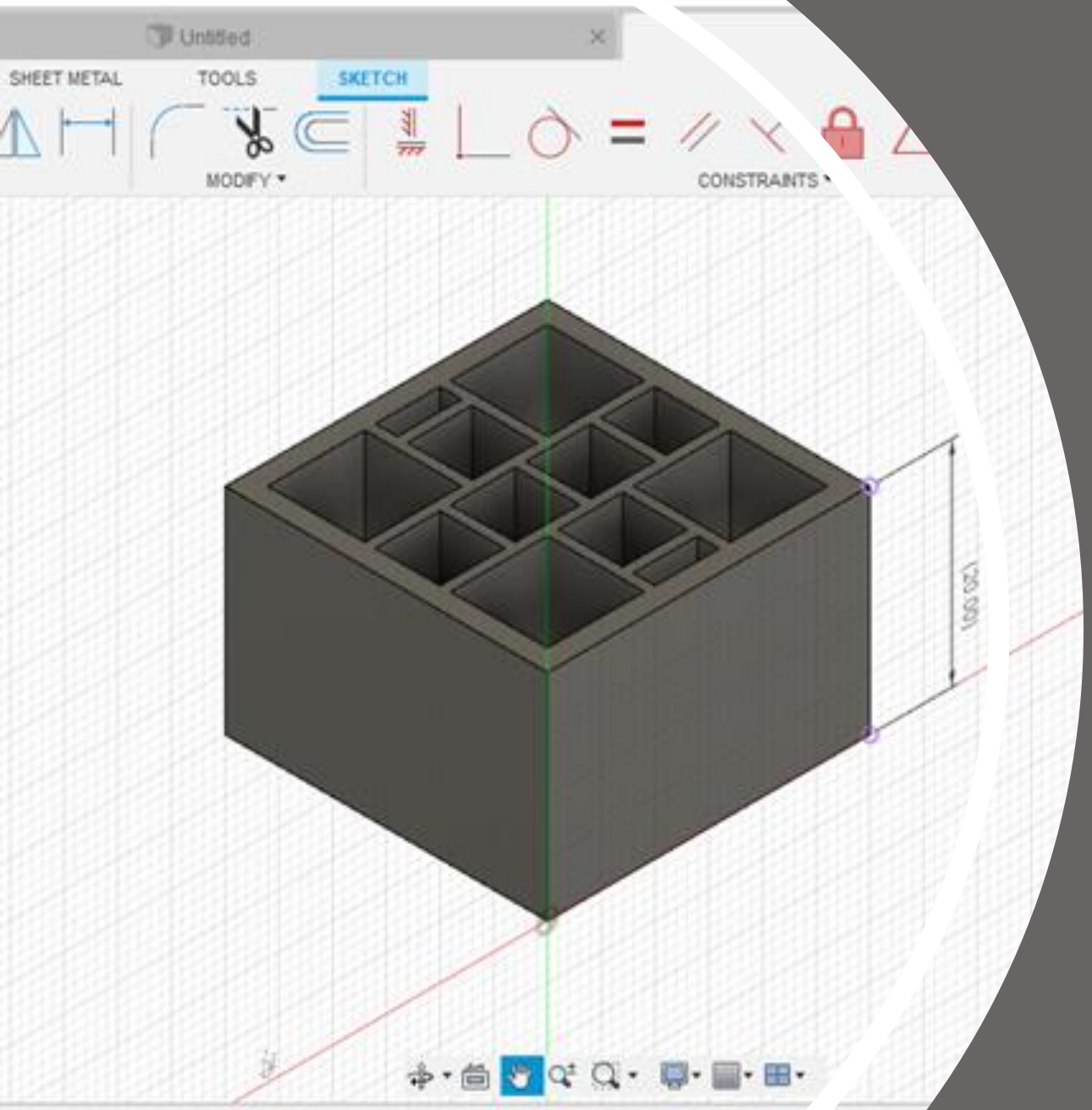
COMPRESSIVE STRENGTH TEST:

- Maximum Tensile Strength: 2.5 MPa
- Weight of the block: 7 gms
- Compressive Strength-weight ratio: 0.357 MPa/gms

PART 1: INFILL PATTERN DESIGN OF A DUCTILITY TESTING BLOCK

Inspiration

M. N. F. Saniman, 2020, mentioned that rectilinear infill pattern is the best in terms of ductility because of the intersections in the microstructure where they have two layers of contrasting directions. So, rectilinear pattern was selected for this project.



3D MODEL DEVELOPMENT: DIMENSIONS

Drawing 30 × 30 × 20 mm

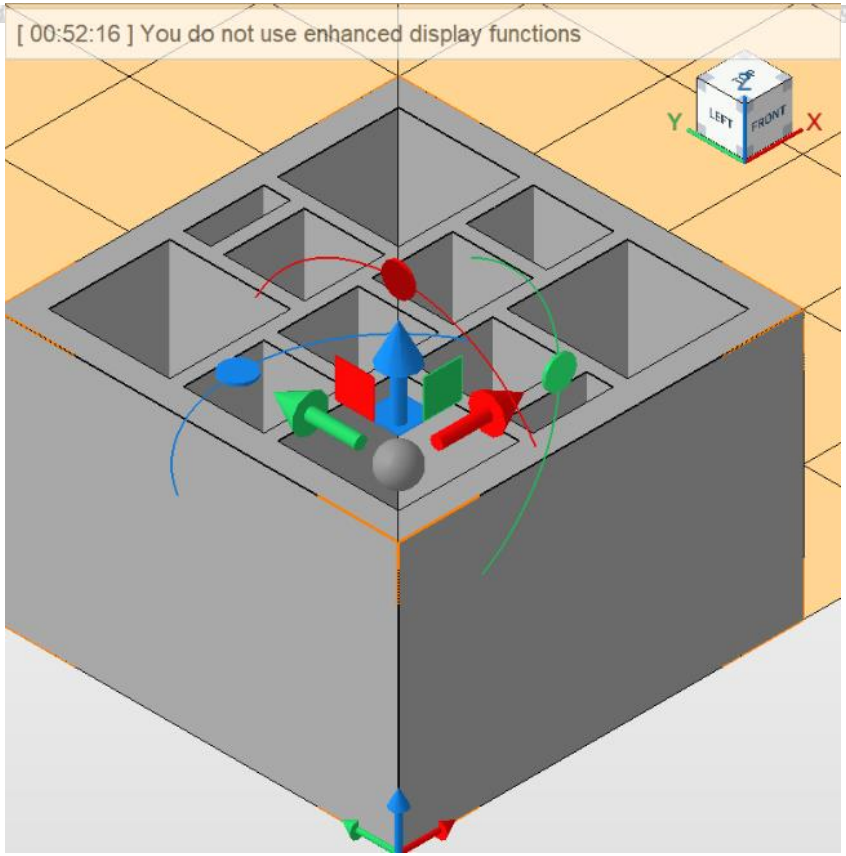
Infill Thickness : 1 mm

Shell Thickness: 2 mm

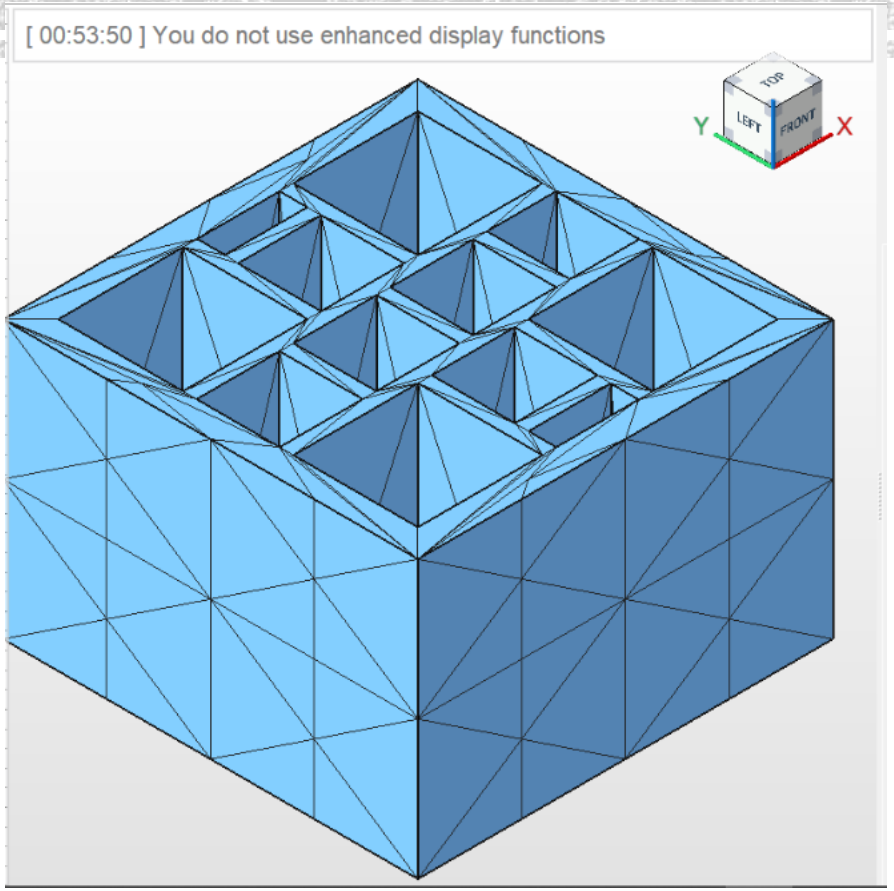
Cross Sectional Area: 342.189 mm^2

Infill Density: 38.021%

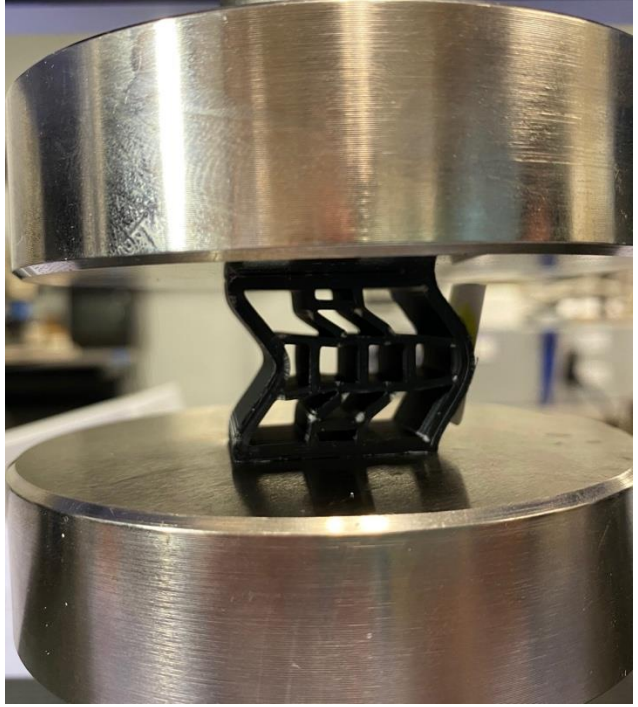
REPAIR: AUTODESK NETFABB

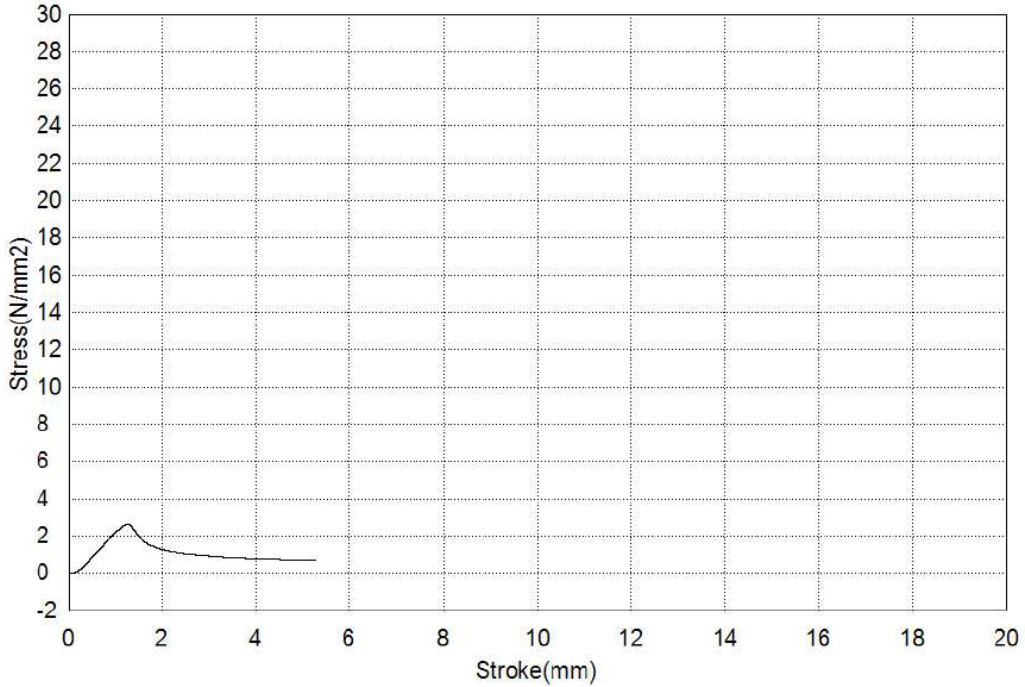


Before Repair Triangles 252



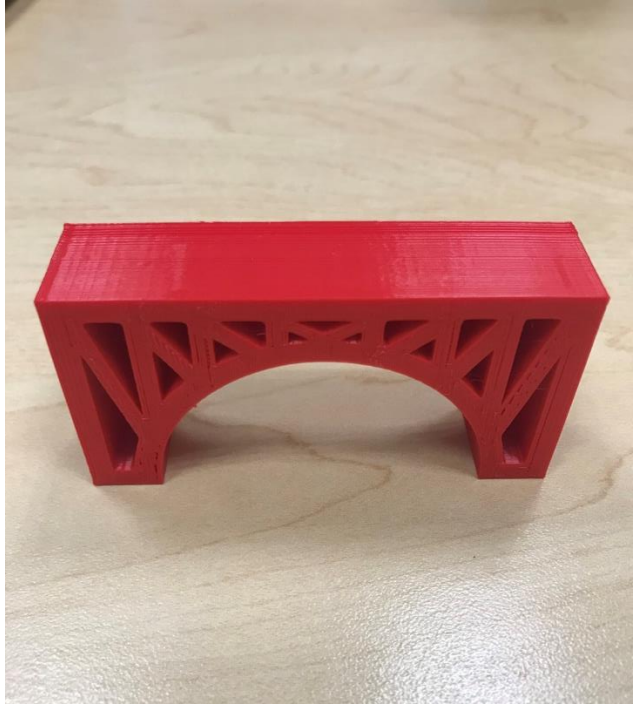
After Repair: 572 Triangles

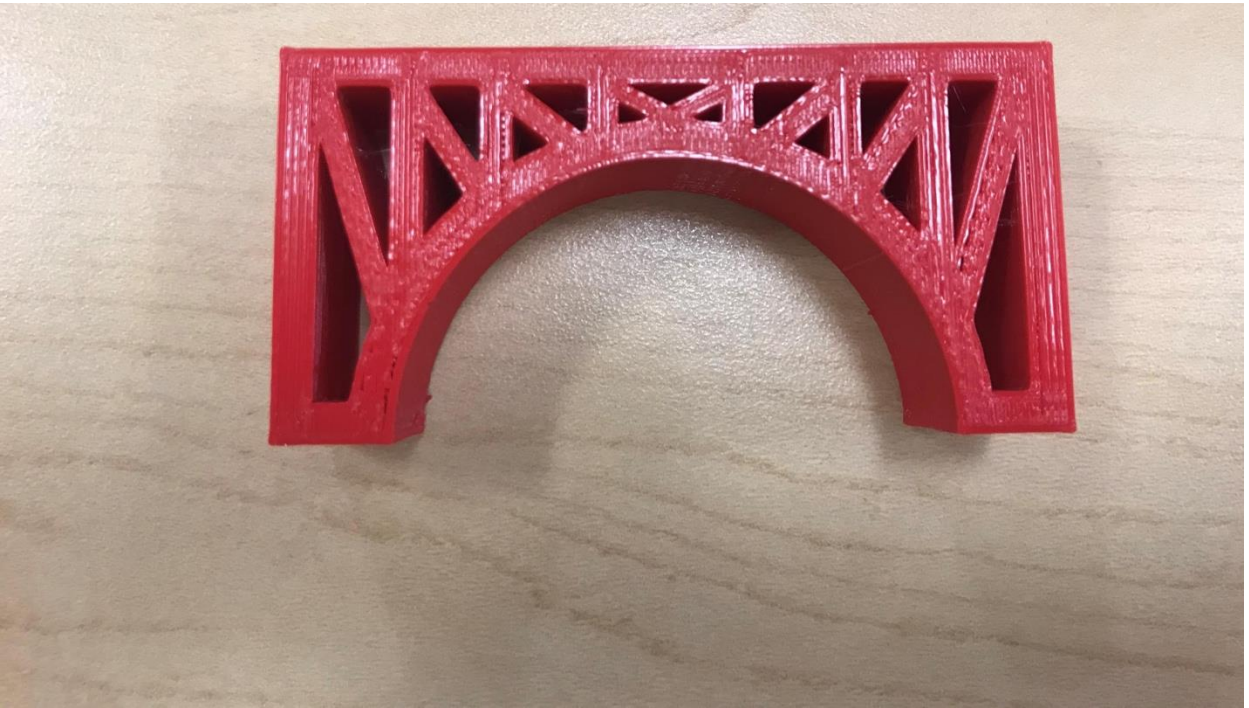




DUCTILITY TEST:

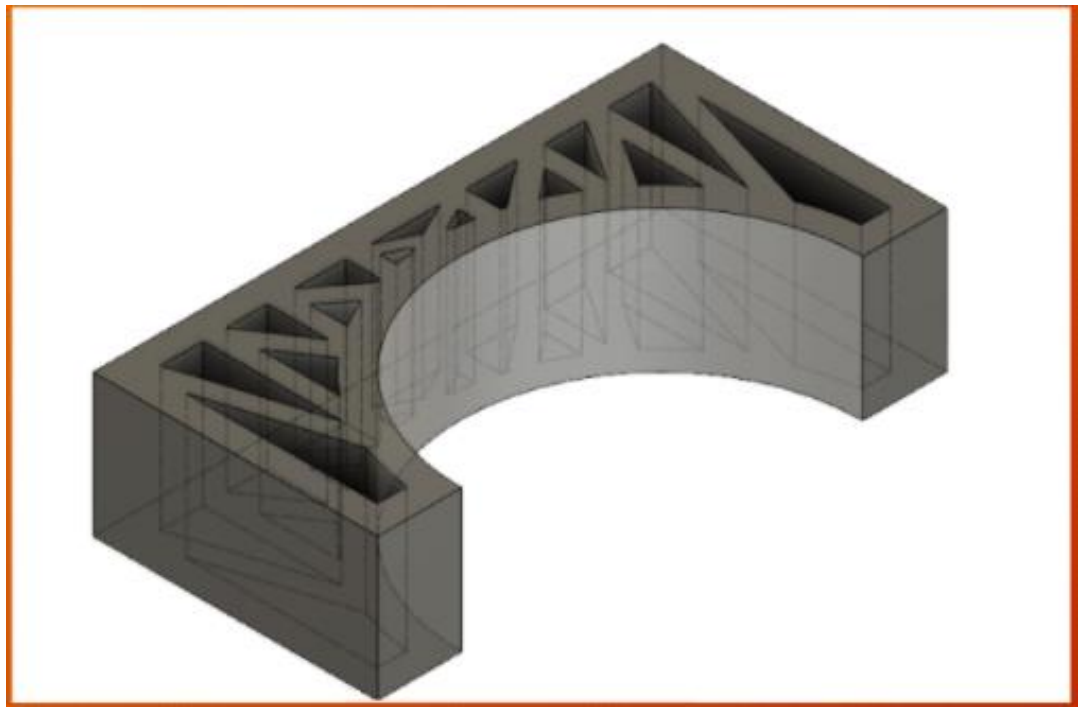
- Maximum Displacement : 5.3 mm
- Weight of the block: 7 gm
- Ductility-weight ratio: 0.757 mm/gm





LOAD BEARING SPECIMEN DESIGN

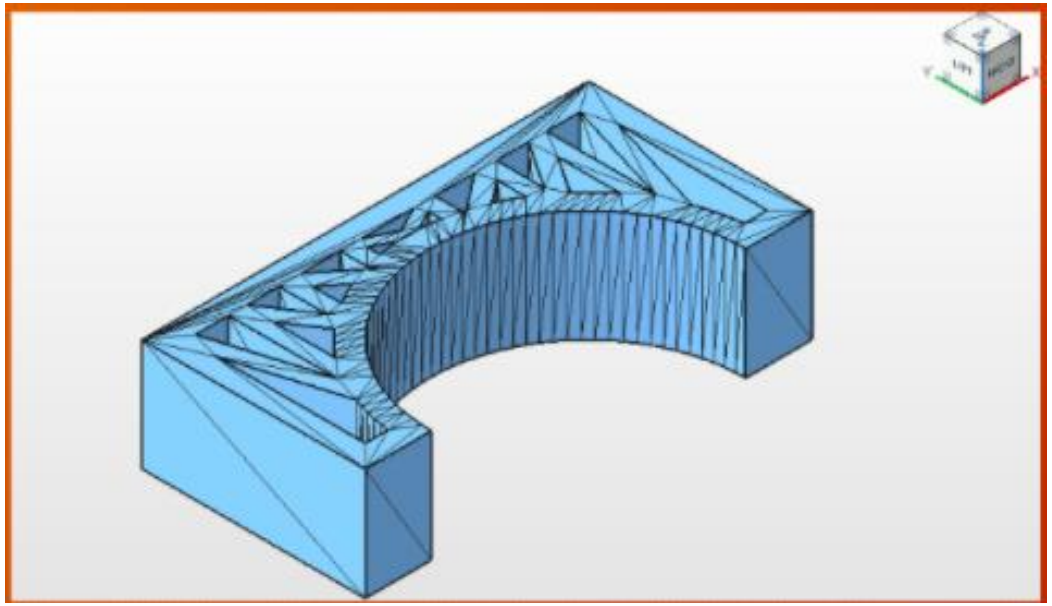
- Truss Design
- High strength to weight ratio



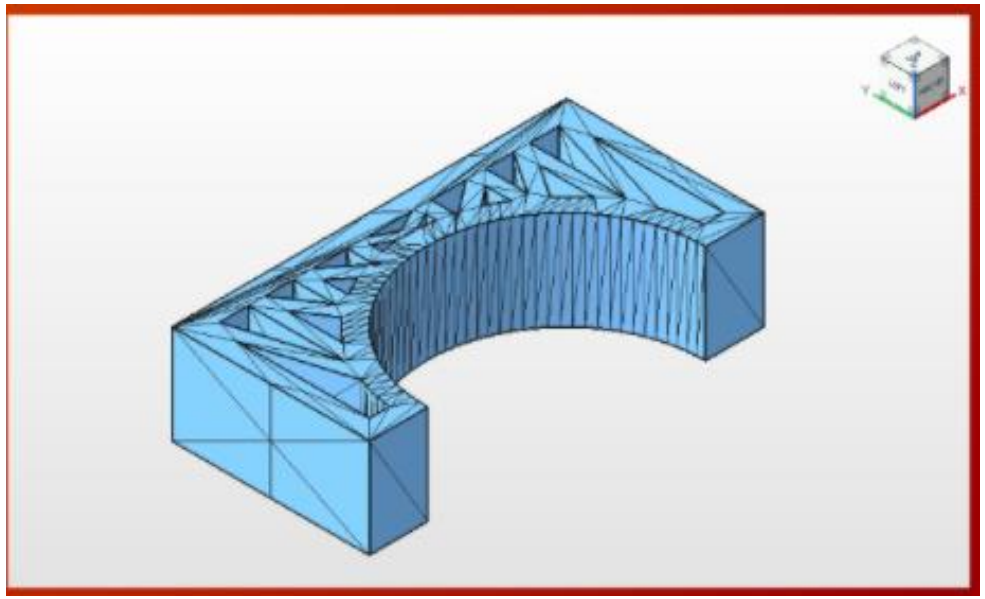
3D MODEL DEVELOPMENT SPECIFICATION

- Cross sectional Area : 1467. 961 mm^2
- Beam Thickness 3 mm
- Base, Deck ,Wall, Arch : 4 mm

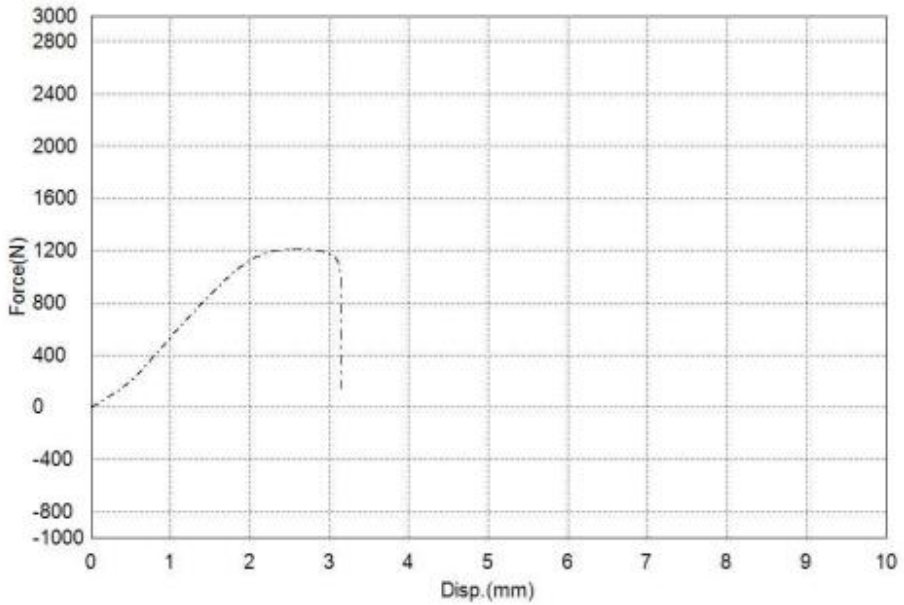
REPAIR: AUTODESK NETFABB

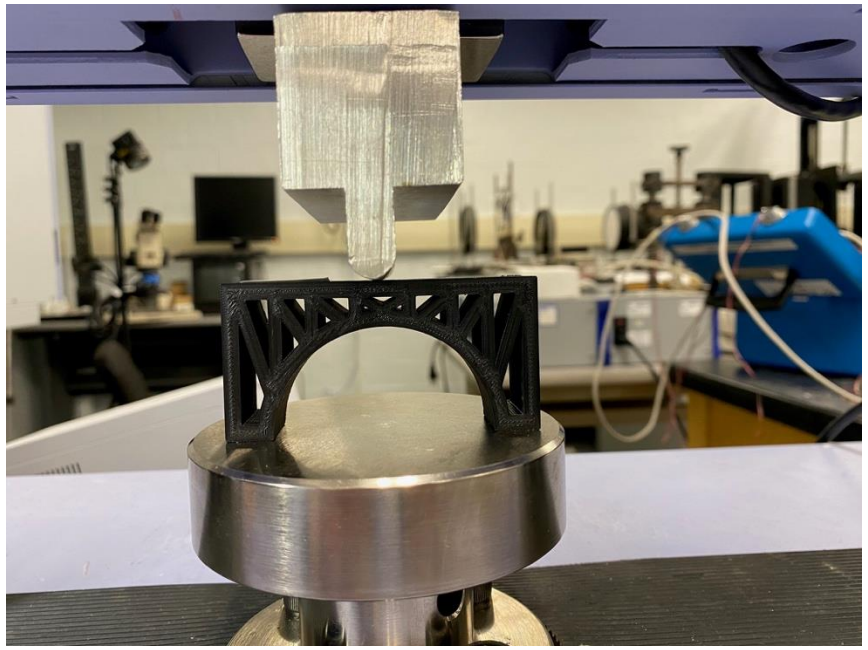


Before Repair:
876 Edges, 584 Triangles



After Repair:
993 Edges, 662 Triangles



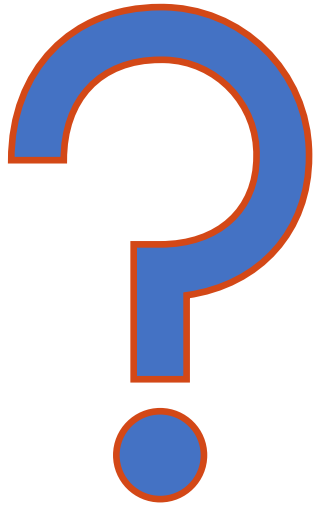


LOAD BEARING TEST:

- Failure Point: 1200 N
- Displacement: 3.2 mm
- Mass: 29 gm
- Load bearing to Mass ratio: 41.379 N/g

SUMMERY & CONCLUSION

- Practical Experience of Fabrication of FDM parts.
- Real life challenges like alignment of the parts
- Introduction to stl. file repair by Autodesk Netfabb
- Impact of Infill and structural designs on mechanical properties.



QUESTIONS?