Lunar Terrain Vehicle (LTV)

Tarleton State University | Mayfield College of Engineering | RELLIS Campus
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Background

Our Project is about the challenging mission to revolutionize the way we transport astronauts and supplies on the lunar surface, which will be achieved by the introduction of the Lunar Terrain Vehicle (LTV). The lunar terrain is famous for its extreme changes in elevation, and the changes in temperature, low gravity and the regolith that has very abrasive properties.

Objective

The main objective for the Lunar Terrain Vehicle (LTV) project is to research, design, and develop a lightweight, cost effective, and durable transportation system for traversing the lunar terrain. The end product is expected to be a vehicle that can withstand the lunar terrain for an extended period of time and do so reliably, and while under the constraints of cost, weight, and power.

This semester's objective is to focus on the wheel design of the LTV, specifically looking at different tread patterns, widths, and support structures. The goal is to optimize these aspects about our wheels to achieve the optimal traction, and stability. With these aspects being optimized, it will lay a foundation for further development of the LTV as a whole. The ultimate goal of our project is to deliver a complete prototype ready for the lunar terrain.

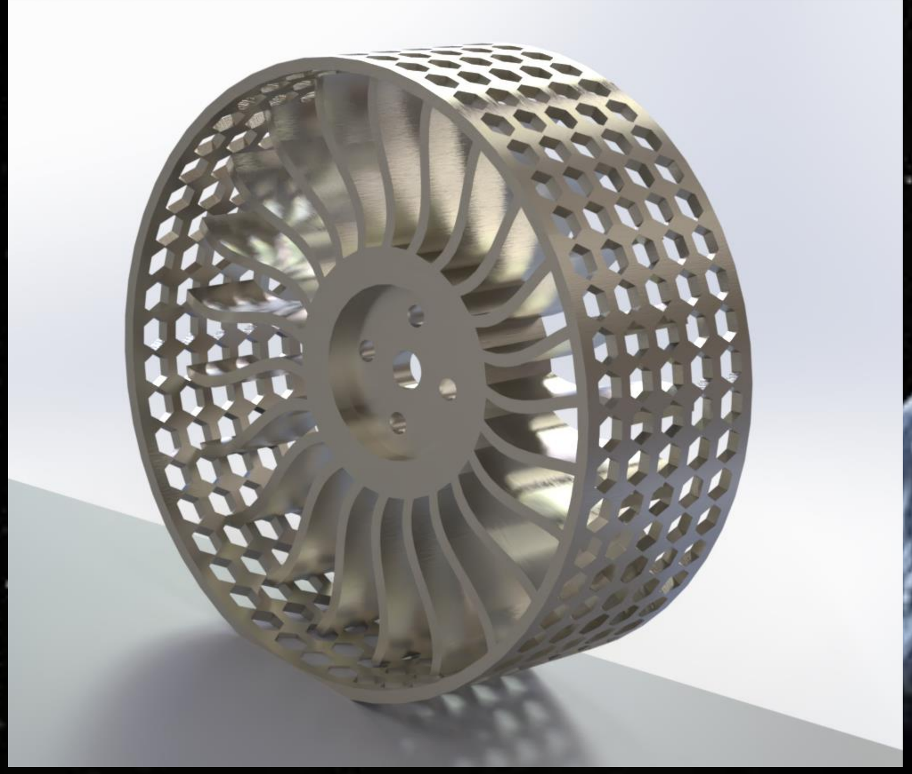
Conclusion

The design for the wheels of the LTV are tailored for the rugged lunar environment providing durability, stability and traction. Using a SMA (Shape Memory Alloy) material like NiTinol that has self-healing and super elastic properties, provides the wheels with lightweight, long-lasting material, while our different tread designs maximize traction and prevent slippage on the regolith. By undergoing extensive testing under lunar simulated conditions, we can refine aspects of our designs and allow the LTV wheel to become the best choice for the future of lunar travel.

Future Considerations:

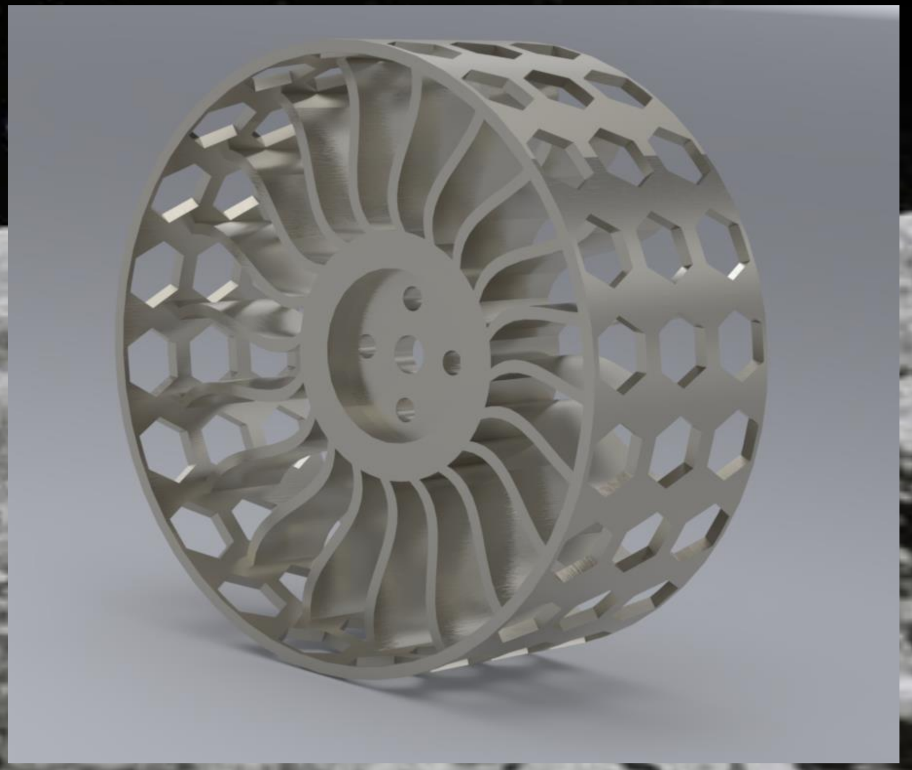
-Implement the deformable property to our wheel designs
-Refine how our wheels attach to the motors
-Testing and development of hyper deformable wheel with newly acquired materials
-Have new dynamic FEA simulations of our updated wheel designs

Wheel Designs



Design 2

Design 3



Design 1

Control

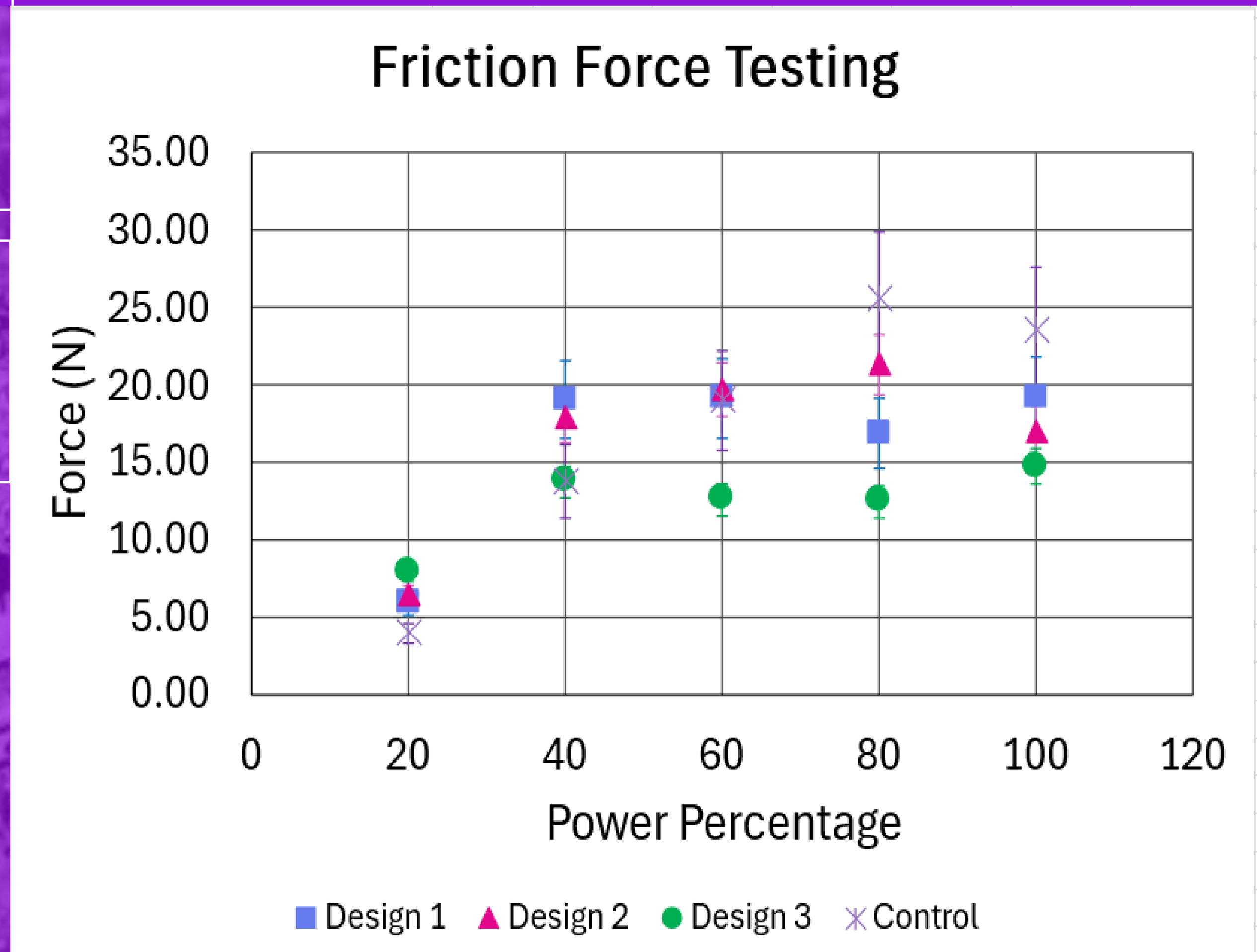
Testing

Time and Force Results: (60% Power)

Design 1 Time: 1.36 seconds
Design 2 Time: 1.18 seconds
Design 3 Time: 1.10 seconds
Control Time: 1.17 seconds

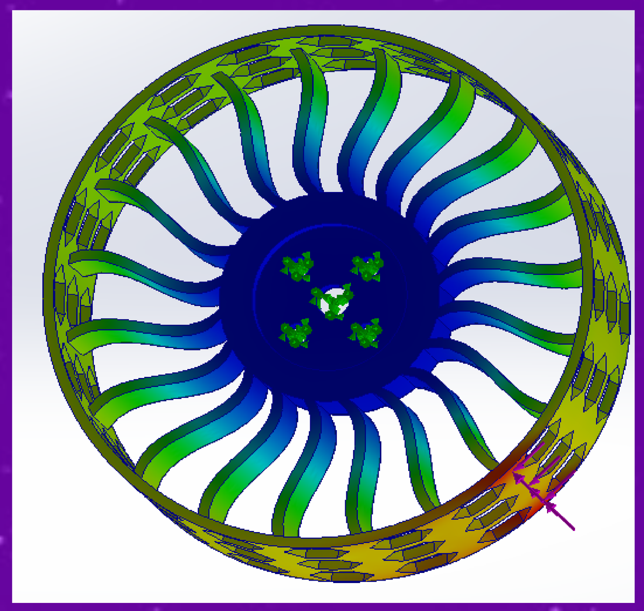
Design 1 Force: 19.13 N
Design 2 Force: 19.73 N
Design 3 Force: 12.6 N
Control Force: 19.03 N

Design 1 Sinkage: 2.5 cm
Design 2 Sinkage: 2.23 cm
Design 3 Sinkage: 2.07 cm
Control Sinkage: 2.77 cm

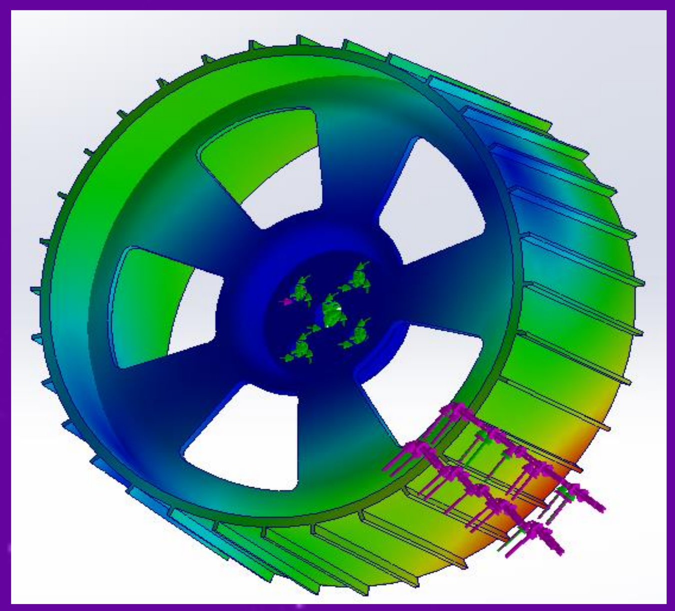


FEA (Finite Element Analysis)

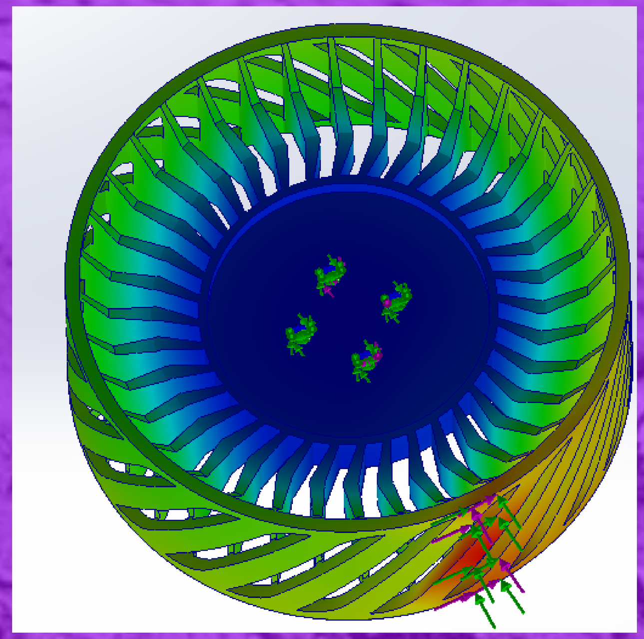
Normal Force on All Wheels: (735.75N), Friction Force on All Wheels: (441N) (Resulted Displacement Shown for All Wheels)



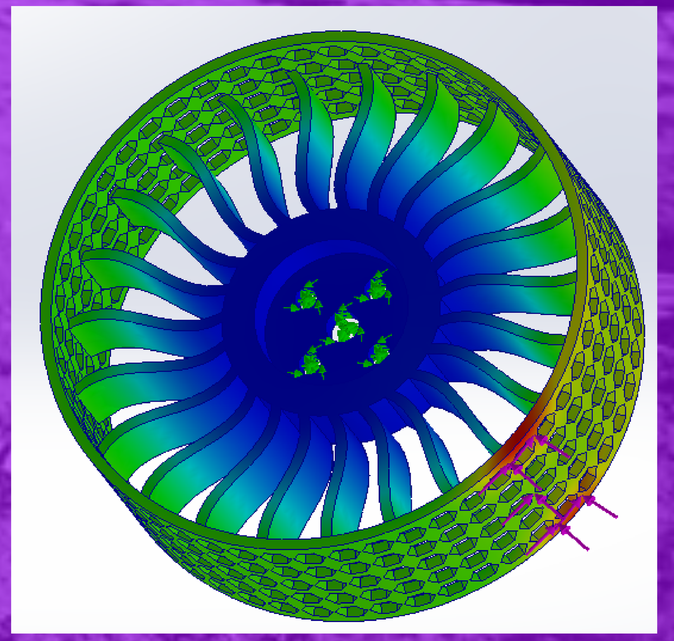
Design 1
-Minimum Displacement- 0.00mm
-Maximum Displacement- 0.03947mm
-Minimum Stress- 5.762x10^3 N/m^2
-Minimum Strain- 5.333x10^-8
-Maximum Strain- 8.398x10^-5



Control
-Minimum Displacement- 0.00mm
-Maximum Displacement- 0.23885mm
-Minimum Stress- 8.359x10^3 N/m^2
-Minimum Strain- 1.081x10^-7
-Maximum Strain- 1.56x10^-4



Design 3
-Minimum Displacement- 0.00mm
-Maximum Displacement- 0.02475mm
-Minimum Stress- 5.802x10^3 N/m^2
-Minimum Strain- 5.954x10^-8
-Maximum Strain- 1.33x10^-4



Design 2
-Minimum Displacement- 0.00mm
-Maximum Displacement- 0.04305mm
-Minimum Stress- 1.597x10^3 N/m^2
-Minimum Strain- 2.337x10^-8
-Maximum Strain- 8.751x10^-5

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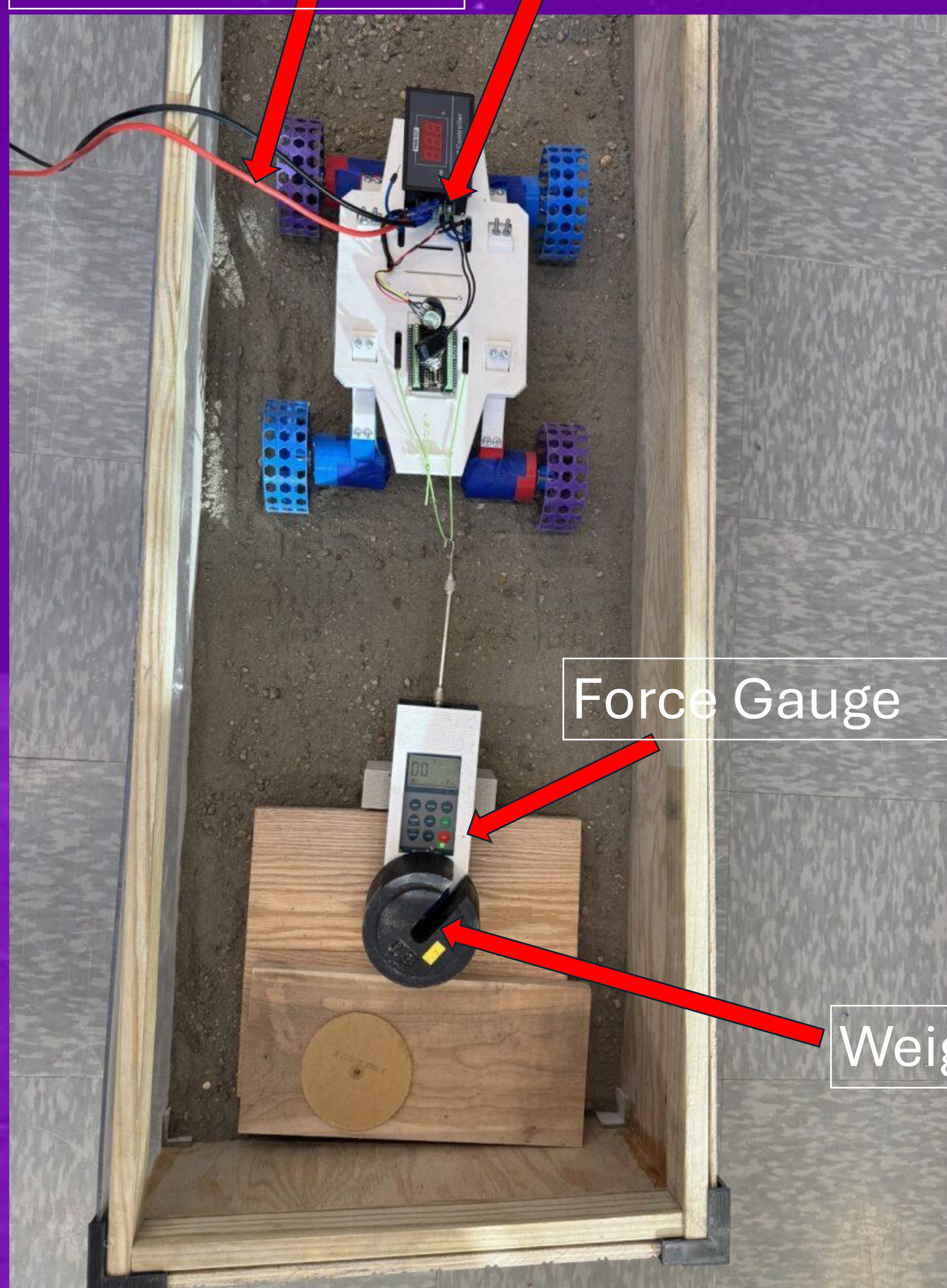
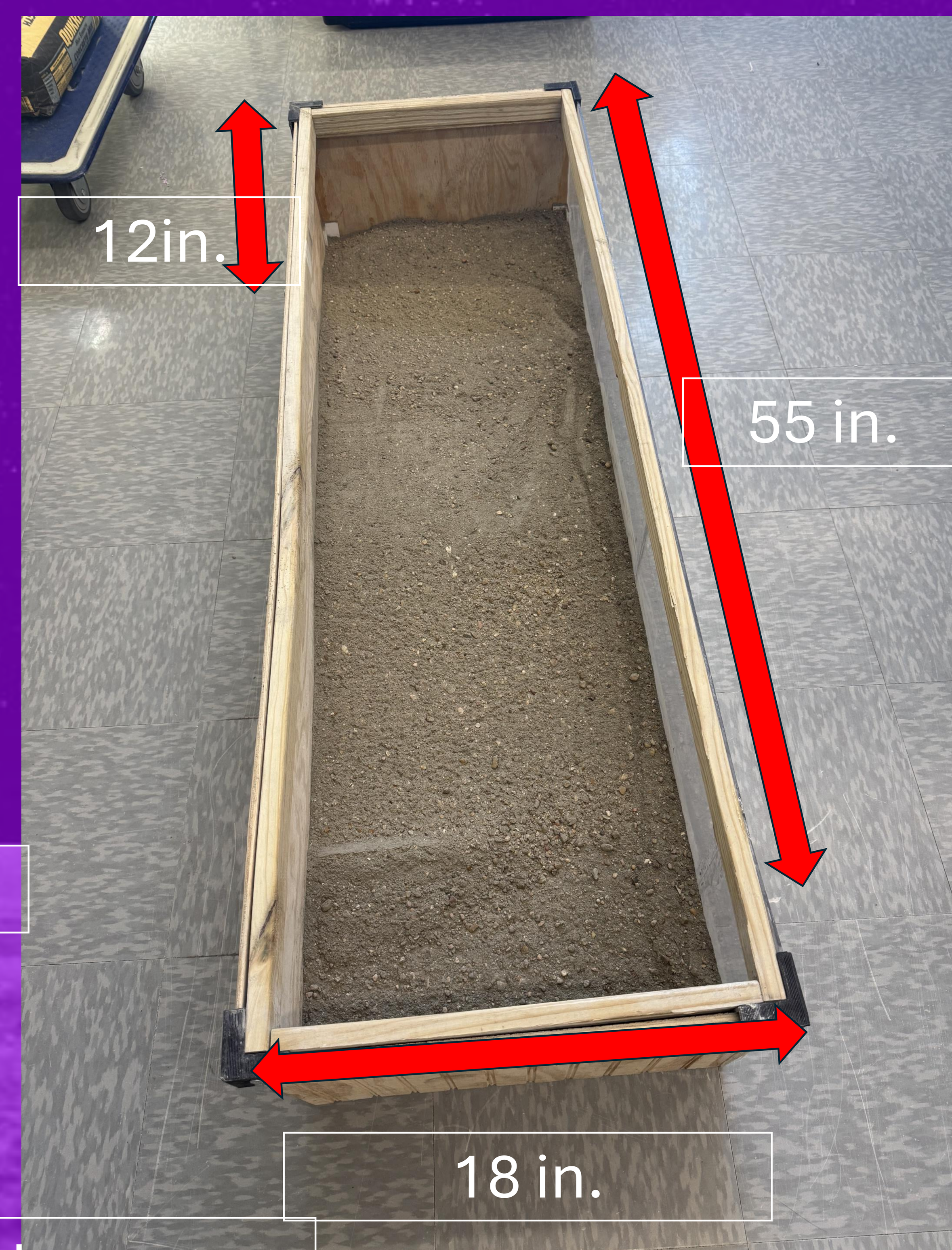
Test Bed





Test Bed After Time Testing for Design 1, Control, and Design 3.

LTV Design