HYPERXITE
Pod Transport Vehicle

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Executive Summary

U.S. transportation sector, which includes cars, trucks, planes, trains, and boats, emits 1.9 billion tons of CO_2 annually [1]. The Hyperloop is a clean and sustainable alternative form of transportation, relying solely on electric power while being able to travel up to 760 MPH, about 3 times the speed of a high-speed passenger train.

Established in 2015 at the University of California Irvine, HyperXite is a team of undergraduate students endeavoring to build a small-scale Hyperloop pod.

As such we require a vehicle that will allow us to easily transport our 300kg pod to different locations in addition to serving as a workstation to service and assemble the vehicle during the building stages.

Requirements/Constraints

Requirements

- Shall support and transport a 300 kg pod
- Shall align the HX Pod with the I beam track
- Shall cost less than $600
- Must be less than 5 ft in Width
- Must be less than 7 ft in Length
- Must have a minimum working vertical clearance of 12 inches
- Abides by a factor of safety of 2 according to EH & S standards

Attributes

- Height adjustability
- Easy to utilize
- Easily manufactured
- Easy to service a vehicle on chassis

Procedure

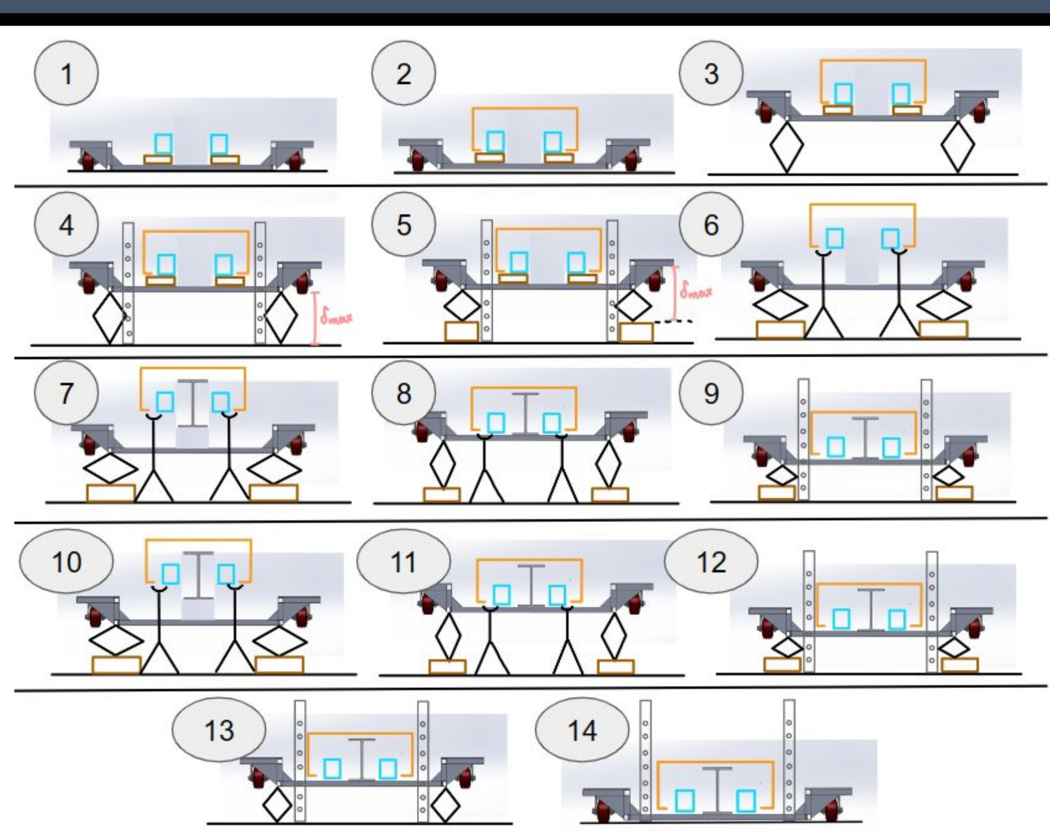

Figure 1: Intended Vehicle Operation, Pod Servicing, and LIM Integration Procedure

Key Features of Project

- Concept Selection
  - Compared multiple iterations of each component
    - Cost vs functionality
    - Custom vs Existing design
- Design
  - Refining model based on simulation results
    - Adding gussets
  - BOM integration
  - Gray Box Diagram
- Simulation Iteration
  - Verified FOS and yielding
    - Max stress and displacement
  - Risk Mitigation
    - Common points of failure
- Manufacturing
  - In house via Machine Shop and Welding
  - Inventory Data Sheet
  - System verification plan
    - Increase load and examine joints for deformation

Figure 2: Measuring Steel Beams to Cut

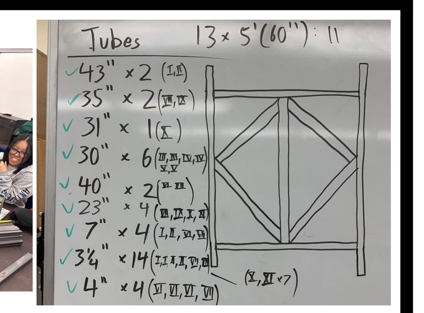

Figure 3: List of Beam Lengths and Quantity

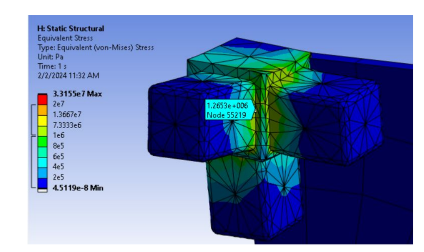

Figure 4: Simulation Result of Common Failure Point

Design Analysis/Iteration

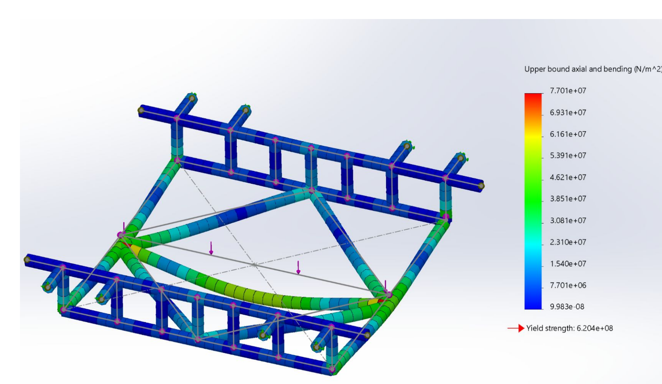

Figure 5: Stress on first iteration of chassis

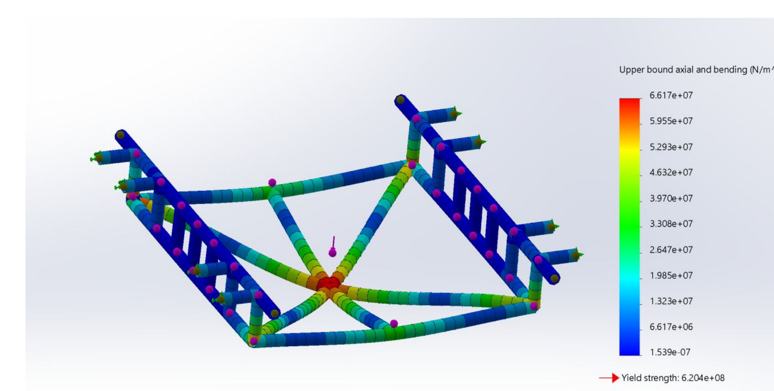

Figure 6: Stress on Second iteration of chassis

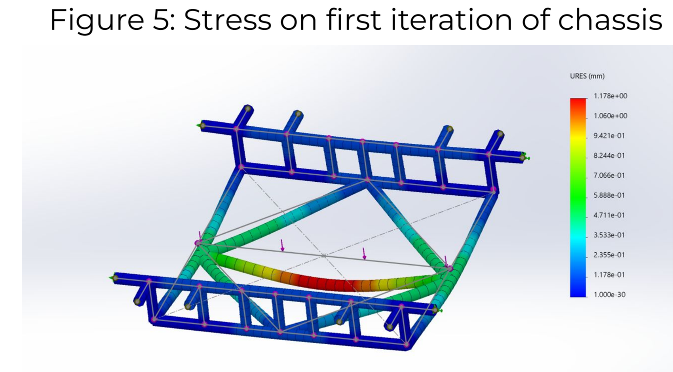

Figure 7: Displacement on first iteration of chassis

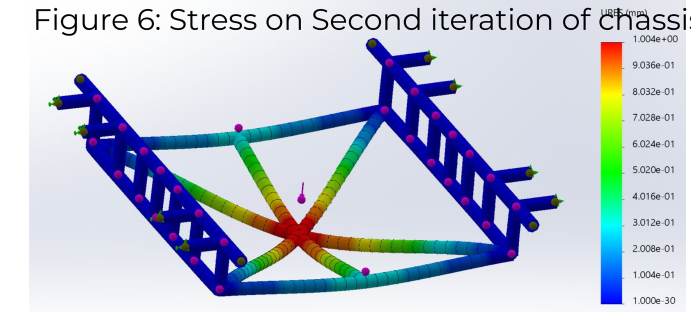

Figure 8: Displacement on first iteration of chassis

Simulations

- Simulated 2980 N load to simulate 300kg pod on PTV

Results

- Similar Displacement of around 1mm
- Similar Stress and Factor of Safety of around 9

Decision

- Choose the First iteration of chassis as it provided greater room to service the pod while on the Pod Transport Vehicle

Conclusion/Lessons Learned

MAE 151A Team Contribution:
- Full Product Design and Manufacturing

Future Improvements:
- Hydraulic Lift and Support System
  - Easier fail-safe implementation and actuation
  - Can be utilized on uneven terrain
  - More compact system

Impacts:
- Supports further testing of scaled hyperloop pods
- Allows for safe transportation, service, and assembly of pods

Final Design

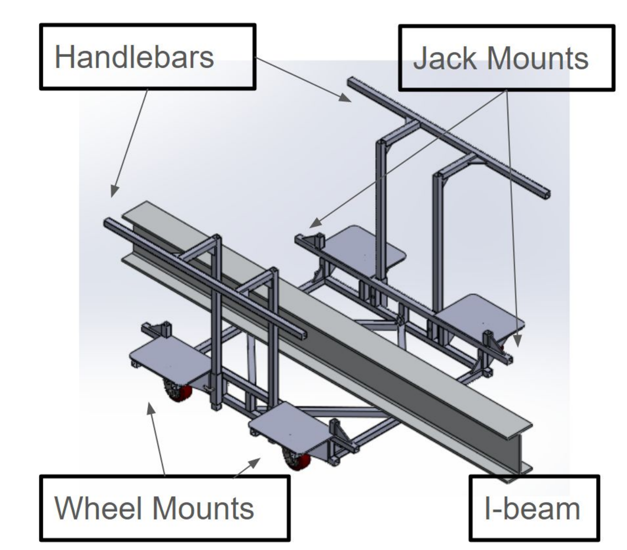

Figure 9: Key Features & Final Design

The final design consists of a main structure of 1" x 1" square, steel tubes that support the I-beam the pod rests on. Components of this main chassis include four wheel mounts for swivel casters, four jack points, and two sections of handlebars to safely steer the PTV. The vehicle is designed to allow room to perform maintenance on as well as transport the pod.

References

- AWS Committee on Welding Qualification ; under the direction of AWS Technical Activities Committee. Standard Welding Procedure Specification (WPS) for Shielded Metal Arc Welding of Galvanized Steel : 10 through 18 Gauge, Irvine, CA :American Welding Society, 199
- "Transportation Replaces Power in U.S. As Top Source of CO2 Emissions." *Yale E360*, 2017, e360.yale.edu/digest/transportation-replaces-power-in-u-s-as-top-source-of-co2-emissions .
- Tech Committee. *EHW Rules & Regulations*. 16 Feb. 2024.

Acknowledgements

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