NASA HUMAN EXPLORATION ROVER CHALLENGE

Cosmic Javelinas

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RECAP

In the previous semester, the Cosmic Javelinas designed a Rover to compete in the HERC. Features include: Ackerman steering, reclined seats, double wishbone suspension, and rear wheel pedals. This semester, the team built a half-scale prototype of the model.

BACKGROUND

NASA Human Exploration Rover Challenge (HERC): Includes a total of 10 obstacles with an 8-minute limit

HPV Division: Teams design and build human-powered rovers to overcome various terrains.

Obstacles & Terrain

Obstacles in the competition test the strength and adaptability of the rover. The course includes obstacles with steep inclines/drops, steering capability, and different types of terrain(sand, gravel, etc.)

Figure 1: Uneven terrain with alternating terrain elevations

Figure 2: Ascending and descending terrain; ramps.

Figure 3: Heavily reliant on steering capability

Figure 4: Traversing through gravel/pebble terrain

OBJECTIVES

Construct a human-powered rover to complete the 10 obstacles in under 8 minutes. Goals to achieve are:

- Total weight of the rover under 130 pounds
- Turning radius under ten feet
- Braking system can hold drivers on 30-degree incline
- 12-inch ground clearance to appendages of drivers
- Maximum Dimensions: 5 feet $LxWxH$

3-D MODEL

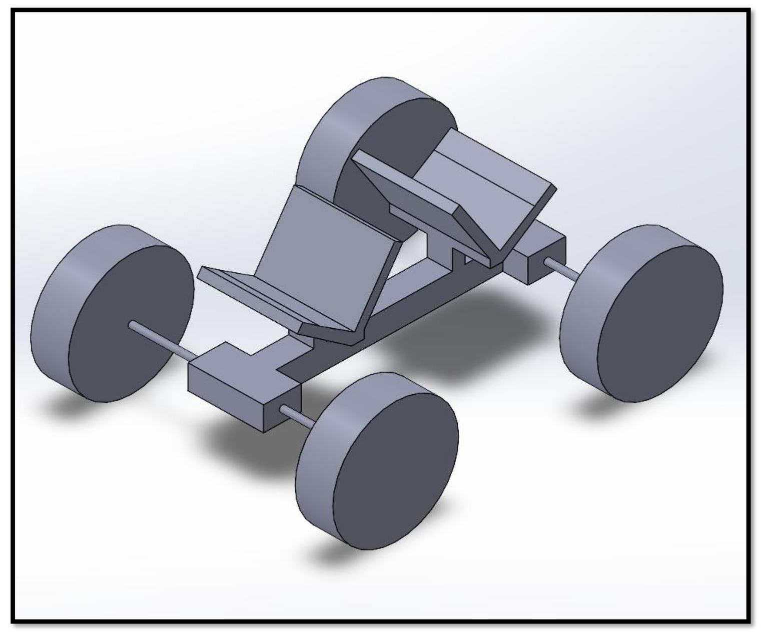

Figure 5: First rover concept

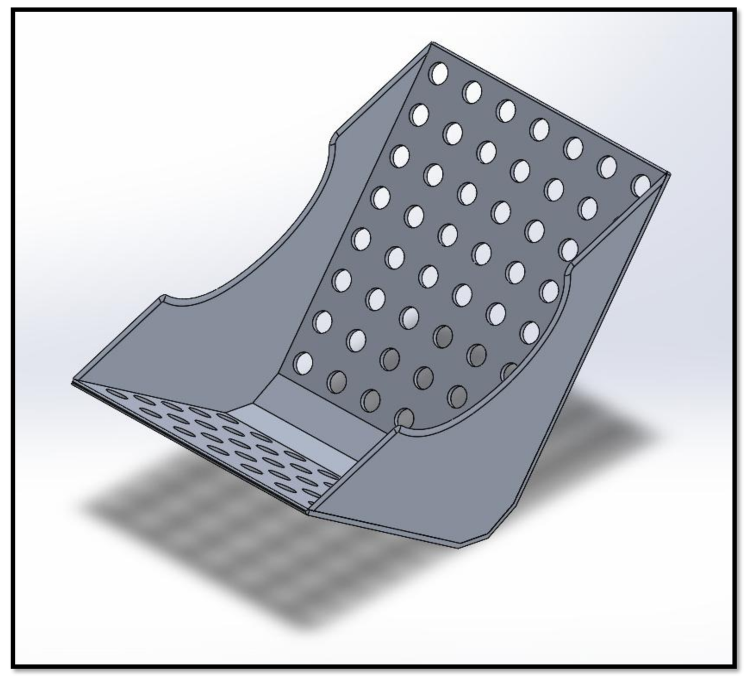

Figure 6: Final Seat Concept

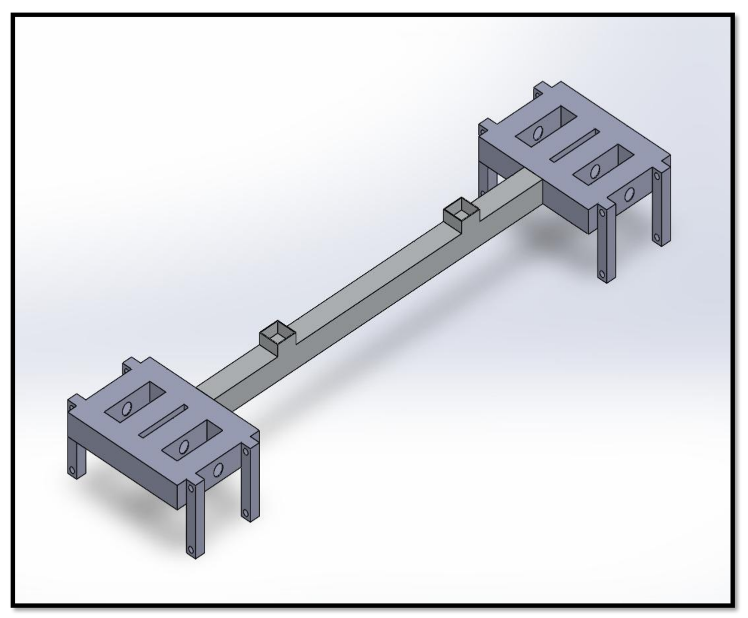

Figure 7: Final frame design

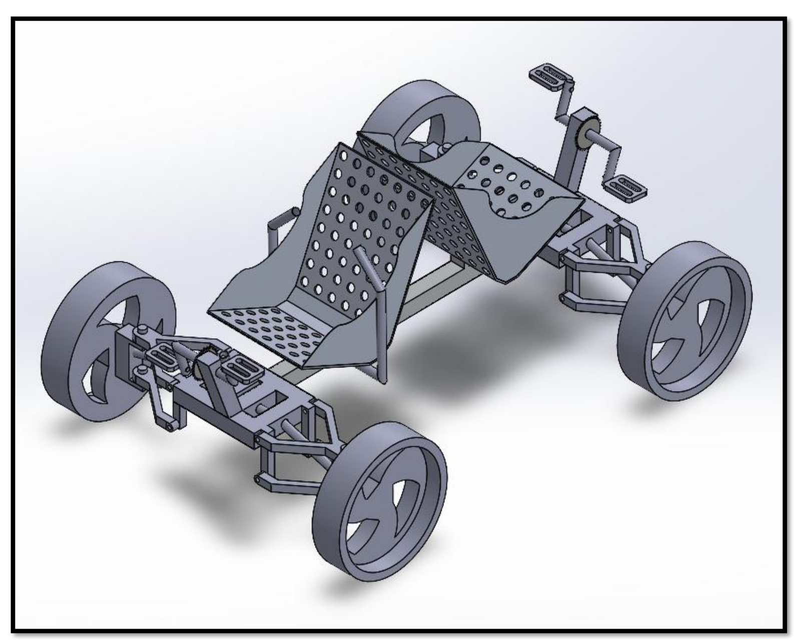

Figure 8: Final rover concept

OPTIMIZATIONS

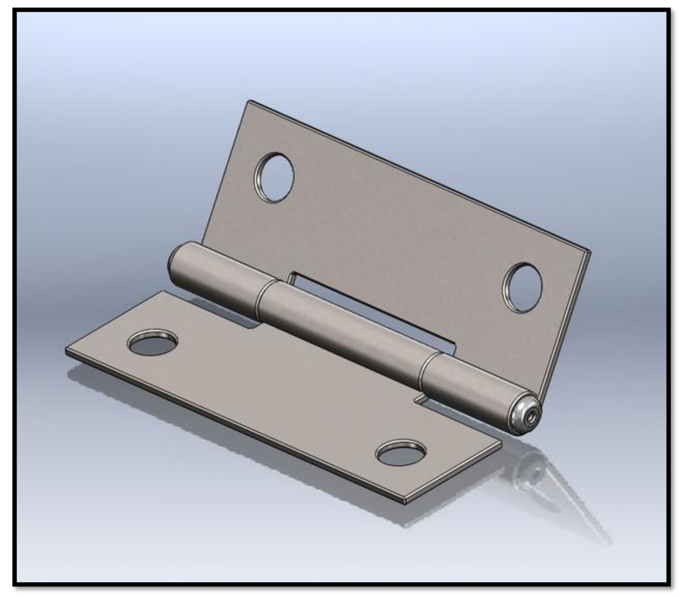

Figure 9: Hinge example

Hinge: In the official HERC handbook, creating a rover that can fold below maximum dimensions is not against the rules. Allowing a longer wheelbase. Reference [1]

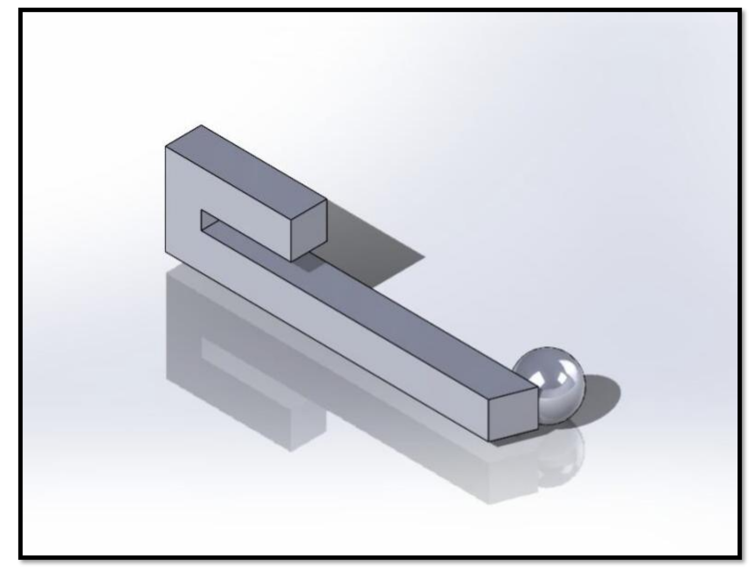

Figure 10: Locking mechanism

Locking Mechanism: To maintain the rover's folded and unfolded positions, latches were designed to secure the positions in place.

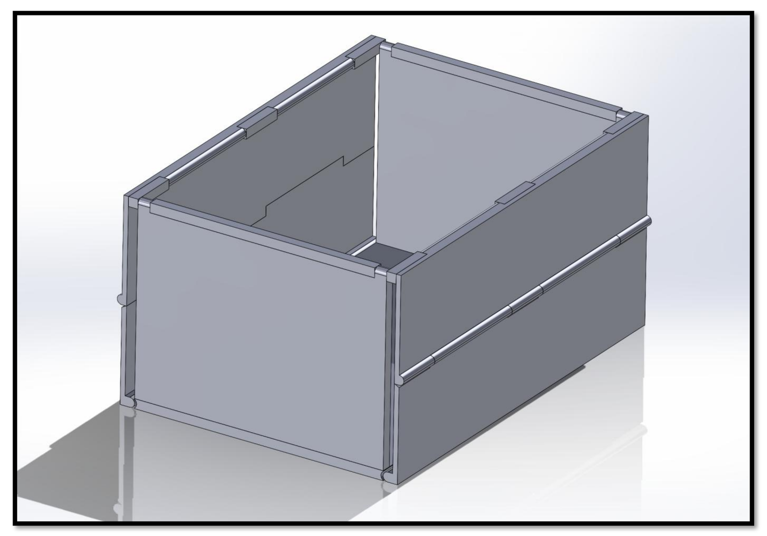

Figure 11: Collapsible crate

Collapsible Crate: The rear seat is interchangeable with a crate for additional storage. The crate is collapsible for easy transportation.

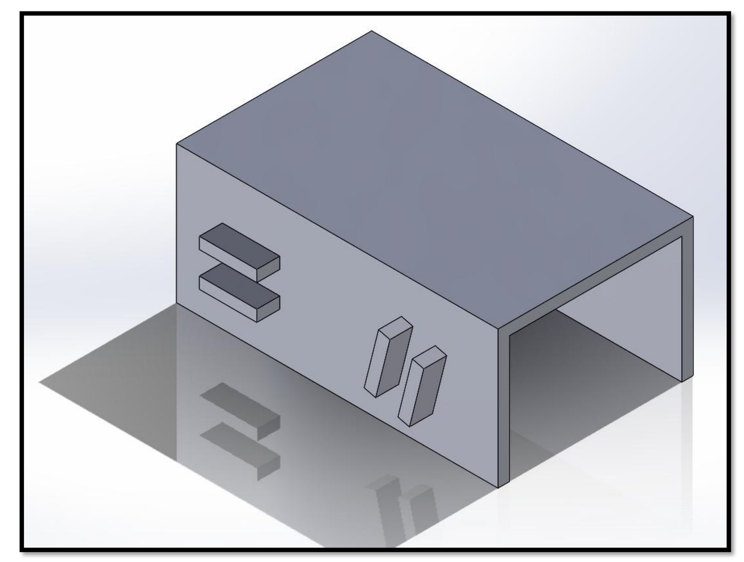

Figure 12: Weld cover

Weld Cover: Designed with the intent to relieve any possible stress acting on the hinge. This was done to prevent the pin inside the hinge from failing.

DESIGN SPECIFICATIONS

With the new modifications, the dimensions of a full-scale rover are:

- 61.03”x44”x28.65” (unfolded)
- 35”x44”x37.5” (folded)
- Final material is Aluminum 6061A
- Final weight is 91.22 lbs.

The dimensions for the half-scale model are:

- 30.5" x 22" x 14.3" (unfolded)
- 17.5" x 22" x 18.75" (folded)
- Material used:
  - Steel for the frame
  - Copper for control arms
  - PLA for wheels, pedals, sprockets, and crate

CONCLUSION

TRL 6

- System/subsystem model or prototype demonstration in a relevant environment (ground or space)

Technical Readiness Level (TRL) – 6. The objectives have been met, and the half-scale rover has been successfully built. Incorporating the optimizations designed this semester was completed. The biggest challenges faced were difficulty welding. The original frame is designed for aluminum, which requires gases for welding that our school does not have. Half scale is made from steel, and flux core was used for welding. Funding comes from the Texas Space Grant Consortium, sponsorships, and university support.

ACKNOWLEDGMENTS

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NASA Mentor: George Salazar, P.E., ESEP, LSMIEEE

Machinist: CJ

REFERENCES & QUESTIONS

[1] “Free CAD Designs, Files & 3D Models | The GrabCAD Community Library,” *Grabcad.com*, 2025. https://grabcad.com/library/hinge-2--1

[2]” Technology Readiness Levels,” https://www.nasa.gov/directorates/somd/space-communications-navigation-program/technology-readiness-levels/, 2023.

[3]”Human Exploration Rover Challenge,” https://www.nasa.gov/learning-resources/nasa-human-exploration-rover-challenge/, 2024.

[4] J. Vogel, “Tech Explained: Ackermann Steering Geometry,” *Racecar Engineering*, Apr. 06, 2021. https://www.racecar-engineering.com/articles/tech-explained-ackermann-steering-geometry/

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