# NASA HUMAN EXPLORATION ROVER

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## ABSTRACT

The responsibility of the NASA Human Exploration Rover Challenge (HERC) team is to produce a rover to complete a series of obstacles and mission tasks (Figure 1). Specific needs and requirements are presented to the team to create a competitive rover and earn points. The competition is hosted by NASA, where NASA is looking for new and innovative ideas on generating rover designs under specific criteria. As Senior Design Engineering students, the team would have competed at the NASA Marshal Flight Center in Alabama in April 2022. Due to Covid restrictions, though, the live competition was cancelled. Instead, a local option was provided so the team could still compete. Along side the NASA competition, the team has completed a series of assessment and documents to better understand the design process of a product.

## CUSTOMER NEEDS & SPECS

**Combined Needs List**

- Rover will be light weight.
- Rover will maneuver the course (Figure 17)
- Team will assemble the rover.

**Customer Specifications**

- Rover must be <170lbs (Figure 4)
- Rover must fit in a 5x5x5 foot cube
- Rover must complete the course in under 8 minutes.
- Team must assemble the rover in under 2 minutes.

## CONCEPTS

Figure 1 shows a rough sketch of the team's final design. This design focuses on tandem seating and provides the drivers flexibility with operational functions, four-wheel drive, and task completion.

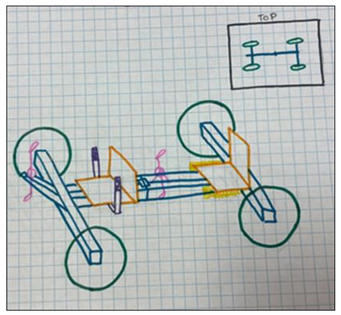


**Figure 1: Final Design Sketch**

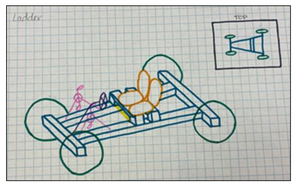


**Figure 2: Concept 1**

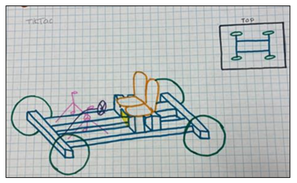


**Figure 3: Concept 2**

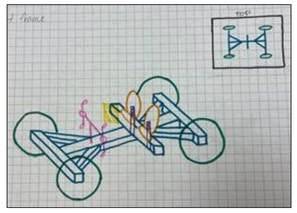


**Figure 4: Concept 3**

Figures 2-4 show other other concepts the team produced when brainstorming, based on the needs and specs.

## TESTING

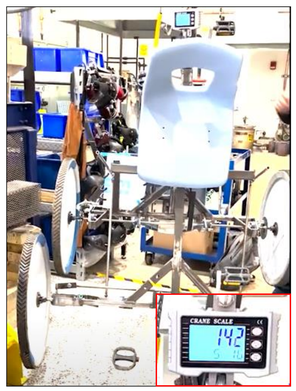


**Figure 5: Rover Weight**

**Figure 6: Virtual Reality Driving Simulation**

The team tested each component of the rover along the way. Figure 6 shows a virtual reality test. Finally, Figures 7-8 show the testing of different weights on the wheel.

**Figure 7: 260lbs Vertical**

**Figure 8: 160lbs Lateral**

## BUILD

Shown below, Figure 9-13, is the building of each subcomponent of the rover. This consists of wheels, steering, Task tools, drivetrain, and brakes.

**Figure 9: Wheels**

**Figure 10: Steering**

**Figure 11: Task Tools**

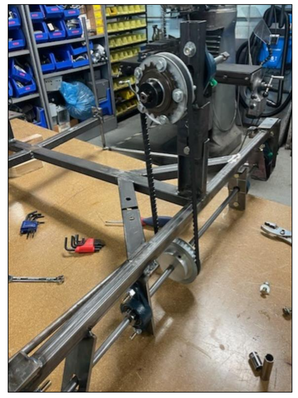

**Figure 12: Drivetrain**

**Figure 13: Brakes**

## FINAL DESIGN

After finishing and testing the rover's design, Figures 14 and 15 and making a few changes, the team had finalized the design and could prepare for traversing the course.

**Figure 14: First Final Design**

**Figure 15: Rover Testing**

## CONCLUSION

NASA cancelled the live competition again this year but provided teams with the opportunity to construct a limited course to demonstrate rover capability. Figure 17 shows the course design and Figure 18 shows the team, rover, and actual built course.

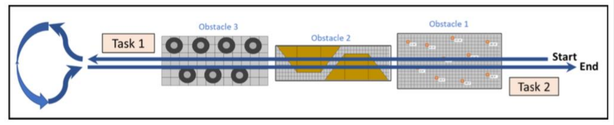


**Figure 16: NASA Competition Course**

**Figure 17: Final Course Run**

The team was able to traverse 2/3 of the course obstacles and complete both tasks within 6.02 minutes. The rover was 142 lbs., fit within the 5-foot cube, and was assembled in 28 seconds.

## LESSONS LEARNED

- The final rover will be far from the initial concepts.
- Focus on tool training early on.
- Designs don't always work the first time.
- Teamwork is essential to communication.
- Meet with outside sources.
- Don't be afraid to ask for help.

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