

AIM-UW Bash Guard



Background

Mining environments are dangerous with 31 fatalities and about 6000 injuries in the last year¹. Integrating AI mining equipment can lower these rates by minimizing the number of people in the mines.

AIM Intelligent Machines is investigating a precise method to track the position of the 980 wheel loader bucket, delivering real-time data for the AI to optimize its learning and control, while also ensuring long-term sensor durability in the harsh operating environments. Our team is tasked with developing a bash guard to protect the sensor. Additionally, the mounting location of the bash guard must be determined for an accurate bucket location.

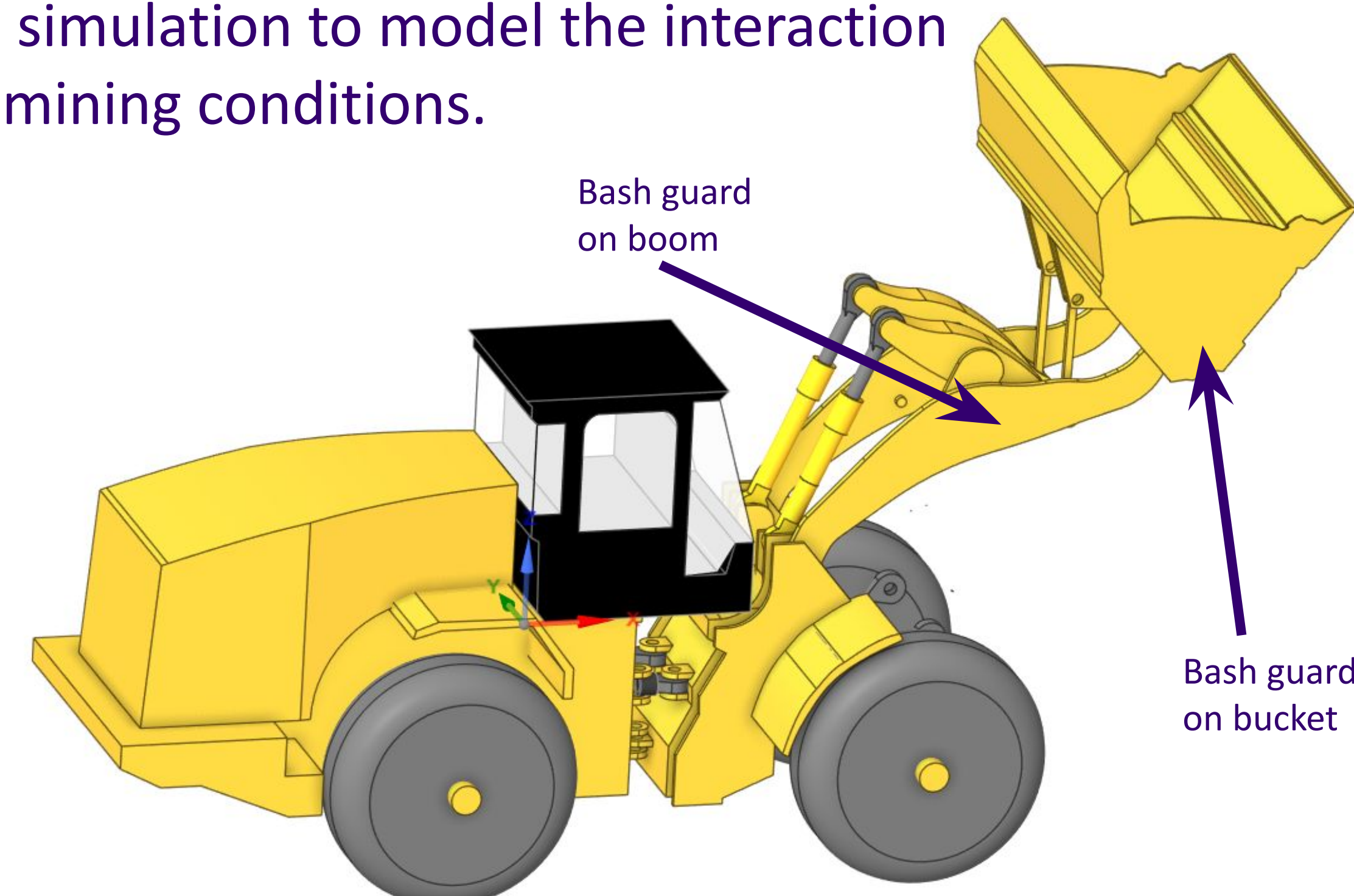


980 Wheel Loader²

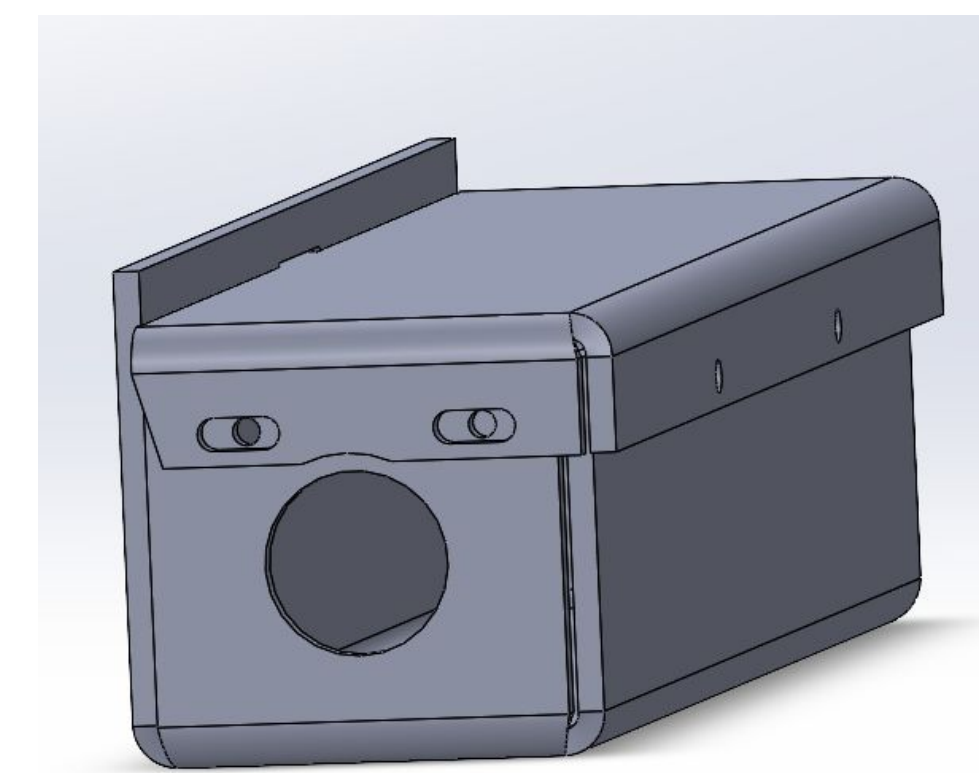
980 Wheel loader Simulation

Purpose

To track the location of the bucket, 2 sensors are needed: 1 on the bucket and 1 on the boom. These need to be protected from harsh mining conditions. The wheel loader CAD will be used with a physics simulation to model the interaction with the mining conditions.



Bash Guard Development



CAD

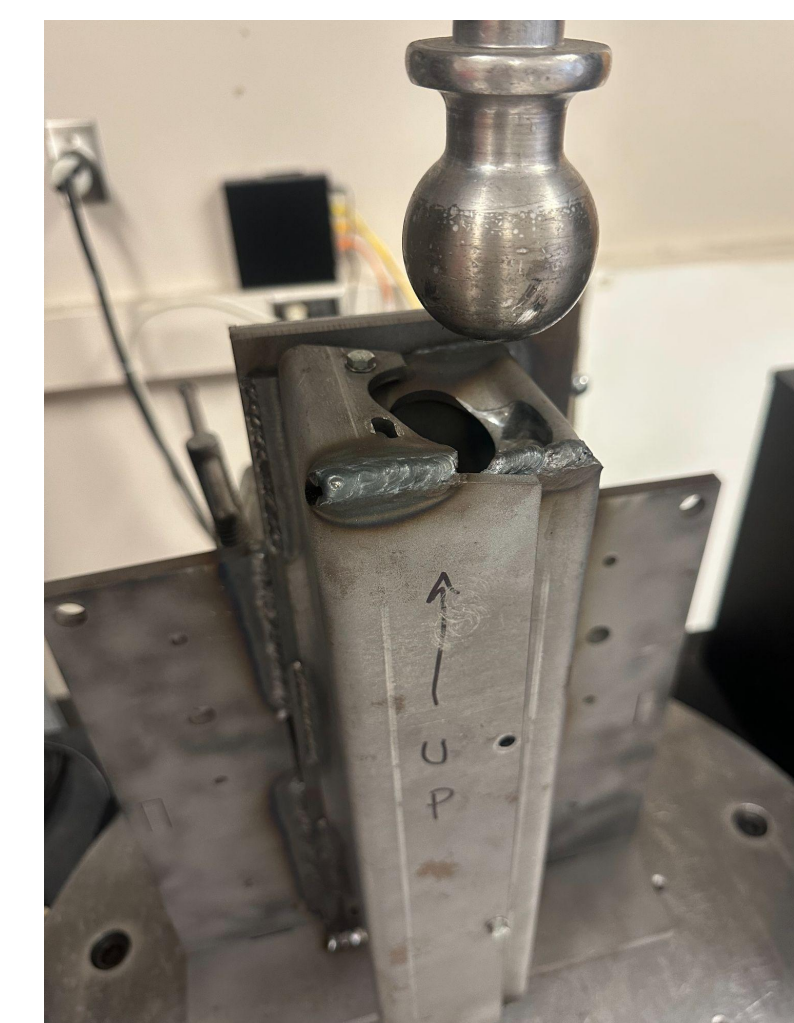


Initial Design

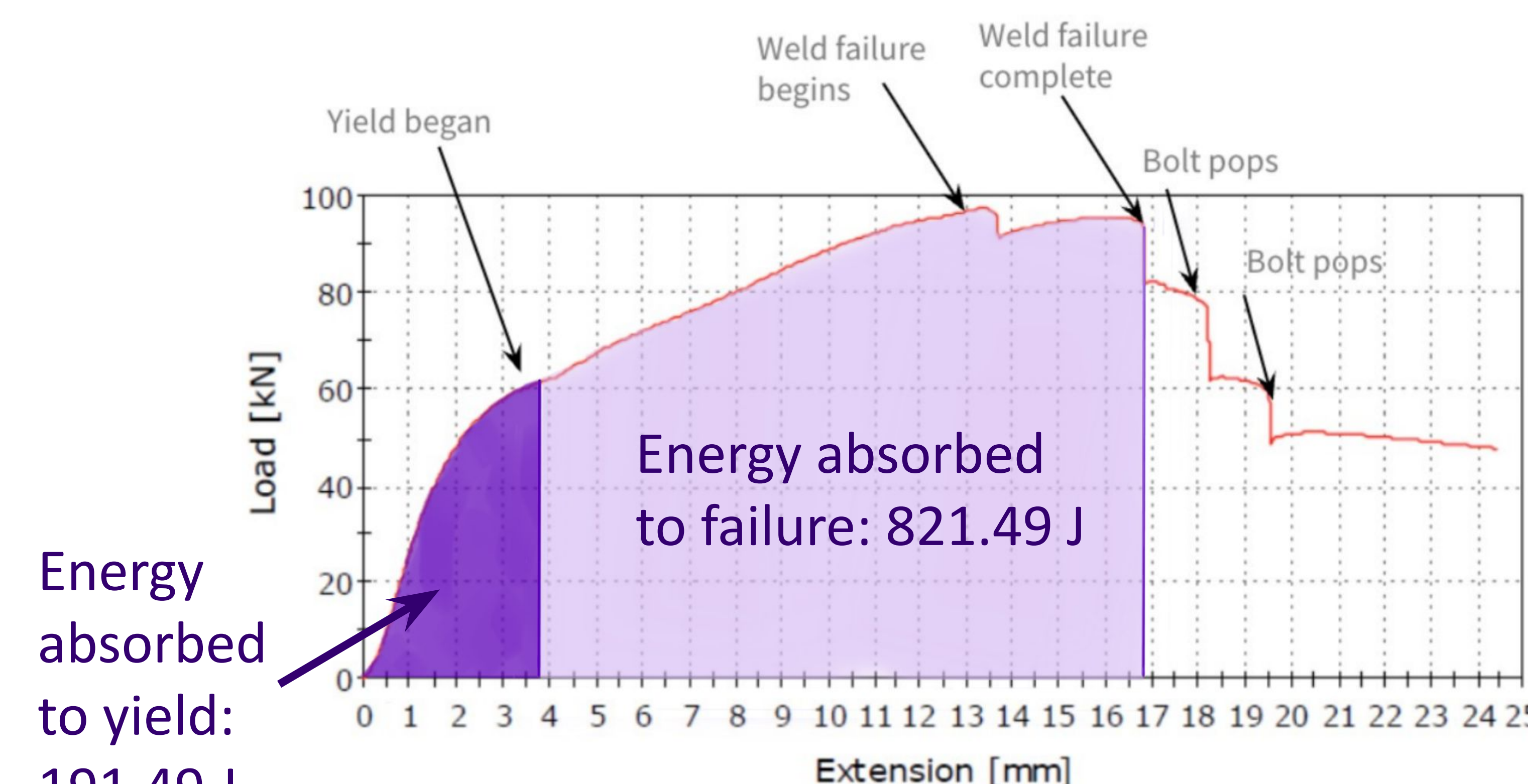
We designed an A36 steel enclosure to protect the sensors. This is our initial design, that met the following goals:

1. Withstand the simulated harsh mining environment
2. Successful installation of sensors into bash guard
3. Drainage was able to eliminate water build up

VALIDATION

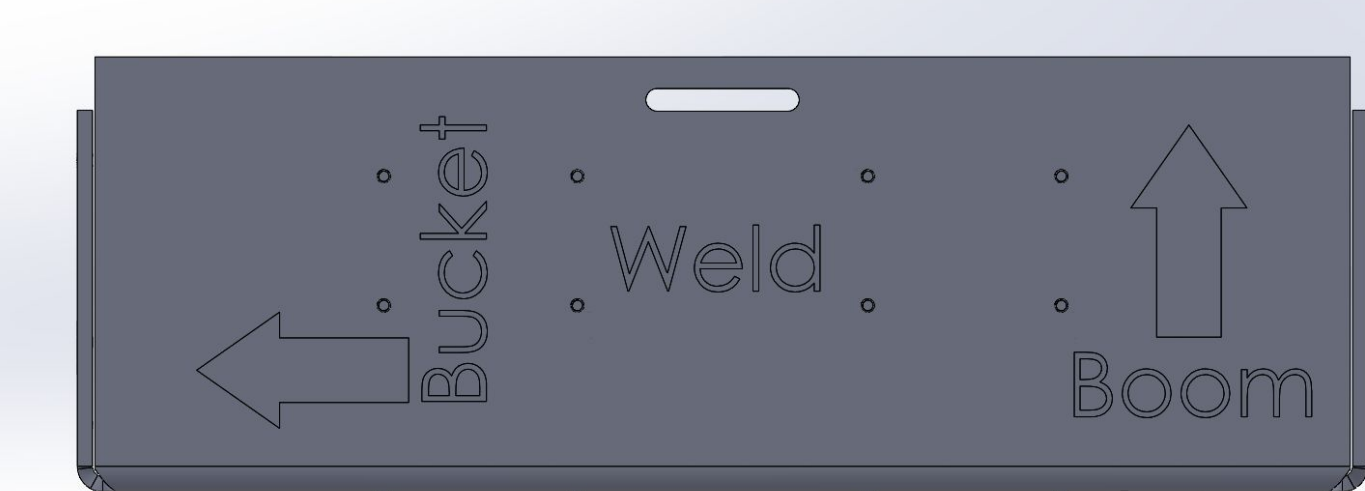
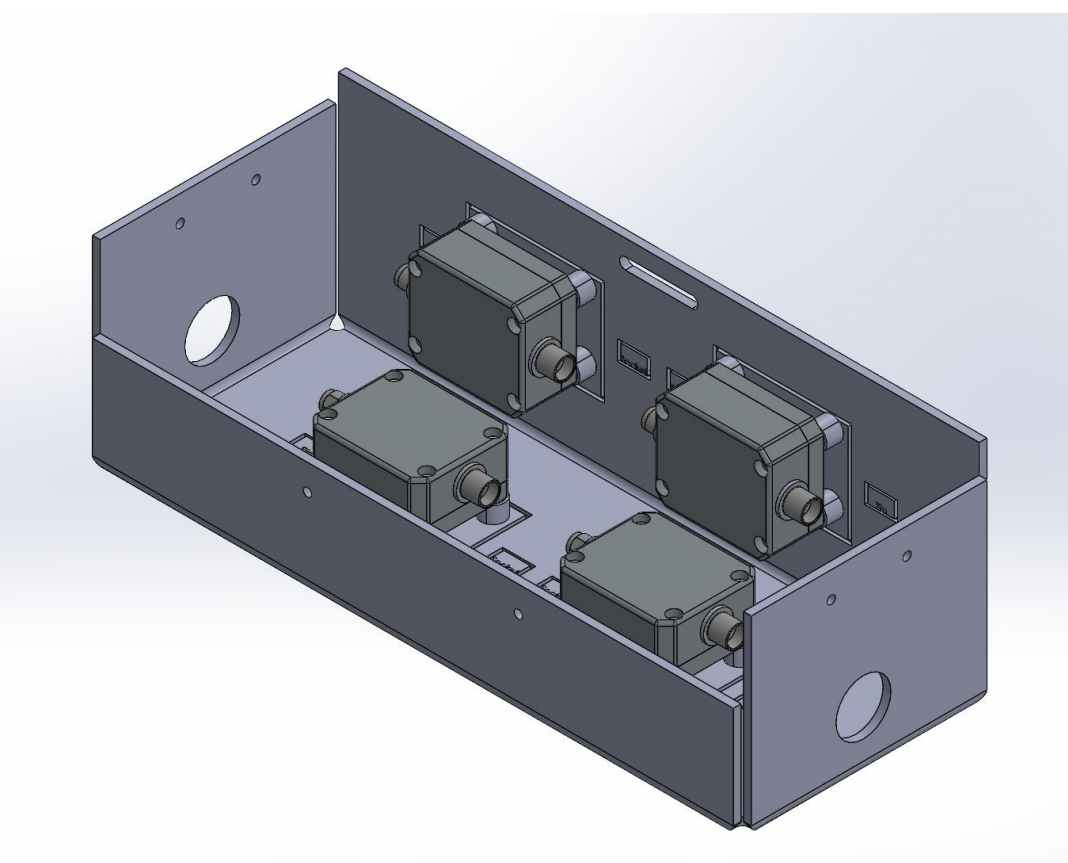


We conducted a compression test using an Instron machine equipped with a 250 kN load frame and a spherical load applicator.



Yield: 63 kN Total Failure: 97 kN

Finalized Design



We iterated our bashguard after our physical testing to further meet the clients needs.

1. With failure at 97 kN, sensors were undamaged.
2. Ease of installation: room for gloves + cables, engravings, instruction manual
3. 8 mm drainage holes to reduce small gravel build up
4. 1 bash guard for 2 sensor orientations

Next Steps

1. Redesign for dual-axis sensors
2. Run FEA on new design to prove it will protect against harsh environments
3. Test instructions
4. Test drainage holes in the field

Acknowledgements

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Faculty mentor: Eli Patten
Lab Engineer: Bill Kuykendall
Instructional Technician: Eamon McQuaide & Veasna Thon
Heavy Machinery Supplier: NC Machinery

References

- [1] Mine Safety and Health Administration, "Mine Safety and Health at a Glance - Fiscal Year," U.S. Department of Labor. [Online]. Available: <https://www.msha.gov/mine-safety-and-health-glance-fiscal-year>. [Accessed: 19-Mar-2025].
- [2] Caterpillar, 980 Medium Wheel Loader, CAT. Available: https://www.cat.com/en_US/products/new/equipment/wheel-loaders/medium-wheel-loaders/124966.html (accessed Mar. 19, 2025).

Mechanical Engineering Capstone Exposition

June 3rd 2025, Husky Union Building, University of Washington, Seattle