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Problem

- Current Access System design does not meet industry standards in low ground pressure (LGP) configuration with extra-wide track shoes
- Operator safety while accessing the cab is very important

Background

- Machine Access / Egress System is located on the left hand side of the D8T track-type tractor
- Current design is addressed through risk-assessment but needs improvement in order to meet ISO Standards

Customer Requirements

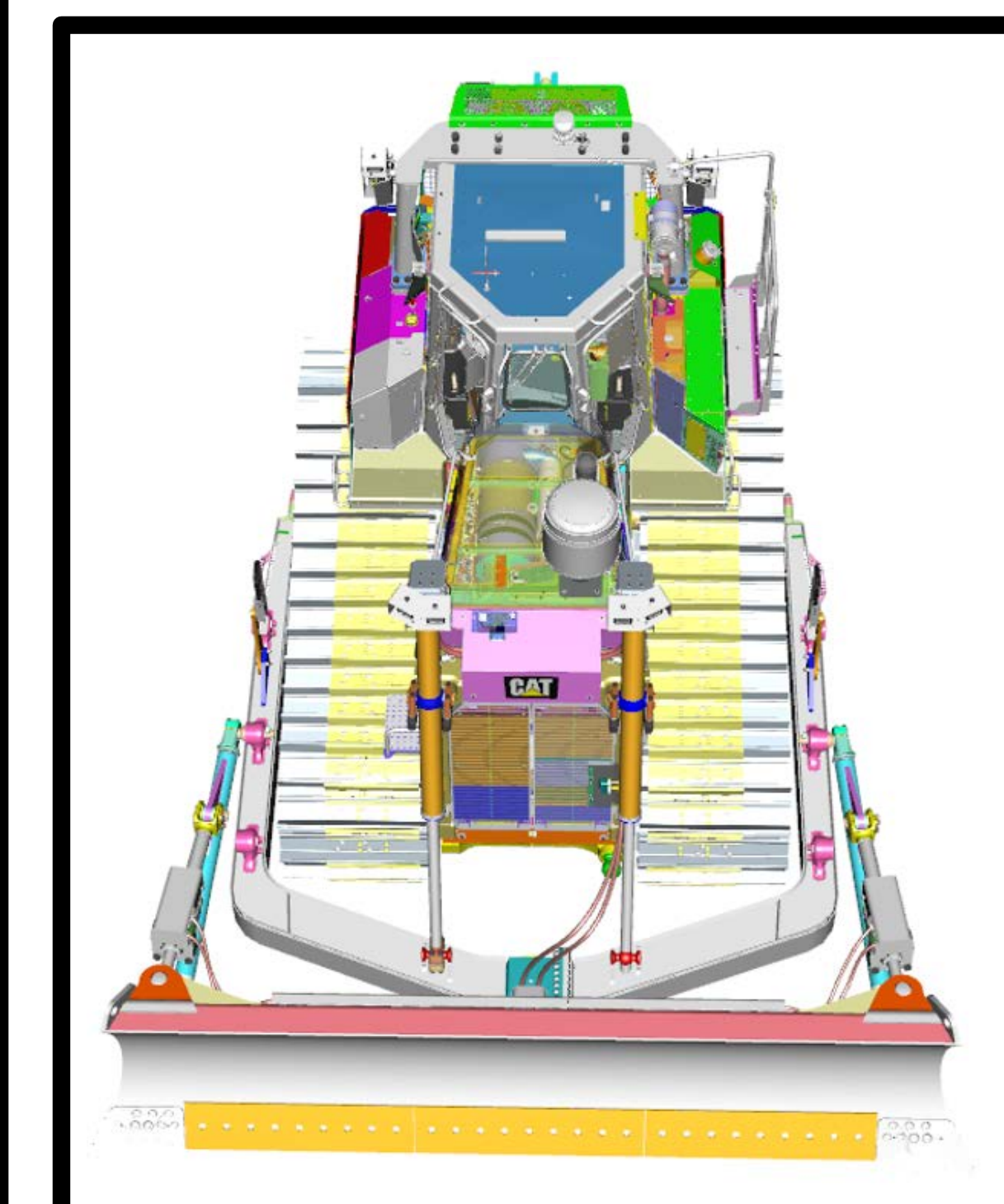
- Ease of use
- Safety / Reliability
- Fully compliant design
- Robust enough to survive in the field
- Cost of project: less than \$2000



Standards/Safety Requirements

ISO 2867:2011 Earth-Moving Machinery – Access Systems

- Three-point support system needs to be maintained
- Track surfaces are acceptable as part of the access system, if three-point support is provided
- Handholds should be able to withstand a minimum force of 1,000 N applied at any point from any direction without visible permanent deformation



- Steps should be able to withstand a (1) 2,000 N force applied in the most unfavorable position and (2) a uniformly distributed force of 4,500 N without visible permanent deformation
- Correct use of access system shall be self-evident without special training

Alternative Solutions

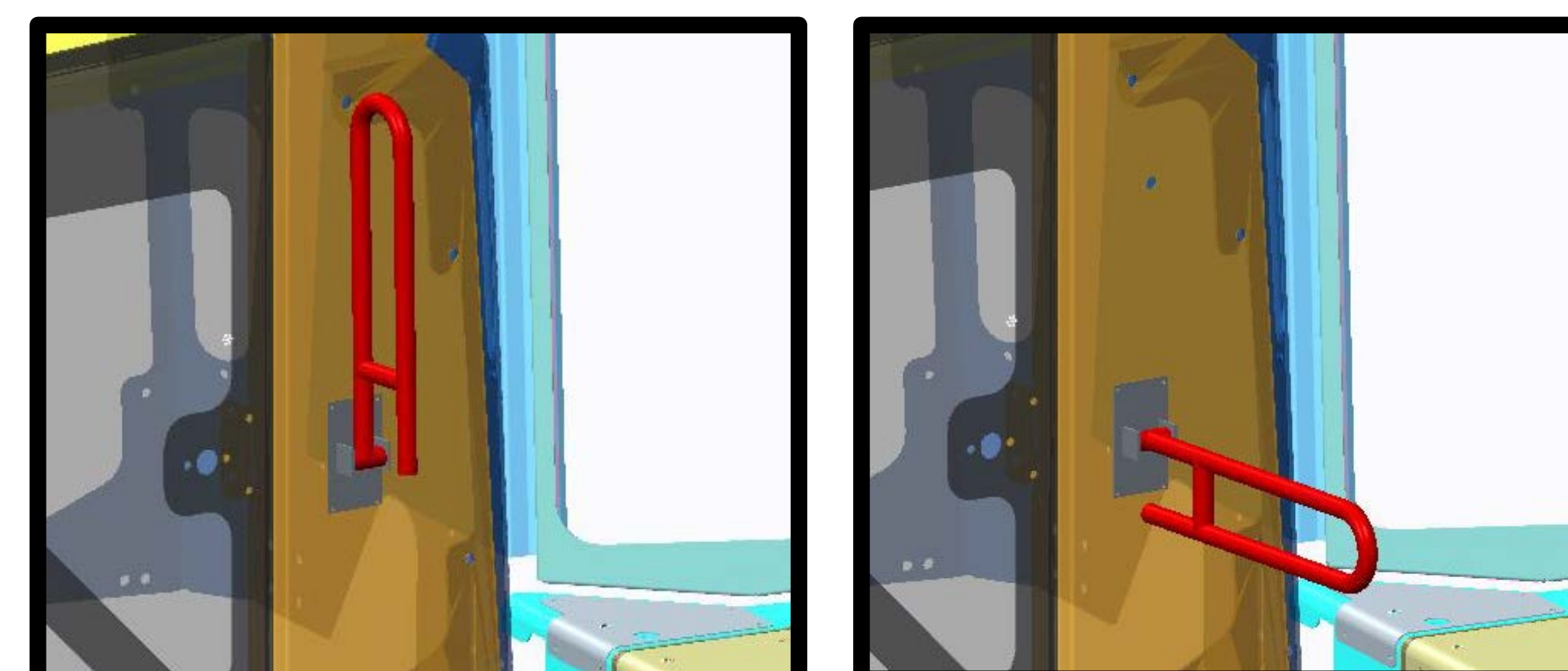
Mechanically Controlled Ladder

- Hinged platform with up and down position
- In up position when bulldozer is moving
- Would eliminate the need for handhold and steps



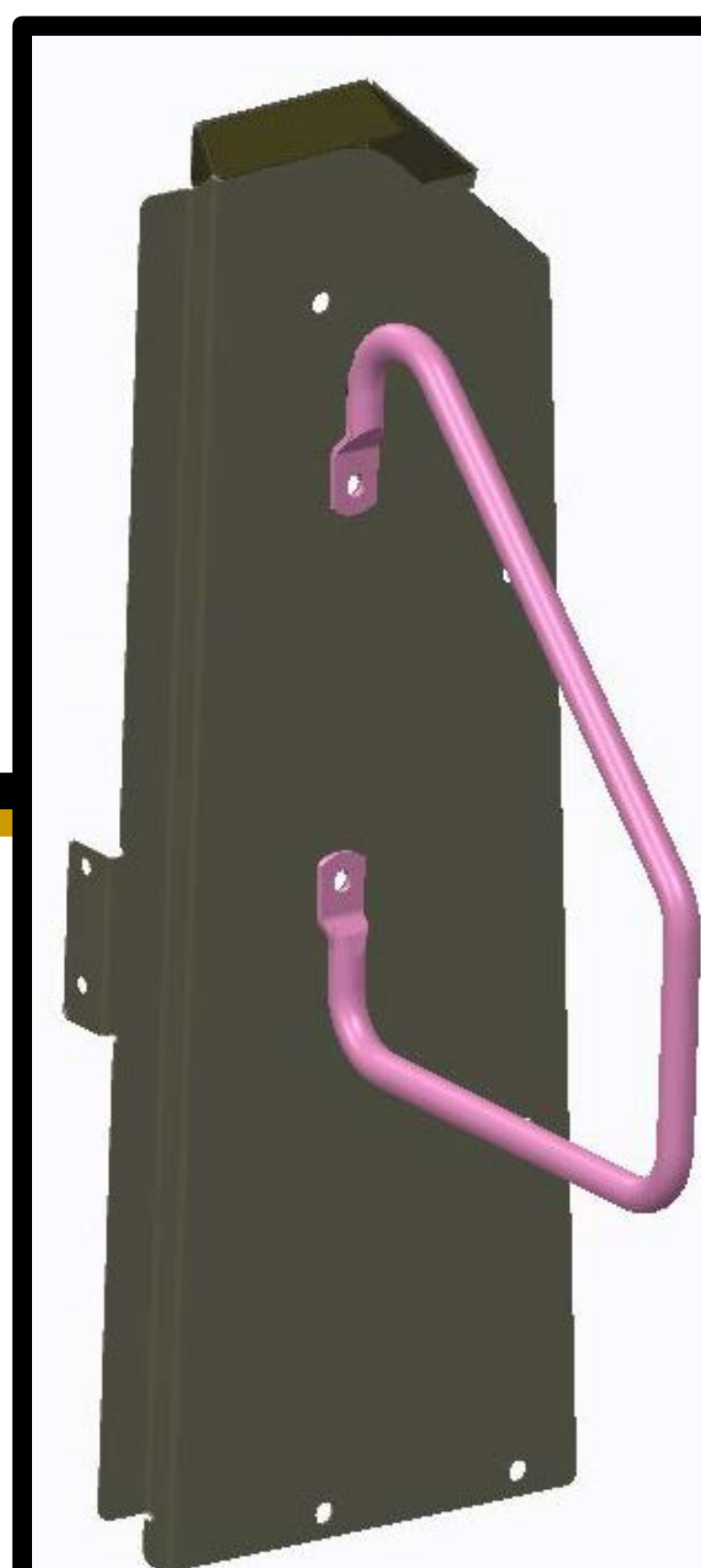
Hinged Handhold

- Hinged handle with up and down position
- Bolts to location as current design



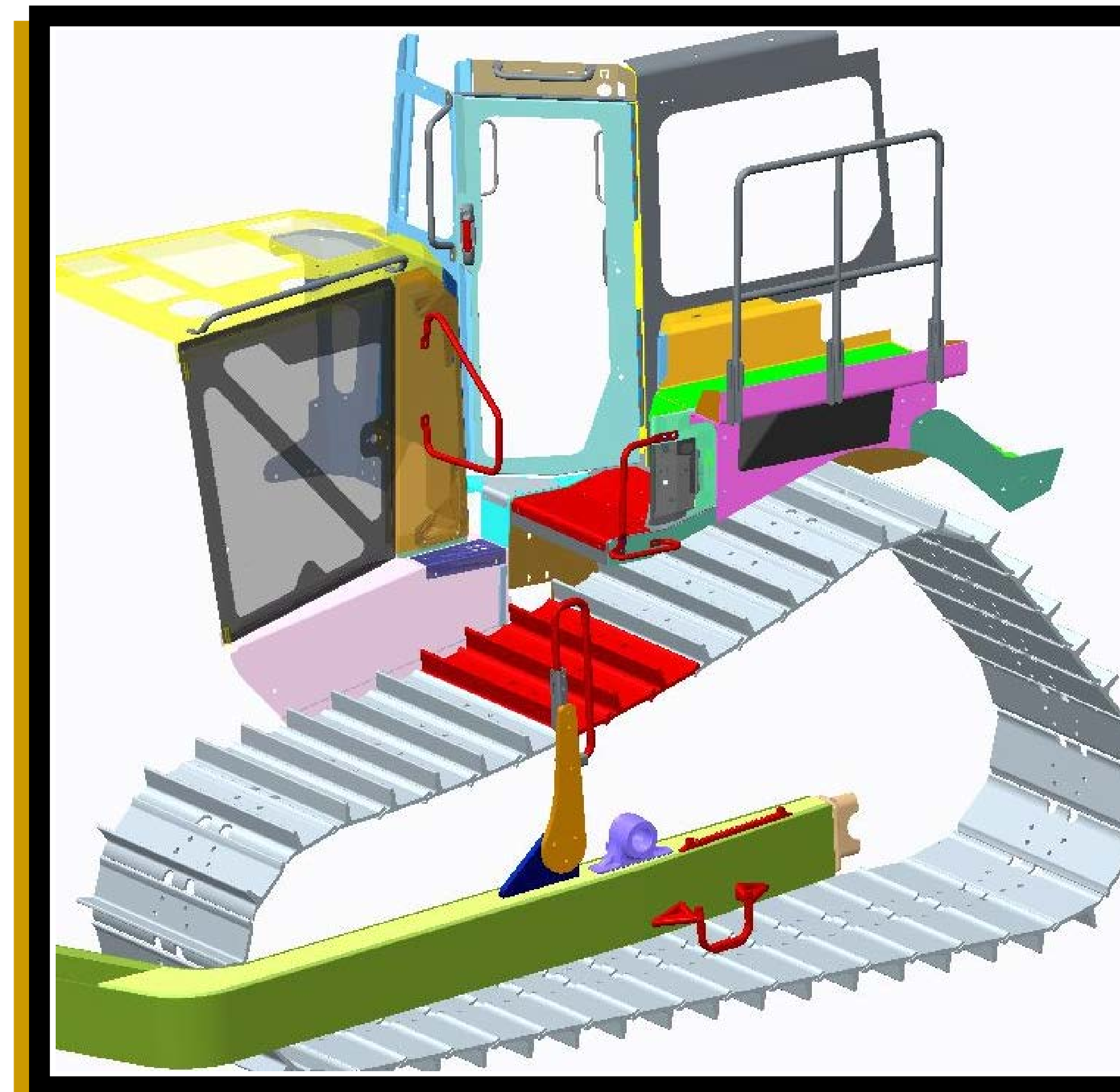
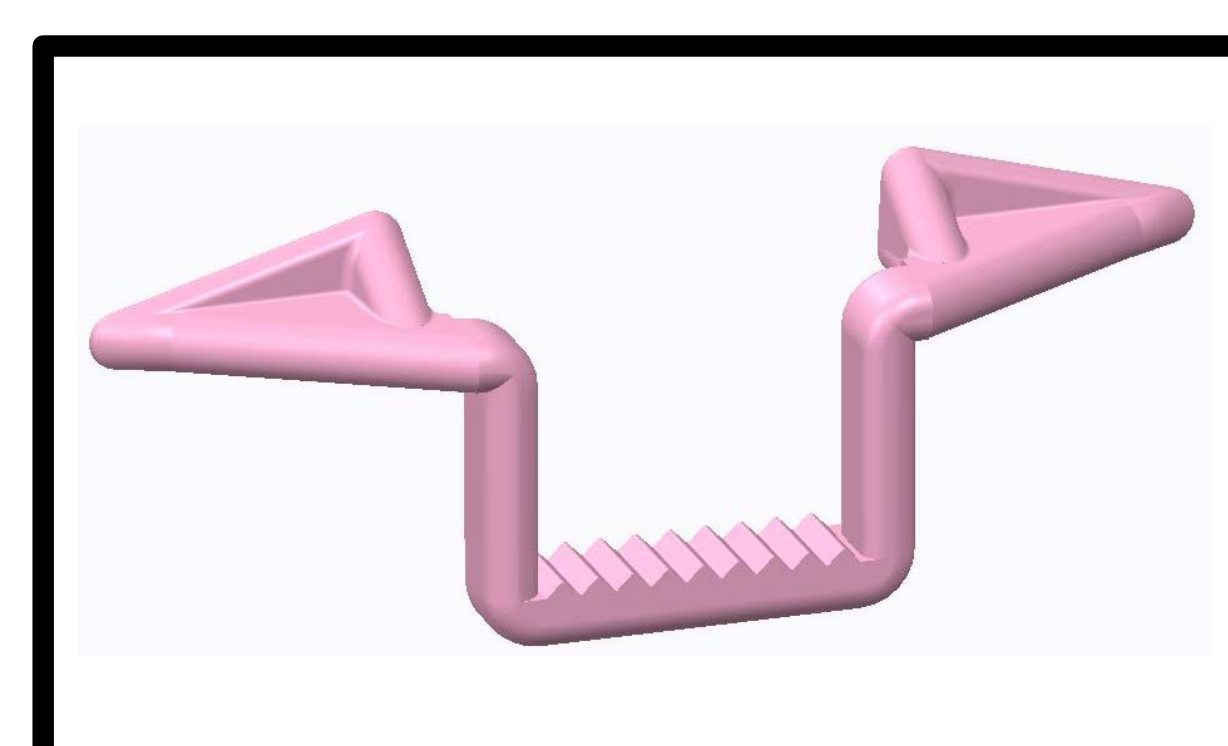
Extended Handhold

- Bolts to same location as current design
- Use more material with same design and add more bends



Stirrup Step

- Weld to same location as current design
- Drop step design down lower



Analysis

- Creo Parametric Simulate and Finite Element Analysis were used to model and analyze how the parts of the final design would act under different situations
- Static, Modal, and G-loading tests were analyzed
- Models were compared against the current design parts
- To validate the final design of the handhold, a thicker tubing can be used and an extra plate on the backing of the panel can be added for more stability and will create less stress

Impact on Society / Sustainability

- Implementation provides a safe and fully compliant design
- Safer points of reach that provide stability
- Operator is less likely to sustain injury while accessing the cab

Final Design

- All options were evaluated before choosing the final design of the parts
- Mechanically Controlled Ladder would have been too costly
- Pull Down Handle had moving pieces, would be susceptible to damage from vibration, and would not have been reliable
- Extended Handhold and Stirrup Step met the criteria for the ISO Standard constraints
- FEA and modeling results can be used as a tool to further develop the machine access / egress system



Economic Analysis

The Machine Access System Senior Design Project used \$24 on material for prototyping. The extra material in the handhold and in the step will create an increase in the production cost of the system comparable to the previous design.

- Estimated Cost of Production: \$100.85 (includes materials of the handhold and step only)

Item	Cost
1" OD ASTM/A53M Pipe Tubing	\$ 76.90
Sand Casting & Steel Material	\$ 15.74
Bending of Handhold	\$ 3.00
Welding of Step	\$ 4.13
Other Machining	\$ 1.08
Total	\$ 100.85

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