PURDUE UNIVERSITY

CAPSTONE/DESIGN EXPERIENCE 2016

Caterpillar Collapsible Guardrail

Agricultural & Biological ENGINEERING

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Problem:

- Common to see guardrail be ripped off machine accidentally or purposefully removed
  - Hazard is formed when guardrail is removed
- Current design is rigidly mounted and receives heavy vibrations
  - When this occurs on the jobsite the problem is commonly ignored and leads to rail being damaged or shaken loose
- Visibility is obstructed with current design
  - Full visibility at all times is very important

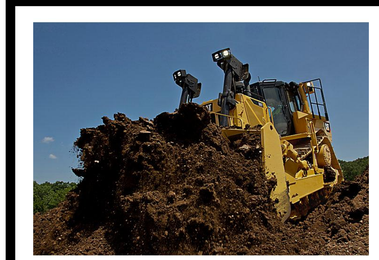
Background:

- Guardrail is located on the left hand side of D8T track-type tractor and is mounted to the fender
- Purpose is to assist operator in refilling various fluids and tending to common maintenance items
  - DEF Fill, Fuel Fill, Batteries, Cab Air Filter, E-Bar Lube, Cab Window Washer Fluid, Window/Light Cleaning
- Current design is functional but could use improvement

Standards/Safety Requirements:

"ISO 2867:2011 Earth-Moving Machinery – Access Systems"

- Guardrails must have a rail placed midway between the top rail and the platform
- Guardrails should be provided along the side of the platform if the platform is 3 meters or more above the ground
- Minimum height: 1,000 mm
- Maximum height: 1,100 mm
- Guardrails shall be able to withstand a minimum force of 1,000 Newtons without visible permanent deformation.



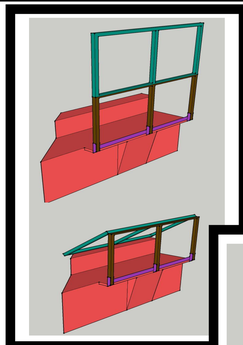
Customer Requirements:

- Functionality
- Lightweight and easy to use guardrail
- 10,000 hours field life

Alternative Solutions:

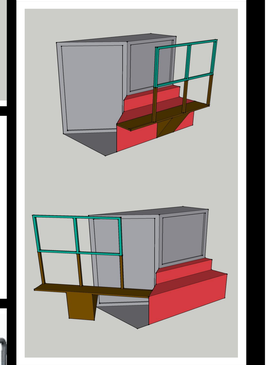
Option 1: Single Fold Guardrail

- Decrease platform width
- Use existing guardrail, but eliminate vertical center bar
- Install two Variloc hinging mechanisms on each side right below horizontal bar
- Make it actuated so that the guardrail is always in the safe position



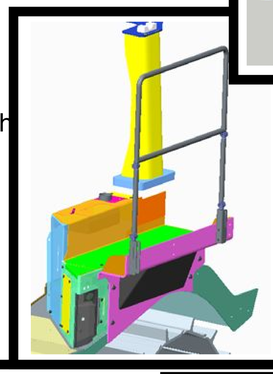
Option 2: Swinging Guardrail

- Use existing guardrail
- Hinge the mounting platform so the guardrail swings towards the cab door
- Install locking mechanism so the guardrail locks in place



Option 3 Final Design: Double Fold Guardrail

- Use existing guardrail, but eliminate vertical center bar
- Install two Variloc hinging mechanisms on each side right below horizontal bar and right above both mounting brackets
- Use a cable activation system to actuate the guardrail



Impact on Society/Sustainability

- Keeps operators safe during maintenance without being an inconvenience.
- Increased the life of the guardrail.
- Increased durability of the guardrail will decrease the amount spent on replacements.
- Decreases the damage done to the work environment by previous guardrail design.
- Increased durability of the guardrail will decrease the amount of material and manufacturing.

Solution Evaluation

- All options were designed,and evaluated before choosing a final design.
- Option 1 would of been over budget and not met the time constraints.
- Option 2 did not meet testing requirements and would of had a short life span
- Option 3 met all of the criteria for the guardrail constraints

Economic Analysis

The collapsible guardrail project used $700. The adjustable locking hinges causes an increase in the production cost of the guardrail comparable to the previous design.

- Cost of Production Goal: ~ $440
- Actual Cost of Production: $473
  - Cost of production includes materials of the guardrail only.

Item	Cost
1" OD x ⅛" Wall HR CS Tubing	$81
Variloc Heavy Duty Locking Hinges	$372
Mounting Brackets	$20
Cable Release	$20
Misc. Hardware	$40
Welding & Bending	$165
Total	$698

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