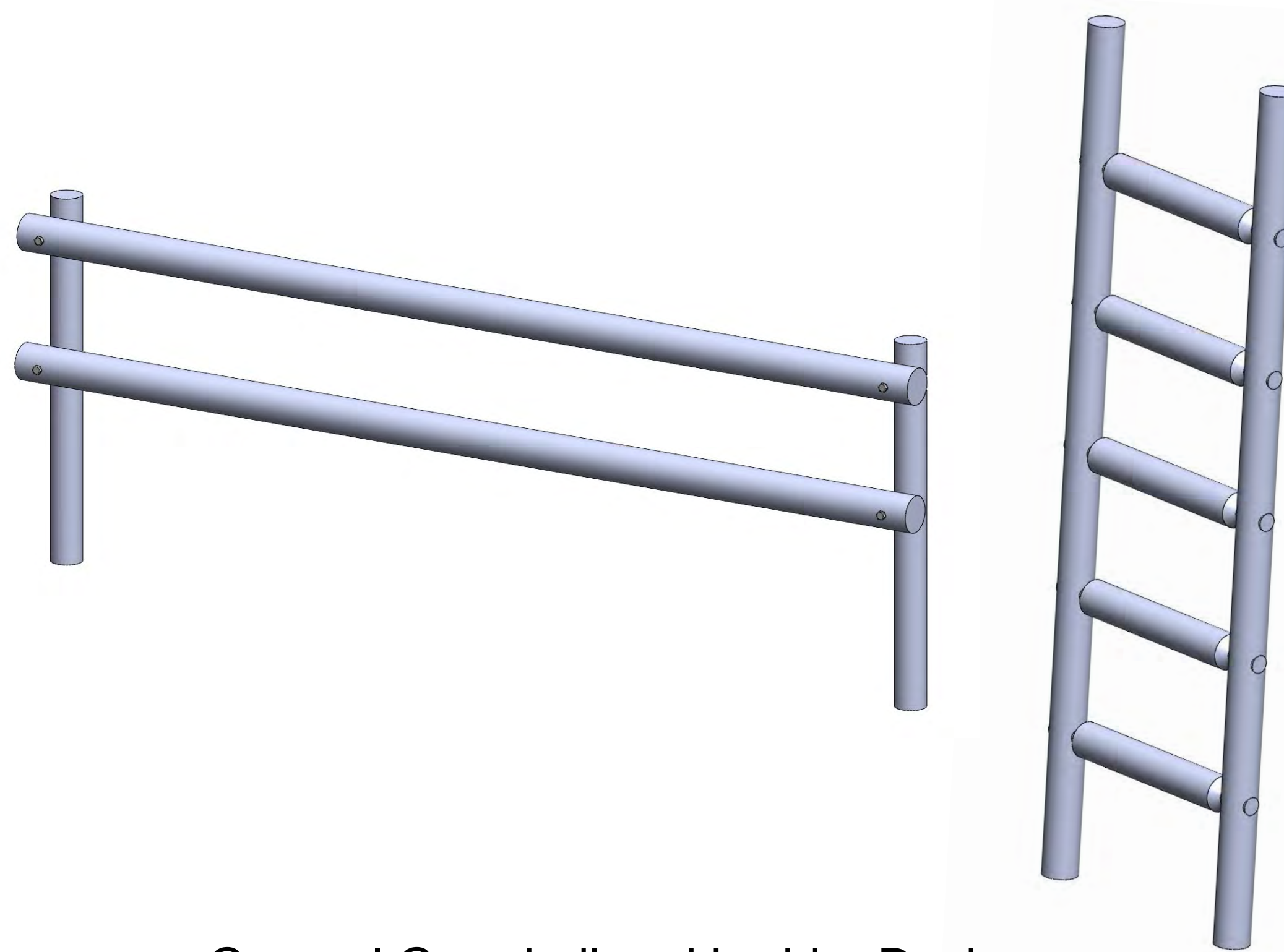


Background

Utah's Hogle Zoo, a zoological park committed to wildlife conservation and education, is enhancing its safety systems to better protect its zookeepers and maintenance staff. The focus is on designing a fall-protection system for zoo workers who perform maintenance and cleaning within the outdoor orangutan and gorilla exhibits that comply with OSHA and UOSH regulations.



General Guardrail and Ladder Design



Image of the Hogle Zoo's outdoor orangutan exhibit

Objective

To address the need for enhanced safety, the proposed solution is to design and construct a set of guardrails and ladders tailored to the unique challenges of the orangutan and gorilla exhibits. The design prioritizes safety by incorporating features that prevent entrapment or entanglement while considering animal welfare. Materials are selected to withstand environmental conditions and are chosen to avoid any chemical reactions from processed wood or rusted metal, ensuring durability and animal safety.



Image of the Hogle Zoo's outdoor gorilla exhibit

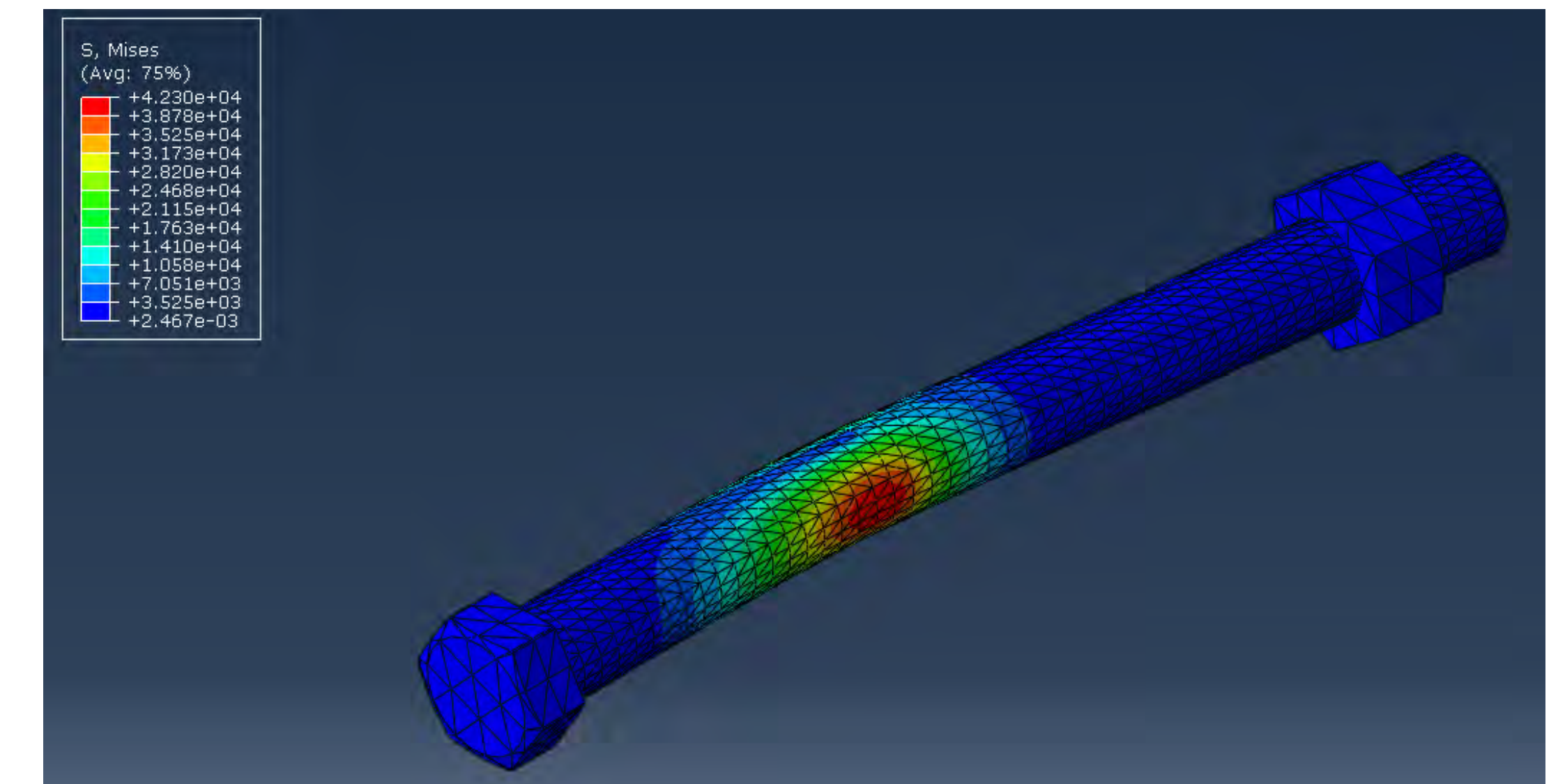


Completed construction of guardrail and ladder system

Structural Analysis

To ensure the structural integrity and safety of the proposed fall-protection system, a comprehensive finite element analysis (FEA) was conducted. This analysis evaluated the system's response to various loading scenarios, with a primary focus on determining the minimum diameter of the guardrail and bolts needed to maintain safety standards. The goal was to ensure that the system could withstand potential forces exerted by both zoo workers and the animals while preventing yielding or failure.

After several rounds of FEA simulations, an optimized solution was developed that determined the minimum diameter required for each section's bolts and guardrail to ensure safety and durability.



FEA model of bolt

	Max Stress Wood	Yield Stress Wood	Safety Factor	Max Stress Bolts	Yield Stress Bolts	Safety Factor
Horizontal Load	6.2 ksi	11.6 ksi	1.9	22.8 ksi	80 ksi	3.5
Top Load	3.7 ksi	11.6 ksi	3.2	27 ksi	80 ksi	3.0

Table of FEA results