# Gripper Analysis

## A detailed structural evaluation was conducted on both the horizontal and vertical grippers before manufacturing to ensure their mechanical integrity and operational reliability. This analysis aimed to assess their ability to withstand the forces exerted by the piston during actuation and determine their maximum load-bearing capacity within safe operating conditions.

## Horizontal gripper

To validate the structural resilience of the horizontal gripper, three key studies were performed. The first analysis examined the gripper in its fully opened state, where the maximum force exerted by the piston during the opening stroke was 135 N. A finite element stress analysis was conducted to evaluate the stress distribution and identify potential failure points.

The results indicated that the highest stress concentration occurred at the U-bracket, with a peak value of 21.373 MPa. Additional stress was observed on. The minimum factor of safety was calculated to be 1.6, falling within the recommended range of 1.5 to 3, confirming the design’s structural adequacy.A blue and green model of a mechanical tool

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A second analysis assessed the gripper in its fully closed position, where the piston applied a force of 113 N. The corresponding stress analysis identified a peak stress of 25.130 MPa, primarily concentrated at the spacers as well. The minimum factor of safety in this configuration was determined to be 6.2, reinforcing the gripper’s ability to function safely under operational

conditions. A blue object with a rainbow spectrum

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A blue model of a mechanical device

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The final assessment evaluated the gripper’s maximum load capacity. With a factor of safety of 2 applied, the maximum weight the gripper can securely handle was calculated to be 14.6 kg.

## Vertical Gripper Analysis

The vertical gripper underwent a similar series of evaluations to confirm its mechanical strength and durability. The first analysis focused on the gripper in its fully opened position, where the piston applied a force of 135 N. The stress distribution results identified critical areas experiencing a peak stress of 22.777 MPa, while the minimum factor of safety was determined to be 1.857, indicating a structurally sound design.

In the fully closed state, where the piston applied a force of 113 N, a stress analysis was conducted to assess its impact on the gripper. The analysis revealed a peak stress of 18.107 MPa, with the highest stress concentration occurring at U-bracket. The minimum factor of safety was calculated to be 5.018, verifying the structural integrity of the gripper under operational loads.A blue tool with a rainbow spectrum

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Additionally, a load-bearing capacity evaluation determined the maximum weight the vertical gripper can safely handle. With a factor of safety of 2 applied, the adjusted maximum load capacity was 11.8 kg.

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