THE CHINESE UNIVERSITY OF HONG KONG
DEPT OF MECHANICAL & AUTOMATION ENG

MAEG5160 Design for Additive Manufacturing

Assignment #2

by

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Introduction

Loading brackets are critical components in jet engines, as they must support the engine's weight during handling without distortion or breaking. Topology optimization is a widely used technique to determine the most efficient material distribution under given loading conditions. This lab report aims to optimize the topology of a bracket, by applying topology optimization and analyzing the resulting stress distribution.

Methodology

To optimize the topology of the bracket, we employed topology optimization using SolidWorks software. The specified boundary condition in this project was that interfaces 2-5 were fixed, and we applied a reasonable loading on interface 1. Specifically, we applied loading of 3000 N parallel and perpendicular to the bottom plate to the two round holes of interface 1 as shown in Figure 1. Our objective was to optimize the material distribution while reducing the mass of the bracket by 40%.

Results

Our optimization process yielded very smooth results, and we were able to achieve the desired mass reduction while maintaining the structural integrity of the bracket. The optimized topology of the bracket is shown in Figure 2a, and it can be seen that the material is distributed more efficiently compared to the initial design.

We analyzed the stress field distribution in the optimized bracket using the SolidWorks software. The stress distribution is shown in Figure 2b, and it can be observed that the stress distribution is very good. The stress is distributed evenly throughout the bracket, with no regions of high stress concentration. This indicates that the optimized bracket can handle the applied loading without distortion or breaking.

Discussion

Our optimization process successfully optimized the topology of the bracket while reducing its mass by 40% and maintaining its structural integrity. The stress distribution in the optimized bracket was very good, indicating that it can handle the applied loading without distortion or breaking. Our results demonstrate the effectiveness of topology optimization in optimizing the material distribution of loading brackets under given loading conditions.

Conclusion

We successfully optimized the topology of a loading bracket by employing topology optimization and analyzing the resulting stress distribution. The optimized bracket achieved the desired mass reduction while maintaining its structural integrity and exhibiting a very good stress distribution. Our results highlight the effectiveness of topology optimization in optimizing the material distribution of loading brackets under given loading conditions.

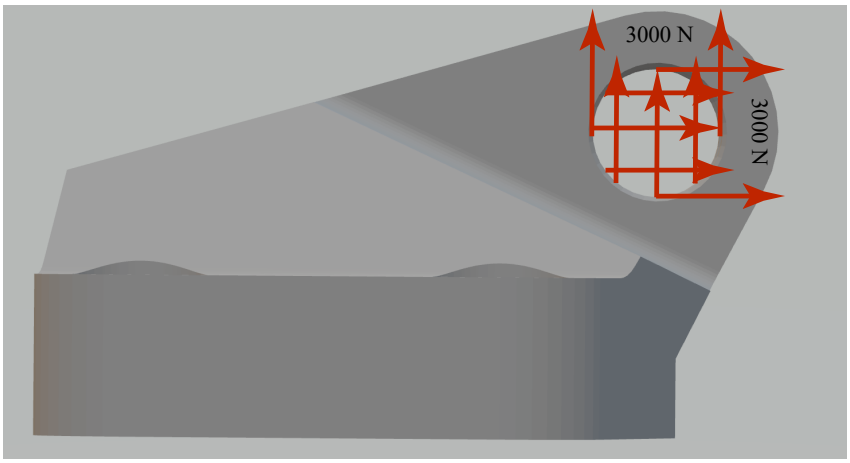
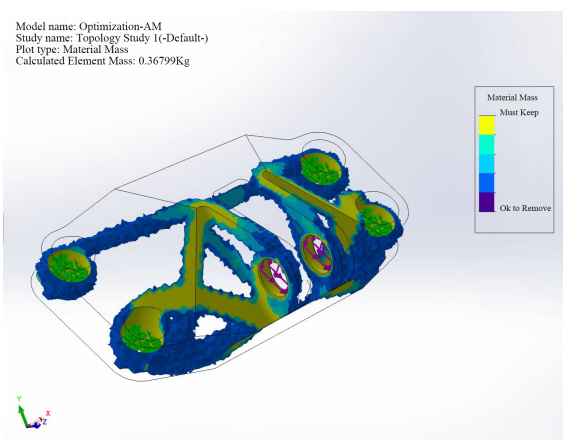
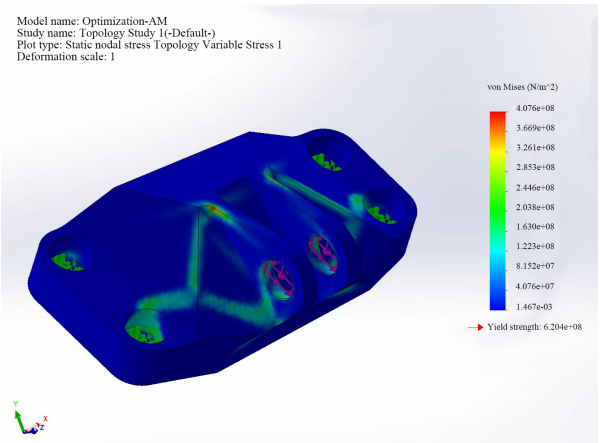


Figure 1: Force distribution at Interface 1.



(a) Material mass distribution.



(b) Stress field distribution.

Figure 2: Topology results.