"Integrating Finite Element Analysis for Continuous Improvement in Design and Manufacture"

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Aim of the Project

The aim of the project is to integrate Finite Element Analysis (FEA) for Continuous Improvement in Design and Manufacture.
The component being tested is displayed in Figure 1. The Gripper component, (made from PEEK 30% CF) is used within a Manufacturing Assembly Line.

Objectives:

- Create an S-N Curve for PEEK 30% CF to use within simulation software.
- Use FEA simulations to identify areas for improvement on the component.
- Develop improvements for the component to increase its life span and reduce fatigue.
- Improve manufacturing processes by integrating a continuous improvement cycle (DMAIC) to enhance the product.

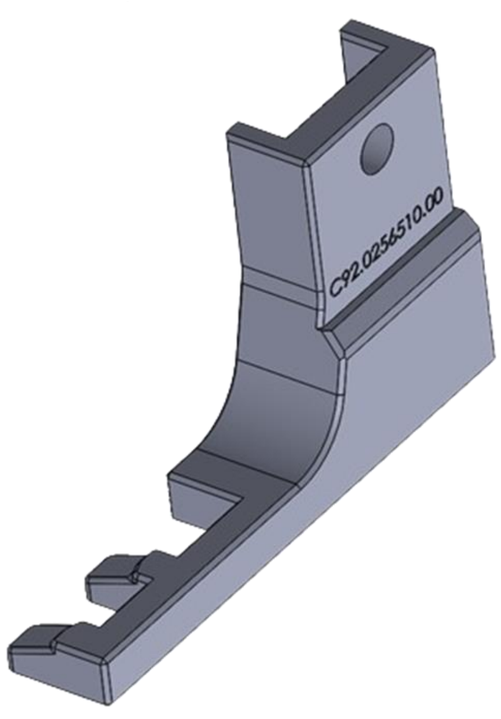

Figure 1: Gripper Component

Background / Lit Review

FEA is widely used in analysis and design of various systems of varying complexities. FEA breaks down models into finite entities/ nodes to determine their characteristics under specifics boundaries and constraints.

Six Sigma is a methodology aimed at improving process quality by identifying and eliminating defects. It uses data-driven techniques to reduce variability and achieve near-perfect processes, typically aiming for no more than 3.4 DPMO. It follows structured approaches like DMAIC for improving processes.

DMAIC is a problem-solving framework used in Six Sigma to improve existing processes

- Define: Identify the problem and goals.
- Measure: Collect data on current performance.
- Analyze: Find the root causes of issues.
- Improve: Implement solutions to address the causes.
- Control: Monitor to ensure improvements are sustained.

Methodology

The DMAIC framework will be used to carry out the project.

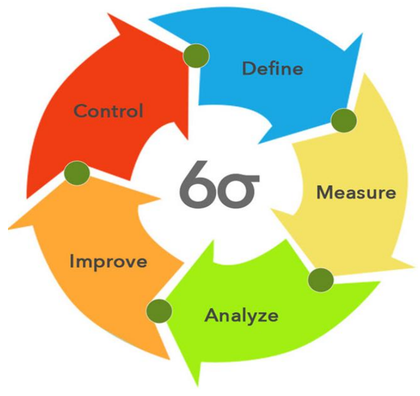

Figure 2: DMAIC Framework

DEFINE

The Problem - The component suffers a fracture in the location outlined below in Figure 3. The Gripper fails between 180,000 – 240,000 cycles

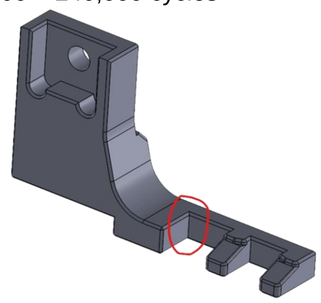

Figure 3: Failure Location

MEASURE

Simulations were carried out on Ansys Workbench, to verify the fracture location (Max stress - Figure 4), and verify the number of cycles before fatigue failure (Figure 5).

ANALYSE

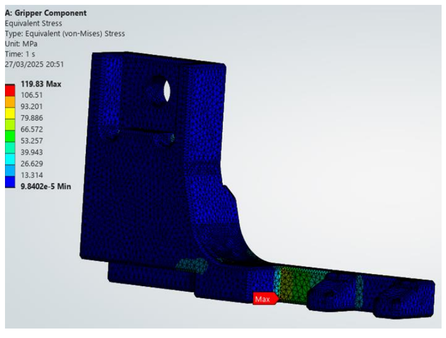

Figure 4: Max. Stress Location (119.83MPa)

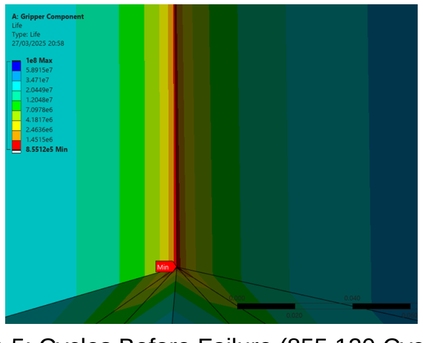

Figure 5: Cycles Before Failure (855,120 Cycles)

IMPROVE

Improvements were made based on the results from the Measure and Analyse phase. A 2mm fillet was added to the fracture location. This improvement reduced the Max. stress to 100.41 MPa and increased the cycles to 47,763,000.

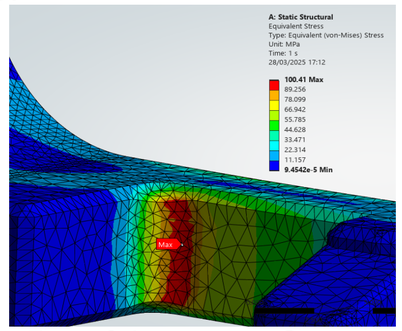

Figure 6: Improvement Simulation

CONTROL

To control the Grippers quality, ensure the improvements are effective and don't have a negative effect on the product. Once the product is under control the DMAIC cycle can start again with a new problem, i.e., Continuous Improvement.

Conclusion

In conclusion, the DMAIC framework was very effective in integrating FEA into a continuous improvement cycle. Through the DMAIC framework, the problem area was identified, and an effective improvement was put in place. The cycle can be repeated to identify and improve another problem associated with the Gripper

Acknowledgments

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