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Metal to Composite: Pump Housing Redesign

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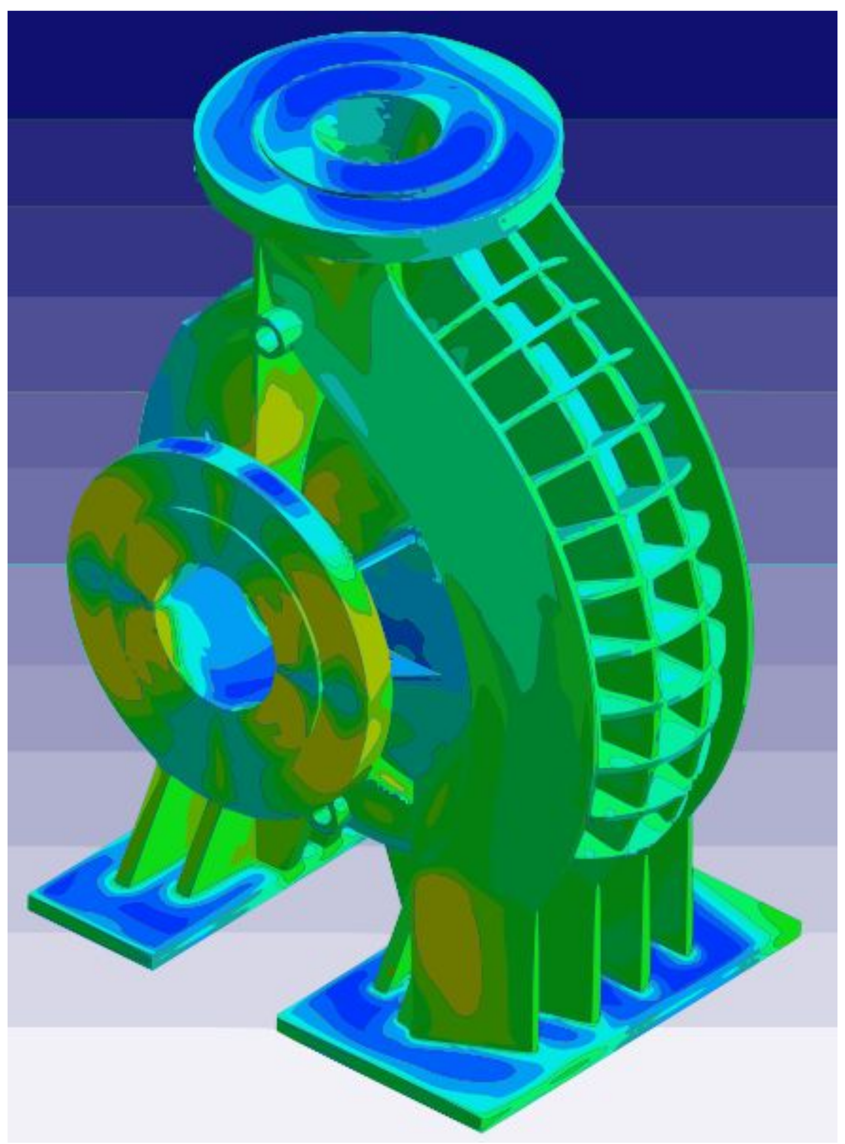
1. Introduction

This project concerns the redesign of a pump housing from the Grundfos NB 65-200 pump.

The existing pump housing is made of cast iron, and therefore corrosion represents a critical issue for the degradation/maintenance of the pump. Consequently, the aim of this project is to redesign the existing pump housing, making use of a short fiber composite material in pursuance removing this critical issue.

2. Material Modeling

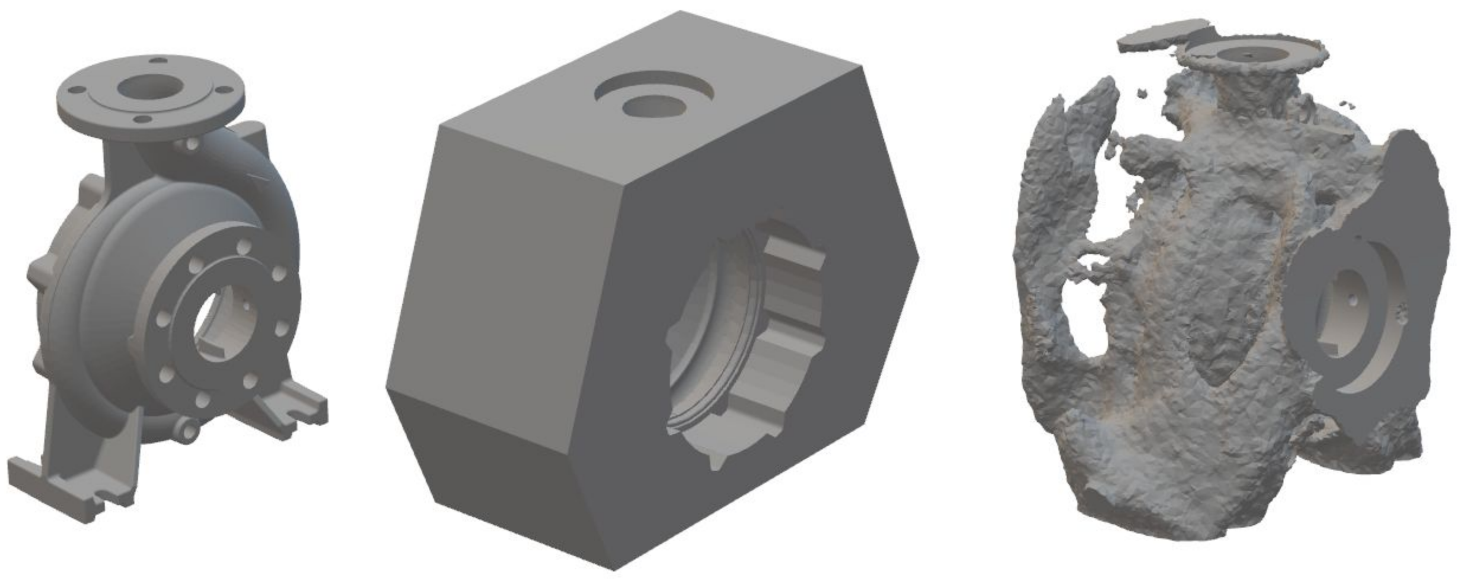
The anisotropy of the material is determined by the probability of orientation of the fibers, which is characterized by the flow field during the injection molding process. For simulating the injection complex geometry of the pump the state-of-the-art software Moldex3D has been used, which allows the prediction of fiber orientation. Anisotropic models for stiffness and strength are used to characterize the whole compound.



3. Structural Optimization

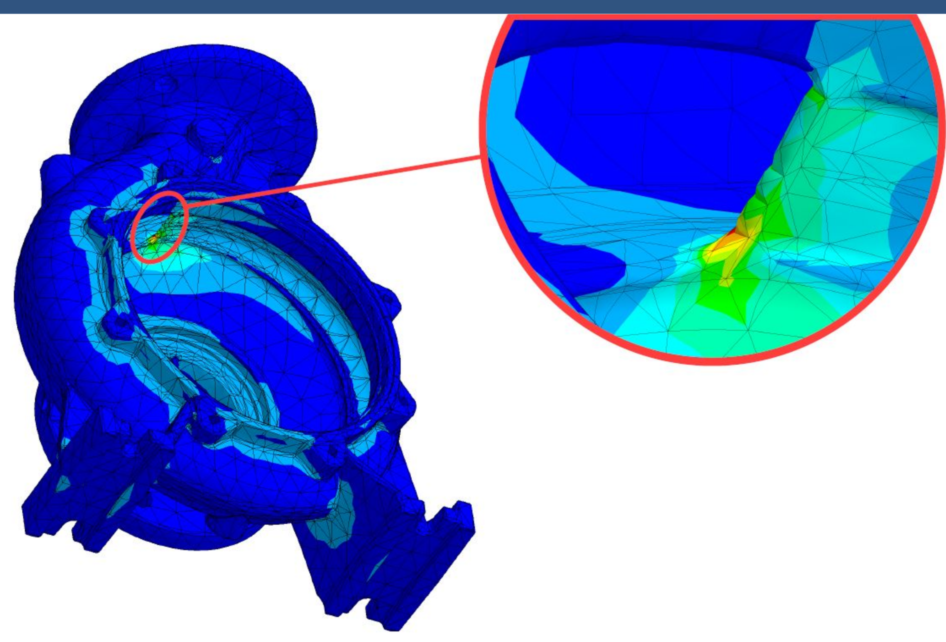
Changing the material means that the shape of the initial design is subject to change. For this reason a topology optimization is performed on a bulk block of mass with the correspondent boundary conditions and load case. For hydrodynamic reasons the inner shape of the pump is maintained for this optimization.

Initial design | **Topology Optimization Input** | **Topology Optimization Output**



After the topology optimization an interpretation of the output is done in order to have a model to work with in the next process, which involves the detailed design of the pump housing.

The most critical part of the pump housing with respect to the stress magnitude is the tongue. This feature, located in the inner part of the pump, requires a reinforcement to reduce the stress level created by a breathing deformation of the pump.

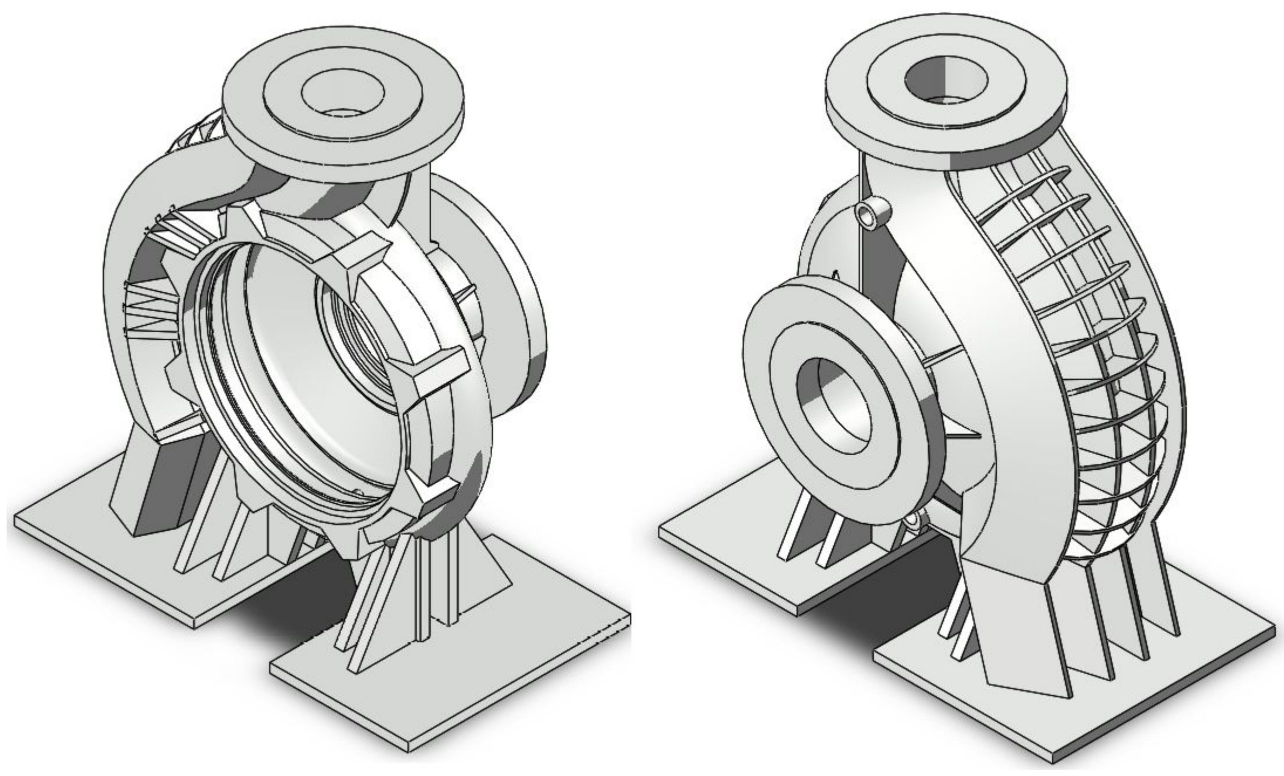


A shape optimization of the tongue will be the first step and then an intuitive optimization adding reinforcements will follow so the objective is fulfilled.

Simultaneously, an eigenfrequency optimization will be done to comply with the requirements.

4. Results

Having performed the optimization for distribution of volume, optimization for eigenfrequencies and design for the stress in the tongue separately, the results now needs to be combined for a final design proposal. A shoulder reinforcement, which was the result of the tongue design, is included. The support of the pump are a result of the eigenfrequency design, which are much more complex, than the existing design's supports, but still manufacturable due to the manufacturing method of injection molding being used. Lastly, the design is made for injection molding, having uniform thickness in most areas.



5. Conclusions

In this project, models have been made for redesign of a centrifugal pump. A new design is proposed, which results in:

- A stress state that is 6.6 times lower than the current stress in the pump,
- The product being designed for injection molding and thus having eliminated corrosion by changing to a polymer material.

The conclusions of the project leads to the desire of further investigation of especially eigenfrequencies and possibly harmonic analysis to judge the severity of the modes.

Acknowledgement

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