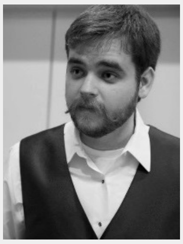
DTU

Optimal Design of Stiffeners for Bucket Foundations



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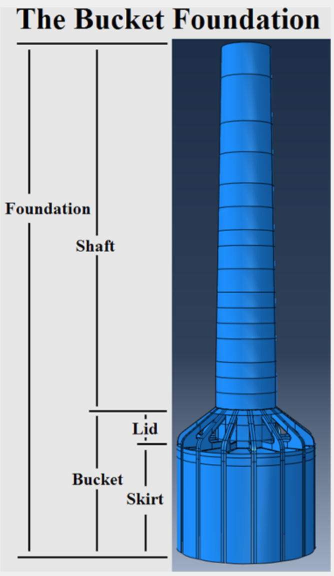
Abstract

The potential for structural optimization of the bucket foundation's outer stiffeners is investigated using the commercial optimization software *Tosca Structure.* Results show that shape optimization of the initial design can reduce stress concentrations by 38%. Additionally, topology optimization has led to a new design with a mass reduction of 25% when compared to the initial design.

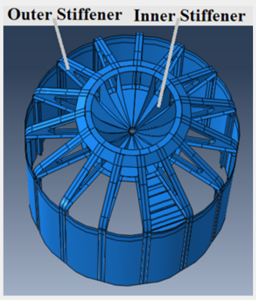
Methodology

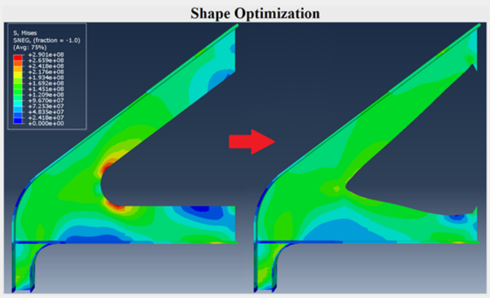
An initial bucket foundation design has been provided by Universal Foundation A/S and is modelled using the finite element software *Abaqus*. The model assumes fixed boundary conditions at the skirt (thereby neglecting soil interactions) and is loaded with an extreme static horizontal load at the top of the shaft. Both shape and topology optimization problems are then developed and solved using *Tosca Structure*.



Shape Optimization

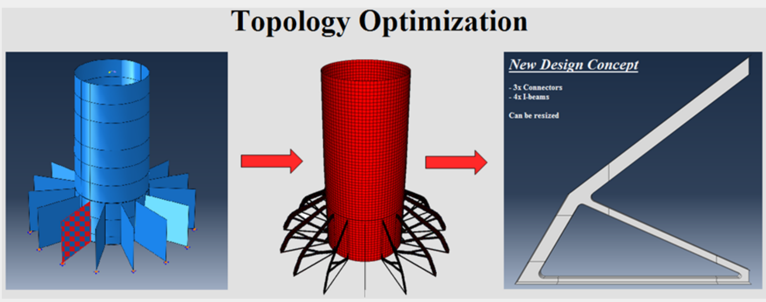
The shape optimization problem is formulated as minimize the maximum von Mises stress in the outer stiffener, subject to a volume constraint, with the design variables being the position of the nodes in the stiffener's inner edge.





Topology Optimization

The topology optimization problem is formulated as minimize the structure's compliance, subject to a volume constraint, with the design variables being the density of the shell elements representing the outer stiffener's design area. The result is then interpreted as a new design concept.



Conclusions

- Shape optimization can **reduce** the maximum von Mises **stress** in the outer stiffener **by 38%** without adding mass to the design.
- A new outer stiffener design has been developed with a **mass reduction of 25%** (19 tons total).

Future Work

- Further shape and sizing optimization of the new outer stiffener concepts can potentially reduce mass.
- Initial investigations into optimization of the inner stiffener and lid suggest a potential mass reduction of over 30 tons.

Acknowledgements

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