Assignment 7

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Finite Element Analysis I

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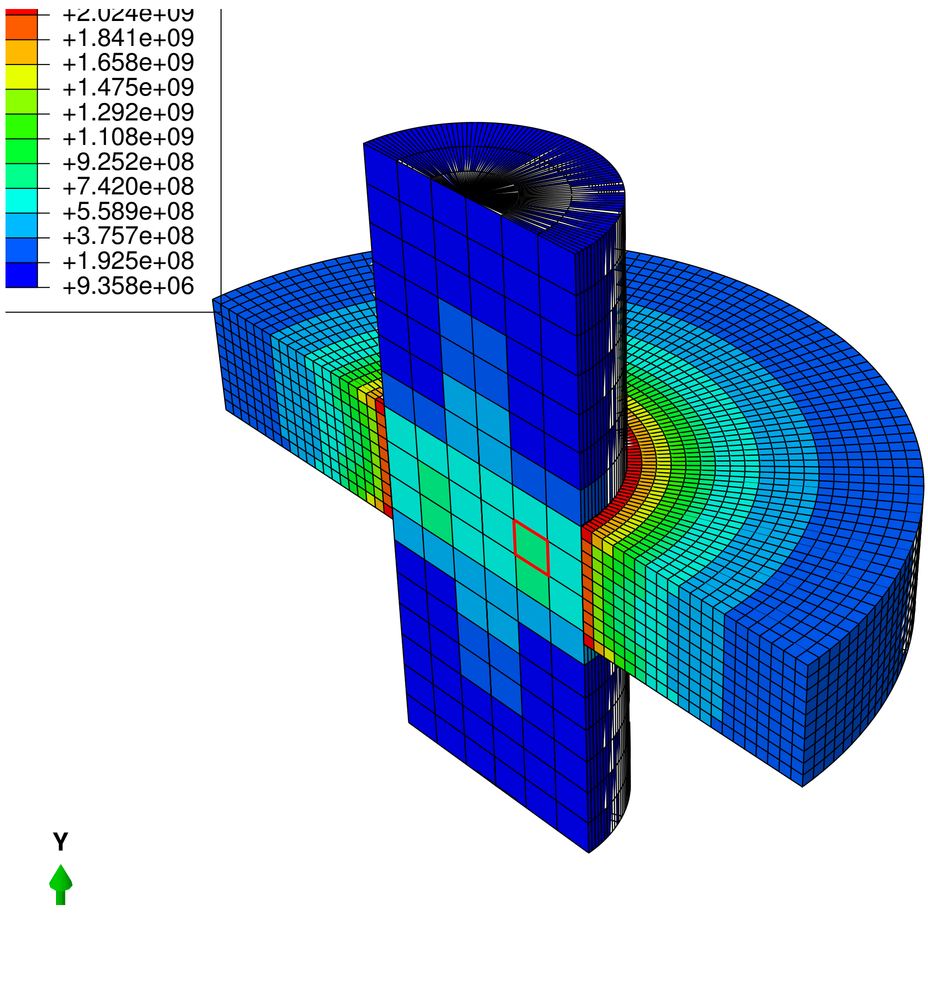


Abstract

In this assignment we investigate the a cooling disc which is mounted on a shaft. The occuring stresses after cooling are then assessed.

Contents

1 Introduction

The disc is heated up to increase its diameter, then cooled down to form an interference fit. This is a common procedure in mechanics to fit parts together (e.g. bearings on shafts). It is therefore interesting to know, by how much the disc has to be heated in order to get an inside diameter which fits over the shaft. In a practical application, this could be used to specify manufactoring tolerances.
As shown in Figure **??**, the fibers are orientated differently in both simulations.

2 Methods

2.1 Diameter as Function of Temperature

The inside diameter of the disc changes with temperature. The rate of change depends on the thermal heat expansion coefficient.

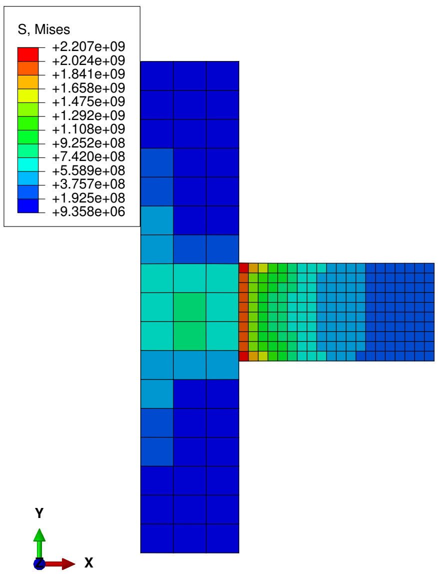
$$\mathrm{D}_\alpha = \kappa(I_3 - 3) + (1 - 3\kappa)(I_{4(\alpha)}) \quad (1)$$

2.2 Modelling

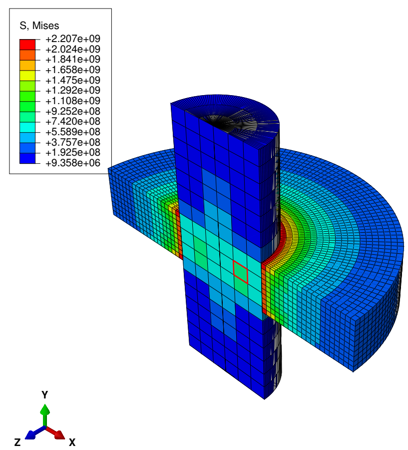
It is important to sequence the model into different steps. Contacts are only activated after both instances are clear of each other (after heating up the disc).

3 Results and Discussion

The results vary greatly with different mesh sizes. Especially when using quilt plots, results may differ quite heavily from one mesh to another, as there is no averaging between elements. Quilt plots are good for evaluation on an element-by-element basis. We reach a maximum mises sstress of arounf 1.2GPa, which is way below the plasic deformation threshold for the shaft material, which lies at 200GPa. When thinkin about the real world application, this seems reasonable, because the shaft could not be reused after the diss (or bearing) would be removed.



(a) Stresses with



(b) Stresses with

Figure 1: Stresses on Sample

3.1 (

conclution)

References

[1] Michel Goossens, Frank Mittelbach, and Alexander Samarin. *The LaTeX Companion*. Addison-Wesley, Reading, Massachusetts, 1993.

[2] Michel Goossens, Frank Mittelbach, and Alexander Samarin. *On the Use of Biaxial Properties in Modeling Annulus as a Holzapfel–Gasser–Ogden Material*. Sharaki et al., University of Toledo, Toledo, OH, USA, 2015.