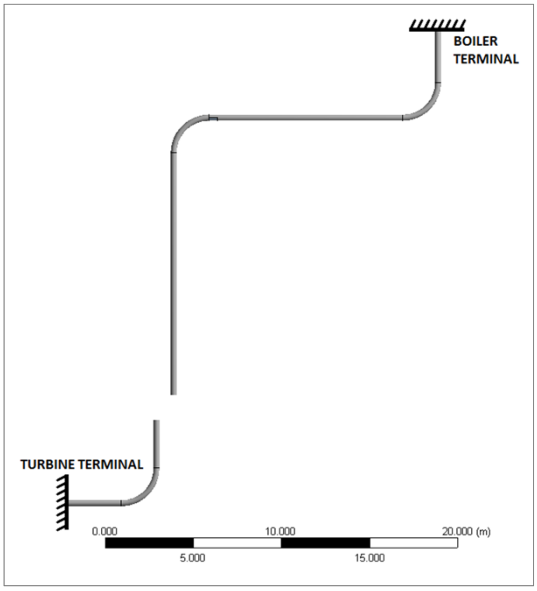
**Universität Stuttgart**
Fakultät für Bau- und
Umweltingenieurwissenschaften

**Alexander Keiser**

# Thermally Induced Pull of Curved pipes

## Problem Description

In fossil fuel fired power plants, the transfer of high-temperature working fluid from the boiler to the turbine can cause significant thermal expansion in the piping and potentially damage the connected equipment. To combat this, a fraction of the expected thermal expansion can be built into the structure to prestress the piping against thermal expansion; however, traditional cold pull negative expansion gap closing procedures can cause high, unknown stresses at the terminals. A prestressing procedure known as the thermal bending technique can be used to correct piping angulation using an applied temperature gradient from the application of ceramic heating pads, thereby reducing the required forces and terminal stresses during the procedure.

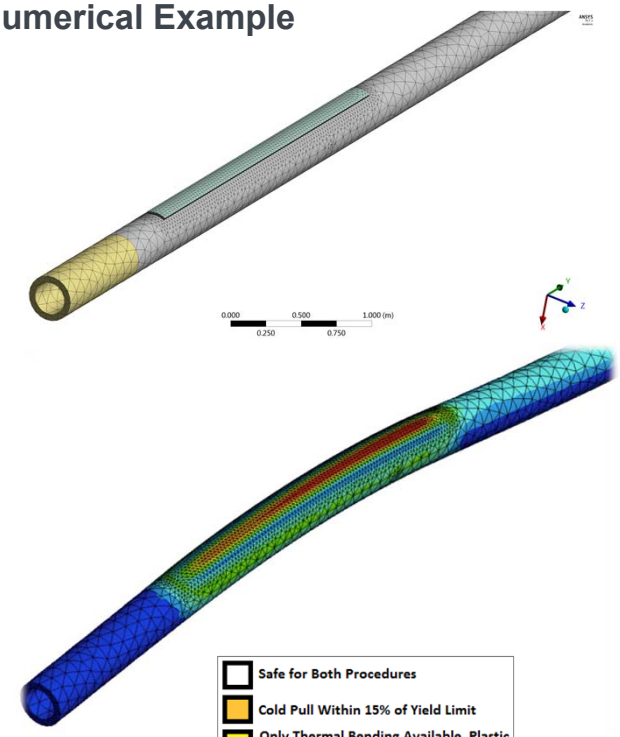


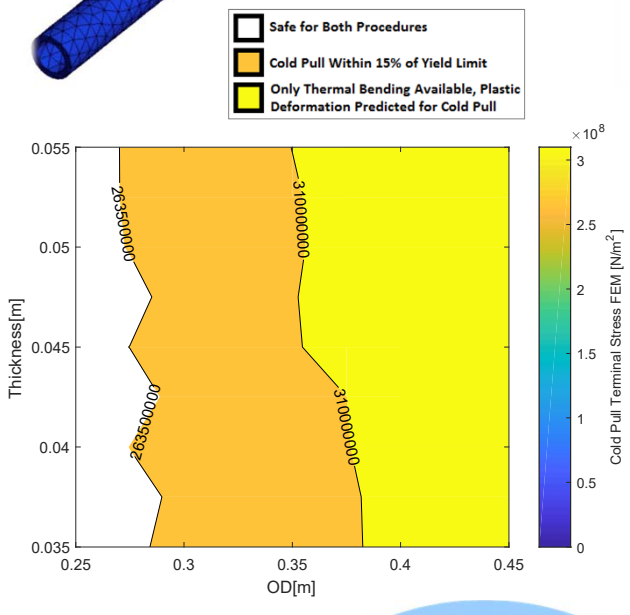

## Solution

**Approach**:
Finite element models of two prestressing procedures are developed. The procedures are the traditional cold pull technique and an improved thermal bending technique utilizing volumetric heat generation loading within modeled ceramic heating pads. The terminal stresses are measured for each procedure.

**Results:**
The thermal bending technique is shown to reduce terminal stress during the procedure by a factor of 15. Parametric results additionally show the geometric ranges of viability for each procedure for an included negative expansion fraction of 0.5.

## Numerical Example






## Literature:

Popplewell, P L, and K Riley. Thermally Induced Curvature in Pipes as a Means of System Preload. Roc Instn Mech Engrs, vol. 195, 1981, pp. 377--387.

Supervisor: Dr.-Ing Anton Tkachuk
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