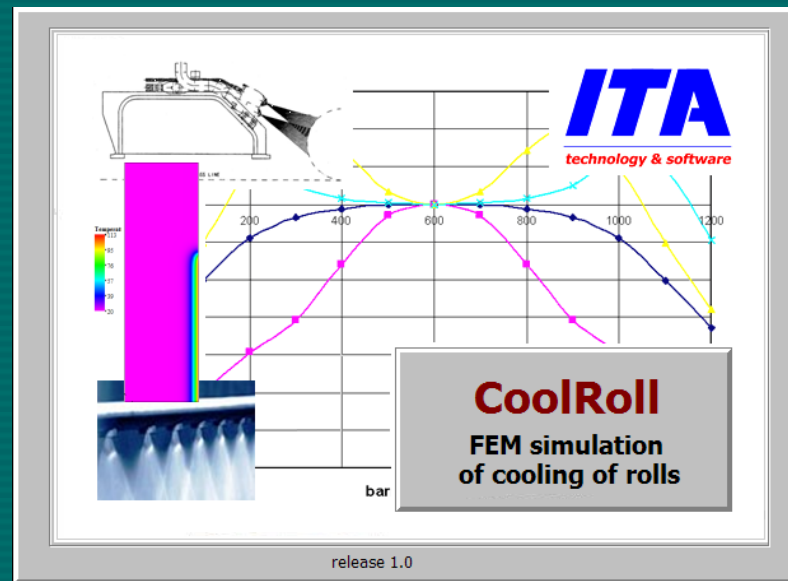# CoolRoll

Concept of the software for the FEM simulation of cooling of rolls

CoolRoll – FEM simulation of cooling of rolls
Introduction

**CoolRoll** is FEM based software developed by ITA Ltd. for computer simulation of various cooling strategies of rolls during their rolling campaign.

CollRoll pre-processing enables user friendly formation of FEM model, specification of heat transfer boundary conditions and roll campaign.

CoolRoll enables non-stationary heat transfer analysis coupled with elastic analysis to calculate temperatures and deformations and stresses caused by temperature changes in thermal loaded rolls.
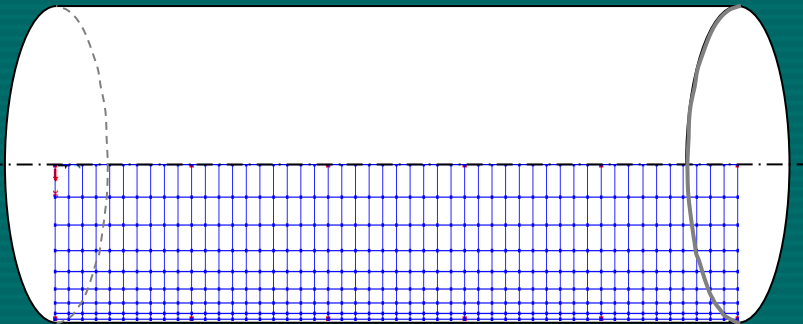
CoolRoll – FEM simulation of cooling of rolls
Work Roll FEM Model – Geometry & Mesh
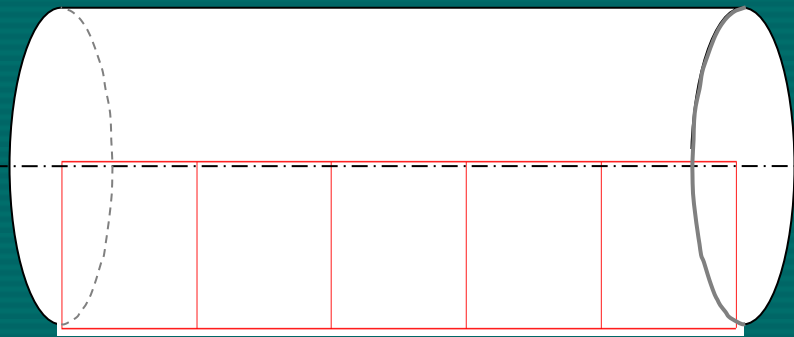
WRoll Geometry:

• flat cylinder defined by diameter and length,
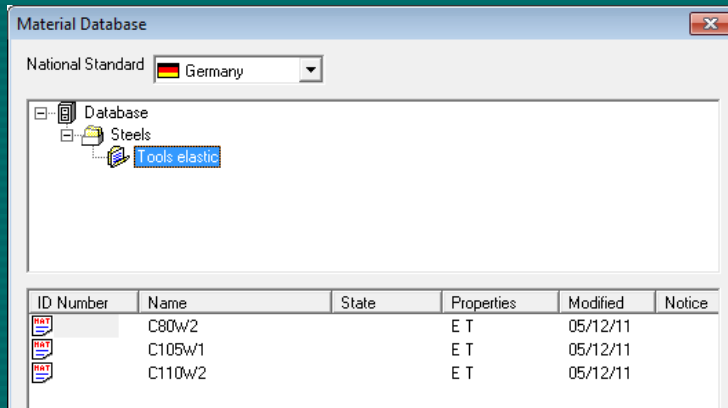
• specified number of lengthwise segments

WRoll Mesh:

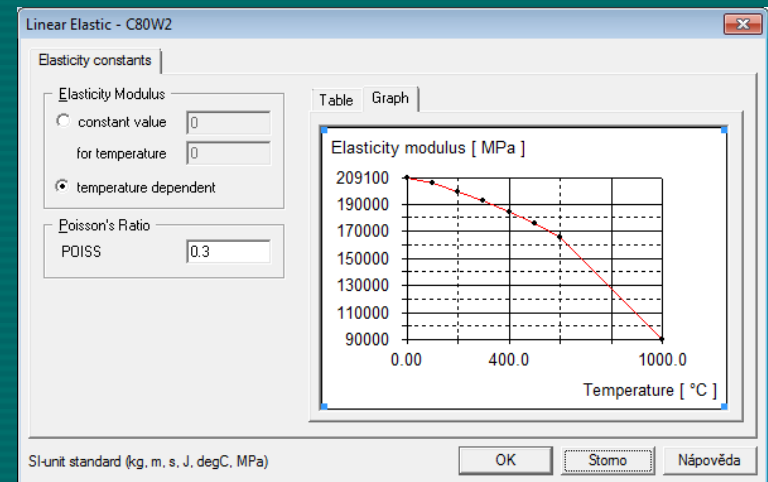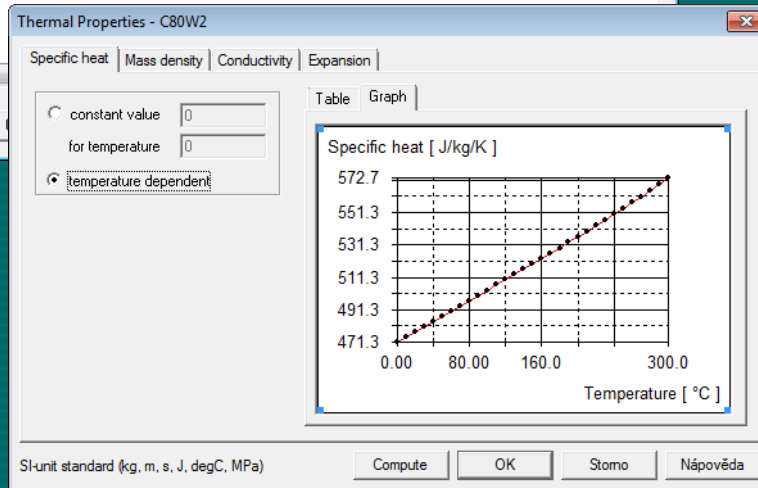• mesh made of linear 4node finite elements,

• automatic meshing.

CoolRoll – FEM simulation of cooling of rolls
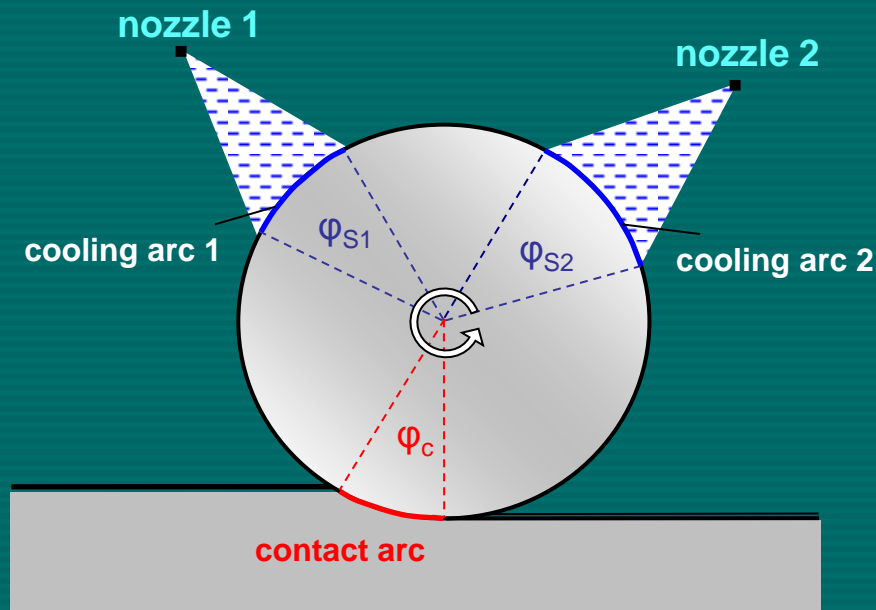## Work Roll FEM Model – Material Properties

Material Database:

• thermal properties (specific heat, density, conductivity and thermal expansion)

• elastic properties (elasticity modulus, Poissons ratio)

CoolRoll – FEM simulation of cooling of rolls
Work Roll FEM Model – Heat Transfer conditions

nozzle 1

nozzle 2

cooling arc 1

φ_{S1}

φ_{S2}

cooling arc 2

φ_C

contact arc

Problem of the model dimension:
FEM model of the WRoll is created in the lengthwise plane but boundary conditions change in transversal plane as well

special pre-processing of Heat Transfer conditions was developed!

Special pre-processing of Heat Transfer (HT) Conditions:

• HT conditions for each arc are specified,

• time sequence of HT conditions for one rotation of the WRoll is created,

• time sequence of HT conditions for one pass or one pause between passes is created,

• temperature of the WRoll for each pass or pause between passes is calculated by 1D FEM module (average temperature from the surface to the centre of the WRoll)

• average HT conditions (heat transfer coefficient and ambient temperature) for each pass or pause beween passes are calculated

CoolRoll – FEM simulation of cooling of rolls
User Interface – Main CollRoll Window
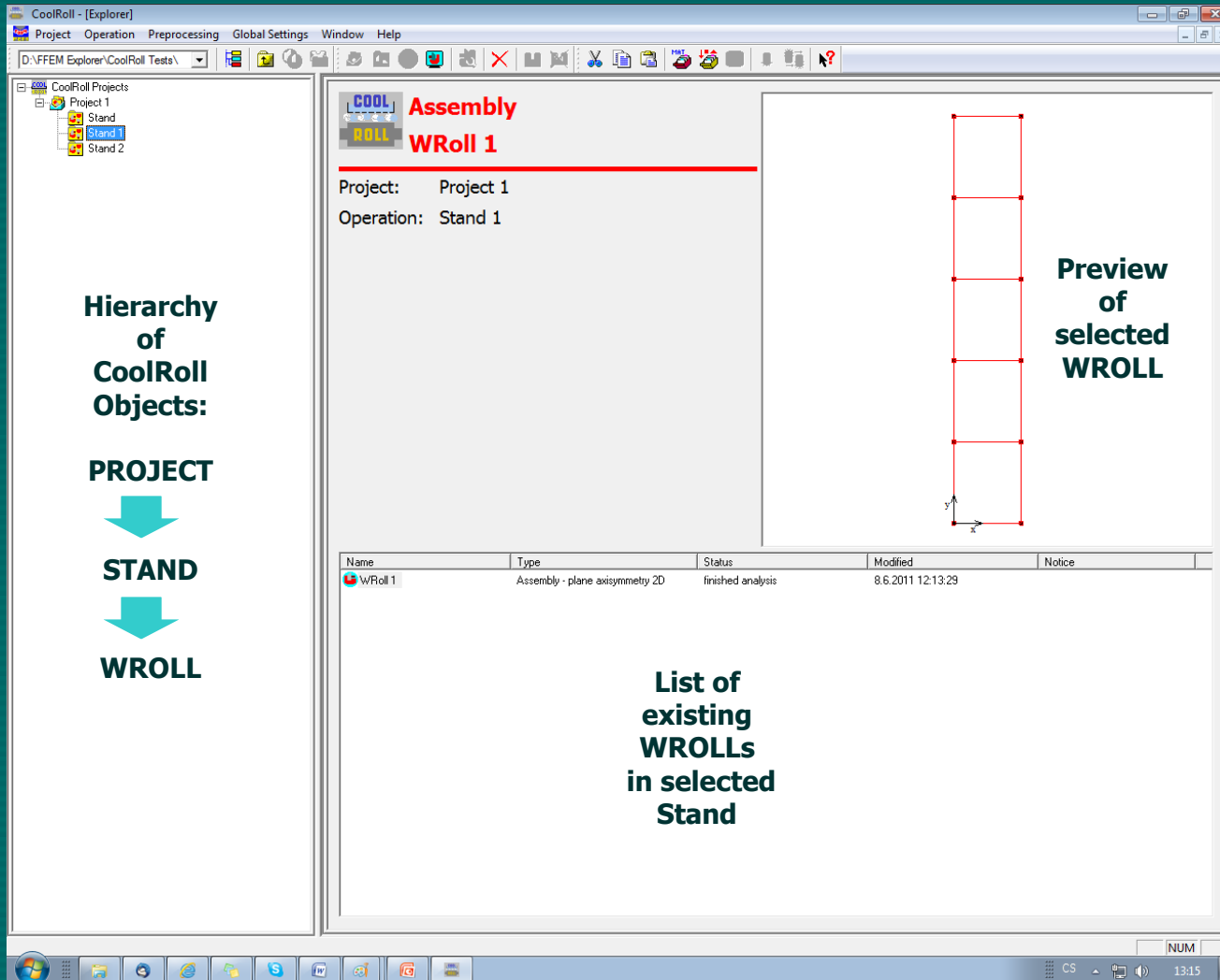
CoolRoll – FEM simulation of cooling of rolls
Pre-processing Wizard 1 – Work Roll FEM Model

CoolRoll – FEM simulation of cooling of rolls
Pre-processing Wizard 2 – Campaign & Technology

CoolRoll – FEM simulation of cooling of rolls
Pre-processing Wizard 3 – Campaign & Cooling strategy
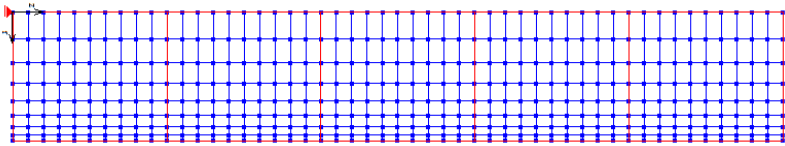
CoolRoll – FEM simulation of cooling of rolls
Pre-processing Wizard 4 – FEM Analysis options

CoolRoll – FEM simulation of cooling of rolls
Screen of running FEM Analysis
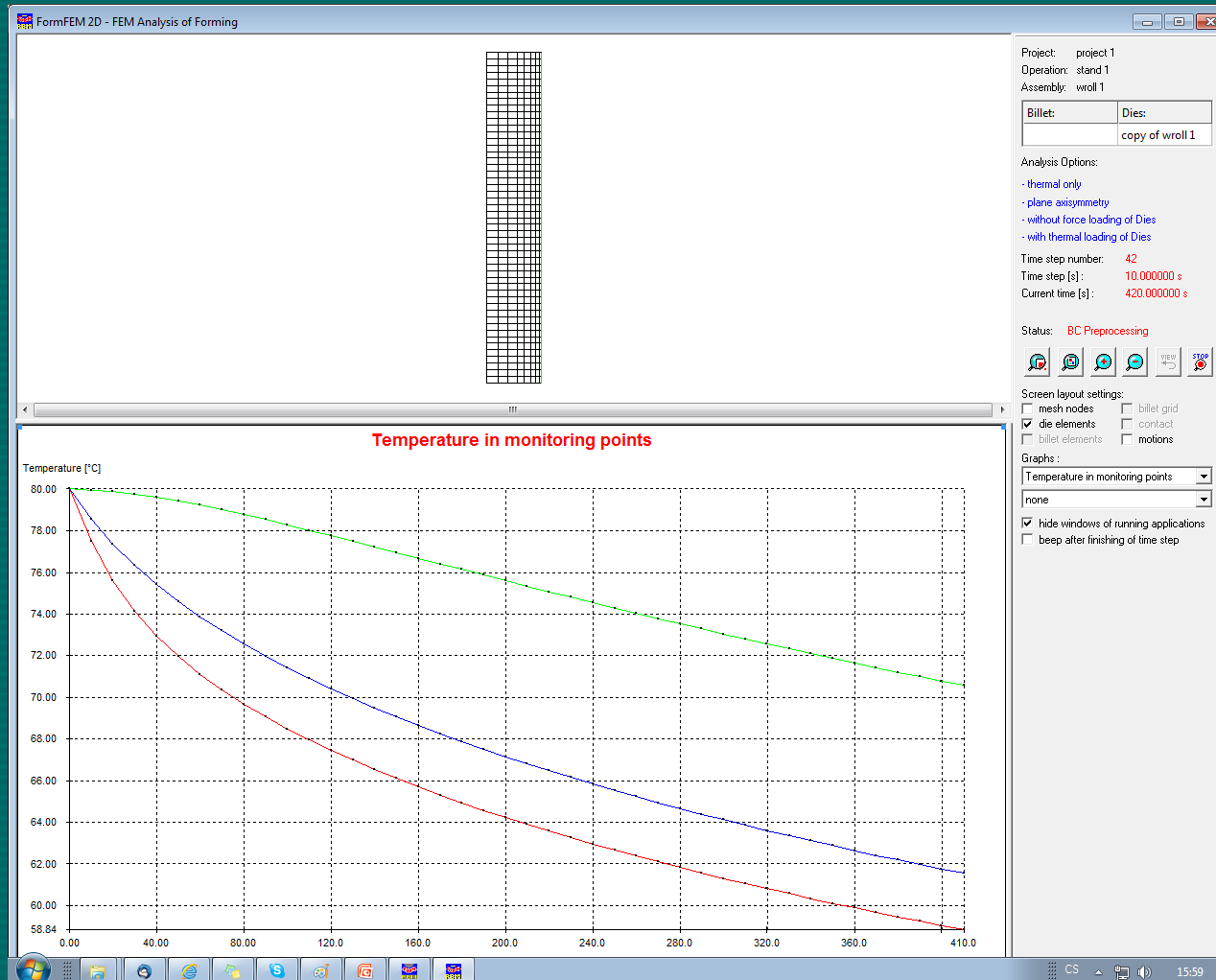
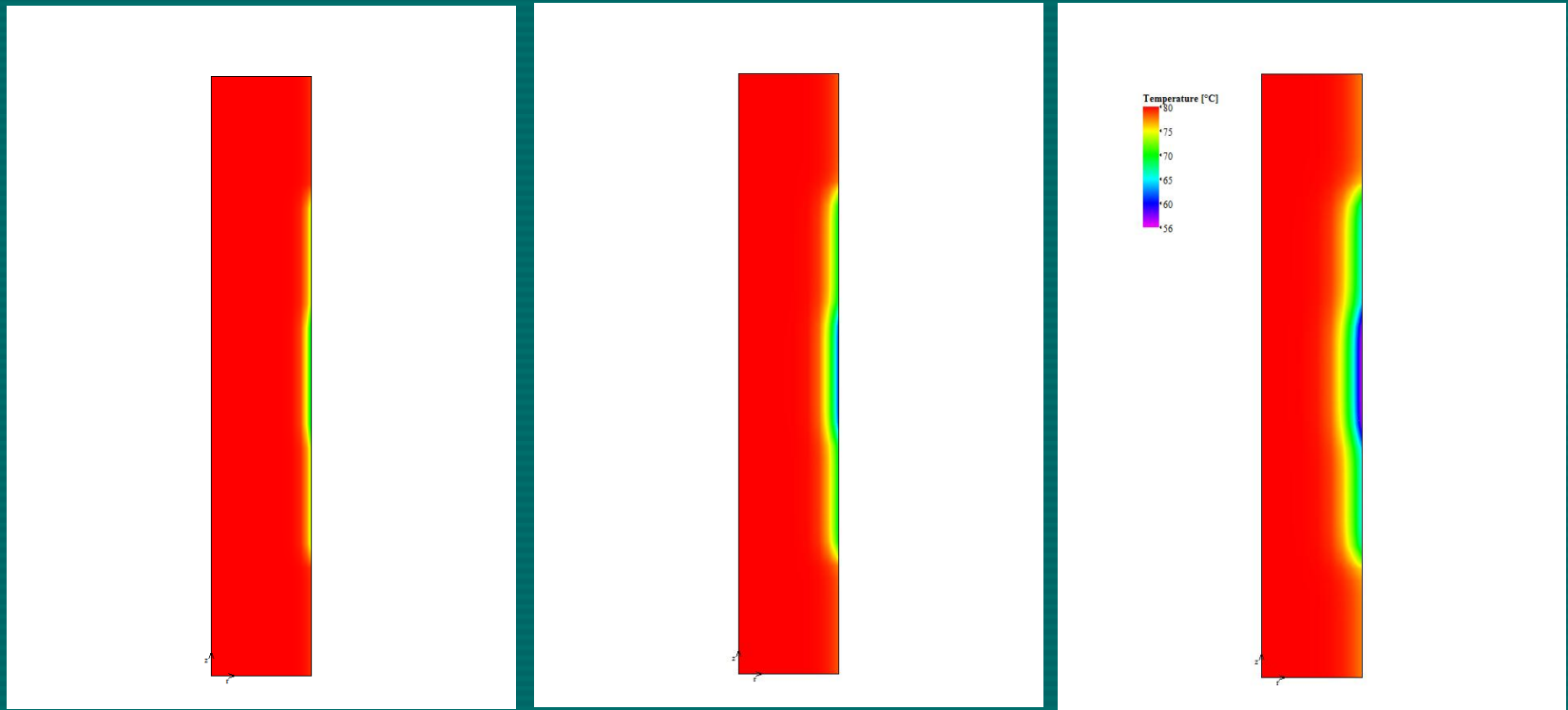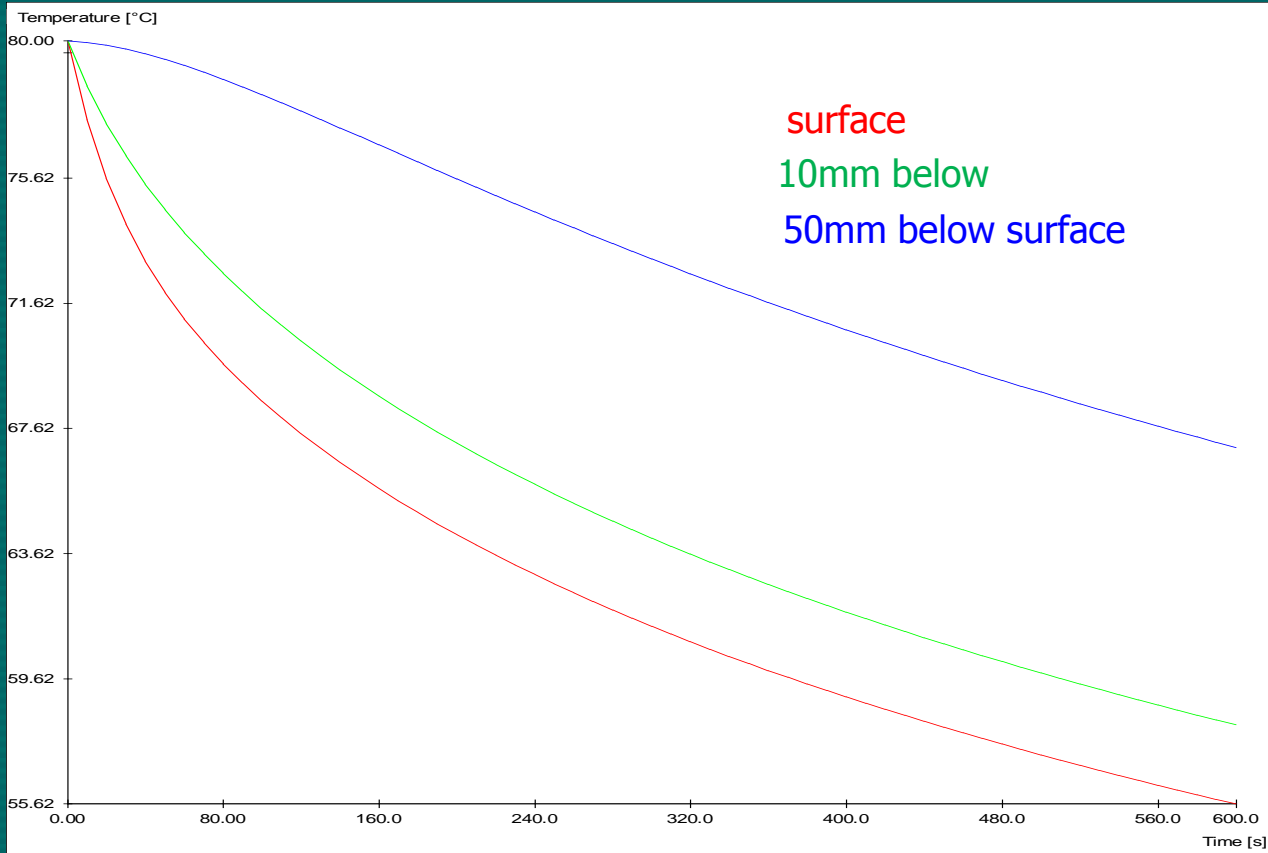# CoolRoll – FEM simulation of cooling of rolls
Post-processing of results

Temperature distribution in specified time of the roll campaign

CoolRoll – FEM simulation of cooling of rolls
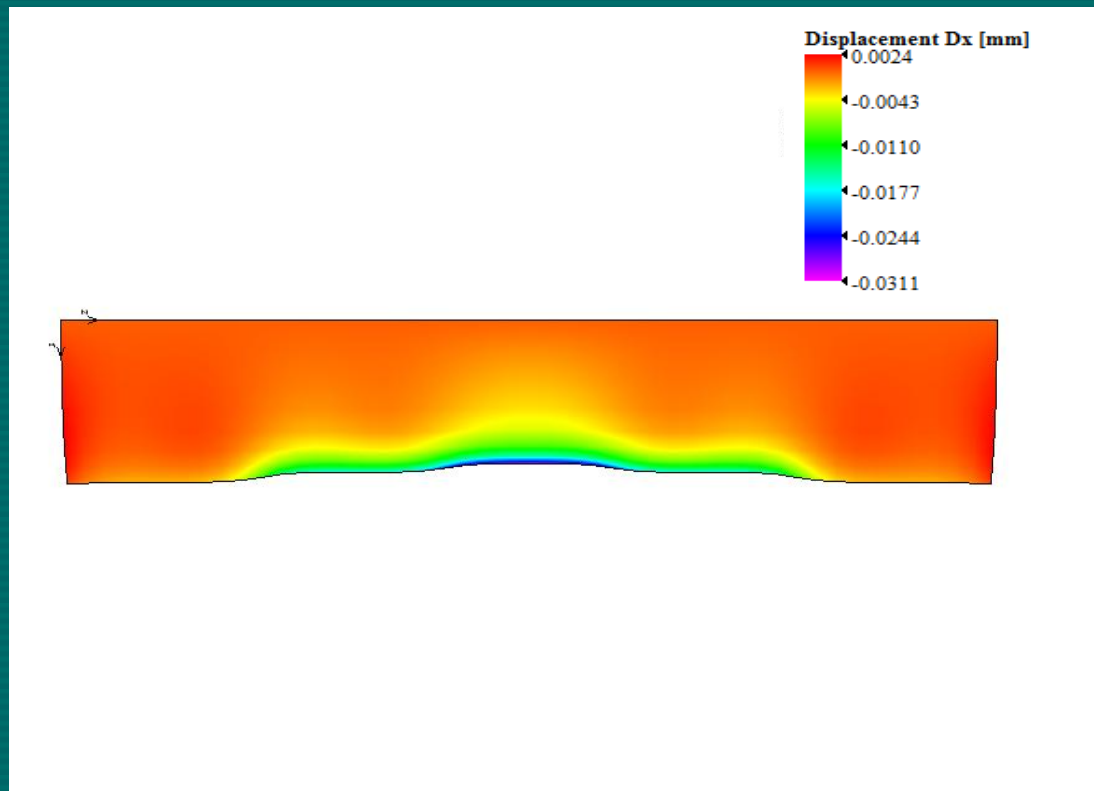## Post-processing of results

Time history of temperatures in specified monitoring points of the roll

CoolRoll – FEM simulation of cooling of rolls
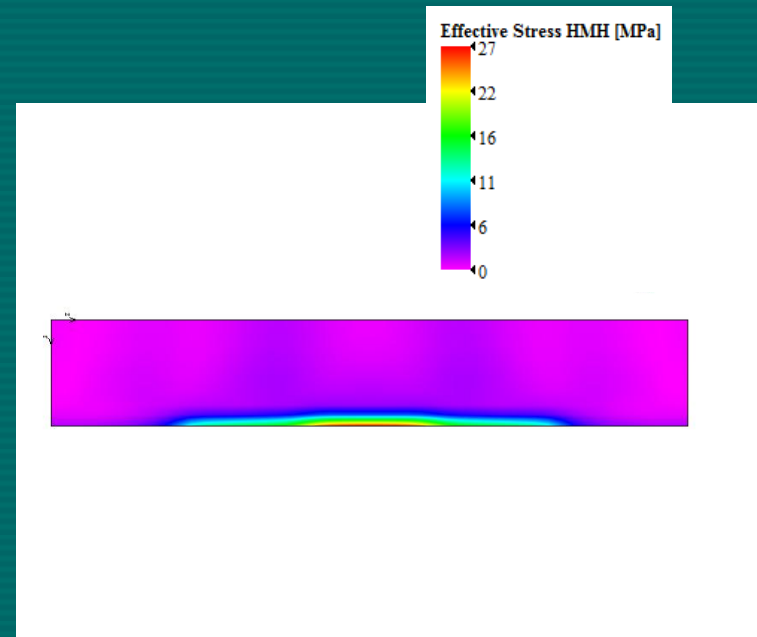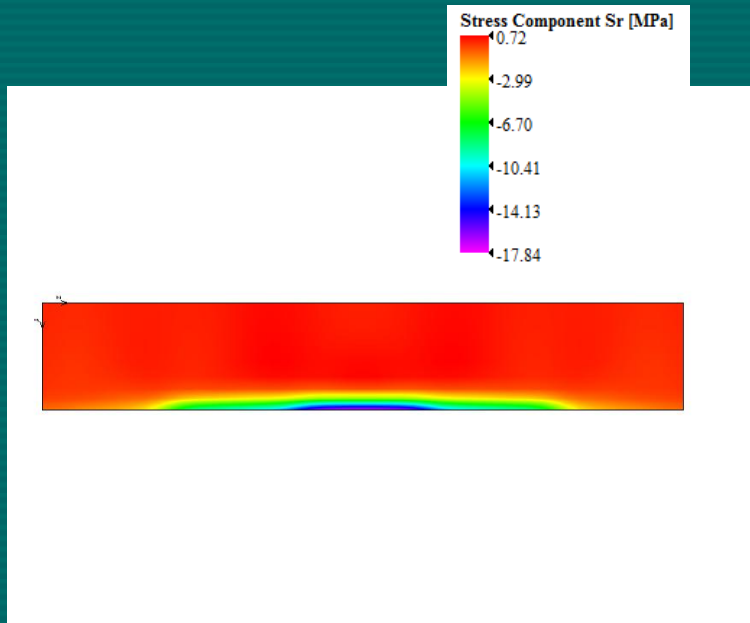## Post-processing of results

Deformation of the roll due to temperature changes in specified time of the roll campaign

CoolRoll – FEM simulation of cooling of rolls
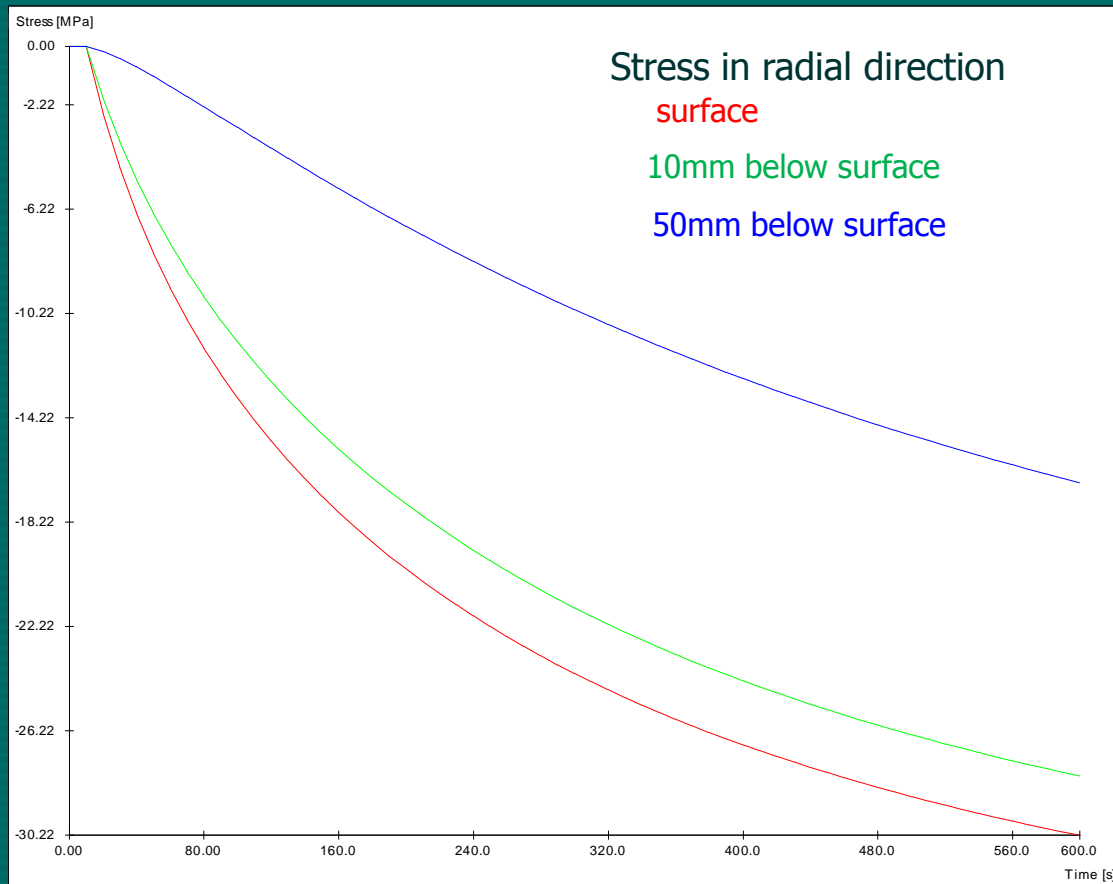## Post-processing of results

Distribution of stress components in specified time
of the roll campaign

CoolRoll – FEM simulation of cooling of rolls
Post-processing of results

Time history of stress components in specified points of the roll

CoolRoll – FEM simulation of cooling of rolls

Summary