

Evaluation of experiments on short steel columns exposed to standard fire and axial load



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Content

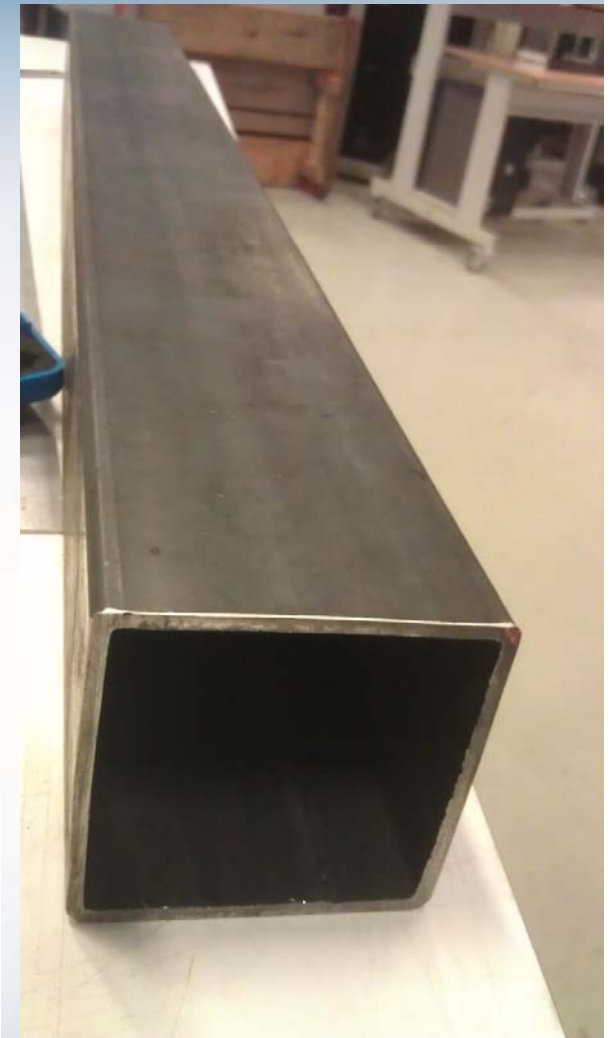
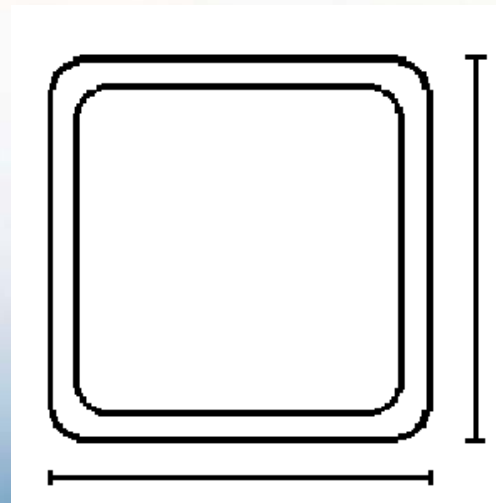
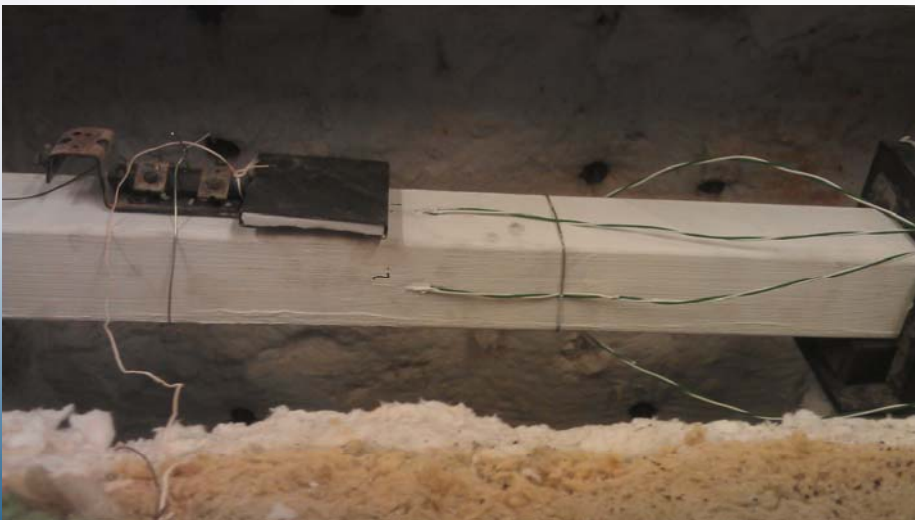
- Experimental set-up
- Nominal geometry vs. measured data
- Coupon test of the steel column
- Results of experiments
- Prediction of the experimental results by EN1993-1-2
- Conclusions

Objectives

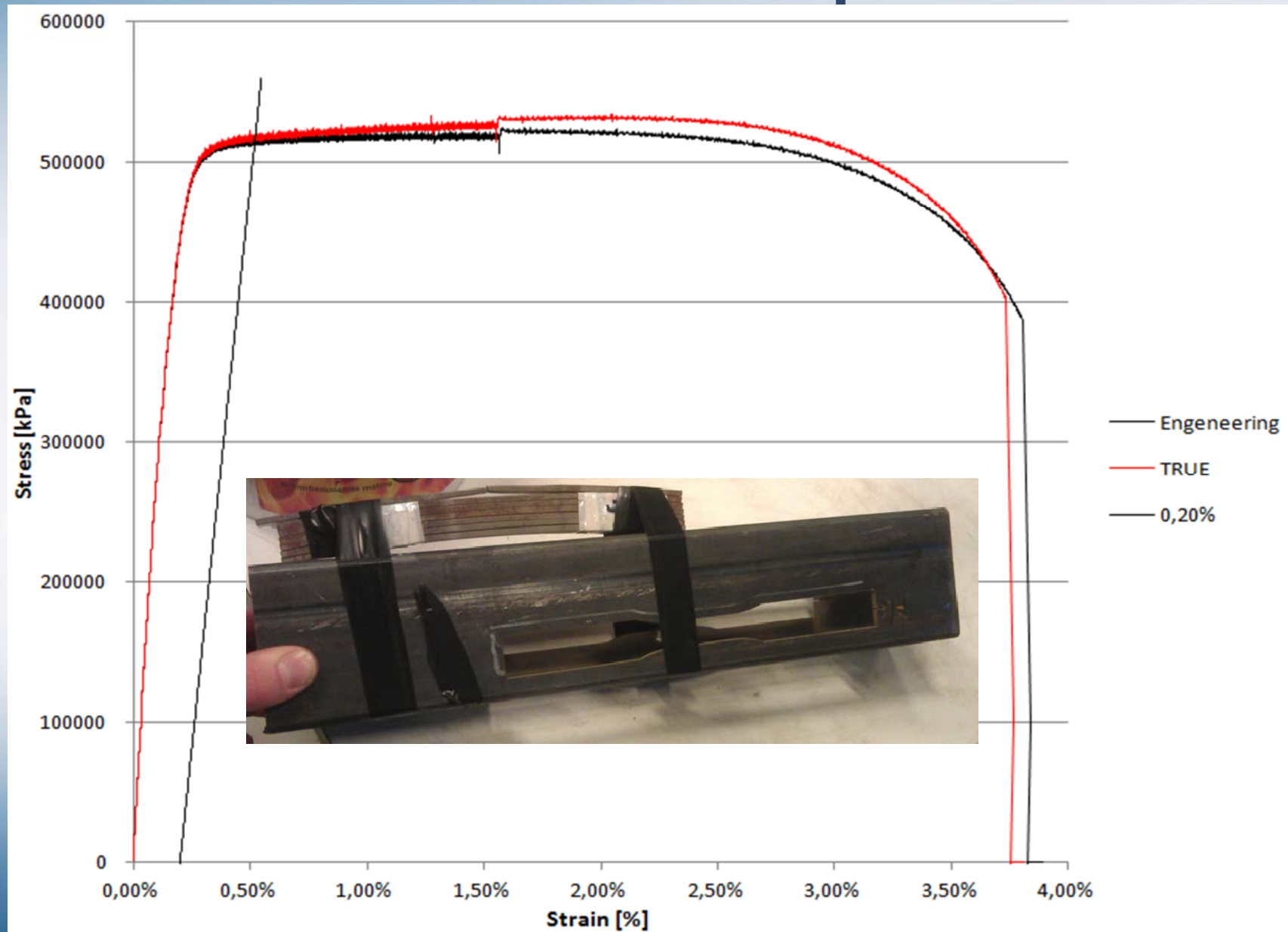
- Experimental values for critical temperature of short column in compression
- Comparison of protected and unprotect column
- Interpretation of experimental data
- Comparison with nominal and experimental data
- Prediction of experiments by EN1993-1-2

Test set-up

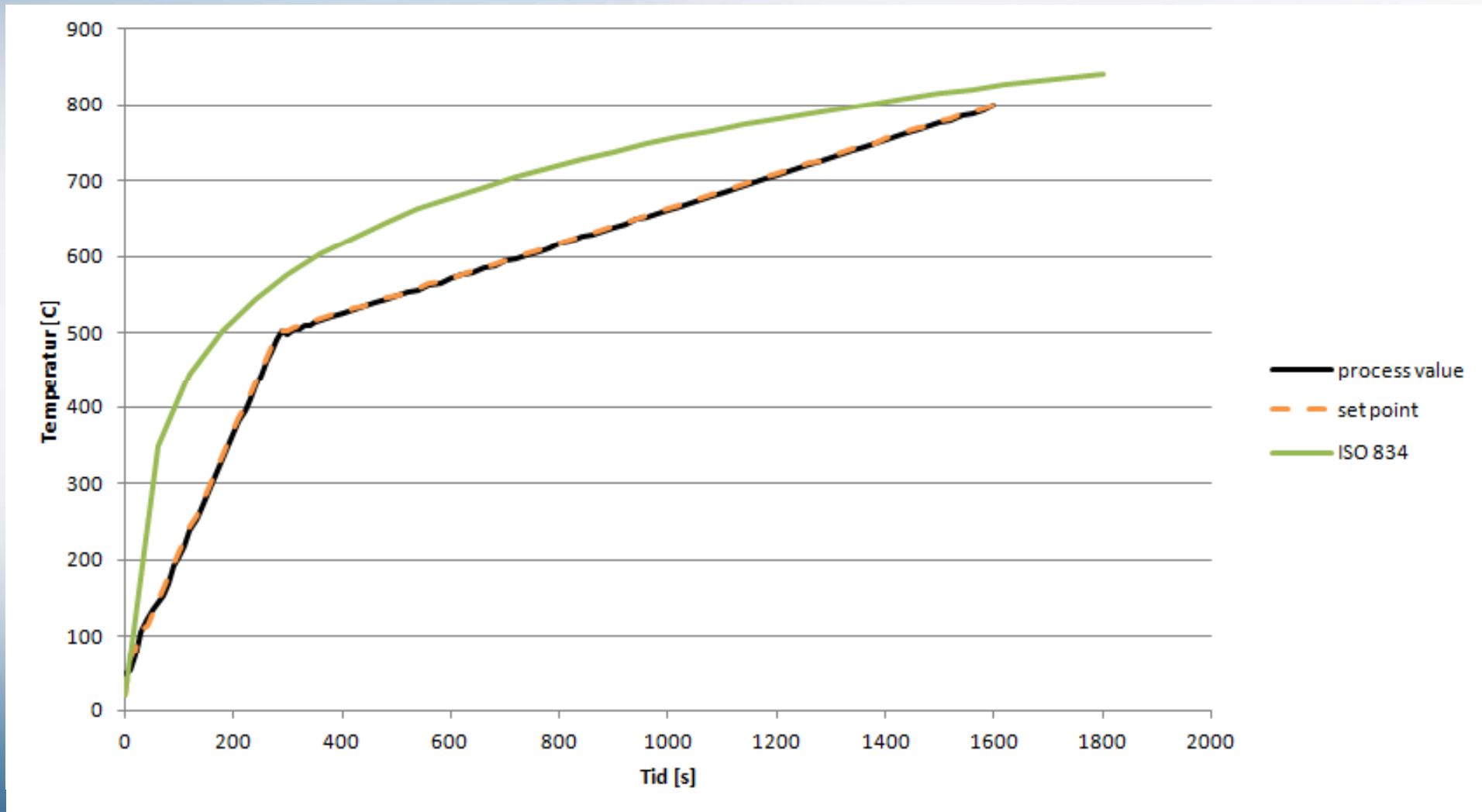
- Two columns
- One protected, one unprotected
- Applied constant load 150 kN
- $L=800$ mm
- "80x80" mm



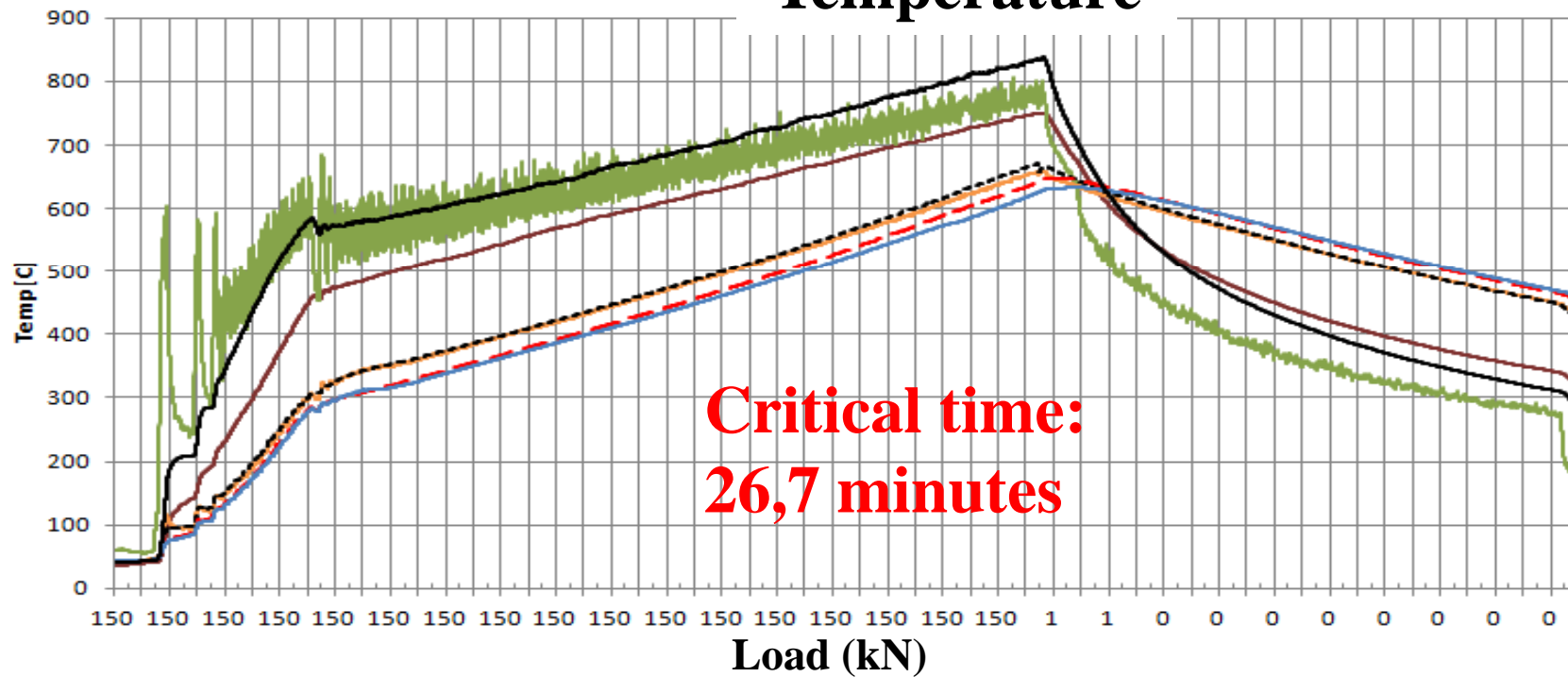
Results of the coupon tests



Gas temperature in furnace

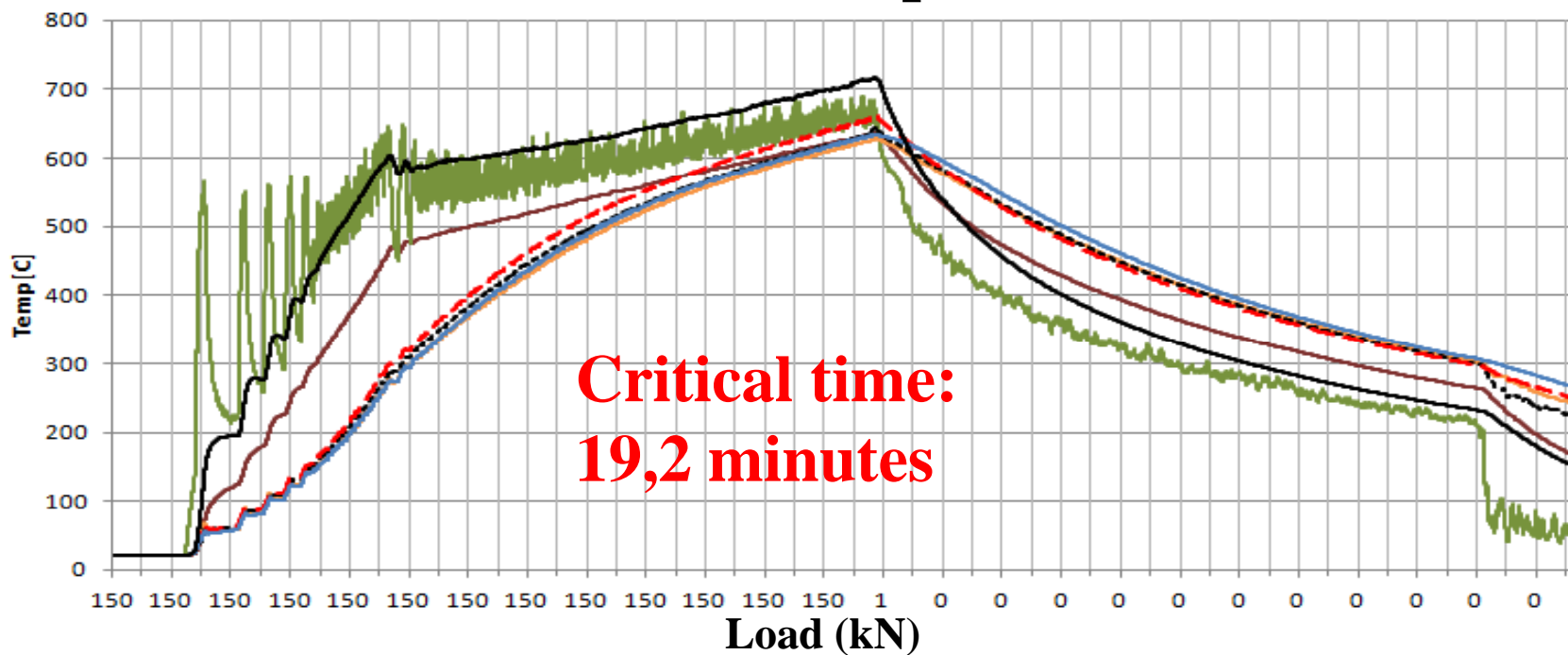


Temperature



Protected

Temperature



Unprotected

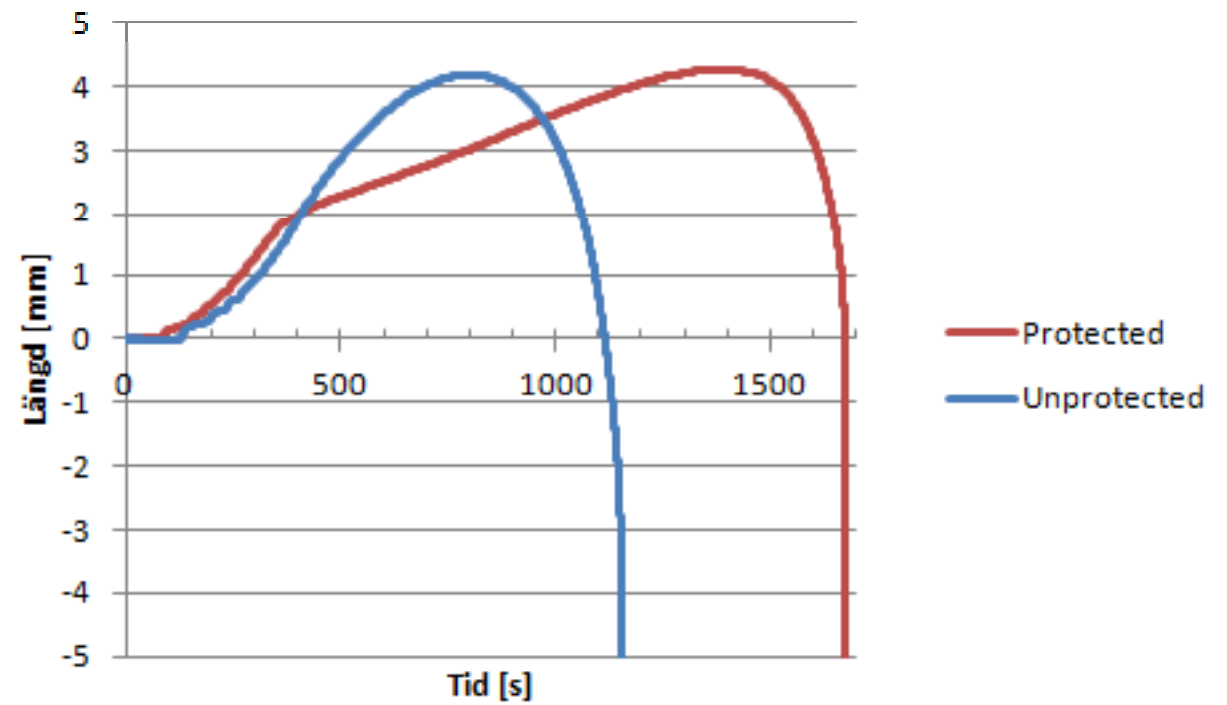
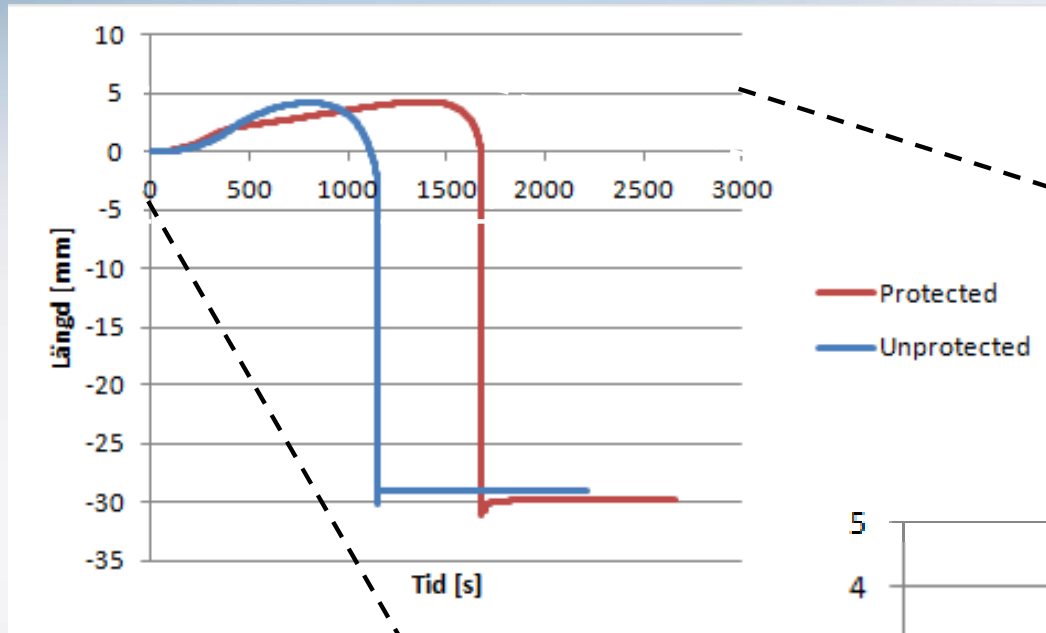
Calculated critical temperature for unprotected column

- Arcelor

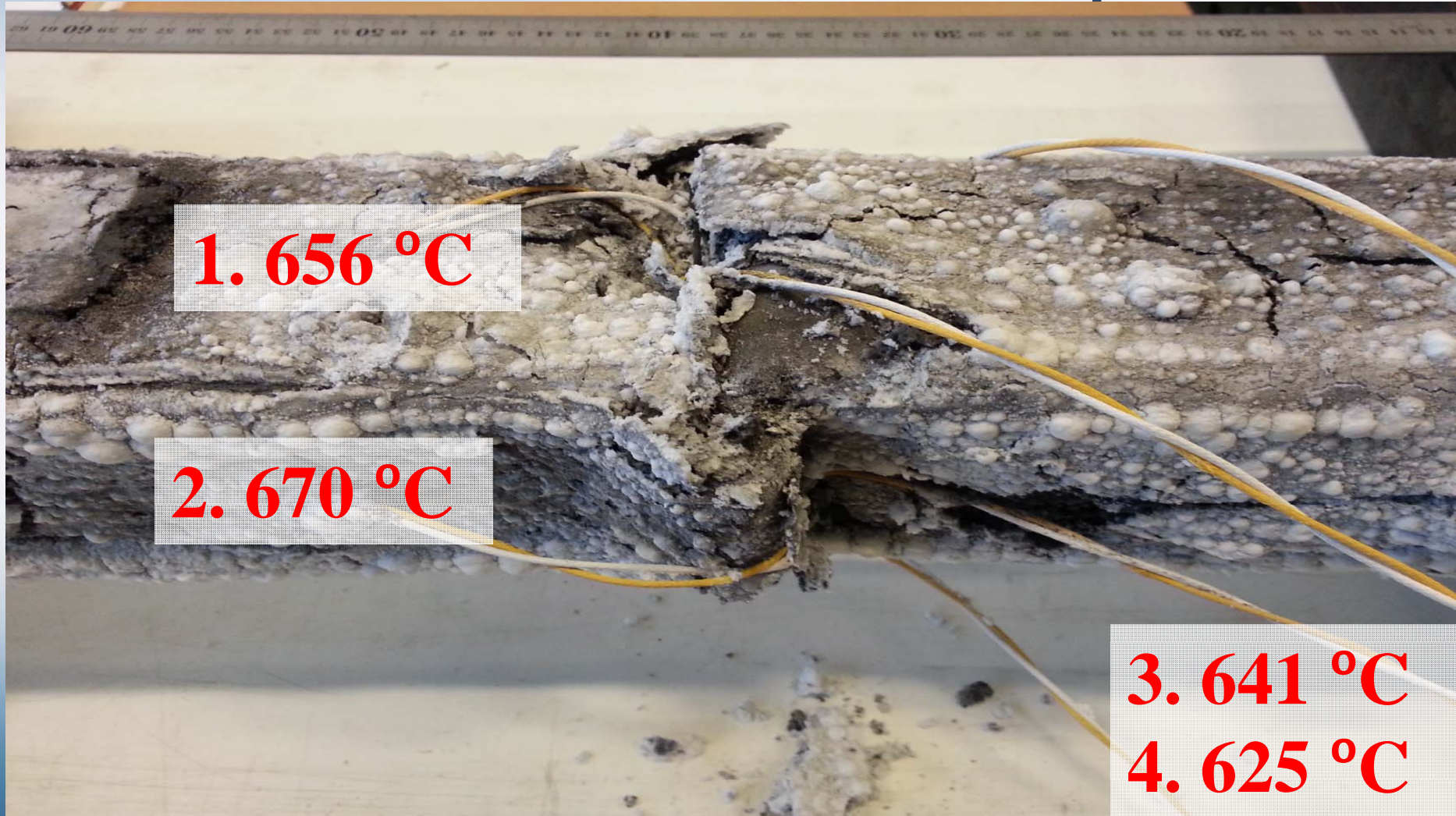
Table 4.2 : Critical compression stress $f'_{y,\theta,\bar{\lambda}}$ for S355 steel

	Temperature θ_a					
	400°C	500°C	600°C	700°C	800°C	900°C
$\bar{\lambda}(20^\circ\text{C})$	$f'_{y,\theta,\bar{\lambda}}$ [N/mm ²]					
0.0	355	277	167	82	39	21
0.1	334	261	157	76	37	20
0.2	313	246	147	71	35	19
0.3	293	231	137	66	33	18
0.4	272	215	126	60	31	17
0.5	250	199	116	54	28	16

Stroke / time

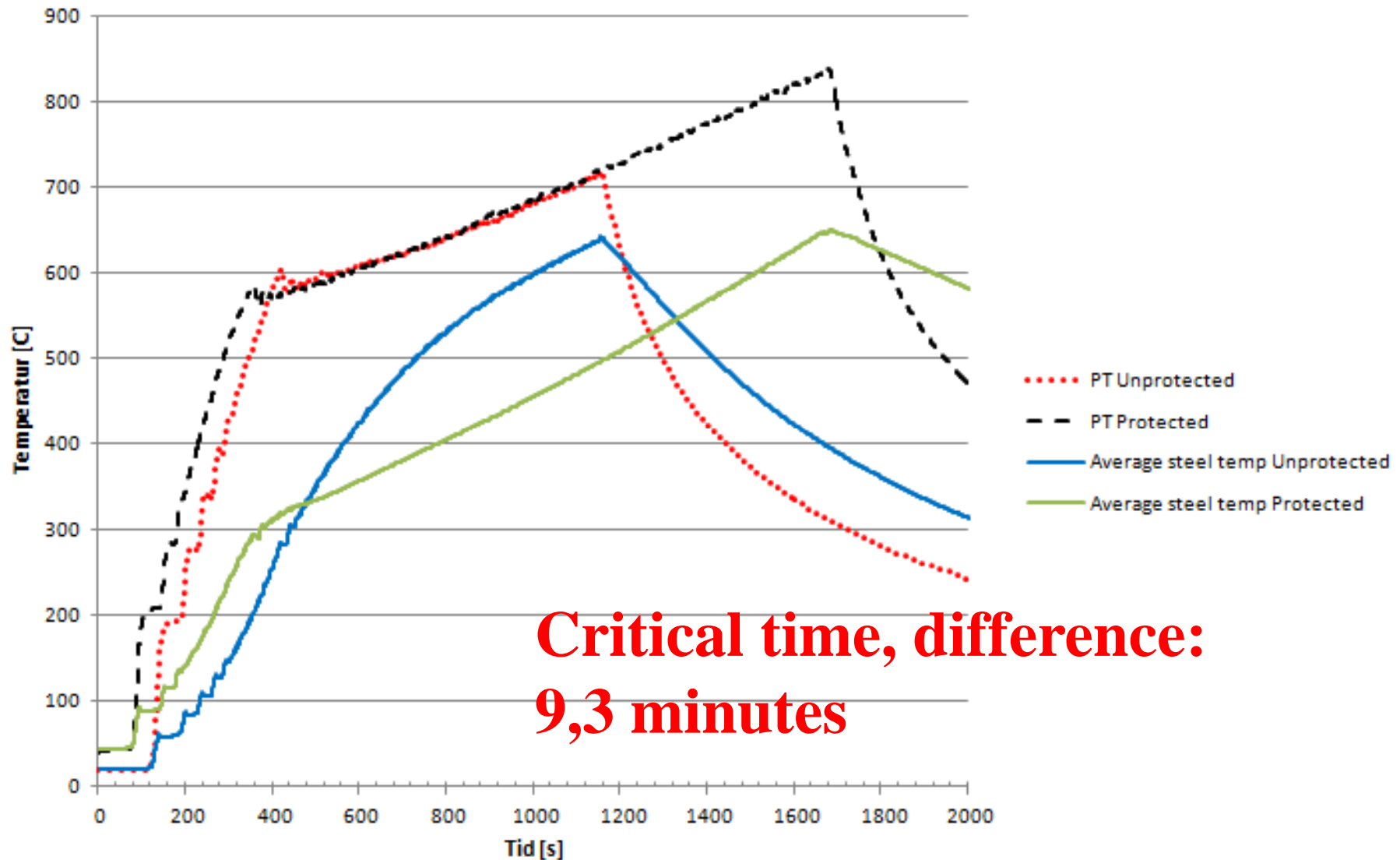


Critical temperature measurements for different thermocouples



Critical time

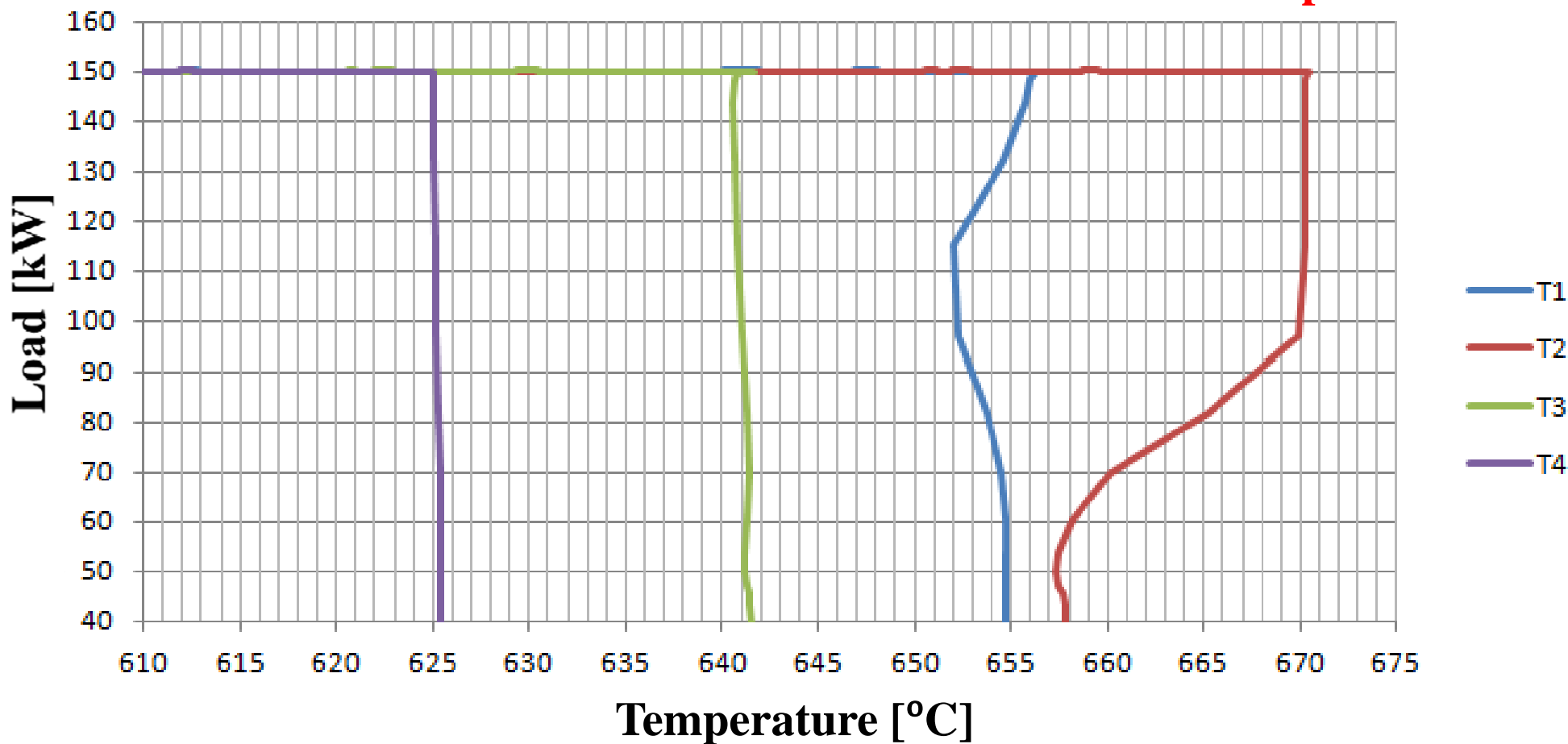
Protected vs. unprotected column



**Critical time, difference:
9,3 minutes**

Load vs time result for the unprotected column

Load/Temperature Critical temperature 670 °C



Conclusions

- Non-typical steel grade, looks like high strength steel rather than S355 which was the nominal steel grade
- Good prediction by Eurocode procedure
 - For steel with yield strength 515 MPa critical temperature measured is: 670 °C
 - For steel with S460, critical temperature calculated is: 638 °C