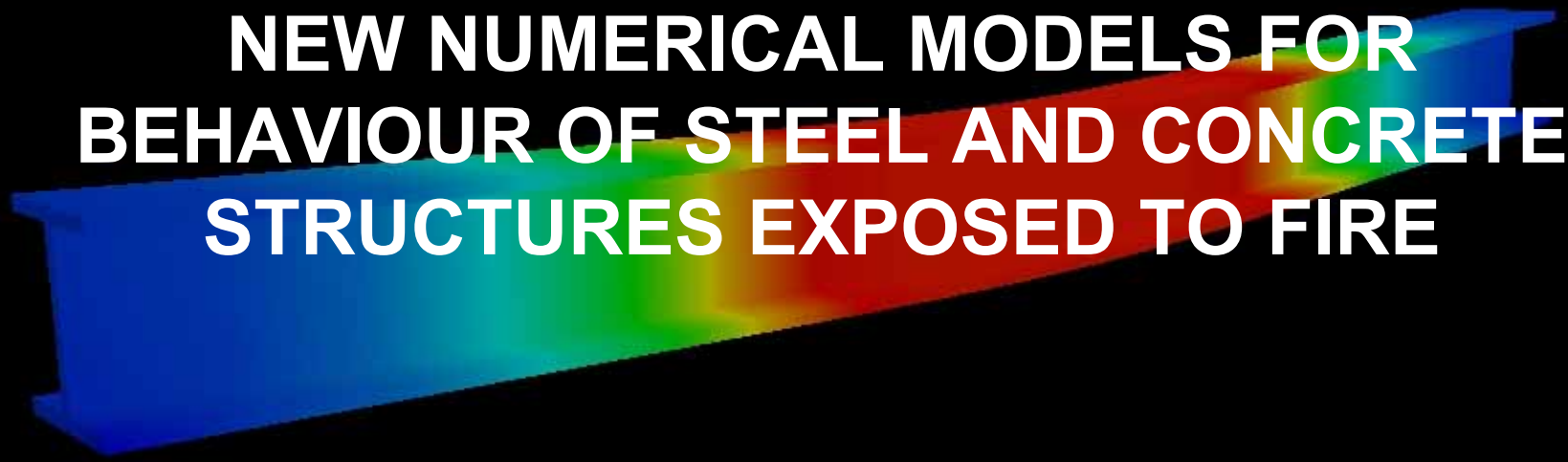
COST Action TU0904
Integrated Fire Engineering and Response
Training school
University of Malta, Sliema, 11.-14. April 2012.

Scientific project: Reliability of Structures and Risk Assesment to Extreme Loading, Ministry of Science and Tehnology, Croatia

NEW NUMERICAL MODELS FOR BEHAVIOUR OF STEEL AND CONCRETE STRUCTURES EXPOSED TO FIRE



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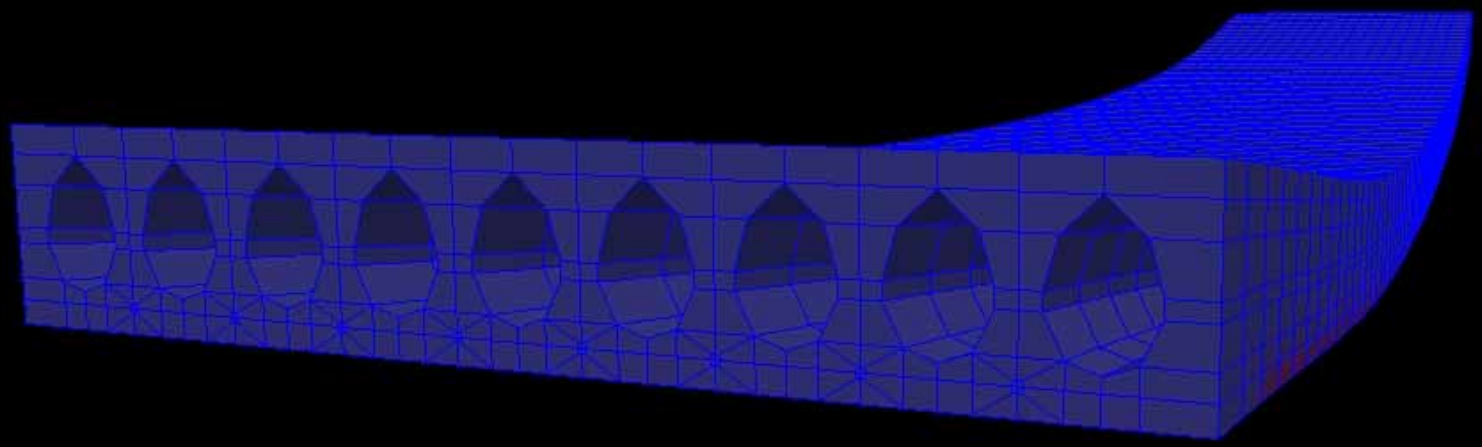
FACULTY OF CIVIL ENGINEERING, ARCHITECTURE AND GEODESY
Chair for steel and timber structures

OVERVIEW

- Introduction
- Research concept
- Numerical model for behaviour of steel and concrete structures exposed to fire
- Experimental research
- Numerical examples
- Discussion

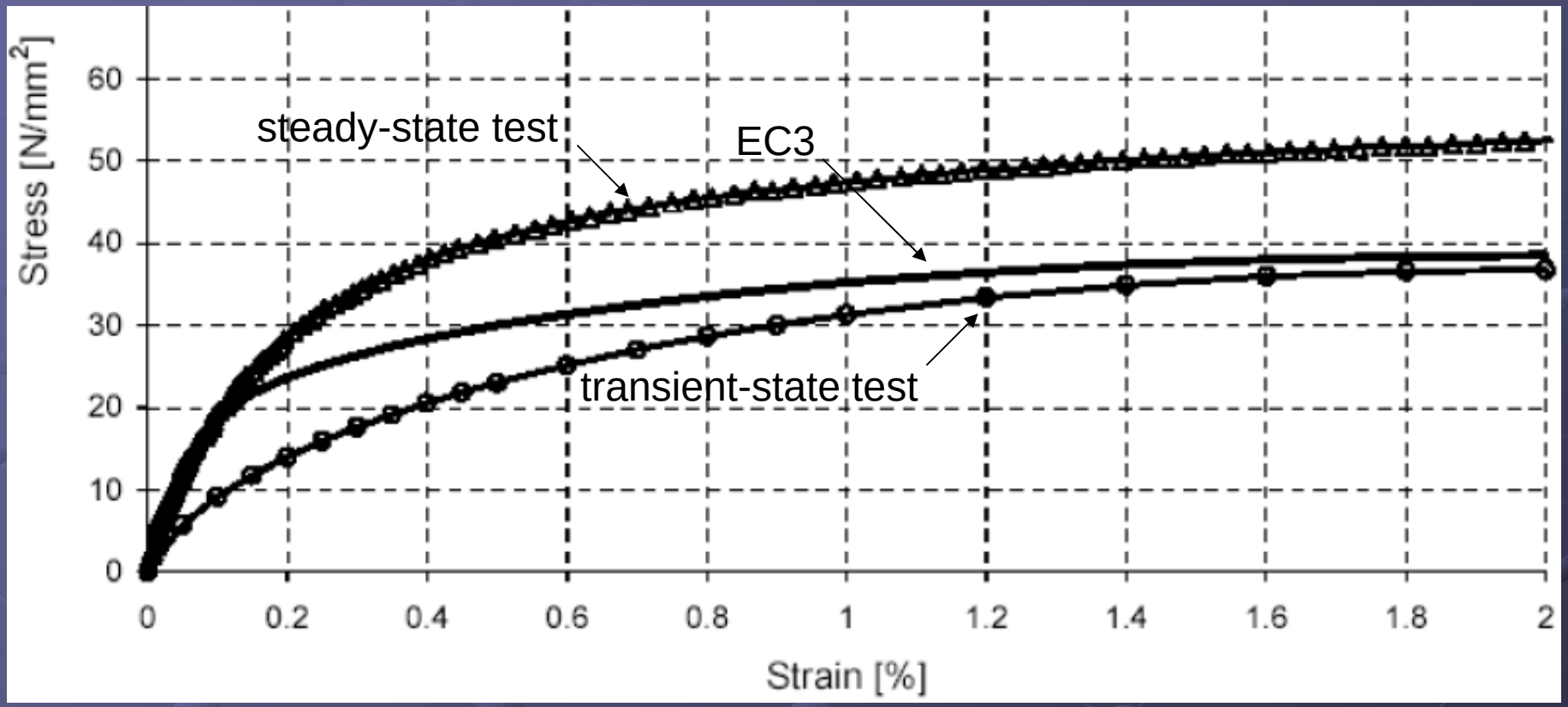


INTRODUCTION

- Development of structural analysis models for predicting fire behaviour
- Current research is focused on development of structural analysis model comprised of 3D heat transfer model, model for calculating mechanical properties of the cross section and model for structural analysis
- Development of simplifed model for calculating mechanical properties of the cross section taking into account the additional load dependent strains that occur during heating (creep, transient-creep)
- Calculation of modified stress-strain curves which implicitly take into account the additional load dependent strains (**strain modified curves**)

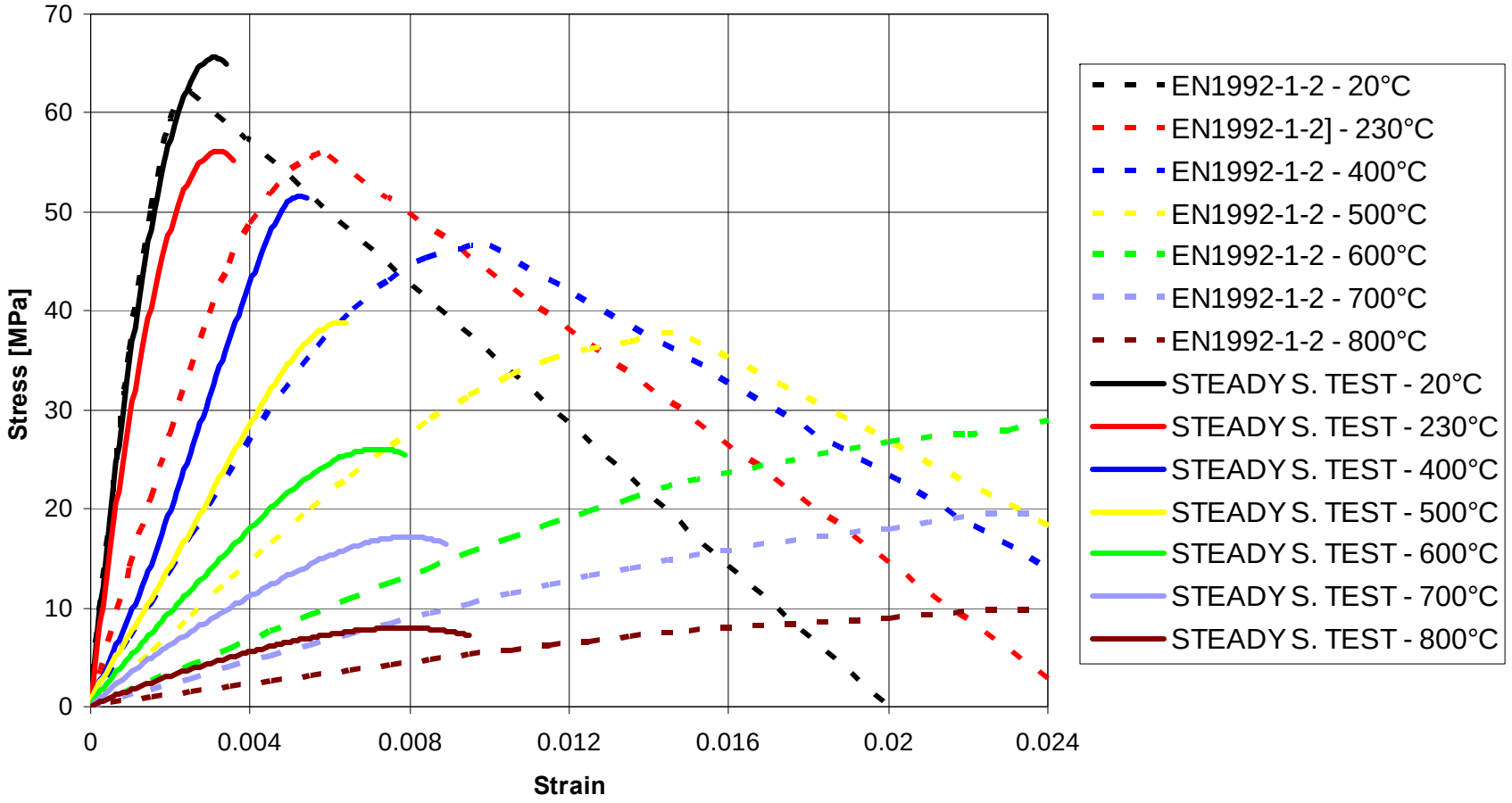
RESEARCH CONCEPT

Steel – **steady state test** vs. **transient state test** vs. **EC3**

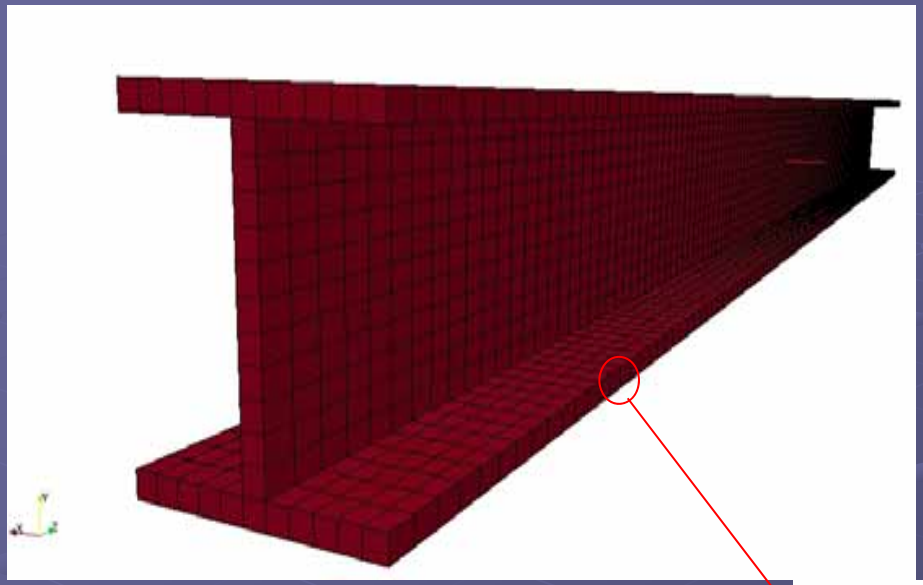


RESEARCH CONCEPT

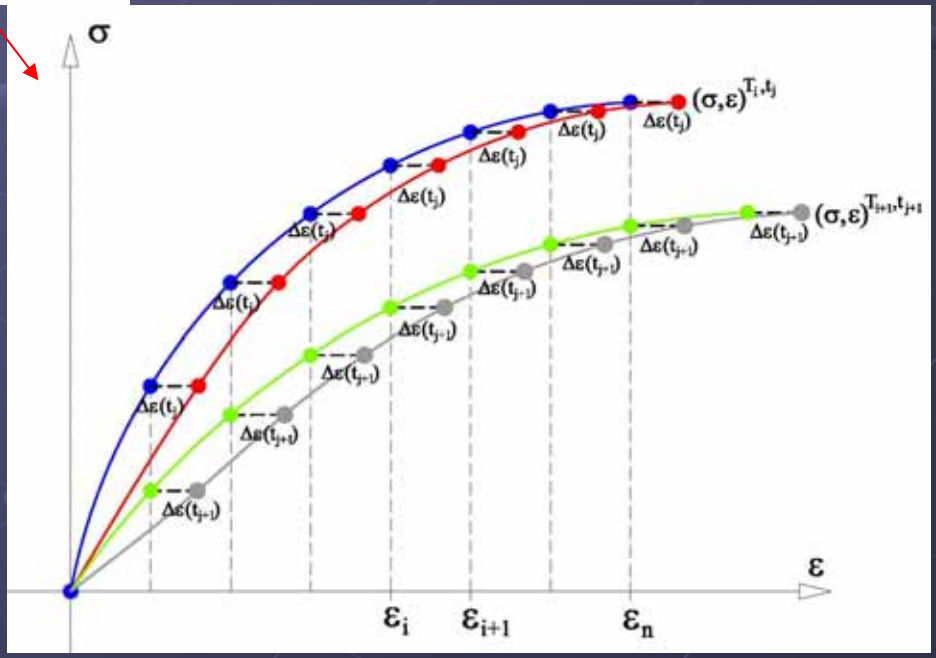
Concrete – steady state test vs. EC2



RESEARCH CONCEPT

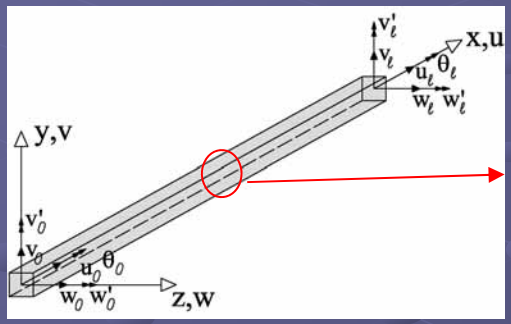


- Strain modified curve



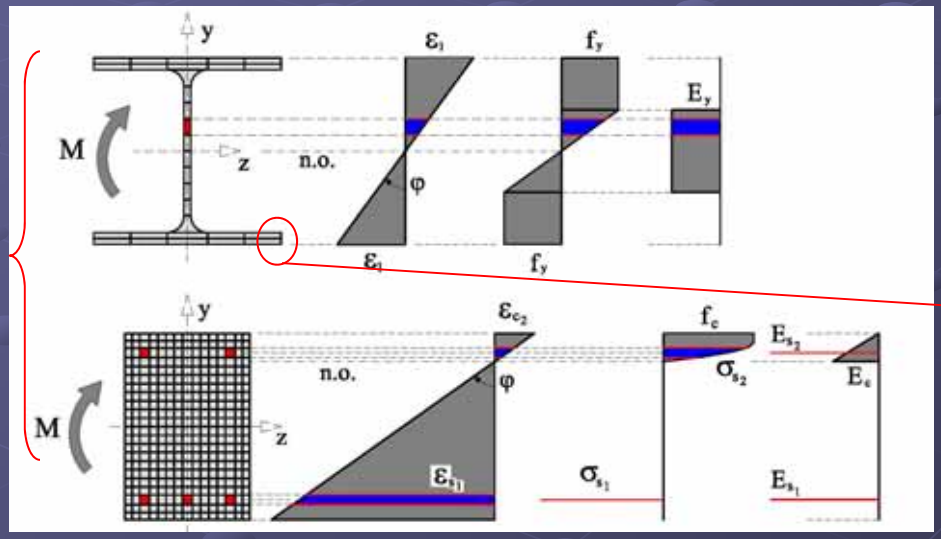
NUMERICAL MODEL FOR BEHAVIOUR OF STEEL AND CONCRETE STRUCTURES EXPOSED TO FIRE

- 3D nonlinear heat transfer model,
- Model for calculating mechanical properties of the cross section
- Model for structural analysis

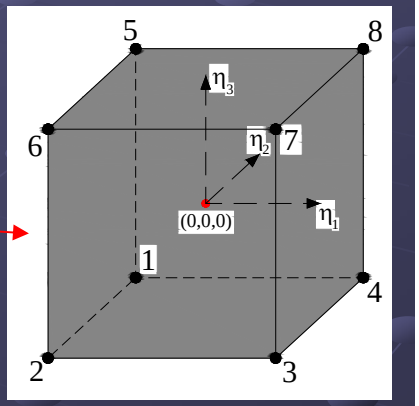


3D Bernoulli beam

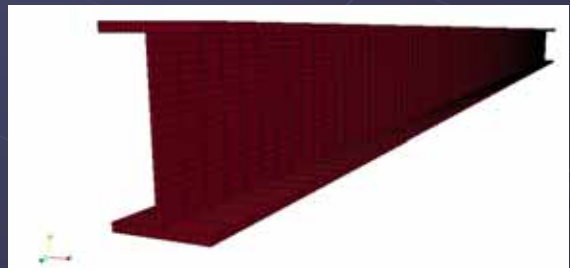
(6 D.O.F.)



Cross-section discretization

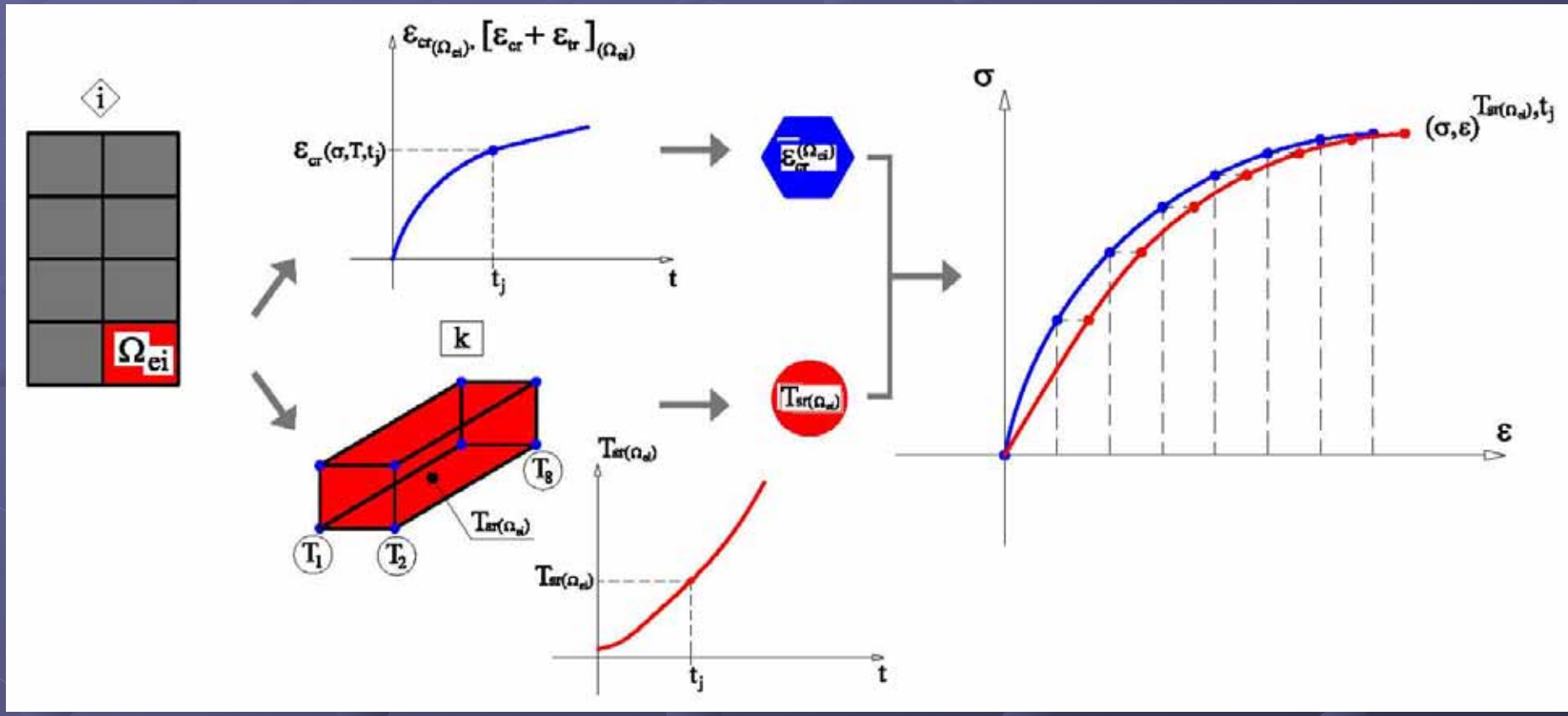


3D Cube element



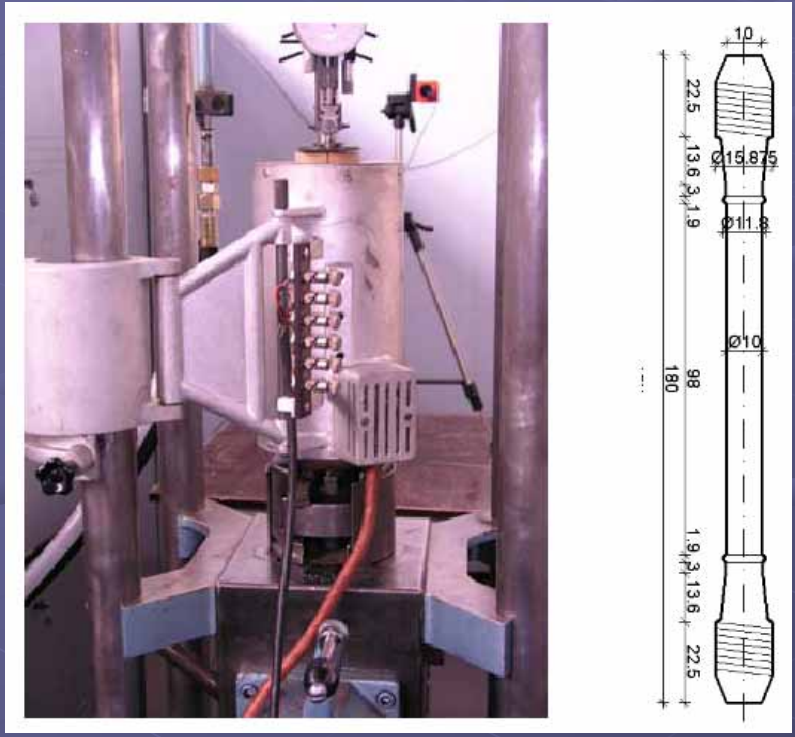
NUMERICAL MODEL FOR BEHAVIOUR OF STEEL AND CONCRETE STRUCTURES EXPOSED TO FIRE

- Calculation procedure for strain modified curve



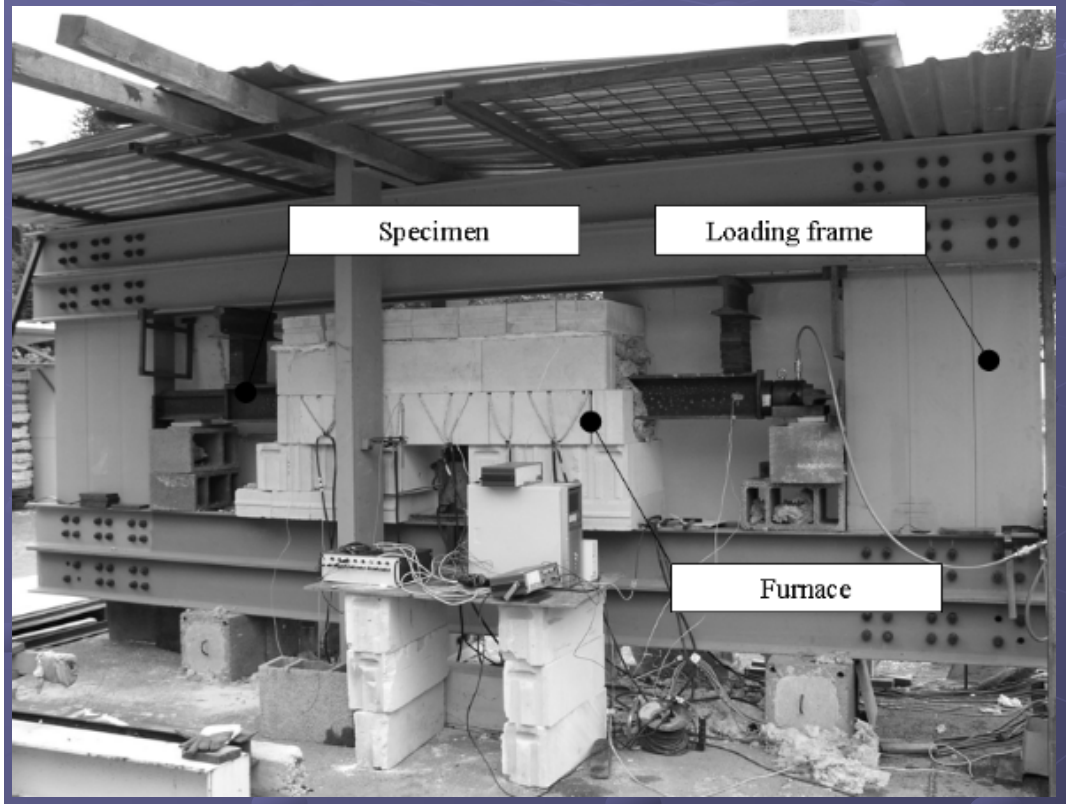
EXPERIMENTAL RESEARCH

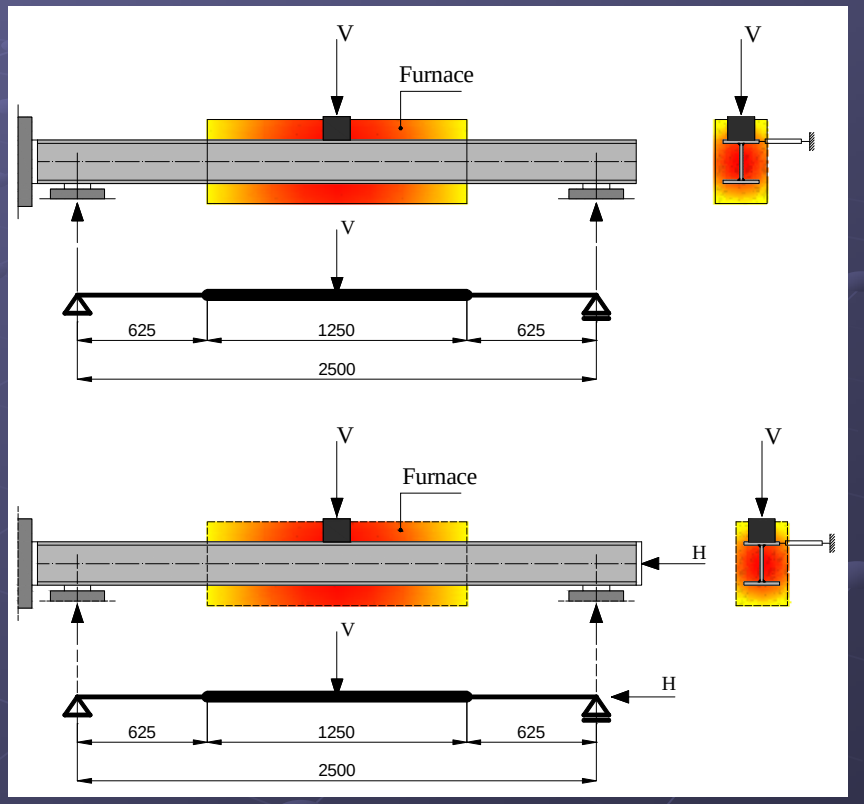
- Material behaviour



EXPERIMENTAL RESEARCH

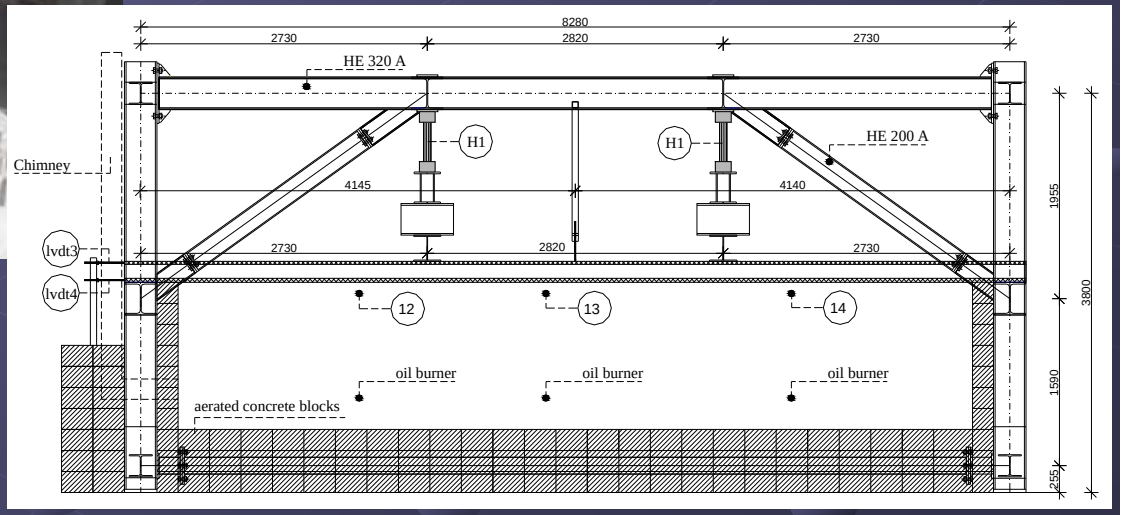
- Structure behaviour





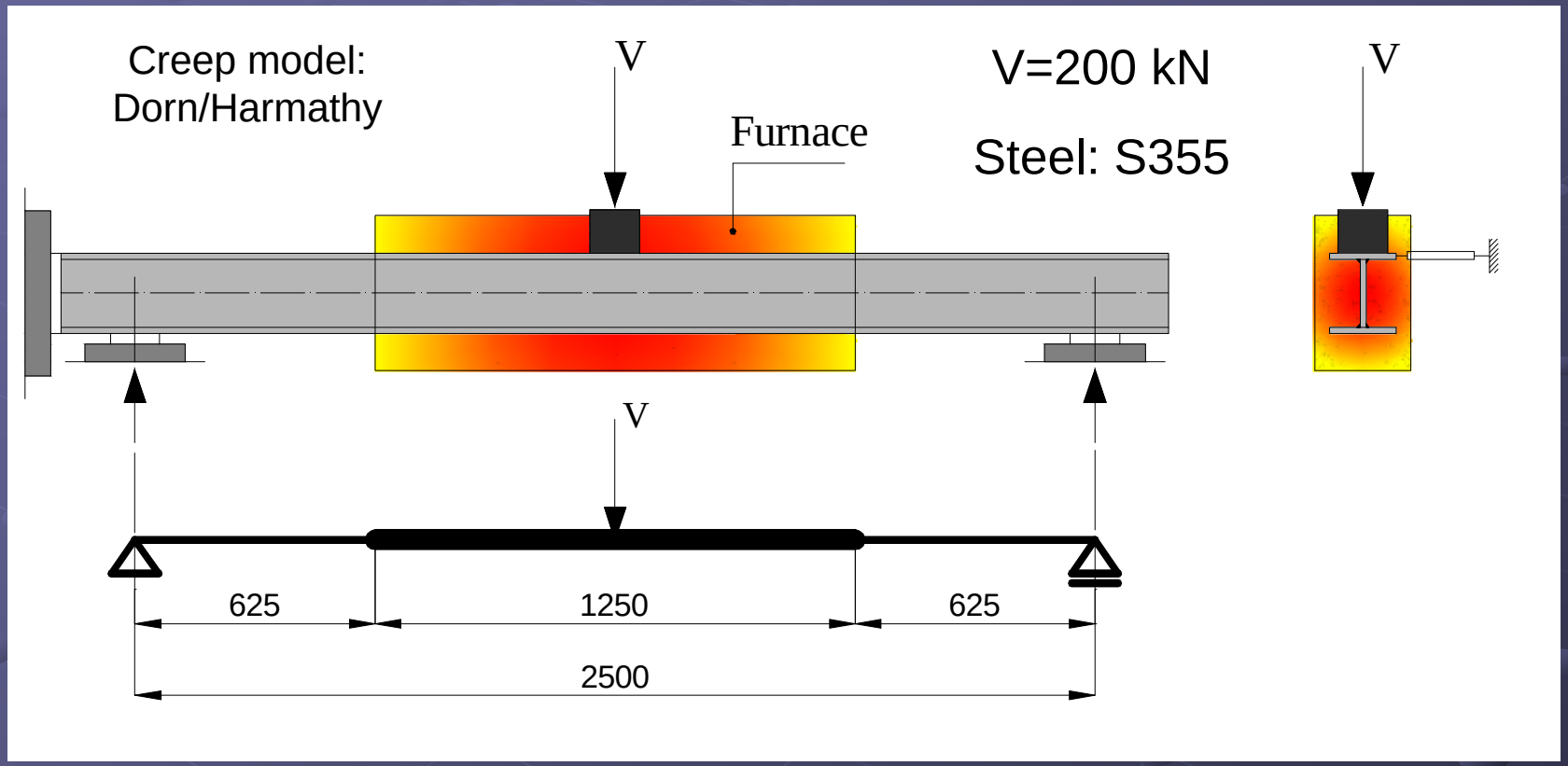
EXPERIMENTAL RESEARCH

- Structure behaviour



NUMERICAL EXAMPLES

Example 1



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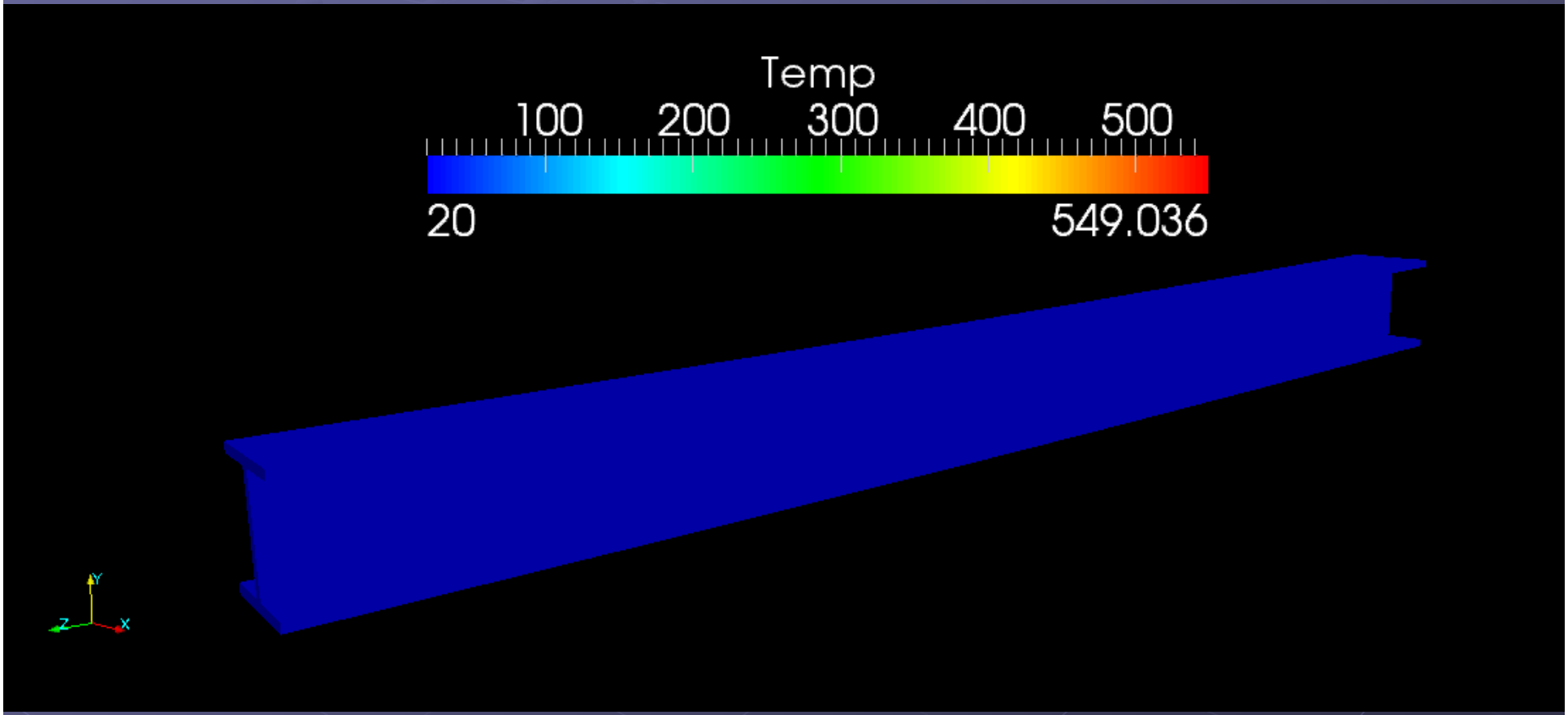

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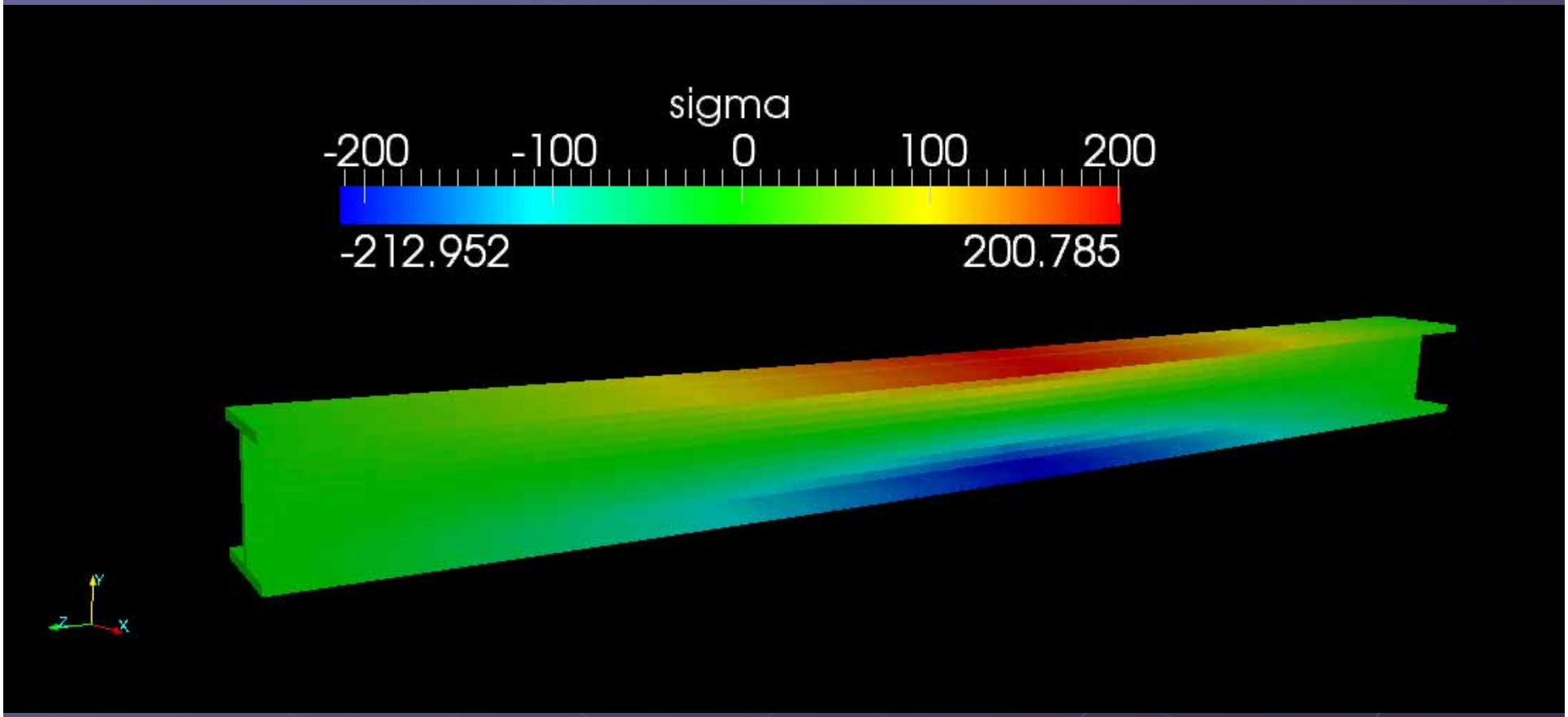

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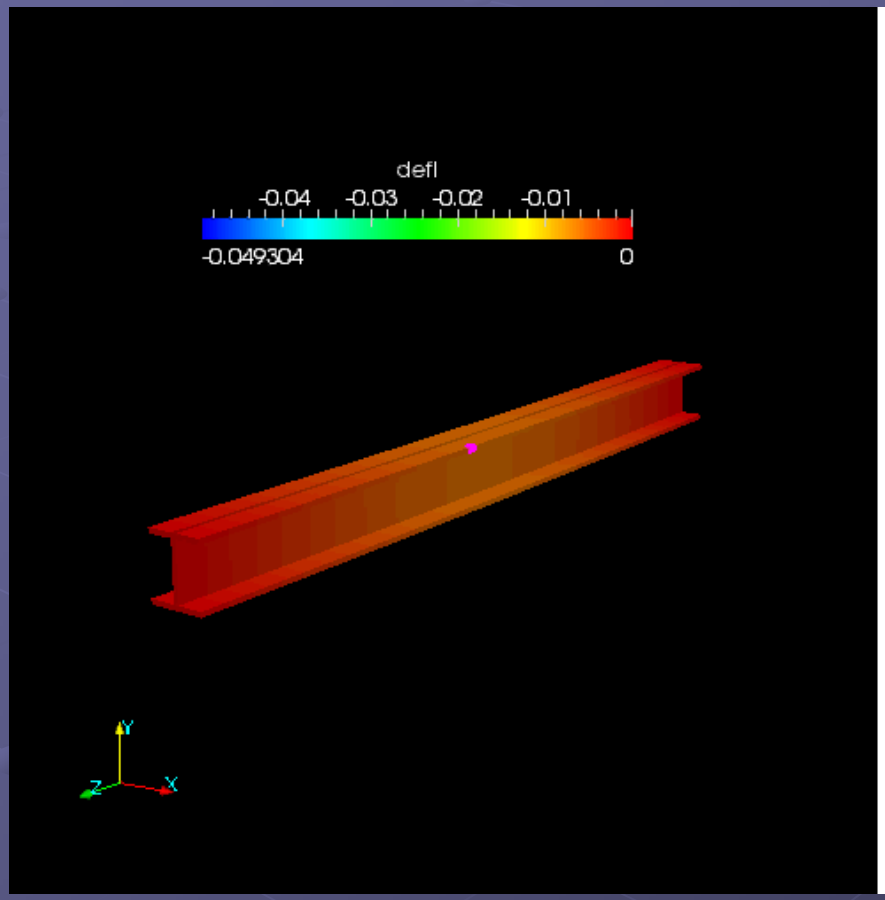

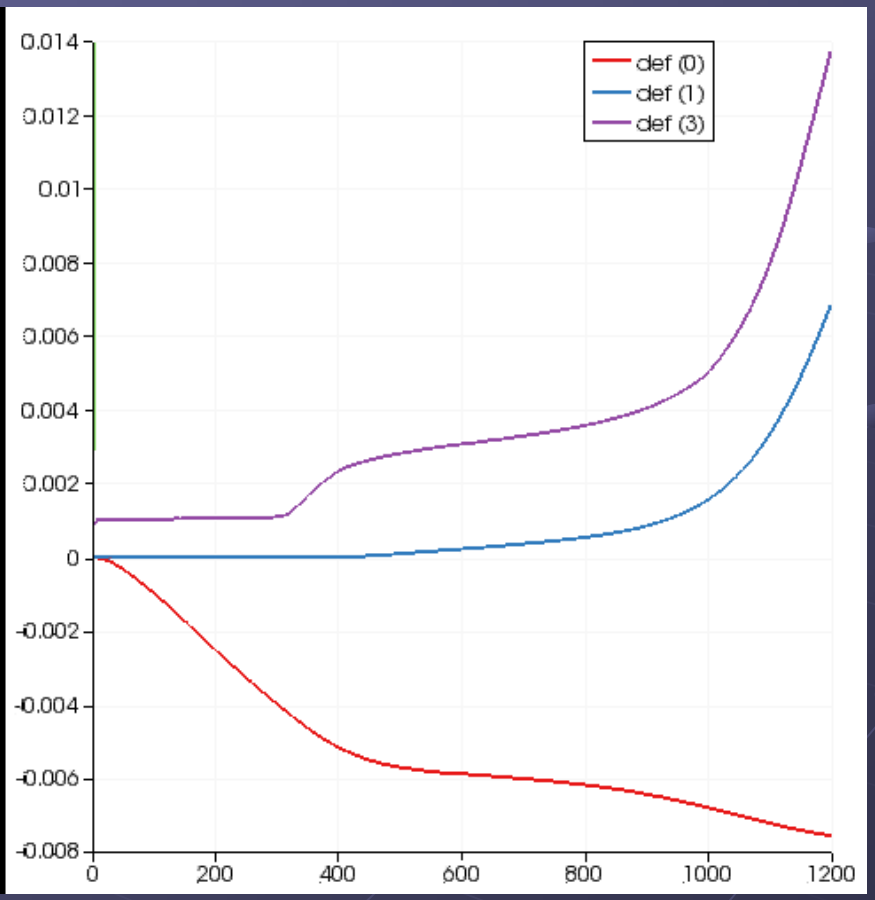

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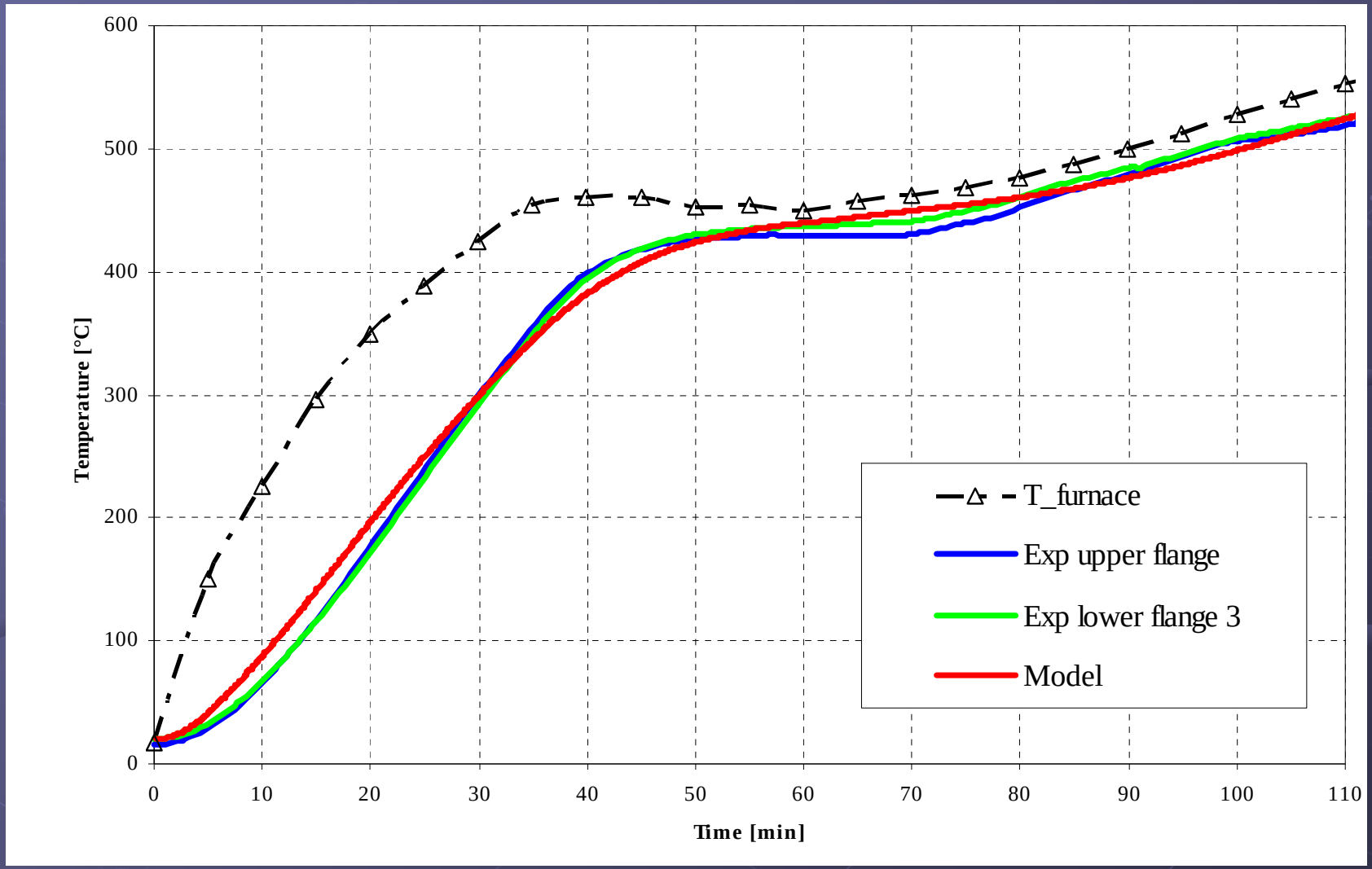

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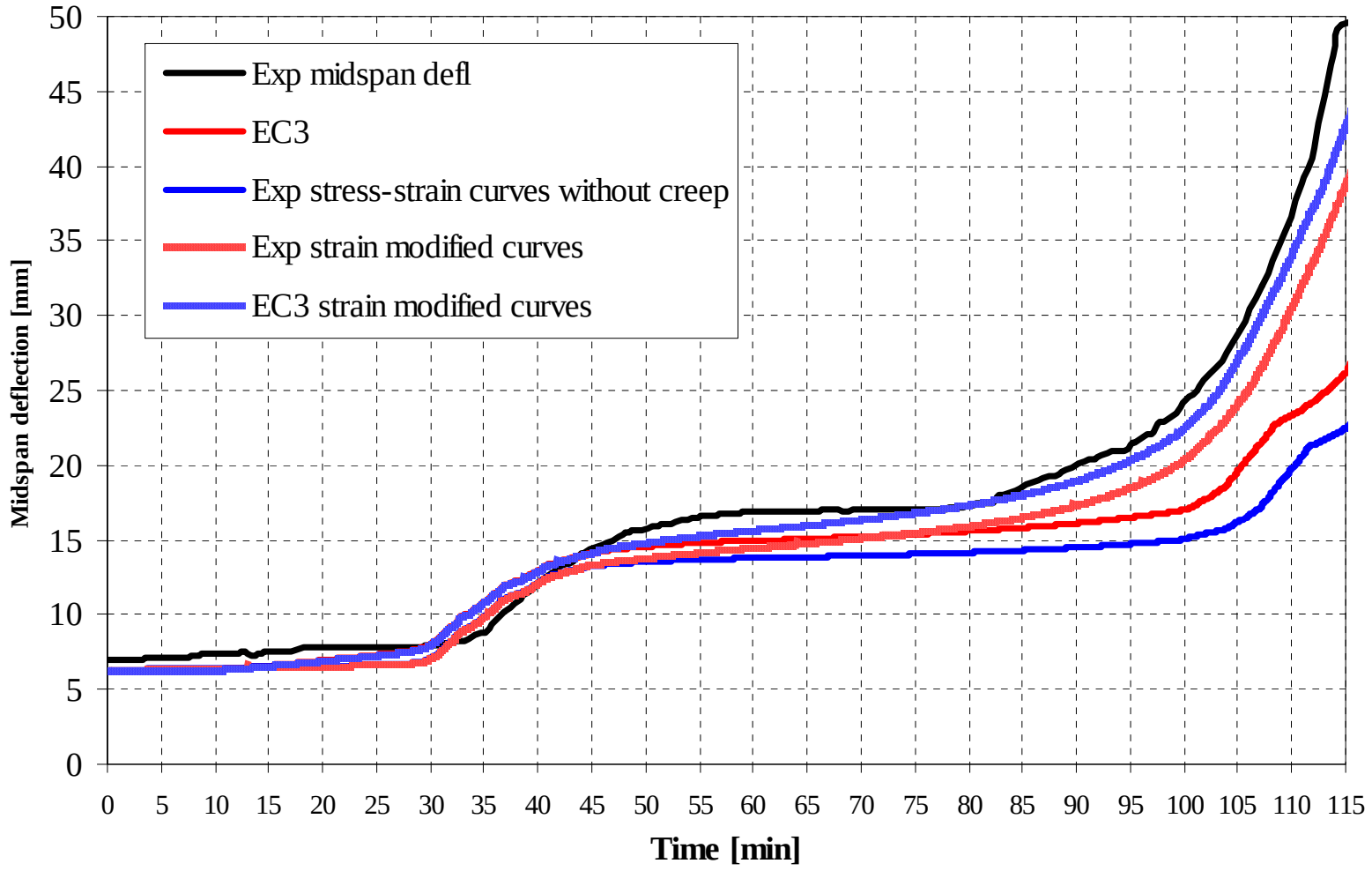
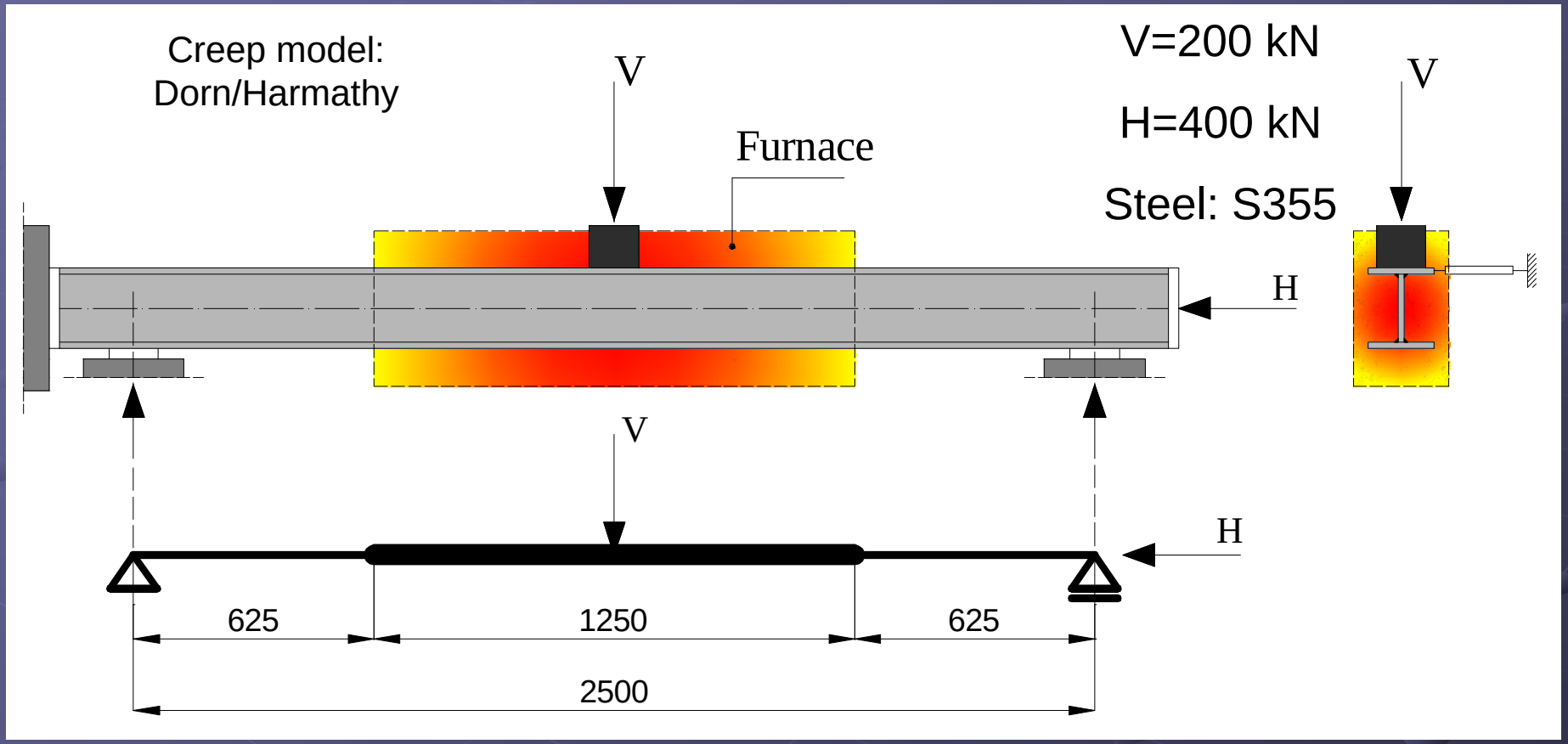


NUMERICAL EXAMPLES

Example 2



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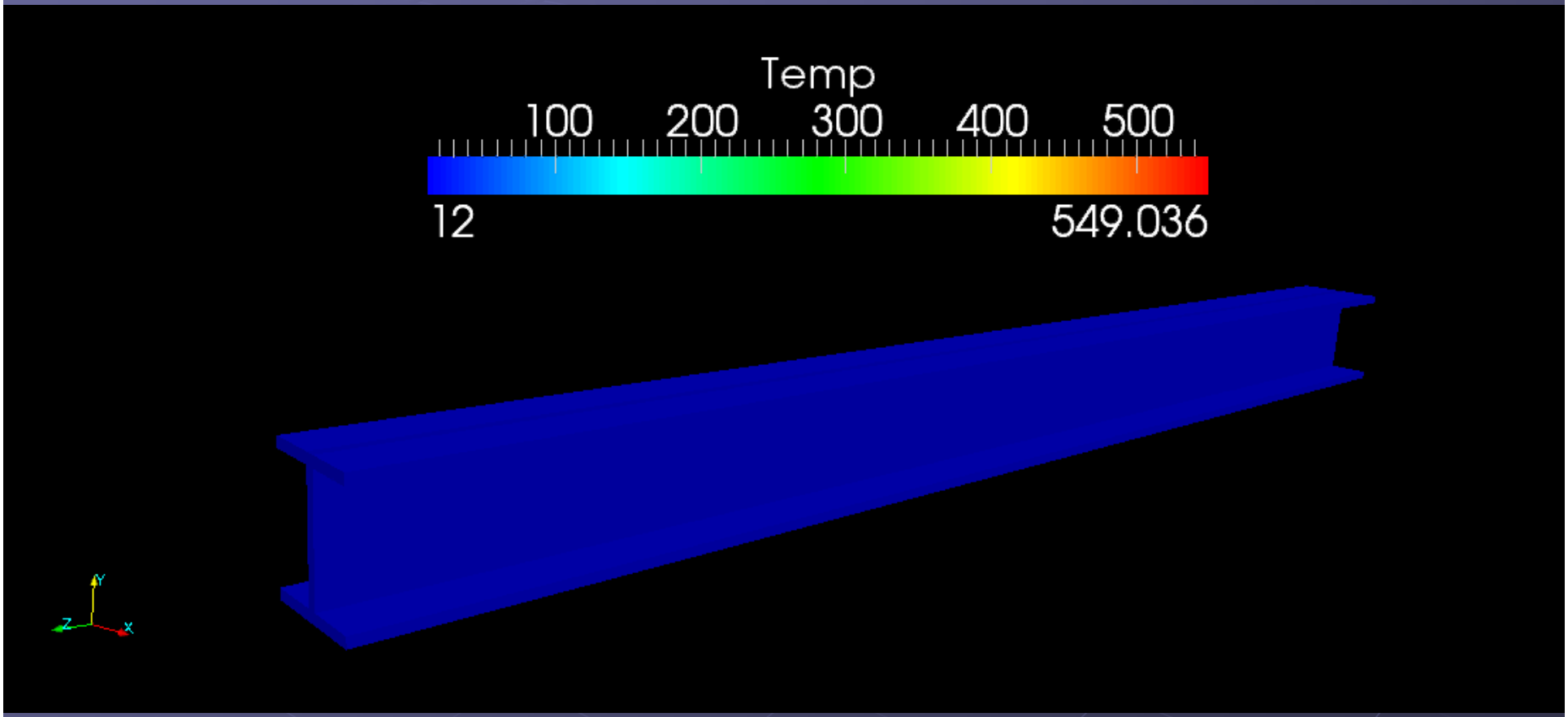

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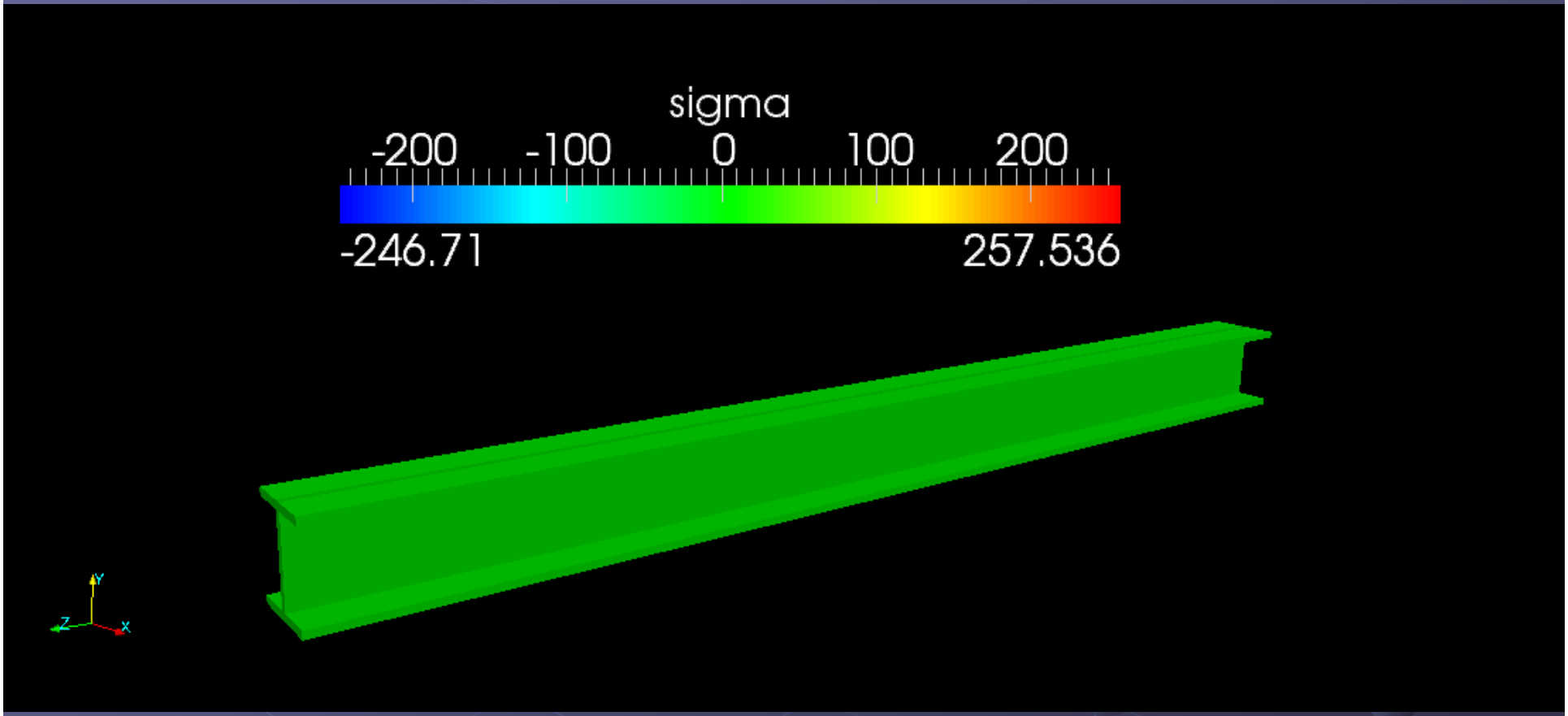

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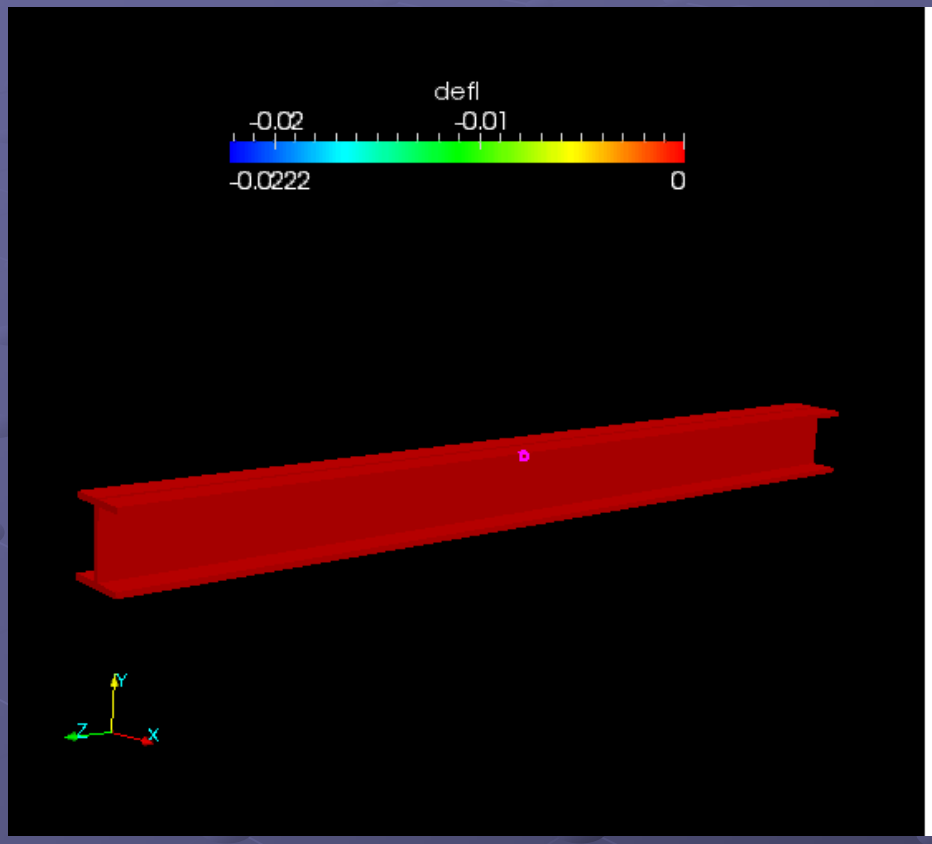

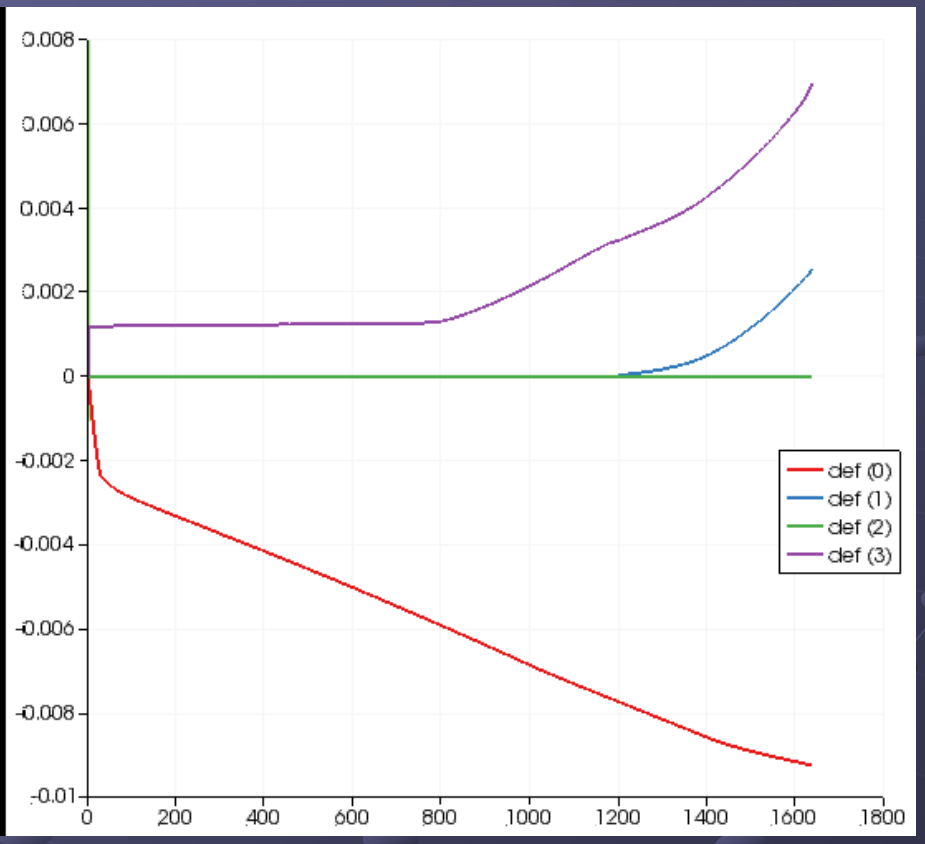

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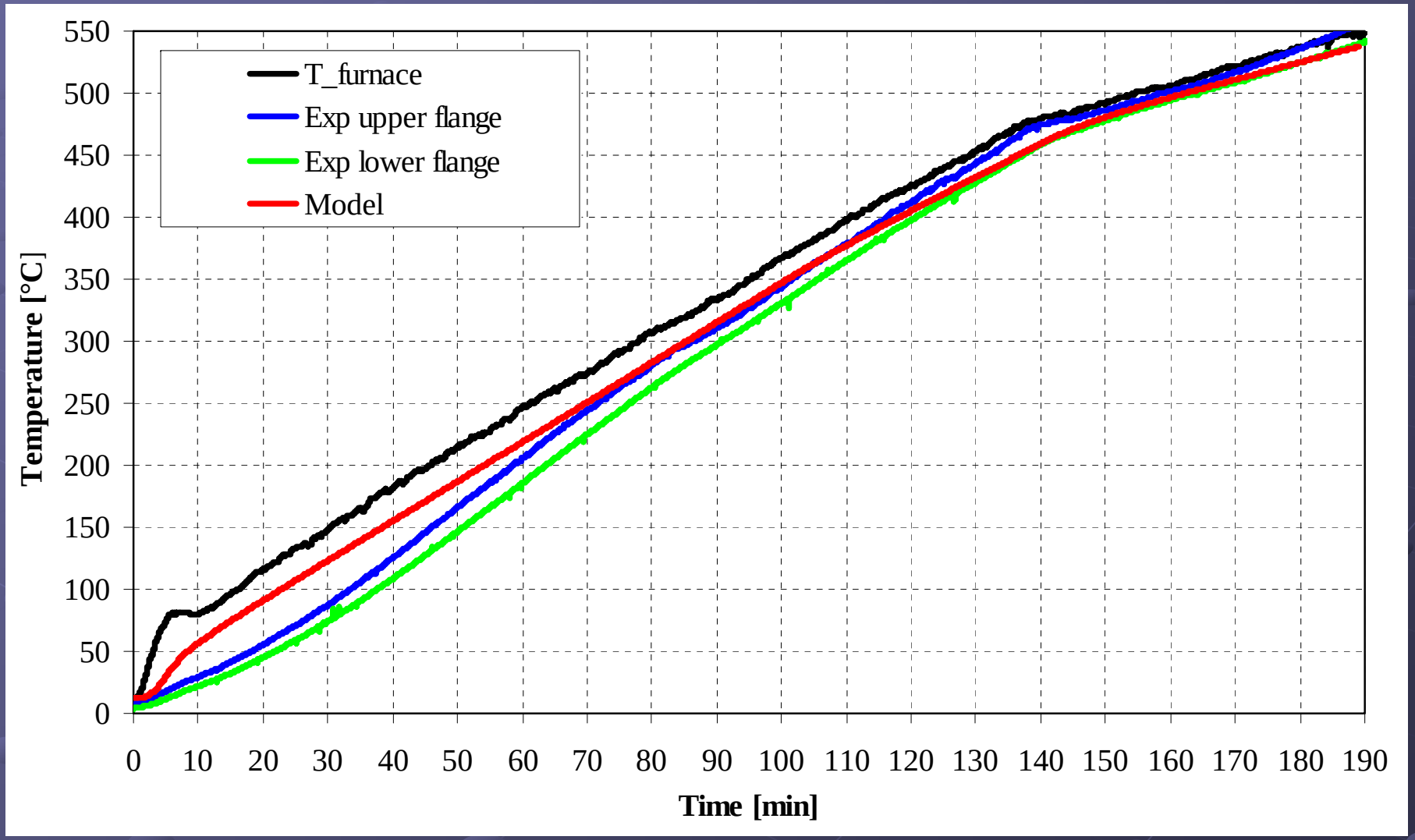

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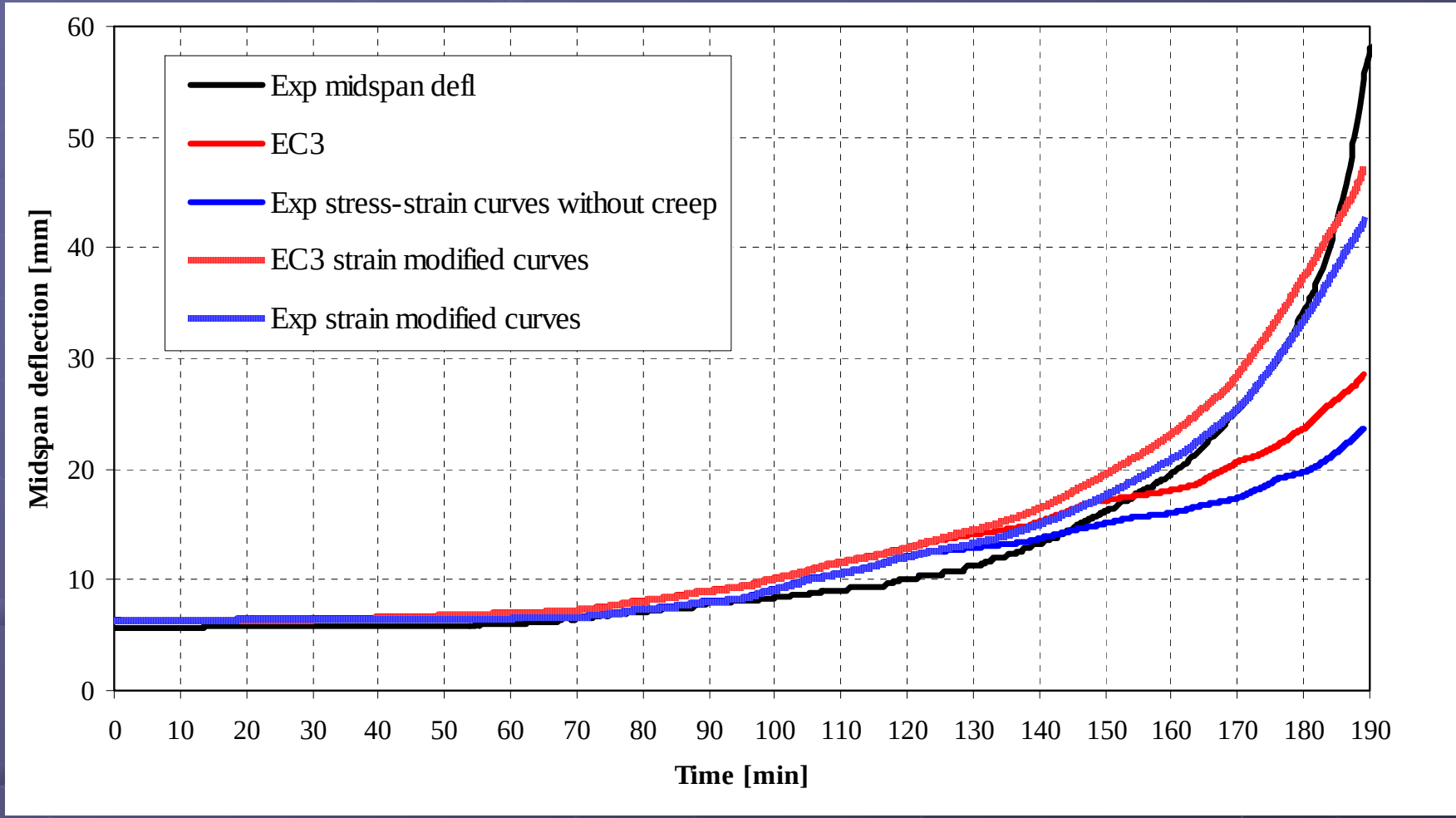

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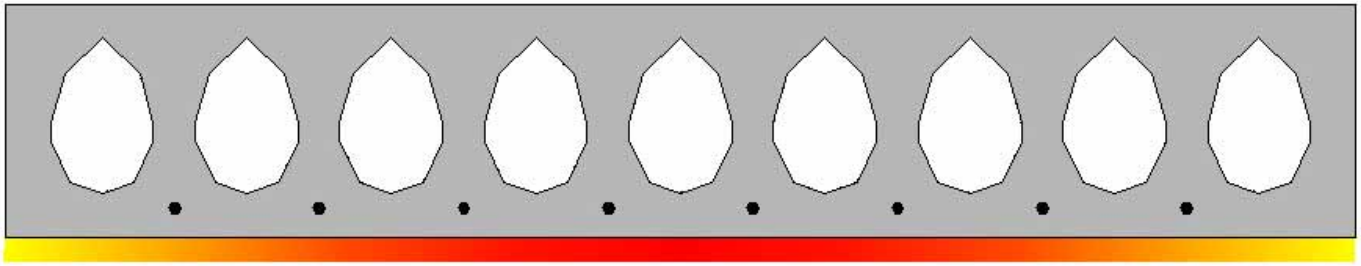
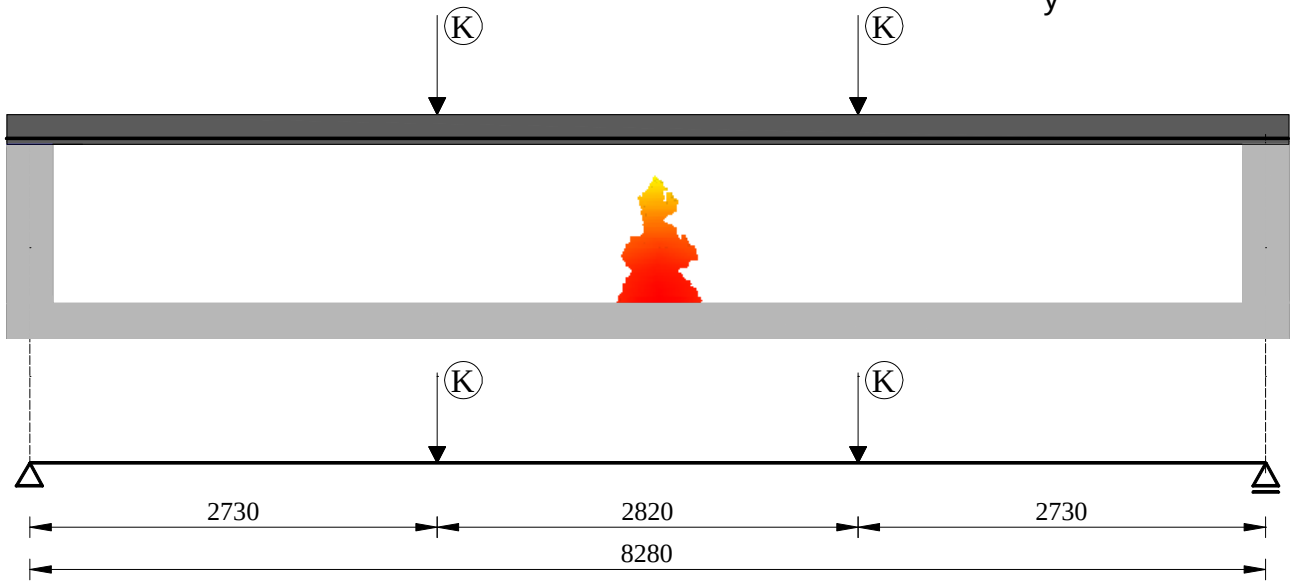


Transient-creep model:

Anderberg/Thelandersson

d=20 cm
K=20 kN
Concrete: C 60/70
Prest. Steel - f_y=1600 MPa



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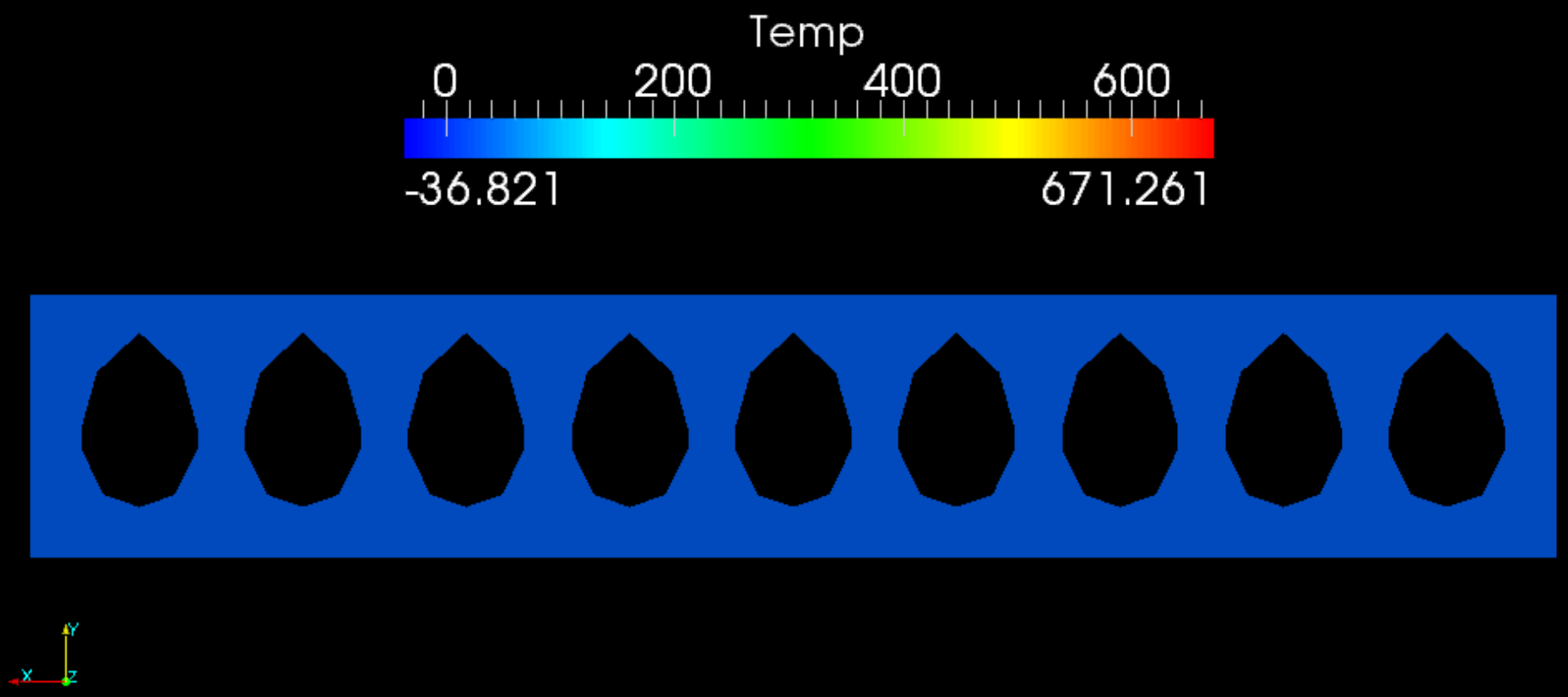

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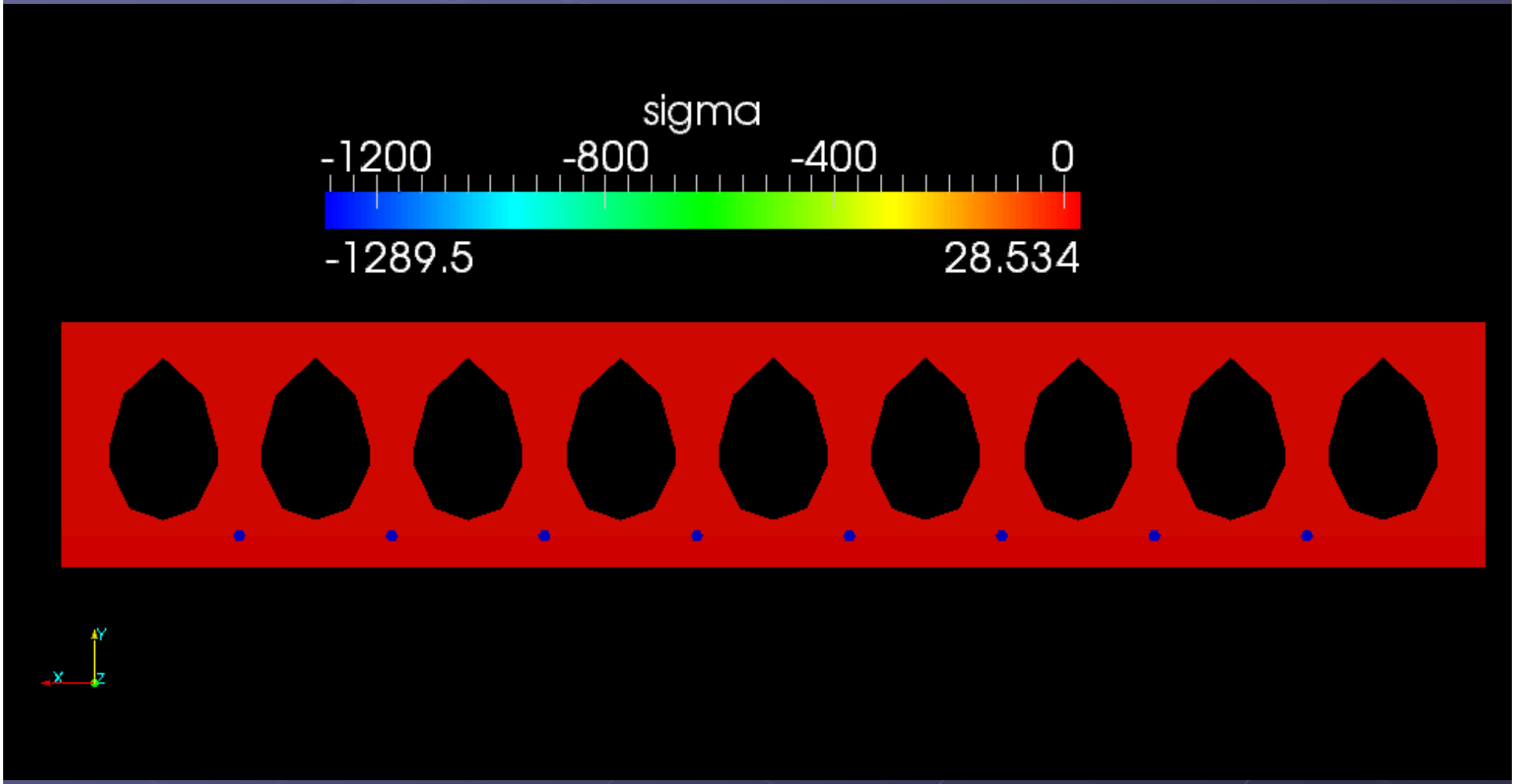

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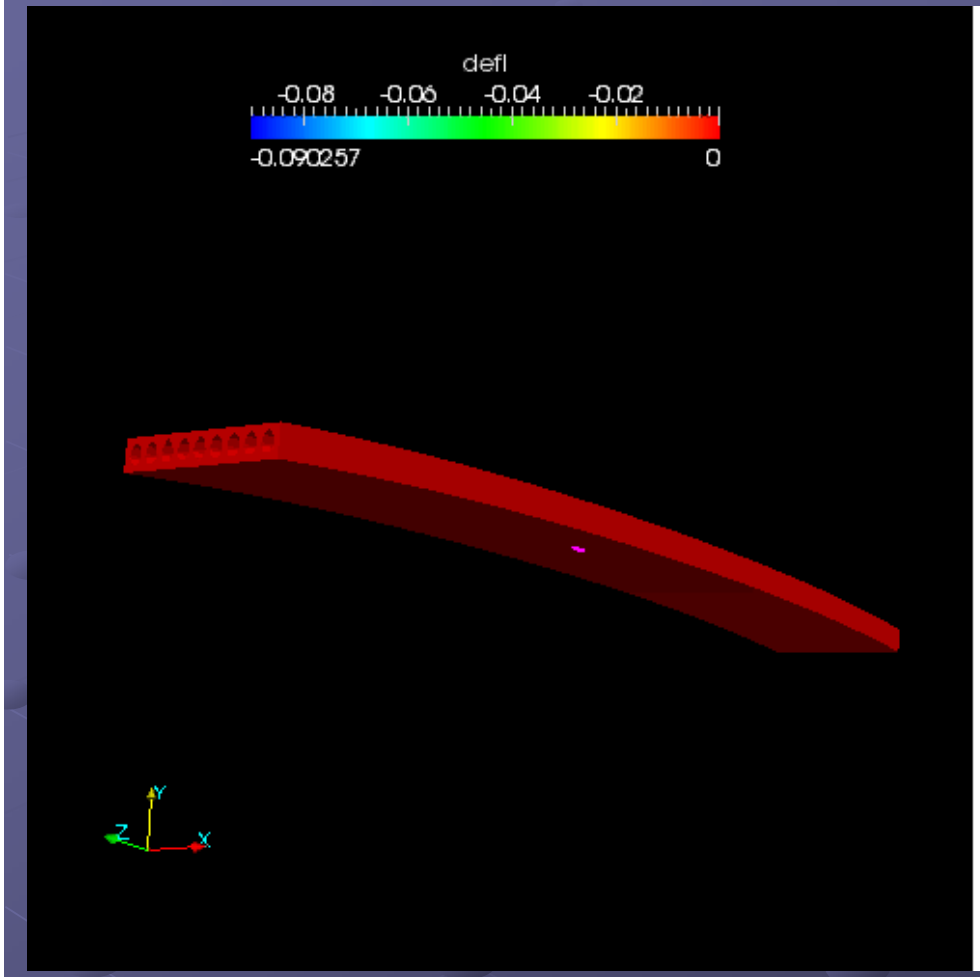

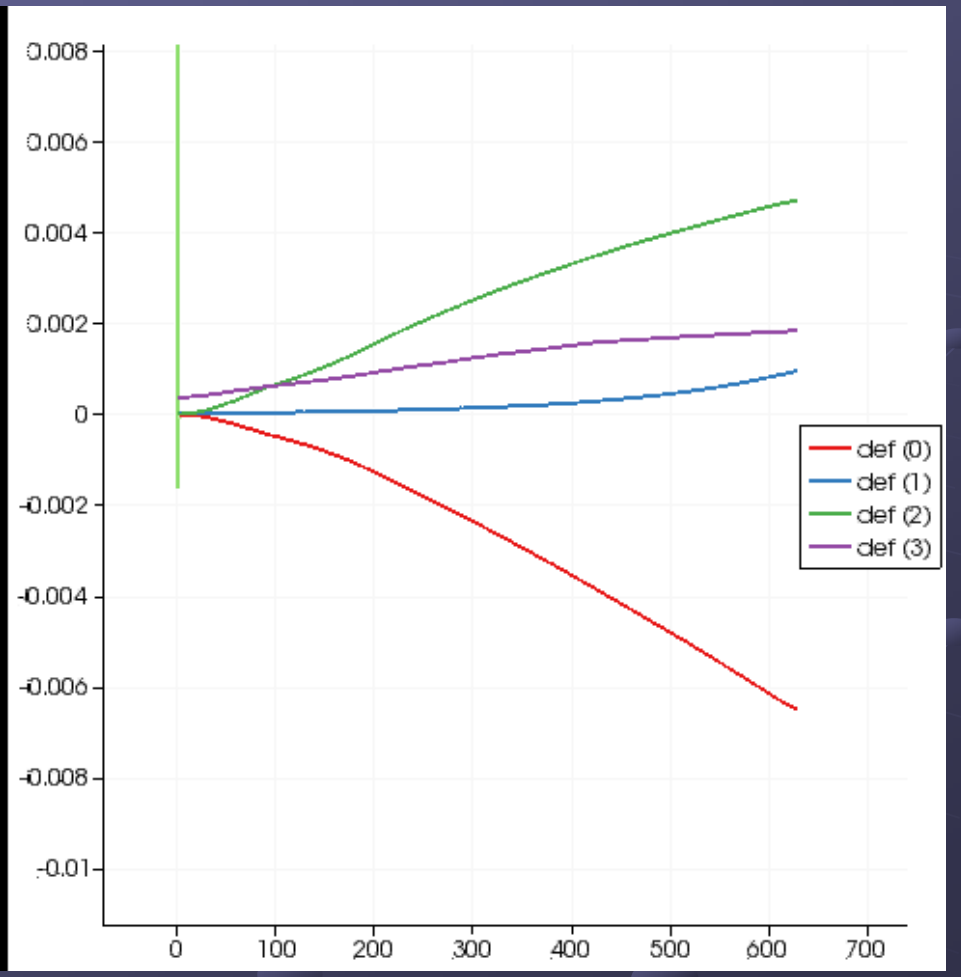

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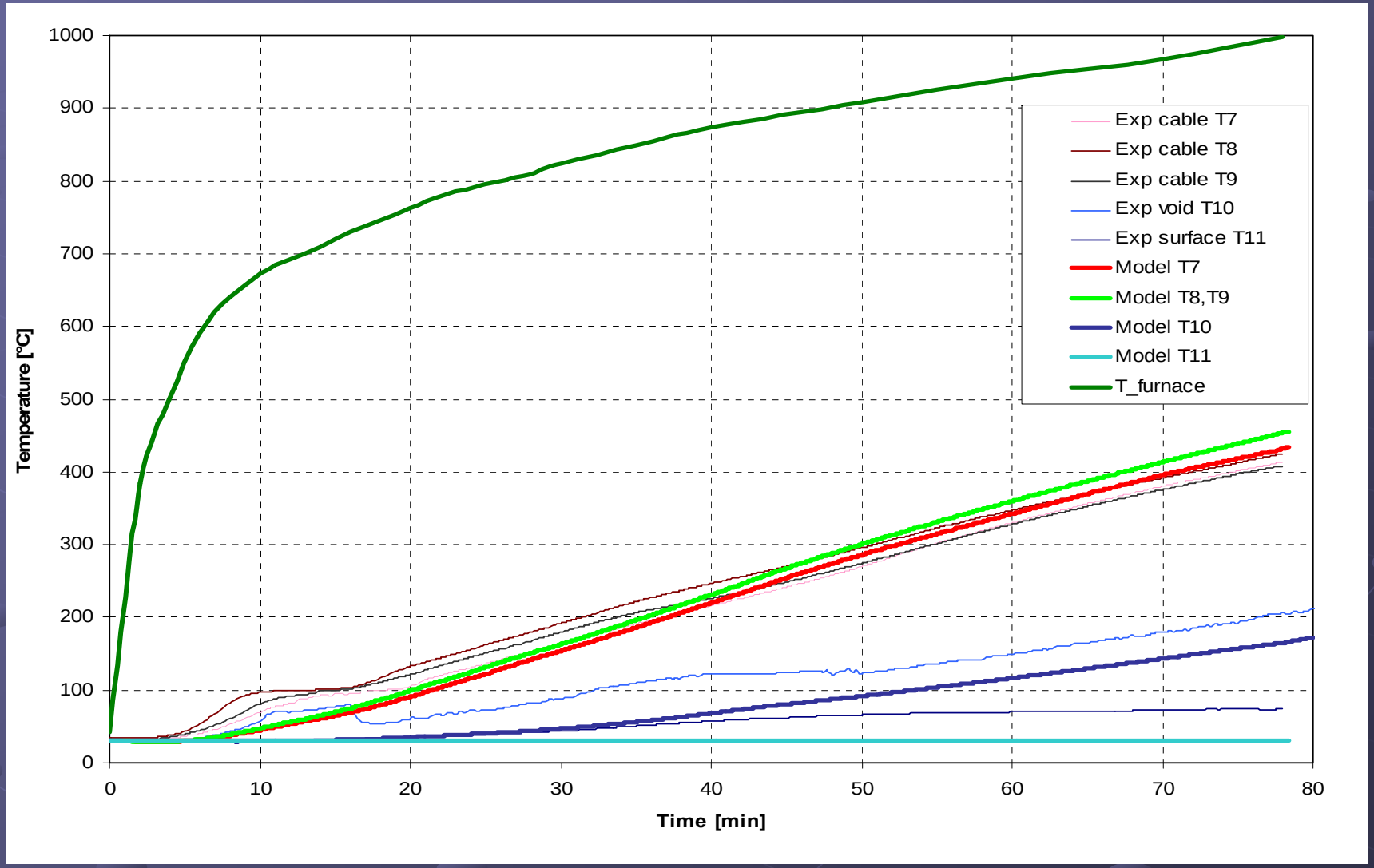

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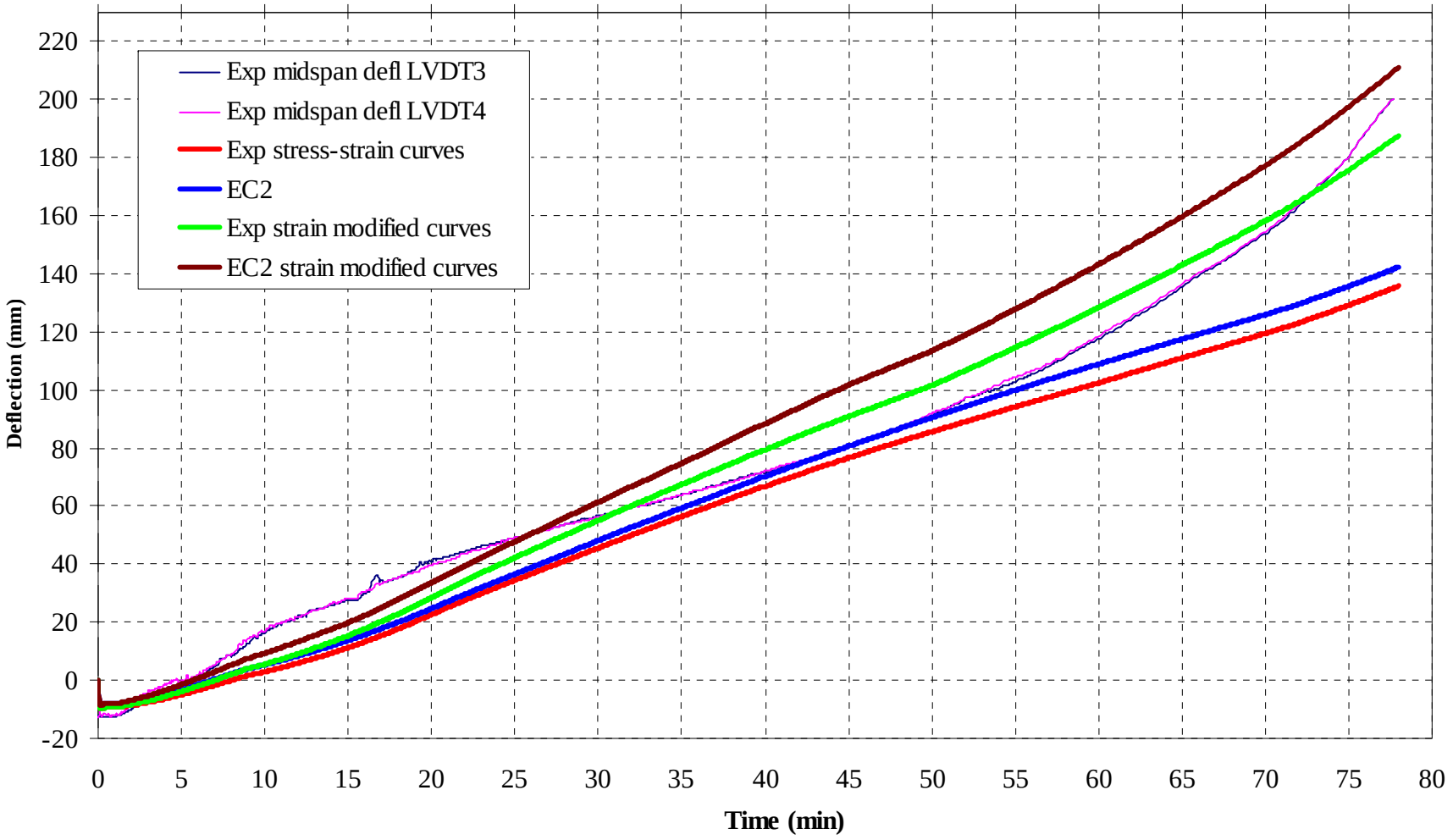
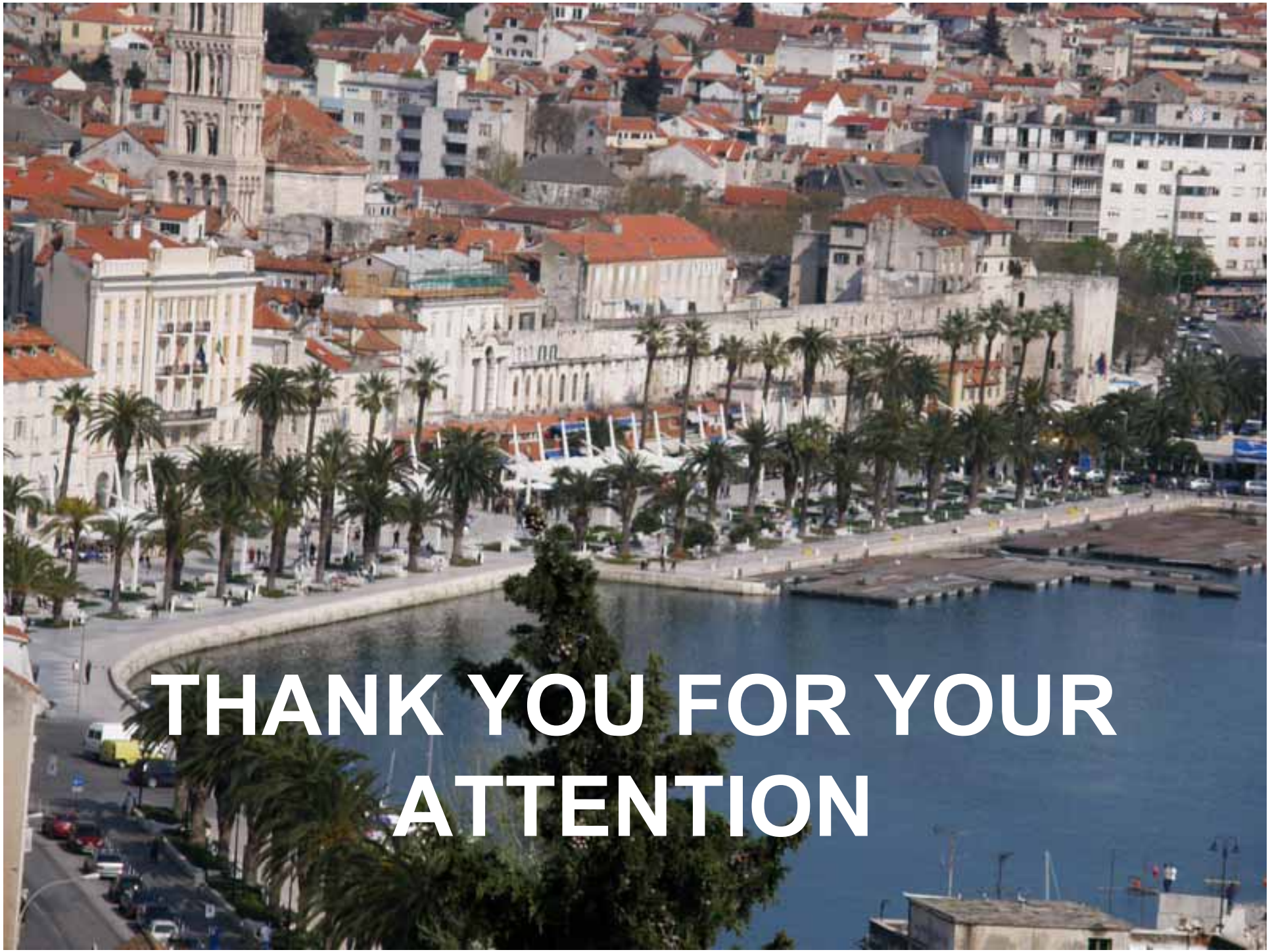


DISCUSSION

- Application of strain modifed curves in classical structural analysis calculation was presented
- Validity of the strain modified curves was tested on results of three different experiments conducted on testing of simply supported steel and prestressed concrete elements exposed to high temperatures
- Numerical results of the three presented examples show good agreement with the experiment by using strain modified curves in terms of predicting the structural stiffness
- Further research is required to confirm the application of the presented calculation methodology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