



# **COST TU0904 - WP4 BENCHMARK STUDIES**

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# Fire analysis

## FIRST PHASE Fire Scenarios

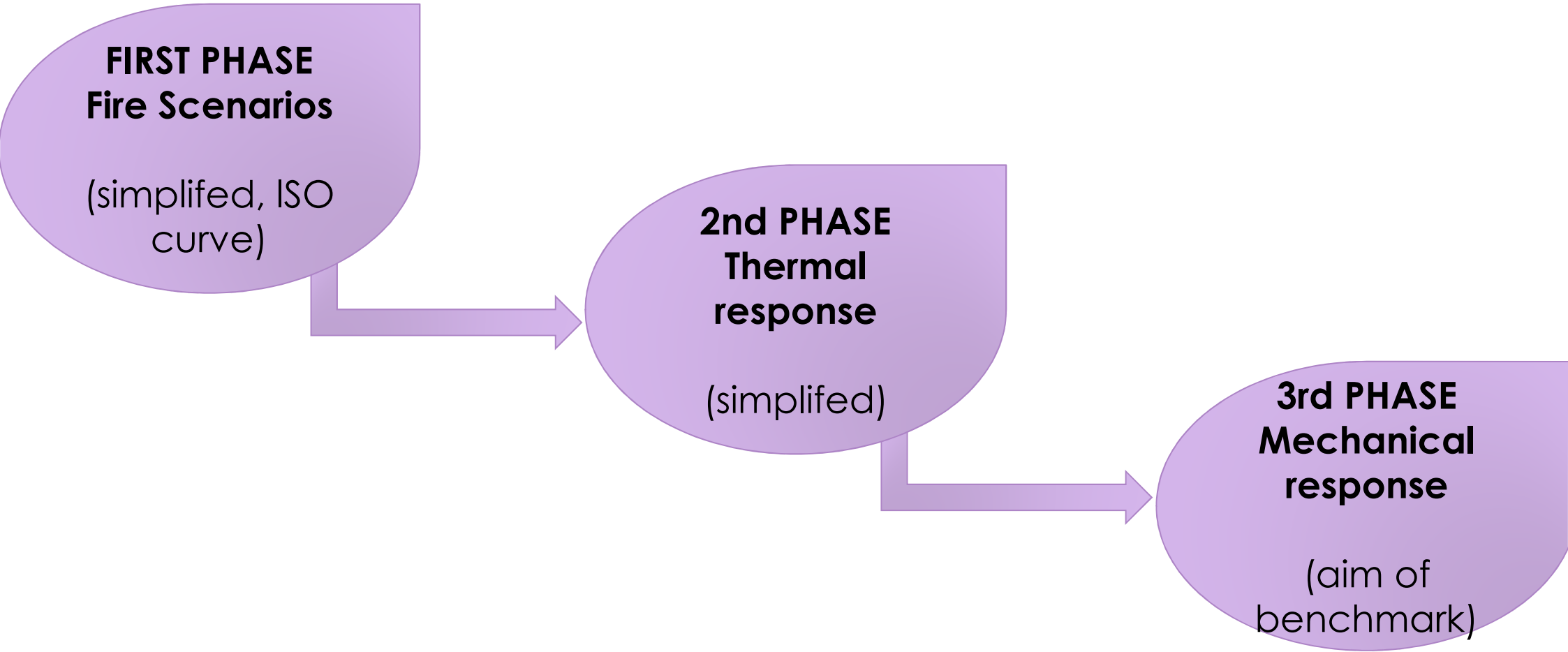
(simplified, ISO  
curve)

## 2nd PHASE Thermal response

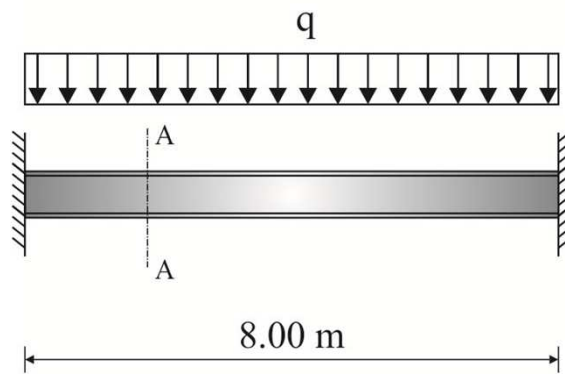
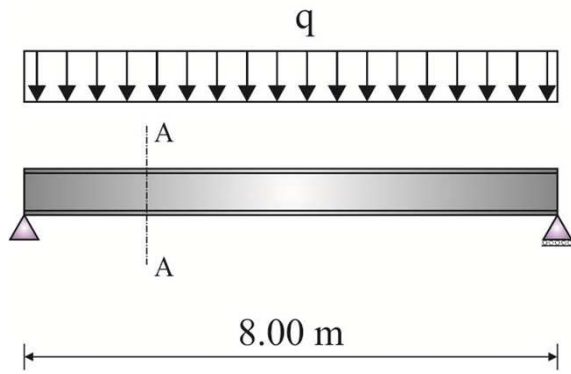
(simplified)

## 3rd PHASE Mechanical response

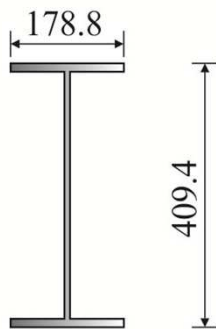
(aim of  
benchmark)



# Simple steel structures

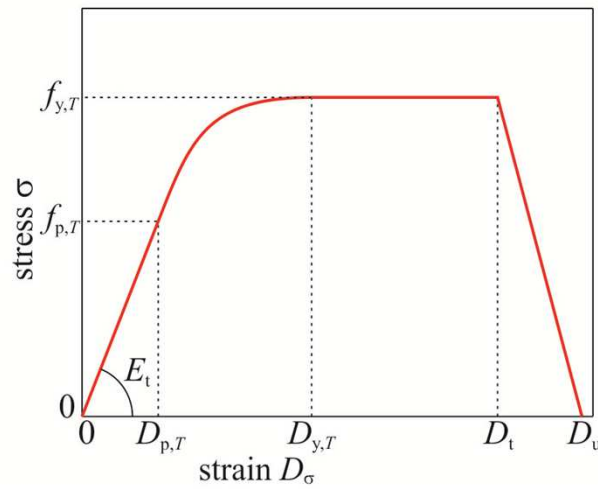


cross-section A-A  
UB 406x178x67

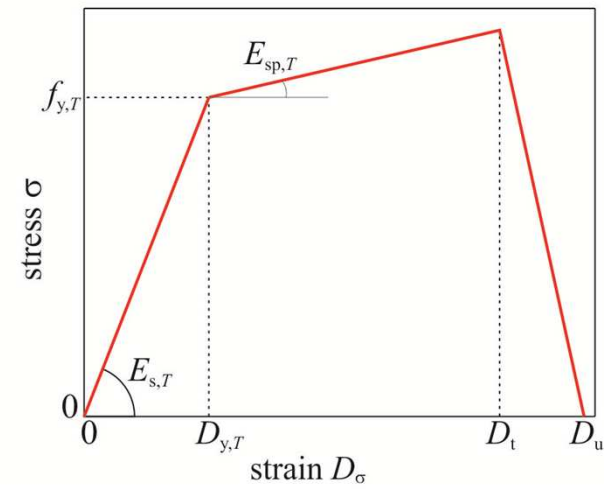


$t_f = 14.3$   
 $t_w = 8.8$   
units in mm

(a) EN 1993-1-2



(b) bilinear model



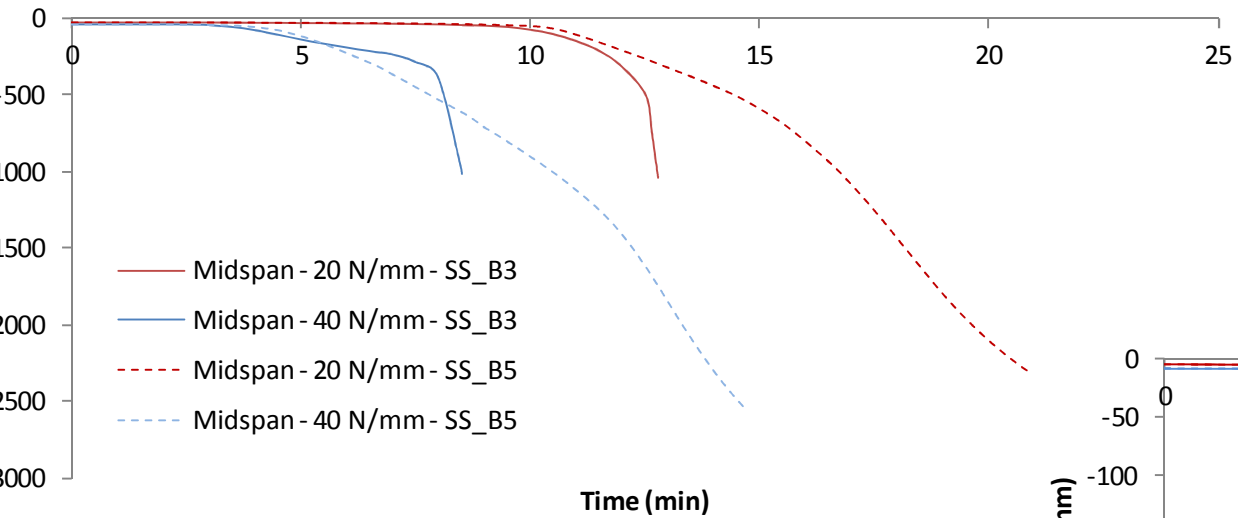
# Simple steel structures

List of performed analyses.

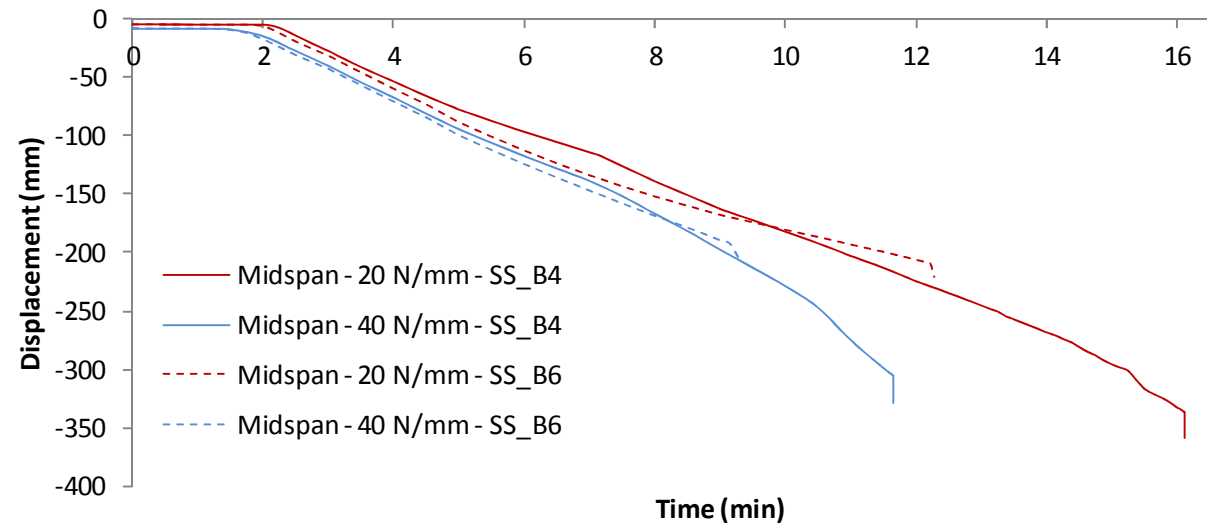
<b>Name</b>	<b>Material model</b>	<b>Load q [N/mm]</b>	<b>Heating regime</b>	<b>Thermal analysis</b>	<b>Creep</b>	<b>Boundary conditions</b>
<b>SS_B1</b>	EC 3	20 and 40	linear 30C/min	none	NO	pin - roller
<b>SS_B2</b>	EC 3	20 and 40	linear 30C/min	none	NO	pin - pin
<b>SS_B3</b>	EC 3	20 and 40	ISO834	Simplified, EC3	NO	pin - roller
<b>SS_B4</b>	EC 3	20 and 40	ISO834	Simplified, EC3	NO	fix - fix
<b>SS_B5</b>	Bilinear	20 and 40	ISO834	Simplified, EC3	YES	pin - roller
<b>SS_B6</b>	Bilinear	20 and 40	ISO834	Simplified, EC3	YES	fix-fix

# Simple steel structures

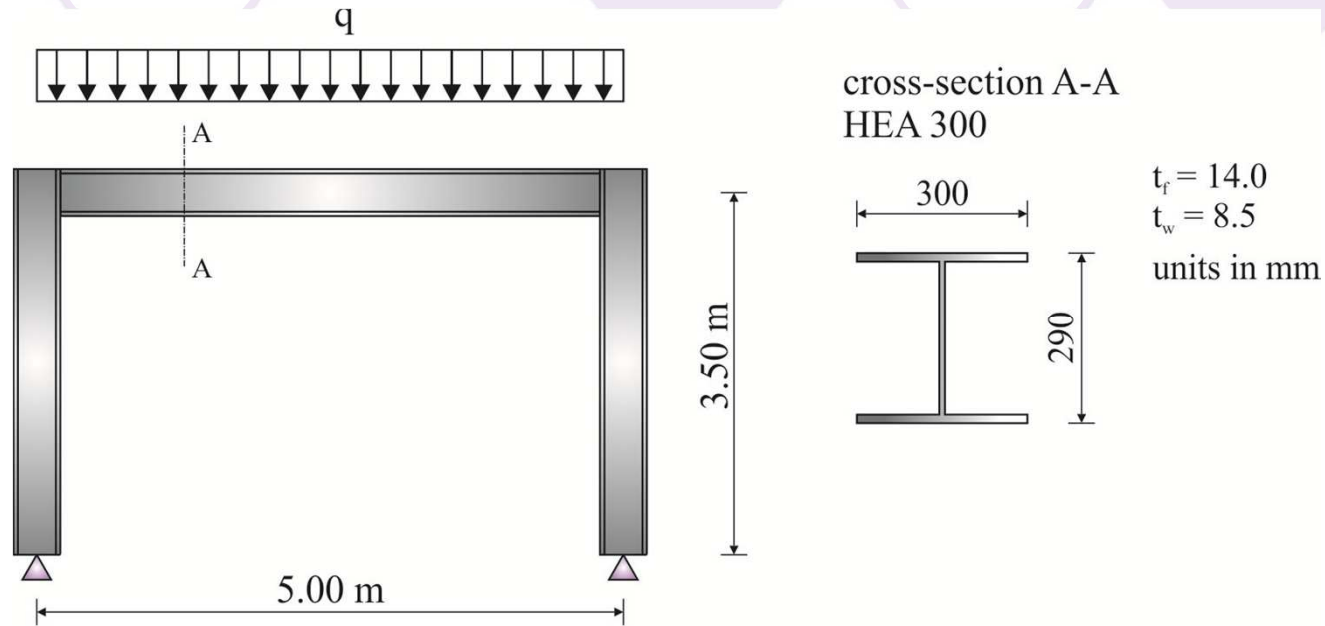
## SS\_B3 & SS\_B5 Displacements



## SS\_B4 and SS\_B6 Displacements



# Steel frame



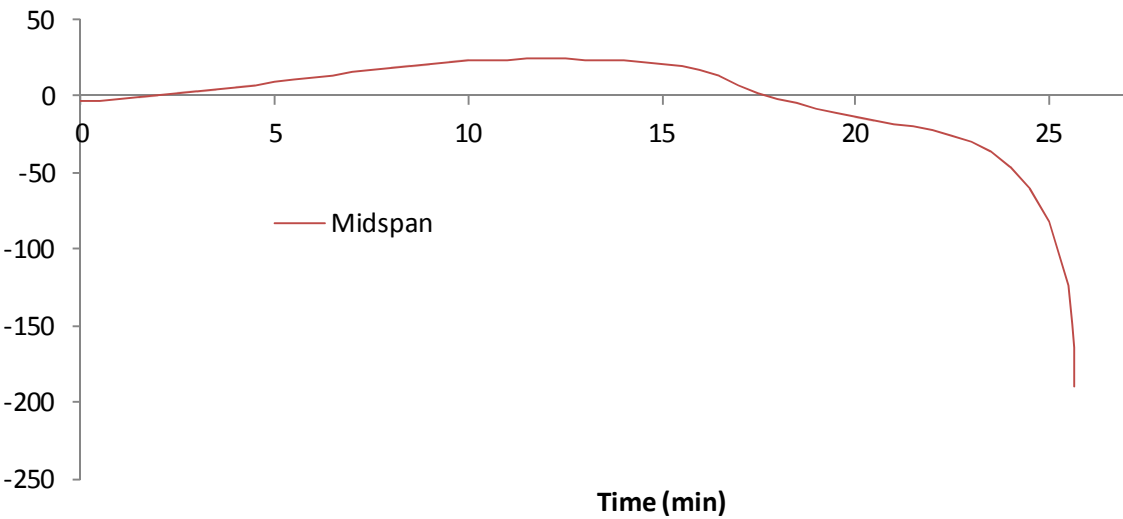
List of performed analysis.

Name	Material model	Load q [N/mm]	Heating regime	Thermal analysis	Creep	Boundary conditions
FR_BS1	EC 3	30	ISO834	Simplified, EC3	NO	pin - pin
FR_BS2	Bilinear	30	ISO834	Simplified, EC3	YES (Au50)	pin - pin

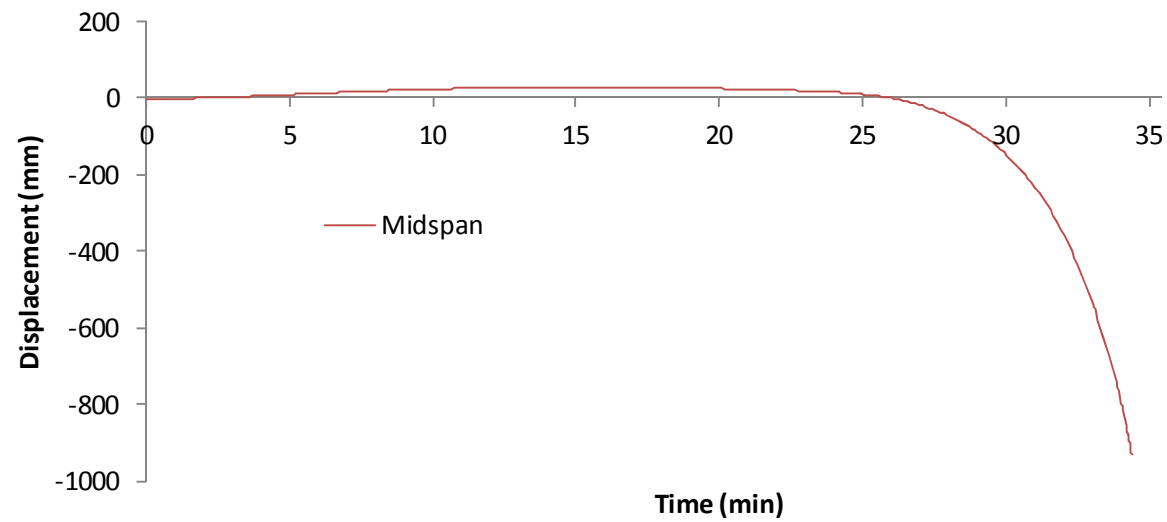
# Steel frame



FR\_BS1 Displacements

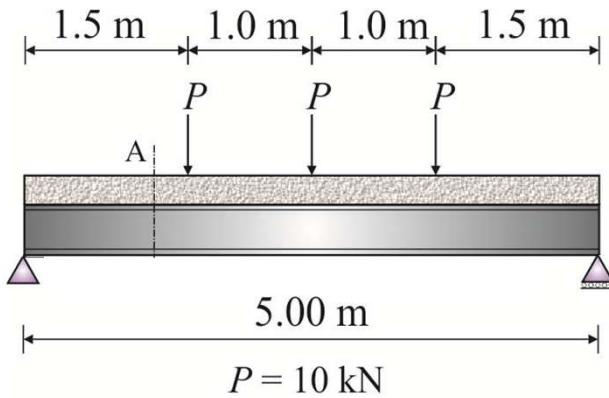


FR\_BS2 Displacements



# Simple Composite structures

List of performed analyses.

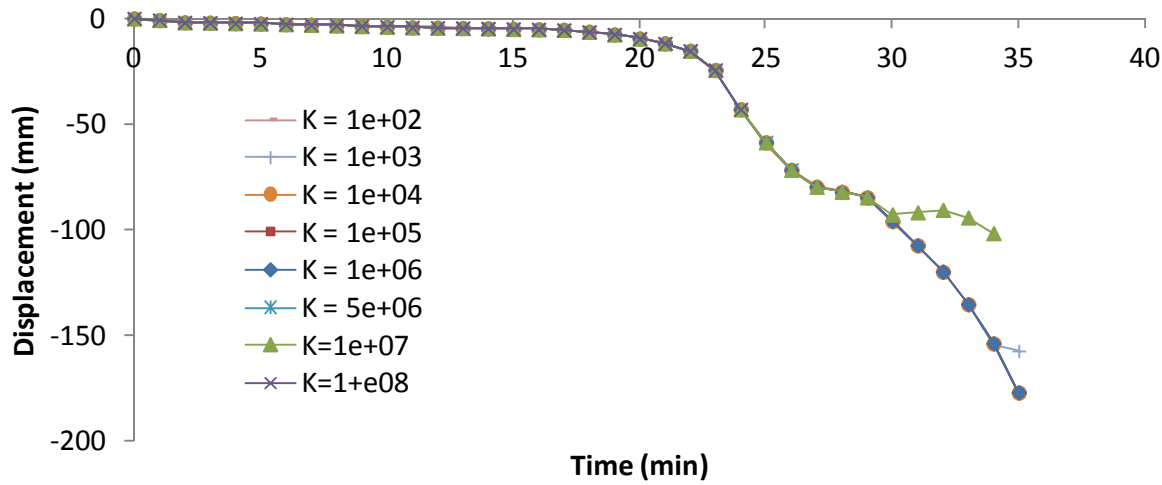


Name	Material model	Load [N/mm]	Heating regime	Thermal analysis	Subst lo
SC_B1	EC	$P = 10$ kN	30C/min – steel	none	pt =
			9C/min - concete		
SC_B2	EC	$P = 10$ kN	30C/min – steel	none	qt = K
			9C/min - concete		
SC_B3	EC	$P = 10$ kN	30C/min – steel	none	*
			9C/min - concete		
SC_B4	EC	20 and 50 N/mm	30C/min – steel	none	qt = K
			9C/min - concete		
SC_B5	EC	20 and 50 N/mm	30C/min – steel	none	*
			9C/min - concete		

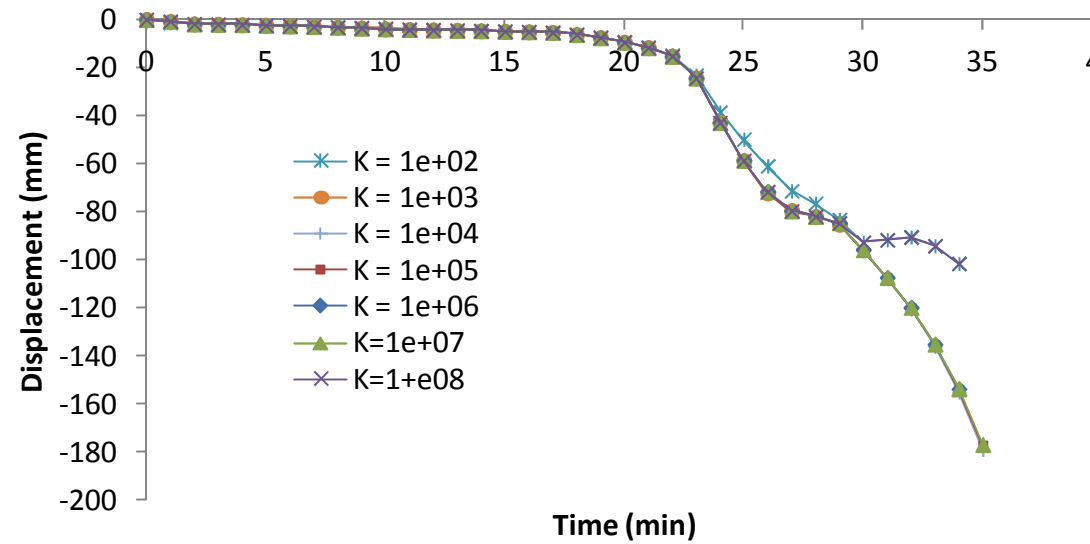


# Simple Composite structures

SC\_B1 Displacements

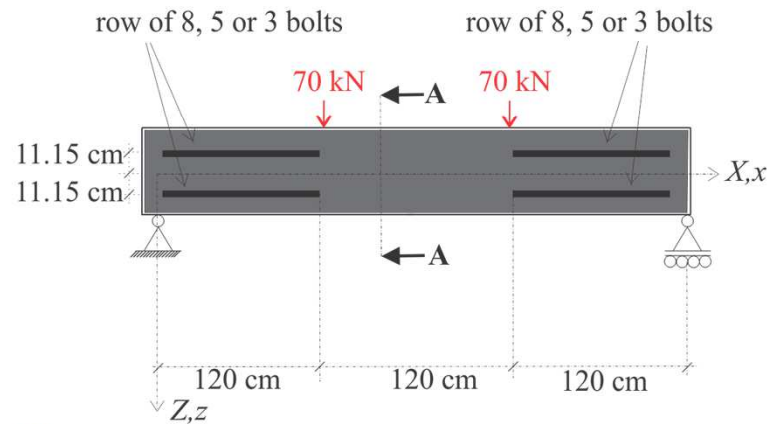


SC\_B2 Displacements

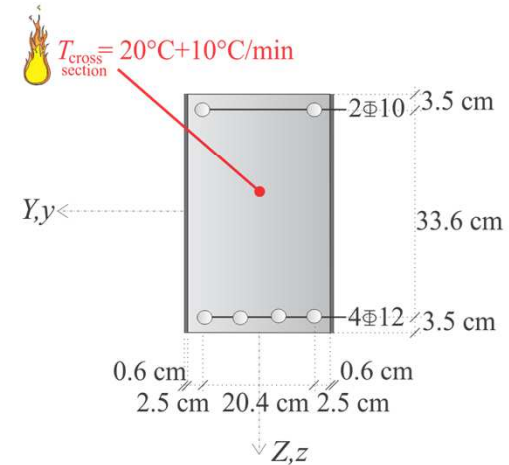


# Simple Composite structures – advanced analysis

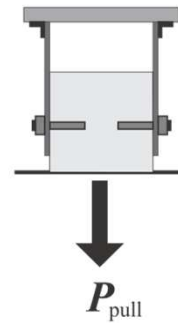
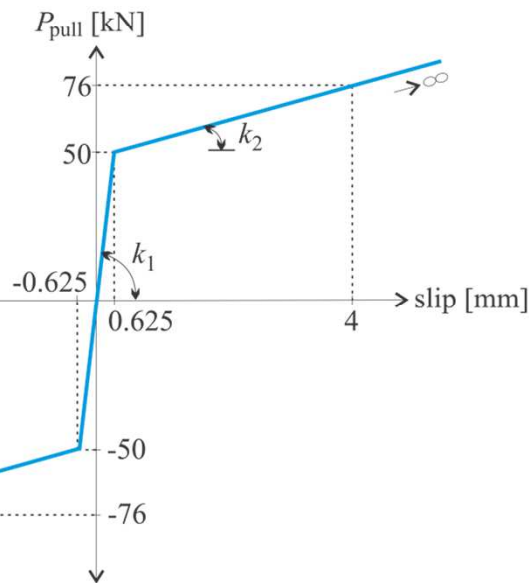
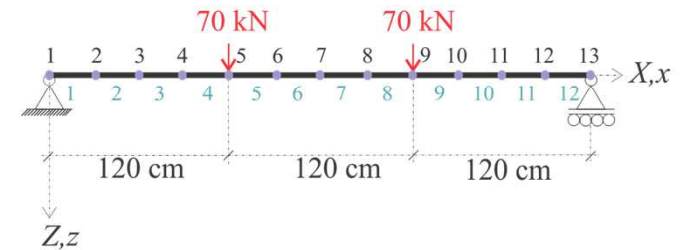
(a) Geometry



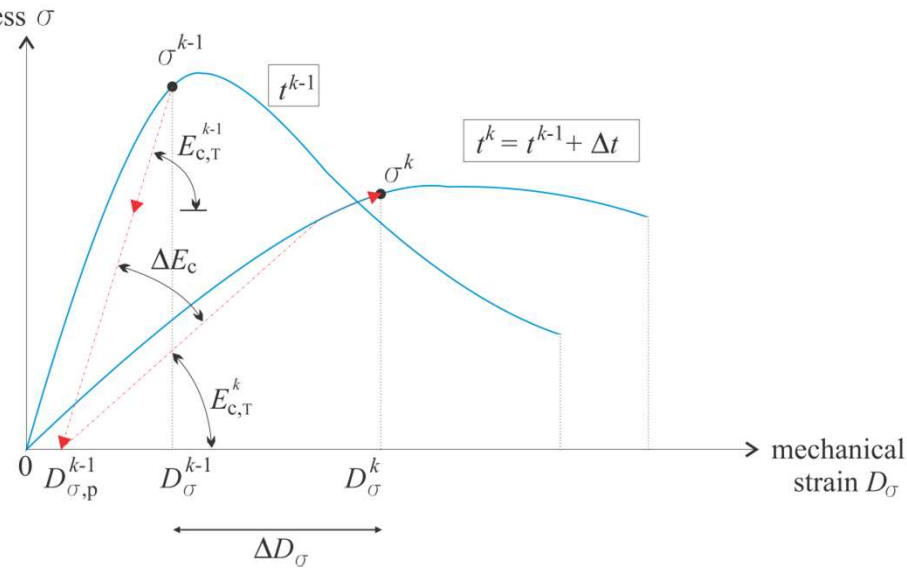
A-A:



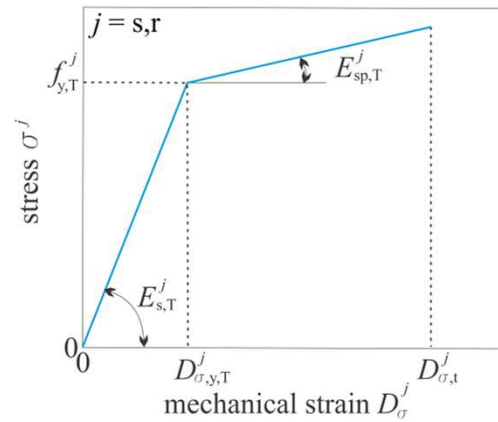
(b) Numerical model (13-node mesh density)



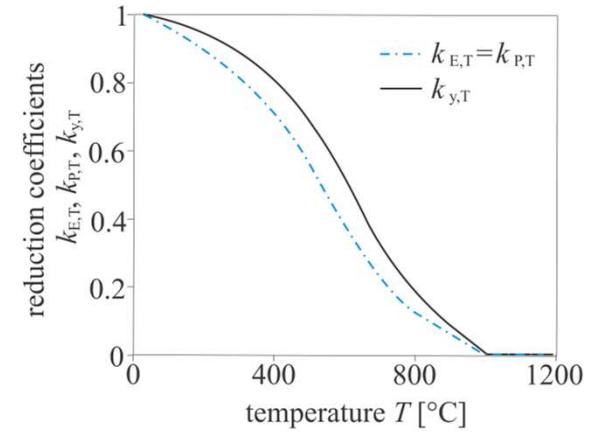
# Simple Composite structures – advanced analysis material models:



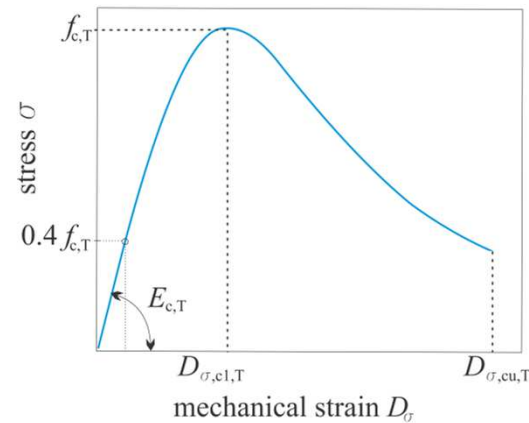
(a) bilinear constitutive model of steel:



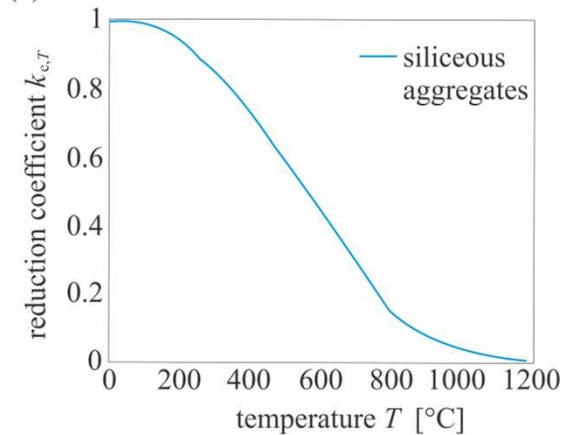
(b) reduction coefficients for steel:



(c) EC2 constitutive model of concrete:

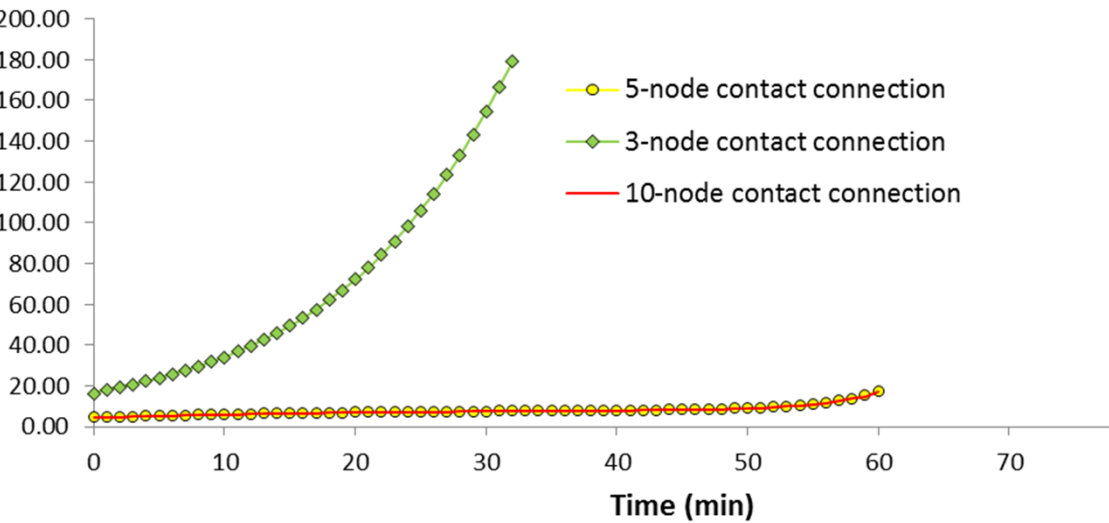


(d) reduction coefficient for concrete:

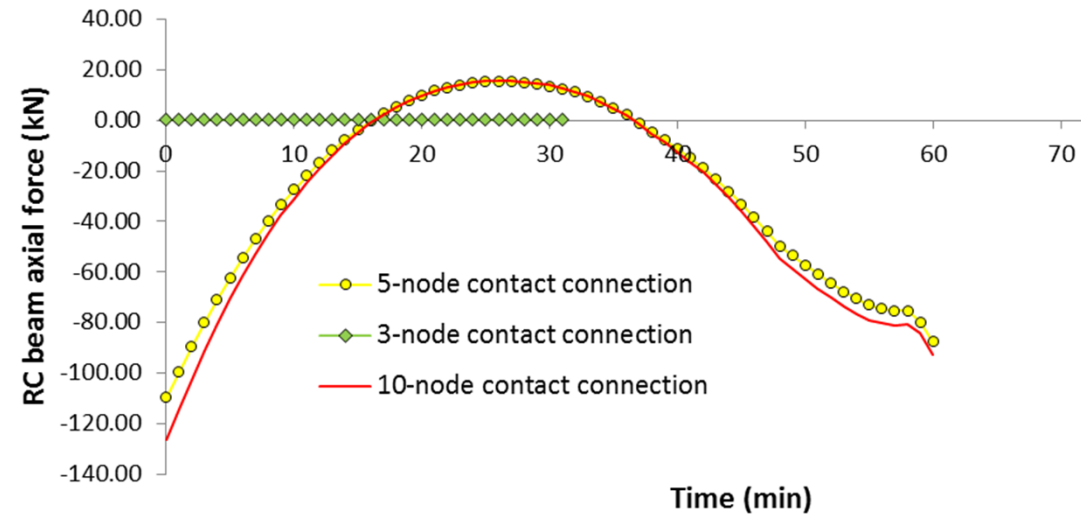


# Simple Composite structures –advanced analysis

## Midspan deflection of the RC beam

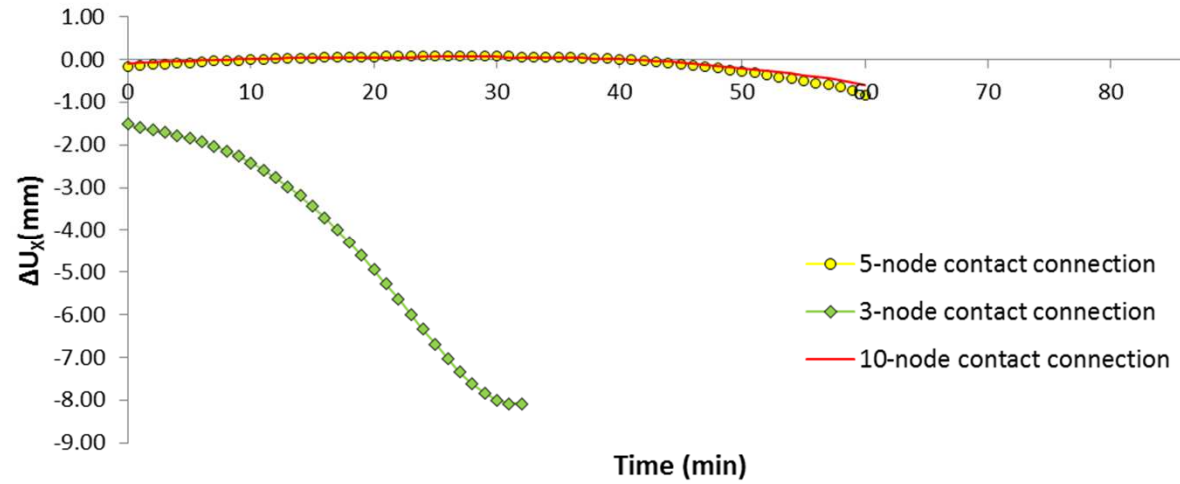


## RC beam axial force at midspan

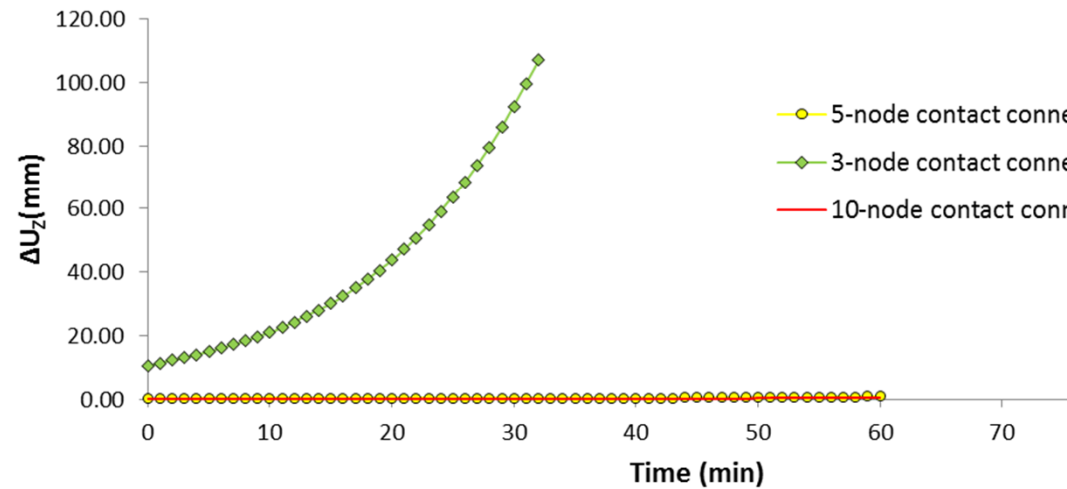


# Simple Composite structures –advanced analysis

Longitudinal slip ( $\Delta U_x$ ) at X = 360 cm, Z = 0 cm



Transversal slip ( $\Delta U_z$ ) at X = 120 cm, Z = 0 cm





**Thank you for your attention!**

