VŠB-TU, Faculty of Civil Engineering
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STUDY OF SLAB FIRE RESISTANCE ACCORDING TO EUROCODE
Using different computational methods

Application of Structural Fire Engineering, 29th of April 2011 Prague, Czech Republic

Heat –exposure

Input data

Heat conductivity:

Upper limit value $\lambda_c = 2.0 - 0.2451(\theta/100) + 0.0107(\theta/100)^2$ $W.m^{-1}.K^{-1}$

Lawer limit value $\lambda_c = 1.36 - 0.136(\theta/100) + 0.0057(\theta/100)^2$ $W.m^{-1}.K^{-1}$

Specific heat: $c = 900 \rightarrow 1100$ $J.kg^{-1}.K^{-1}$

initial humidity - local encreasing

Initial density:

PENV $\rho = 2300$ $kg.m^{-3}$

EN 1991-1-1 $\rho = 2400$ $kg.m^{-3}$

Study example:

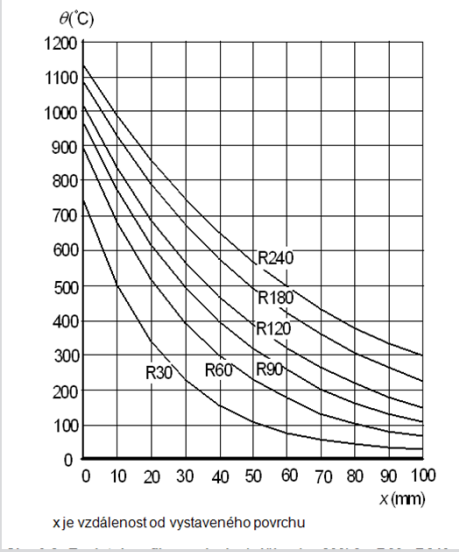
Reinforced concrete slab
Thickness: 200 mm
Concrete cover: 25 mm
Reinforcement profile: 10

Heat –exposure temperature distribution

Fourier equation: $$\frac{\partial \theta}{\partial t} = \frac{\lambda}{c.\rho}\left(\frac{\partial^2 \theta}{\partial x^2} + \frac{\partial^2 \theta}{\partial y^2} + \frac{\partial^2 \theta}{\partial z^2}\right)$$

Temperature profiles Slab of thickness 200 mm

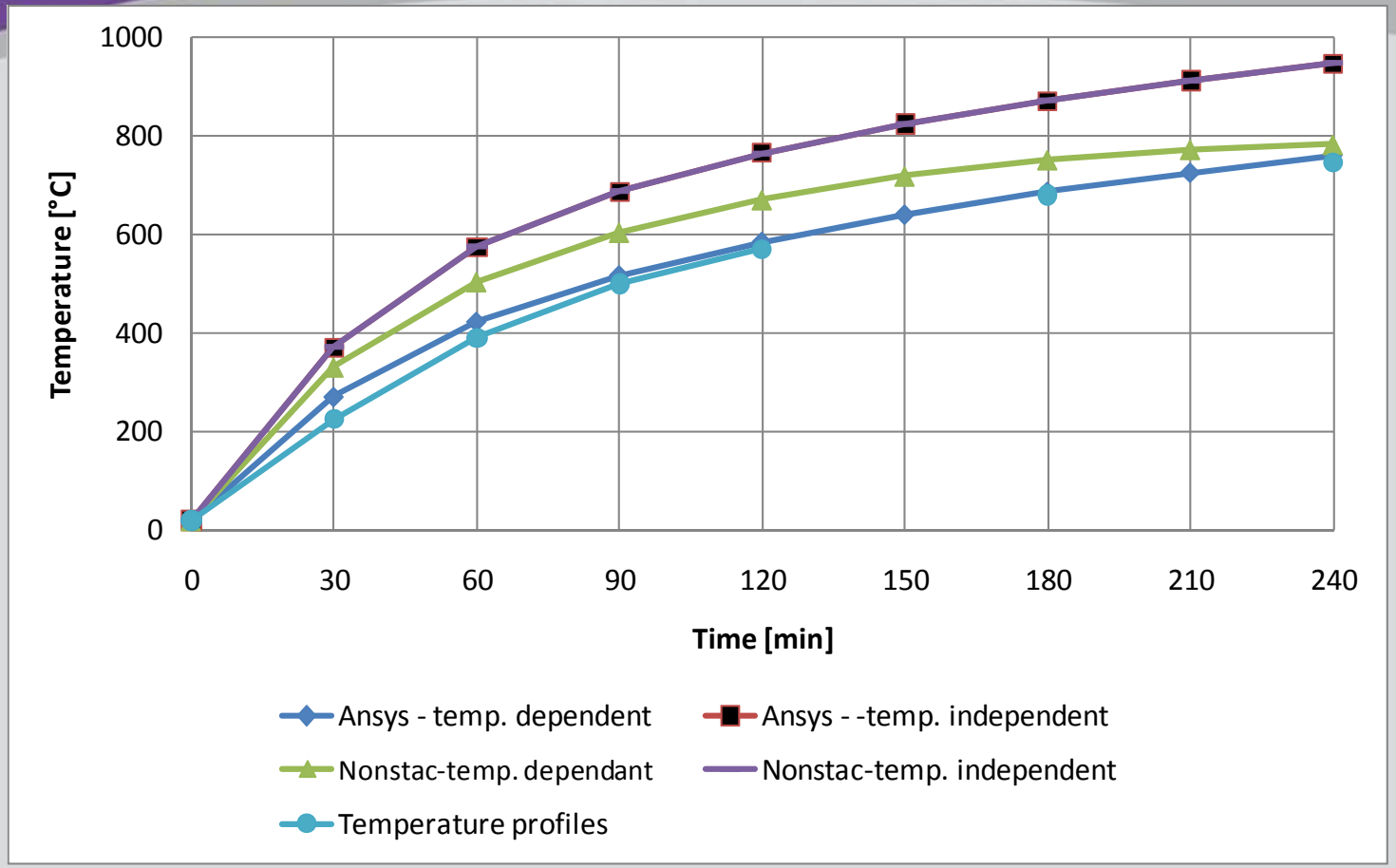
Ansys: FEM analysis



Nonstac: Runge-Kutta method
One dimensional temperature array
Input data - temperature dependant
Heat transfer – both convection and radiation

Heat –exposure

Temperature distribution



Structural response

Fire resistance

Tables: **REI 90 minut**

Simplified calculating method: **Assesssment in time 90 minutes**

			Profiles	Ansys	Ansys	Nonstac
Heat conductivity - temp. dep.	λ	kJ/kg.K		2.0	2.0	2.0
Density - temperature dep.	ρ	kg/m^3		2400	2300	2400
Temperature in reinforcement	θ_R	°C	500	517	524	604
Steel strength	$f_{yd,fi}$	Mpa	328	305	232	193
Bending moment - capacity	$m_{Rd,fi}$	kNm/m	42	39	30	25
Bending moment - action effect	$m_{Ed,fi}$	kNm/m	32	32	32	32
Assessment			OK	OK	X	X

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Thanks for attention!