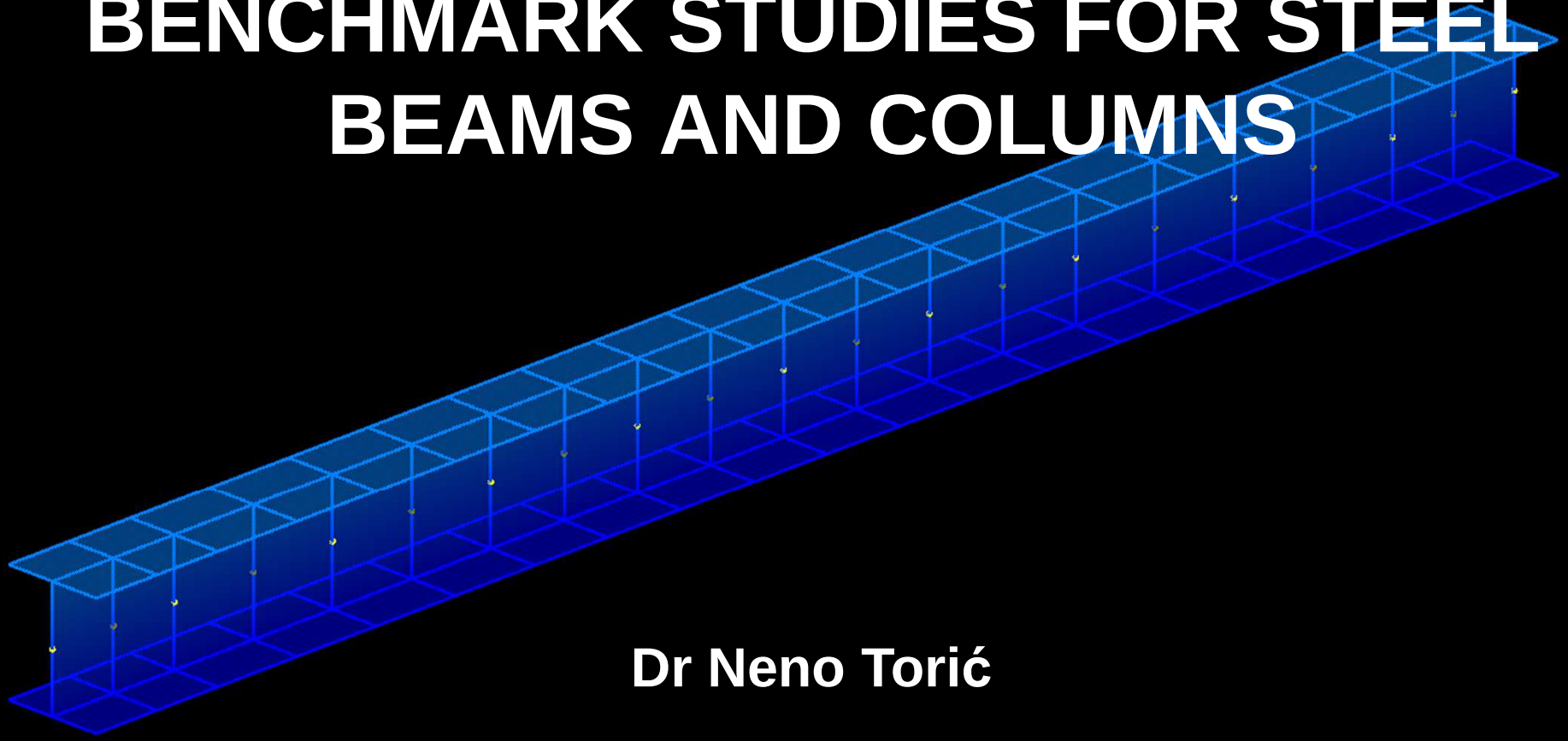
COST Action TU0904
Integrated Fire Engineering and Response
Training school for young researchers
Lulea University of Technology, Lulea, 12.-15. March 2014.

BENCHMARK STUDIES FOR STEEL BEAMS AND COLUMNS



Dr Neno Torić

UNIVERSITY OF SPLIT
FACULTY OF CIVIL ENGINEERING, ARCHITECTURE AND GEODESY
CHAIR FOR STEEL AND TIMBER STRUCTURES

BENCHMARK STUDIES PACKAGE

Benchmark studies
Experimental validation of numerical models in fire engineering

No. 1 BENCHMARK STUDIES FOR PARTIALLY HEATED STEEL BEAMS

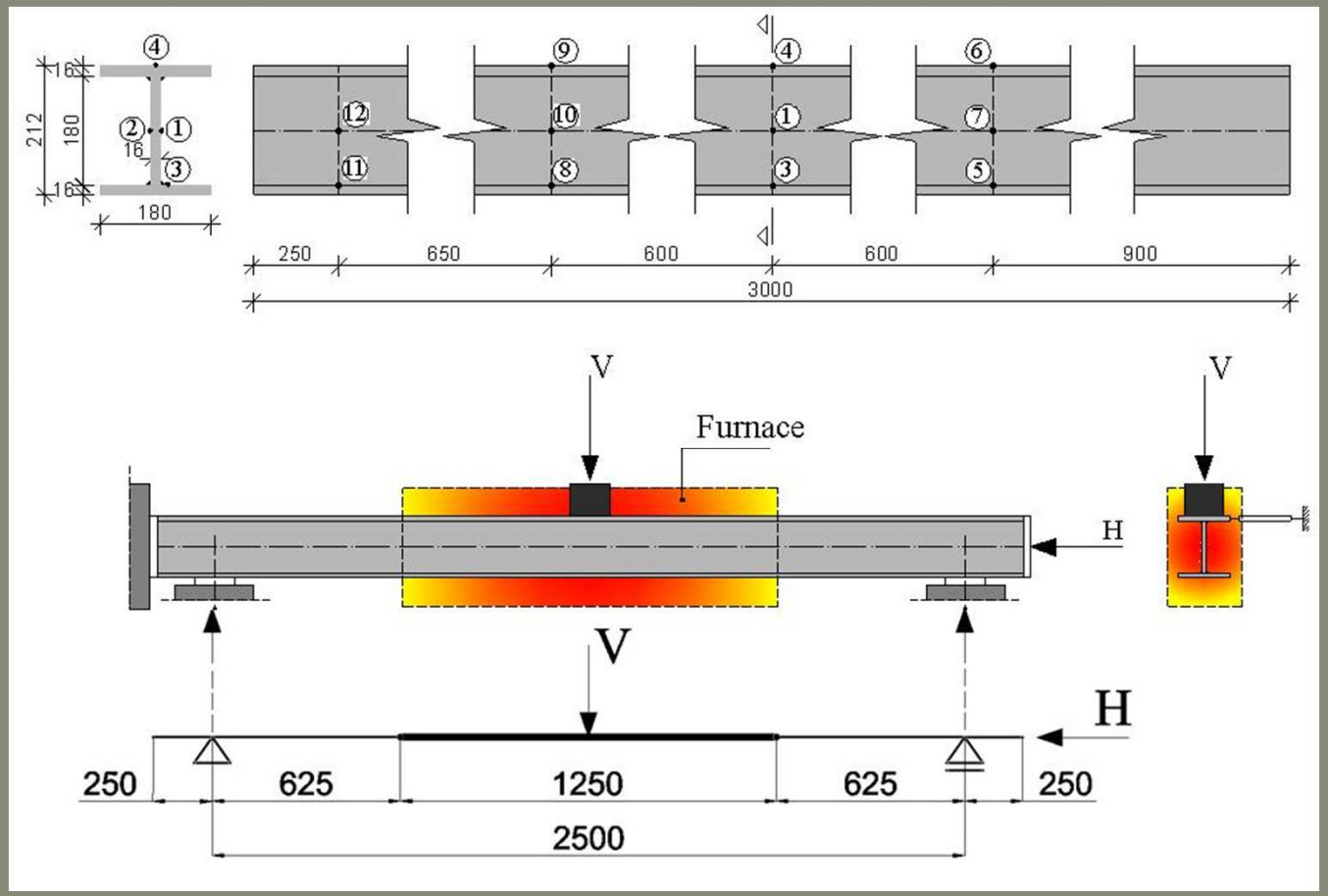
Verification of numerical models in fire engineering

No. 13 CREEP ANALYSIS OF STEEL COLUMNS WITH DIFFERENT HEATING RATES

Authors: Neno Torić, Ian Burgess

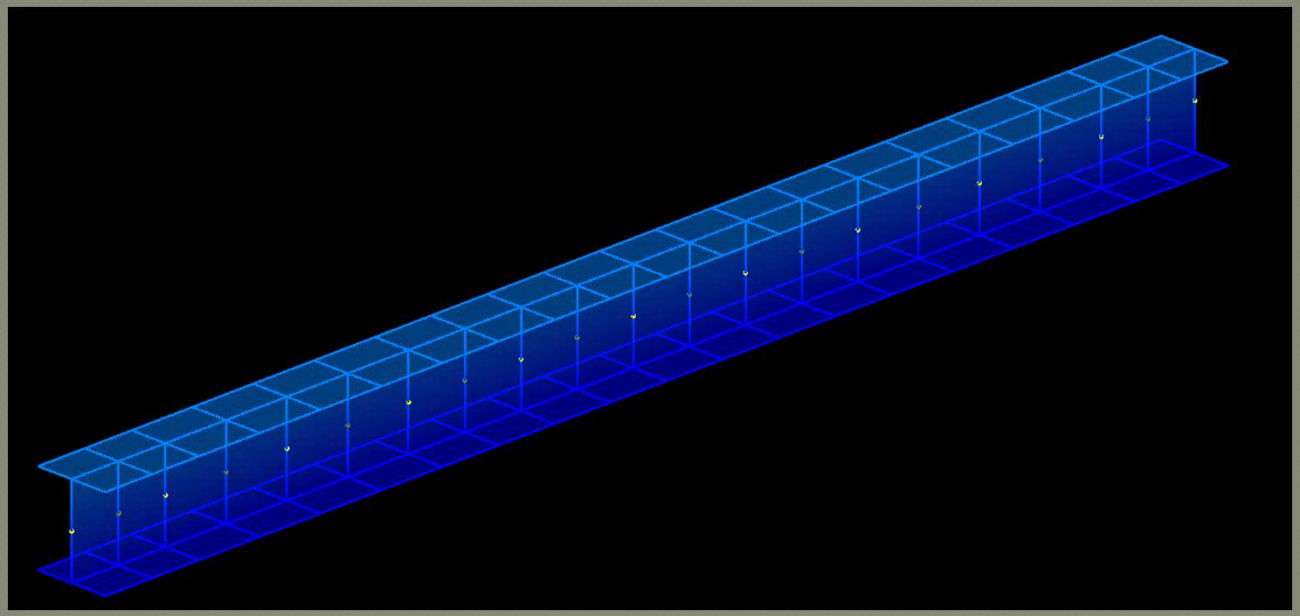
BENCHMARK STUDIES FOR PARTIALLY HEATED STEEL BEAMS

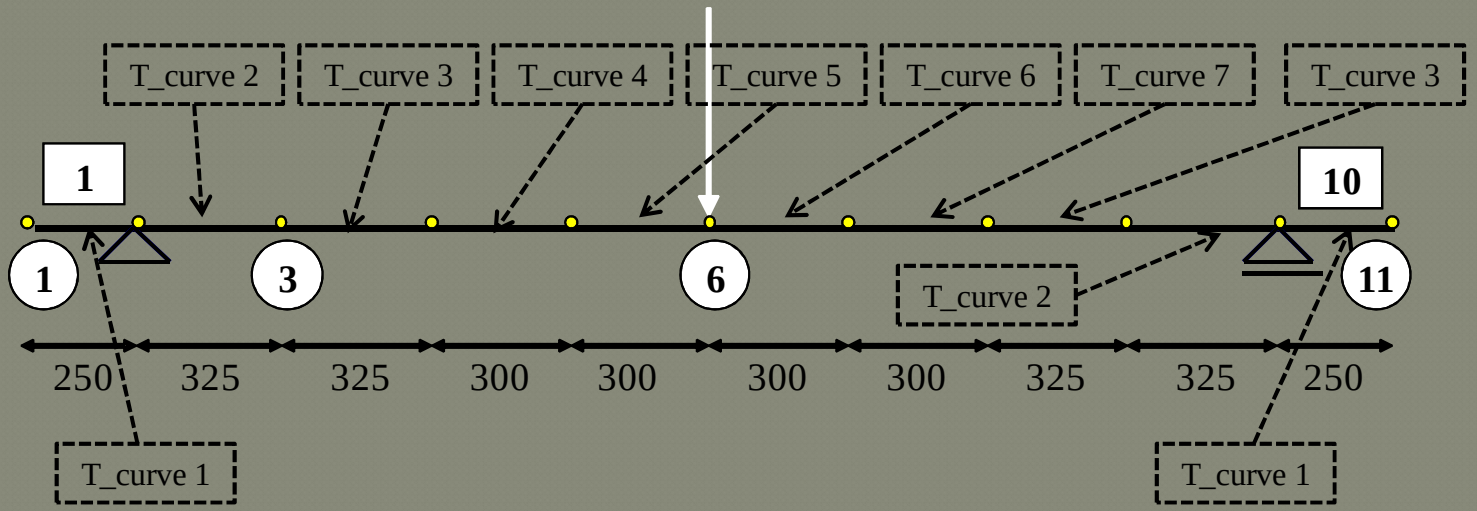
- Four fire tests conducted on simply supported and partially heated steel members;
- Two partially heated simply supported steel beams loaded with a vertical force, two partially heated simply supported beams loaded with a vertical and a compressive force;
- Temperatures used in the numerical modelling were based on those measured during the fire tests;



BENCHMARK STUDIES FOR PARTIALLY HEATED STEEL BEAMS

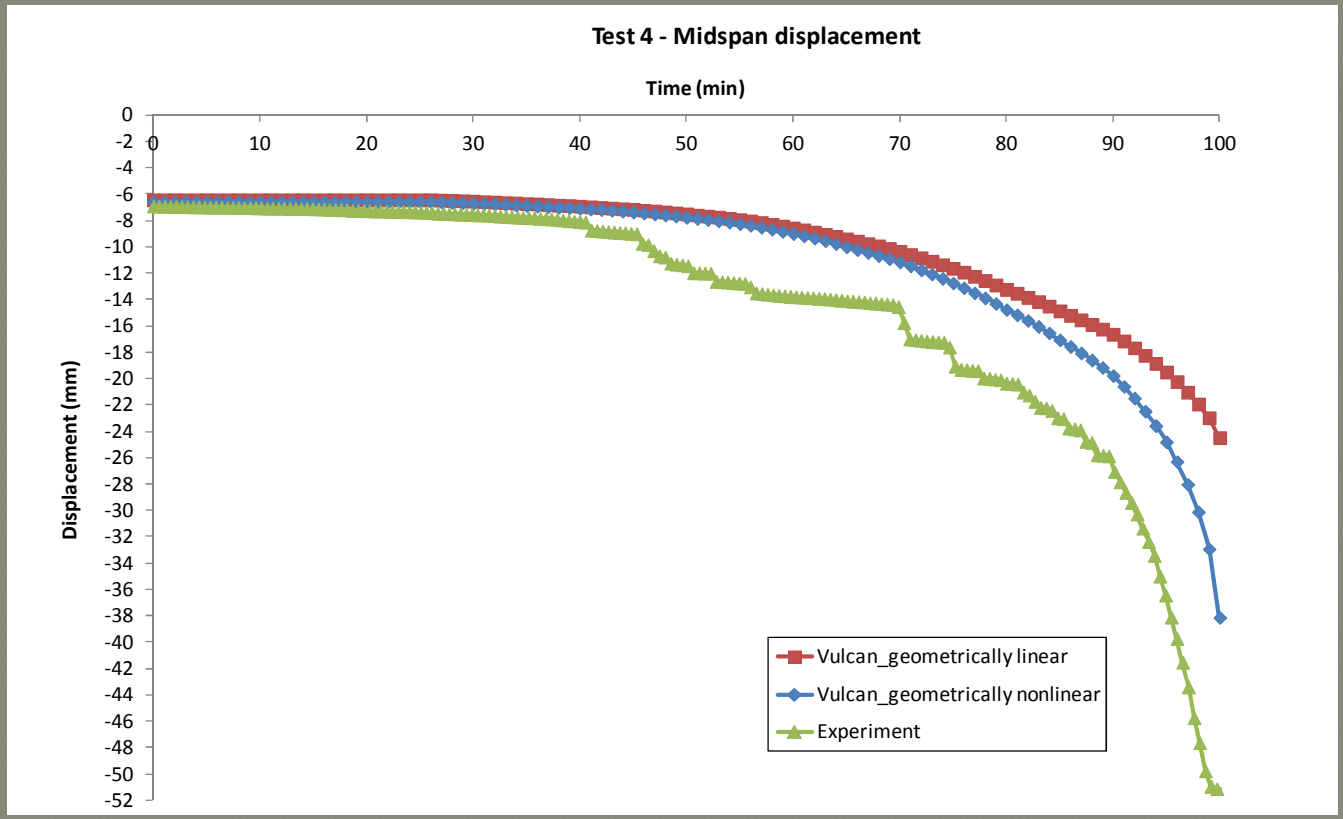
- Geometry&Mesh;





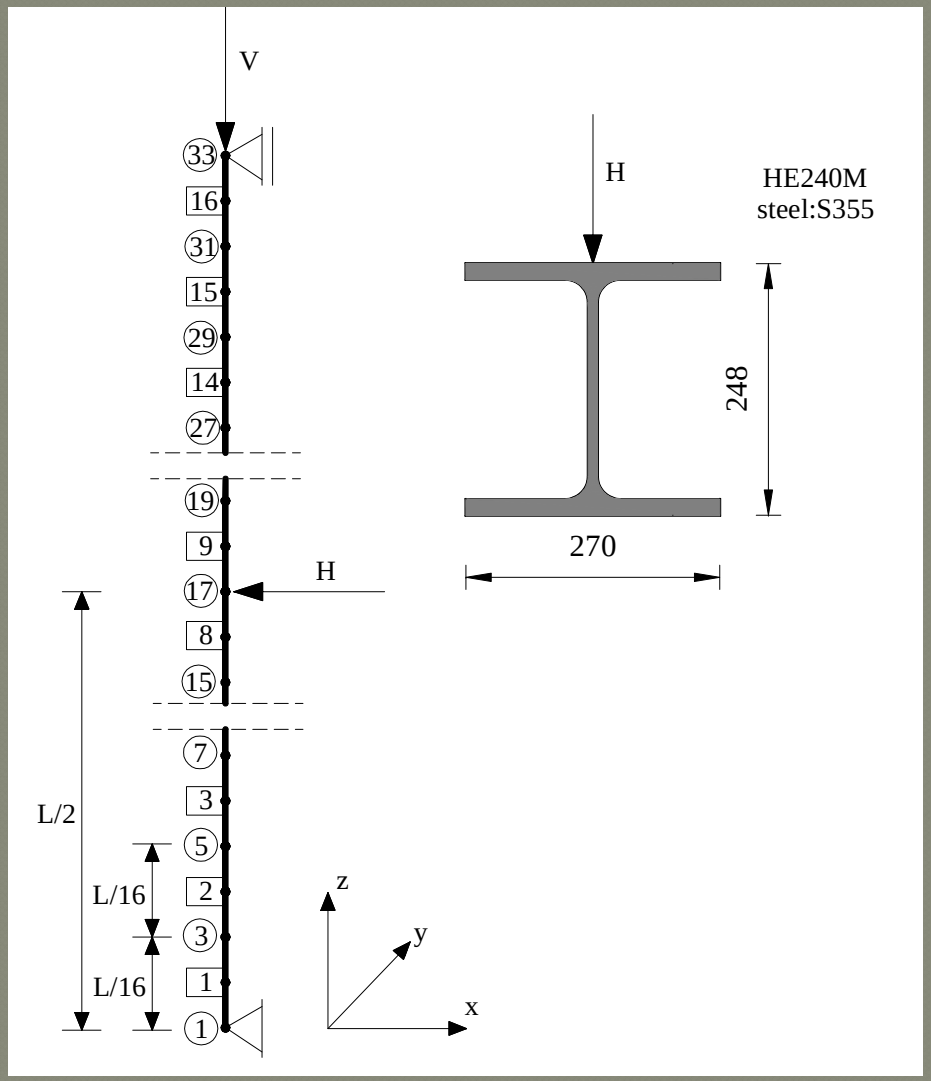
BENCHMARK STUDIES FOR PARTIALLY HEATED STEEL BEAMS

- A discrepancy between the results obtained by Vulcan and the experiment is observable for some tests.
- Several factors can be attributed to this, but the important ones are connected with the simplified treatment of temperature field in the beams, usage of reduction factors and material constitutive law from Eurocode 3 and neglecting the realistic creep strain analysis (Eurocode curves consider creep strains implicitly in the material constitutive law).

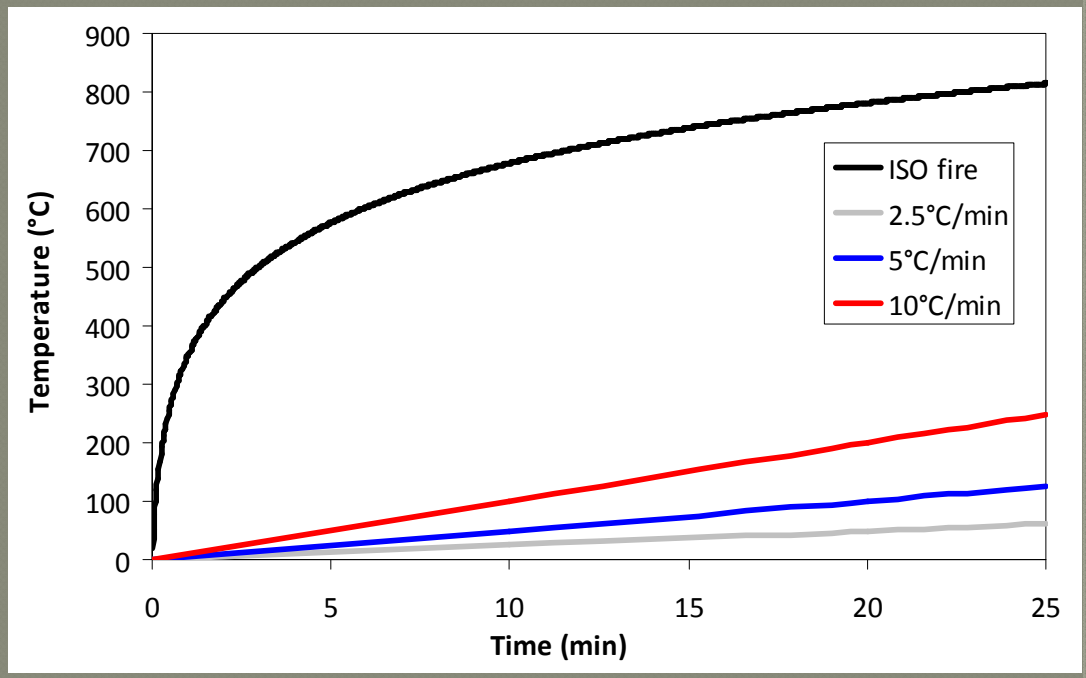


CREEP ANALYSIS OF STEEL COLUMNS WITH DIFFERENT HEATING RATES

- Benchmark studies for steel columns including explicit creep analysis;
- Input taken from benchmark study No. 15 (Sannino *et al*);
- Two creep models, based on time and strain hardening rules;
- Implementation of creep models in Vulcan research code;



- Geometry&Mesh



- Heating curves

CREEP ANALYSIS OF STEEL COLUMNS WITH DIFFERENT HEATING RATES

- The results of the benchmark studies have shown that the reduction of a stocky column's critical temperature is typically approximately 10% from that of the same column determined without considering creep;
- The level of reduction is more pronounced for the higher levels of slenderness, illustrating that creep strains act as an amplifier of the effect of geometrical imperfections;
- Beyond the heating rate of 10℃/min which was the highest used in these studies, creep strains have little influence on the column critical temperature.