

March 12-15 2014, Lulea

STRUCTURAL FIRE ENGINEERING BENCHMARKING OF COLUMNS AND SPACE-FRAMES USING VULCAN AND SAFIR



WG3 - I. Del Prete

WG1 - E. Nigro

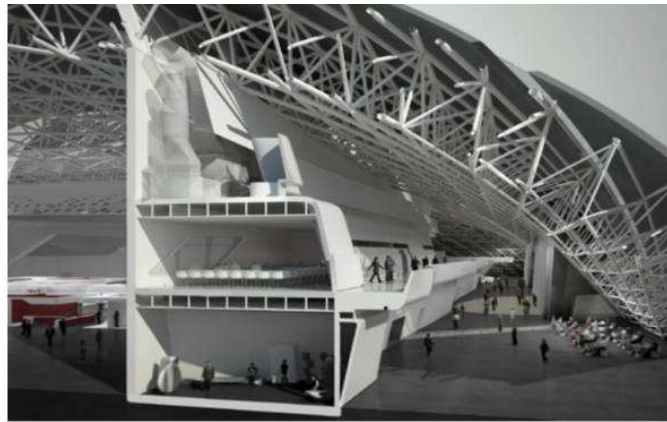
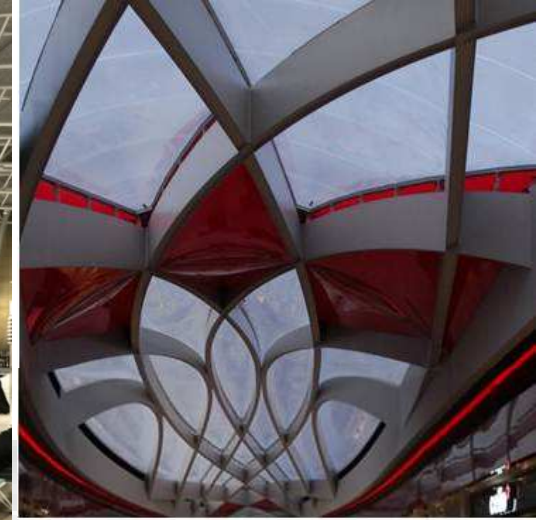
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WG1 - F. Block

T. Lowry

Buro Happold

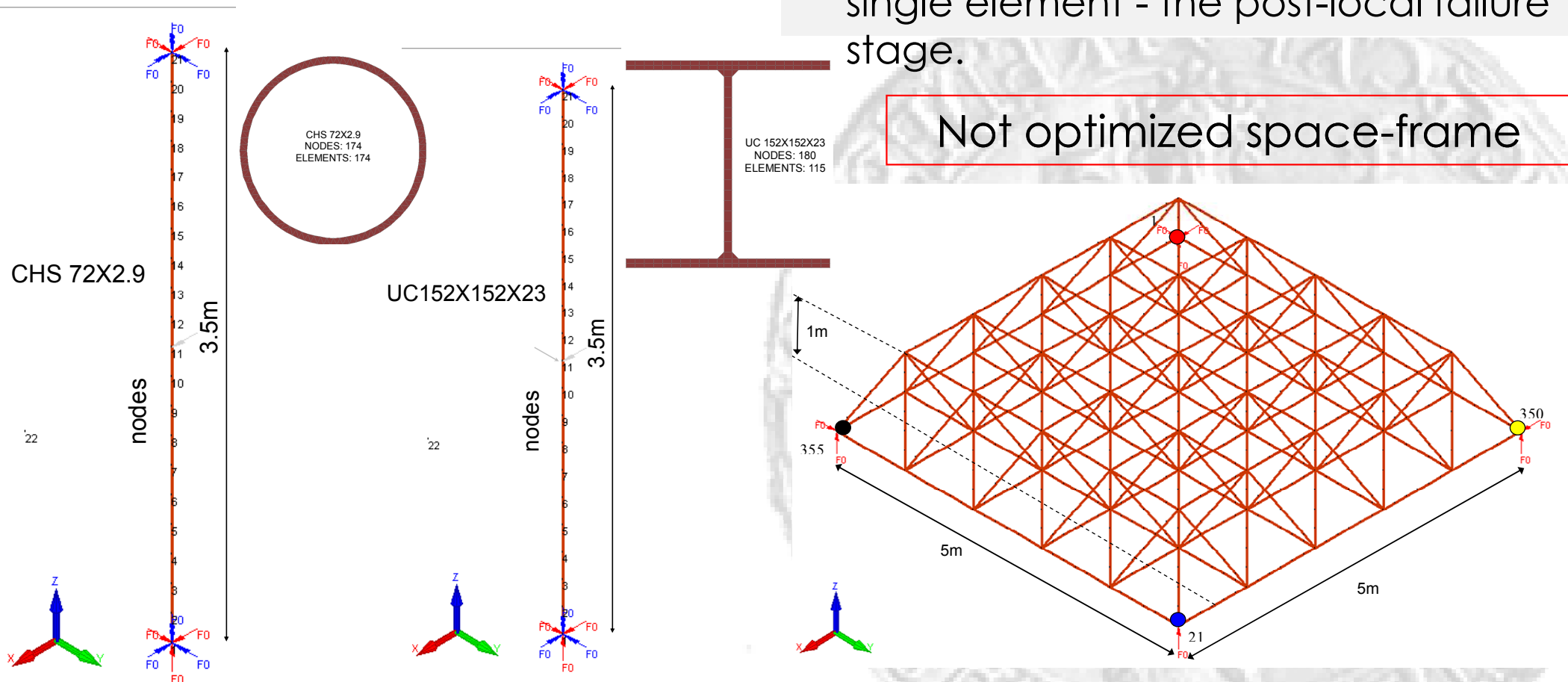
Introduction



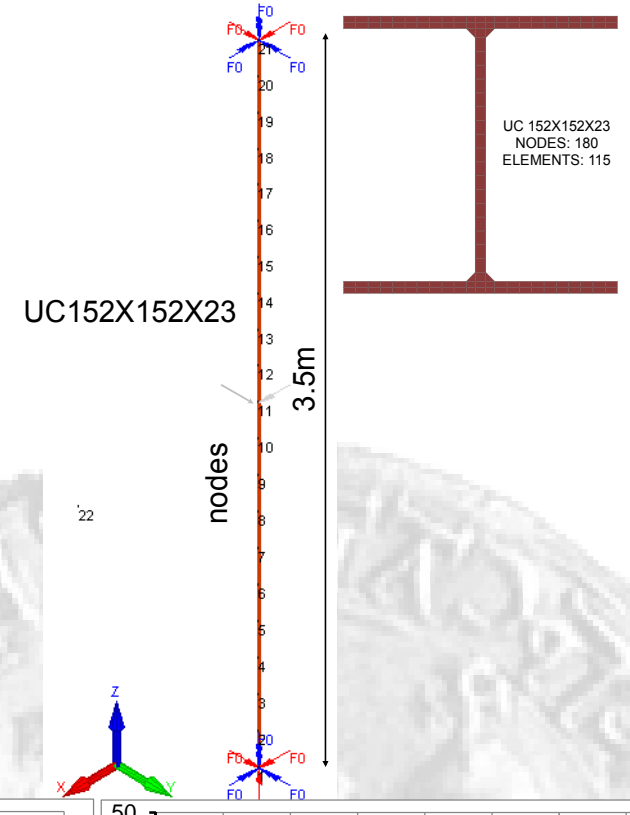
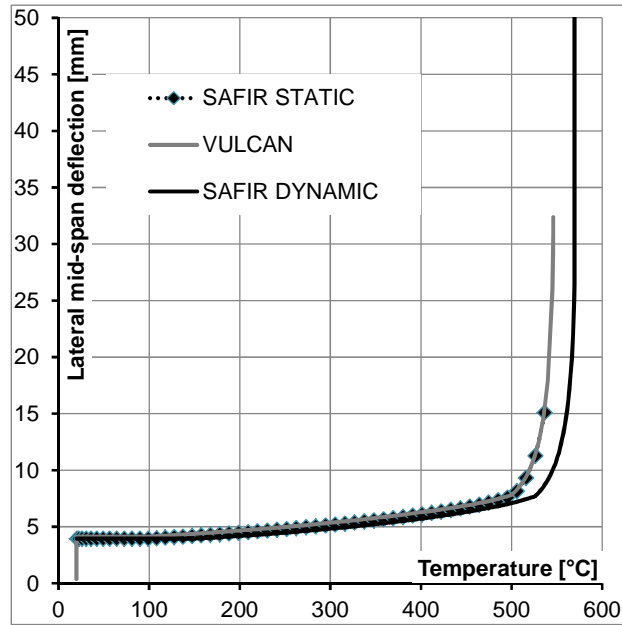
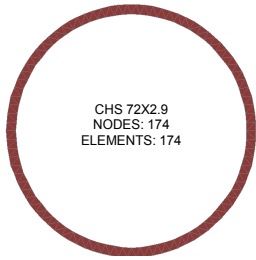
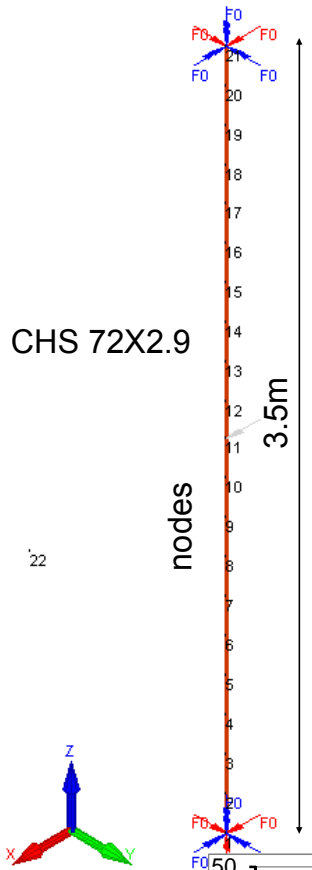
Summary

- A range of columns were uniformly heated by a linearly increasing temperature profile in order to establish how close the agreement between the results obtained in **SAFIR** and **VULCAN** is for simple cases

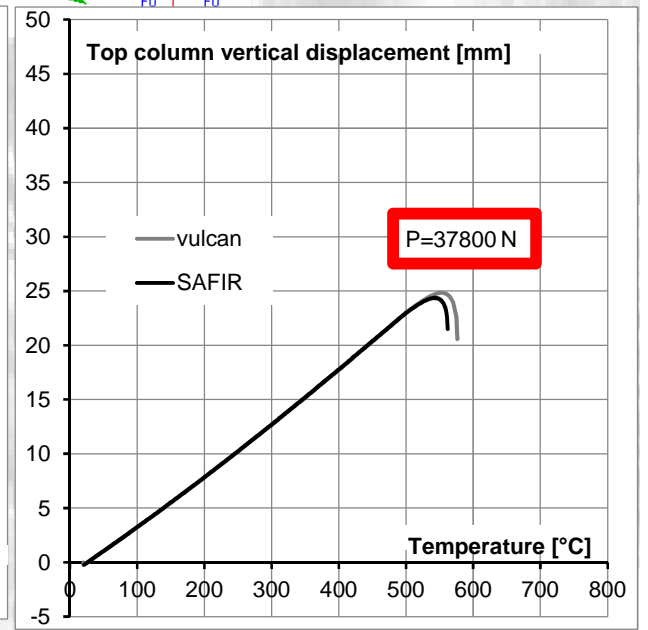
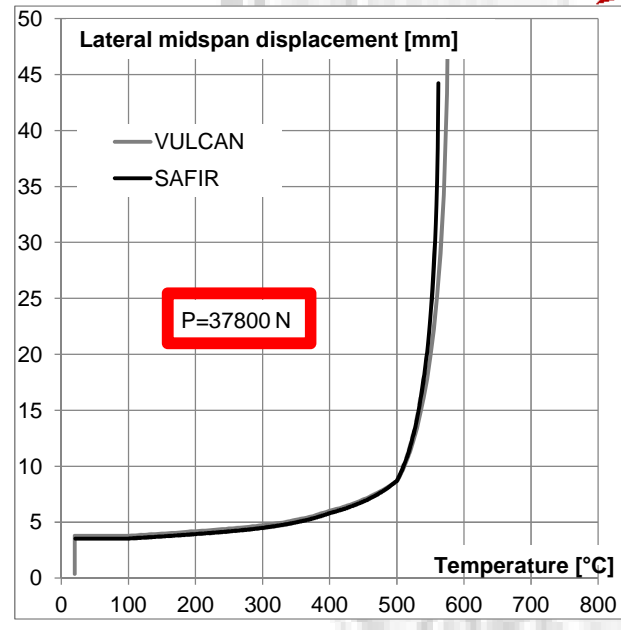
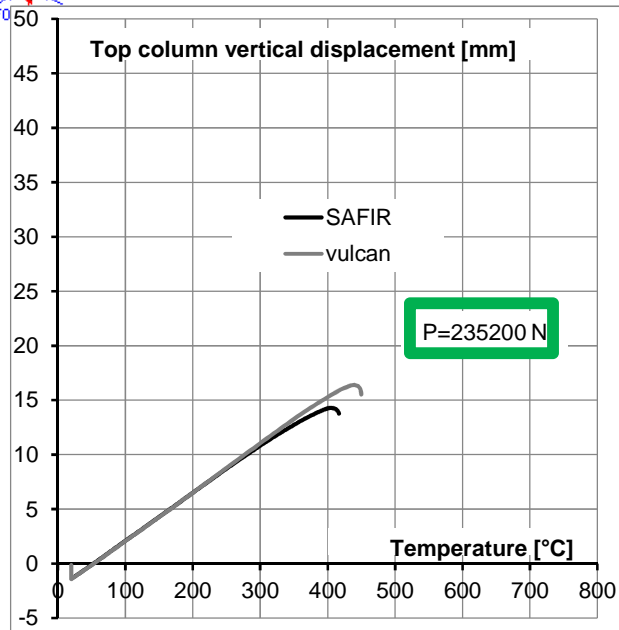
- A thermo-mechanical analysis was carried out where a space-frame roof was exposed to both localised and uniform heating regimes to evaluate the ability of the software packages to analyse the structural behaviour after the buckling of a single element - the post-local failure stage.



Benchmark of columns

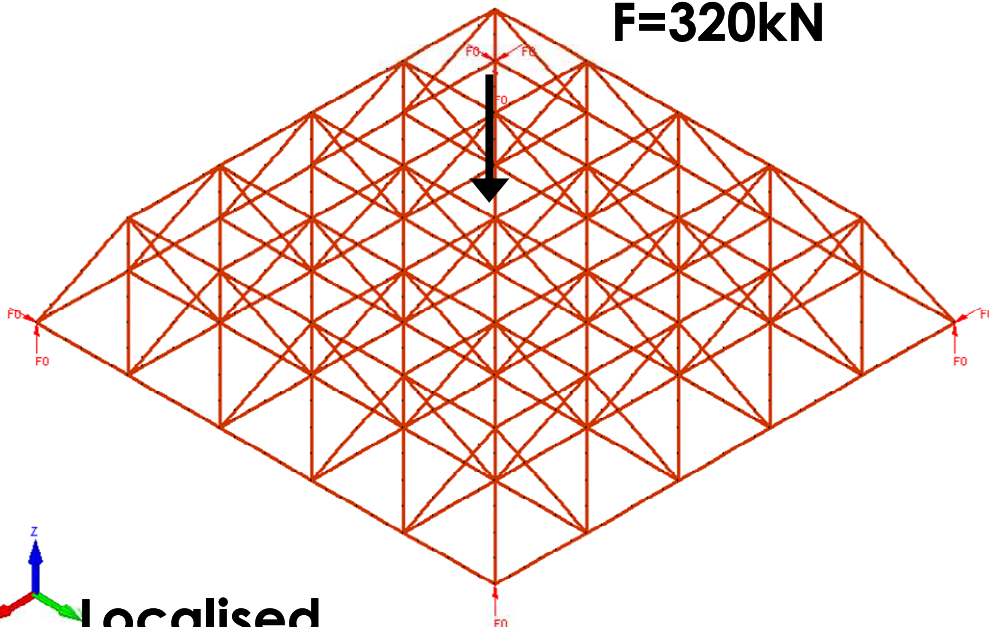


UC 152X152X23
NODES: 180
ELEMENTS: 115

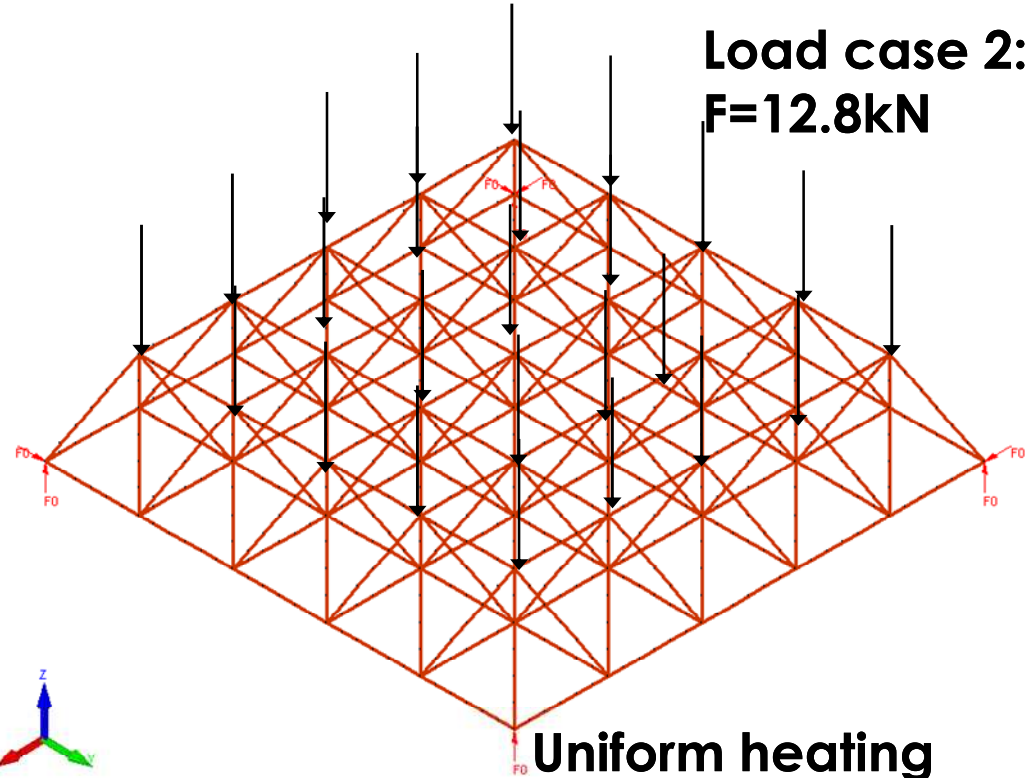


Benchmark of space-frame

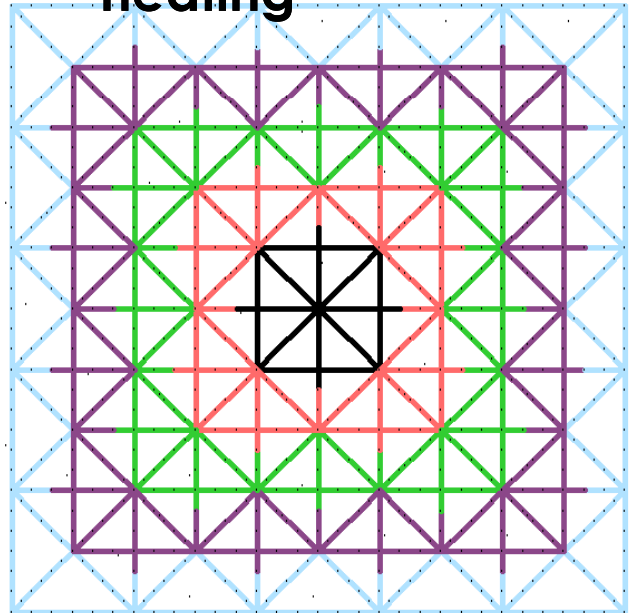
Load case 1:
 $F=320\text{kN}$



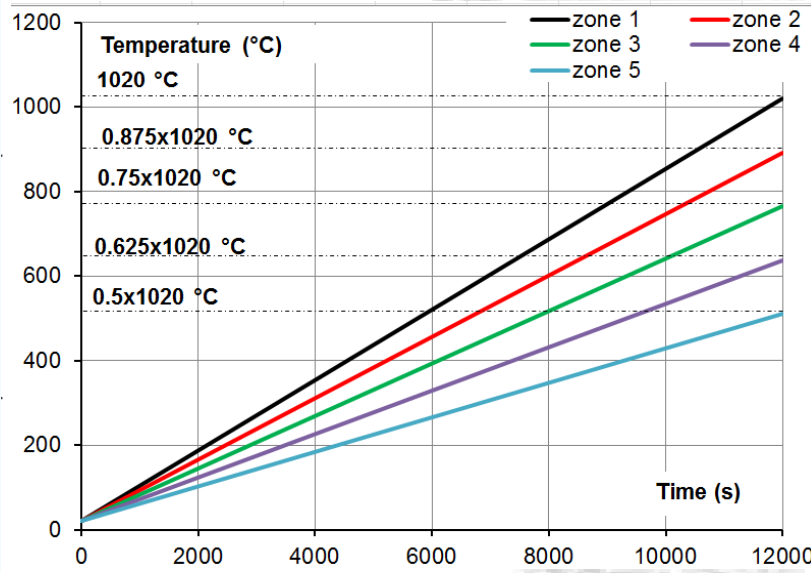
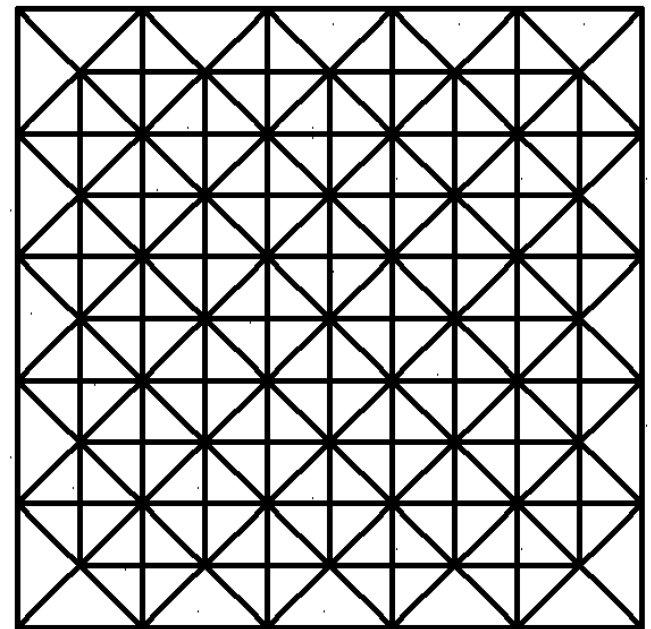
Load case 2:
 $F=12.8\text{kN}$



 Localised heating

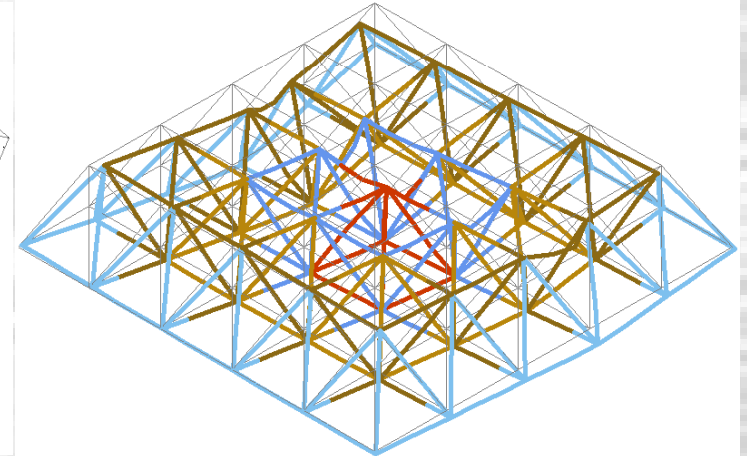
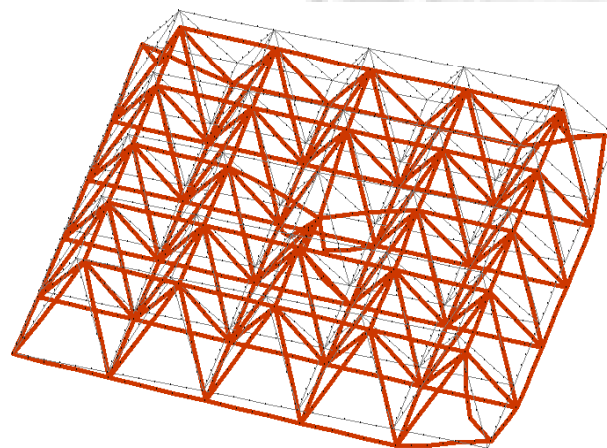
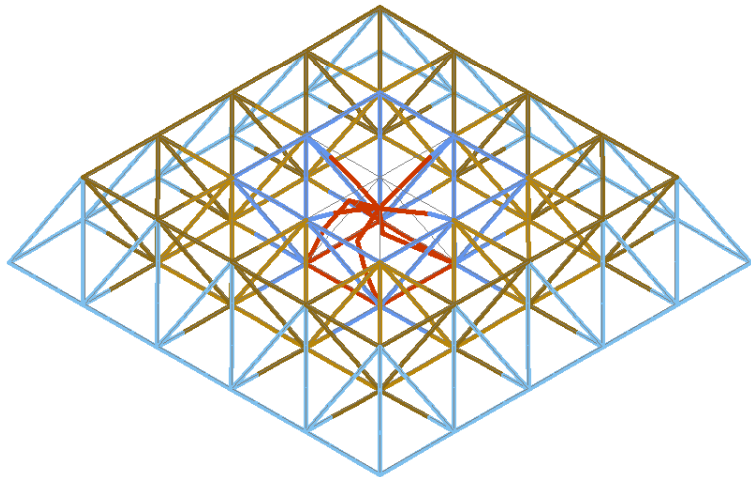


 Uniform heating



Benchmark of space-frame - results

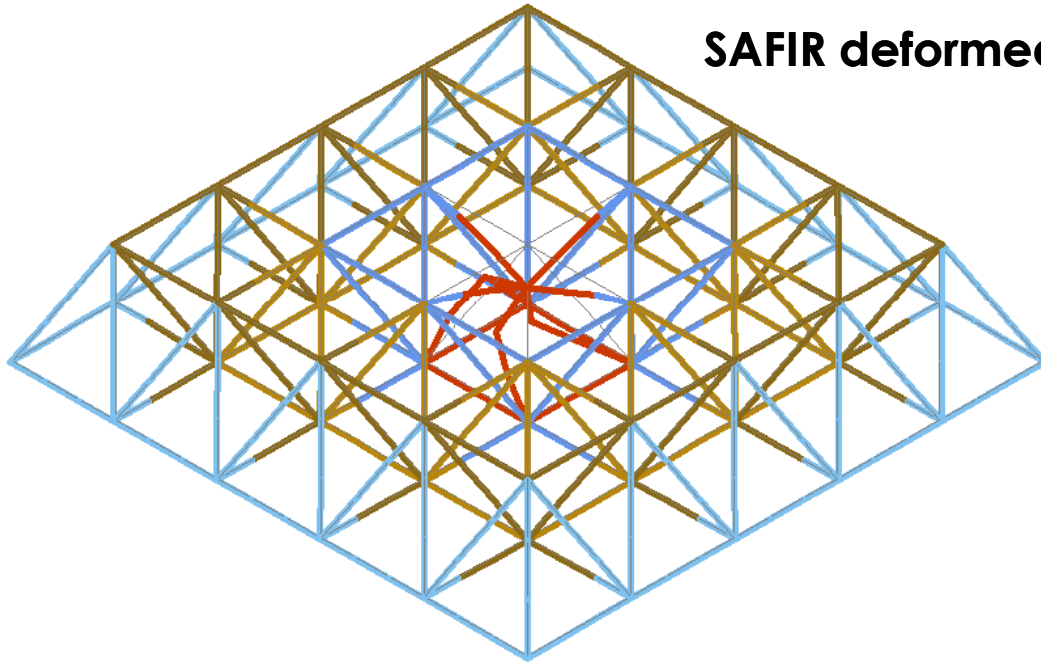
Temperature patterns	Loading cases	Critical Temperature in beam (SAFIR)	Critical Temperature in beam (VULCAN)
Localised fire	1 Point load in the centre (Load case 1)	527°C	520°C
Localised fire	25 Point loads (Load case 2)	919°C	921°C
Uniform fire	1 Point load in the centre (Load case 1)	524°C	515°C
Uniform fire	25 Point loads (Load case 2)	524°C	515°C



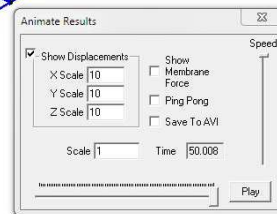
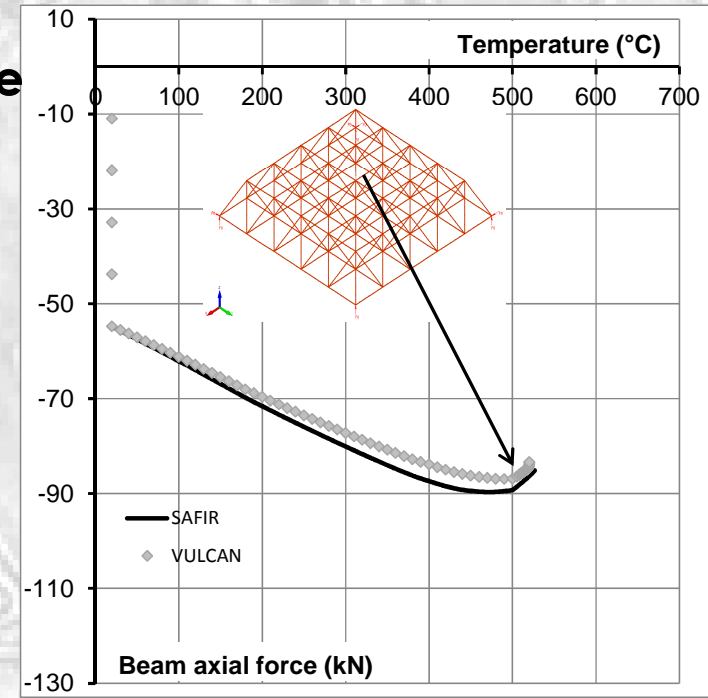
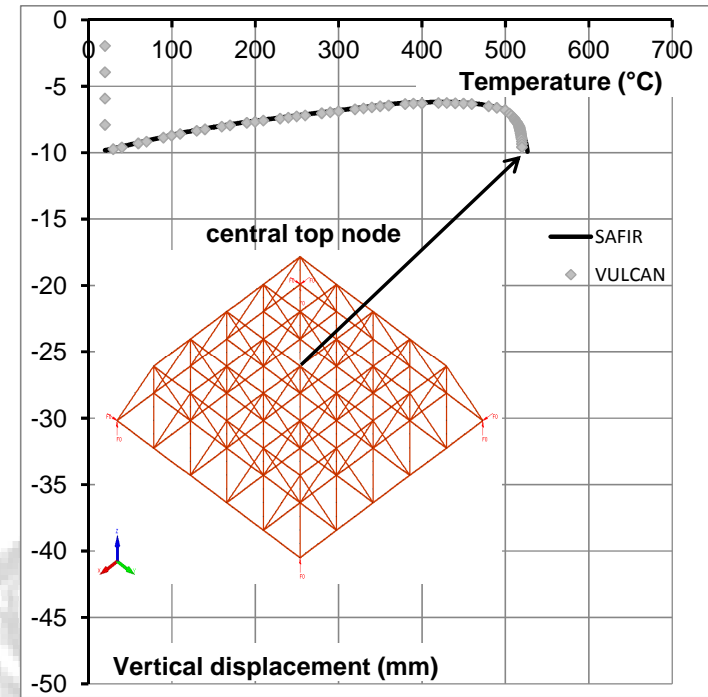
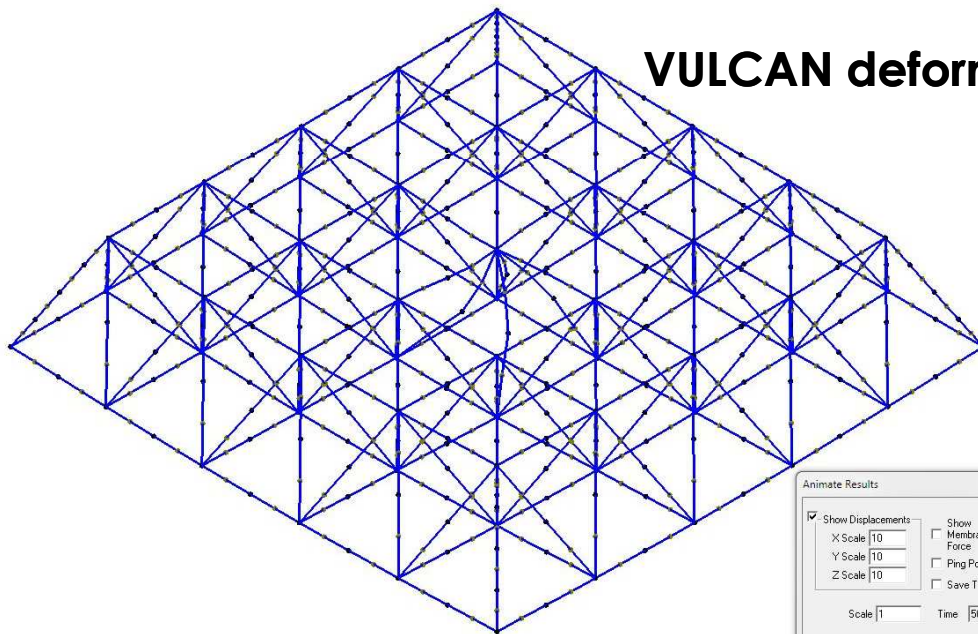
Benchmark of space-frame - results

Load case 1, Localised heating

SAFIR deformed shape



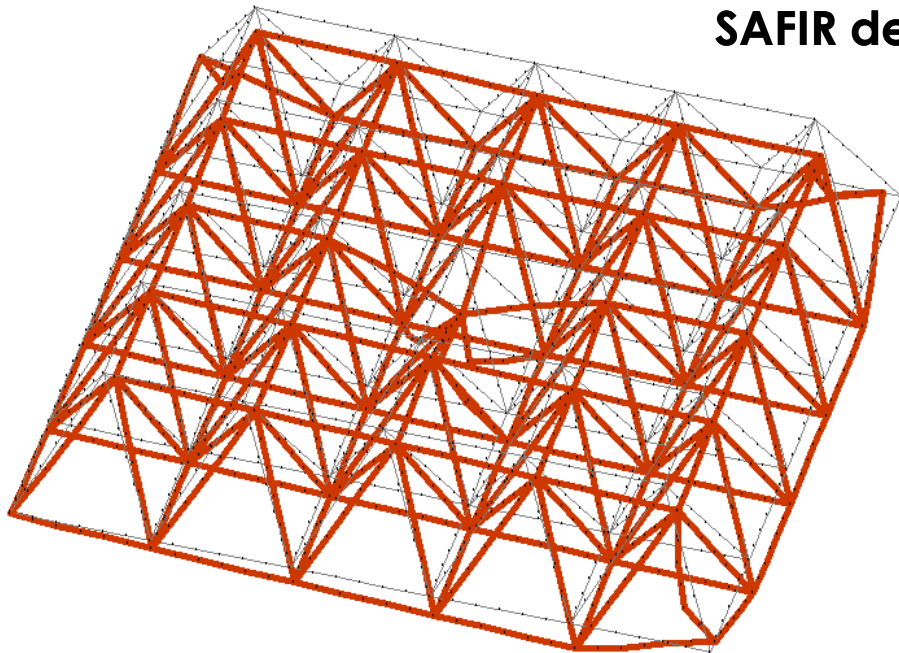
VULCAN deformed shape



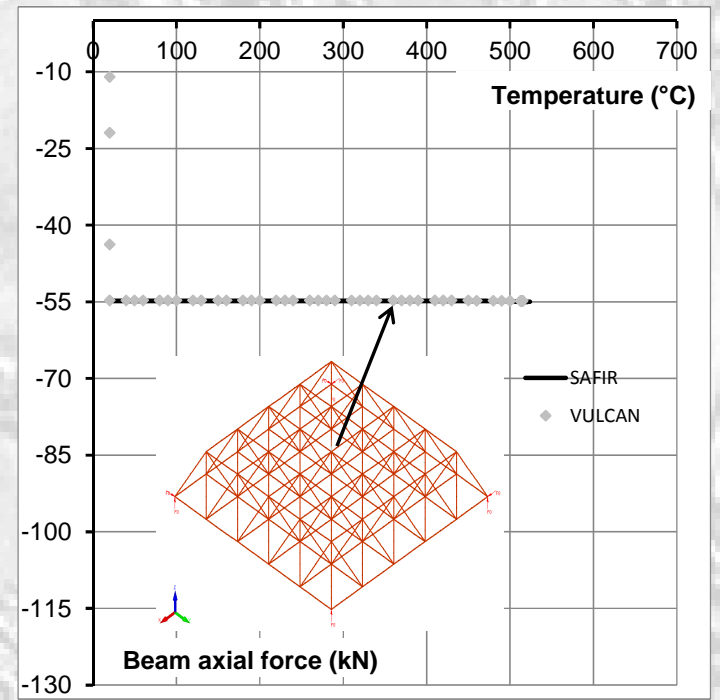
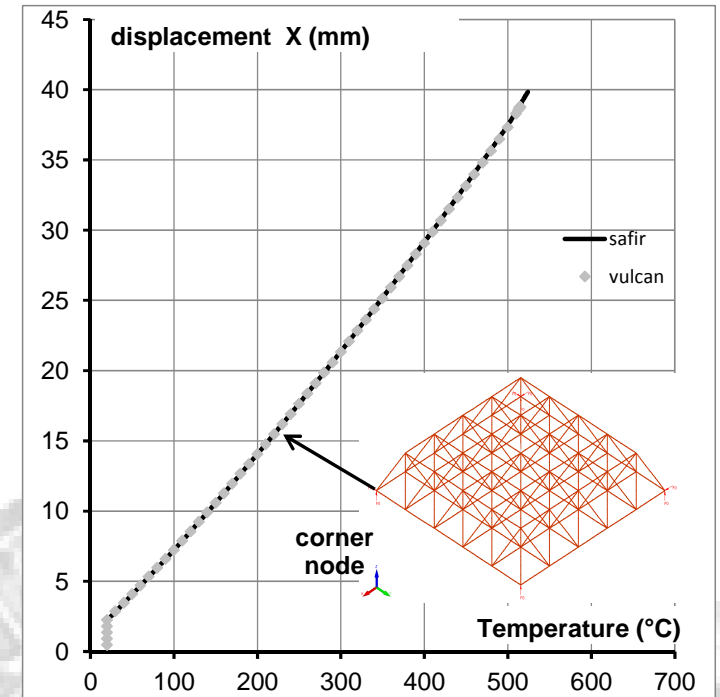
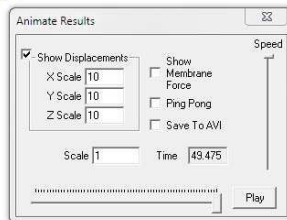
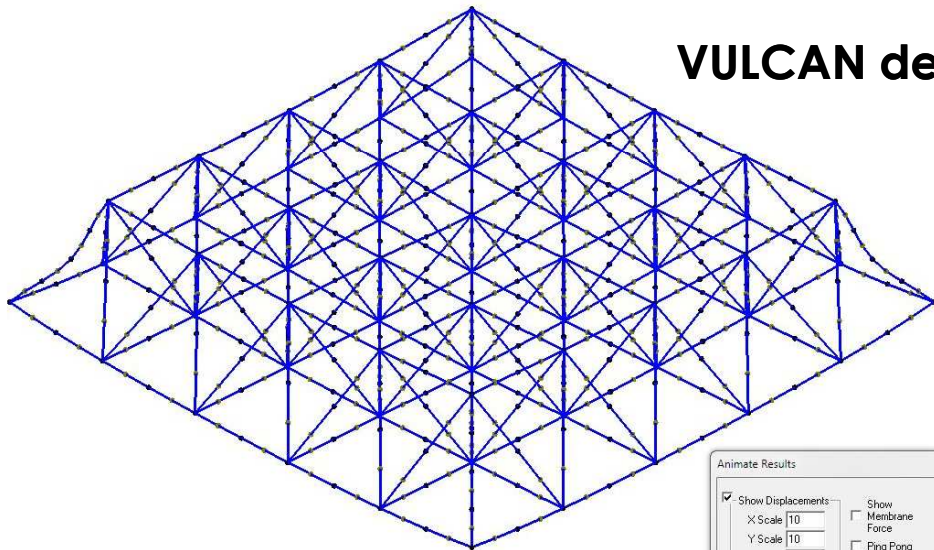
Benchmark of space-frame - results

Load case 1, Uniform heating

SAFIR deformed shape



VULCAN deformed shape



- ✓ Important topic because nowadays modern architects very usually propose **“crazy structures”**, generally designed as space frame structures
- ✓ **VERY GOOD** agreement between SAFIR and VULCAN, also when a complex structure is modelled
- ✓ The space-frame analysed is **not optimized structure** because the same cross section is considered for all beams
- ✓ In case of optimized structure, that we are analysing, an **earlier failure** in case of localised heating is obtained

Thanks for your attention

