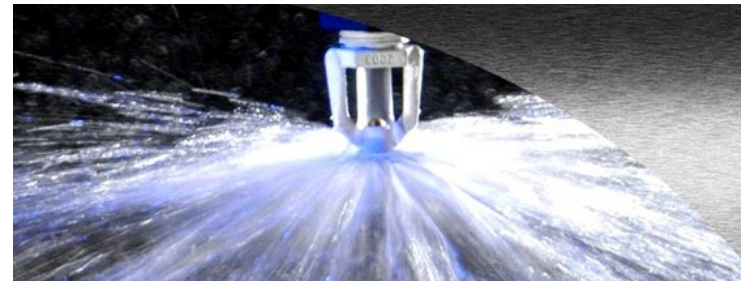


Ruukki Fire Solutions

31/05/2011

Dr. Jyri Outinen

Ruukki Construction
Business & technology development
Technology and research



RUUKKI



Ruukki Fire Solutions

Content of the presentation

- Objectives, real fires
- Fire protection possibilities
- Natural Fire Design
- Fire protection with water sprinklers
- Fire design of thin-walled structures
- Fire retardant painting
- Fire Design Guide

Ruukki Fire Solutions

Objectives

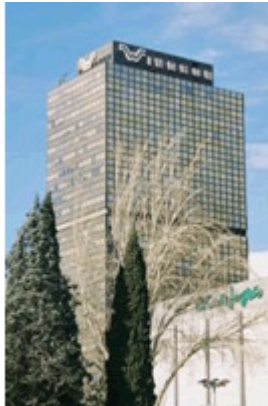
- Better quality and safe solutions to clients
- Cost effective, safe products
- More efficient tools to design
- Ensuring the structural fire safety
- Supporting the research in building construction

Ruukki Fire Solutions

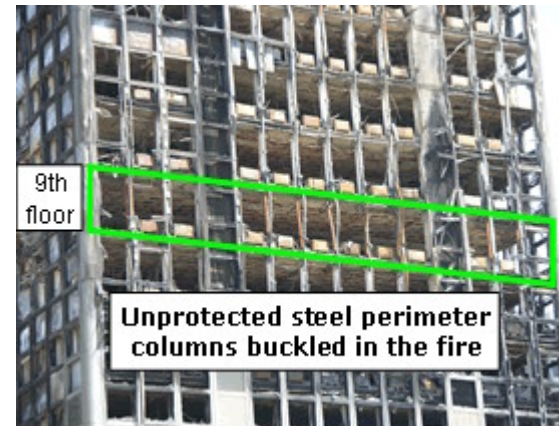
Background

- New regulations in Finland ([RakMK E1-2011](#)), also changes in other countries. The Fire requirements always national
- Solutions depend highly on fire load determination and building classification
- 1-2 storey buildings --medium regulations
- High-rise (over 8 floors) buildings – high requirements
- Co-operation with fire consultants of high importance

Real Fires: Windsor Tower, Madrid 2005



The Windsor Tower was among the ten tallest in Madrid, Spain.
(Photo: Unknown source)



<http://www.mace.manchester.ac.uk/project/research/structures/strucfire/CaseStudy/HistoricFires/BuildingFires/default.htm>

Mandarin Hotel, Beijing 2009



RUSSIA / Façade in fire



Finland, Vantaa, Hong Kong Store 1/2011



Ruukki Fire Solutions

Fire protection possibilities

- Passive fire protection
- Active fire protection
- Performance based fire design

Ruukki Fire Solutions

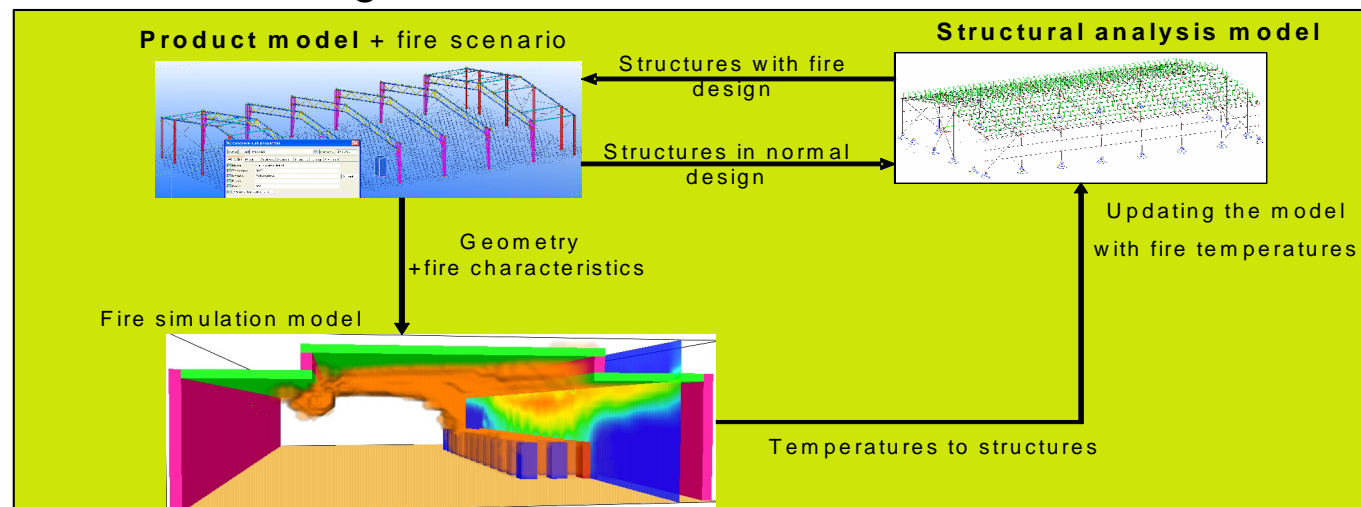
Fire protection possibilities

<u>Passive</u>	<u>Active</u>	<u>Performance based</u>
<ul style="list-style-type: none">• Overdimensioning• Fire protection boards• Insulation materials, Rockwool etc.• Intumescent• <u>Materials directly attached to the protected member</u>	<ul style="list-style-type: none">• Water extinguishers• Smoke vents• Automatic alarm• Automatic info to fire brigade• Fire brigade action	<ul style="list-style-type: none">• Passive+active• Taking into account realistic building, situation and conditions• Simulation-based temperatures
<p>Cases</p> <ul style="list-style-type: none">• Normal, standard buildings	<p>Cases</p> <ul style="list-style-type: none">• Large, important buildings	<p>Cases</p> <ul style="list-style-type: none">• Large, complicated, important buildings

Ruukki Fire Solutions

Natural fire design =performance based design

- Performance based design concept
- Aim to optimize fire protection
- Calculations with verified fire loads and scenarios
- Instructions to authorities published
- Last design: Salmisaari sports centre
- New design case under work



RUUKKI
more with inside

Performance-based structural fire safety design

Performance-based fire safety design is an accepted methodology in both Finnish and European building regulations for the verification of structural resistance in fire conditions. A calculation procedure that takes into account the individual characteristics of the building and passive and active fire protection methods has been developed in a joint European research project.

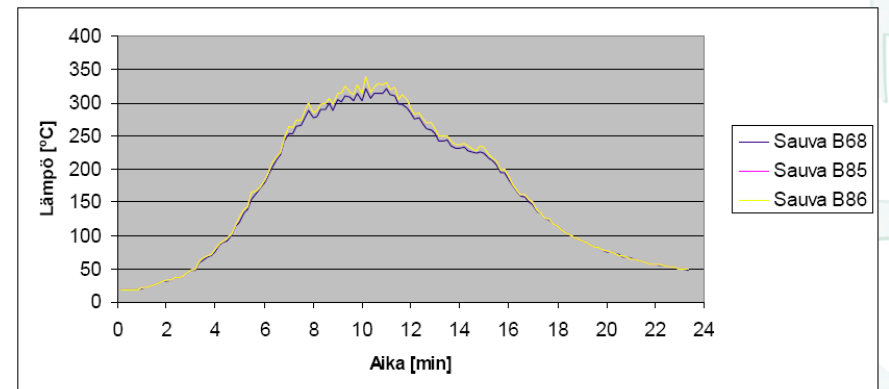
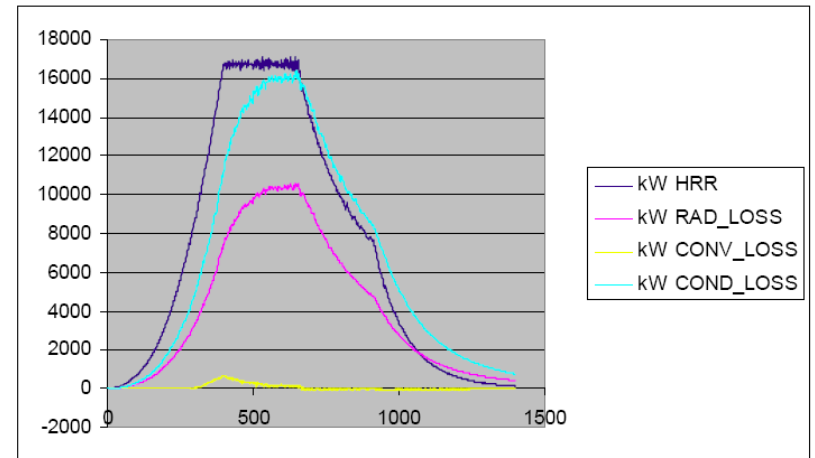
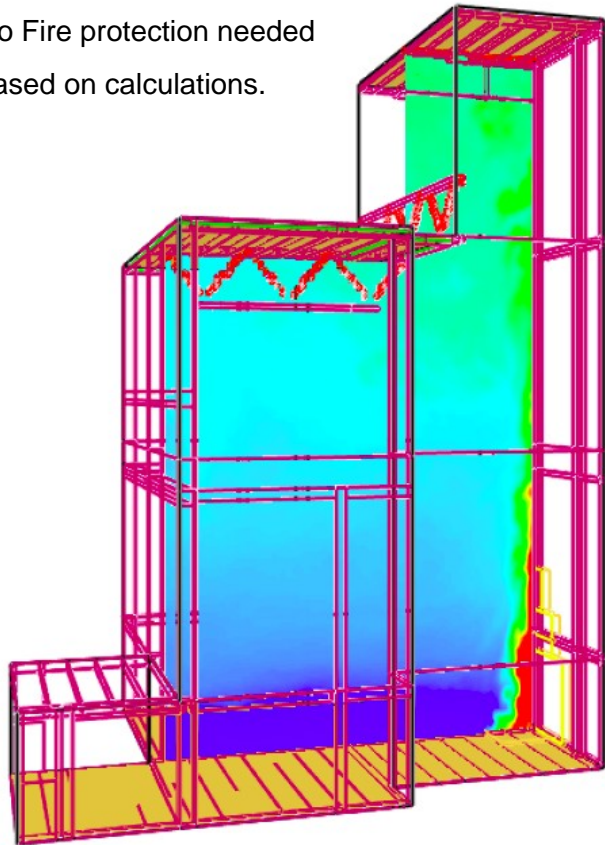
A realistic understanding of the behaviour of structures in fire can be achieved and the overall safety of the building can be verified by using performance-based fire safety design. Through the more profound understanding of phenomena and a more precise analysis of structures in fire, an equal to or higher safety level than with prescriptive fire design can be obtained.

Ruukki Fire Solutions

Software tools for natural fire design

Sport Hall, Helsinki, 18 000m²

Simulation of climbing wall
 No Fire protection needed
 based on calculations.



Climbing hall, the wall burning

Ruukki Fire Solutions

Fire protection with water suppression

- Based on water cooling of steel structures
- Finnish product approval ready
- CE-marking applied
- Protection to Ruukki steel structures
 - R90,
 - 1-2 storey buildings
- Cost-effective way
- Better safety to people and property

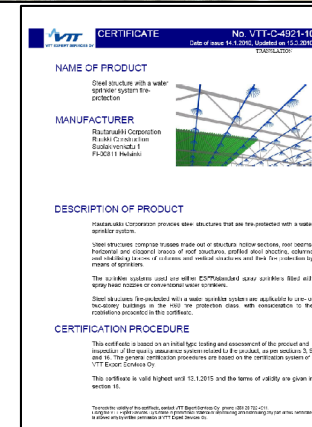


Latest case

Tervaskangas shopping centre,
about 60 000m²

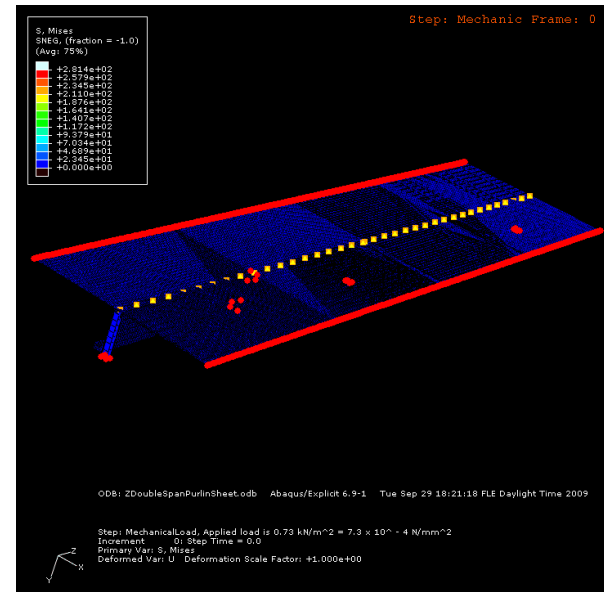
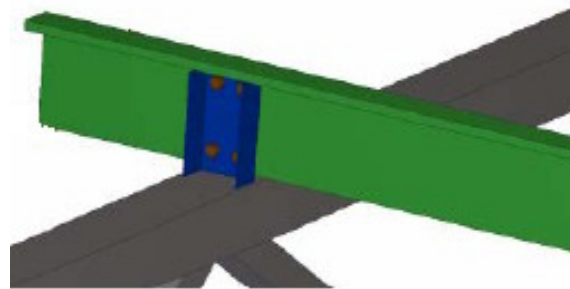
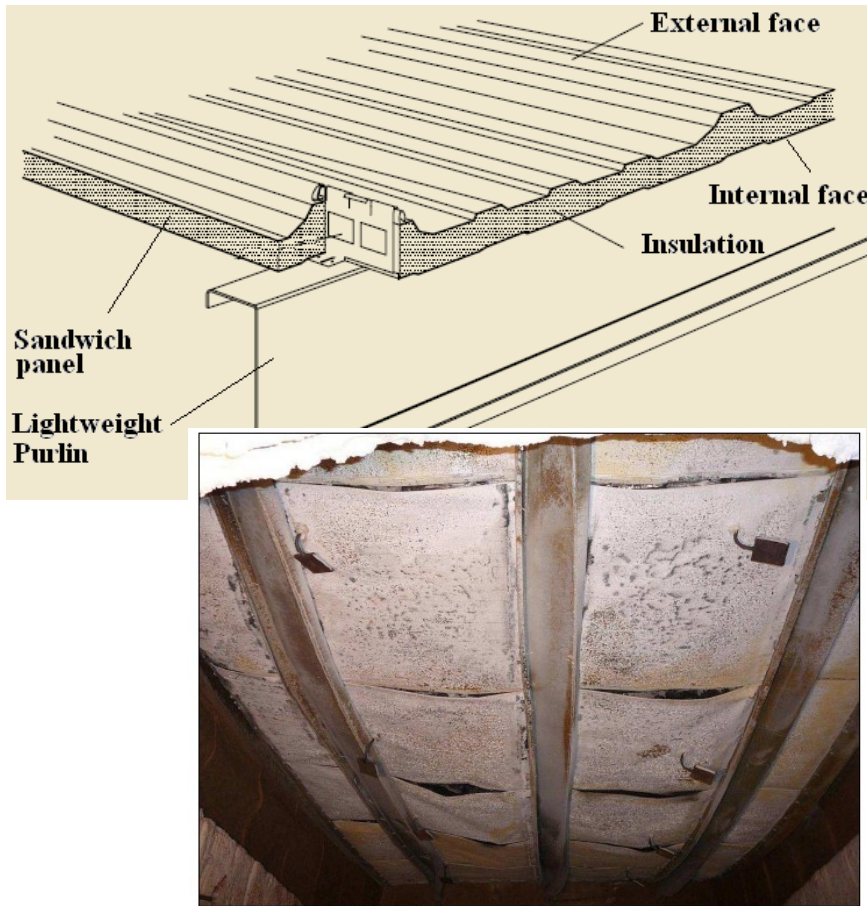
[Further info](#)

[Video](#)



Ruukki Fire Solutions

Structural Behavior of Purlin with Steel Sheeting on its Top in Fire



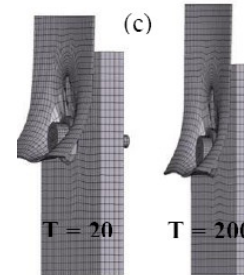
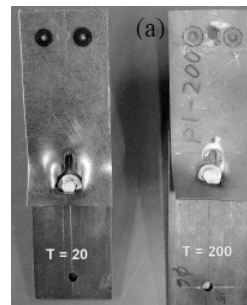
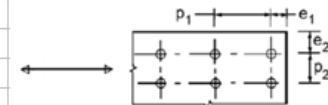
Ruukki Fire Solutions

Structural Behavior of Steel Sheeting in Fire

- Report 2010 ready
- Excel tool **draft** ready
- More research on connections in fire planned for 2011
 - self-drilling screws
 - shot nails



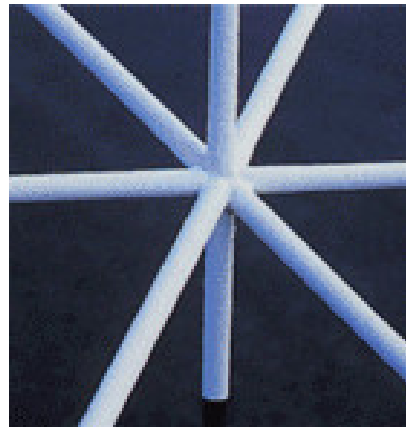
Fire resistance of corrugated steel sheet			Note
Parameters			
Profile	RAN	153	
Profile nominal thickness	t	1	mm
Fire resistance time	T	15	min
Span	L	6000	mm
Load in fire situation	q	1.50	kN/m ²
Connector type		Screw	
Diameter of connector	d	5.50	mm
End distance	e ₁	600.00	mm
Edge distance	e ₂	10.55	mm
Partial safety factor in fire	γ _{M,fi}	1.00	
Partial safety factor in fire-bearing	γ _{M,fi,b}	1.00	
Way to calculate temperature at connections at support	CTWay	F/V	
Input F/V	F/V	166.00	m ⁻¹ <small>Input value when using your own F/V</small>



Ruukki Fire Solutions

Fire retardant paints (Intumescent)

- Decorative finish under normal conditions
- Foam and swell in fire
- Produces an insulating char layer, about 60 times thicker than in normal temperature
- Applied by spray, brush or roller
- Both national and European product approvals in use
- Plenty of products available
- Most of the products are meant for in-house use

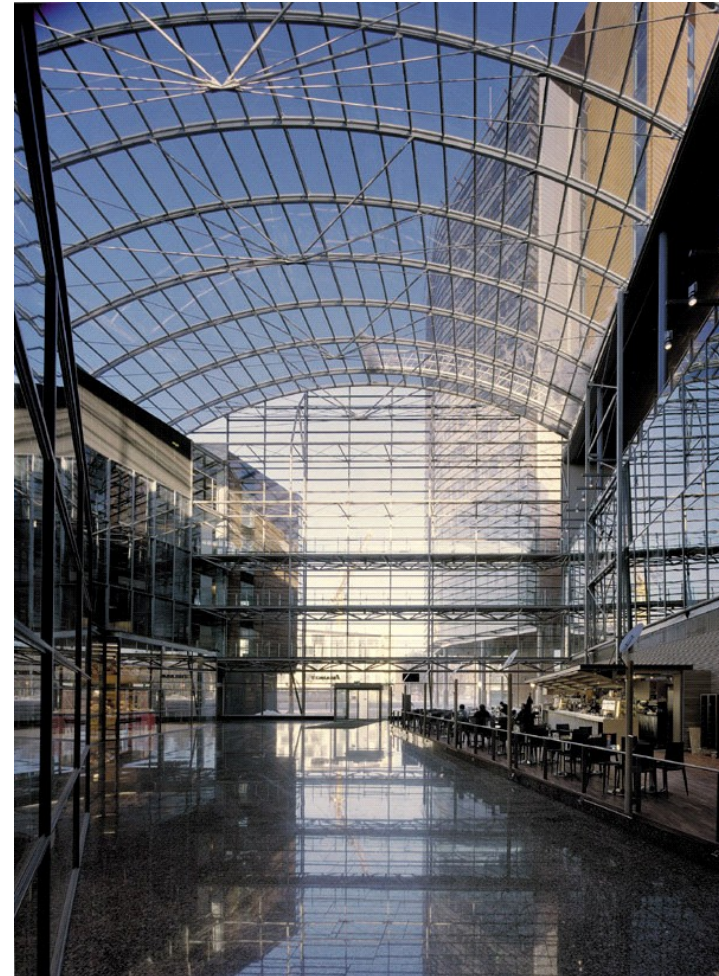


Ruukki Fire Solutions

Fire retardant paints (Intumescent)

Essential issues

- Professional painters and inspectors
- Accepted combination of primer, basecoat and topcoat
- Right atmosphere
- Accurate documentation of the work
- Instructions for maintenance



Ruukki Fire Solutions

Fire retardant paints (Intumescent)

- Commonly painted structures:
- Trusses,
- Beams, columns
- WQ-Beams, bottom flange -> R30-R120
- Can be done on or off-site
- Products for outdoors are studied
- [Finnish product approvals, FSCA \(TRY\)](#)
- [European approvals, EOTA](#)



Ruukki Fire Solutions

The Ruukki solutions will be published in Fire Design Guide 2011

The screenshot displays a PDF document. On the left is a table of contents with a blue background, listing chapters from 1 to 10. On the right is the cover of the 'RUUKKI Fire design guide 2011', which features a photograph of a modern building's interior with a complex steel truss roof structure. At the bottom of the cover is a contact information table.

Meikkaus Oy	Suomenkatu 11 P.O. Box 126	Tel. +358 20 2611	Business ID 0110276-9
	F-00511 Helsinki	Fax +358 20 2623266	VAT no. FI 0110276-9
		www.ruukki.com	Registered Office Helsinki

Ruukki Fire Solutions

More information:

Jyri Outinen
R&D manager, fire engineering

Ruukki Construction
jyri.outinen@ruukki.com



Thanks!

NUUKIKI
more with metals