1.6 Recent projects in Finland

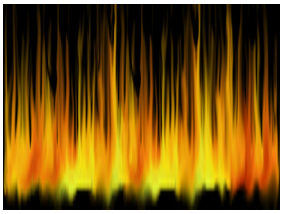
Heinisuo M., Outinen J. (WG3), Finland

Recent projects in Finland
COST – IFER

Integrated Fire Engineering and Response

Barcelona Workshop 5.-6.7.2010

Dr. Jyri Outinen, Rautaruukki Ltd.,
Prof. Markku Heinisuo, TUT



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1

Recent projects in Finland
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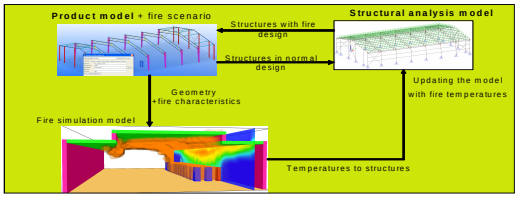
Natural fire design

- Instructions to authorities
- Gathering and publishing the needed fire loads and scenario database
- Software tools development ->to be continued..



2

Recent projects in Finland
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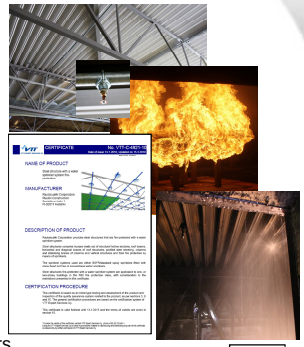
Fire protection with water suppression

- Finnish product approval, (Renewed 2010, also in english)
- Protection up to R60 1-2 storey buildings
- Covers trusses, bracing, columns, corrugated sheeting
- Cost-effective way of protection, especially in cases where the sprinklers are required by authorities or by customer
- Based on water cooling of the fire area and structures in fire situation
- Better safety to people and property
- Conventional, spray and ESFR sprinklers (ESFR = early suppression fast response)



Video

3

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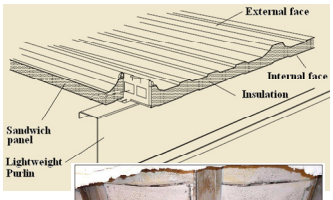
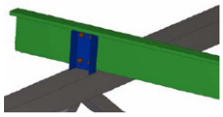
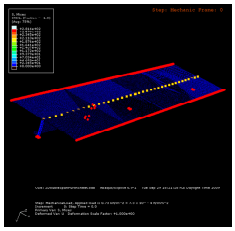
Structural Behavior of Purlin with Steel Sheeting on its Top in Fire







4

Performance based fire design in Finland

- Accepted method in Finnish regulations
- Used in large buildings, especially shopping centres
- Recently in a big sports/ wellness center in Helsinki
- Big differences in acceptance criteria along the country
- Normally 3rd party inspection required-> good!
- Only few experts that can handle both fire and structural design

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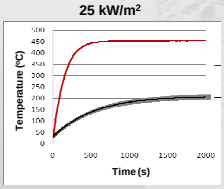
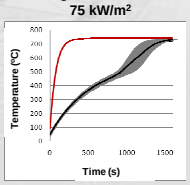
Effect of hot dip galvanizing to emissivity of steel plate at elevated temperatures

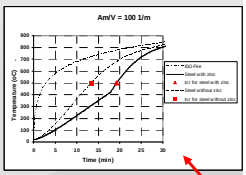
Financing: UCS (University Consortium of Seinäjoki, Finland)
Completed: 2009-2010, Researcher Hanna Jutila, Ms Sci thesis
Experimental research using cone calorimeter of Seinäjoki laboratory
Test specimen: 100x100x2 mm³ S235JRG2
Without zinc and with 65, 85 and 105 µm zinc coating
Heat flows: 25, 50 and 75 kW/m²

Results:
Red: without zinc, black with zinc including variations in tests

25 kW/m² 75 kW/m²







Main result: Zinc coating has LARGE effect for steel temperatures at the begining of fire
Emissivity before zinc melts (<420 °C): 0.2, after that 0.7 following EN 1993-1-2
Next step: Effect to resistance=? Preliminary: A_m/V = 100 1/m, T_{cr} = 500 °C => t_{cr} = 13.4 ->19.3 min

Cost action TU0904 IFER
Barcelona, 5-6 June 2010

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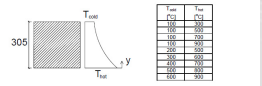
Shear resistance of metal plates at non-uniform elevated temperatures

Financing: Rautaruukki Oyj and Tampere University of Technology
Completed: 2009-2011, Researcher Mikko Salminen
Problem: How to apply EN standards for non-uniform temperatures?

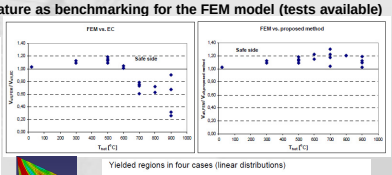
So far completed: Buckling resistance for rectangular simply supported rectangle carbon steel, stainless and aluminium plates
Solution: Reduction method of elastic modulus at non-uniform temperatures
Details: Licenciate thesis of Mikko Salminen and related papers
Next step: Ultimate shear calculatrion under development (PhD thesis of Salminen)
Preliminary results: One square steel plate 305x305x1.5 mm³, ECCS TC8, Oslo 25.6.2010
Uniform temperature as benchmarking for the FEM model (tests available)

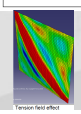
Calculations for 9 linear and 9 non-linear temperature distributions:

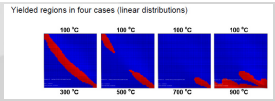
- Linear distributions: $T(y) = T_{cold} + (1 - \frac{y}{305mm})(T_{hot} - T_{cold})$
- Non-linear distributions: $T(y) = T_{cold} + (1 - \frac{y}{305mm})^3 (T_{hot} - T_{cold})$



T cold [°C]	T hot [°C]
100	200
100	500
100	700
100	900
200	500
300	600
400	700
500	800
600	900







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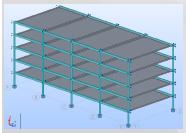
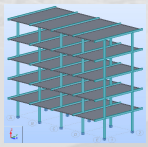
Metal joint behaviour in 3D in ambient and fire conditions

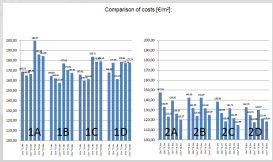
Financing: Regional Council of South Ostrobothnia,communs and companies from Seinäjoki region
Completed: 2008-2011, Researchers Henri Perttola (ambient), Hilkka Ronni (fire)
Problem: Verification of 3D component method (rake model)
Methods: Tests and comprehensive FEM models (Details: see Poster)

Optimization of office frames in ambient and fire conditions

Financing: City of Hämeenlinna, University of Applied Sciences Hämeenlinna, Rautaruukki Oyj
Completed: 2009-2011, Researcher Karol Bzdawka
Problem: Find optimum for 3D frames including steel foundations
Frames: Composite columns (steel tubes filled with concrete), slim floor beams
Design variables: Framing systems, column spacings, dimensions and materials of members
Constraints: Requirements of EN standards (mainly resistances)
Objectives: Costs of structures (frames, foundations, hollow core concrete slabs so far)
Optimisation: Particle swarm optimisation (PSO) algorithm







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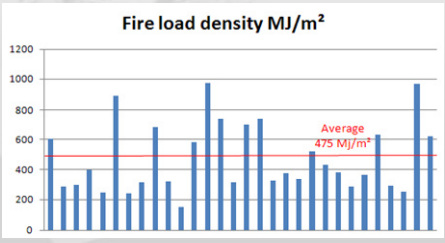
Investigation of fire loads

Partners of cooperation

- Seinäjoki University of Applied Sciences (project cordinator)
- Tampere University of Technology
- VTT Technical Research Centre

So far completed

- The investigation covered 30 shops . Shopping spaces and storage spaces were investigated separately
- Fire loads investigated using following distribution of materials: wood, paper, plastic, textile and miscellaneous.
- At this moment there is going also other investigations of fire loads, among others in housing
- Fire load density of shopping spaces:



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