

# WG3 - Robustness of systems

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# WG3 – MoU: planned activities

Activities planned in WG3:

- Characterisation of multi-scale variability in timber structures.
- Analysis of system effects for several types of timber structures.
- Qualification of robustness as a characteristic of timber structures.
- Establishing
  - Framework for reliability based design and assessment of timber structural systems based on these considerations.
  - Guideline on ‘Recommendations for practical design for robustness of timber structures’

# WG3 – focus points

## 1. Reliability of timber systems:

- Roof trusses / Roof elements / Glued laminated beams / solid timber structures / ...
- Spatial dependence for material strength parameters / 'foreseen' loads / 'unforeseen' incidents & human errors
- Reliability of systems / risk assessment

# WG3 – focus points

## 2. Robustness of timber structures:

- Characterisation of timber structures with respect to robustness
- Reliability / risk based requirements related to consequences of direct failure consequences and follow-up consequences
- Consensus on the characteristics of timber systems regarding redundancy and robustness
- Development of simplified approaches for assessment of robustness, suitable for day-to-day engineering purposes – how to increase robustness of timber structures?

# WG3 working items

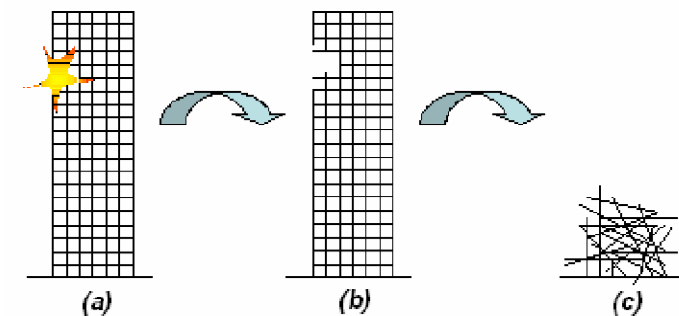
- Review collapses with respect to robustness
  - Ballerup arena
  - Bad Reichenhall Ice-arena
  - German and Scandinavian investigations of structural failures – WG1 link
- Benchmark examples
  - Norwegian sports hall
  - Austrian bridge
  - Traditional Portuguese truss
  - Solid timber building
  - 300 years old church in Krauchtal, Switzerland
- Papers: conferences and journals + reports
- Guideline: Recommendations for practical design for robustness of timber structures'
- JCSS PMC: update of Timber Probabilistic Model Code
  - System aspects
  - Robustness

# Robustness aspects

- Exposures:
  - ‘Normal’ loads
  - Errors in design, execution and operation
  - Unforeseeable incidents
- covered by:
  - partial safety factors etc.
  - quality control? / Robustness?
  - robustness

Correlated / uncorrelated for different elements?

- Redundancy (series / parallel system): good or bad?
- Ductility always good?
- Conventional / unconventional structure
- Consequence of failure
- Seismic areas – earthquake design requirements



# WG3 – Trondheim March 2009

## Presentations:

- Philipp Dietsch: Secondary Structures - Purlins - Robustness Considerations
- Jørgen Munch-Andersen: Robustness versus Human Errors
- Jørgen Munch-Andersen: Robustness of column – slab system
  
- Jorge & Luis: Potugese timber structures – robustness issues
- Jelena Srpacic: Damage on timber roof structures caused by storms in January 2008
  
- Poul Henning Kirkegaard: Robustness Assessment of Timber Structures with Ductile Behaviour
- Dean Cizmar: Robustness of timber structures – case study: Norwign sports hall

# WG3 – Trondheim March 2009

## Documents:

- Philipp Dietsch: The Bad Reichenhall Ice-Arena Collapse
- Philipp Dietsch: Secondary Structures - Purlins - Robustness Considerations
- Jørgen Munch-Andersen: Robustness versus Human Errors
- Jørgen Munch-Andersen: The Siemens Arena collapse in a robustness perspective
- Dean Cizmar: : Robustness of timber structures – case study: Norwign sports hall
- Guideline for Design for Robustness of Timber Structures
  - Jorge Branco: Current requirements in buildings regulations and codes - EN 1998-1
  - Luis Neves: Current requirements in buildings regulations and codes – ASCE 7-05



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# WG3

- Continue Benchmark examples
  - Norwegian sports hall DC and PHK
  - Austrian bridge PHK & Portuguese group
  - Traditional Portuguese truss Portuguese group
  - Solid timber building PHK
  - 300 years old church in Krauchtal DC
  
- Guideline: Recommendations for practical design for robustness of timber structures
  - Task group meeting before Ljubljana meeting
  - Updated drafts of selected chapters: end of August 2009
  - Next meeting:
    - Discuss draft chapters
    - Distribute tasks to update chapters and write new final draft chapters
    - Updating of JCSS PMC
  
- Conference papers