

## WG1 meeting

**Copenhagen, October 4-5, 2010**

Attendance: Marco Haberland, Krzysztof Cichocki, Dean Cizmar, Silvia Rominu, Goran Turk, Enrico Rizzuto, Rina Farhat, John Sorensen, Michael Faber, Alexander Taushanov, Radu Bancila

### 1) Minutes from the meeting of WG1 in Brussels

Glossary was discussed (the leader of the Glossary preparation is Enrico Rizzuto). There were a number of comments and questions. The terms and explanations should be coherent within the WG1 and between WG's.

- a) The most important issue is the definition of robustness. Is it the property of the structure only, structure and exposure, or structure, exposure and consequences?
- b) Presentation of Marco Haberland about Recommendation for Designing Collapse-Resistant Structures, Disproportional Collapse (task group of Structural Engineering Institute of the ASCE). The list of main terms: disproportional and/or progressive collapse (there should be two distinct definitions); abnormal event; initial damage; collapse resistance is the combination of vulnerability and robustness; hazard scenarios; performance objectives; direct and indirect design methods; (for details see Marco Haberland's presentation). The definition of robustness is different than the definition of WG1 (COST TU0601) (conditional robustness vs. robustness).
- c) Enrico Rizzuto: There was a discussion on what the performance objectives means. Is "acceptable extent of collapse" performance objective? The term "objective" is very general, perhaps too general for the specific use.
- d) Enrico Rizzuto will prepare the new version of the glossary, following the presentation of Marco Haberland but using the concepts that were agreed upon before in TU 0601.

### 2) Discussion of the document: 'Theoretical framework on structural robustness' Status and what is missing:

Basic fact sheets:

- Glossary (Enrico Rizzuto prepared by October 23).
  - Element (component) of a structural system
  - structural system (passive system)
  - system
  - environment of a system (surroundings, neighborhood...)
  - scenario
  - performance
  - assessment of a system
  - categories of scenarios
  - design scenarios (on intact structures, damage design scenario...)
  - exposure – deviation from the normal state (physical, accidental load, abnormal resistance, construction errors, design error...)
  - magnitude of the exposure
  - damage
  - failure
  - consequences (tangible assets, intangibles)

- consequences (persons, nature, ...)
- consequences (systematic, occasional, rare)
- consequences (direct, indirect, ... local damage)
- vulnerability
- damage tolerance (system probability of failure conditioned to damage)
- robustness (general definition), combination of vulnerability and damage tolerance
- robustness (quantitative – robustness index is indicator of robustness), several definitions are possible.
- risk (direct, indirect)

- Robustness - Theoretical framework

The framework will consist of risk analysis of the structures and definition of robustness based on risk analysis, the following subsections will include other approaches (probabilistic, deterministic) which can be considered as simplification of the complete risk analysis.

Question: Is the robustness a property of the structure? It seems that robustness is not solely a property of the structure. All possible loadings and other events such as human errors should be included.

(John Sorensen will rearrange the text by the end of October.)

- 'Reliability of systems - the robustness' (Goran Turk and Dean Cizmar will prepare the proposal by the end of October), related to the work of COST E55
- Robustness - Acceptance criteria (Krzysztof Cichocki will prepare this section by November 8)
  - Based on LQA
  - Based on cost benefit analysis

3) Proposal for papers (special issue):

Theoretical framework for the robustness of structures

Reliability approaches for the quantification of robustness of structures

4) **Summer school**, three lectures (two hours) are expected (2<sup>nd</sup> day of the summer school)

Theoretical framework for the robustness

- Probability and risk
- Probabilistic Modeling in Engineering and Risk Assessment of Systems
- Structural robustness assessment

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