VALIDATION AND VERIFICATION IN FIRE DESIGN OF STRUCTURES A VALUABLE COST NETWORK OUTCOME

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Abstract

Participants of European COST Action TU0904 Integrated Fire Engineering and Response prepared for validation and verification Benchmark studies based on their national projects. They are intended to help European researchers, educators and design engineers with their application of advanced numerical modelling for fire engineering. To complement the textual presentation of the examples the input and output data are included in MS Excel tables so that the studies can be reproduced in detail by the users of the volume. These can be downloaded from the web page fire.fsv.cvut.cz/ifer/benchmark.

Keywords: fire design, advanced model, validation and verification, COST action

1 VALIDATION AND VERIFICATION

The process of verification and validation of engineering models and their results has been an integral part of advanced structural design practice and research for some years. Both of these are supported by information technologies at all levels, from conceptual design, pre-design, calculations, drawings, fabrication and on the construction site – as well as integration with building services and architectural finishes through Building Information Modelling (BIM) systems. The transfer of data on all of these aspects of planned and existing structures is the domain of object-orientated databases, which can used during the life of the structure for refurbishment, and will in future also be used for demolition. For the purposes of fire safety and structural fire engineering design both purpose-designed and general software tools are used. Reliable means of verification of numerical models, both simple and advanced, is an essential part of the analytical design process. For advanced design using commercial software a range of worked examples (benchmark studies) are necessary to check that a software tool is being applied correctly to particular problems, including validation examples to check the physical correctness of results. In the structural Eurocodes for fire engineering design are prepared general principles for the application of advanced models in standard EN1991-1-2. In COST Action TU0904 Integrated Fire Engineering and Response in 2010 - 2014 were prepared materials for validation and verification in two volumes; 'Experimental validation of numerical models in fire engineering' and 'Verification of numerical models in fire engineering'. For verification are prepared the Benchmark studies for fundamental as well as for more complex cases. For concrete structures are developed studies for the side-plated RC beam, slab floor system and buckling of column .Studies for steel structures are prepared for beams including local and lateral-torsional buckling, for steel columns is covered also temperature gradient, different finite element types, constitutive laws and questions of creep, joint modelling, cold-formed steel portal frames and for the frame structural behaviour. Steel and composite structures are represented by simplified and advanced calculation methods for composite beams, columns and floors. A benchmark for modelling of charring of timber is prepared for timber structures. The physical correctness of models is demonstrated in the second volume, where the models are validated on tests.

2 DELIVERABLES OF ACTION

The COST Action TU0904 Integrated Fire Engineering and Response was prepared for researchers in structural fire engineering. Its first deliverable, the State of the Art Report attempted to bring together the current state of research, mainly in the participating countries but set into the context of knowledge world-wide. The second deliverable, emanating from the Action Conference in Prague in 29 April 2011, allowed all experts in the Action, as well as international researchers in general, to present current research findings in two Conference Proceedings. The third deliverable, a compilation of Case Studies presented current advanced design practice and accumulated knowledge in fire engineering. These included, within the fire engineering applications presented, explanations of the decision processes, the scientific assumptions and the practical constraints, as well as integration of the different aspects of fire engineering. The fourth deliverable, on Fire Brigade Reports and Investigations, consists of a set of contributions from members of the Action relating to: the organisation of national fire and rescue provision in different EU countries; available statistical data; recommendations for questions to be included in standardised fire fighters' reports in order to improve the comparability of national statistics; and lessons to be learned from specific disasters.

After publishing the support of advanced model in Benchmark studies, were summarised the knowledge in national projects to support the new face of European structural standards in area of design against fire. The material Fire Eurocodes - The Future? is divided into three parts. First is summarised the current European design practice in the member countries with respect to fire safety in buildings. In second part are prepared the requirements for the contents of documentation on fire safety design, allowing to merge nationally managed issues concerning safety and common procedure for its securing in European structural standards**.** The third part of this volume summarises a collection of knowledge developed in recent European and national research projects, which suggests that amendments should be made to the 'fire' parts of the Eurocodes. The work is categorised in terms of existing and expected standards, and is intended both to inform the direct development of the Eurocodes, but also to aid the production of Technical Documents which will accompany the next generation of Eurocodes.

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