

COST Action TU904

“Integrated Fire Engineering and Response”

This is a network which brings together representatives drawn from the various research disciplines of fire engineering, fire safety, structural design, building control and fire services in various countries, on the general theme of performance-based integrated fire engineering and response.

In the European Union issues of safety are generally subject to national jurisdiction, and controls on fire safety in the built environment are exercised either by local or national agencies. Fire engineering researchers tend to specialise in areas such as fire dynamics, structural fire engineering, active/passive fire protection, environmental protection or human response. Since the background sciences of these disciplines are different there is little interaction between them. Practitioners, including fire engineers and building/fire control authorities, tend to consider fire safety as a whole, but lack in-depth awareness of recent advances in research and are outside the academic research networks.

Through encouraging integration of different aspects of fire engineering and response, this network will enable researchers across these fields in different countries to understand better advances in parallel fields, so that they can see their own research in context. The non-research community will benefit from exposure to advanced research findings, discussion with researchers, and the sharing of best practice. Their input will make researchers aware of real-world constraints, and where new research and standards are needed.

Background

Over 20 years there has been a rapid growth of research in fire engineering. Because of the lack of connection between research and practice, and between different groups of researchers, a network of researchers, designers and authorities has been needed. The barriers which exist between researchers from different disciplines (such as fire science and thermo-structural modelling) need to be broken down. In countries of the EU where fire-related research is in a low state of development there is a clear requirement to spread a general awareness of the current state of research. It is also desirable that the new knowledge should not be confined to academia, but should extend to its natural end-users. It is necessary for practitioners to convey their perspectives and needs to researchers, and to point out opportunities where gaps in existing knowledge and ongoing research exist.

TU904 is mainly aimed both at European economic/societal needs as well as scientific/technological advances which, by their nature, affect the whole of society. It aims to propagate the principles of modern performance-based methods for existing and new buildings, for composite building technology and for change of use of buildings. Another objective is to encourage integration of active and passive fire protection systems, new materials and environmental protection. A desirable result would be an increase in the basic fire safety of buildings and of fire fighters during fire events.

Objectives

The overriding mission of the Action is to gather, review and exchange information on solutions for fire safety of civil structures, and to develop benchmark studies to verify potential solutions. It will expose these methods in the public domain through technical papers, datasheets, reports and an accessible web site. It aims to exchange international experience, ideas and the state of the art on fire risk concepts, assessment methods, and their applications to fire design practice. Fire safety design practice is rapidly shifting from compliance with conventional prescriptive codes to using performance-based design methods. Performance-based methods, and to a lesser extent codes, have been developed in several countries. However there is an ever-present concern about whether fire risk aspects have been adequately considered in their development, although they all implicitly recognise that sound fire safety design should be based on risk analysis. TU904 will consider the background to simplified rules, as well as advanced fire modelling, heating of the structure, development of temperature profiles and structural behaviour in fire. Leading-edge research findings will be shared across the EU, and this will raise awareness among academics and designers. These developments will be explained to national fire brigades and control authorities, and the perspectives of these key stakeholders will be sought.

The primary objectives are:

- Acquisition of relevant scientific knowledge by the academic institutions of the countries involved. This can be transferred to new generations of engineering students.

- Upgrading the expertise of construction professionals by disseminating performance-based approaches.
- Discussing the different perspectives of fire-fighters, fire authorities, designers and researchers.
- Enhancing researchers' awareness and understanding of real life constraints to their research.
- Propagating the principles of modern performance-based design methods and current research to building control authorities.
- Identification of topics which need further research and/or development as design procedures.
- Recommendations for improving national codes from the perspective of fire safety.

Main Tasks

The scientific work plan is based on a series of Work Packages:

- WP1. State-of-the-art report to summarise of the current level of knowledge will be the initial task, to be finalised at a workshop, held after the first year.
- WP2. Case studies presenting current practice and accumulated knowledge. These will be prepared and disseminated during the second year. They will cover fire engineering applications: clear explanations of decision processes, scientific assumptions, practical constraints, and how different aspects of fire engineering are integrated.
- WP3. Fire brigade reports and investigations are one of the most important sources of information, but are at present largely unavailable to researchers. The aim of this work package is to establish how useful information from fire brigade reports and investigations in the member states can be extracted and utilised.
- WP4. Benchmark studies will enable validation of different solutions, and establish appropriate levels of investigation. The quality of the benchmark studies is expected to be checked by invited international experts.
- WP5. Short-term scientific missions: Sharing of knowledge will be promoted by creating short-term scientific missions, which will allow young researchers to spend short periods with leading research groups at partner institutions.
- WP6. Dissemination: Local Seminars will be held in the member states. A project web site will make all materials freely available, with facilities for feedback, amendment and a discussion forum. This will ensure that knowledge is shared as widely as possible. A conference at the end of the Action will summarise all aspects of the work and consider future needs.

Working Groups

Three Working Groups will consider different themes, which constitute different levels on which the issues arising from fire can logically be considered.

WG1. Fire Behaviour and Life Safety will focus on the behaviour and the effects of building fires, and will combine this research-based knowledge with the most effective means of protecting human life against the occurrence of fire in the built environment. The latter combines active measures in fire-fighting with the effects of building form on the inherent risk to inhabitants.

In the context of fire-fighting and rescue the following issues are important:

- The effectiveness of communication between first-responders and their managers,
- The organization of rescue operations,
- Virtual training for rescue operations,
- How to facilitate a rescue operation,
- How rescue operations function, considering human behaviour as victims and responders,
- How structural stability may be assessed to adapt the fire fighting strategy.

Rescue operations are most affected by the behaviour and movement of the fire itself, together with movement of the smoke, which is generally the most important threat to the lives of building inhabitants.

Computational fluid dynamics is increasingly able to predict smoke movements in buildings, although the spread of fire itself from compartment to compartment still presents a considerable challenge, given the uncertainties about local failure of internal walls, windows and the effects of atria in buildings. There is still a very significant role for simplified fire and smoke modelling, and a considerable task in interfacing between the rather complex discipline of fire science and the practical interests of the fire brigades and building control authorities. This in turn needs to be reflected in building design, and so the opportunity for practitioners to enter into a debate with the researchers will be very valuable.

WG2. Structural safety will cover passive protection measures and the recent developments of structural fire engineering, and also new materials and technologies. Crucial problems of structural fire engineering concern changes in the use of the buildings and the current questions arising from energy saving and protection of the environment after fire.

WG3. Integrated Design brings together design and research across the disciplines of fire in the built environment. In structural design this includes integration of fire resistance with all the other functional requirements of a building, from conceptual design onwards, rather than the conventional process of adding fire protection after all other processes are complete. The issue of sustainability in all aspects of design has become a front-line criterion in recent years, and this will affect fire resistance design in the same way that it has affected ultimate and serviceability design. A further aspect of integration is the recognition that fires are often the most devastating consequence of earthquake and terrorist attacks. In these contexts the outbreak of fire can trigger disproportionate collapse, as in the “9/11” events, or can cause widespread fires which cause considerable loss of life. It is necessary to design robustness into structures so that local damage is mitigated rather than amplified by the outbreak of fires.

Short-term scientific missions will be organised to involve young researchers in experimental and numerical work at hosting institutions. A training school will also be organised in order to offer them the experience of fire-fighting in the training facilities of a fire service of one of the participating countries, so that they have some first-hand experience of fire-fighting, and so that they can provide some feedback to fire authorities about more effective use of their training facilities. In the organisation of conferences the Management Committee will place an emphasis on supporting the participation of young researchers and PhD students, inviting poster presentations on work in progress and offering prizes for the best of these. In the aftermath of the conferences, proceedings will be published which will include reviewed contributions by young researchers and PhD students.

Timetable

The action will last until March 2014.

Year 1: WP1: State-of-the-Art Report.

Years 2-3: WP2: Case Studies presenting current practice and accumulated knowledge. These will be initiated, and dissemination will start, during the second year of the action.

WP3: Fire brigade reports and investigations.

Years 3-4: WP4: Benchmark Studies.

Years 1-4: WP5: Short Term Scientific Missions.

Years 2-4: WP6: Dissemination.

Keywords: Fire safety engineering, Fire authorities, Decision processes, New materials, Fire after earthquake or explosion.