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Proposer Details

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Scientific Content

Title

Integrated Fire Engineering and Response

Abstract:

Fire engineering researchers are specialists working in specific areas, such as fire dynamics, structural fire engineering, active/passive fire protection, environmental protection and human response. Since the background sciences of these disciplines are different there is little interaction between researchers. 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. The proposed Action will enable researchers in different specialisms and countries to understand better the recent advances in research in parallel fields, as well as their limitations, so that they see their own research in context and identify opportunities. Practitioners will benefit from exposure to research findings, discussion with the research community and the sharing of best practice. Their input will make researchers aware of real-world constraints, and requirements for new research.

Key Words:

Fire, Fire safety, Fire engineering, Fire authorities, Information technologies, Decision processes, Forensic investigation, Fire risk analysis, Building fires, Passive fire protection, Sprinkler protection, Intumescent coatings, New materials, Environmental protection, Mixed building technologies, High-rise buildings, Change of use of buildings, Fire after earthquake, Fire after blast.

Preferred COST Domain:

Transport and Urban Development

Text of proposal:

A. BACKGROUND

Construction technologies have a high impact on the global economy, environment and quality of life, because of the scale of projects and the demand for more efficient methods. The normal design criteria of civil engineering structures, such as strength, durability, reliability, sustainability are addressed in design codes. However, safety in use, environment, and quality of life are equally important. To meet all the requirements of buildings a multi-discipline approach to design. This proposal addresses the hazard to occupants, emergency services and property caused by building fires. While disastrous fires continue to occur, the need for fire safety based on understanding of the issues and interactions involved is recognized in the civil engineering community.

In the EU fire safety is a national responsibility, but is recognised as the main exceptional loading type in the Construction Products Directive (89/106/EEC). Research and development is dispersed between universities and test centres. The EU is fortunate in having the greatest concentration of World-leading research groups on fire safety, fire science and structural fire engineering. This is a vibrant research area in Europe, contrasting with isolated pockets in the USA, Canada, the Far East and Australasia. In the USA, where there was research up to the 1980s, activity is almost extinct; even after “9/11” little new research has started. The 8 proposers have recently hosted 25 projects on structural elements and connections, funded both nationally and by EU sources. RFCS has funded projects on industrial and low-rise buildings, realistic fire design, active safety measures, post-local failure simulation and external steel structures. RFCS, local and industrial funding have supported major fire projects on connection behaviour and robustness, composite construction systems, material properties and innovative structural systems. The completed COST Actions C17, C19 and C22 have shared knowledge of management of various extreme events. Action TU0601 provides advanced models for extreme loading. The current Action C26 has created a network on major events including fire, explosion, earthquake and other extreme loadings.

Research on structural fire engineering has accelerated for 10 years; an important stimulus was the programme of fire tests at BRE Cardington (1982-2003) of which the last were the full-scale test series in the mid-1990s, part-funded by ECSC 7210, and the 2003 test funded by CV5535. The events of “9/11” raised significant questions on fire spread, interaction with emergency services, and response of buildings. Robustness (avoidance of disproportionate collapse) is particularly important for structural protection and life safety.

Because of the rapidly growing research in this field a network of researchers, designers and authorities is needed so that the new knowledge is not confined to academia, but extends to its natural end-users. It is necessary for practitioners to feed their perspectives and needs to researchers. In countries where fire-related research is in a low state of development there is a need to spread the research effort and to point out opportunities where gaps in existing knowledge and ongoing research exist.

General agreement on the requirements for fire safety and improvement of standards for fire-resistant design would be welcomed by industry, stimulate research and facilitate marketing. The common design rules embodied in the Eurocodes should encourage a market extending beyond the borders of the EU. Several Asian and Latin American countries are using the Eurocodes, either generically or as a basis for domestic standards, with obvious potential for EU firms. This Action will facilitate cooperation between the authorities of EU countries, as well as between researchers in fire topics. It will help to introduce the latest research into

standards.

B. BENEFITS

The proposed Action, gathering experts from several disciplines, will improve the uptake of non-traditional materials and methods for fire safety of structures. It should increase the potential for use of recycled materials, improved energy-saving and environmental protection. The presence of fire engineering practitioners among specialist researchers will foster better understanding of how research and practice interact. A key aspect is that it allows designers and researchers to consider the viewpoint of fire fighters. It will create a platform for extensive discussions of key issues by some of the most influential World researchers on fire-related topics. By introducing the latest research findings into EU practice it will be possible to explore new methods of fire protection, new materials and energy-saving technologies.

C. OBJECTIVES, DELIVERABLES AND EXPECTED SCIENTIFIC IMPACT

The main aim is to gather, review and exchange information on new 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.

The Action will consider the background to simplified rules as well as advanced fire modelling, transfer of heat to the structure, development of temperature profiles and structural behaviour in fire. The results of front-line research 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 are sought.

Explicit objectives are:

1. Acquisition of relevant scientific knowledge by the academic institutions of the countries involved. This can be transferred to new generations of engineering students.
2. Upgrading the expertise of construction professionals by disseminating performance-based approaches.
3. Discussion of the different perspectives of fire authorities, designers and researchers.
4. Propagating the principles of modern performance-based methods and current research to building control authorities.
5. Identification of topics which need further research and/or development as design procedures.

While the direct participants in research, university education, design, building control and fire-fighting are the immediate beneficiaries, society as a whole will ultimately benefit, gaining more efficient and safer buildings. The fire-safety of buildings, occupants and fire-fighters will increasingly be established on the basis of validated performance-based models rather than the prescriptive methods currently used.

D. SCIENTIFIC PROGRAMME AND INNOVATION

This is an open and flexible network whose main task concerns dissemination of very recent research knowledge and to propagate it in building design and control. It is expected that there will be participation from about 20 EU countries. The interest of control authorities in the application of research knowledge is demonstrated by their participation among the proposing institutions. A key objective is to promote the use of performance-based rather than prescriptive methods.

The proposed Action will address the most actual problems of structural fire engineering design: the need for robustness, high-rise buildings, new construction materials, composite building types, fires following earthquake or explosions, protection of the environment and change of use of buildings. It is intended to

minimize risk as a result of fires by encouraging the application of new knowledge and technology in methods for fire protection, and to promote the use of performance-based design across the EU. Another area where network can help society is in informing fire-fighters' decision-making and in post-fire investigation.

E. ORGANISATION

A COST framework is the natural means of achieving the objectives, bringing together scientific knowledge, design, building control and field experience from different EU countries for the benefit of fire engineering design in the EU in general. COST coordination is important; research tasks will continue in separate countries with their own funding. Three Working Groups are anticipated:

WG1: Life Safety,

WG2: Structural Safety,

WG3: Integrated Design.

These constitute three different levels on which the issues arising from the fire hazard can logically be considered. While the Working Group activities are concurrent throughout the life of the project, they will contribute to Work Packages whose activities are mainly sequential:

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 of the action. They will cover fire engineering applications: clear explanations of decision processes, scientific assumptions, practical constraints, how different aspects of fire engineering are integrated.

WP3 Benchmark Studies will enable validation of different solutions, and establish appropriate levels of investigation. Sharing of the most appropriate 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 organisations. The quality of the Benchmark Studies is expected to be checked by invited international experts.

WP4 Dissemination will be by three main methods: Local Seminars will be held. A complete Web Site, based on a content management system, will make all materials freely available, with facilities for feedback, amendment and a discussion forum. This will ensure that the products are shared as widely as possible. A Conference at the end of the Action will summarise all aspects of the work and consider future needs.

Participants interested in network:

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2-. Jyri OUTINEN, VTT, FI
3-. Peter SCHAUMANN, Leibniz Universität Hannover, DE
4-. Milan VEJLKOVIC, Luleå University of Technology, SE
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6-. Meri CVETKOVSKA, Ss Cyril & Methodius University, MK
7-. Paulo VILA REAL, Universidade de Aveiro, PT
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10-. Steve BECKLEY, Chief Fire Officers Association and Greater Manchester fire and Rescue Service, UK