European Cooperation in the field of Scientific and Technical Research - COST -

Secretariat

Brussels, 5 December 2006

COST 324/06

MEMORANDUM OF UNDERSTANDING

Subject :	Memorandum of Understanding (MoU) for the implementation of a European Concerted Research Action designated as COST Action TU0601: Robustness of Structures

Delegations will find attached the Memorandum of Understanding for COST Action TU0601 as approved by the COST Committee of Senior Officials (CSO) at its 166th meeting on 20/21 November 2006.

MEMORANDUM OF UNDERSTANDING
FOR THE IMPLEMENTATION OF A EUROPEAN CONCERTED RESEARCH ACTION DESIGNATED AS

COST ACTION TU0601

Robustness of Structures

The Signatories to this 'Memorandum of Understanding', declaring their common intention to participate in the concerted Action referred to above and described in the 'Technical Annex to the Memorandum', have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 299/06 'Rules and Procedures for Implementing COST Actions', or in any new document amending or replacing it, the contents of which the Signatories are fully aware of.

2. The main objective of the Action is to provide the basic framework, methods and strategies necessary to ensure that the level of robustness of structural systems is adequate and sufficient in relation to their function and exposure over their life time and in balance with societal preferences in regard to safety of personnel and safeguarding of environment and economy.

3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at approximately 14 million EUR in 2006 prices.

4. The Memorandum of Understanding will take effect on being signed by at least five Signatories.

5. The Memorandum of Understanding will remain in force for a period of 4 years, calculated from the date of the first meeting of the Management Committee, unless the duration of the Action is modified according to the provisions of the document referred to in Point 1 above.

COST ACTION TU0601

Robustness of Structures

A. ABSTRACT AND KEYWORDS

Robustness of structures first received significant attention 40 years ago following the partial collapse of Ronan Point, and recent terrorist attacks have resulted in renewed international resources being devoted to the topic. Despite its importance, the engineering profession has yet to reach consensus on quantification of robustness for use in design codes and construction projects. The COST Action aims to develop a foundation for treatment of structural robustness in future structural design codes. Building on the expertise and experience of European experts and close coordination with the European and international engineering associations such as IABSE, ECCS, CIB, fib, Rilem, ISO and the Joint Committee on Structural Safety (JCSS), a new risk-based approach for assessing robustness will be developed and a model code will be produced to guide improvements in future Eurocode revisions. This will greatly improve the efficiency of structural design, ensure the rational treatment of structural safety, safeguard the qualities of the environment, protect societal functionality and economical assets and is expected to increase the international competitiveness of the European building and construction sectors.

Keywords: Robustness, structures, design codes, risk, safety.

B. BACKGROUND

The awareness of the significance of the robustness of structures was intensified some 40 years ago following the partial collapse of the Ronan Point. As a consequence a significant amount of research has been invested into the various aspects of robustness and has resulted in a number of useful recommendations on how to achieve robust structures. During the last 10 years structural robustness has gained an even greater significance due to the apparent increase of malevolence and terrorism in an ever increasing complexity of the societal infrastructure.

Despite many significant theoretical, methodical and technological advances over the recent years, structural robustness is still an issue of controversy and poses difficulties in regard to interpretation as well as regulation. Typically, modern structural design codes require that the consequences of damages to structures should not be disproportional to the causes of the damages. However, despite the importance of robustness for structural design such requirements are still not substantiated in more detail, nor has the engineering profession been able to agree on an interpretation of robustness which facilitates its quantification. The recent events of terrorism have emphasized the urgent need for rational approaches to ensure that risks to people, environment, assets and functionality of the societal infrastructure and the built environment are acceptable and societal affordable.

On an international scale the research on structural robustness and developments of methodologies to ensure an appropriate level of structural robustness in building structures and societal infrastructure in general has so far been dominated by North America and Europe. The most promising contributions to this research field have roots in the theory of structural reliability and in this respect the contributions from the Joint Committee on Structural Safety (JCSS) are worth mentioning.

The JCSS is a committee founded some 35 years ago by a group of professional associations related to structural engineering, (International Association of Bridge and Structural Engineers (IABSE), federation internationale du beton (fib), Comité Euro-International du Béton (CEB), Consuil Internationale de Batiment (CIB), Reunion Internationale des Laboratories D'essais et de Recherches sur les Materiaux et les Constructions (Rilem) and The European Convention for Constructional Steelwork (ECCS)), with the purpose to develop a sound and reliability based foundation for codification of design of structures. The present generation of structural Eurocodes is to a high degree based on the fundamental works performed within the JCSS. The members of the JCSS constitute a significant number of the most internationally recognized researchers in the field of structural reliability including scientists from Europe, North America, Japan, China and Australia. Besides the JCSS also the Building Research Establishment (BRE) has been a driving force in research as well as in the development of recommendations and guidelines to ensure structural robustness.

In North America significant research into robustness of structures has taken place in parallel with developments in Europe and until recently the progress achieved there can be considered at the same level as the level achieved in Europe. Due to the recent events of terrorism attacks such as the Oklahoma City bombing and the World Trade Center attacks, the research in North America has been strengthened in terms of economical support and correspondingly accelerated. The National Institute of Standards and Technology (NIST) was given the assignment of the detailed investigation of the collapse of the World Trade Center and subsequently to propose improvements of national standards and regulations for the design of building structures in the USA. Due to the international significance of the North American standards and regulations in general, the work presently being undertaken at NIST will have a large impact on an international scale for the building industry. It is thus important for Europe to be in a position to influence and direct such developments appropriately. This is only possible if the relevant European institutions and researchers join forces and proactively influence pre-codification work at a fundamental level.

Over the recent 12-18 months a number of relevant initiatives have been taken for the present Action. First of all the JCSS in collaboration with the IABSE arranged a workshop at the Building Research Establishment (BRE) in London, UK, in December 2005. The conclusions from this workshop with more than 50 experts representing research institutions, companies and government representatives from most of the world are provided in summary in the Annex. However, the general consensus of this workshop was that robustness is not only of extreme importance but that the present situation with regard to ensuring sufficient structural robustness through codes and standards is highly unsatisfactorily. With regard to what is understood by structural robustness, again a general agreement could be observed amongst the participants. However, despite agreement on the attributes of structures which contribute to structural robustness no immediate agreement could be established on how to quantify this. Furthermore, and maybe even more importantly, there seems to be no suggestions at present on how to establish criteria on what might be understood as sufficient robustness.

What could be agreed upon at the workshop was, however, that a future framework for the quantification of structural robustness and for establishing acceptance criteria for structural robustness should be based on considerations of risk, such that the different decision alternatives with regard to improving structural robustness are assessed in terms of their implied risks and ranked accordingly.

As a follow-up activity on the workshop it was decided that a small special task force of professionals (6-8) was established to take a first step in establishing an improved basis for pre-codification work on structural robustness. This group, which contains members from mostly Europe, is presently coordinated by the Joint Committee on Structural Safety has been given the assignment to within less than two years from now to establish a first document (guidelines) on possible approaches for the quantification and implementation of structural robustness in design and assessment of structural systems. It is obvious that this group is only able to take a first step in the direction of developing frameworks on how to quantify structural robustness. Much more research and development efforts will be necessary before an improved basis for the codification of design and assessment of structures is established.

The present COST Action therefore brings together a group of European professionals with the mission to set up a sustainable basis for exchanging and promoting research in the area of structural robustness over a sufficient period of time and thereby to provide the basis for improved standards and regulations in design and assessment of structures in Europe. This group includes relevant persons and institutions in the areas of research, codification and standardisation within the European communities and, furthermore to ensure the largest possible impact of European research, also integrated members of the international scientific community in structural engineering and standardization. The group also includes practising engineers in order to be firmly anchored in the professional society.

The present COST Action builds upon the preliminary finding and recommendations of the special task force on structural robustness and provides a sustainable basis for the continued efforts of this group anchored in a larger, more representative and also more resourceful consortium of experts within the European Union.

The above mentioned activities, which are still ongoing, are not the only present or recent activities of relevance for the presently suggested Action. In the following a list of activities and projects is given which the present Action will make sure to build upon and coordinate with in striving to ensure synergy and consistency in European research efforts.

COST Action C26	Urban Habitat Constructions under Catastrophic Events.
COST Action E55	Modelling of the Performance of Timber Structures.
JCSS/IABSE WC1	Special Task Force on Structural Robustness.
UK Government	Terrorist attack on buildings – enhancement of robustness: Scoping Study.
UK Government:	Design and assessment of performance of concrete buildings in fire situations.
EU project:	Integrated advanced 3-D modelling of steel and composite structures subject to natural fires.
EU Project	Performance of steel-concrete composite buildings when subject to fire conditions subsequent to an earthquake.

Between the present COST Action and the presently already running activities under EU sponsorship, synergies are expected to be achieved from a strong coordination and exchange of results with the COST Action C26. It is important to note that the present COST Action and COST Action C26 are complimentary. Whereas the present COST Action will look at all main aspects required to assess robustness of structures, within a scenario based risk assessment framework, including the consequences of structural failure, the COST Action C26 focuses on the assessment of structural response subject to extreme load events. The C26 Action will thus be able to provide important input to the present COST Action. Furthermore, the present COST Action will be able to provide directions to COST Action C26 in regard to a scenario based modelling framework for representing exposures, vulnerability and robustness.

The participating researchers and institutes are all presently involved, several over many years, in various activities related to research on structural robustness, implementation of robustness requirements into codes and/or the use of these in practice. What is needed is a yet non-existing platform to accommodate a closer and targeted joint effort between the European experts in this field. The COST Action is believed to form a very adequate means of achieving such collaboration during as well as beyond the project period.

C. OBJECTIVES AND BENEFITS

C.1. Objectives

The main objective of the present COST Action is to provide the basic framework, methods and strategies necessary to ensure that the level of robustness of structural systems is adequate and sufficient in relation to their function and exposure over their life time and in balance with societal preferences in regard to safety of personnel and safeguarding of environment and economy.

In reaching the main objective of the present COST Action several sub-objectives are strived for. These include:

- Establishing a mid to long term platform of European professionals working in the area of structural robustness, risk assessment of infrastructures and buildings, engaged in or with stakes in pre-codification and codification of structural design, assessment, monitoring and condition control.
- To reach a consensus in the engineering profession and improving the state of the art on how robustness will be assessed, possibly quantified and improved for new and existing structures.
- Providing a pre-normative probabilistic model code on how to assess and ensure a sustainable degree of robustness of structures.
- Developing and distributing a guideline for practicing engineers on how to assess and enhance the robustness of structures from a holistic life-cycle perspective.
- Disseminate through conferences, workshops, publications and internet new knowledge on robustness of structures to the engineering profession in Europe as well as on an international scale.
- Conducting training for students, young researchers as well as already practicing engineers on the issues of robustness of structures.
- Improving the European impact on international codification on robustness of structures.

- Reducing risks in the built environment in Europe and thereby enhancing a competitive and sustainable development of Europe for the future.

The end users of the results of the COST Action will comprise European pre-codification and codification committees on structural design as well as all actors in the European building and construction industry including design, architectural and consulting companies as well as contractors and owners of structures at both a public and private level. The COST Action will enhance efficient and sustainable allocation of societal resources for structural reliability and therefore not only improve European competitiveness but also directly and indirectly benefit the individuals of the European society. Finally the present COST action provides results in terms of education and knowledge transfer to the practicing engineers, the research community as well as structural engineering students.

C.2. Benefits

Societal benefits on the European scale

Structural safety including the many important aspects of vulnerability and robustness is an issue of general importance for the individuals of society. When structures fail the consequences hereof may be very severe and associated with loss of lives, damages to the qualities of the environment and significant economical losses to society.

However, whereas it would be desirable to reduce risks due to various causes of structural failures to zero this is presently not achievable and also not a completely rational objective. First of all it is hardly practically achievable because there are still theoretical and technical problems to be solved in assessing and implementing structural safety, hereunder structural vulnerability and most importantly structural robustness. Secondly, to ensure structural safety it is necessary to have some idea about what the considered structures will be subjected to in terms of exposures over their lifetime; in hind cast it appears that reality has been very good in coming up with surprises in this regard not least considering the recent increase in malevolent activities in society. Thirdly, and probably more important, because risks can only be reduced at a cost, there is a limitation to what society can effectively afford to invest into structural safety as opposed to other life saving activities in society.

The present COST Action aims to develop the theoretical, methodical and technical foundation for enhancing the treatment of structural robustness in the structural design and assessment codes in the future. This will greatly improve the efficiency of structural design, ensure rational treatment of structural safety and increase international competitiveness of the European building and construction sectors.

Benefits for the structural engineering industry

The benefits for the actors in the structural engineering industry will be quite significant in the sense that the expected results of the present COST Action, hereunder the probabilistic model code for robustness assessment and the guideline for ensuring robust design of structures will provide significant support for an improved basis for design and assessment of structures in both a pre normative context and in the daily practice of engineers. This improved basis will enhance safe and efficient utilization of materials in the structures, improve competitiveness and facilitate the development of new designs and innovative combinations of materials. Finally the COST Action will provide a good basis for ensuring that the practicing structural engineers and the structural engineering research community speak the same language on the issues of structural robustness and that industrial needs and research directions are coordinated and planned for the highest possible benefit of the European community.

Benefits for the engineering research community

The research community of structural engineers will benefit significantly from the results of the present COST Action through the development of common perspectives and consensus on the difficult and controversial issues of structural robustness. The present COST Action will surely not be able to succeed in solving all problems related to the topic of robustness but the expected results will provide a substantial improvement and further help in focusing research and developments of the future in the directions of the greatest needs. It is also expected that the COST Action will attain the role of being a platform from which further joint European and international research projects will emerge.

Educational benefits

There will be several beneficial effects resulting from the present COST Action for the education of new and already practicing engineers. Following the intension of the COST Action programme in general it is anticipated that several short term research missions will be conducted throughout the duration of the present COST Action. This facilitates that young researchers within the European community will be able to acquire the available knowledge and experience from research groups and organisations participating in the COST Action. It is also anticipated that towards the end of the present COST Action a workshop in the form of a summer school will be conducted on robustness of engineering structures and students as well as young and experienced researchers will be invited to participate in the workshop.

D. SCIENTIFIC PROGRAMME

The innovative contribution of the present COST action lies in a new risk based perspective to the following problem complex:

- What is robustness of an engineered system; how is it defined?
- Which are the indicators of structural robustness?
- How may robustness be represented in engineering models?
- How may robustness be assessed or even quantified?
- How can robustness be ensured in the design of structures?
- How can robustness be improved in existing structures?
- How may robustness be controlled and maintained over the life cycle of structures?
- How to assess criteria for acceptable robustness?

Traditionally robustness is considered to be an inherent property of a structure defined through the design of the structure. However, the new risk based approach considers robustness from a life cycle perspective to be a product of design together with strategies for operation, maintenance and control as well as appropriate emergency response measures. Assessment of robustness necessitates the consideration of the possible scenarios leading to collapse, their probability of occurrence as well as the corresponding consequences.

This more differentiated and rich perspective of robustness not only allows for its assessment and in some cases its quantification but also for a categorization of structures such that codes and standards for a given type and use of a structure more adequately will:

- Provide guidelines with regard to how to improve robustness efficiently.
- Set minimum requirements to the acceptable robustness.

The fundamental idea followed in the present COST Action rests on recent developments in structural risk assessment which takes the perspective that the "system" subject to assessment will be represented in terms of the exposures acting on the structure, the damages which may result on the individual components of the structure as an immediate consequence of the exposures and finally the impact (consequences) of the damages on the overall structural systems integrity as well as consequences derived hereof. The principle is illustrated in Figure 1.

As indicated in Figure 1 exposures will be understood as any effect acting on the structure with the potential to imply damage to the constituents of the structure. In this way exposures include fires, explosions and impacts by vessels but also aggressive environments such as de-icing salt, water and carbon dioxide. The vulnerability of a structure is described through the degree the structural constituents (members) are damaged by the effects of the exposures. Structural damages may thus constitute loss of one or several structural members but also just through the reduced performance of individual members or joints. The structural robustness is understood as the ability of the structure to sustain the damages implied by the exposures without partial or fully developing collapse.

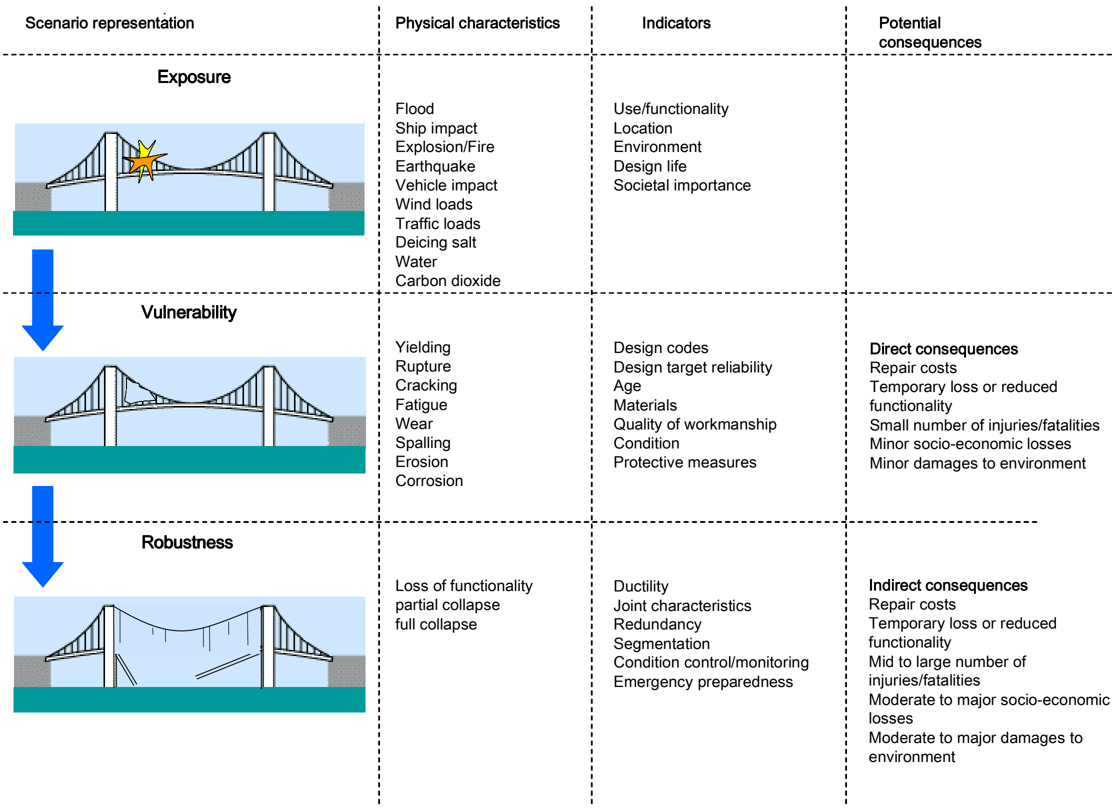

Figure 1: Illustration of system representation in the risk based approach to robustness assessment of structures.

Whereas structural design codes at the present time are focusing on ensuring structures with appropriate safety in regard to component failures and thereby are implicitly addressing mainly vulnerability aspects of the structural performance, the aim of the present COST Action is to establish a better understanding on the aspects related to the robustness, i.e. focussing on how structures may be designed, operated and maintained such that potential damages are sustained with an appropriately high level of safety.

Following Figure 1 structural robustness can be considered as being conditional on the prevailing exposures as well as the specific characteristics concerning the structural vulnerability. When assessing the robustness of a structure it is thus in principle necessary to consider all relevant exposure and immediate damage scenarios. However, the robustness characteristics of a structure for given types of exposures and damages will also be interesting in the context of codification of structural design and assessment and is therefore also to be considered in the present COST Action.
As structural robustness here is understood as the degree to which structural damages will be sustained by the structural system or other measures and thereby reduces additional consequences in terms of collapse. The present COST Action will also be concerned about the assessment of consequences of damages and collapse of structures.

The envisaged approach will to a high degree utilize the different indicators which may in some way be observed or assessed for a given class of structures or for a specific structure and which contain information in regard to exposures, vulnerability and robustness. The present COST Action will be organized into a number of activities as illustrated in Figure 2 where also the flow of the project and the interactions between the different activities have been indicated.

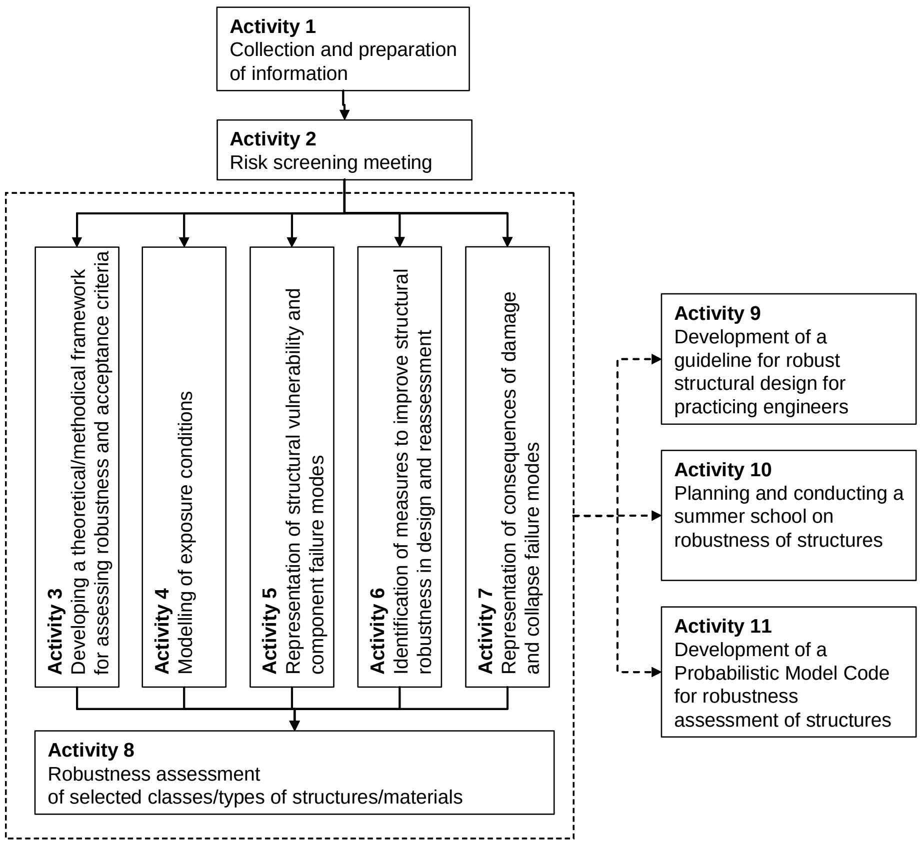

Figure 2: Illustration of interaction between the activities of the COST Action.

In the following the scientific contents of the individual activities are outlined in short:

Activity 1: Collection and preparation of information.

In this activity the individual partners prepare themselves for the participation in a first workshop which is conducted with the purpose of focussing the efforts of the present COST Action. The preparation will include collecting information (e.g. from studies of observed failures) and research results on the performance of structures of different types and materials under different exposure conditions and subject to different damage states.

Activity 2: Risk screening meeting.

This activity will form the first workshop in the COST Action and aims to focus the efforts of the work and research to be performed in the Action. The focusing will concern the choice of which types of structures, materials and exposure conditions will be considered in the Action. It is considered important that these issues are not predetermined and fixed in the MoU as it is important to involve and commit the participating experts in the action, to benefit from their experiences and also to accommodate for their needs in the COST Action. The risk screening workshop will also identify the relevant failure modes and indicators of robustness which are to be considered in the Action. Other important aspects to be decided during the workshop will concern the types of consequences to be included and which risk reducing measures should be considered as means of achieving a sufficient degree of robustness during all phases of the service life of structures.

Contacts will be made with the COST Action C26 in due time prior to this workshop and researchers from that Action will be invited to the workshop.

Activity 3: Development of theoretical/methodical framework for assessing robustness and acceptance criteria.

In this activity the main issue concerns the development of a theoretically sound basis for the assessment of robustness and acceptance criteria for structural robustness. These developments will facilitate the development of practice relevant methods for ensuring robust design as well as strategies for maintaining the robustness of existing structures throughout their service life.

Activity 4: Modelling of exposure conditions.

In this activity the issue of concern regards the engineering modelling of the exposures identified during the risk screening. The tasks to be performed include assessment and modelling of the probabilistic characteristics of exposure occurrences and intensities.

Activity 5: Representation of structural vulnerability and component failure modes.

In this activity structural vulnerability is considered with emphasis to the assessment and modelling of (component) damage scenarios resulting from the considered exposures. Based on the identified damage scenarios relevant failure modes are identified for further consideration in the robustness assessments.

Activity 6: Identification of measures to improve robustness in design and reassessment.

In this activity the emphasis is on the identification and modelling of relevant measures for the improvement of robustness for different categories of structural exposures and materials. This activity also considers the economical implications of implementing the identified measures.

Activity 7: Representation of the consequences of damage and collapse failure modes.

In this activity the consequences identified as being relevant during the risk screening will be assessed for the identified component and system collapse failure modes.

Activity 8: Robustness assessment of selected classes/types of structures/materials.

Taking basis in the results of the previously mentioned activities robustness assessments are performed for a selected number of principally different cases. The aim of this activity is to gain insights on the efficiency of different means of improving robustness and to form a basis for providing guidelines on improved robustness in engineering design, reassessment and life cycle condition control.

Activity 9: Development of a guideline for robust structural design for practicing engineers.

In this activity the insights and knowledge collected during the COST Action are collected in a guideline for robust design of structures. The guideline will be aimed at practicing engineers and will provide examples for selected situations of high practical relevance.

Activity 10: Planning and conducting a summer school on robustness of structures.

This activity forms an important part of the dissemination strategy for the present COST Action and is anticipated to comprise a one week course for students, researchers and practicing engineers.

Activity 11: Development of a Probabilistic Model Code on Design for Robustness.

In this activity the main aim is to establish a probabilistic model code on how to assess the robustness of structures being designed or reassessed. It is envisaged that the Probabilistic Model Code will be adapted as part of the JCSS Probabilistic Model Code towards the or immediately after the end of the Action.

E. ORGANISATION

The organisation of the COST action will follow the usual procedures in regard to management through the formation of a Management Committee (MC), a Steering Group (SG) and, for the present Action, three Working Groups (WG's) and one Task Group (TG). The COST Action will be led by the MC.

Responsibility for the detailed planning, execution and documentation of the individual activities will be delegated by the MC to the SG, consisting of the chairperson of the COST Action, the vice-chairperson, the Working Group coordinators and, when necessary, others through appointment by the MC. Where possible, the MC or SG meetings will be organised in connection with WG meetings, workshops and conferences to minimise the costs involved in the coordination of the COST Action.

The main activities of the COST Action are to be carried out at the WG level. The WGs will act as links between the COST Action and existing research programmes, and will be the forums for intensive interactions between the industry and the research community. WG meetings for sub-groups or for the entire WG will be organised as and when required within individual activities.

Exchange visits of scientists, especially young scientists, within the Short-term Scientific Mission scheme will be encouraged by the MC to foster collaboration between institutions, laboratories and industries of COST countries.

To facilitate a coordinated and efficient progress of the work to be performed within the present COST Action the activities of the Action have been grouped into three Working Groups and one Task Group. Working group 1 will be mainly responsible for the development of theoretical and methodical aspects of the Action (activity 3) whereas Working Group 2 will be responsible for the issues related to engineering modelling (activities 4 and 5). The work of WG 3 is related to implementation aspects (activities 6, 7 and 8). The task group is constituted by researchers from all working groups and the management committee and will be responsible for the formulation of the results (activities 9, 10 and 11). The remaining activities 1 and 2 will be managed by the COST Action Management Committee.

Thus, the activities of the different Working Groups and the Task Group are specified as follows:

WG1: Theoretical and methodological framework ↔ Activity 3

WG2: Modelling of exposures and vulnerability ↔ Activities 4 and 5

WG3: Robustness assessment, implementation ↔ Activities 6, 7 and 8

TG: Dissemination Actions ↔ Activities 9, 10 and 11.

Workshops, Short-term Scientific Missions, an Action www homepage as well as general coordination between the participants and other research programmes will aim to optimize the outcome of the action and its dissemination. In this connection especially the coordination and exchange of results with COST Action C26 will be important. A close collaboration will be maintained with this Action and contacts have already been established. The coordination will be further ensured by inviting members of Action C26 to participate in the workshops of the present Action.

The participating researchers and institutes are all presently involved, several over many years, in various activities related to research on structural robustness, implementation of robustness requirements into codes and/or the use of these in practice. What is needed is a yet non-existing platform to accommodate a closer and targeted joint effort between the European experts in this field. The COST Action will form a very adequate means of achieving such collaboration during as well as beyond the project period.

The three WGs are closely linked to each other. To provide the key information from within the WGs to the MC of the COST Action, and to stimulate the interactions between the WGs, two or three workshops or seminars will be organised. These workshops/seminars will include a one-day session for each of the WGs, which will run in parallel, followed by a one-day plenary session.

In addition, this Action will make use of the training school-scheme (summer school) for the training of professionals from both the industry and academia. This sector is a technological one and so it changes rapidly in terms of the methods used to plan projects and control products, and legislation. At the same time, this instrument will help disseminate information emerging from this Action.

At a midterm conference and a final conference the results of this COST Action will be presented to a broader audience. These conferences will be organised in connection with established international conferences.

F. TIMETABLE

The duration of the Action is four years. The time schedule for the different activities of the present COST Action is shown in Table 1.

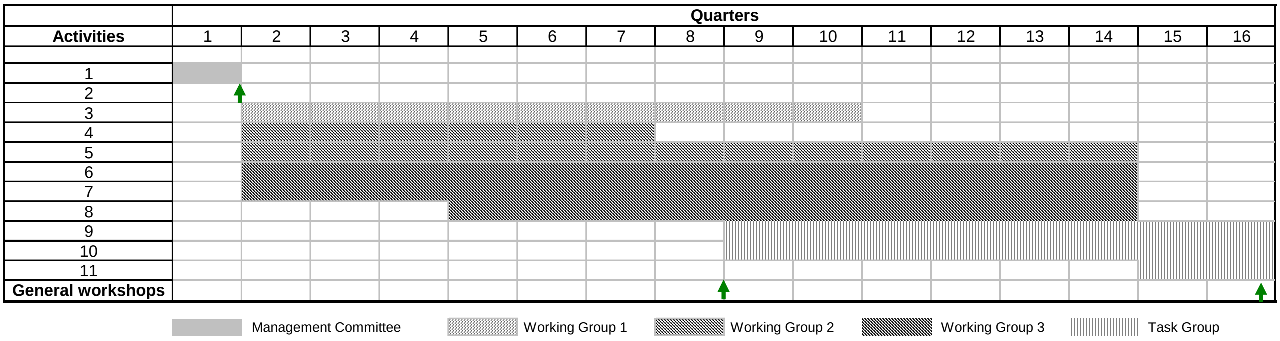

Table 1: Organisation and preliminary timetable of the Action activities.

In Table 1 also the mid term and end conferences are indicated as general workshops. The different texture codes in the figure indicate the different responsibilities of the activities as explained in Section D.

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest:

Belgium, Croatia, Czech Republic, Denmark, Norway, France, Germany, Italy, Netherlands, Sweden, Switzerland, United Kingdom and Spain.

On the basis of national estimates provided by representatives of these countries the economic dimension of the activities to be carried out under the Action has been estimated, in 2006 prices, at approximately EUR 14 million.

This estimate is valid on the assumption that all the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

H. DISSEMINATION PLAN

The dissemination of the results of the present COST Action plays a major factor for the motivation behind the Action as such. The issue here is not only to develop scientifically interesting new insights but more importantly to improve the present situation in structural engineering by transferring the insights and their implications for the engineering practice to the engineering community. There is a clear need to bring awareness of the issues of robustness more into the daily practice of structural engineering both in practice and research. To facilitate these aims the plan for disseminating the results of the present COST Action comprises a number of activities such as:

- Issuing a guideline on robust design of structures.
- Drafting a probabilistic Model Code on Reliability Based Robustness Assessment.
- Conducting COST Action workshops with open participation.
- Conducting a summer school on Robustness of Structures.
- Setting up and maintaining a COST Action home-page on the www.
- Publishing co-authored papers in scientific journals.
- Arranging and organising special sessions at international conferences.

In addition to these specific and measurable activities an important dissemination will take place through the active participation in European and international pre normative and normative committees of many of the experts participating in the COST Action. Alone through the drafting participants organisations such as IABSE, CIB, fib, ECCS, JCSS and ISO are represented. Furthermore, several of the drafting participants have been and are actively involved in the development of the EUROCODES.