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

Brussels, 21 November 2012

TU1207

MEMORANDUM OF UNDERSTANDING

Subject :	Memorandum of Understanding for the implementation of a European Concerted Research Action designated as COST Action TU1207: Next Generation Design Guidelines for Composites in Construction

Delegations will find attached the Memorandum of Understanding for COST Action as approved by the COST Committee of Senior Officials (CSO) at its 186th meeting on 20 - 21 November 2012.

MEMORANDUM OF UNDERSTANDING
For the implementation of a European Concerted Research Action designated as

COST Action TU1205
NEXT GENERATION DESIGN GUIDELINES FOR COMPOSITES IN CONSTRUCTION

The Parties 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 4154/11 "Rules and Procedures for Implementing COST Actions", or in any new document amending or replacing it, the contents of which the Parties are fully aware of.

2. The main objective of the Action is to contribute to the development of design guidelines compatible with European standards on the use of structural composite reinforcement for both new structures, as well as existing deficient concrete, masonry, steel and timber structures.

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 EUR 68 million in 2012 prices.

4. The Memorandum of Understanding will take effect on being accepted by at least five Parties.

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 Chapter V of the document referred to in Point 1 above.

A. ABSTRACT AND KEYWORDS

Construction is rapidly becoming the leading outlet for FRP composites. Although the use of composite materials in construction started in the 1980s, civil engineers only recently started gaining confidence in this technology for use in primary structural applications. Despite the considerable technological developments in this field, there are still key scientific and logistical issues that need to be addressed for the widespread acceptance in construction. For example, existing design recommendations are largely based on work carried out more than fifteen years ago on first generation reinforcing products and their conservativeness is hindering the development of innovative and more efficient products and design solutions.

This Action aims to: coordinate European research in the field; develop and maintain a critical mass of researchers; offer a link between academia and industry; and develop a new generation of design guidelines based on European Standards. This will facilitate the adoption of European products not only in Europe but also internationally and help Europe stay one step ahead of International competitors.

A.2 Keywords: Composites, Fibre Reinforced Polymers, Strengthening, Design Guidelines, Life Cycle Analysis

B. BACKGROUND

B.1 General background

Corrosion of steel reinforcement is the most significant factor limiting life expectancy of reinforced concrete structures in Europe and worldwide. In Europe alone, the annual cost of repair and maintenance of the infrastructure is about 50% of the construction turnover, currently standing at more than €300bn. The development of more durable structures and efficient rehabilitation solutions will lead to less disruption and associated costs and thus are the driving forces behind the introduction of composites in construction.

Composites (or Fibre Reinforced Polymers – FRPs) have been used extensively in the aerospace, automotive and defence industries since the early 60s. Nonetheless, their use in construction only started in the 1980s in Japan, and civil engineers in Europe have only recently begun to gain confidence in this technology for primary structural applications.

The composites industry has grown recently through key markets (including construction, wind energy, aerospace, automotive) to reach a worldwide market of €68bn and the demand for

composites within the European construction market, including reinforcing bars and strengthening systems, is estimated to grow fast and reach €3.1bn by 2013.

As exemplified by the plethora of conferences in the field, research on FRPs is currently undertaken by a large number of individual groups in Structural Engineering and continues to attract the interest of new blood researchers. Despite the overwhelming research popularity that FPRs are currently enjoying, and the growing number of applications in the construction industry, there are still key scientific questions that remain unanswered. Along with these scientific challenges, a bigger barrier to the more efficient and innovative use of this emerging technology, is the poor communication amongst researchers themselves, as well as between academia and industry. Interaction between the two sectors is still limited and often potential specifiers or users, who are unfamiliar with these materials, do not see past the initial material costs and fail to appreciate the long term benefit of using composites. As a result, practical applications more often reflect the conservativeness of the construction industry rather than the state of the art.

In addition, existing design recommendations are largely based on work carried out more than fifteen years ago on first generation reinforcing products, and their conservativeness adds costs and hinders the development of innovative products and efficient design solutions. Whilst design guidelines are necessary to enable the use of new materials, they should be made flexible enough to accommodate future developments and facilitate the quick adoption of innovative products.

Hence, the main need in this field is not for extensive fundamental research, but rather of communication and interaction. The COST Action will:

- Foster active communication amongst researchers and promote the establishment of a strong community
- Cross pollinate research through the dynamic dissemination of ideas, experiences and best practice
- Enable the faster consolidation of knowledge and the more proactive advancement of the state-of-the-art
- Facilitate knowledge transfer and the advancement of current design practice into much needed standardised provisions

Through the co-ordination and dissemination activities that will be implement, this COST Action will also offer a unique one-stop forum that will enable the active involvement of the major stakeholders (manufacturer, distributors, contractors, and standardisation committees), the roles of

which are otherwise limited by the confines of nationally (and few FP7) funded projects. This will in turn assist in increasing the international standing of the European Research Area and the international competitiveness of the European Composite Industry.

B.2 Current state of knowledge

Composite materials can be engineered to be highly corrosion resistant providing a highly durable reinforcing solution to increase the design life of new constructions as well as rehabilitate and strengthen existing structures. FRPs were first introduced in the construction industry in the 80s by the Japanese, who led this field through a government initiative to develop a non-magnetic infrastructure for the Magnetic Levitation National project. Following the 1995 Kobe Earthquake, FRPs were also adopted extensively there in seismic strengthening applications.

In Europe, research in the field started in the early 80s at EMPA laboratories, in Switzerland, with trials on external strengthening of structural elements. Meanwhile, tests on the use of FRP tendons for external pre-stressing applications were conducted in the Netherlands and subsequently in the UK, and Greece.

The North Americans were closely monitoring the Japanese developments and the pioneering work done in Europe and, in the early 90s, were the first to launch FRPs explicitly for concrete reinforcement, even though those composites were not developed specifically for the concrete environment.

The early 90s marked the beginning of the adoption of FRPs in construction, and the first international symposium in the field took place. Since then, the research in this field has grown exponentially and it is now one of the most researched topics in structural engineering, with up to 25% of all publications being on FRP, and with several dedicated journals as well as numerous national/international conferences. Early experimentations have resulted in many successful applications and first generation design guidelines and recommendations are already available in Japan (JSCE 1993), USA (ACI 2006, 2008), Canada (ISIS Canada 2001a, 2001b) and Europe (IStructE 1999).

Despite the massive research interest, the research is still largely uncoordinated and much arises from new researchers having little awareness of previous expertise. This was also one of the main conclusions of an international workshop held in Capri, Italy, in 2001, during which 30 international specialists were invited to assess the state-of-the art in the field, and, unfortunately, it still holds true.

Canadian researchers were amongst the first to realize the importance of a structured approach to

research to guarantee a prompt and successful adoption of composites in construction and were able to secure the support of the Canadian government and attract funding for a total of $40.35M over the 16 year mandate of the ISIS Network. This enabled the ISIS Network to build a critical mass of researchers in the field, thus achieving International recognition and considerable advancements, including the development of the only national code in the world that permits the use of FRPs in concrete construction (CSA 2006).

Examples of various European coordinated efforts, however, do exist and it is clear that they have contributed to the significant progress in the field, in addition to being the most innovative. In the mid-90s, several European research projects (e.g. Eurocrete) targeted specific problems, including durability in the concrete environment, basic design guidelines and best practice. This led to the first composite reinforcement to be developed specifically for the concrete environment. Task Group 9.3 of *fib* (International Federation for Structural Concrete) was established in 1996 and, in collaboration with the EU TMR network ConFibreCrete and the EU RTN Encore, produced two milestone, technical bulletins on the use of externally bonded (fib 2001) and internal FRP reinforcement (fib 2007), and fuelled the work of other national committees (CNR 2004, 2006), and in 2010 led to the introduction of FRP materials in the new version of the Model Code (fib 2010a and 201b). The Model code is a future oriented code that serves as a basis for future national and international codes (including the Eurocodes). More recently, RILEM (International Union of Laboratories and Experts in Construction Materials, System and Structures) established two technical committees on the use of advanced composites for the strengthening of masonry (TC223-MSC) and concrete structures (TC234-DUC).

In the new millennium, the use of FRPs has become more accepted within the construction industry. In Europe alone, the use of FRP materials for strengthening and rehabilitation of deficient concrete and masonry structures is quickly pervading the construction industry and the available commercial systems were proven to be an economically competitive alternative to traditional repair solutions. Though composite materials are readily used in a large number of applications, a set of accepted design guidelines does not yet exist. The development of accepted design standards for the use of composites in construction is therefore much needed as this will ensure optimal yet safe use of FPR materials as well as increase their competitiveness in the construction market.

Further research, is still required in some areas to gain a much deeper understanding of the underlying principles, and examine the long term behaviour of FRP strengthening systems.

Key research areas include:

- development of advanced models for FRP-concrete/masonry/timber interaction
- definition of suitable serviceability conditions and determination of appropriate safety limits
- development of advanced models for long-term behaviour and durability
- advanced models for chemical/mechanical anchorage of externally bonded and near surface mounted reinforcement
- strengthening of joints and statically indeterminate structures (especially for seismic upgrading)
- advanced models for concrete confinement
- models for behaviour in fire and elevated temperature
- continuous health monitoring and post-strengthening assessment
- development of performance-based design methods for FRP strengthening

This Action will innovate by bringing together the experts from different scientific and standardisation committees, so as to foster communication, cross pollinate research, consolidate knowledge and facilitate knowledge transfer.

B.3 Reasons for the Action

The relatively slow uptake of composites in European construction (compared to North America, Japan and Australia) can be attributed mainly to: a) lack of standards and design guidelines, b) uncoordinated research, c) limited awareness of major stakeholders and d) the conservativeness of the construction industry.
In this fast moving field, the strategic outlook provided by the network of experts that this Action brings together will allow the Action to:
1) direct the research to fill existing gaps and lead to scientific/technological advances;
2) identify and respond to new developments;
3) contribute to the development of standard tests;
4) directly support European and International standardisation committees (economic/societal need).
The Action will also have a further significant economic/societal impact as it will contribute to the creation of more durable structures, resulting in vast environmental and socio-economic benefits due to the reduction of the cost of current and future repair and maintenance.

The potential of expansion of composites industry that this Action will assist is also very exciting, since this is expected to lead to the creation of many more jobs and wealth.

B.4 Complementarity with other research programmes

Two large training networks funded under FP5 and FP6 on the use of composites in construction (ConFibreCrete 1997-2002 and Encore 2005-2008) have successfully demonstrated that networking, sharing of information and training of young researchers can generate increased interest in new technologies, speed up their commercial uptake and foster a more rapid technological and scientific advancement. fib TG9.3, along with the two RILEM TCs 223-MSC and 234-DUC continue to actively coordinate the work of learned groups in the field, and more recently, the European Committee for Standardization (CEN) has initiated discussions to introduce composites in the Eurocodes through their WG2 and WG4.
The time is right to build on these disconnected initiatives and capitalise on the invaluable amount of knowledge and information already generated through individual research programmes.
This Action will also enable the coordination of future FP7 project proposals to maximise their expected output and avoid duplication of research.
This Action with link with COST Action TU0904 on Integrated Fire Engineering and Response (IFER) so as to complement their work and jointly examine the behaviour in fire and elevated temperature of new FRP reinforced structures and existing, FRP strengthened structures.

C. OBJECTIVES AND BENEFITS

C.1 Aim

The main aim of the Action is to contribute to the development of advanced design guidelines, compatible with European standards. These guidelines will address both new structures reinforced with FRPs, as well as the rehabilitation and strengthening of existing deficient concrete, masonry, steel and timber structures. Key scientific and technological challenges (individuated in part B.2) will be addressed along with the new challenges identified by this Action. Technical reports, databases, scientific publications, training and informative communications will be produced on four main priority areas: Material Development and Characterisation; New Structures; Strengthening Applications; Whole-life-costing and life cycle assessments.

C.2 Objectives

The specific objectives are:

1. To review the current state-of-the-art and define research priority areas
2. To address selected scientific challenges (see Section D)
3. To assist the European composite industry to identify improvements and new uses for their materials for applications in construction
4. To transfer the knowledge into standards and design recommendations by facilitating the work of fib TG 9.3, RILEM TC 223-MSC and 234-DUC and CEN
5. To disseminate knowledge to young researchers and relevant stakeholders
6. To inform the general public through outreach activities

C.3 How networking within the Action will yield the objectives?

This Action will leverage the already large amount of work carried out by individual COST research teams and existing learned groups. It will also provide an exciting and truly multidisciplinary forum for experts in material engineering, structural engineering, experimental mechanics, manufacturing processing and material technology. Individuals representing all of the relevant stakeholders (e.g. researchers, manufacturers, distributors, engineers and members of standardisation committees) will join the Action..
This large resource capacity will enable this Action to successfully achieve its main aim by:

- Setting out a clear and structured research agenda and identifying future research and industry needs
- Identifying and addressing specific scientific challenges by creating working groups, promoting short-term scientific missions, compiling and maintaining databases of information and holding regular meetings

- Bridging the gap between academia and industry and increasing the competitiveness of the European composite and construction industry worldwide by organising two industry seminars
- Developing tests, models and guidelines to assist standardisation and preparing two bulletins on design and strengthening in a format suitable for adoption by European standards
- Disseminating knowledge by organising two training schools, developing an educational website, and organising one international scientific conference
- Reaching out through the publication of a monthly blog and a YouTube channel showcasing the activities of the proposed Action.

C.4 Potential impact of the Action

The development of new generation design guidelines based on European Standards will facilitate the adoption of composites, not only in Europe but worldwide, and help Europe stay one step ahead of International competitors. This Action will bring together the scientific community in this field and will help enhance the quality of research and training, as well as reduce duplication of work. The indirect benefits of this Action are significant. The use of FRPs in lieu of steel will reduce the lifetime costs of corrosion prone structures by over 80%, through reduced maintenance and down time for repairs. Furthermore, the use of composites in rehabilitation of existing structures will reduce overall costs (including time for execution) by over 25% and for seismic retrofit the cost reduction over conventional techniques can be up to 50%.
The potential of expansion/diversification of the composites industry is also very exciting as it is expected to lead to the creation of many more high value jobs, wealth, higher safety and reduced risk. In Easter Europe in particular, the composites industry has suffered following the collapse of the Soviet Union and the loss of the defence contracts. Diversification into construction will not only help create jobs, but also help maintain the high level of expertise and innovation potential.

C.5 Target groups/end users

The results of this Action will be directly exploitable by researchers, FRP composite manufacturers, practicing engineers and architects, and standardization bodies. The long term benefits resulting from the development of recognised standards will also address the needs of infrastructure and building owners and end users.
All of these target groups are already well represented in this Action and contributed to the definition of the desired outcomes.
It is worth noting that European standards are also adopted in countries outside Europe and this Action will attract the interest of a large group of International stakeholders thus increasing the dissemination level of the work of the Action and guaranteeing an unprecedented impact on policy making worldwide.

D. SCIENTIFIC PROGRAMME

D.1 Scientific focus

As explained earlier, much of the work on FRP composites for construction is undertaken by researchers relatively new in the field with often limited resources. As a result, a large number of analytical and experimental projects deal with simple material and flexural tests, often on development products (i.e. pre-production) and using available set-ups that differ substantially from place to place. Most of the research takes place using new concrete elements at laboratory conditions. Whilst such activities are useful if undertaken as part of research training, often they add little new to existing knowledge and even increase the variability and uncertainty in results. Hence the scientific focus will be placed on the relatively neglected areas as well as in areas where there is still considerable disagreement or uncertainty in developed models.
FRP composites in construction are used in two main distinct applications. The first application is for New Structures, where durability and serviceability considerations dominate. The second application, which is most popular in Europe, is that of strengthening. The main considerations here are limit state and developing reliable behavioural models. The main considerations for both applications can vary considerably depending on the materials used, and although the use of new materials can often solve some problems, it can also create new ones. Hence, it is important for this Action to keep an eye on material development and to be able to characterise the materials using standard tests in different environments. Finally, given the fact that engineers and stakeholders will

need convincing arguments to adopt new materials and technologies, no such study would be complete without whole-life-costing and life cycle assessment.
With the above considerations in mind, the main research tasks to be coordinated by the Action are briefly summarised below. The identified tasks will be examined by four Scientific Working Groups as discussed in section D.2. These tasks are not exhaustive and the various Working Groups can expand in new areas after their initial discussions.

1. Material Development and Characterisation
Manufacturers are constantly modifying materials and improving manufacturing processes and there is a universally expressed need for the development of standard test methods to assess the mechanical properties of advanced composites in different environments, both in the short and long term. The work within this priority area will focus on:

- Assessing the different tests so as to select candidates for standardisation
- Bond behaviour of FRPs to concrete, steel, timber and masonry
- Behaviour of FRPs at elevated temperatures
- Accelerated tests and development of models to assess durability of FRPs in typical environments, including embedment in cement mortars and concrete

2. New Reinforced Concrete (RC) Structures
The low stiffness and lack of ductility of FRPs affect the behaviour of FRP RC elements at both serviceability (higher deflections and wider cracks) and ultimate limit states (brittle failure modes), thus differing greatly from conventional steel RC elements. This Action will focus on the following issues:

- Serviceability requirements
- New products and prefabricated solutions
- Long-term behaviour
- Behaviour of FRP RC elements exposed to fire or elevated temperature

3. Strengthening Applications

This is the field that has received the interest of the majority of researchers, manufacturers and other major stakeholders in Europe and has seen an exponential growth in the number of commercial applications in the last decade. Significant innovative work has already been carried out on rehabilitation of concrete, masonry, steel and timber structures, including the use of new resins and fibre systems, near surface mounted reinforcement, and textile reinforced mortars. Work in this area will focus on:

- Behaviour of confined concrete using different types of fibres and bonding systems
- Behaviour of strengthened reinforced concrete, masonry, steel and timber elements, in flexure, shear and punching shear
- Models and techniques for the pre-stressing of strengthening systems to enhance the utilisation of composites at service conditions
- Novel seismic strengthening and rehabilitation solutions and development of design models to avoid shear, anchorage, splice and buckling failures.

4. Whole-life-costing and life cycle assessments

The introduction of innovative products or technologies in civil engineering applications has always been slower than in other engineering fields (e.g. aerospace or bioengineering). This is often related to a lack of education and training of professional engineers as well as the fact that relevant stakeholders often struggle to see retrospectively the higher initial costs and fail to appreciate the long term benefit of such new technologies. This Action will address these issues and work will focus on:

- Whole-life cost assessment of new FRP reinforced concrete structures
- Whole-life cost assessment of rehabilitated structures
- Recycling and reuse of composite materials
- Innovative structural solutions using existing and future materials

The accomplishment of the above scientific tasks requires many person-years of research, which

will not be funded by the COST Action. However, most of this research will be undertaken either as part of the research training of PhD (and in some cases Master) students or other targeted research projects at the national on international level. The Working Groups will aim to create wish lists of desired projects in their domain, and encourage researchers in the field to undertake them in a coordinated action. The Working groups will also assist by providing letters of support for new research grant applications in the desired projects.

D.2 Scientific work plan methods and means

The work plan will be continuously monitored and adjusted to accommodate unforeseen scientific and technological developments. The main scientific themes will be examined in four Scientific Working Groups (WG). Central to the activities of all WGs will be the preparation of state-of-the-art reports and the creation and maintenance of relevant databases of experimental results, as well as wish lists for future research projects.

WG1:Material Development and Characterisation

This Working Group will deal with short and long-term material characteristics. The mechanical properties of composites for construction, and their interaction, in particular with concrete and masonry, through bond and anchorage, are still difficult to characterise, due to their vastly different material strength and stiffness. Although a considerable amount of work has already been carried out at various research institutions and by the manufacturers, primarily for quality control, reliable standard bond and anchorage tests as well as accelerated conditioning tests (to assess long-term behaviour) that are directly relevant to design have still to be developed.

This WG will provide recommendations on standard procedures for material testing and create (by gathering contributions from participants and from the literature) and maintain a large database of experimental results that will be made available to the wider research community. This will enable a more comprehensive assessment of available constitutive models and lead to the development of more accurate predictive equations.

The work of this WG will benefit from the results of extensive round robin testing exercises that have already been undertaken as part of the FP6 funded Marie Curie Network Encore (MRTN-CT-2004-512397), RILEM TC 223-MSC and other nationally funded projects. The participation of a wide group of international researchers will benefit particularly this WG as it will enable the collection of a vast amount of test data.

WG2: New Structures

This Working Group will coordinate research on the use of composite materials as internal reinforcement for concrete structures. Although in Europe composites were firstly introduced in Civil Engineering applications primarily for their durability advantages as reinforcement for concrete structures, this is the field that has attracted less attention from building and infrastructure owners. This has partly to do with the lack of appreciation of the savings that are possible over the lifetime of a structure. To determine whole life costing, it is necessary to understand the long-term behaviour of FRPs exposed to a variety of environments, to the alkalinity of concrete, fire, etc..
FRP reinforcement is much more popular in North America and it is important to understand the reasons behind that. In fact, there is a major difference in approach in dealing with durability between the two continents. Whilst in Europe the emphasis is placed on ensuring the use of high performance concrete and adequate concrete covers (something which is not always possible), in North America the emphasis for structures vulnerable to corrosion is on using corrosion resistant reinforcement. Hence, a reassessment of the strategy of the European standards may be necessary in this respect.
The output of this WG will be in the form of state-of-the-art reports, scientific papers and databases of experimental results.

WG3: Strengthening Applications

This Working Group will coordinate research on the use of advance materials for the strengthening of existing structures (including concrete, masonry, steel and timber). Strengthening applications have dominated the European market and are still responsible for the largest portion of the research carried out in this field. Although several national committees have been established and several design guidelines have been produced, critical aspects of the behaviour of strengthened structures are not yet fully understood. In particular, ensuring a strong and durable bond between the FRP composite and the original structure, as well as ensuring high ductility in seismically deficient structures is still a challenge.
This WG will bring together experts from different fields and will assist in the development of a much needed holistic approach to the rehabilitation and strengthening of existing deficient buildings. State-of-the-art-reports and discussion documents will be prepared and disseminated in the key research areas identified in section D.1 and will examine accepted strengthening solutions, such as the use of externally bonded (EB) FRPs, as well as more recent developments: near surface mounted (NSM) reinforcement (including pre-stressing); textile reinforced mortars (TRM); anchorage solutions.

WG4: Whole-life-costing and life cycle assessments

The work of this WG relies on the outputs from all three other scientific WGs. Material properties

and performance in different environments from WG1 will provide the necessary data needed for assessing the deterioration of materials. Behavioural models developed/compiled by WG2 and WG3 will then enable the determination of damage at the structural level.
Activities of this WG will focus on compiling a database of existing projects and case studies. The industrial participants will be of particular help in this WG. A report on available methodologies to assess the whole-life costing and performance of new and rehabilitated structures will be produced to enable interested stakeholders to compare different solutions using traditional and novel materials.

E. ORGANISATION

E.1 Coordination and organisation

All of the rules and procedures described in COST 4154/11 will be implemented for the coordination and organisation of this Action.
The work of this Action will be overseen by the Management Committee (MC), which will meet twice per year and monitor and direct the activities of the five WGs. The Chair and Vice Chair of the MC and the Chairs of the five WGs will be nominated at the kick-off meeting of the Action. These nominated individuals will also form the Steering Group (SG), which will monitor closely the activities of the Action and review the progress of the WGs, report to the MC and actively liaise with existing learned groups (fib TG 9.3, RILEM TCs, IIFC, CEN). The SG will meet twice per year, in conjunction with the MC meetings, and can call additional e-meetings to deal with urgent issues at any time.
Milestones
At each meeting the SG and MC will assess the progress of the Action and ensure that all of the objectives set out in Section C are met and that the activities reported in Section F are completed. Specific milestones are set as specified in the table below to assist in monitoring scientific, training and dissemination activities.

Lead	Milestone number	Milestone name	Month	Progress Indicators
MC WG5	M1.1	Launch of Action	1	- Kick off meeting - Election of SG and WG Chairs - Establishment of website
SG/MC WG5	M1.2	Presentation of the Action to the wide Industry community	12	- First industry seminar - No of attendees at first industry seminar
SG/MC WG1-5	M2.1	Training, Dissemination and Outreach (1)	18	- At least 6 STSMs initiated - First training school - No of attendees at first training school - Establishment of educational website - Establishment of YouTube channel - At least 4 peer reviewed journal papers submitted
WG1-4	M2.2	State-of-the-art reports and databases (1)	24	- Submission of state-of-the-art reports - Establishment of databases of test results
ALL	M3.1	Training, Dissemination and Outreach (2)	30	- At least 10 STSMs completed - Review of content on educational website and YouTube channel - No of visitors of educational website and YouTube channel - At least 8 peer reviewed journal papers submitted
SG/MC WG5	M3.2	Industry Outreach	36	- Second Industry Seminar - No of attendees at second industry seminar

				- First draft of bulletins
ALL	M4.1	Training, Dissemination and Outreach (3)	42	- At least 14 STSMs completed - Second training school - No of attendees at second training school - At least 12 peer reviewed journal papers submitted
ALL	M4.2	End of Action Activities	48	- All STSMs completed - Press coverage of Action activities - Final draft of bulletins - End of Action Conference - No of attendees at conference - At least 15 peer reviewed journal papers submitted

E.2 Working Groups

A total of five WGs will be established to coordinate the research and dissemination activities of this Action. Four WGs (WG1 through 4) will coordinate research in the areas identified in Section D. WG 5 - Knowledge Transfer: will coordinate and promote inter-sectorial collaboration and outreach activities, including the establishment of the Action website, organisation of industry seminars, training schools, Short-Term Scientific Mission (STSMs), maintenance of online databases, preparation and dissemination of reports and publications.
Each WG will be led by a Chair and a deputy Chair. WG chairs will coordinate the activities of the WG and report to the SG. The chair of WG5 will also serve as Dissemination and Communication Manager (DCM) within the SG and will ensure a proactive flow of information between the participants of the Action to ensure the timely and successful achievement of the established objectives.
Meetings of the WGs will be arranged in conjunction with the meetings of the MC and continuous exchange of information will be facilitated through the Action website.

E.3 Liaison and interaction with other research programmes

A high level of interaction with existing and future COST Actions will be promoted and, whenever possible, joint activities will be coordinated. For example, this Action shares some of its overarching objectives and target groups/end users with the on-going Actions TU0904 on Integrated Fire Engineering and Response and TU0905 on Structural Glass - Novel design methods and next generation products, which will end in 2014. Joint meetings and seminars (e.g. the first industry seminar planned for the end of Year 1) will guarantee a larger dissemination potential of the activities of this Action and a wider exposure to the construction and building sectors as well as scientists with complimentary expertise.
This Action will promote collaboration amongst the participants and will facilitate the development of interdisciplinary and inter-sectorial teams that can outlast the life of this Action, steer research in needed directions and gain additional support through the coordination of future FP project proposals and other national and European research programmes.
This Action will proactively liaise with existing learned groups (fib TG 9.3, RILEM TCs, IIFC, CEN) through the organisation of joint meetings and technical seminars, and the sharing of information.

E.4 Gender balance and involvement of Early-Stage researchers

At the moment less than 10% of publications in this field are published by women, and this highlights the need to address gender balance. The Action has currently been able to attract the interest of many experts, 20% of whom are female, and whom will be encouraged to take up leading positions both within the MC and WGs This Action will set the ambitious target to achieve 40% female participation with a minimum of 25% of the MC chairs being female. This target will be monitored regularly and reviewed by MC at its regular meetings.
This field is very popular with Early-Stage researchers. Early-stage researchers will also be strongly encouraged to take on leading positions in all WGs and will be entrusted with the co-ordination of training and outreach activities, some of which have been specifically devised to target younger scientists (e.g. monthly blogs and YouTube channel). In addition, at least 60% of the STSMs will be targeted to Early-Stage researchers. The participation and engagement of Early Stage Researchers will be monitored regularly and will be reviewed formally at each MC meeting.

F. TIMETABLE

The duration of the Action is four years. Management and progress meetings of the MC, SG and WGs will take place twice a year (with additional meetings of the SG as outlined in Section E.1). The scientific, training and dissemination activities coordinated by the various WGs will take place as shown in the table below.

In summary, the main activities will include:

- 2 Industry Seminars: Month 12 and 36
- 2 Training Schools: Month 18 and 42
- 16 Short Term Scientific Mission: 4 per annum
- 1 end of Activity Conference: Month 48
- preparation of scientific publications: continuous

Activity/Months	Year 1				Year 2				Year 3				Year 4			
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
Meetings		*		*		*		*		*		*		*		*
Industry Seminars				*								*				
Training Schools						*								*		
STSMs	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Scientific Activities	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Conference																*
Milestones	M1.1			M1.2		M2.1		M2.2		M3.1		M3.2		M4.1		M4.2

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: BE, CY, CZ, DE, EL, ES, FR, HU, IT, LV, NO, PL, PT, RO, SE, SI, UK. On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 68 Million € for the total duration of the Action. This estimate is valid under 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

H.1 Who?

The results of this Action will be of direct interest to:

- Researchers working in the field
- University educators and students
- Practicing structural engineers and architects
- Composite manufacturers
- Construction industry
- Standardization Bodies (national standardisation committees, fib TG 9.3, Rilem TCs 223-MSC and 234-DUC, CEN for the Eurocodes, ACI-440)
- Governmental Bodies, Public and Private Owners who are responsible for building, managing and maintaining infrastructure networks and heritage assets (such as Public Works Department, Highway and Railway Agencies, Port and Airport Authorities, Utility companies for telecommunications, gas, water, electricity, Offshore industry, Precast Concrete manufacturers, House Builders, etc.)
- Building owners and end users (especially the output stemming from the work of WG4 and WG5)

H.2 What?

A combination of traditional and modern media outlets will be used depending on the desired target audience.
All audiences

- General information will be available via the Action web site and will be written for the general audience
- Action leaflet and poster
- Press releases and joint articles to be submitted to national and international magazines and websites directed to professionals and the construction and composite industry
- YouTube videos (Developed by annual competitions)

Action internal communication

- e-mail correspondence
- Discussion forum
- Meetings and Events
- A secured area of the Action website will be used to manage and maintain draft documents and databases until ready for wide distribution

Researchers (in particular young scientists)

- Monthly blogs will be managed by the Early Stage Researchers involved in the Action and used to target a technical audience and stimulate active discussions on various technical aspects
- Presentations at major national and international conferences in the field
- Joint papers to appear in international peer reviewed journals

Young scientists, University educators and students

- A YouTube channel will be used to disseminate: interviews with Action participants (representing all of the relevant stakeholders); lectures; tutorials; conference and seminar presentations; videos of material and structural testing
- Lecture notes of the training courses organised by the Action will be made available on the Action's website

All major stakeholders

- Industry seminars and conference
- Proceedings of the industry seminars and conference organised by the Action
- State-of-the-art-reports and bulletins

H.3 How?

A dedicated Working Group with a leader is allocated for this task. WG5 will coordinate all of the dissemination activities, continuously monitor their progress and review them and propose adjustments, if necessary, at specific milestones.
The establishment of the Action website and the publication of this Action information on the COST channels will provide wide exposure and will enable the dissemination of quick information sheets that will appeal to the general public.
The Action web site will include a secure area that will enable the dissemination of internal working documents, joint preparation of reports, collection and maintenance of databases of experimental results and case studies. This will assist in both managing and monitoring the progress of the Action. A discussion forum will also allow participants to initiate discussions on technical and practical issues and enable the prompt resolution of pressing matters, thus increasing the productivity of the various WGs.
WG5 will also provide coordination support for the preparation of technical contributions to conferences and peer reviewed journals. Publications resulting from the work of the Action will generally include authors from different institutions and clear communications channels and collaboration tools will facilitate the preparation and review process. Actions on publications will be taken during the Action's regular meetings and Early Stage Researchers will be actively involved in all aspects of dissemination and outreach. In addition, scientific publications will be expected to

be prepared by all Early Stage Researchers undertaking a STSM.

The two industry seminars and the end of Action conference, which will be open to the wider community, will enable the Action to reach out to all of the major stakeholders thus maximising exposure and impact.

The implementation of media outlets such as YouTube and monthly blogs will reach out to the young scientists, university educators and students and will stimulate interest in the field and nurture the next generation of researchers.

Since most of the Action's meetings will take place at the same time as major conferences or International committee meetings, the results of the Action will feed directly into the standardisation (and pre-standardisation) committees, ensuring a high impact for this Action.