WORKING GROUP

SUSTAINABLE CONSTRUCTION METHODS & TECHNIQUES

INTERIM REPORT

July 2003

CONTRACT NUMBER :
B4-3050/2003/352567/SER/B4

Reference : ENV.B3/SER/2003/0007r

"Service contract to assist an EU Expert Working Group supporting the development of the thematic Strategy on the Urban Environment"

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0. Executive Summary

The Directorate General Environment of the European Commission is responsible for drafting the **Urban Thematic Strategy** of the European Commission's 6th Environment Action Programme. In order to offer advice to the Commission, the EU Expert Group on the Urban Environment established four working groups, including the working group **SUSTAINABLE CONSTRUCTION METHODS AND TECHNIQUES.** This is chaired by Livia Tirone and co-ordinated by the Architects' Council of Europe.

This working group is due to submit a report by the end of 2003, which will cover the following questions of Sustainable Construction:

- What is the State of the Art of more Sustainable Construction in Europe ?
- What barriers are preventing the mainstreaming of pockets of good practice ?
- What are the recommendations (policies and tools) to overcome these barriers ?
- What kind of quantitative and qualitative targets can be proposed ?

The aim of the working group is to define a clear set of priority actions in every relevant area of construction, in order to make sustainable construction common practice across Europe.

On the State of the Art:

The State of the Art in terms of making building and construction more sustainable is constrained by a number of imponderables and in real life terms one can only strive for the best available and achievable in the prevailing circumstances. Limiting factors include:

- Economic constraints - whether perceived or actual, there is a limit as to how far one can go as the law of diminishing returns comes into play;
- Best available techniques are constrained by available technologies and manufacturers; This particularly relevant in the context of energy use and conservation; Burning hydrocarbons drawn from non-renewable sources remains the predominant method of heating and cooling most buildings rely on; Although technologies to use renewable energies exist, they are far from available;
- In terms of the use of renewable energies, the construction sector relies on the energy sector to make available economically attractive solutions;

- There are gaps in research, which need to be identified and communicated to the European Commission;

We can conclude that there are relevant positive aspects that characterise the State of the Art:

- A trend towards integrated solutions seems to be in motion;
- Cultural Heritage has been acknowledged as a determining factor (already in FP5) in enhancing the quality of life of people;
- The dissemination efforts of sustainable construction have resulted in relevant applications;
- There is a considerable amount of quality literature available on the subject of sustainable construction;
- The relevance of the construction sector in Sustainable Development has been understood;
- There is a popular support for the idea of sustainability;

Since there is no doubt that the methods and techniques are available to move towards sustainable construction, getting the relevant actors in the construction industry to implement them in their day to day practice, may rely predominantly on how effectively they can be motivated to take on the liability / risk associated with change.

On Barriers and Recommendations listed in order of priority

The Urban Thematic Strategy reaches across the different sectors of governance in Europe in an attempt to increase the effectiveness of the resulting laws (directives / recommendations) and their impact in the day to day life of citizens. This integrated approach reflects vision on behalf of the EC and constitutes an opportunity, which this WG welcomes and embraces.
The present report attempts to reflect the reality of the construction industry, in as much as it covers a very large spectrum of stakeholders / actors and that it has such a diverse and far-reaching impact on our society. The far-reaching dimension of the construction industry is apparent in Annex 1, where Barriers and Recommendations are listed per Actor.

On the basis of all that has been stated in the previous chapters, it is clear that sustainable construction is not a finite goal, but a continuously redefined direction and that mainstreaming sustainable construction will require a clear and coherent top-down message (expressed in a set of EU common goals). Achieving these will require a significant effort on behalf of some of the main stakeholders / actors in the construction sector.

- The top-down political message has to come across to the market as clearly and coherently as possible – therefore:
  - All public money will be spent on projects that respect the quantified (measurable) requirements of more sustainable construction; Funds and subsidies will set requirements in line with more sustainable construction; Public procurement will set the example in terms of more sustainable construction;
  - Taxes and other regulatory mechanisms at global, regional and local political levels will be adapted and used to help motivate the stakeholders / actors to contribute to the achievement of these goals;
  - Urban planning instruments must make room for more sustainable construction, encourage it and even make it a condition for construction permits;
- Bottom up market initiatives towards sustainable construction need to be accommodated and encouraged by local urban management – therefore:
  - More sustainable construction has a positive impact on the environment, and this added value has an extra cost that the market is not yet willing to pay for; Municipalities must collaborate with the reduction of this extra cost, by offering more flexible conditions;
  - More sustainable materials have a positive impact on the environment and the added value has an extra cost that the market is not necessarily willing to pay for; Taxes and subsidies should help encourage the Research and Development necessary;
  - Many of the qualities intrinsic to more sustainable construction can have direct cost reduction implications for the end user as well as health enhancing implications; Raising awareness of the end user to the choices he / she has includes the marketing / campaigning of relevant environmental information on: energy consumption in buildings (buildings energy certification), on toxic emissions of materials' and ventilation systems' impact on indoor air quality (could be included in the building certification if the scope of the 'passport' can be widened), on waste separation and disposal etc;
  - The use of non-renewable resources (specifically waste disposal, energy and water supply) should become more sustainable by encouraging the implementation of utility run local systems: for the recycling of grey water, for decentralised energy production, for decentralised waste collection;
  - Encouraging a shift in attitudes in all the stakeholders / actors of the construction sector, via education and continuous training is an indirect but nonetheless relevant area of action;
- In order to make more sustainable construction possible, having already determined that sustainability is a direction rather then an absolute goal, this direction needs to be clearly

identified, so that efforts can be focussed efficiently and results can be attained in the short term – therefore:

- It is important to define the holistic, environmental, common EU indicators and the respective quantified objectives (targets) within each indicator adapted to each MS, together with the adequate common EU assessment method, using a common language to all stakeholders of the construction industry;
- There is a need to integrate principles of sustainability into the practice of design, construction, maintenance and management of buildings; The parameters that matter most must be identified in a language that is consistent with the issues typically addressed in the construction sector. As methodology: 1. Identify what can be kept from the current common practice integrating cultural and regional values (as valid for new buildings as it is obviously for retrofitting) 2. Identify what needs to be changed, new techniques and processes; 3. The resulting product must be assessed starting from the design phase in an integrated manner from the point of view of the fulfilment of the requirements and the environmental impact at all levels from the local, to the regional, to the global.
- Certification of construction must be performance based rather than prescriptive, in order to challenge the design team to find creative and diverse solutions leaving them the relevant flexibility to be inventive;
- Sustainable construction should be implemented through integrated approaches, and optimised solutions within the domain of each actor in the construction sector.

Preliminary Conclusion:

There are relevant examples of sustainable construction all over the EU, but it is far from being a stream and much less a main stream.

There is no unique / single realistic recommendation to mainstream more sustainable construction; Although the scope and intensity of the barriers is as far-reaching as the impact of the construction industry on our society, they can be collectively and individually addressed and overcome. Annex 1 breaks down each barrier per actor in the construction industry and points out recommendations to overcome these barriers. If the road towards more sustainable construction is about offering the capacity for choice then, in order to have sustainable construction chosen as the alternative for tomorrow, it has to be promoted today as a viable alternative for the future.

1. Chapter 1 – INTRODUCTION and BACKGROUND

Since the first oil shock of 1973, Europe has become conscious of its strong dependency on non-renewable fossil fuels. With the Brundtland Report in 1987 a new dimension of human activities on this planet was disclosed – that of their local and global environmental impact on the planet and therefore a new responsibility was articulated: protection of the heritage of future generations' heritage[1]. This is how the notion of sustainability was born.

This new dimension was consolidated and expanded with the Rio de Janeiro conference in 1992 which launched Local Agenda 21, and the Kyoto Protocol in 1997, the latter setting clear targets under the burden sharing agreement for the reduction of carbon dioxide (CO2) emissions in the EU Member States. Although the Kyoto Protocol is a global / world initiative, Europe is trying to set a good example with a commitment to a 5% reduction in CO2 emission in relation to 1990 levels within the agreement period 2010-2012. The European Climate Change Programme started the policy process, making each Member State put a National Climate Change Programmes in place in order to achieve commitments to the Kyoto Protocol, along with other policies encouraging energy efficiency in the building and transport sectors as well as promoting the use of renewable energies.

The built environment has a very important impact on the quality of life of people and on the natural environment[2]:

- In the EU 80% of the population lives in cities;
- In the EU, people spend almost 90% of their time in buildings;
- In the countries of the Organisation for Economic Co-operation and Development (OECD), almost 50%[3] of the energy that is produced is consumed in the built environment;
- Buildings are responsible for a considerable amount of the world's waste production, although most of this waste is inert and increasingly re-used and recycled;
- The construction sector accounts for approximately 50% by weight of all material taken from the Earth's crust, and in a few instances natural, non-renewable resources are being depleated beyond sustainable levels;
- The built environment is a stable environmental resource;
- Buildings cost up to ten times more to run during their life time, than their initial construction cost;

In Europe, it is an accepted, recognised and established fact that, once constructed in a sustainable manner, the built environment can co-exist with the natural environment without being a burden. This working group's task is to establish how more sustainable construction methods

[1] Needs to be the official quote;
[2] The statistics that back the statements up need to be available;
[3] Is it 50 or 40% - a consensus needs to be reached;

and techniques can become part of the 'business as usual' scenario of all the relevant actors, within the framework of EU and national legislation in the context of present market circumstances.

The aim is to increase sustainability in building, implementing ongoing improvement in terms of their accessibility to all, their promotion of indoor and outdoor health and comfort, their protection of the environment by performing efficiently and their rational use of natural non-renewable resources.

1.1 Vision

The following vision statement needs to evolve and reach consensus within the Working Group:

Construction is one of the oldest expressions of the intervention of Man on the planet. Whether to mark his territory, as shelter from the elements or to celebrate his achievements and beliefs, Man has developed a relationship with the environment that has not always been friendly. (Hence the terminology environmentally friendly.) Today's challenge lies in including construction into the integrated cycle / system of the environment, without giving up attained levels of quality of life (comfort) nor social, economical and cultural values, while protecting the heritage of future generations.

Without claiming to be an absolute truth, rather a direction, sustainable construction aims to respond to this challenge, by introducing, in a holistic approach, the dimension of buildings' environmental performance into the whole cycle of construction – from inception to demolition and re-use.

Nonetheless, in order to create the context for sustainable construction to grow into a mainstream, a new set of holistic, integrated and far-reaching criteria have to be assimilated covering health, comfort, energy, materials and ultimately creating a new culture among all the stakeholders / actors of the construction sector.

There is a need for a common set of indicators, goals and evaluation criteria in the EU, in order to make the top-down political message clear and coherent and this will be the first step to help motivate these stakeholders / actors to transform / move in the right direction.

If the European Institutions intend to mainstream sustainable construction, then Public Procurement needs to set an example for construction to follow at the globalization rhythm that is required;

1.2 Sustainable Construction – Definitions and Terms

This section will be discussed and completed during the next stage of work;

Key definitions and terms are provided for clear understanding of sustainable construction methods and techniques:

- Sustainable construction:
- Methods and techniques:
- Buildings:
- Built environment:
- Non-renewable resources:
- Renewable energies:
- Energy efficiency:

2. CHAPTER 2 – STATE OF THE ART

What is the State of the Art of Sustainable Construction in Europe ?

2.1 Key Issues:

Sustainable construction is here to stay. Although most of the successful built examples are new buildings, if durability is a critical indicator for sustainability, those buildings that have survived for more than 1000 years (like villas, palaces, churches and cathedrals) cannot be excluded from this appraisal. These persistent surviving buildings only fail us today because our ancestors didn't contemplate the comfort levels our life style demands today.

There are pockets of good practice across Europe demonstrating that sustainable construction is a viable proposition. It will be necessary to focus on the refurbishment sector in order to have a shorter term and wider impact in the built environment.

- There are successful examples of sustainable construction in most EU Member States, largely more prominent in the new buildings sector than in the refurbishment sector, in which more focus is needed in order to have a shorter term and wider impact in the built environment;
- Across the EU, the annual rate of new building activity is between 0.5% and 2.0% of the total building stock, which means that even if all new buildings were sustainable, it would still take several decades or even centuries to make a significant impact;
- With the best available and proven technologies, methods and techniques it is possible to refurbish, design and construct or refurbish more sustainable buildings, although there is not one single, universal recipe for sustainable construction, as these techniques are related to use, culture, climate and available resources;

- Information on the positive potential of sustainable architecture is not generally and widely available and professional education and training does not provide the students with a profound understanding of sustainability in construction nor always integrate the tools that are relevant to promote sustainable construction;
- Sustainability in buildings is measured through their performance that is associated with a set of quantifiable targets / goals;
- Many of the parameters for assessing sustainability are quantifiable: indoor thermal comfort, indoor air quality, energy consumption and resulting CO_2 emissions, water consumption, materials in terms of their whole life cycle and toxicity, rational use of resources, diversity of volume, colour, texture, typology and property, flexibility to adapt to unknown future needs;
- But other performance parameters and qualities in sustainable construction, which are also of critical importance to the quality of life of people, are not so easy to quantify: cultural expression and cultural identity, integration into the existing urban and natural context, attractiveness, all factors which can motivate people to care for their built environment;
- Sustainable construction as a performance based concept, is free of any architectural style; This is as much a responsibility during the creative process as it is a freedom;
- More than 50% of the construction activity is refurbishment and this segment continues to grow;

2.2 Context

Sustainable development is a much-discussed but poorly-specified and not yet enough applied concept. One particular reason for this is that there are many dimensions to sustainable development, including environmental, technical, economic, social and cultural aspects. These and other considerations must be taken into account in any attempt to move closer to sustainability and this requires an integrated approach based on practical knowledge of the development process, its implementation and its impact in all areas of human concern. Application of sustainability in construction faces further challenges related to the diversity of this area of activity which is involved in the creation, maintenance and renewal of the built environment. There are many different components of the built environment including residential buildings (houses, apartments, etc.) and non-residential buildings (offices, factories, shops, schools, hospitals, etc.), and all their associated infrastructure such as transport facilities (roads, railways, canals, airports, etc.) and utility networks (electricity, natural gas and district heat grids, water supply, treatment and disposal systems, etc.). In terms of environmental sustainability, the function of the built

environment is to provide appropriate, efficient and pleasant communities in which humans can live, work and socialise whilst avoiding irreparable damage to the natural environment which supports all life and belongs to future generations. Hence, sustainability in construction is a process that embraces qualitative as well as quantitative issues and human satisfaction as well as environmental protection.

2.3 Research

There has been extensive research on sustainable construction methods and techniques for new buildings, especially residential property, and infrastructure projects, particularly water systems. As regards new buildings, many of the major issues of sustainability have been examined, particularly the enhancement of comfort for occupants (good thermal, visual and air quality conditions for the internal environment), energy saving design, insulation improvements, addition of thermal mass, passive and active solar energy systems, water collection, re-use and on-site treatment, and selection of low-environmental impact materials. In terms of infrastructure, most attention seems to have been paid to the design and implementation of sustainable urban drainage systems. In contrast, only sporadic research effort appears to have been undertaken on specific topics related to transport infrastructure (such as recycling of road materials) and utility networks (such as integration of planning and construction).

Considerably less research has been directed at sustainable construction methods and techniques for retrofitting, refurbishment and renovation. This is an important concern since, in most areas of the EU, the annual rate of new building activity is between 0.5% and 2.0% of the total building stock. Consequently, if reliance is placed only on new building at these rates to improve the sustainability of the built environment, then it will take many decades or even centuries to make a significant impact. The limited research which has been conducted on retrofitting, refurbishment and renovation appears to concern mainly residential and office property. Much less research has been performed on the remainder of the non-residential building stock which includes diverse yet important building types such as factories, shops, schools, hospitals, etc. Independently of new or retrofit, further research in building functions, construction systems and materials is also relevant.

Diversity within the built environment is a fundamental problem for research on sustainable construction methods and techniques. The nature and implications of this inherent diversity does not seem to be widely understood and appreciated. One particular reason for this is that essential information on the composition of the total building stock, and its consumption of energy and water varies greatly between different EU member states. Such information is important because it is

needed in order to devise and target relevant sustainable construction methods and techniques for particular types of building. The diversity of the building stock is a significant consideration as it leads to large differences in energy and water consumption within and between different building types. Similarly, information on the performance of the construction industry, in terms of energy consumption, materials usage and waste generation, is collected on an inconsistent basis across the EU. Some member states have quite detailed information which is updated regularly, whilst others have little or no information and monitoring.

A significant amount of research has been performed on the development of design principles for sustainable construction. However, such design principles chiefly concentrate on new residential buildings so that there is much less coverage of new non-residential buildings, retrofitting, refurbishment and renovation for all buildings, and the construction and maintenance of infrastructure. Apart from the basic diversity of the built environment, there are a number of important reasons for the lack of widespread and practical design principles. In particular, the process of designing for sustainability requires effective integration between many different actors including architects, engineers, builders, promoters, financiers, owners and occupiers. Only limited research appears to have been conducted on such integration. Additionally, there can be no universal approach to design for sustainable construction since essential local factors, such as climate, culture, resources, regulations, laws, markets, finance, etc., must be taken into account. Furthermore, design for sustainability in retrofitting, refurbishment and renovation is intrinsically more difficult than new build due to the building-specific nature (location, orientation, nature of the existing building etc.) of such work.

Considerable research effort is required to provide suitable design tools and skills, which can be used with confidence and ease by the whole design team over the wide range of possibilities available to raise the level of sustainability in construction. Such tools and skills must be reinforced by robust and acceptable integrated methods for predicting, evaluating and monitoring performance in more sustainable solutions. Although notable progress has been made with a number of these methods, their application is constrained by various considerations including their relevance to specific types of building and countries. However, the fundamental problem for all methods is the lack of clear definition and interpretation of sustainability. Most practical research in this area resolves this problem by concentrating on apparently agreed major issues, such as natural resource depletion, global climate change, etc. As such, there is a recognition that, due to the complexity of the topic, the best outcomes which can be achieved currently are measures of comparative sustainability. Whilst this may not be ideal, it represents a balance between progress and practicality.

Prominent amongst the techniques, which can support the promotion of increasingly sustainable construction is life cycle assessment. This technique is founded on a background of general research, which has been conducted over a number of years. This has resulted in the publication and dissemination of the International Standard EN ISO 14040 Series on life cycle assessment, which has enabled its application to become more routine so that both practitioners and their clients are using it with relative confidence. Additionally, a collection of software tools has been produced for practitioners and these tools often contain important databases. The availability of relevant and reliable data is essential to the application of life cycle assessment and for client confidence in results. Unfortunately, such databases are still limited due to the extensive range of materials, products and services for which life cycle assessment data are required. These databases are also country-specific. Apart from the time and resources required to collect and analyse such data, some databases are proprietary. Such data limitations affect the transparency of life cycle assessments, which undermines their use in decision-making in making buildings more sustainable. Additionally, lack of data restricts the development of environmental product information systems necessary for "green" certification and eco-labelling schemes.

2.4 Publication

It is apparent that there has been progress with research on sustainable construction methods and techniques in certain areas, especially with new residential buildings. Although this research needs to be extended to embrace all aspects of the creation, maintenance and renewal of the built environment, it is clear that a range of basic components, technologies, methods and techniques are already available for application in sustainable construction. However, there is an important gap between current knowledge and actual application, which must be addressed by dissemination, initially in the form of publication. Numerous individual studies, reports, papers, articles, books, catalogues and databases of sustainable construction methods and techniques have been produced. Despite this, there appear to be problems with access to this information by all the relevant actors in the construction, management and use of the built environment. This may be partly due to the integrated approach needed to achieve sustainable construction. It may also be due to the fact that the construction methods and techniques need to be adapted to each cultural / climatic context before they become applicable. Hence, whereas publications may exist for individual specialists and specific cultural / climatic contexts, relevant material has to be assembled from various sources addressing the whole design and development team, which is engaged in sustainable construction and adapted to the different cultural / climatic contexts. Consequently, apart from improving access to publications for all actors in the built environment, it is necessary to address the lack of integration and interdisciplinary approaches in professional

education and training, as well as the lack of co-ordination of assessment methods and standardisation of products.

2.5 Demonstration

Demonstration is an important means of disseminating concepts, ideas and solutions to promote the acceptance, implementation and replication of sustainable construction methods and techniques. There are numerous examples of new zero–heating, low-energy and zero-energy residential buildings. However, whilst these can be influential within the relevant professions of the design team, especially architects and engineers, they may not be as effective amongst all actors in the built environment. This is mainly because such examples must appeal to the different perceptions of different people. First, examples are needed for all aspects of the built environment which includes not only new residential buildings but also non-residential buildings, retrofitting, refurbishment and renovation, and infrastructure. If we follow this intention, this means that a considerable number of demonstration projects are required across the EU to achieve effective dissemination and this requires a large investment. Second, the type and nature of demonstration is important. For example, architects, engineers and some developers might be inspired by novel and unusual solutions to sustainable construction. This may conflict with the needs of most developers, owners and occupiers who just want reliable yet commonplace solutions which happen to be sustainable. This presents a major challenge to those who wish to demonstrate sustainable construction methods and techniques to a broad audience so that they can be disseminated and replicated widely and successfully. This involves achieving a balance between the inspiration of novelty and the acceptability of the mundane.

Demonstration projects are intended as references that prove that the construction methods and techniques live up to their promises, but they have not reached the desired impact in the market context. One of the main reasons for this failure may be that relevant dimensions of the built environment have not been taken into account in the selection of demonstration projects: such as the cultural and aesthetic dimension. Although this dimension is very difficult to measure, it is easily perceived by local actors and the lack of appropriateness can make or break the success of the building. The result is that the very objective of creating a positive reference for the construction sector, is inverted and the building becomes a reference of what not to do.

2.6 Conclusion

The State of the Art in terms of making building and construction more sustainable is constrained by a number of imponderables and in real life terms one can only strive for the best available and achievable in the prevailing circumstances. Limiting factors include:

- Economic constraints - whether perceived or actual, there is a limit as to how far one can go as the law of diminishing returns comes into play;
- Best available techniques are constrained by available technologies and manufacturers; This particularly relevant in the context of energy use and conservation; Burning hydrocarbons drawn from non-renewable sources remains the predominant method of heating and cooling most buildings rely on; Although technologies to use renewable energies exist, they are far from available;
- In terms of the use of renewable energies, the construction sector relies on the energy sector to make available economically attractive solutions;
- There are gaps in research, which need to be identified and communicated to the European Commission;

We can conclude that there are relevant positive aspects that characterise the State of the Art:

- A trend towards integrated solutions seems to be in motion;
- Cultural Heritage has been acknowledged as a determining factor (already in FP5) in enhancing the quality of life of people;
- The dissemination efforts of sustainable construction have resulted in relevant applications;
- There is a considerable amount of quality literature available on the subject of sustainable construction;
- The relevance of the construction sector in Sustainable Development has been understood;
- There is a popular support for the idea of sustainability;

Since there is no doubt that the methods and techniques are available to move towards sustainable construction, getting the relevant actors in the construction industry to implement them in their day to day practice, may rely predominantly on how effectively they can be motivated to take on the liability / risk associated with change.

3. Chapter 3 – BARRIERS and RECOMMENDATIONS

What barriers are preventing the mainstreaming of more sustainable construction ?
What are the recommendations to overcome the barriers ?

3.1 Key Issues

The construction sector is labour intensive and has a very large spectrum of stakeholders / actors, deeply linked to the geography and cultural roots; Each actor is of critical importance for the completion of the construction chain and needs to be addressed individually and as an integral part of the team, if Sustainable Construction is to be mainstreamed. In this chapter, the barriers that stand in the way of mainstreaming Sustainable Construction and the recommendations to overcome them, will be addressed from the perspective of each actor, in the case of new buildings and in the case of retrofitting, refurbishment and renovation.

- The political top down message has to be as coherent and clear as the Kyoto protocol commitment is serious and the links between economy and the environment need to become more direct and transparent;
- Many of the barriers that stand in the way of mainstreaming sustainable construction are culture and value related, thus requiring actions to increase public awareness;
- Construction methods and techniques are deeply rooted and form part of established processes that service / supply local markets – changing them requires integrated actions involving all relevant actors, helping them to work towards the same goals;
- There is a need for international co-operation in the definition of strategies and performance targets for the built environment;
- Research and development are required in refurbishment and renovation;
- Too technical approach in the development scene; sustainability needs more human and comprehensible applications (social and cultural sustainability);
- Complexity of ecological factors and their causalities as a whole; There are insufficient methods to cope with these;
- There is a need to measure the progress, while moving to a more sustainable environment; A recognised system of benchmarking / assessment of the sustainability in buildings is needed;

3.2 Context

Sustainable construction can contribute to a balanced existence between buildings, constructions and the environment, simultaneously supporting sustainable communities;

Given the fact that there are successful examples of sustainable construction across the whole of the EU, serving the respective communities, while reducing the impact of buildings on the environment, the main reason these are not common practice must be other than technical. Identifying the barriers that stand in the way of mainstreaming sustainable construction and finding the actions that will help overcome them is the objective of this working group.

Within the framework of this question it will be necessary to address what different incentives and penalties each actor requires in order to be motivated to invest in and implement the necessary change, for each actor and within the context of each climate region;

Overcoming the barriers will imply a considerable effort on behalf of the actors involved in the construction sector, as they will have to adapt the way they design and build in their everyday practice to a new set of values and quality criteria. The fact that an effort is essential to overcome the status quo, probably constitutes the dominant cause, why change is not forthcoming in spite of the fact that results of good practice are convincing. The need for co-operation among the different professions and actors, in order to create sustainable and efficient buildings, also requires changes in the current work methodology in many EU MS.

It is important to be aware of the fact that, across the EU, traditional construction methods have, in the past, been much more environmentally friendly than they became since the industrial revolution (motivated by production) and in more recent years (motivated by short term economic thinking). Values have changed, along with cultural evolution and aggressively marketed fashions and trends have taken over from native, common sense.

Section A

Sustainable construction as a quality issue in building projects has developed over the last 10 years in a number of European countries and also outside Europe, e.g. in USA, Canada, Japan. The background to sustainable construction in Europe is the concept of 'sustainable development' with its three pillars: economic, social and environmental. In the context of the United Nations Brundtland report, 'sustainable construction' is the contribution to sustainable development of decisions about raising the sustainability of the built environment.

The scope of building quality issues has widened from the building itself (indoor climate, building physics) to the impact of buildings on environmental resources (upstream data) and the whole life cycle of buildings, including their total or partial re-use and demolition strategies.

Sustainable construction combines a focus on the quality of life of the users with the long term (life cycle) economic value / benefit, while retaining a balance in the use of resources, making sure that the environment as a whole does not get overloaded or over-exploited.

Sustainable construction introduces life cycle thinking on all aspects of a building: architecture, construction methods and structural engineering, mechanical and electrical installations. The use-value and cultural identity are essential.

Adaptability and flexibility are key aspects in achieving more sustainable buildings.

Sustainable construction involves all participants in the building sector. This process is closely related to the regulatory requirements and to the user demands.

Section B[4]

During the design phase, when the buildings or other constructions are defined, and unless there are divergences during the construction period, the design determines the performance of the resulting building / construction on the long term. Many of the relevant performance based quality objectives of sustainable construction can be quantified, but there are less quantifiable objectives in sustainable construction that are no less important and often upstream in relation to the quantifiable ones.

There is a consensus on the following less quantifiable quality objectives of sustainable construction that include urban design measures:

- Intensify the identity and character of the built environment;
- Introduce diversity and variety of texture, colour, form, typology, use and property;
- Introduce flexibility to cater for unknown future needs;
- Increase the life span of buildings and public spaces;
- Optimise orientation of buildings to benefit from climate conditions;
- Guarantee accessibility to all;

There is consensus on the following more quantifiable quality objectives of sustainable construction:

- Improve indoor and outdoor air quality;
- Improve indoor and outdoor thermal comfort conditions;
- Reduce CO2 emissions per capita and per sector;
- Improve energy efficiency of buildings by implementing appropriate construction methods and techniques (passive solar design) internalising the best of the local climate conditions;
- Integrate renewable energy systems (active solar and wind) and energy management systems for permanent monitoring;
- Use non-renewable resources rationally (materials, energy), taking into consideration the life cycle of materials and their re-use and recycling potential (up stream and down stream);
- Specify systems to maximise efficiency in operation, making room for flexible performance;

[4] The following text forms part of the Architects' Council of Europe Policy on Sustainable Architecture;

- Reduce waste and facilitate waste separation;
- Reduce water demand and implement grey water recycling systems at the local level;
- Reduce running and maintenance costs;
- Improve impact on bio-diversity;

These objectives all aim to support / create sustainable communities, offering the highest possible quality of life to the users.

3.3 Barriers and Recommendations listed per actor

The following actors are identified as relevant for the construction industry and are listed below, organised in five clusters of actors that belong together:

Cluster 1: Ownership-related actors:

Actors motivated by financial criteria:

- Property management companies
- Owner
- Real estate agent and valuer
- Promoter

Cluster 2: Production-related actors:

Actors motivated by financial criteria:

- Manufacturer
- Labour force
- Contractor
- Controller
- Utilities
- Design Team

Cluster 3: Policy-related actors:

Actors motivated by environmental criteria:

- Urban Planner
- Municipality / Local Authority
- Health Care
- Member States
- Standardisation Institutes

- European Institutions

Cluster 4: Market-related actors – Consumer /Communication / Information / Education:
Actors motivated by cultural, environmental and social criteria:

- Occupier
- Local Media
- Education and Training
- Research
- NGO and local opinion associations / groups neighbourhoods
- Global Media

Cluster 5: Finance-related actors:
Actors motivated by financial criteria:

- Insurance Companies
- Banks / Mortgage Institutions

The input of each of these actors is by no means similar in quality, quantity nor relevance; Some actors are listed mainly because of the barriers they pose, others because their potential beneficial role could be relevant to mainstreaming good practice. The Annex 1 lists for each of the above actors in the vertical chain of action of the construction industry, the barriers they experience and create and the recommended actions each can take on, to overcome those barriers:

3.4 Barriers and Recommendations listed in order of priority

The Urban Thematic Strategy reaches across the different sectors of governance in Europe in an attempt to increase the effectiveness of the resulting laws (directives / recommendations) and their impact in the day to day life of citizens. This integrated approach reflects vision on behalf of the EC and constitutes an opportunity, which this WG welcomes and embraces.
The present report attempts to reflect the reality of the construction industry, in as much as it covers a very large spectrum of stakeholders / actors and that it has such a diverse and far-reaching impact on our society. The far-reaching dimension of the construction industry is apparent in Annex 1, where Barriers and Recommendations are listed per Actor.

On the basis of all that has been stated in the previous chapters, it is clear that sustainable construction is not a finite goal, but a continuously redefined direction and that mainstreaming

sustainable construction will require a clear and coherent top-down message (expressed in a set of EU common goals). Achieving these will require a significant effort on behalf of some of the main stakeholders / actors in the construction sector.

- The top-down political message has to come across to the market as clearly and coherently as possible – therefore:
  - All public money will be spent on projects that respect the quantified (measurable) requirements of more sustainable construction; Funds and subsidies will set requirements in line with more sustainable construction; Public procurement will set the example in terms of more sustainable construction;
  - Taxes and other regulatory mechanisms at global, regional and local political levels will be adapted and used to help motivate the stakeholders / actors to contribute to the achievement of these goals;
  - Urban planning instruments must make room for more sustainable construction, encourage it and even make it a condition for construction permits;
- Bottom-up market initiatives towards sustainable construction need to be accommodated and encouraged by local urban management – therefore:
  - More sustainable construction has a positive impact on the environment, and this added value has an extra cost that the market is not yet willing to pay for; Municipalities must collaborate with the reduction of this extra cost, by offering more flexible conditions;
  - More sustainable materials have a positive impact on the environment and the added value has an extra cost that the market is not necessarily willing to pay for; Taxes and subsidies should help encourage the Research and Development necessary;
  - Many of the qualities intrinsic to more sustainable construction can have direct cost reduction implications for the end user as well as health enhancing implications; Raising awareness of the end user to the choices he / she has includes the marketing / campaigning of relevant environmental information on: energy consumption in buildings (buildings energy certification), on toxic emissions of materials' and ventilation systems' impact on indoor air quality (could be included in the building certification if the scope of the 'passport' can be widened), on waste separation and disposal etc;
  - The use of non-renewable resources (specifically waste disposal, energy and water supply) should become more sustainable by encouraging the implementation of utility run local systems: for the recycling of grey water, for decentralised energy production, for decentralised waste collection;
  - Encouraging a shift in attitudes in all the stakeholders / actors of the construction sector, via education and continuous training is an indirect but nonetheless relevant area of action;

- In order to make more sustainable construction possible, having already determined that sustainability is a direction rather then an absolute goal, this direction needs to be clearly identified, so that efforts can be focussed efficiently and results can be attained in the short term – therefore:
  - It is important to define the holistic, environmental, common EU indicators and the respective quantified objectives (targets) within each indicator adapted to each MS, together with the adequate common EU assessment method, using a common language to all stakeholders of the construction industry;
  - There is a need to integrate principles of sustainability into the practice of design, construction, maintenance and management of buildings; The parameters that matter most must be identified in a language that is consistent with the issues typically addressed in the construction sector. As methodology: 1. Identify what can be kept from the current common practice integrating cultural and regional values (as valid for new buildings as it is obviously for retrofitting) 2. Identify what needs to be changed, new techniques and processes; 3. The resulting product must be assessed starting from the design phase in an integrated manner from the point of view of the fulfilment of the requirements and the environmental impact at all levels from the local, to the regional, to the global.
  - Certification of construction must be performance based rather than prescriptive, in order to challenge the design team to find creative and diverse solutions leaving them the relevant flexibility to be inventive;
  - Sustainable construction should be implemented through integrated approaches, and optimised solutions within the domain of each actor in the construction sector.

Looking at the barriers from the perspective of just one of the key actors, in order to illustrate their scope:

The kick start for any construction is launched by the entrepreneur / promoter (public or private), who identifies a market need and decides to take on the financial risk associated with transforming an idea / a construction brief into reality.

As such, the relevance of this actor is dominant. If we ask what motivation reaches the promoter to make him an accomplice of sustainable construction, the answer is very discouraging:

- Urban Planning rules and regulations don't encourage sustainable construction at all, on the contrary they make it more difficult;
- Utilities and Infra-structures are not forthcoming – their aim is to sell their product / service, the more the better – to make room for sustainable construction;
- Financial institutions don't practice positive discrimination in favour of sustainable construction;

- The market is not always receptive and is driven by other factors (such as culture, fashion, geography), and is not even aware of the relevant benefits of sustainable construction;

Conclusion:

There are relevant examples of sustainable construction all over the EU, but it is far from being a stream and much less a main stream.

There is no unique / single realistic recommendation to mainstream more sustainable construction; Although the scope and intensity of the barriers is as far-reaching as the impact of the construction industry on our society, they can be collectively and individually addressed and overcome. Annex 1 breaks down each barrier per actor in the construction industry and points out recommendations to overcome these barriers. If the road towards more sustainable construction is about offering the capacity for choice then, in order to have sustainable construction chosen as the alternative for tomorrow, it has to be promoted today as a viable alternative for the future.

4. Chapter 4 – EXAMPLES OF TARGETS

What kind of quantitative and qualitative targets can be proposed ?

Globally, nationally, regionally, and locally relevant environmental targets must be addressed to economical sectors, including the construction sector. These should be short, medium and long-term environmental targets. Ideally these targets are agreed between major parties in a sector.

The working group SCMT is aware that in order to retain the full qualitative input of every actor of the building sector it is important to set targets as opposed to prescribe solutions.

As stated above, there is a consensus on the following less quantifiable quality objectives of sustainable construction that include urban design measures:

- Intensify the identity and character of the built environment;
- Introduce diversity and variety of texture, colour, form, typology, use and property;
- Introduce flexibility to cater for unknown future needs;
- Increase the life span of buildings and public spaces;
- Optimise orientation of buildings to benefit from climate conditions;
- Guarantee accessibility to all;

For these the targets have to be set locally and as performance based as possible;

As stated above, there is consensus on the following more quantifiable quality objectives of sustainable construction, which can all be translated into indicators with targets:

- Improve indoor and outdoor air quality;
- Improve indoor and outdoor thermal comfort conditions;
- Reduce CO2 emissions per capita and per sector;
- Improve energy efficiency of buildings by implementing appropriate construction methods and techniques (passive solar design) internalising the best of the local climate conditions;
- Integrate renewable energy systems (active solar and wind) and energy management systems for permanent monitoring;
- Use non-renewable resources rationally (materials, energy), taking into consideration the life cycle of materials and their re-use and recycling potential (up stream and down stream);
- Specify systems to maximise efficiency in operation, making room for flexible performance;
- Reduce waste and facilitate waste separation;
- Reduce water demand and implement grey water recycling systems at the local level;
- Reduce running and maintenance costs;
- Improve impact on bio-diversity;

During the next stage of development of the report, these targets will hopefully be defined or at least illustrated with examples from MS;

5. Chapter 5: OVERLAPS WITH THE OTHER URBAN THEMATIC STRATEGY WORKING GROUPS:

The most important outcome of the work of the SCMT working group will be the definition of measures to be implemented at political and market level, which will bring sustainability into the every decision of the complex process of creating our European built environment.

On the working group's scope and thematic substance:
As sustainable construction relies on a holistic approach in relation to all the relevant areas, there will be common ground with the related sectors, such as urban design and management and transport infrastructures.

The group decided not to focus on the definition of the borderlines, rather to focus on the core of the thematic substance and work towards the related sectors.

Some areas of common concerns are nonetheless clear:

With urban design:

«A well designed urban context won't be damaged by bad architecture, and a badly designed one can't be saved by good architecture» quote by Klas Tham;

Solar orientation and overshadowing, wind protection (enclosure) are defined at the urban design scale, and can prevent (or make possible) the creation of good and comfortable indoor and outdoor spaces;

It is therefore clear that sustainable construction depends on sustainable urban planning;

The role of this Working Group SCMT in relation to the Urban Design WG is defined as follows: SCMT WG is looking at the building and its quality both in relation to the built environment and to itself, from a holistic and an integrated perspective;

With sustainable urban management:

Part of urban management is the approval of proposals for the built environment, and as such there is an enormous potential of influencing the end result in terms of a goal of sustainable construction; Many of the SCMT working group's recommendations will address the urban management area;

With transport infrastructures:

As a higher density of the built environment can favour the efficient use of all urban infrastructures as well as make people's lives easier, it is important to be aware of its strengths and weaknesses;

For density to become a positive element in people's lives, planning, management and architectural performance are even more critical than in low-density urban contexts, mainly because tolerances reduce in a higher density urban context.

Another physical common area between construction and transport are the car parking areas; As buildings can be energy producers (photovoltaics) and cars are energy users, another common ground can be found.