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NEEDS of RESEARCH for the CONSTRUCTION INDUSTRY

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1. INTRODUCTION

It is not my purpose to reveal something you don't already know. Rather, my purpose is to rearrange the information that is known by the people of the Construction Industry in such a way that we can look at RTD as a whole for this industry, which is the reason of this initiative.

Therefore, after making some general comments about the Construction Industry, I will answer the following questions:

- . Where is the Construction Industry and its RTD today?
- . What challenges will we face tomorrow?
- . What actions should be taken?
- . What specific actions should be taken in RTD?

2. GENERAL CONSIDERATIONS ABOUT THE CONSTRUCTION INDUSTRY

2.1. Importance of the CI

It is not necessary to point out in this forum the strategic importance of the construction industry in all our countries. Its repercussion on the GNP and on creating gross capital are decisive for the economy of any country.

The economic importance of maintenance and repair expenses for what has already been built makes us double our efforts to build better so that the overall cost (construction plus maintenance) can be reduced to the absolute minimum.

Therefore, all the investments we make in researching and developing technologies which reduce the cost of maintenance and repair will be highly profitable in themselves.

2.2. Characteristics

Nor is it necessary to mention the singular characteristics of this industry which make it basically different from all the others. The most significant singularities are:

- industrial fragmentation
- diversity of agents
- dispersed locations
- the prototype nature of any construction
- personal risk of the workers
- technological diversity (from simple buildings to industrial complexes, off-shore platforms, etc.).
- and so on.

Any effort, whether in research or elsewhere, towards eliminating or reducing these adverse factors will benefit the construction industry, its immediate clients and the countries in general.

2.3. Agents

The construction industry should not be understood as limited to the contractors but also includes:

- materials manufacturers
- equipment manufacturers
- designers
- specific software developers
- construction companies (large and small, general and specialized).
- control and testing companies
- end users
- etc.

Although everyone has a general concern for the technological processes, not all of the agents can be interested in every partial aspect of a technology.

Each agent usually has a specific interest for a part of the technology, but they complete together its scope.

2.4. Interest of end users

Technological progress in construction should not only be of interest to the companies in the sectors mentioned above, but also to their end users. Of these, the National Governments will be the first to benefit from this progress, as well as other large investors in construction such as the electric, oil and chemical companies. By this reason, the role of end users is the most important.

2.5. Current situation of RTD in Construction Industry

Due to the mentioned fragmentation, it's difficult to know the exact figure of the research effort in Construction Industry. Nevertheless it's not risky to say that we would need to multiply our efforts by 2 or 3 to reach the medium industrial level.

Traditionally, RTD in construction has been carried out away from the jobsite by public and private entities and some manufacturers of materials and equipment. Contractors' participation has been very low. Therefore, Research Centers have been producing knowledge, guidelines for designs, standards, codes and regulations, etc., but they did not produce new products, new construction techniques, new processes, new tools, etc.

One point to be signalled is that few research projects were done on full scale at the jobsite (test sections on highways, tunnels, structures, etc.) because the promoters of the works must be involved (Governmental agencies, private clients, etc.).

2.6. Reasons for the Low Level of RTD in Construction

The reasons for the low level of RTD in the Construction Industry, at least in Europe, are:

- . Benefits for the construction companies are low
- . Lack of stability in the industry which is closely connected to the economic crisis and cycles.
- . Brief duration of the construction process in comparison with activities in other industries.
- . Excessive and harsh competition between companies, enhanced by investment authorities.
- . Etc.

Furthermore, it takes time and is difficult to apply the advances achieved on an experimental level. The reasons for this could be that:

- . the people who define what is to be built are not aware of the options of new products, materials, equipment, etc.
- . the behaviour on long term of some innovations is still unknown.
- . etc.

3. FUTURE CIRCUMSTANCES OF THE CONSTRUCTION INDUSTRY

These are some of the circumstances which will affect the Construction Industry in upcoming years. In this list there are priorities: these are, in my opinion, the requirements coming from ENVIRONMENT and from ENERGY areas. We'll have to face:

- . More requirements derived from the **Environmental** Policy. Thus, supportable development will mean:
 - . limited use of raw materials
 - . better management of raw materials
 - . reusing materials
 - . recycling materials
 - . using ecological materials
 - . using all types of waste products
 - . using marginal materials
 - . considering durability of the materials and of the finished construction
 - . considering the cycle of materials, etc.
 - . soil recovery
- . The Environmental Policy will also require better conservation and less **energy consumption** (in buildings, etc.). In this line, new concepts for the design of buildings, highways, railways, etc. will have to improve the general efficiency of the Society.
- . The need to improve comfort in buildings will signify:
 - . reducing air and noise pollution
 - . providing intelligence systems to buildings and their surroundings
 - . considering fire safety in buildings
 - . considering users with specific demands (elderly, single people, disabled, etc.).
- . The need to improve the conception, design and construction of urbanizations and of the centers where community life is carried out.
- . There is also a need to improve and increase transport and communications infrastructures.
- . There will also be new requirements derived from other industrial sectors which use construction, such as design and construction of:
 - . infrastructures for private clients
 - . underground spaces for various uses (for example to storage gas, fuels, etc.)
 - . large enclosed spaces with climate control for agricultural use or in cold zones, etc.
- . We will have to evaluate and maintain what we have built up to date (buildings, infrastructures, etc.). Today, this represents 35% of the industry's activity.
- . We will have growing demands for Quality Assurance and Reliability.
- . We will have to respond to greater demands in Safety and Health at the jobsite
- . We will have to face the progressive ageing of the population.

There will be greater competition due to the progressive internationalization of the economy and, therefore, the need to increase our attention to:

- . new design procedures
- . new building procedures
- . new materials (concrete with fibres, plastics, HRC, etc.)
- . upgrading traditional equipment
- . upgrading traditional processes
- . applying Information Technologies (CAD, CIM, Lean production, simulation techniques...)
- . using mechatronics
- . considering the competitive risk represented by the development of Japanese robots.
- . further industrialized construction
- . the growing need to train specialized personnel in new technologies.
- . the need of after sales services

and so on.

4. ACTIONS to IMPROVE the COMPETITIVENESS of the CONSTRUCTION INDUSTRY

After showing you the present and future scenarios, we need to look for actions.

4.1. Actions in general

In view of these challenges, the Construction Industry must become more competitive.

A good part of the progress of the industry in this respect, and especially of the construction companies, would simply come from:

- restructuring the industry: better organization within the companies and the sector as a whole.
- modifying the forms of contracting
- constantly training the technical staff in new techniques
- applying more intensively those technologies of proven efficiency
- furthering standardization to encourage prefabrication and industrialization

4.2. Actions for technological progress

For the technological progress of this Industry, all the agents of this Industry need to make efforts to improve its technological level. We need to follow at least these lines of action:

- To stimulate a rapid integration of the scientific developments into technological processes.
- To spread knowledge about the existing technologies and their use. Most of the necessary technologies already exist. They must be made known and

their application must be taught. The diffusion of know-how is essential. Also it is important to recover the feedback of first applications.

- To make RTD more effective through coordination and exchange of information between countries and different agents:
 - . Create data banks with the projects under way.
 - . Create networks to exchange information between RTD Centers to compensate their structural fragmentation.
 - . Contemplate formulae for contracting the first application of advanced technologies.

4.3. Actions for improving RTD

We could consider:

- To encourage innovation
- To increase the amount of funds dedicated to RTD.
- To Start real pilot experiences, as technological progress in construction needs to be sanctioned by the application of new technologies at the jobsite. Since these have owners, it is only with their permission that new materials or specific technologies can be used there. Only the technologies which affect the manufacture of known materials and design, organization, testing and control techniques can be developed without the owner's authorization.

5. FINAL REMARKS

Given the economic importance of the Sector as pointed out at the start, we must take advantage of occasions such as this initiative to consider together the mechanisms which we have to activate RTD of Construction.

I am happy to have had the opportunity to participate in this workshop and congratulate the organizing committee for this initiative, hoping that the debate will be beneficial for everyone.