CURRENT STATUS OF SUSTAINABLE CONSTRUCTION IN EUROPE

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1. INTRODUCTION

The construction sector is one of the industries generating the greatest environmental impact and thus the sector must encourage sustainable development. However, at present, the concept of sustainability is not solving the environmental problems caused and requires an immediate change [1]. Also, the level of sustainable implementation in Europe varies substantially from one country to another. In some countries, a movement wanting to shift from implementing degenerative or "less bad" strategies to other strategies aiming a positive net environmental impact, by means of regenerative sustainability criteria. Regenerative sustainability promotes buildings that not only achieve zero environmental impact, but their impact is positive, meaning that buildings are able to "regenerate" their users and the environment [2, 3]. In this sense, the COST Action "RESTORE" (REthinking Sustainability TOwards to Regenerative Economy) was developed, aiming to transform the sector and promote this new way of understanding sustainability.

2. AIM

This work presents the first results obtained in the RESTORE Action and particularly in Working Group 3 that deals with Sustainable Building Construction, regarding the level of implementation of sustainability in the different countries of Europe.

3. METHOD

For this, a short survey was developed, focusing on three main construction aspects: materials, technology and tools. The survey was structured into different sections. In the first section, respondents were asked to indicate about their experience and general information. In sections 2 and 3 (materials and technologies) respondents were asked to indicate to what extend do they use traditional/advanced/emerging materials or technologies in each stage of the construction process: foundation, structure, façade, interior partitions and finishings. Respondents had to answer on a 5 options scale of "I don't implement it at all"; "10-20%"; "20-50%"; "50-90%"; "I always implement them". In the last section, tools, respondents were asked to identify the most commonly used construction standard and certification system. The survey was sent to more than 150 professionals covering different construction agents and 62 responses were received.

GENERAL INFORMATION ABOUT RESPONDENTS

MATERIALS

- Traditional materials: such as stone, reinforced concrete, mortars, gypsum plaster, bricks, wood, adobe, etc.
- Advanced materials: including prefabricated materials such as: plasterboards, Glass Reinforced Gypsum; precast concrete, Glass Fiber Reinforced Concrete, etc. and sustainable materials such as recycled materials, biomaterials, etc.
- Emerging materials: including phase-change materials and restorative materials such as: self-healing materials; materials improving the indoor/outdoor air quality; etc.

TECHNOLOGIES

- Traditional technologies: Concrete mixers, Excavators, Tower cranes, Hand tools, etc.
- Advanced technologies: Computer-Aided Design (CAD) and Building Information Modeling (BIM), Computer Numerical Control (CNC) Machines, Robots, etc.
- Emerging technologies: Internet of Things (IoT), Augmented Reality, Drones, 3D Concrete Printing, etc.

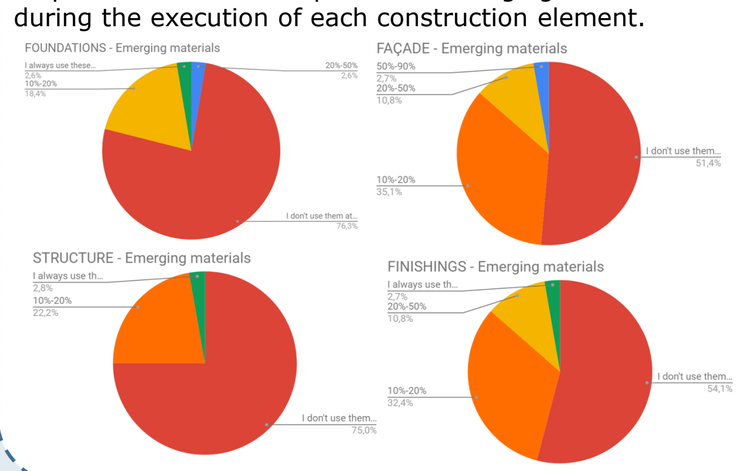
TOOLS

- Construction Standards: ISO, Eurocodes, DIN, BSI, others
- Certification System: LEED, BREAM, DGNB, others.

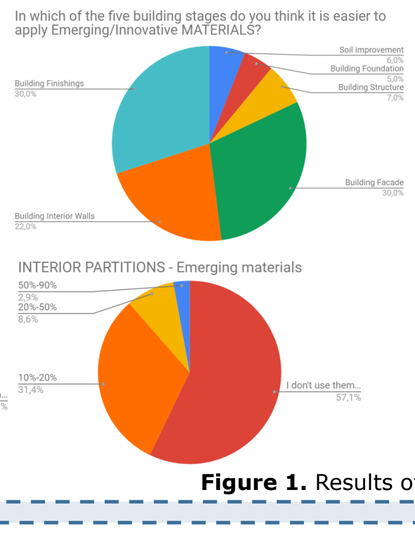
4. RESULTS

MATERIALS

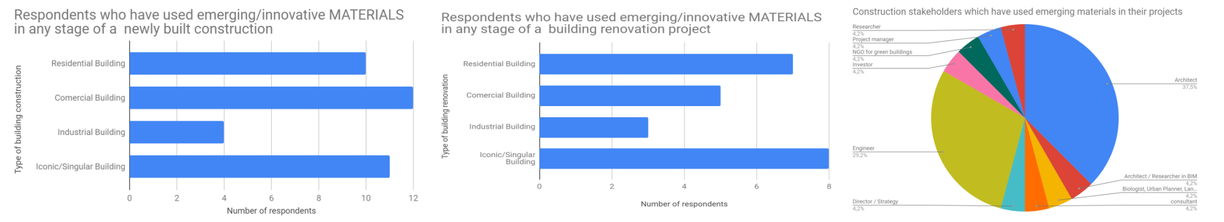
The charts below show the low percentage of respondents which implement emerging materials during the execution of each construction element.



Furthermore, respondents were asked to identify which of the five building construction stages is easier to implement or use emerging/innovative materials. Results show that the majority of the respondents (30%) consider the building façade or finishings as the building activities were emerging materials can be easily implemented.



Those respondents who have used emerging materials, were asked about the type of building were they applied such materials. Iconic buildings are the major building types were emerging materials were incorporated in a newly built project and rehabilitation projects.

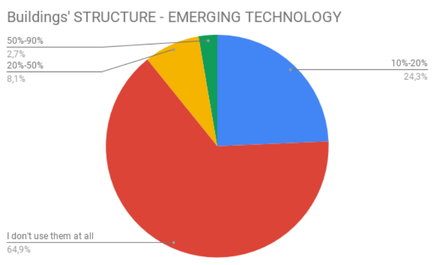


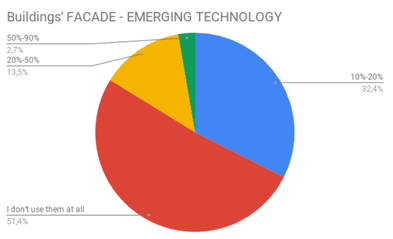
Furthermore, it was found that architects and engineers were the major agents implementing these materials, accounting for 37.5% and 29.2% respectively. Finally, the lack of training among construction stakeholders and the lack of knowledge of the existing emerging materials, are the main barriers identified by the respondents. The high cost of these materials was the third drawback highlighted by the respondents.

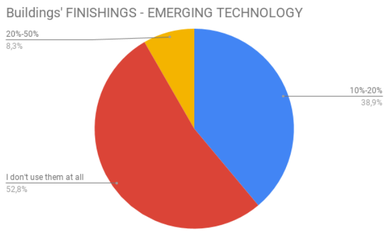
Figure 1. Results of implementing emerging materials in Europe

TECHNOLOGIES

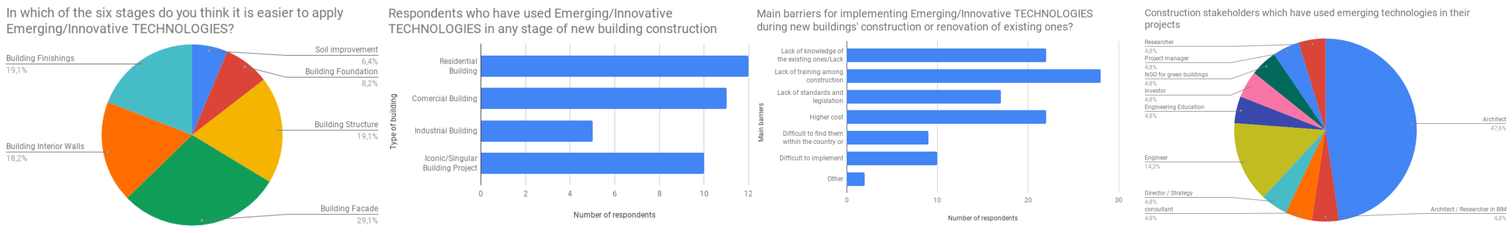
The results show very low use of emerging technologies in all construction phases. The option 'I do not use them at all' seems to prevail over the second option that is '10-20%' in all phases of Buildings' tasks.







Moreover, the results in the question 'In which of the six stages do you think it is easier to apply Emerging/Innovative TECHNOLOGIES?' show that first choice is Buildings' façade with 29.1%. The results in the question 'If you have used Emerging/Innovative Technologies in any stage of a new building or building renovation, please specify the type of building/s' show that the use of these technologies at any construction stage has a higher rate of application in new construction than renovation with first choices Residential buildings and Commercial buildings respectively.

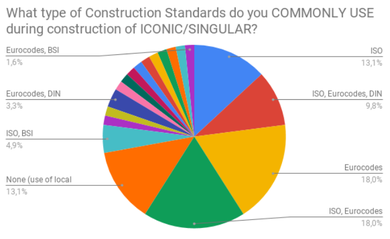


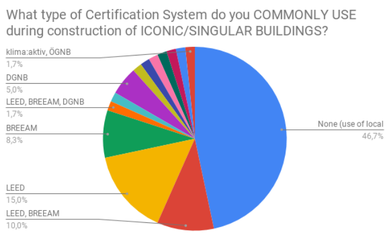
Finally, the answer 'Lack of training among construction stakeholders' has the highest rate of response with 25.5% regarding the main barriers in implementing emerging technologies. The 'Lack of necessary information' and 'Higher cost' with an equal rate of 20.0% are the second most selected answers by respondents. Also, it was found that architects and engineers were the major agents implementing these technologies with 47.6% and 14.3% respectively.

Figure 2. Results of the implementation of emerging technologies in Europe

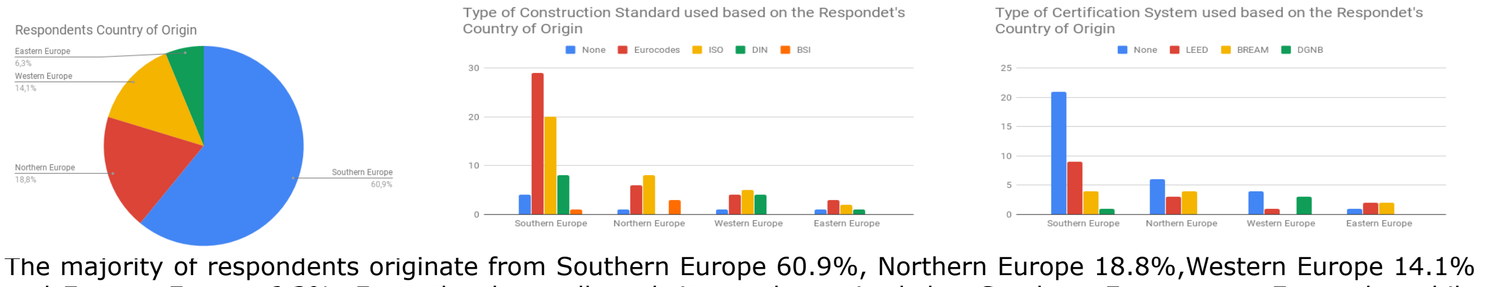
TOOLS

The results show that the most commonly used construction standard during construction of residential, commercial, industrial and iconic buildings is Eurocodes followed by other standards such as ISO which is mostly used during construction of Iconic Buildings.
While the most commonly used Certification Systems, are local ones 46.7%, depending on the local law requirements in different countries, followed by LEED Certification system which is mostly used during construction of Iconic Buildings.





Besides, when asked to identify the reason why the respondents don't use any of the official Construction Standards, the most frequent answer was, usage of local/national standards required by law. But there were also answers indicating that application of construction standards increases the project cost or that they don't use because it is not mandatory and the investors are not interested. While the common reason given by the respondents for not using the Certification System, is lack of requirement by the investor and in Industrial Buildings, it goes up to 58.3%



The majority of respondents originate from Southern Europe 60.9%, Northern Europe 18.8%,Western Europe 14.1% and Eastern Europe 6.3%. From the data collected, it may be noticed that Southern Europe uses Eurocodes while Nothern and Western Europe prefer ISO.
It can easily be noticed that the most un-certified buildings are located in Southern Europe while other regions, choose to use LEED or BREAM, and in few cases in Western Europe, DGNB.

Figure 3. Results of implementation of tools in Europe

5. CONCLUSIONS

Results show that, in general, there is a lack of regenerative sustainability criteria in Europe, especially in the southern countries. Most countries rely on traditional materials and technologies rather than advanced and emerging materials and techniques. Finally, the results obtained help to understand the current situation of sustainability and to identify the challenges and difficulties of implementing Sustainable Construction in the Europe.

References

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