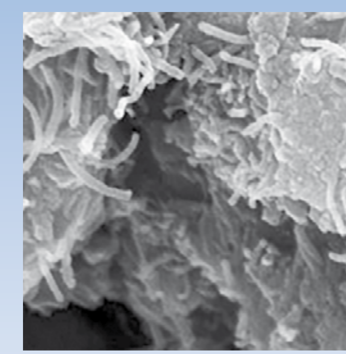
4th Workshop on

The New Boundaries of Structural Concrete

University of Naples Federico II – ACI Italy Chapter
Anacapri – Italy, September 29th – October 1st, 2016

Editors
Antonio Bilotta, Gennaro Magliulo, Emidio Nigro,
Roberto Realfonzo, Paolo Riva



EDIZIONI READY

4th Workshop on

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The IV Workshop "The New Boundaries of Structural Concrete", organized at the University of Naples Federico II (Villa Orlandi, Anacapri (NA), Italy) in September-October 2016, arises from a joined initiative between this University and the American Concrete Institute (ACI) Italy Chapter.

The Workshop has been articulated by organizing about 50 presentations in six different sessions. The sessions are listed below by following the chronological order scheduled by the Workshop program:

Session A – Performance and life-cycle cost of new concrete structures
Session B – Controlled-performance concrete
Session C - New scenarios for concrete
Session D – Concrete quality control on site
Session E – Innovative strengthening systems for concrete structures
Session F – SUPERCONCRETE

The proceeding volume collects the latest advances of the research in the above mentioned topics and so, it is addressed not only to members of the scientific community but also to representatives of the industry and to professionals directly involved in the design and construction of new structures and in the retrofitting of existing ones.

ISBN 978-88-98720-14-9
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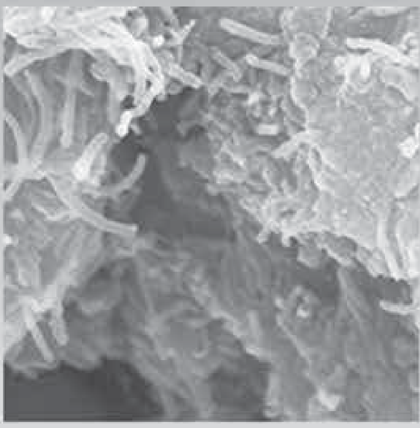


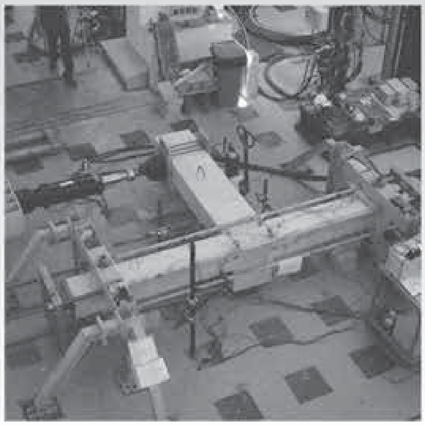

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Antonio Bilotta, Gennaro Magliulo, Emidio Nigro, Roberto Realfonzo, Paolo Riva

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Department of Structures for Engineering and Architecture, University of Naples Federico II
Via Claudio 21, 80125 Napoli (NA),
E.Mail: aciitalychapter@gmail.com; maddalena.cimmino@unina.it, Tel: 0817683669

Pubblicato da:

EDIZIONI IMREADY

IMREADY Srl
Strada Cardio, 4 - 47891 Galazzano (RSM)
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New scenarios for concrete

Session D

Concrete quality control on site

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Innovative strengthening systems for concrete structures

Session F

SUPERCONCRETE

Analysing the Practice of Economic and Environmental Evaluation of Structural Concrete

V. García[1], D. García[2], J.T. San-José[3] and J.S. Dolado[4]

ABSTRACT: Concrete science is looking for new binders, recycled aggregates and improved admixtures to develop environmentally friendly and cost-competitive concrete formulations. With all those ingredients, it can be difficult to select the most sustainable options. Life Cycle Approach has been adopted by professionals to make decisions in building and civil engineering projects, determining respectively the most cost-efficient solution and the quantitative environmental releases during the whole life of the structure. However there are several challenges to be considered for their application in concrete and derived projects: quality of the data, uncertainties, allocation, land impacts and abiotic resource depletion, etc. This paper summarizes what is being done in this sustainability assessment field and the stress the necessity of Low Carbon cements and further improvements in data and methods for the evaluation of concrete sustainability.

1 INTRODUCTION

1.1 Costs and environmental impacts in concrete industry

Concrete is by far the most important, the most versatile, and the most widely used building material worldwide. On average, each year, three tons of concrete are consumed by every person on the planet (Rubenstein, 2012). Cement is the primary ingredient in modern concrete. To produce cement, limestone and other clay-like materials are heated in a kiln at 1400°C and then ground to form a lumpy, solid substance called clinker. Portland cement (PC) manufacturing is highly energy and emissions intensive because of the extreme heat required to produce it. As a result of that, the concrete industry has an enormous impact on the environment (Meyer, 2005).

Taking a look to average production costs distribution (Proin, 2010), it follows that the most important component is the materials, particularly the cement, so it is necessary to make the best use of them.

Table 1. Production costs distribution of conventional C25/30 ready-mix concrete

Materials (including transport to concrete plant)	Costs
Cement	40.46%
Fine aggregates	15.14%
Coarse aggregates	15.14%
Additions and admixtures	1.32%
Water	0.28%
Total for materials	72.34%
Concrete transport	15.42%
Direct costs (personnel and others)	7.88%
Indirect costs (management and selling)	4.36%

[1] *MS Engineer, TECNALIA research and innovation, veronica.garcia@tecnalia.com*
[2] *PhD Engineer, TECNALIA research and innovation, david.garcia@tecnalia.com*
[3] Associate *Professor, University of the Basque Country (UPV/EHU), josetomas.sanjose@ehu.es*
[4] *PhD Physics, TECNALIA research and innovation, jorge.dolado@tecnalia.com*

- Use "statistical" methods: Interval algorithms, Gaussian error propagation formulas, Monte-Carlo simulation, Fuzzy logic approaches, etc.

Integrating uncertainty into LCA and LCCA begins with identification and prioritization of uncertainty sources. Due to the high level of uncertainty in many aspects, originating from both epistemic and aleatory sources, the prioritization of the sources can be leveraged to help focus specific characterization efforts.

Traditional sampling methods (e.g., Monte-Carlo) can be used to deal uncertainty in LCA and LCCA. The following steps need to be done (Swei, 2012):

- Consider every input parameter as a stochastic variable with a specified probability distribution (mean value and standard deviation)
- Construct the LCA or LCCA model with one particular realization of every stochastic parameter
- Calculate the LCA or LCCA results with this particular realization
- Repeat this for a large number of realizations (n=1000)
- Investigate statistical properties of the sample of LCA or LCCA results

3 CONCLUSIONS

PC is the main responsible of the environmental effects and initial costs for structural concrete mix. Increased use of valorisation materials as recycled aggregates or efficient transport have some economic and environmental benefits but a relevant CO_2 reduction can only be obtained with the partial substitution of PC by other SCM or its total replacement by low CO_2 cements.

Researchers and market stakeholders need Life Cycle evaluations to be able to quantify the effect of changes in the formulations. In this regard, an accurate definition of the scope, system boundaries and functional requirements is critical for a later correct analysis and interpretation of any result.

There has been observed that data availability and confidence is lagged behind other industries. For that reason it is necessary to increase the research work and data gathering to dispose of good quality information, more in special in those areas that strongly contribute to the global cost and environmental impacts.

Allocation should help to reduce the environmental impact of cement production. Pressures from the waste or co-products producers aim to reduce the environmental footprint of steel and carbon-based energy. However, since the generation of those co-products cannot be avoided in their respective processes and they are not specifically obtained in a separate production, a minimum impact should be allocated to concrete, i.e. only the secondary process for valorisation (cooling, grinding, sieving, transport, etc.) for their new application.

Finally, uncertainty should not be ignored in concrete evaluations in order to show the maximum transparency of the assessment process. In most cases this means identification of missing data, extra research work and normative effort but incorporation of statistical analysis to the evaluation.

4 ACKNOWLEDGEMENTS

This paper was possible thanks to financing support of Green Concrete Research group (TECNALIA), Superconcrete project (H2020-MSCA-RISE-2014 n.645704), the Basque Regional Government research group IT781-13 and, likewise, to the Spanish Ministry MINECO and FEDER through BlueCons project (BIA2014-55576-C2-2-R).

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