Durability-based design of advanced cement-based materials in aggressive environments: a holistic approach

Educational and technical training (MOOC)

01- ABOUT THE MOOC

In the framework of H2020 programme, the European Commission has funded the project ReSHEALience whose main goal is to develop an Ultra High Durability Concrete (UHDC) and a Durability Assessment-based Design (DAD) methodology to improve durability of structures and predict their long-term performance under Extremely Aggressive Exposures (EAE).

The project will define the composition of UHDC tailored for specific applications, upgrade experimental methods to validate its durability in service conditions, and develop a theoretical model to evaluate ageing and degradation of UHDC structures.
New design concepts will be validated through design, construction and long-term monitoring in six full-scale proofs-of concept, selected as representative of cutting edge economy sectors, such as green energy, Blue Growth and conservation of R/C heritage.

The project consortium, coordinated by Politecnico di Milano, has gathered together 13 partners from 7 countries, including 6 academic institutions and 7 industrial partners, covering the whole value chain of the concrete construction industry.

ReSHEALience project has received funding from the European Union's Horizon H2020 research and innovation programme under grant agreement Nº 760824

The course is addressed to PhD students, researchers, academics, engineering and industry professionals working with advanced cement based materials from both material and structural point of view.

START DATE: May 11, 2020

LANGUAGE: English

COST: Free

100% ONLINE: *[Before starting, you'll have to register]

Full information in:
https://uhdc.eu/mooc

02- PROGRAMME

UHPC/UHPFRC: material concept and structural design. (P. Serna, UPV)
It shows some initial aspects related with the materials, composition, mix design, properties an characterization of the properties of a UHPFRC.
The material behavior at fresh and hardened state is considered, and typing recommendation for the material are exposed.
General design criteria, both at sectional and structural level are commented thinking in present the basis to adapt to the particular requirements.
Examples of real applications in the international experience and others to expose or demonstrate the interest of good specific conditons of the mateal to be compared with tradictional constructions.

TRC: material concept and structural design. (A. Peled, BGU)
The presentation provides a general overview on Textile Reinforce Concrete (TRC), including motivation of using this technology, possible fabric materials, textile geometry, and matrix types. The main focus of the presentation is on durability concerns of TRC elements, specifically on their cracking behavior including crack healing, water permeability, and their resistance to aggressive environmental exposure reach with Cl- ions.

From UHPC to UHDC: testing the durability and identification of design parameters. (M.C. Alonso, CSIC)
The talk deals with the relevance role of concrete characteristics to improve the durability of concrete structures. Concrete innovation and challenges in the 21st century are addressed. The evolution of concrete technology and the incorporation of new additives to reach ultra-high durability concretes is analysed and compare with respect to more conventional concretes. Aspects considered are related to the relevant parameters that characterise the durability of concrete according to the aggressiveness of the environment under operation. Key performance indicators for the durability assessment are under evaluation. Concrete technology plus the incorporation of suitable concrete constituents to enhance concrete durability, in concrete to resist the aggressiveness of the environment, in reinforcement to prevent from corrosion and crack control to improve durability through crack sealing.

Principles of durability based design. (L. Ferrara, PoliMi)
The presentation will provide the description of the framework and methodology for Durability Assessment based Design approach for structures made of/retrofitted with the Ultra High Durability Concrete materials conceived, produced and investigated in the project ReSHEALience.
The innovative design concept informing the whole approach will be formulated shifting from a set of prescriptions, mainly referring to material composition and also including, in case, an allowable level of damage defined and quantified in order not to compromise the intended level of "passive" protection of sensitive material and structural parts (deemed-to-satisfy approach; – avoidance-of-deterioration approach), to the prediction of the evolution of the serviceability and ultimate limit state performance indicators, as relevant to the application, as a function of scenario-based aging and degradation mechanisms.

Principles of LCA. (M. C. Caruso, STRESS)
The presentation deals with the methodology for assessing the environmental sustainability of products/services, according to the ISO 14040 and ISO 14044. Furthermore, a description of the software for performing LCA studies is provided and some case studies are presented.

Case study 1: Offshore floating platform for wind turbine based on UHDC. (C. Suesta, RVM)
The presentation about Case Study compiles the information to understand the interest and motivation of Rover maritime in developing the prototype that is a Concrete Floating Platform for offshore wind turbines. This presentation also shows the details about the design, construction and assembly of this prototype and the characteristics that are going to be monitored during marine exposure.

Case study 2: Geothermal application for water basin and mud basin. (I. Mazzantini, EGP)
Enel Green Power is one the biggest operator for Geothermal Power Plant in the world. In the ReSHEALience project Ultra High Durability Concrete (UHDC), designed from Politecnico di Milano, is testing in infrastructures of Geothermal field; in particular the tests concerns the realization of water basin for cooling tower and mud basin for water from drilling operation. In this presentation we explain the holistic approach, and we deepen the design of structures.

Case study 3: The Restoration of a Degraded Historic Reinforced Concrete Water Tower using advanced Techniques, based on Ultra High Durability Concrete and Textile Reinforced Self-Healing concrete. (R.P. Borg, UoM)
The lecture refers to the restoration of a 1930s historic reinforced concrete water tower in the Grand-Harbour of Malta. The Water Tower, consisting of a 15m high reinforced concrete tank based on shell elements, resting on 12 columns, suffered severe degradation in a coastal environment. The presentation refers to the restoration strategy, documentation and mapping of degradation, materials and structure assessment and testing, advanced non-destructive assessment, finite-element modelling, repair interventions including patch repair, electrochemical chloride extraction & re-alkalisation, UHDC jackets to strengthen columns based on self-healing, fibre-reinforced and self-compacting concrete composite with crystalline admixture and nano-additives, and Textile Reinforced Concrete applied to shell elements, the installation of an advanced sensor network system for durability, structural health and environmental monitoring and the setting up of an Education and Technology Platform.

Case study 4: Experimental verification of deflection hardening structures under service. (E. Camacho, RDC)
The presentation shows in detail the pilot number 3 produced in the ReSHEALience project. It is explained why ultra-high concrete technologies are optimum for this type of application, and how the pilot will be a tool to better understand the UHPC-UHDC structures under cracked state.

03- LECTURERS

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