Exploring the Potential of Low-Carbon Geopolymer Concretes under Cyclic Loading for Sustainable Marine Energy Infrastructure (EPSMEI)

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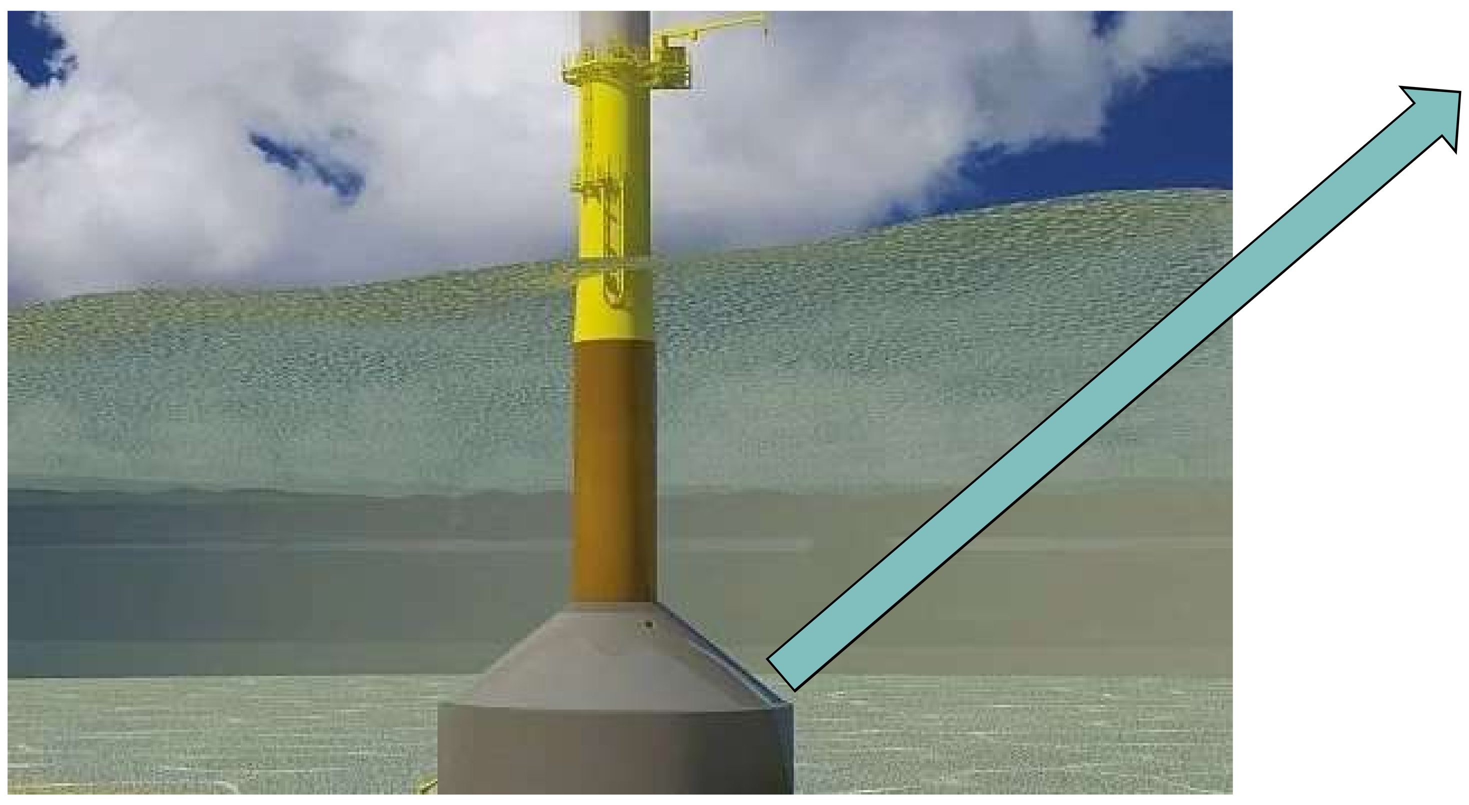
Context & Objectives:



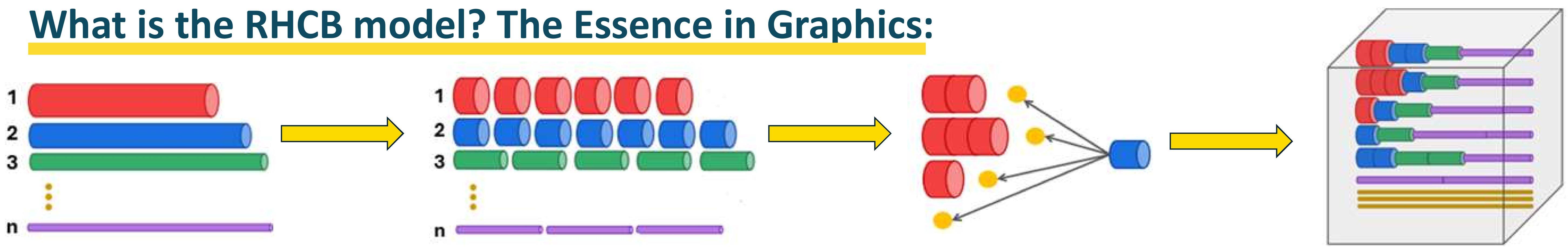
Source: https://www.iims.org.uk/

Geopolymer concrete, as the foundation of offshore wind turbines, is susceptible to experience seawater-induce dynamic fatigue loads with frequencies ranging from 0.1-1 Hz. This loading is an aggression that can threaten the service-life of the foundation of offshore infrastructures.

In this project, **the defined objectives are**:

- Understanding the mechanical behavior, plus the **crack initiation & propagation** patterns of geopolymer concretes under **dynamic fatigue loading** with different frequencies.
- Defining "gas permeability" of geopolymer concrete as its "durability indicator", and estimating it within the context of **RHCB (Random Hierarchical Capillary Bundle) model** before & after dynamic fatigue loading.

What is the RHCB model? The Essence in Graphics:



Stage 1: Identifying *n* classes of capillaries within the porous material via Mercury Intrusion Porosimetry (MIP) method

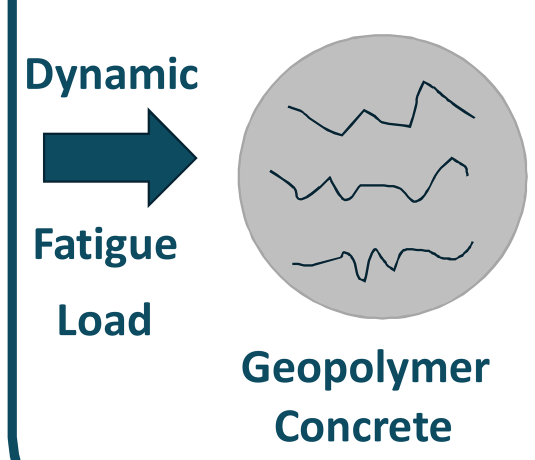
Stage 2: Random discretization of the Identified capillaries into numerous segments

Stage 3: Random hierarchical assembly of the segments, toward the reconstruction of the porous network

Stage 4: Cumulative calculation of the intrinsic gas permeability of all the reconstructed hierarchical capillaries

Details of the RHCB formulation: A.N.Omrani, I., Koniorczyk, M., Choinska Colombel, M. et al., Sci Rep (2026), https://doi.org/10.1038/s41598-026-45134-8
Source of the graphics: https://doi.org/10.1016/j.conbuildmat.2022.129859

Techniques, Novelties & Benefits of the Project:



Microstructural analysis of cracking pattern & pore size distribution of geopolymer via **MIP/SEM** which is not fully understood under dynamic fatigue loading

Measuring the **gas permeability** of geopolymer before & after dynamic fatigue loading

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Predicting its durability within the context of RHCB under seawater actions

Accordingly, this multi-functional project promotes the future use of **low-carbon, sustainable** geopolymer concrete in **offshore infrastructures.**

Cette action est soutenue par NExT et par l'Etat au titre du Plan d'investissement France 2030.