

Woh Hup Distinguished Lecture



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Department of Civil and Environmental Engineering

The Path to Ultra-High Performance Fiber Reinforced Concrete: Five Decades of Progress



by

Professor Emeritus Antoine E. Naaman

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<p>Date: Friday, 18 February 2022 Time: 4:00pm to 5:30pm (Pending PDU)</p>	
On-site	Virtual
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<p>Due to COVID-19 safety measures, onsite lecture is restricted to the first 40 participants. Only fully vaccinated can register for onsite event. You will receive an email confirmation 3 days before the lecture date.</p> <p>Venue: National University of Singapore 4 Engineering Drive 3 Singapore 117583 E4-04-06 - E-CUBE 2</p>	<p>You will receive an email confirmation with the zoom link upon registration</p>

*****Seats are limited. Please register early. All are welcome and admission is free*****

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Abstract

Cementitious matrices such as concrete have low tensile strength and fail in a brittle manner. Adding short needle-like fibers to such matrices enhances their mechanical properties, particularly their toughness, ductility and energy absorbing capacity. The resulting composite having two main components, matrix and fiber, is in its simplest form what is defined as fiber reinforced concrete (FRC).



The first part of this presentation focuses on a brief introduction and history of fiber reinforced concrete, the reasons why FRC failed during its first 100 years, the rationale behind its modern developments, and the key milestones that allowed it to transition from an engineering material to a paramount structural material. The second part focuses on UHPC or UHP-FRC (ultra-high performance FRC), considered today the most advanced form of FRC. Indeed UHP-FRC can develop direct tensile strength exceeding 35 MPa and compressive strengths close to the yield strength of mild steel, while exhibiting extremely high durability. Expected service life can be numbered in centuries. The key characteristics of UHPC are explained and the importance of particle packing density is pointed out. An example project carried out at the University of Michigan is used to briefly describe materials selection, examples of mix design and resulting record high tensile properties. Several applications projects ongoing around the world are briefly presented for illustration. The dream and challenge of mixing fibers into concrete to develop a stand-alone structural material, as strong as reinforced concrete or steel, is today closer than ever before.

Speaker's Biography



Antoine E. Naaman is Professor Emeritus at the University of Michigan, Ann Arbor, USA. He holds a Diploma Engineer from ECP in Paris, France, and MS and Ph.D. degrees in Civil Engineering from the Massachusetts Institute of Technology, Cambridge, USA. Dr. Naaman's research studies have led to more than 350 publications in technical journals and symposia proceedings for which he received numerous awards. He is the author of three textbooks and four chapters in handbooks, and editor or co-editor of fourteen Symposia books. His most recent textbook on *Fiber Reinforced Cement and Concrete Composites* (2018) is of particular relevance to this presentation. He is a *Fellow* and *Honorary Member* of the American Concrete Institute (ACI), *Fellow* of the American Society of Civil Engineers (ASCE), *Fellow* of the Precast / Prestressed Concrete Institute (PCI), and *Fellow*, founding member and past president of the International Ferrocement Society (IFS).

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