book of abstracts

16.11.2023

sustainable structural design forum

ReStruct TUDelft

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As the effects of climate change become ever more visible, sustainable structural design comes to increasing importance. This leads to multiple initiatives in practice and academia. At the current rate, the changes in sustainable structural design practice outpace the publication of research outcomes. In recognition of this, the Sustainable Structural Design Forum provides a platform to share and discuss new developments in both practice and academia. By inviting leading scientists and professionals from a wide range of fields, the forum aims for a holistic perspective on the current sustainability discourse. This includes theory and challenges, yet mainly focus on solutions and recent innovations. The forum has three main themes: **resource, reuse, resilience**.

RESOURCE

Conscious use of resources towards low-emission structures

A sustainable built environment relies on conscious use of resources. Using and wasting less resources, avoiding critical materials and using biobased or upcycled materials are strategies to limit resource extraction and develop low-emission structures. Knowledge about material properties and their potential in structural and architectural applications is essential for their large-scale implementation.

REUSE

Closing the loop through effective reuse of reclaimed components

The built environment contains many valuable materials and components that get wasted every day. Closing the loop by reusing, repurposing, remanufacturing, refurbishing or repairing existing components or structures cuts down both on resource extraction and waste production. This requires evaluation of properties and performance as well as design strategies for the effective re-implementation of reclaimed components in new structures. The application of circular design principles like design for disassembly can ease future reuse.

RESILIENCE

Futureproofing the built environment with resilient structures

The climate crisis, population growth and other dynamic trends bring about many uncertainties for the built environment and its building structures. A futureproof structure incorporates future changes and shocks in its design to contribute to the resilience of the building and society. Future scenarios and predictive modelling help integrate and evaluate different types of resilience in buildings and structures.

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organizing committee

Dr. Stijn Brancart
Stijn is Assistant Professor of Circular and Biobased Structures. He is an architectural engineer with a deep affinity for the relation between structural form and performance. His research focuses on the reuse of structural components, timber and biobased structures.

Prof. Mauro Overend
Mauro is Professor of Structural Design and Mechanics. His research and teaching interests are at the interface of structural engineering, materials engineering and architecture which underpin the performance of high performance building envelopes and sustainable structures.

Prof. James O'Callaghan
James is Professor of Architectural Glass. He is a structural and façade engineer with over 20 years of experience. He is co-director and co-founder of Eckersley O'Callaghan. Both in research and practice, James pushes the boundaries of materiality, performance, form, energy, and the aesthetics of architectural glass.

with support of the scientific committee
Lars De Laet, Günther Filz, Catherine De Wolf,
Elias Knecht, Roberto Gentile & Daniele Perrone

exploring structural sustainability of tall buildings subject to seismic loads

investigation of the effects of architectural forms using deep learning surrogate modelling

Pooyan Kazemi
Politecnico di Milano, Italy

Pooyan Kazemi, a building engineer, specializes in integrating AI-driven strategies and computational design methods in early-stage design. Concurrently pursuing a Ph.D. in Structural, Seismic, and Geotechnical Engineering at Politecnico di Milano, he is also a visiting researcher at DT section of AET department of TU Delft. His research focuses on merging architecture and structural engineering, specifically focusing on the development of a workflow that harnesses machine learning tools to explore architectural form of tall buildings with efficient structures under time history seismic loading. His ultimate aim is to facilitate collaboration between architects and structural engineers during the early design stage.

In collaboration with **Michela Turrin, Charalampos Andriotis, Alireza Entezami, Aldo Ghisi, Stefano Mariani**

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This research explores the interplay between architectural form and tall building response to seismic loads using advanced computational methods and artificial intelligence-driven strategies. The main objective of the investigation is to optimize the design process, emphasizing cost reduction, structural efficiency, and carbon footprint while exploring various building forms. Understanding building performance is in fact crucial for cost reduction, as structural elements represent a significant percentage of the total construction expense. The research stems from a simplified seismic simulation approach during the form-finding stage, to explore diverse building forms and guide the choices in the early design phase. A significant gap in the field is claimed to be the absence of parametric seismic tools for the proposed activity. To bridge this gap, a unified workflow is here proposed by connecting architectural software with seismic simulation tools based on the OpenSees software. Additionally, the lack of a comprehensive tall building-specific seismic dataset is a critical issue; to speed up the numerical simulations, a surrogate modeling approach is employed. Specifically, the study investigates parameters influencing the architectural form of tall buildings with outer diagrids, including tapered, twisted, and curvilinear morphing from base to the top. The dynamic response to the vertical static loads and lateral seismic excitations is assessed under different ground motion scenarios and a dataset of 1000 models is selected to establish the surrogate predictive model. The dataset comprises time-histories of (inter-story) displacements and forces with a focus on critical structural components. Using a NN surrogate modeling algorithm, this research elucidates the intricate relationships between architectural choices and structural behavior, offering valuable guidance to design professionals while preserving their creative freedom.

AI-enhanced architectural modelling
tall building optimization
architectural form generation
dynamic seismic simulation