

STOCHASTIC DAMAGE MECHANICS OF CONCRETE: RECENT PROGRESS AND FUTURE PERSPECTIVE

Speaker

Prof. Xiaodan Ren

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Abstract

Structural reliability assessments critically depend on understanding material damage. Concrete, inherently heterogeneous with random features, exhibits stochastic constitutive behavior driven by these heterogeneities. Over the past two decades, we have pioneered the Stochastic Damage Mechanics (SDM) framework specifically for concrete. Rooted in continuum damage mechanics, the SDM framework explicitly incorporates material randomness across scales, utilizing multi-level uncertainty quantification to characterize the nuanced progression of damage. This presentation will highlight recent progress within the SDM framework, including random fields on manifolds, time-dependent damage modeling, and mechanics-based modeling of 3-D printed concrete structures. Finally, future perspectives for advancing stochastic damage mechanics of concrete will be outlined.

Biography

Dr. Xiaodan Ren obtained his Ph.D. from Tongji University in 2011 and is currently Professor and Head of the Department of Structural Engineering at Tongji University's College of Civil Engineering. With over two decades of expertise in stochastic damage mechanics and nonlinear structural analysis, he has authored >120 papers in international journals and was recognized among the top 2% of scientists worldwide (Stanford/Elsevier 2024). His honors include the Shanghai Excellent Doctoral Dissertation Award (2012), the ICACM Young Investigator Award (2018), and multiple Shanghai Science & Technology Achievement Awards (First Prize in 2019; Second Prizes in 2020 and 2023). Dr. Ren serves as Subject Editor for Structural Engineering at Engineering Failure Analysis, and holds leadership roles as Director of the Committee of Vibration Mechanics (Shanghai Society of Theoretical and Applied Mechanics), Council Member of the Association of Building Structures (Architecture Society of China), and Leader of Concrete Task Group of the Joint Committee on Structural Safety (JCSS).



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