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Enhanced Structural Safety during Extreme Events through Innovative Materials and Advanced Testing Methods

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Abstract:

The effectiveness of using Fiber Reinforced Polymer (FRP) composites and Shape Memory Alloys (SMA) for repairing and retrofitting structures during extreme events can be accurately evaluated using a combination of physical testing and numerical simulations known as 6-DOF hybrid testing. This approach allows for the replication of complex loading conditions, including axial, lateral, longitudinal, pitch, roll, and yaw forces, which greatly improves the design and implementation of FRP solutions. The presentation emphasizes how hybrid testing enhances seismic retrofitting practices in civil engineering and promotes the acceptance of these repair techniques. It also highlights the effectiveness of SMA in improving the fatigue life of structures. To achieve accurate results, it is crucial to correctly set the interface boundary conditions between the physical and numerical domains and accurately replicate the prototype load using gravity, followed by service and/or extreme loads. The Multi-Axis Substructure Testing (MAST) system at Swinburne University of Technology in Melbourne, Australia, is equipped with stateof the-art loading systems that enhance the capabilities of hybrid testing for six-degrees-offreedom (6-DOF) boundary conditions through switched/mixed load/deformation control. This unique facility in Australasia offers valuable research opportunities and contributes to the global research community and industr