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APPLICATION OF HYBRID COMPOSITE MATERIAL FOR IMPROVING DYNAMIC RESPONSE OF STRUCTURES DURING SEQUENTIAL EARTHQUAKES – MANUFACTURING, TESTING AND NUMERICAL SIMULATIONS

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Summary: Earthquakes continue to expose deficiencies in today's infrastructure and call for engineers to continue to explore new ways to create resilient structures. A disaster, whose implication could result in significant life loss and damages up to the tunes of billions of dollars. An active disaster management scheme for any seismic hazards can involve use of smart composite materials instead of traditional steel reinforcement to dissipate energy and earthquake motion. The use of superelastic shape memory alloy (SMA) fibers with their nonlinear-elastic behavior as reinforcement in the hybrid composite material could potentially provide replacement to steel reinforcement which is prone to yielding and corrosion. Small diameter SMA wires and glass fibers are coupled with polymer matrix to manufacture hybrid SMA-FRP composite which are sought in this research as reinforcing bars to enhance the dynamic response and seismic performance of typical reinforced concrete (RC) moment resisting frame (MRF). Manufactured coupon specimens are tested to achieve constitutive behavior which is used to calibrate numerical material models. These verified material models are subsequently extended to structural models of MRF reinforced with hybrid SMA-FRP composite and steel to perform the inelastic sequential seismic analyses. Results from use of SMA-FRP composite bars show disaster mitigation through reduction in residual inter-storey drifts of reinforced concrete frame while maintaining elastic characteristics.