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Hierarchical Optimization of Composite Deployable Bridge Treadway Using Particle Swarm Optimization

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Abstract : Effective deployable bridges that are characterized by an increased capacity to weight ratio are recently needed for post-disaster rapid mobility and military operations. In deployable bridging, replacing metals as the fabricating material with advanced composite laminates as lighter alternatives with higher strength is highly advantageous. This article presents a hierarchical optimization strategy of a composite bridge treadway considering maximum strength design and bridge weight minimization. Shape optimization of a generic deployable bridge beam cross-section is performed to achieve better stress distribution over the bridge treadway hull. The developed cross-section weight is minimized up to reserving the margins of safety of the deployable bridging code provisions. Hence, the strength of composite bridge plates is maximized through varying the plies orientation. Different loading cases are considered of a tracked vehicle patch load. The orthotropic plate properties of a composite sandwich core are used to simulate the bridge deck structural behavior. Whereas, the failure analysis is conducted using Tsai-Wu failure criterion. The naturally inspired particle swarm optimization technique is used in this study. The proposed technique efficiently reduced the weight to capacity ratio of the developed bridge beam.

Keywords : CFRP deployable bridges, disaster relief, military bridging, optimization of composites, particle swarm optimization
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