The 2025 World Congress on
Advances in Structural Engineering and Mechanics (ASEM25)
BEXCO, Busan, Korea, August 11-14, 2025

Design, manufacturing and impact testing of hybrid composite blade structures for roof-top wind turbine applications

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ABSTRACT

The modern world demands small scale renewable energy solutions which leads to the development of roof-top wind turbines in urban applications. This work investigates the design, manufacturing and impact testing of the hybrid composite wind turbine blades for roof top applications. The design process focused on lightweight, high-strength blades suitable for small-scale, urban wind turbines. To guarantee scalability and cost-effectiveness, the composite blade was fabricated using the vacuum bagging process. Impact testing was performed with a single stage gas gun, which replicates the real-world conditions such as debris strikes, hail ice, and bird strikes. The composite test specimens are clamped in the target box of the gas gun and projectiles are used to hit at different impact energies. Impact damage assessment was performed on various hybrid composite structures. The results highlights that the hybrid composite blade made up of carbon, Kevlar and glass offers enhanced impact resistance than the neat glass fiber epoxy composite blade. This research provides valuable insights into the integration of innovative materials for the next generation of small-scale wind turbines.

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