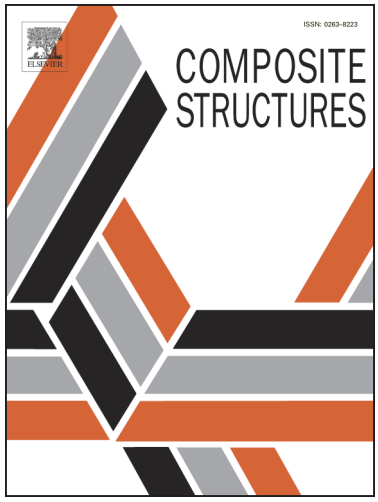


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# Design of carbon/epoxy-aluminum hybrid upper arm of the pantograph of high-speed trains using adhesive bonding technique

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## ABSTRACT

The upper arm of a steel pantograph was replaced by a high stiffness carbon/epoxy composite-aluminum hybrid structure to enhance the mechanical performance of a pantograph for high-speed trains. By considering driving conditions such as high voltage discharge and a wide range of environmental temperatures, the composite laminates were applied to the inner surface of an aluminum pipe by using adhesive bonding with an epoxy adhesive. The bending stiffness of the slender arm structure was the most important mechanical performance criterion; therefore, only simple stacking sequences ($[0]_{10T}$, $[\pm5]_{5T}$, $[\pm10]_{5T}$), which guarantee the higher bending stiffness, were tried to determine the mechanical performance such as maximum deflection and natural frequency. Thermal stress due to environmental temperature (-35°C–65°C) was also evaluated by finite element analysis. The generated stresses in the bonding layers were closely investigated, and it was found that the maximum stress was below 60% of the material strength of the epoxy adhesive under various temperature conditions.

**Keywords**: Pantograph; Thermal analysis; Adhesive bonding; Weight reduction; Stiffness.

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