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Investigation of Lightweight Design and Analysis of Composite Fender

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Abstract

Composite materials, which become rather substantial in the automotive industry by the reason of carbon footprint and lightweight subjects, have gained wide attention in various scientific fields in recent years. This paper represents the lightweight design and mechanical characterization of the fender part as a composite, instead of the traditional metal fender on heavy trucks. In this direction, glass fiber-reinforced composite material was utilized in compliance with the plastic injection method. By conducting the design studies for the composite fender, it is targeted to procure lightweight, mechanical properties, dynamic and static loads. Based on this, the finite element analysis (FEA) method was performed in order to characterize the existing metal structure, modal analysis and fatigue-stress life estimation analyses were performed on the fender initially. Before modeling the composite part, the material characterization was conducted and the tensile test curves of the composite material were obtained. Thereupon, appropriate fender design for composite material has been developed by considering mechanical properties. After the design, the finite element model was constituted on the structure and finite element analysis was accomplished. As part of the analysis, improvements were made in the composite design by characterizing the stress, strain and displacement distributions. After the FEA, the fender holder part was redesigned as a hybrid composite. In the verification stage of the final design, modal analysis occurred due to examining the out-of-limit resonance at 23 °C and 60 °C. Besides, resistance against dynamic loads was analyzed due to investigating the material’s behavior under g loads. After the composite design met the relevant limits on FEA; prototype production was carried out. Regarding the final product, 60% weight reduction was achieved.

Keywords: analysis, automotive, composite material, design, weight reduction