DEVELOPING COMPOSITE ENGINE SUPPORT SUB-FRAME TO ACHIEVE LIGHTWEIGHT VEHICLES

Giovanni Belingardi *, Ermias Gebrekidan Koricho **

Politecnico di Torino,
Dipartimento di Meccanica, Corso Duca degli Abruzzi, 24 – 10129 Torino,
*e-mail: giovanni.belingardi@polito.it, http://www.polito.it/
**e-mail: ermias.koricho@polito.it, http://www.polito.it/

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ABSTRACT

Now a day, due to rise in demand of lightweight vehicle and better mechanical of performance of materials in automotive applications, different material combinations such as composites, plastic and light weight metals are implemented on primary and secondary structural parts of vehicles. Particularly, composite materials, with their high strength-weight ratio and directional dependent stiffness, are attracting automotive, aerospace and naval industries. Applications of composite materials in automotive industries already include some primary and secondary structures such as dashboard, roof, floor, front & back bumper, passenger safety cell, and rarely, A-pillar and B-pillar. Some other parts of vehicle structure such as engine support frame have not been considered in detail as subassembly with possible advantages from this kinds of material, mainly due to complex shapes and loading conditions, method of assembly to the Body in White (BIW).

The main objective of this paper is to analyse the possibility of the replacement of the engine support frame, which at present is made of steel and in some advanced cases in lightweight metals, with a new component made of Carbon/Epoxy composite material. A methodology is developed that helps to point out and solve the existing major constraints with respect to the use of composite structures such as the effect of variation of stacking sequence and ply angles of sub-laminate on load carrying capacity and stiffness of engine sub-frame. Results will comparing the structural performance (with particular attention to the equivalent stiffness) of the new proposed solution based on composite material with lightweight metal one.
Further, optimised simplified design concept of engine support sub-frame is proposed which is suitable for manufacturing process and ultimately reduces the production cost.

To investigate and justify the proposed solutions based on numerical results under different circumstances such as stiffness, load carrying capacity, materials effect and inclusion of stiffeners and reinforcements, numerical simulations have been performed. We have used available commercial FEM software together with MIC-MAC tool, which have the ability to model and optimise composite structures under varieties of design criteria. Finally, comparison of stiffness of composite engine support frame with existing published lightweight metal sub-frame will be proposed. The results show that the implementation of composite solution leads to better results, in particular better weight reduction although with equivalent stiffness with respect to lightweight metal solution.