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OPTIMISATION OF A COMPOSITE BEAM-BASED LOAD BEARING STRUCTURE, FOR AN ULTRA-EFFICIENT ELECTRIC VEHICLE.

Wojciech Skarka, Michał Sosnowski

Silesian University of Technology, Poland
wojciech.skarka@polsl.pl, michal.filip.sosnowski@gmail.com

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Abstract: Continuous development of technologies and state of the environment, as well as emerging from these sources combined market demands, requires creating energy efficient vehicles for the daily commute purposes. The goal of this paper is to present optimisation process of the load bearing structure, which is a part of hydrogen fuel cell powered vehicle, that can be described as a small urban car. Due to its purpose, it is not capable of travelling with high velocities and does not have to cope with major road irregularities. The structure had to obey rules and regulations of Shell Eco-Marathon competition, in which it is going to take part in the custody of Smart Power Team from the Silesian University of Technology in Gliwice. Impact on efficiency, from the structure point of view, comes from aerodynamics, weight and stiffness, which may influence different subassemblies efficiency. The analysed vehicle already possessed shape of the fuselage, which was previously optimised to improve aerodynamics. Therefore, the subject of skin shape optimisation was not taken into consideration in this paper. Nevertheless, deep understanding and familiarity of the outer shape were required, to create efficient supports that transfer loads- for example, aerodynamic loads and ensure fuselage stiffness and mounting to the chassis. As the main goal of the structure was to obtain low weight, materials used in the load bearing system were mainly composite materials like carbon fibre tubes and sandwich structures, but also 3D printed elements. The secondary objective of the conducted work was to develop a structure, which as many parts as possible may be created and assembled by students. As a result of such an approach, costs were reduced significantly and educational value to the project was added. To obtain this goal, without sacrificing the safety of the vehicle and its driver, a special type of joints between carbon fibre tubes was developed in previous work and applied in this design. The methodology used during the optimisation process was based on experiences gathered during simliar structure design by the authors and its main principle is topology optimisation. In order to obtain further improvements, deeper analysis of the structure was required, and as a result number of steps followed during optimization process increased.