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DESIGN METHODOLOGY OF AN ALUMINIUM CHASSIS

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ABSTRACT

The reduction of emissions is a priority for the automotive industry, and for this matter it has focused its attention on 2 alternatives: the reduction of the total weight of the vehicle and the use of electric propulsion systems. For both solutions, a lighter chassis than what is currently produced is required. This paper presents the process to transform a class 8 commercial truck chassis, steel-based material for an aluminium-based one with same performance, achieving a weight reduction of 10%.

Keywords: chassis, design, aluminium, weight reduction.

INTRODUCTION

The chassis is the most important structural component of a vehicle, since it allows to support the effect of static and dynamic loads, which are natural within its normal operation process, such as: the reactions of motor and shaft movements, it receives the reaction forces of the wheels in acceleration and braking, and absorbs the aerodynamic forces of the wind and the impacts of the road through the suspension (Heissing and Ersoy, 2011).

To develop the design of a chassis it is necessary to define the type of vehicle and the operating conditions to which it will be subjected. The critical parameters could be summarized in five categories: dimensional constraints, life time, structural stiffness for different types of loads, available manufacturing and assembly processes, and failure mechanisms.

Although the performance and characteristics of the vehicles have changed significantly in the last 20 years, as a consequence of the developments of electronic technologies, the design of the chassis has remained practically the same.

BACKGROUND

For over 10 years, the automotive industry has been experiencing a trend towards reducing emissions, these have been driven by environmental regulations that are increasingly more restrictive. The efforts were initially focused on technologies for emission control (catalysts) and engine performance optimization (injection, ECU, ... etc).

However, a point of technological saturation has been reached, where the costs and the level of complexity have generated a need to look for other alternatives of control and reduction of emissions. From here, other trends have emerged such as: improvements in aerodynamics, alternatives for weight reduction or even change in the propulsion system.

Given the business characteristics of METALSA, and in response to the needs of weight reduction, it has been working on solutions from several perspectives: new designs, new manufacturing processes, new materials, among others. So far, the most immediate and practical way focuses on the replacement of material: aluminium instead of steel.

RESULTS AND CONCLUSIONS

Initially a structure was taken, and its performance was evaluated at static load conditions. Subsequently, the effect of the material change on its performance was observed, through virtual tests, with finite element simulations, to identify critical areas. Next, design changes that improved the performance of the steel chassis were identified and defined. This process was performed iteratively until a chassis design, aluminum, meets the required performance.

As a result of the previous process, it was possible to formulate a design methodology to transform a chassis made of steel into another based on aluminum without sacrificing performance.

A design methodology was developed to transform a class 8 commercial truck chassis (Cambridge Systematics, Inc., 2017), steel-based material for an aluminium-based one without sacrificing performance, achieving a weight reduction of 10%.

The methodology was implemented to test its effectiveness with a commercial truck chassis design currently in production.

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