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# ULTRA-HIGH STRENGTH STEEL USAGE IN A SEDAN CAR CHASSIS. A THEORETICAL STUDY

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## *Introduction*

In recent years, weight reduction has become a popular automotive topic in order to produce lighter automobiles. With lighter automobiles, not only the cost reductions but also decreased exhaust emissions get an important issue in the industry. Light alloy materials have been used as vehicle chassis material for many car models. The objective of the study is to obtain a light chassis design by using ultra high strength steel (UHSS). As it is known, the chassis is the main part of vehicle frame. Therefore, confirmation of the chassis design is important in automotive engineering in order to have lightweight automobiles. Finite element method is used for the analysis of a sedan car chassis which is equipped with ultra-high strength steel material. Stress and deformation distribution of sedan car chassis design is compared with structural steel based design.

## *Materials and methods*

Structural steel and UHSS were used as chassis materials and the properties for both materials were noted in software program engineering library. Table 1 represents the general material properties of steels.

**Table 1**. Material Properties

| | Density (kg/m³) | Young's Modulus (GPa) | Tensile Yield Strength (MPa) | Tensile Ultimate Strength (MPa) |
|---|---|---|---|---|
| Steel1 | 7850 | 200 | 250 | 460 |
| UHSS | 7850 | 200 | 1100 | 1500 |

A sedan car, which has an atmospheric 1.6-liter engine with nearly 125 HP power was selected as chassis model for analysis.

## *Results and conclusions*

The finite element analyses showed that the highest deformation was occurred for UHSS chassis design due to the lower wall thickness where it was acceptable. It is because that the wall thickness of UHSS chassis design was reduced to obtain lighter chassis. When the weights of the chassis designs are compared, it can be seen that the UHSS is 31.2 % lighter than structural steel. However, the higher deformation was realized for UHSS chassis design. The ultra-high strength steel chassis design stress

value was greater than steel chassis designs. The analysis results are shown in Table 2.

**Table 2**. Analysis Results

| | UHSS | Structural Steel |
|---|---|---|
| Weight (kg) | 186.41 | 270.8 |
| Total Deformation (mm) | 7,50 | 2,863 |
| Maximum Stress (Mpa) | 768.17 | 267 |
| Safety Factor | 1.3 | 1.0 |

As a result of this study, it is seen that using ultra-high strength steel as a chassis material provided a significant weight reduction. According to theoretical results, it can be seen that fuel consumption and exhaust emissions will decrease with respect to environmental topics.

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