TATA TECHNOLOGIES

TATA INNOVISTA
Celebrating Innovation

Ultralight Body Structure Meeting 5-Star Safety

By Tata Technologies | Category: Dare to Try

Globally, automotive OEMs are struggling to meet safety requirements with low weight body structure, which is required for electrification and higher fuel efficiency. The company has come up with a unique lightweight solution for automotive body design, which has structure weighing 205 kg as against the global average of 290 kg, thus meeting 5-star rating. This was designed for vehicles targeted for India market using steel from local market, but was not implemented because of development time and cost. This project has given key insights to the automotive industry in efficient energy management, and making ultra-light body using conventional steel, which the company shall leverage in the future.

The Context

Automotive Safety norms are getting progressively more stringent. In order to meet these norms, it has become unavoidable to add a lot of weight on vehicles to make the structure more robust. However, this affects the fuel economy of the vehicle, as well as CO_2 emission. This also increases the product cost and premium, thus meeting 5-star rating is expensive. Hence, the triggered problem was to develop a structure which is light, and also meets the safety requirements, thus creating a global benchmark.

The Innovation

Internationally, NCAP star rating is the benchmark index for occupant safety; the higher the better. To increase the safety of a car, the designer needs to add a lot of material at critical locations of the vehicle, which results in an increase in vehicle weight. This directly results in higher CO2 emission. The greater is the weight the greater are the emissions. This is not desirable for environmental needs, and it is a prime need of the automotive industry to control the vehicle weight. Generally, the body structure has ~23% share of vehicle weight. It is necessary to optimize the body structure weight in order to control CO2 emission. There are many factors that affect body weight like material, manufacturing process, sheet metal thickness, assembly sequence, part count, part joining method, and so on.

Average body structure weight in the similar segment, with 5-star rating, is 290 kg globally. A team from Tata Technologies, who worked on global OEM Customer Smart Car Project, have designed the lightest weight steel body using local materials weighing 205 kg, thus gaining higher fuel efficiency, with lesser CO_2 emissions. Use of optimum material also saves structure cost by 25%. Multiple factors were studied in detail, focusing on weight and cost, while designing global OEM customer body structure.

Overcoming Challenges

The major challenge set by global OEM customer was to design body structure in 197 kg meeting 3-star performance, and cost target of INR 22,000. This was overcome by unique body design strategy listed below:

- Efficient energy management with smart load path definition to reduce part count, and thus weight a Unique Y shaped load member was added in the front structure to distribute impact loads 30% to upper body and 70% to underbody. Such member is not present in global vehicle structure so far.
- Dead metal removal through identification of non-functional material.
- 100% use of local steel material available in India market.
- Adding multiple functions to single parts, thus reducing part count.
- Cost effective manufacturing process.
- Re-definition of assembly sequence for optimized panel shapes.

Potential Impact of the Innovation

expected revenue impact

₹700 mn