TATA STEEL

TATA

Lightweight seat concept

Development of 'Future Steel Vehicle' seat frame

Background

Tata Steel studied the front seat from the recently-launched WorldAutoSteel 'Future Steel Vehicle' - an ultra-lightweight body structure concept for future electric/hybrid vehicles with 35% weight reduction compared with the project baseline vehicle (and 23% compared with current production small cars).

The 'Future Steel Vehicle' developed a basic front seat frame which allowed side impact load to be transmitted to improve side impact occupant protection but no design or gauge and grade optimisation of the seat was undertaken during the project.

Tata Steel developed the basic 'Future Steel Vehicle' front seat design, optimised steel grades and gauges, and compared cost and weight against the baseline 'Future Steel Vehicle' seat frame design for equivalent performance.

Modelling

Tata Steel developed the basic 'Future Steel Vehicle' front seat using Catia CAD to design the seat track, cushion sidemember, seat base, tubular seat crossmembers, seatback sidemember and headrest support.

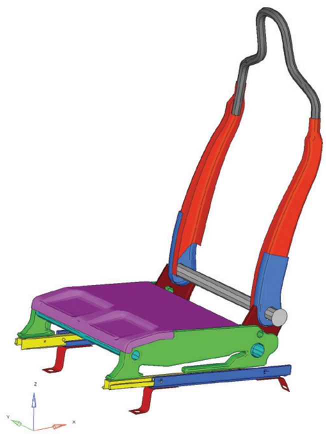
The seat geometry and structure was developed to use the latest thinking in steels, forming and joining processes in seat manufacture, and paid particular attention to achieve the same side impact performance as the Future Steel Vehicle seat and body structure. Upon completion of the seat design model, Tata Steel generated a CAE model using Hypermesh to fully represent the front seat structure, seat and backrest foam cushions and a belted occupant on the seat.

Analysis

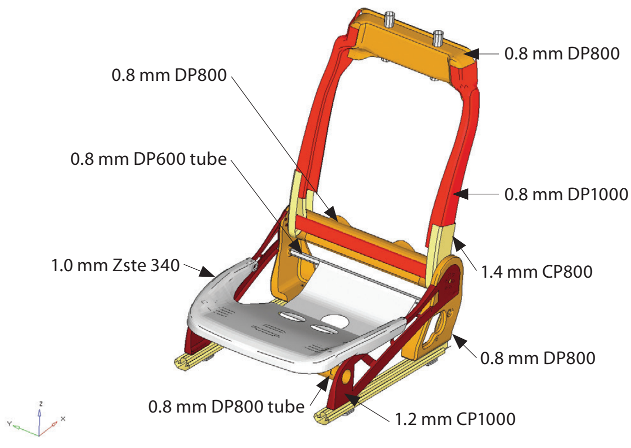
Dynamic finite element analysis using LS Dyna was used to calculate seat deformation; strains and stresses resulting from both forward and rearward crash tests to meet requirements of European regulation (ECE R17).

Front seat frame structural performance (particularly to meet stiffness and occupant safety requirements) was then optimised using advanced CAE simulation techniques to develop the application of latest Tata Steel advanced high strength steels (up to 50% of the seat frame and track material).

FSV front seat design



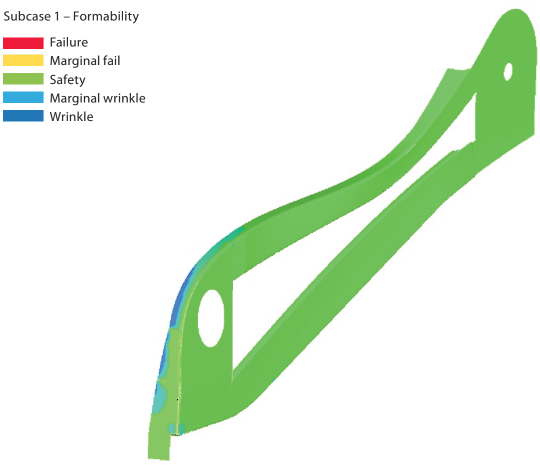
Optimised front seat design



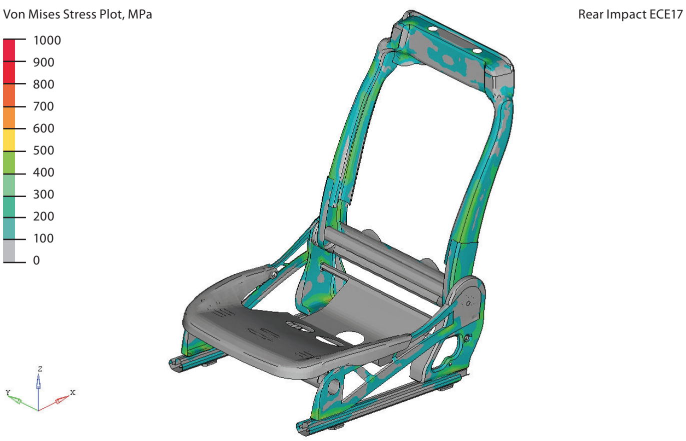
Lightweight seats for customers using advanced high strength steels combined with automotive application design expertise.

We offer a range of HQ1500 steels up to 1500MPa strength levels (after forming and heat treatment) in both uncoated and zinc-coated form. We also offer a wide range of formable, high strength and strain hardenable steels up to 1000MPa strength levels. This includes both Dual and Complex Phase grades in sheet and tube form that are ideally suited to seat frame applications.

Forming analysis of side rail



Optimised front seat design



Analysis results

The results of the CAE optimisation suggest that specification of DP800CR and DP1000CR for the seat frame sidemembers, combined with Tata Steel's CP1000CR for the seat tracks will allow the seat to meet all of the structural performance requirements with a weight reduction of 30% (e.g. seat frame and track weight reduced from 14.7kg to 10.3kg).

Upon completion of the seat optimisation and confirmation of the steel grades, forming simulation techniques were used to ensure that the resulting seat design was feasible for volume production. Tata Steel used Pamstamp CAE software to confirm the manufacturing performance of the advanced high strength steels in both stamping and roll-forming operations.

Cost and weight

Tata Steel then completed a production cost study to ensure that the optimised seat design was cost-effective for volume production. This study compared production tooling, component and assembly costs of the optimised seat with those of the baseline. The study included all steps in component manufacture and showed that whilst the advanced high strength steel in the optimised seat design represents a premium priced steel grade, overall seat production costs were reduced due to the weight reduction in the seat and resulting ease of seat manufacture and assembly.

CO_2 emissions

Finally, Tata Steel performed analysis to compare the CO_2 emissions of the optimised seat design with those of the baseline.

This analysis only considered CO_2 emissions generated during steel production (assumed that CO_2 emissions during seat manufacture and 'in use' are unchanged).

This study highlighted the benefits of Tata Steel's advanced high strength steels that have similar CO_2 emissions during steel production to lower strength steels, but which contribute to reduced CO_2 emissions during the vehicle lifetime due to the seat weight reduction.

Summary

Savings per seat	Optimised design
Weight saving	4.3 kg
Cost saving	€ 3.60
CO_2 saving (optimised steel use)	8.6 kg

Tata Steel
Automotive
PO Box 10.000
1970 CA IJmuiden
The Netherlands
connect.automotive@tatasteel.com
www.tatasteeleurope.com/automotive

AM0216:100:EN:0116

www.tatasteeleurope.com