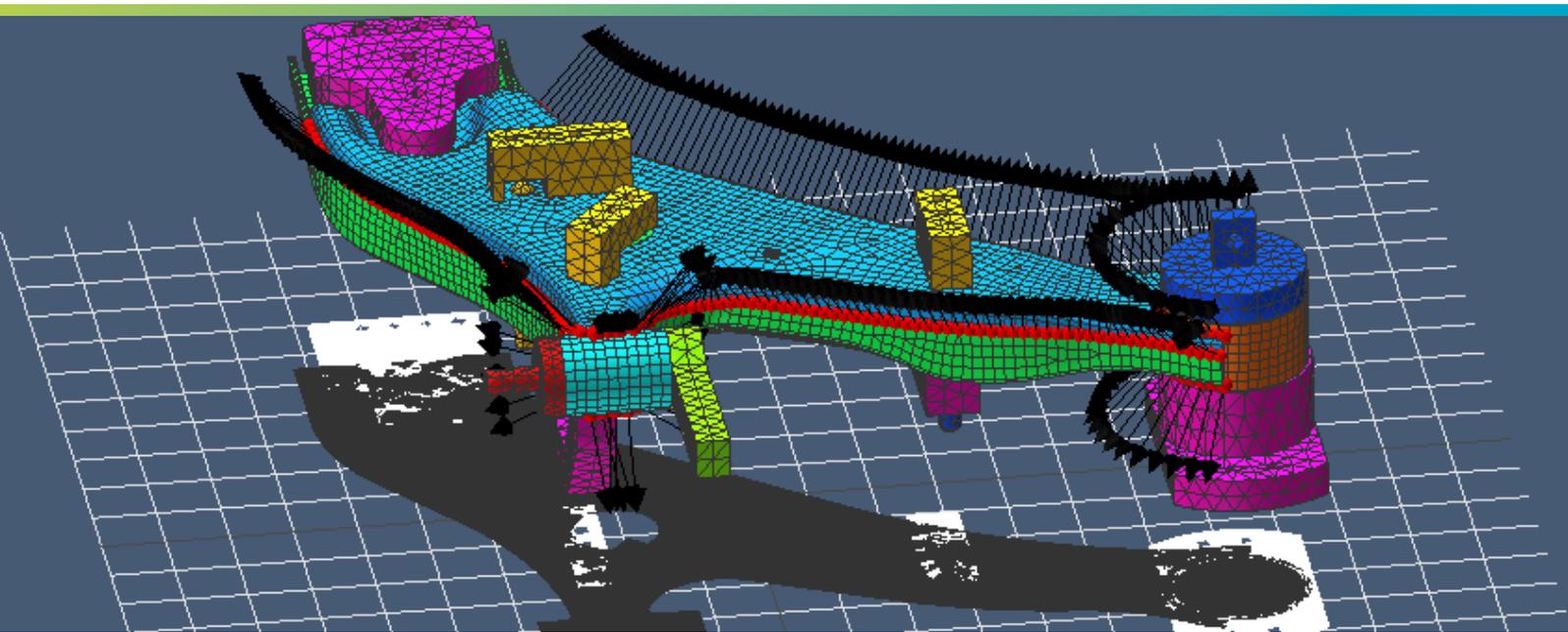


Avoiding Welding Cracks by means of simulation



Case 1: Weld seam of swing arm is cracked, welding residual deformation is too large at key joining point

Challenge

Modern chassis concepts and designs require multiple material mixes in order to guarantee on one hand passenger safety (high strength and stiffness) and on the other hand to save weight and herewith fuel consumption.

In order to connect components of dissimilar metals several welding techniques are applied. The introduction of thermal energy is necessary to melt the metal and create a safe joint but it is also locally changing the micro-structure of the material in the heat affected zones (HAZ) and can thus, contribute to unwanted failure mechanisms like i.e. cracking under work load conditions.

While welding swing arms and torsion beam sub-assemblies frequent cracking near the HAZ were observed. Investigations on the welding conditions and their impact on fatigue life had to be done to prevent pre-mature failure in mentioned sub-assemblies.

**CHALLENGE:**

Through thermal energy metal is melted and creates a safe joint which in turn leads to a change in the micro-structure of the material in the heat affected zones and can thus contribute unwanted failure mechanisms.

SOLUTION:

By combining fatigue analysis and Simufact Welding based results showing welding residual stress, the cracking issue could be reproduced successfully.

PRODUCTS USED:

Simufact Welding

CUSTOMER:

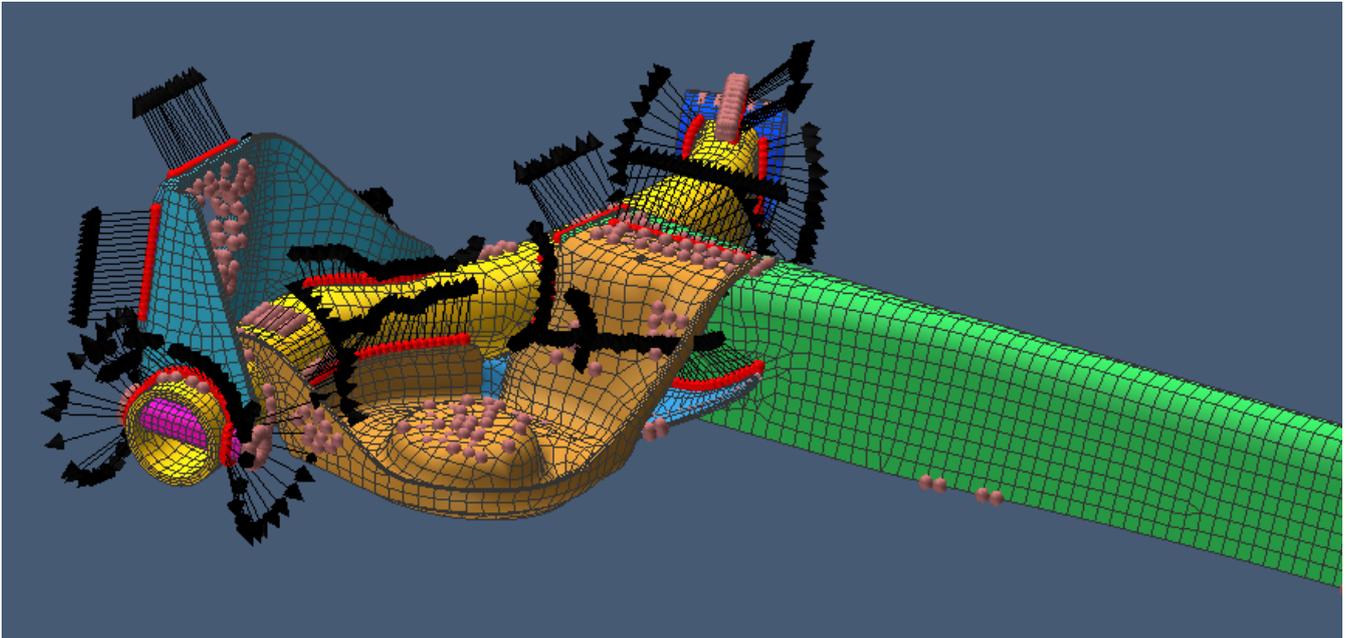
Changan Automobile Company Limited

Simufact solution approach

In order to resolve the technical problem and to find a robust process set-up MSC China team was charged to carry out simulation studies on above-mentioned cases of the welding process and perform subsequent fatigue life calculations. The key point here was to provide residual stresses patterns and the overall “welding history” (i.e. distortions, residual strains, peak temperatures) as an initial condition for the fatigue life simulations. For this purpose Simufact Welding was used as a state-of-the-art simulation tool to virtually predict related result values and to optimize the same by strategically varying welding conditions.

The welding residual stress significantly influences the fatigue performance of a weld seam. In the traditional Finite Element Method for structural and fatigue life simulations the welding residual stress is not taken into consideration, thus the engineers are not able to reproduce the cracking issues. By employing Simufact Welding, the engineers were able to analyze the swing arm welding process and take into account the welding residual stress. By combining fatigue analysis and Simufact Welding-based results showing welding residual stress, the cracking issue could be reproduced successfully. As a result the welding sequence has been adjusted. The current welding process was analyzed in Simufact Welding and findings has been applied to reduce the welding residual stress and the welding residual deformation at the key joining point. This solved the cracking problem and reduced the formerly large welding deformation into acceptable tolerances.

The workflow was applied for given both cases and lead to a perceptible and sustainable reduction of residual stresses, distortions and finally a successful prevention of pre-mature cracking problems.



Case 2: Cracking of weld seams of torsion beam

Benefit:

Changan Automobile can high-precisely analyze fatigue performance of the weld seam via Simufact with considering the welding residual stress and distortion, thus reduce about 20% time and 10% costs in development stage from reducing the testing loop.

Headquartered in Chongqing the company has 90 thousand employees, with 12 production bases, 32 vehicle and engine plants globally. Changan automobile represents 128.1 billion CNY of corporate asset, produces and sells 2.9 million vehicles annually.

The Chinese name “Changan” stands for the main mission of the company: “Lasting safety”

About Changan

Changan Automobile belongs to the top four automotive OEM groups in China and is one of the top selling domestic Chinese car manufacturers. With more than 150 years industrial history and more than 30 years' experience in designing and manufacturing passenger cars, it is an early leader in the growing Chinese automotive market.

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Our technologies are shaping urban and production ecosystems to become increasingly connected and autonomous – ensuring a scalable, sustainable future.

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