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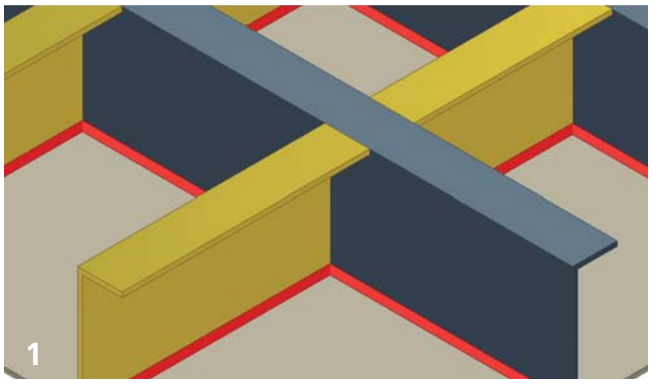
LASER WELDED INTEGRAL STRUCTURES FOR RAILROAD VEHICLES

THE TASK

Railroad vehicle assemblies such as the sidewalls of railroad cars are currently manufactured in a differential construction process. The connection of the outer skin sheet metal to the stiffeners is typically accomplished via point welds in lapped joints.

At the Fraunhofer IWS we have the goal to develop a novel fabrication method based on a design with a complete connection to the stiffeners based via integral construction (Fig. 1).

The advantages of this design are substantial weight reduction and increased structural strength and stiffness. Simultaneously laser beam welding of the metal skin to the stiffeners minimizes warping. This new approach presents as very economical manufacturing method.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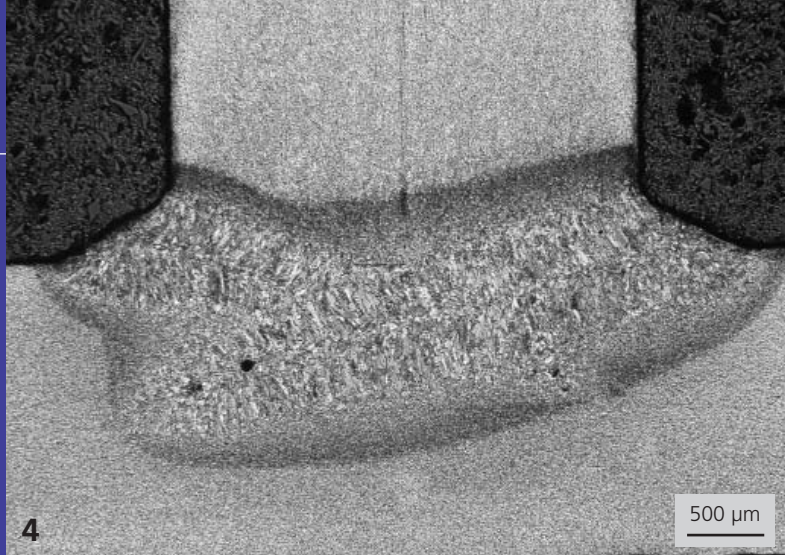
OUR SOLUTION

The basis of this integral construction method is the T-joint. Compared to the original lapping joint the T-joint significantly reduces weight by saving the overlapping material. Such a construction also allows the use of less complex stiffeners (L-profile) and a simplified dimensioning of the integral nodes (connections of the stiffeners with each other).

To fabricate these welding joints we developed a special technology. Dual laser beams under low incident angles are applied to simultaneously weld stiffener fins from both sides (Fig. 2). In areas with limited accessibility or zones of reduced quality requirements it is possible to apply single sided welding to achieve full connection. The key objective for designing the process is to achieve a complete connection of the fin cross section at minimized heat exposure of the material.

Current laser welding process speeds exceed 4 m / min. If consequently utilized, this process taps into an immense potential to save manufacturing time. Welding sequences are optimized for long uninterrupted welding paths, which leads to a marked reduction in auxiliary process time.



At the Fraunhofer IWS we use a highly modern and large portal plant to process parts up to dimensions of 10 m x 3 m. The base plate is held by a vacuum-clamping jig. A process-integrated mobile clamping jig accomplishes the exact positioning and fixation of the elements to be welded. The welding head is sensor controlled, which guarantees a stable welding process and a constantly high weld seam quality.

RESULTS

The developed integral manufacturing process markedly improves the properties of sidewall elements for railroad cars if compared to the original differential method (Fig. 2). The advantages are:

- reduced part weight,
- constantly high weld seam quality,
- improved structural stiffness and strength,
- low part warpage due to minimal heat exposure,
- minimal angle warpage due to symmetrical welding,
- improved corrosion resistance due to avoidance of gaps,
- minimally affected surface quality on the visible side of the sidewall.

As a result of the developed laser welding technology it is possible to manufacture assemblies at high quality and reproducibility and in minimal time. The application of an integrated clamping technique avoids the need for a pre-tacking step.

2 Double-sided simultaneous laser beam welding of lateral fins

3 Laser beam welded integral structure of 1.25 m x 1.25 m and the principle of the integral construction of car sidewall structures for railroad vehicles

4 Cross section of a double-sided welded T-joint

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