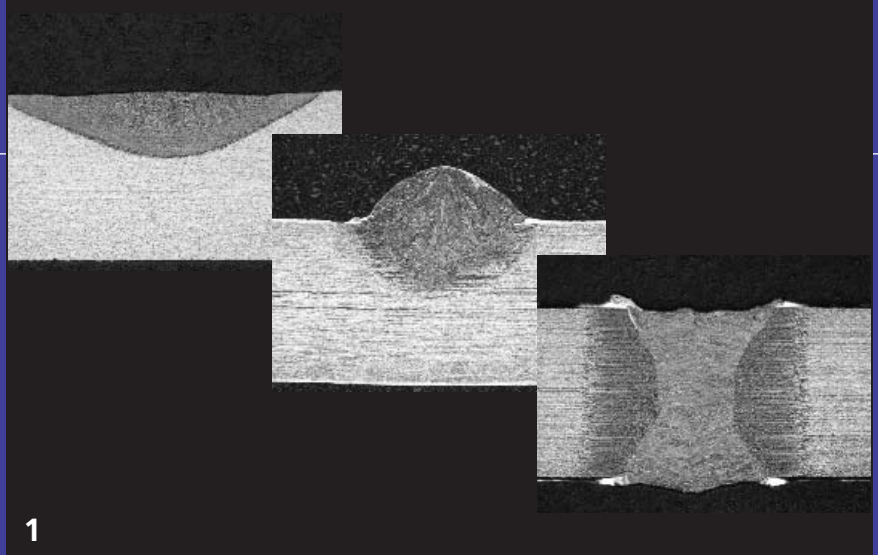


1

LOCALIZED LASER STRENGTHENING TO IMPROVE CRASH BEHAVIOR

THE TASK

Car body makers are increasingly implementing innovative lightweight construction concepts to effectively use resources and effectively decrease environmental issues. Many of the developed solutions are based on high strength materials such as cold hardened multi phase or press hardened steels. However, the processing of such high strength materials is very challenging in manufacturing. This is in particular so for:

- manufacturing process difficulties such as reduced forming capacity of high strength materials or of welded semi-finished parts and the limited weldability of high strength materials,
- increased forming forces, uncontrolled rebound behavior and unfavorable cutting conditions,
- and finally a limited loading capacity of the parts as a result of the complex material strain during fabrication.

The listed problems cause increased production efforts and considerable manufacturing uncertainties. They limit product properties and can lead to enormous cost increases.

OUR SOLUTION

One approach in car body manufacturing is to introduce localized material strengthening only during the assembling step. Processes such as localized hardening, penetration welding and buildup welding can be used for hardenable steel sheet metals. High power lasers with corresponding beam shaping are very promising when it comes to requirements such as precise heat exposure and a modulated temperature field.

The goal is to modify the material's microstructure in part areas that are exposed to high operational loads. The following advantages are envisaged:

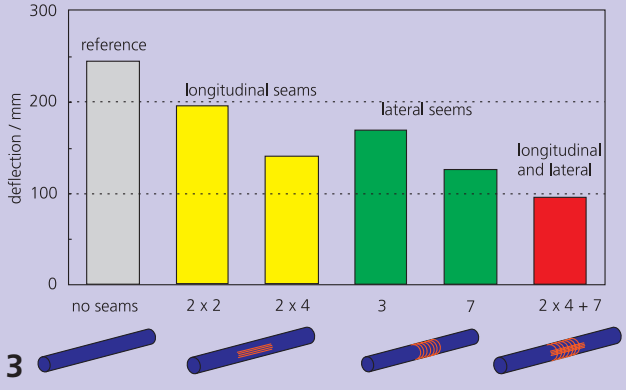
- improvement of part properties during operation (increased loading capacity by increasing the structural strength; optimized stress distribution and thus reducing the local strain in loading points of the body; load adapted part design and thus reduction of the total weight),
- improvement of the crash behavior and thus increasing the vehicle safety by increasing the locally tolerable loads, increase of the absorbable deformation energy, realization of controlled part failure,
- reduction of manufacturing costs through reduced fabrication efforts (parallel utilization of existing laser systems for welding in assembly and heat treatment, using of simpler and less costly semi-finished parts, realization of simpler forming and cutting operations).

2

RESULTS

Laser penetration welding is an advantageous manufacturing process and was applied to locally strengthen parts. The results showed a significantly improved crash performance. Compression experiments demonstrated a predictable part failure mode (Fig. 2).

Improvement of the crash behavior of laser strengthened pipes in dropping experiments



3

Additional dropping experiments with laser strengthened pipes also showed a clearly reduced deflection (Fig. 3).

The localized laser strengthening process is thus capable of:

- generating part properties that are adapted to their specific and complex mechanical loading conditions,
- reducing the part weight by using thinner sheet metal,
- achieving high performance part properties while using low cost low strength steel qualities,
- being cost effective and flexible by using existing laser technology that is also used for other processes.

The research results were developed with the partners Volkswagen, IMA and FES within a SAB funded program.

1 Possibilities of localized strengthening of hardenable steels by laser hardening (top), buildup welding (middle) and penetration welding (bottom)

2 Laser penetration welding strengthened pipes show improved failure behavior during compression experiments

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