EFFICIENT PRODUCTION OF STRUCTURAL COMPONENTS FOR ELECTRIC VEHICLES WITH ROLL FORMING

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NEW CHALLENGES IN CAR BODY ENGINEERING

- Due to active & future CO₂ regulation laws the market share of battery electric vehicles (BEV) will increase compared to internal combustion engine driven cars (ICE)
- Standard body in white (BIW) designs, combined with the weight of the battery systems, especially SUVs will exceed maximum weight of 3.500kg (limit for passenger vehicle license in different countries)

→ Need for lightweight design
LIGHT WEIGHT POTENTIAL
by the use of innovative materials

- Ideal lightweight materials are both, (economic and environmental) efficient in production and use
- Real materials tend to be either one or the other
- High strength steel (HSS) and ultra high strength steel (UHSS) alloys providing tensile strength of up to 1750 MPa compared to 270 – 400 MPa with conventional steel grades
- Compared to other lightweight solutions they are significantly cheaper and better to recycle

Information taken and rearranged from:
and
N.N.: Auto Industry Finds Steel Solution for Lightweighting (2017)
NEW CHALLENGE: CRASH BEHAVIOUR

- With changing the drive concept from ICE → BEV the crash structure must protect the battery system to ensure drivers safety.

- Due to footprint of the battery systems, crash zones are reduced up to 50% and have to be massively reinforced.


Reference: https://www.pallkornmayer.com/work/tesla-model-3-bw
CONSEQUENCES FOR COMPONENTS

Which profile shapes getting developed due to the new challenges?

- Closed section which are stiffer than open profiles
- Multi chamber parts for a maximum energy absorption
- Made from UHSS materials
- Including holes, embossing and 3D cut-off-geometries
## Opportunities and Limits of Different Manufacturing Methods

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Roll forming is perfectly suitable for forming automotive profiles from UHSS.
MULTI CHAMBER PROFILE MADE FROM UHSS

Objective:
- Mass-production of a bumper profile, multiple welded and 100% traceable for all relevant safety requirements
  - Ultra high strength steel (MS1200)
  - Multi chamber cross section

Challenges:
- Constant forming of variable UHSS alloys
- 2 x defined welding process
- Secured quality by traceable production
OBJECTIVE OF THE MANUFACTURING SYSTEM

Possible profiles:
- Material: Mild to ultra high strength steel
- Cross section: Open, single and multi chamber tubes
- Features: Punching, embossing, 3D-bending, …

Possible Applications:
- Rocker, door reinforcements
- Bumper
- Battery trays
LINE SET-UP

Footprint of a sample line:

Main components:
- Strip feeding line, with 21 roll leveler
- DREISTERN pre-punching system
- DREISTERN roll forming system with 30 forming stations up to 2.5mm UHSS
- Intelligent roll forming & quality control systems
- Up to four Laser welding systems
- Inline 3D-Bending station
- DREISTERN flying cut-off system for multiple tool assembly
LINE SET-UP
QUALITY MANAGEMENT IN WELDING

Challenge:
- Securing/Tracking of weld quality in multi chamber welding
  - Works for ordinary weld seem (eddy current check, picture check)
  - Fails for a B-shape geometry with only one weld seam
    - 3 joining partners (2 band edges + 1 bottom blank)
    - Defined joint between top and bottom layer

Vision:
- Inline quality control analyzing all relevant quality parameters in the weld zone
TYPICAL LASER WELDING PROCESS

**Input**
- Easy to set/control:
  - Feed speed
  - Laser Power
  - Focus and Position
  - Filler wire
  - Process gas
- Difficult to set/control:
  - Blank width
  - Quality of strip edge
  - Pre-formed geometry

**Output**
- Visible without destruction:
  - Geometry of joint
  - Heat affected zone
- Visible after destruction:
  - Welding depth
  - Strength of the weld

**TYPICAL LASER WELDING PROCESS**
Weld properties can be predicted based on load measurements!
CONCLUSION

- New car body structures of BEVs put new challenges on sheet metal manufacturing
- Well established manufacturing methods come to limits
- Roll forming offers an attractive alternative to manufacture profile shaped components, even from high strength steel alloys
- Roll forming manufacturing complete parts in only one step AND assure the quality due to inline process monitoring and control
FOR MORE INFORMATION

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