3rd General Assembly

Brussels 3rd December 2014

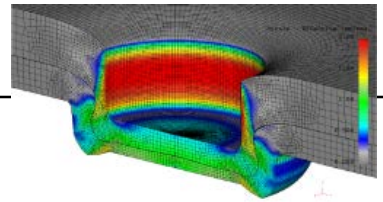
Matchmaking topic: **Thick Sheet Clinching**

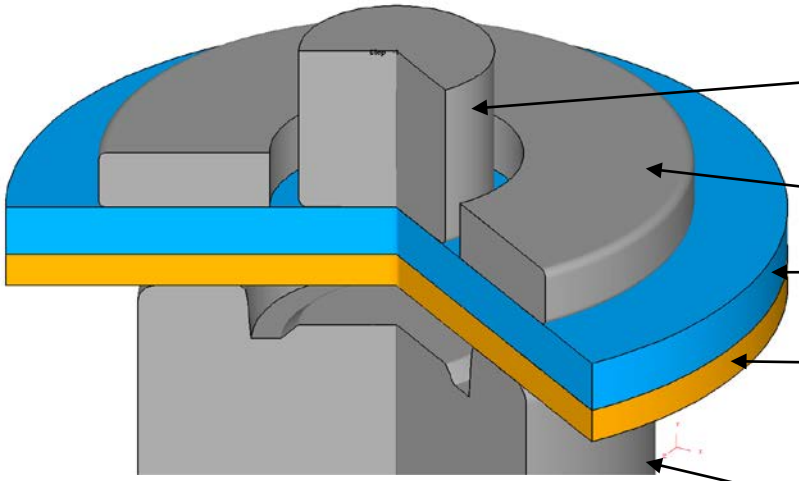
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Thick-Sheet-Clinching





for commercial vehicles



for passenger cars

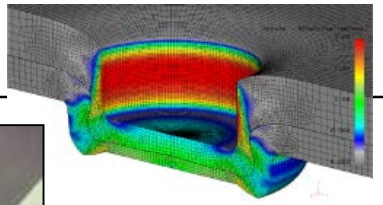
Priciple

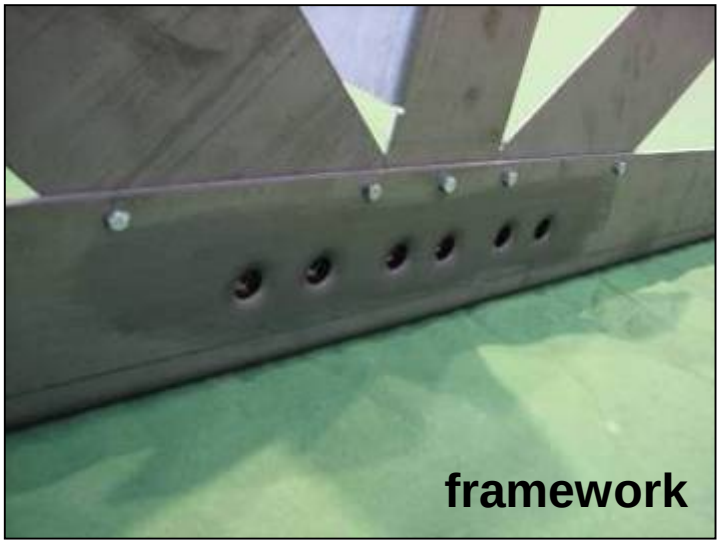
- Cold forming / form fit due to undercut
- Strain hardening due to high plastic deformation

Possible applications

- Truck- und Trailer, rail vehicles
- Total sheet thicknesses: until now ca. 20 mm

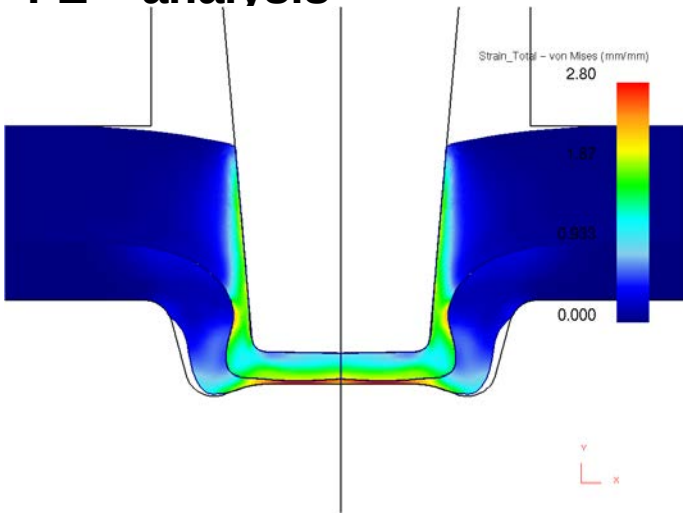
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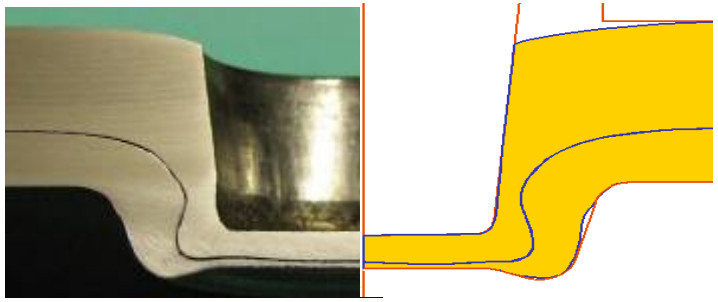




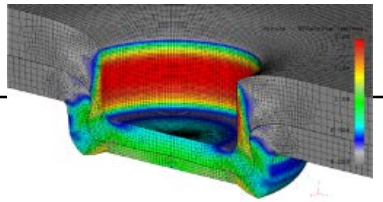
FE – analysis



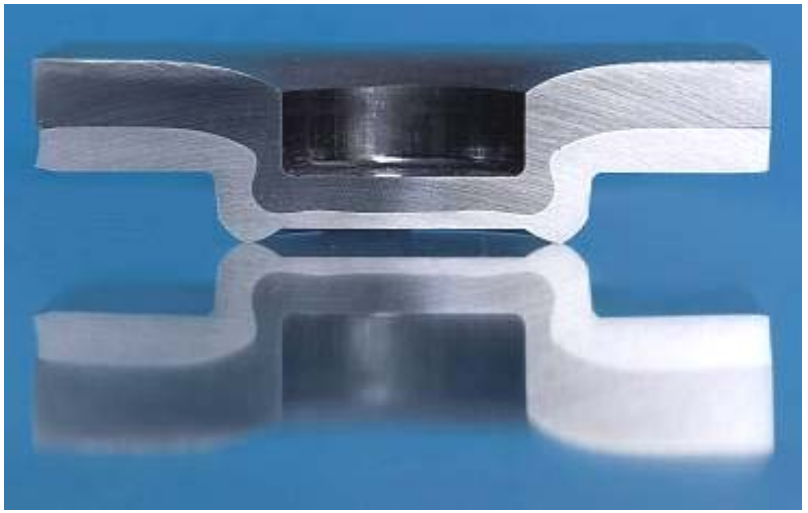
Comparison experiment / simulation



Aspects / Advantages



Innovation aspects:



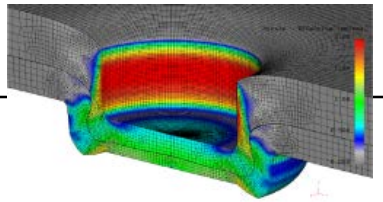
Not state of the art

- **Predictability**
- **Robustness analysis**

Advantages:

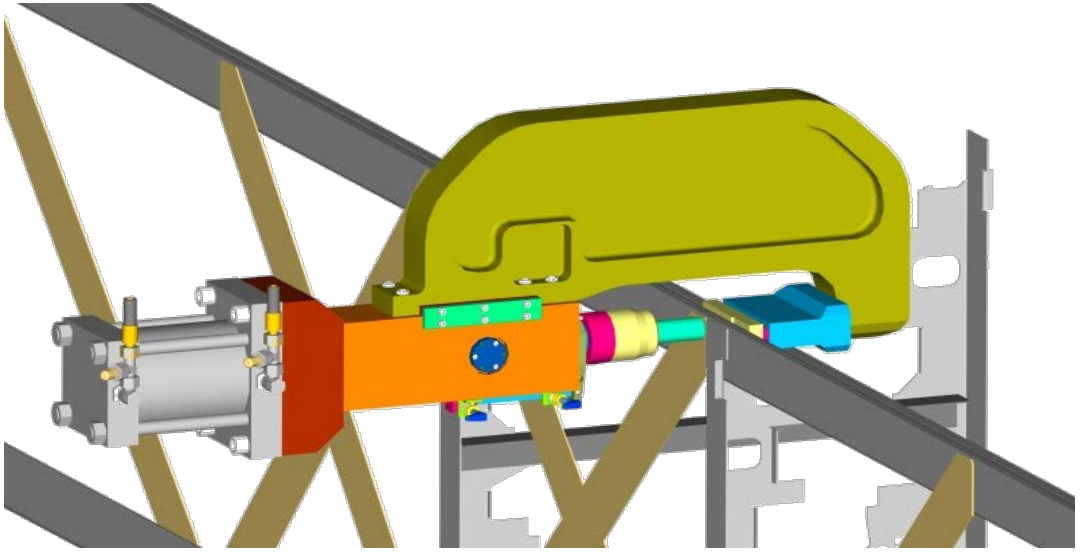
- **Minimum costs**
- **Highest fatigue strength**
- **Minimum elastic and no thermal distortion**
- **Best corrosion resistance**
- **Mixed compounds (steel/alu)**

Project idea



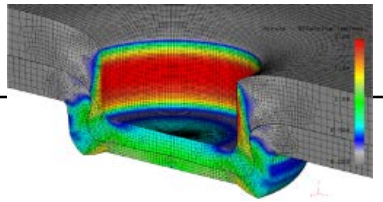
Boundary conditions

- lap joints only ➔ accessibility
- Ductility
  about quality S 700
- Joining direction -
  thick to thin + hard to smooth
- Number of clinch-spots per year



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Project idea



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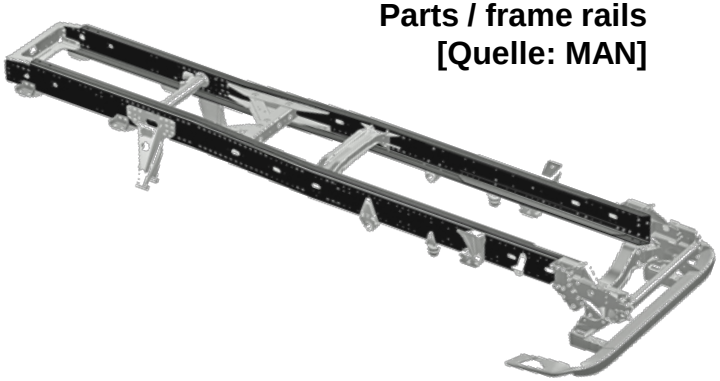


Pivot adjust (left), Package tray (right)

[Source: BTM Europe GmbH]

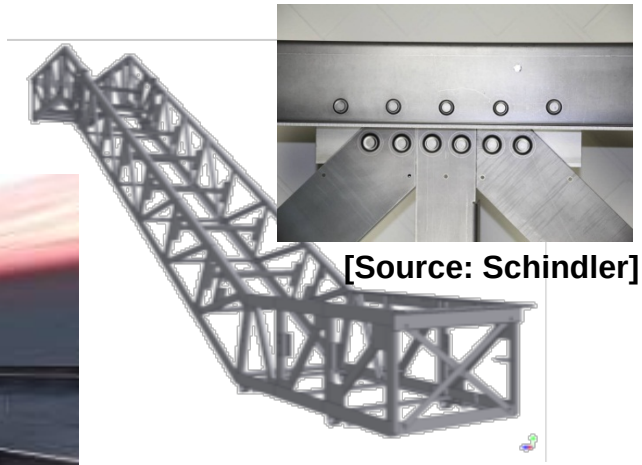
Truck / Trailer / Rail & steel-construction

Parts / frame rails
[Quelle: MAN]





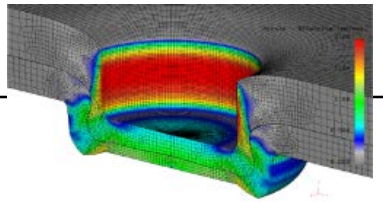
[Source: Bombardier]



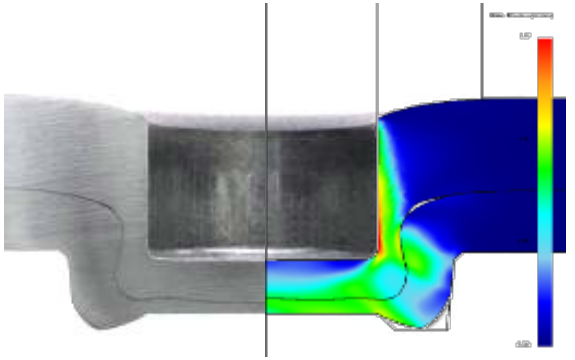
[Source: Schindler]

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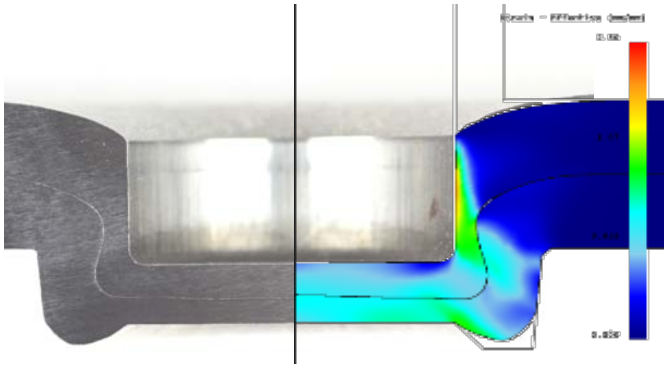
Main Goals



- Numerical optimization of process parameters
- Numerical strength analysis of assembled structures
- Energy rating
- Test
    - Corrosion
    - Hydrogen embrittlement



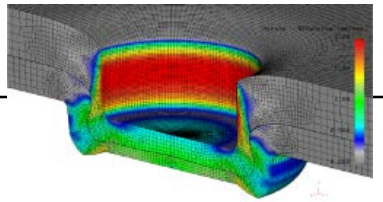
S380MC (6,0 mm) + S235 (4,0 mm)
die diameter: 22 mm



S235 (5,0 mm) + S235 (5,0 mm)
die diameter: 30 mm

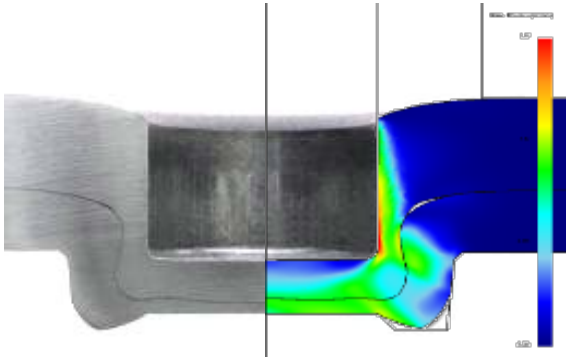
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Target Partners sought



interested parties from industry

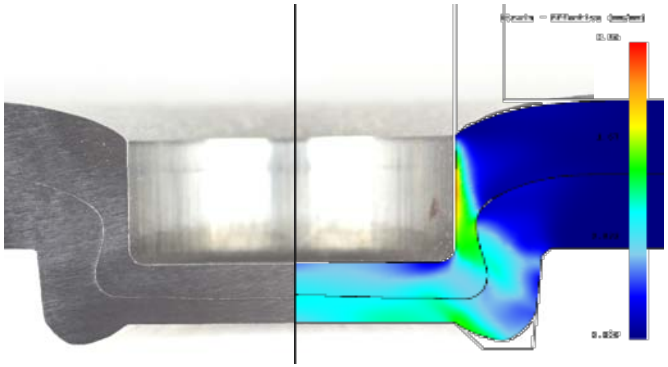
- Commercial vehicles
- Rail vehicles
- Shipbuilding
- Steel construction



S380MC (6,0 mm) + S235 (4,0 mm)
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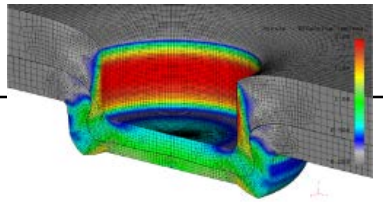
from institutes

- **Strength analysis of large structures**
- **Test Corrosion and hydrogen embrittlement**
- **European authorization**



S235 (5,0 mm) + S235 (5,0 mm)
die diameter: 30 mm

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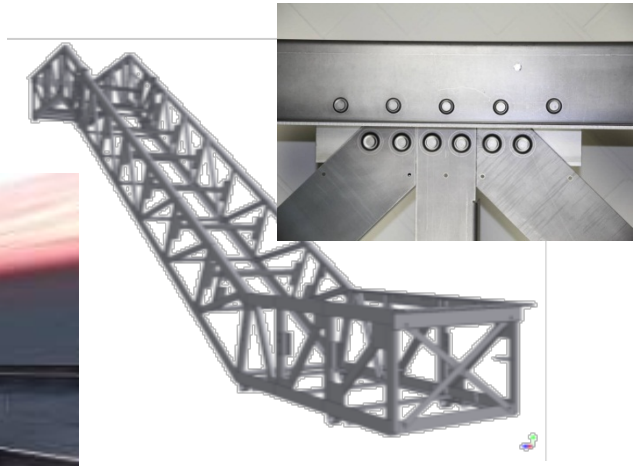




Thanks for attention



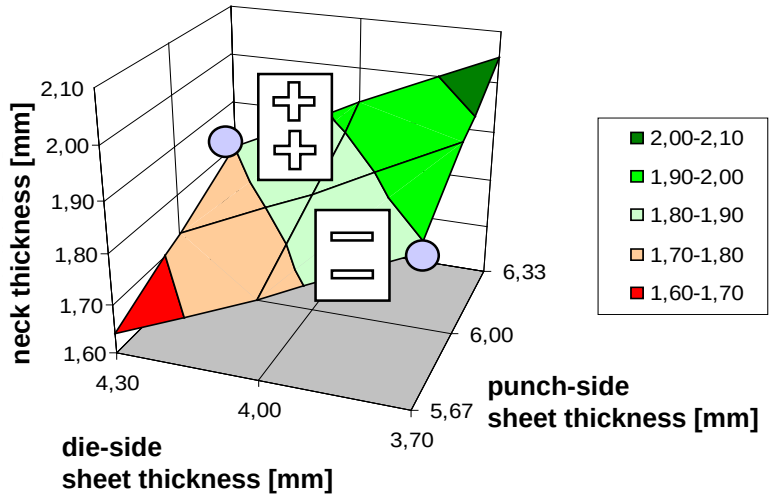


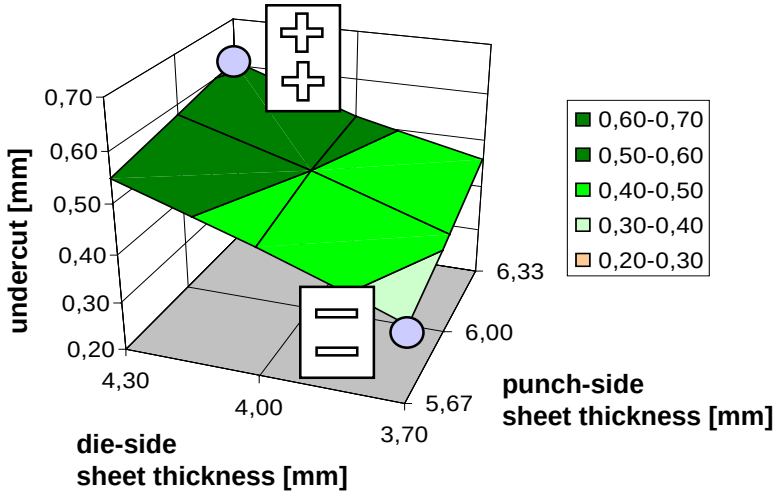


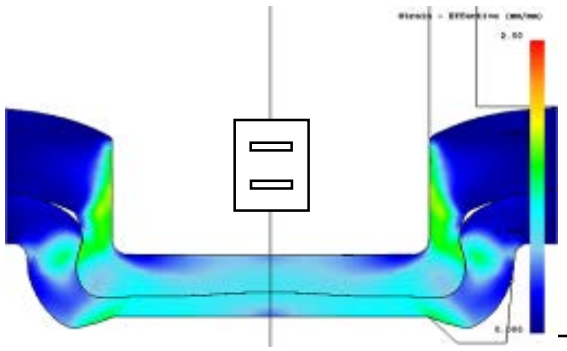
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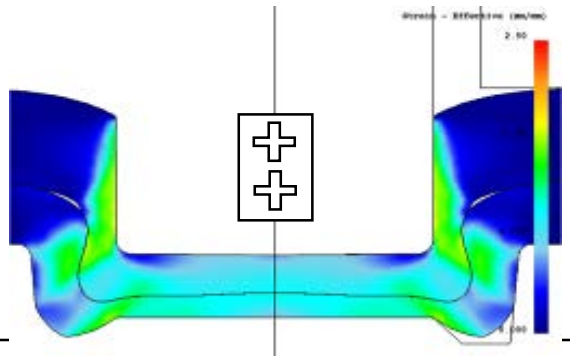
Sensitivity study, Variation of sheet thicknesses

Bsp.: S380MC (6,0 mm + 4,0 mm) – Die diameter 30 mm - FEA



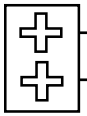






Info

Tolerance in sheet thickness (DIN10051):

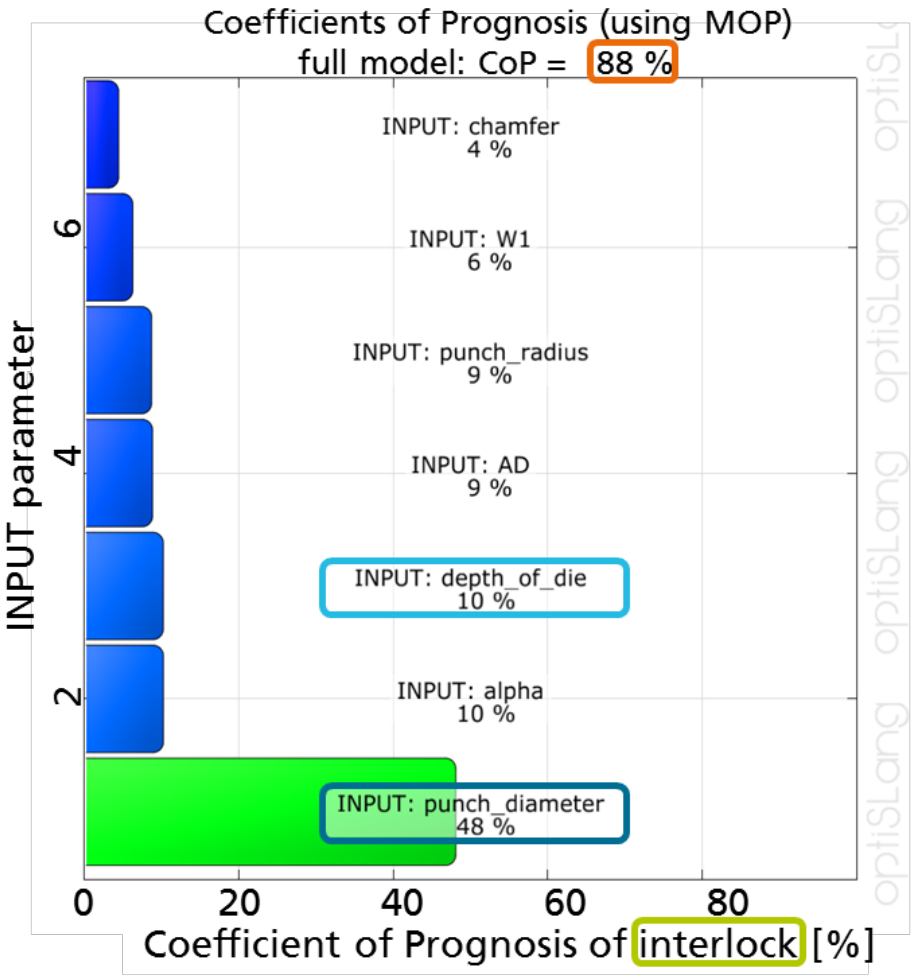


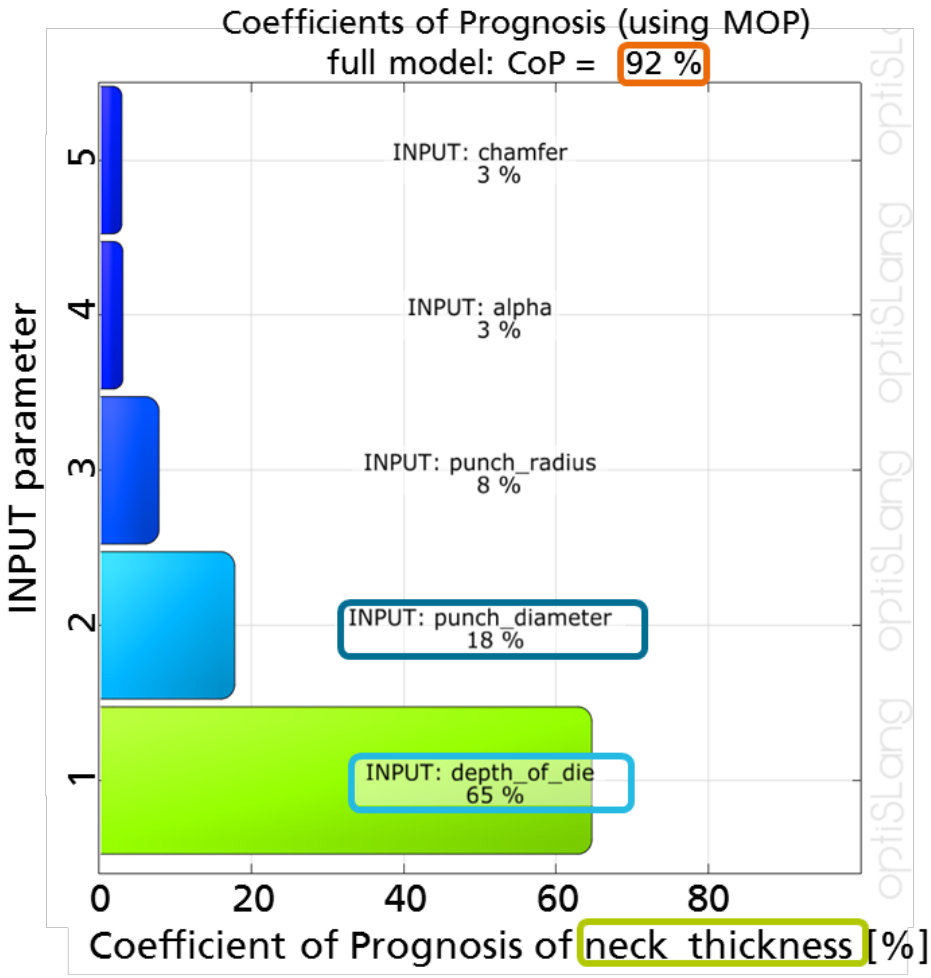
punch-side plus tolerated

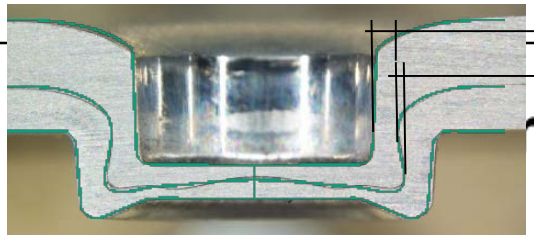
die-side plus tolerated

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Sensitivity analysis of clinching

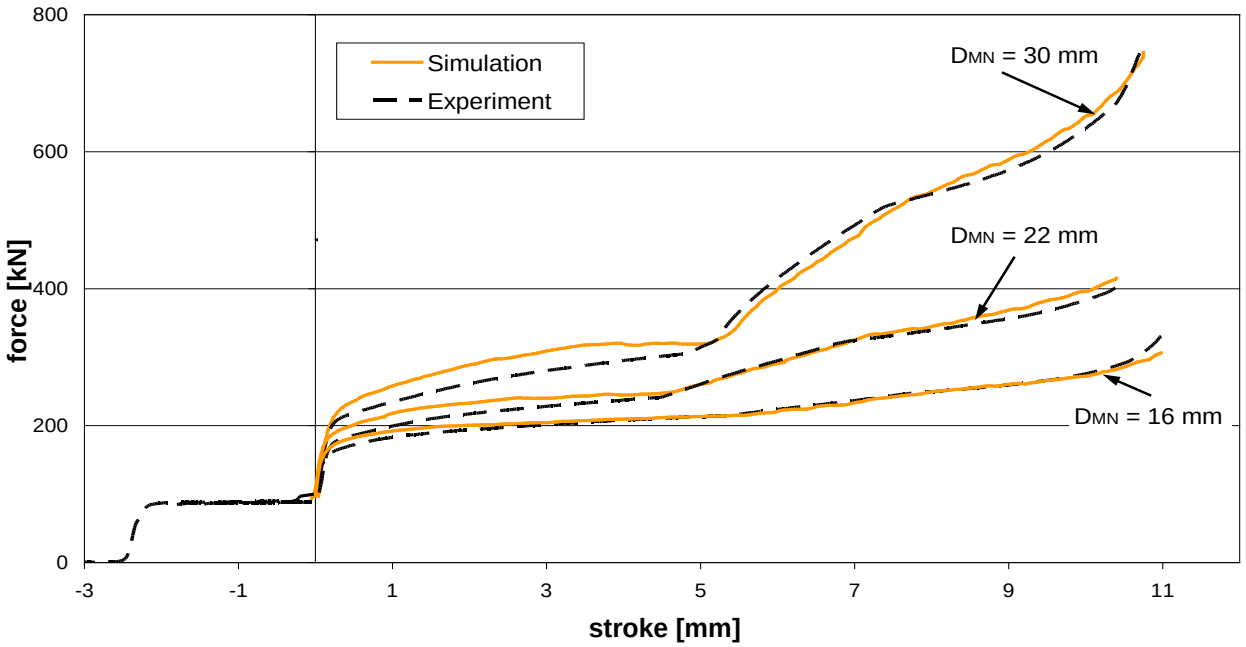




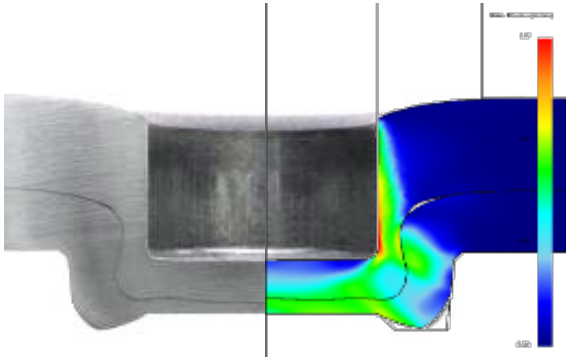


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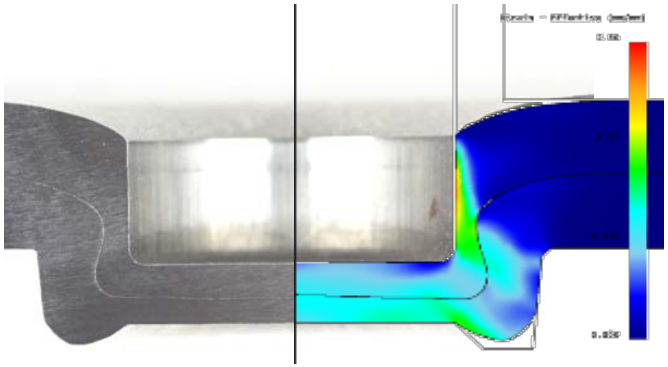
Verification FEA and Experiment



Stroke-force-curves, S380MC (6,0 mm) + S380MC (4,0 mm), die diameter 16 / 22 / 30 mm



S380MC (6,0 mm) + S235 (4,0 mm) die diameter: 22 mm



S235 (5,0 mm) + S235 (5,0 mm) die diameter: 30 mm

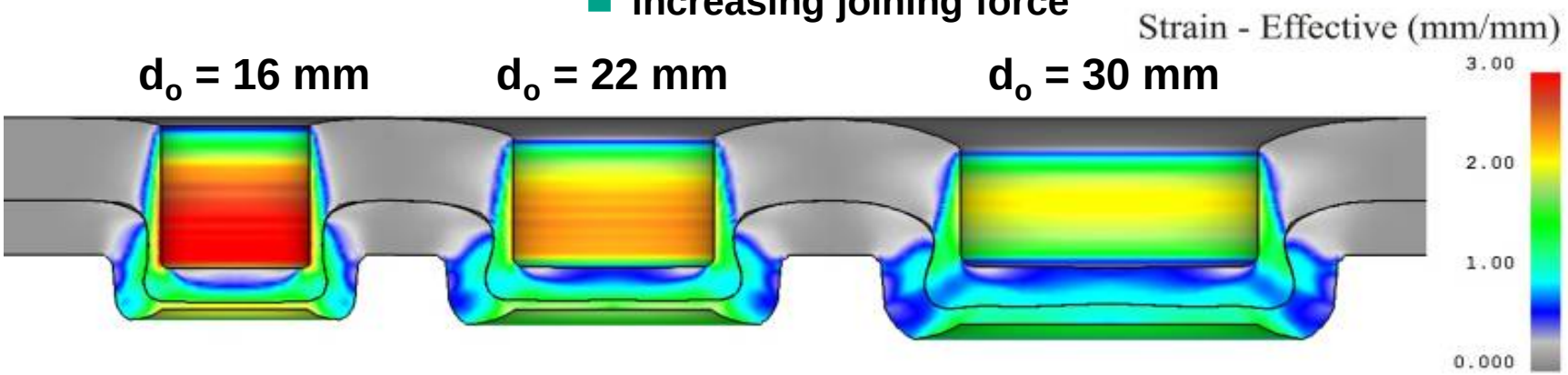
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FEA-based tool dimensioning

smaller point dimension

- increasing neck thickness
- increasing undercut
- increasing bottom thickness
- decreasing strain
- increasing joining force

greater point dimension



FEA results for different joint dimensions), S380 (6 mm) in AlMg4.5Mn (4 mm)