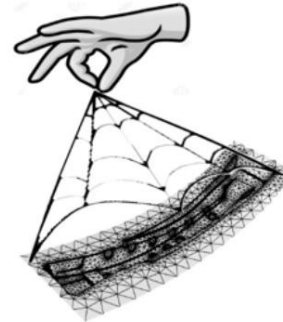


Sheet metal forming and cambering using elastic dies

Johan Pilthammar, Volvo Car Corporation, Peter Ottosson, RISE

CAMBER



PROXIMION

RI
SE



MATRICI

FAGOR 
ARRASATE



SMART 
advanced manufacturing

EUREKA 
innovation across borders

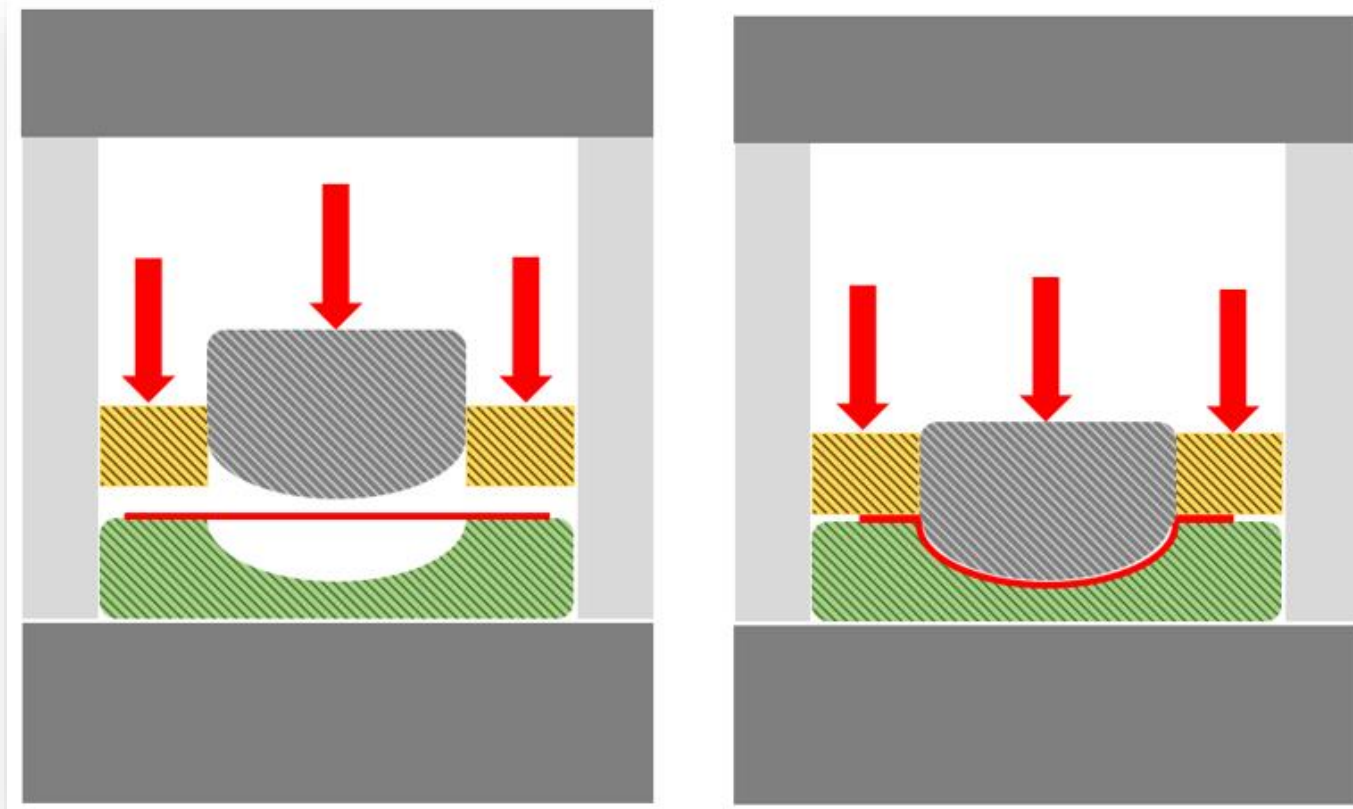


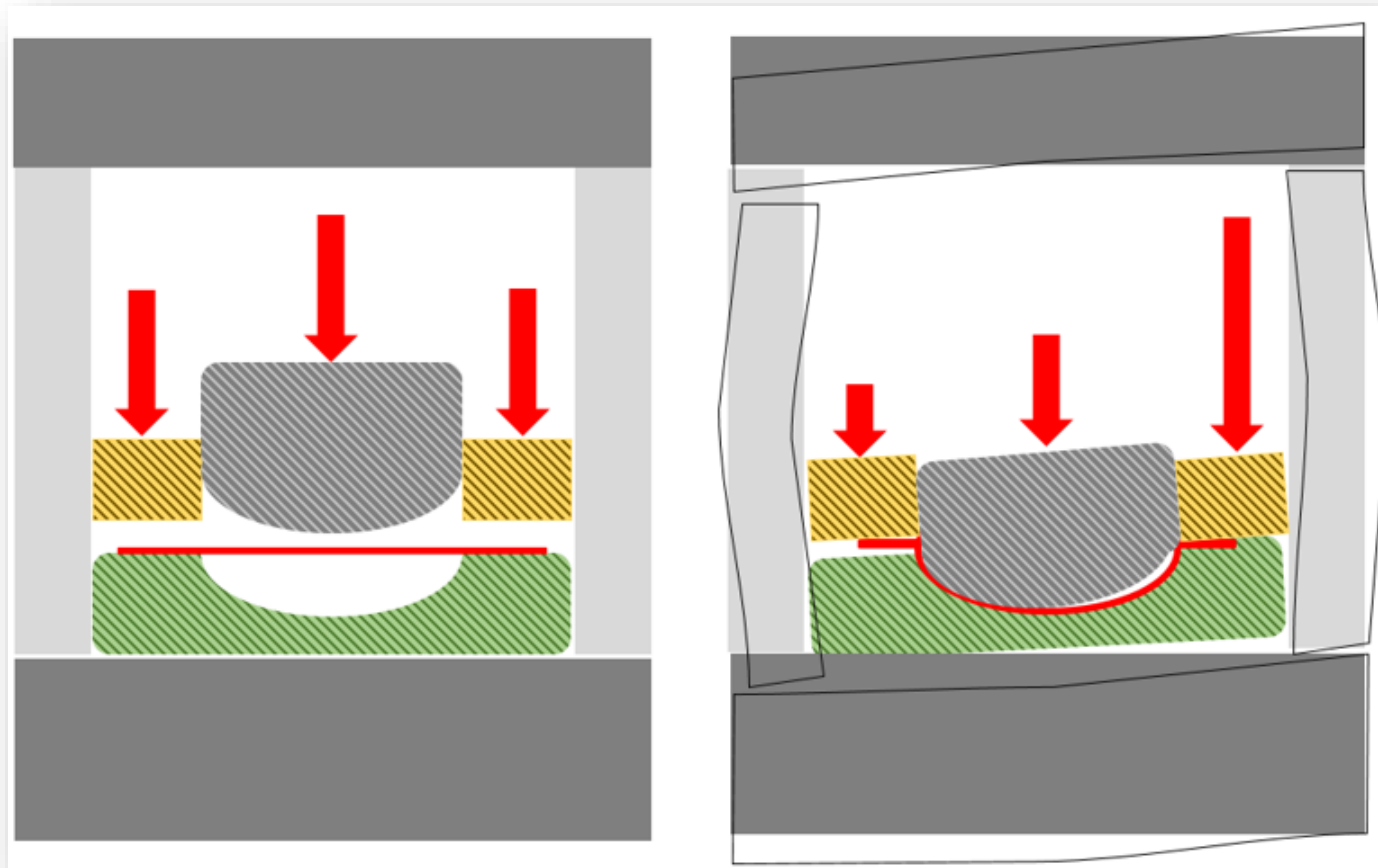
V O L V O



Presenter: Johan Pilthammar
Volvo Cars and Blekinge Institute of Technology
johan.pilthammar@volvocars.com

Contributors: J. Pilthammar, T. Skåre, L. Galdos, K. Fröjdh, P. Ottosson, D. Wiklund, J. Carlholmer, M. Sigvant, M. Ohlsson, E. Sáenz de Argandoña, F. Abbasi, O. Sarasua, A. Garro, W. Rutgersson





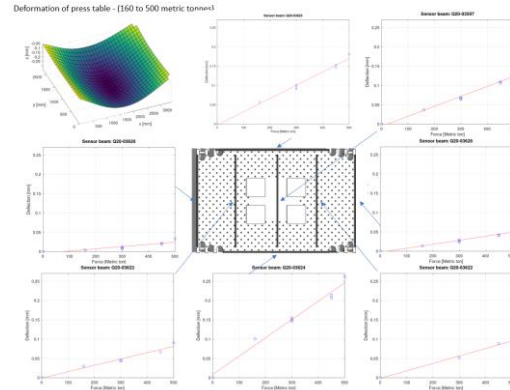
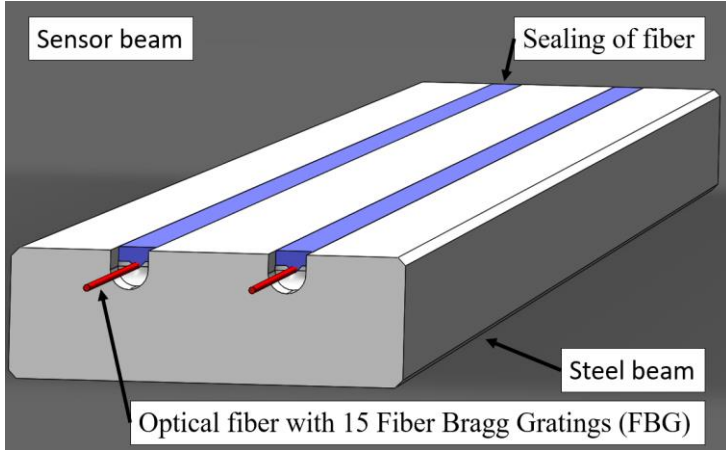
Project objectives

- Develop press deflection measuring devices.
- Develop press substitutive models.
- Develop numerical cambering strategies.

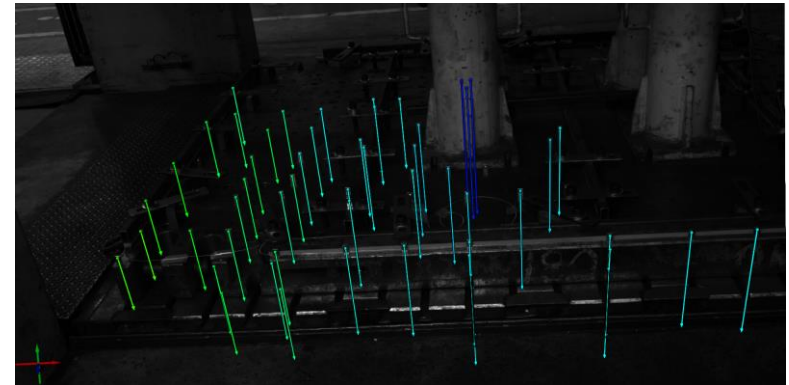
New press deflection measuring devices

- Die tryout is critical for cost, lead time, quality, etc.
- Cambering is today based on previous experience.
- All presses and tools are different.
- Stronger materials and challenging designs are difficult to handle.
- Project partners have developed two different measuring devices to quantify elastic press deformations.
- Create numerical representations of presses.
- Potential to include in presses for health monitoring, Industry 4.0, prevent breakdowns....

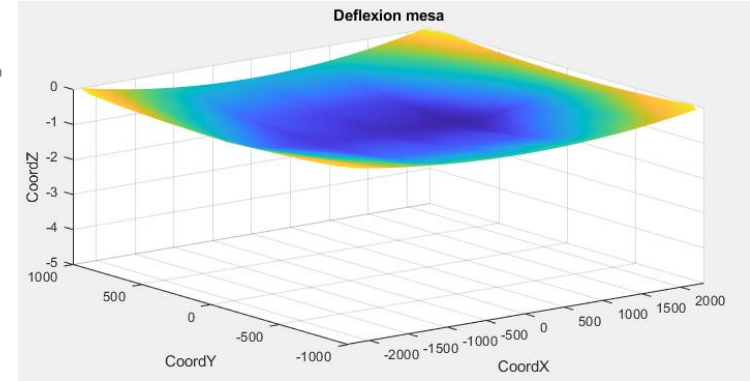
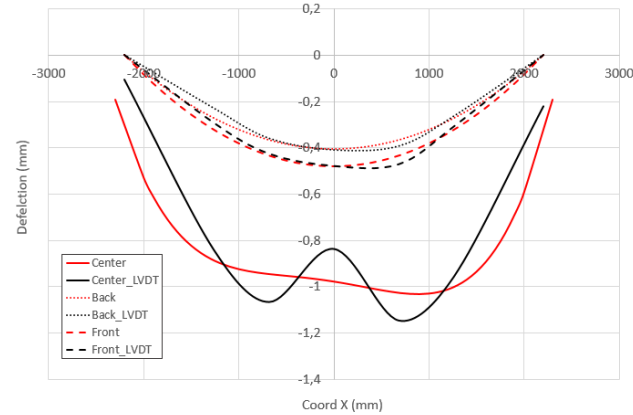
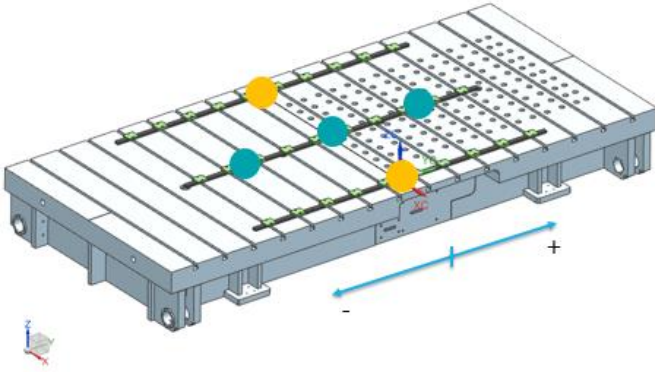
Sensor Beam (optical fiber)



Verification with DIC (ARAMIS)

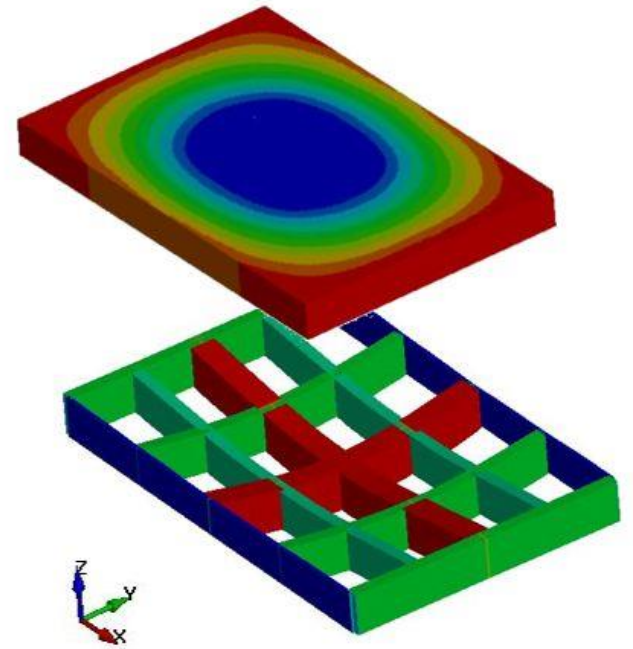
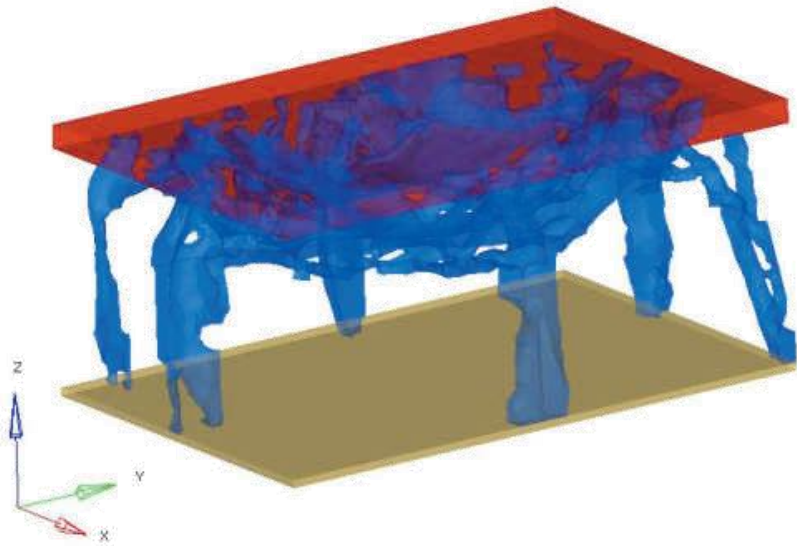


Sensor Beam (Piezoelectric strain sensors)



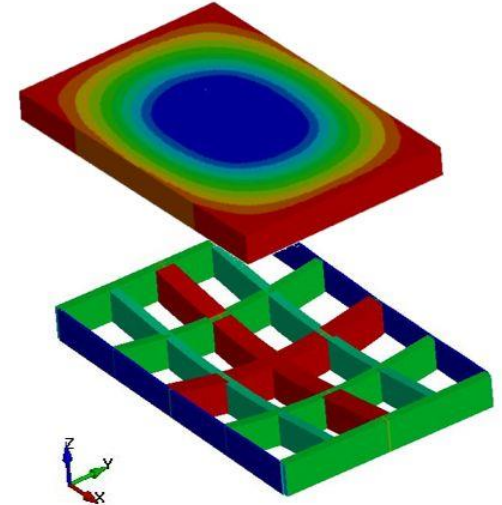
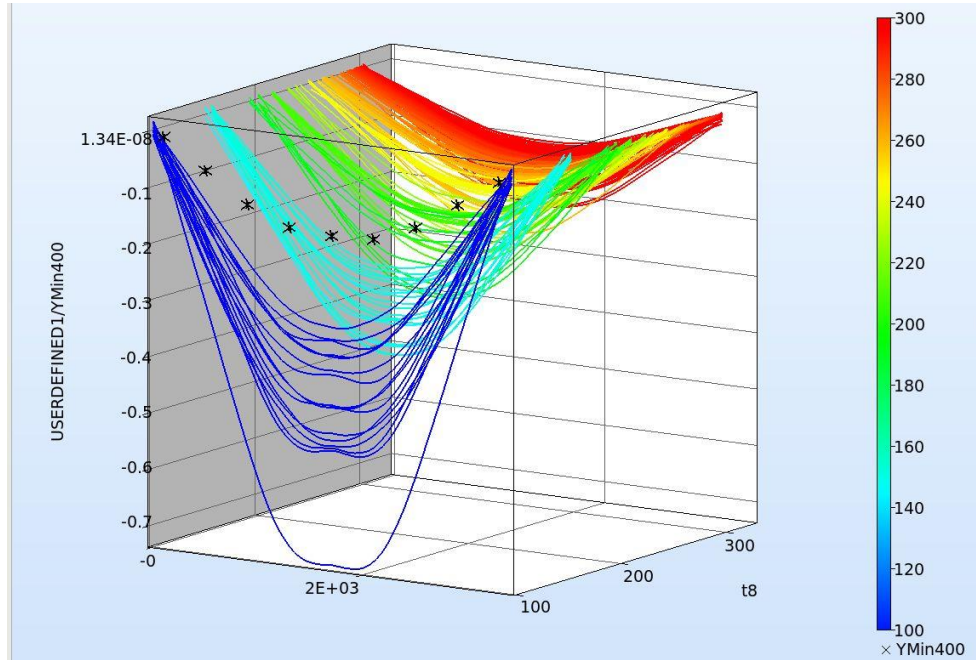
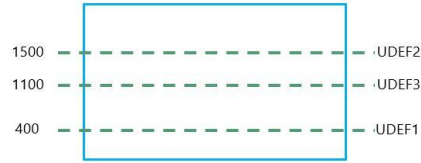
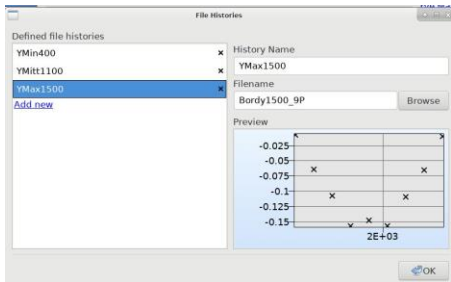
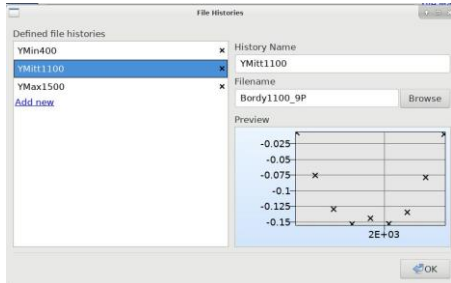
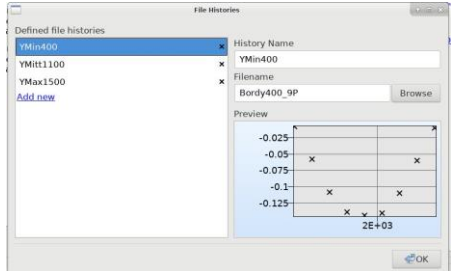
- Simpler measuring technology
- Validated by linear displacement sensors.
- Data fitted by second and fourth order polynomials.
Limited data compared to fibers.

New Substitutive Bolster: Simpler and more robust

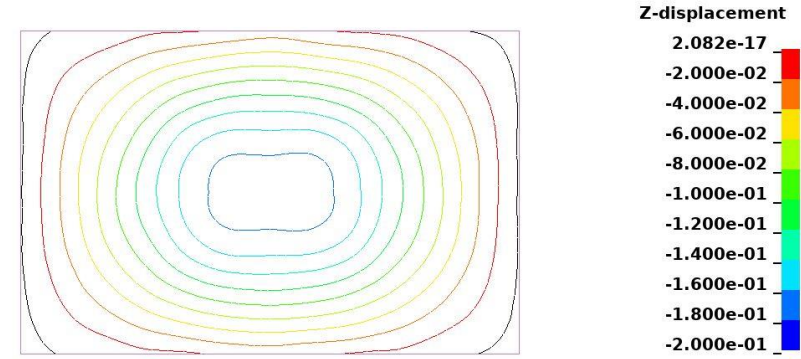
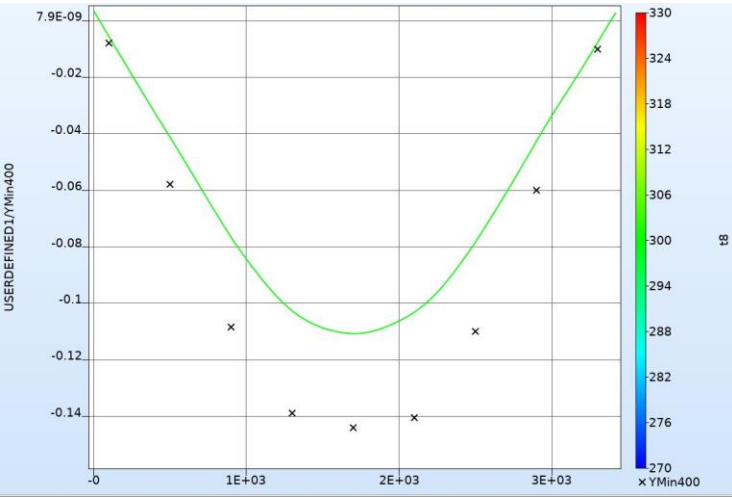
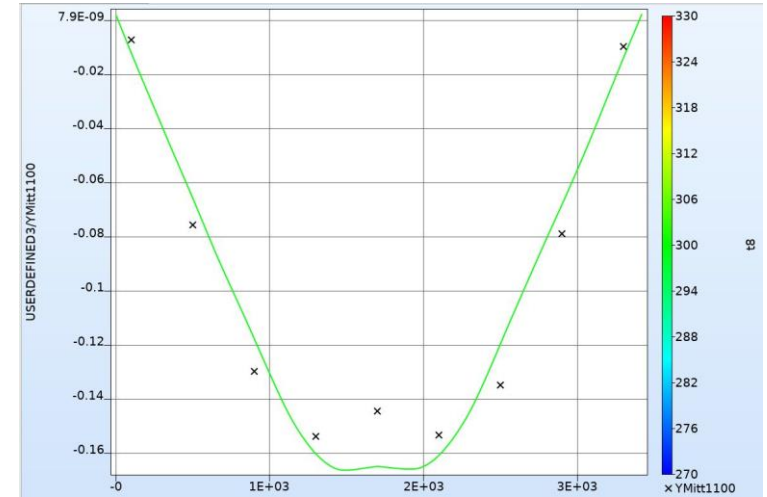
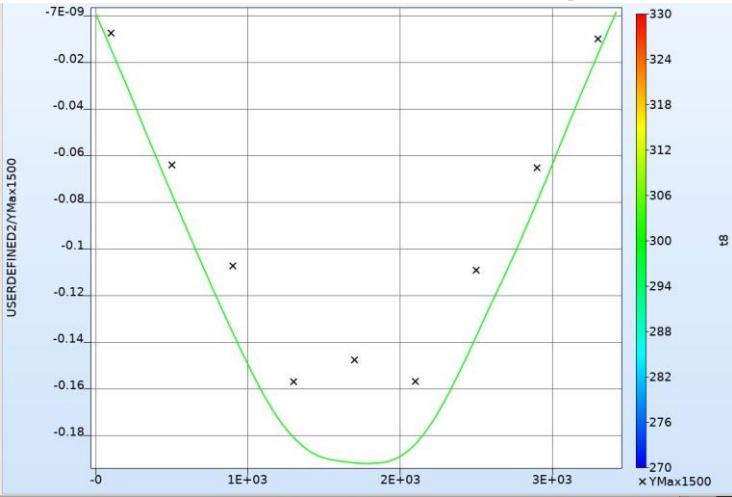


Optimisation of substitutive press model to match deflections with respect to measurements

Using LS-Opt to find optimal press table and slide design parameters with composite curve matching

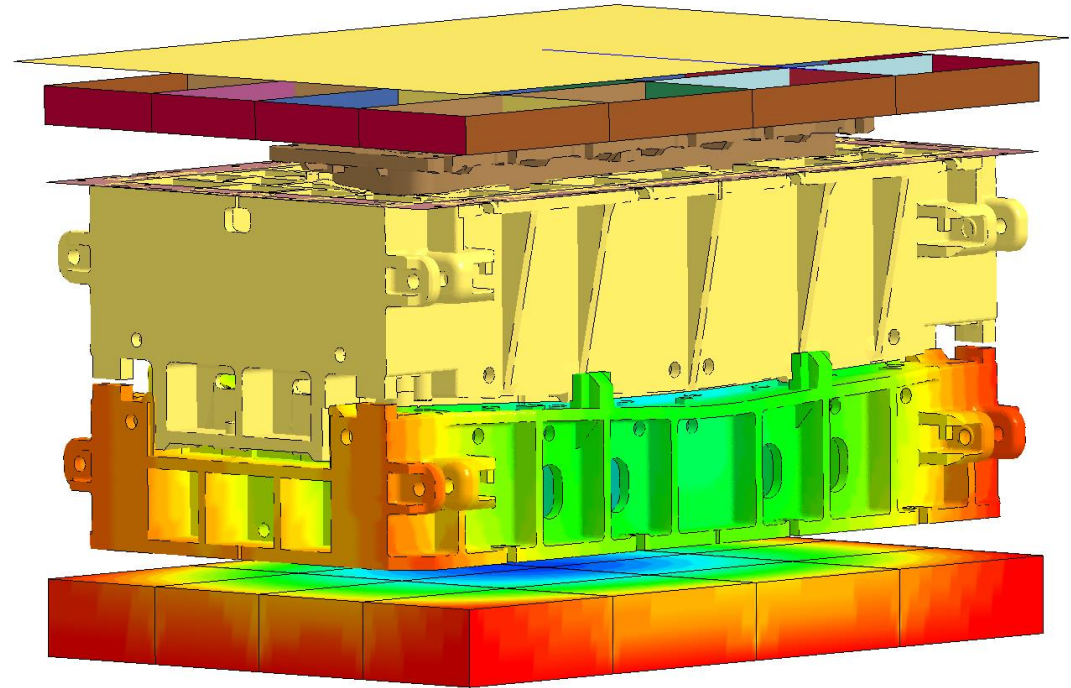
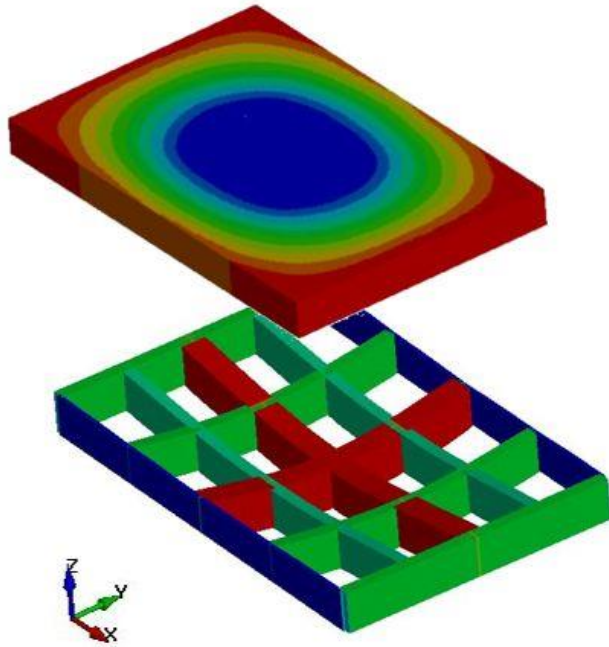


Performance of press table model



Differences between measured and optimised design can originate both from measurements and design restrictions in chosen modelling concept

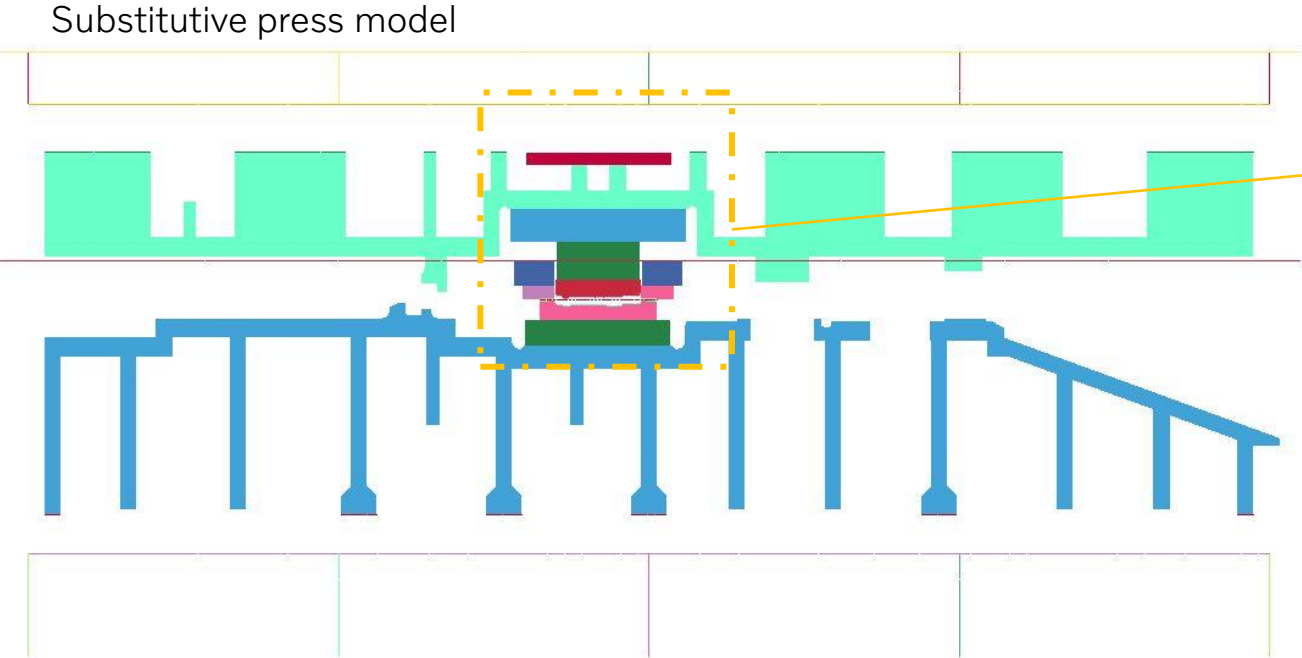
Substitutive Bolster in modelling complex tool set



Digital twin of press

Press and tool model for implementation of press deflection and tool cambering

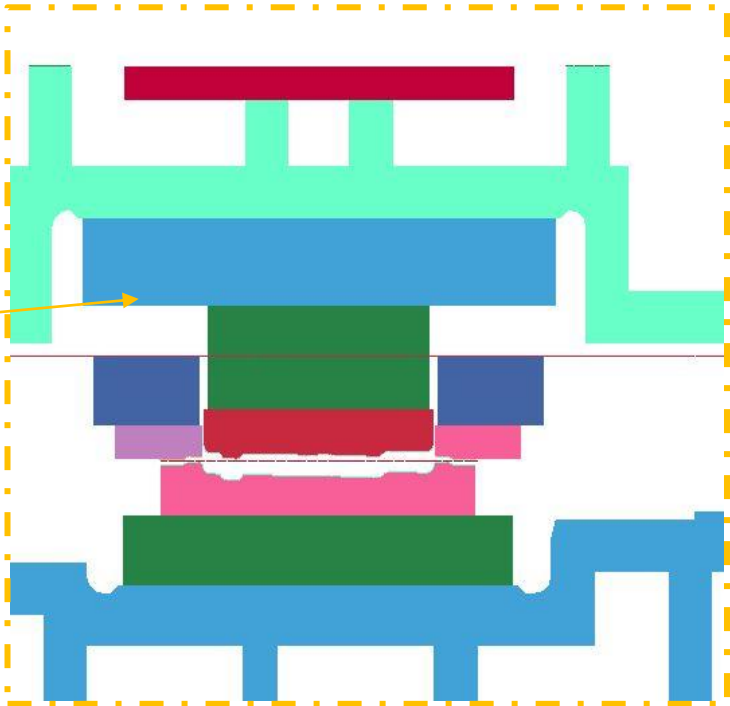
Cross section of tool and substitutive press model



Substitutive press model

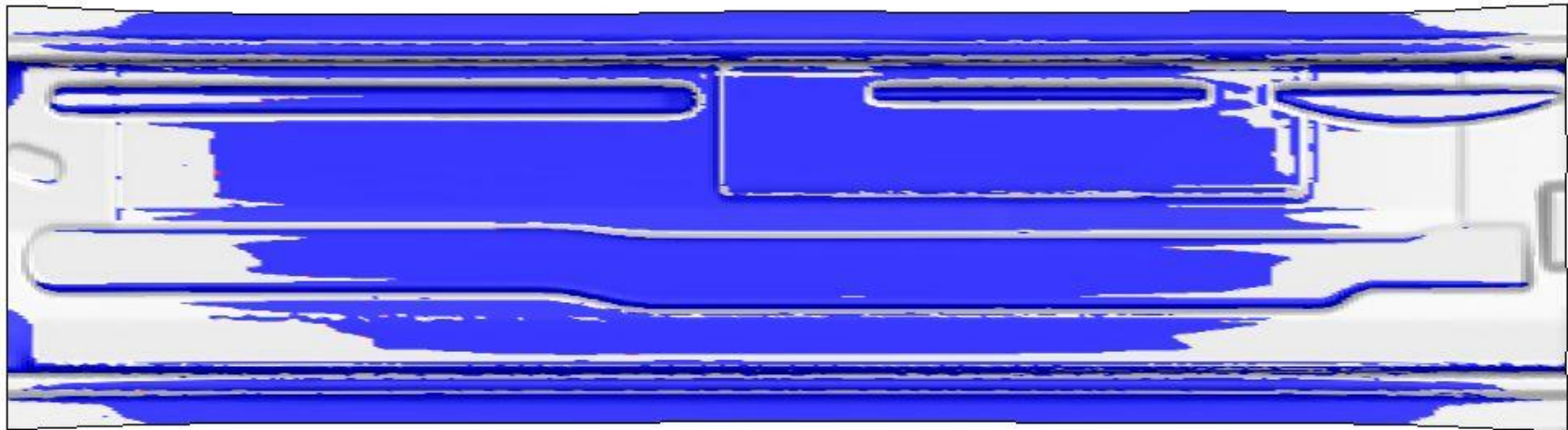
Substitutive press model

Close up of forming station

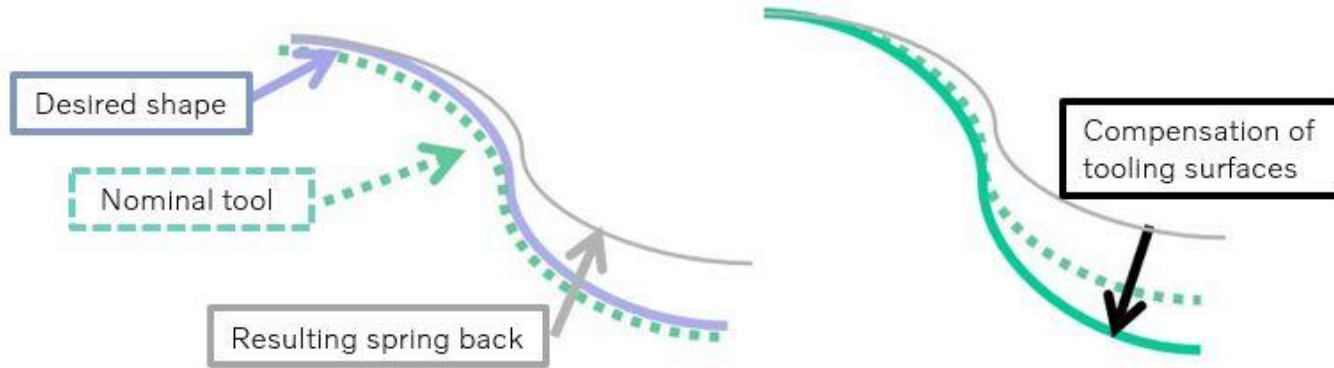


Spotting images

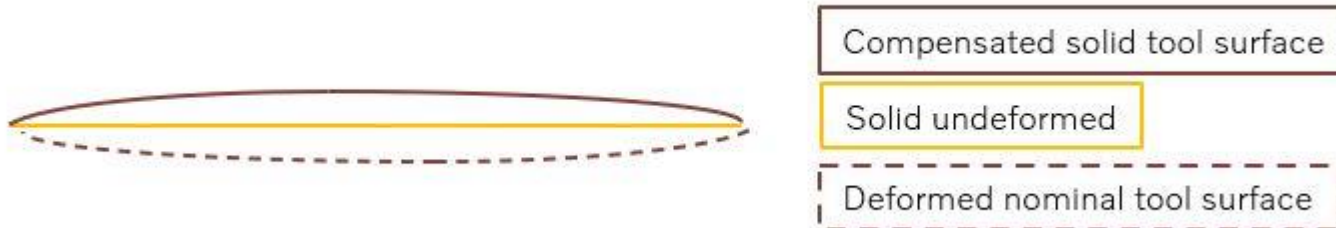
V O L V O



Compensation using LS-Dyna



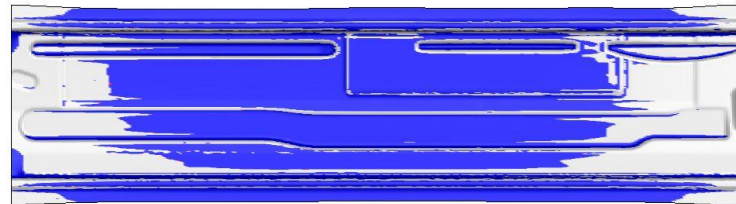
Compensation applied to solid tooling taking press deflections into account



Spotting image after compensation with scale factor 1.5



Before compensation



- Significantly improved tool/blank contact
- One side of tool compensated
 - Based on average z-deflections at max load

Summary

- Fibre method validated by ARAMIS-system. High accuracy.
- Strain sensors. Good agreement but does not capture local deflections.
- Potential for both portable and embedded systems.
 - Smart tryout-press
 - Health monitoring
 - Industry 4.0 / Smart Stamping / Digital Twins
- Using measured press deflections when modelling improve simulations, reduce die try-out effort and aid in cambering

Thank You!



This work has been carried out under the CAMBER European research project.
A project funded under the SMART EUREKA CLUSTER on Advanced Manufacturing programme.

