

Experimental and Hyperform Analysis of Springback in Sheet Metal Forming for DP Steels



**COŞKUNÖZ
HOLDİNG**

“sınırsız şekillendirme,”

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29.10.2010

- **INTRODUCING COŞKUNÖZ METAL FORM COMPANY**
- **STAMPING PROBLEMS OF DP STEELS**
- **SIMULATIVE TESTS**
- **MODELING AND SIMULATION**
- **STAMPING EXPERIMENTS**
- **RESULTS AND COMPARISON**
- **FUTURE WORK**

Mass Production



Tools and Machinery Production



Ford Control Arm



Fiat Fuel Tank



Fiat Cross Car Beam

Tests and Analyses

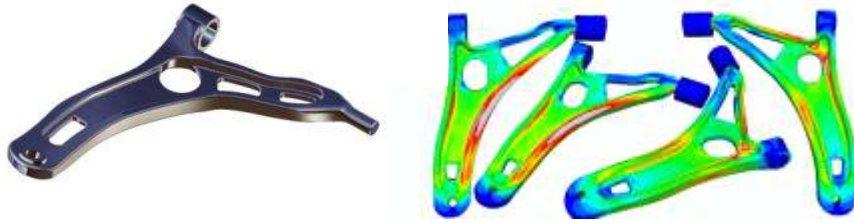


MTS Durability Test System



ATOS Digitizer

Part Design with Catia

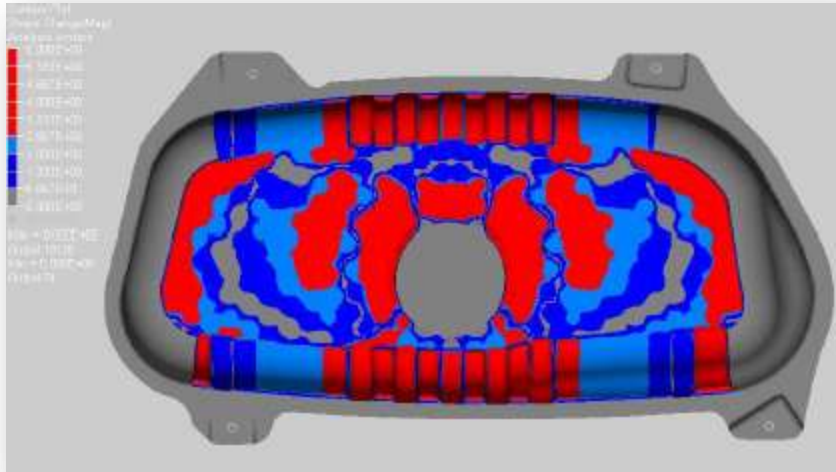


Control Arm – Coşkunöz Design

Forming Simulation with Autoform and Hyperform

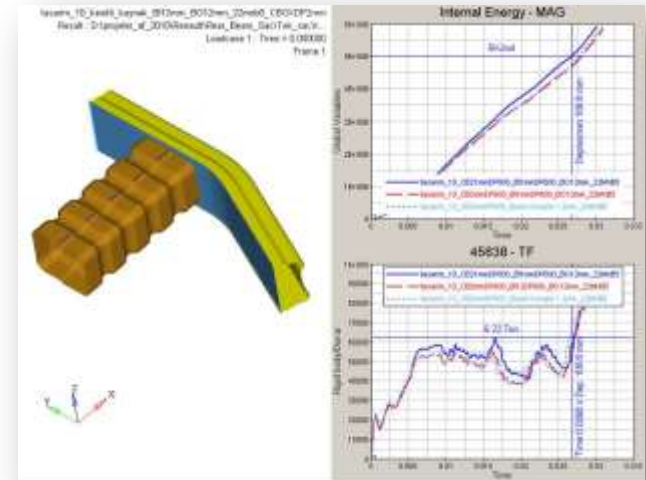


Optimization with Optistruct



Fiat Fuel Tank

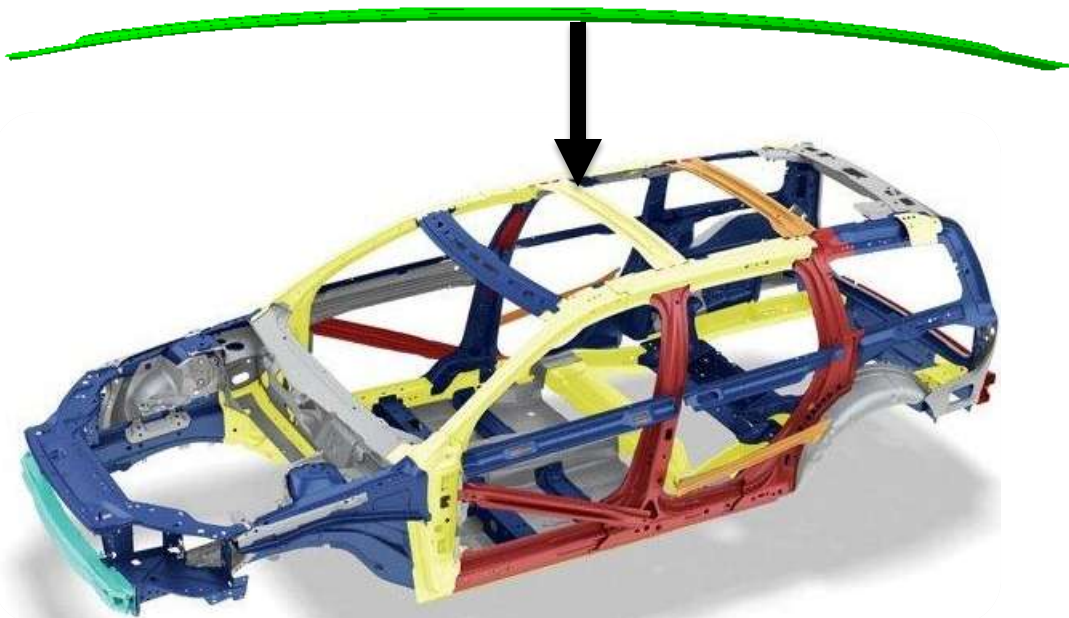
Crash Analysis with Radioss



Bumper – Coşkunöz Design

Stamping Problems of DP Steels

Redesign Roof Stiffner

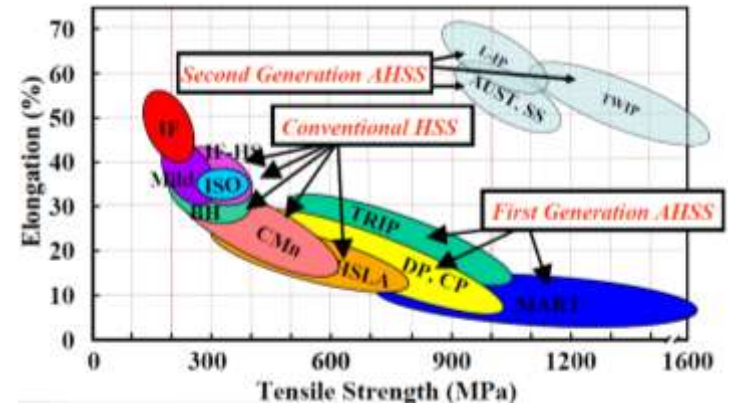


Material :

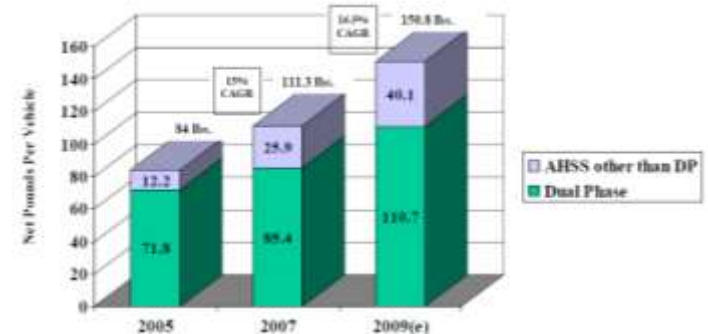
0.8 mm thickness

AHSS Dual Phase Steel DP600

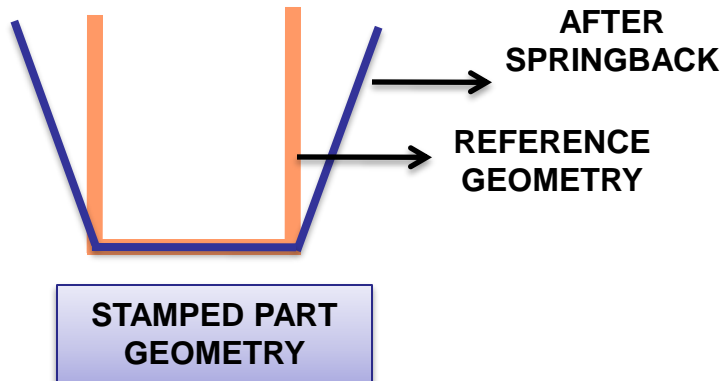
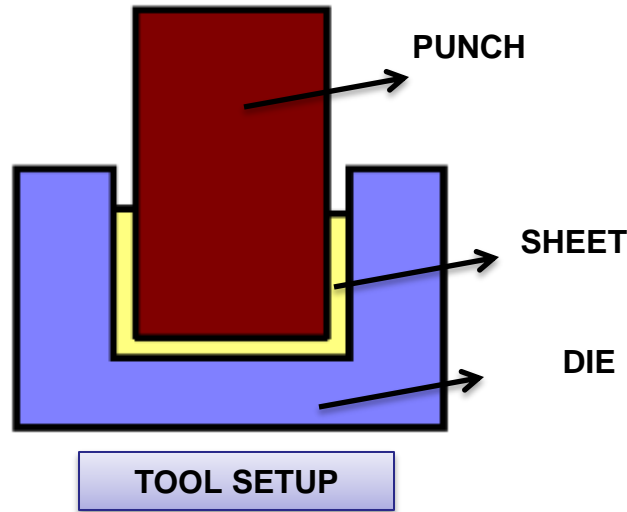
Both sides 10 micron galvanized



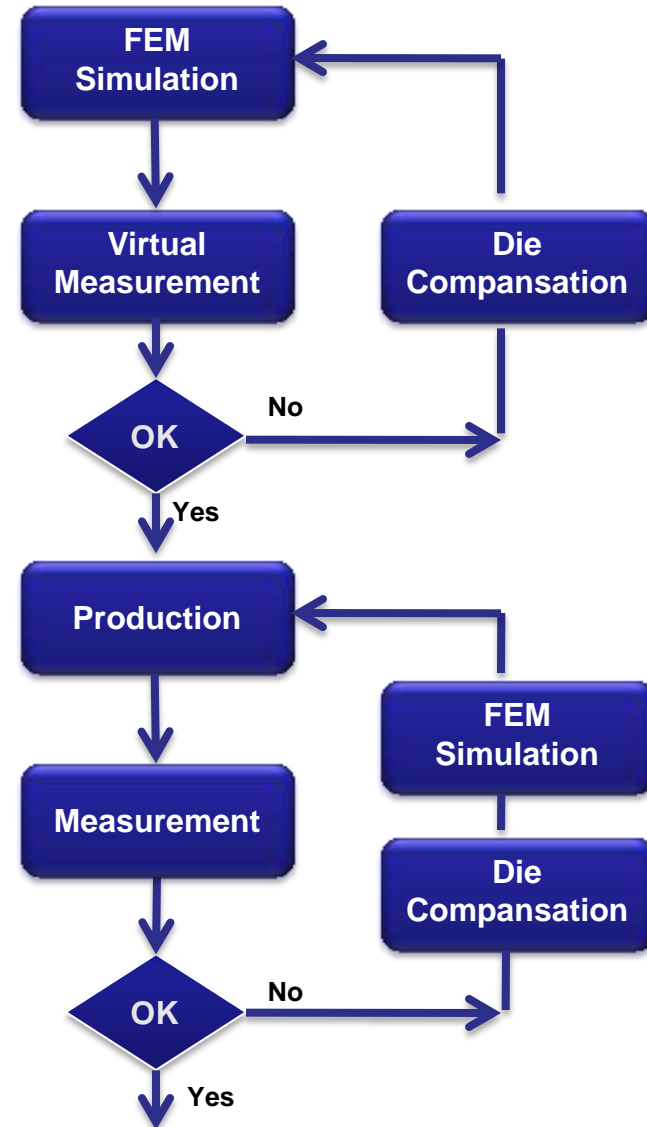
www.autosteel.org

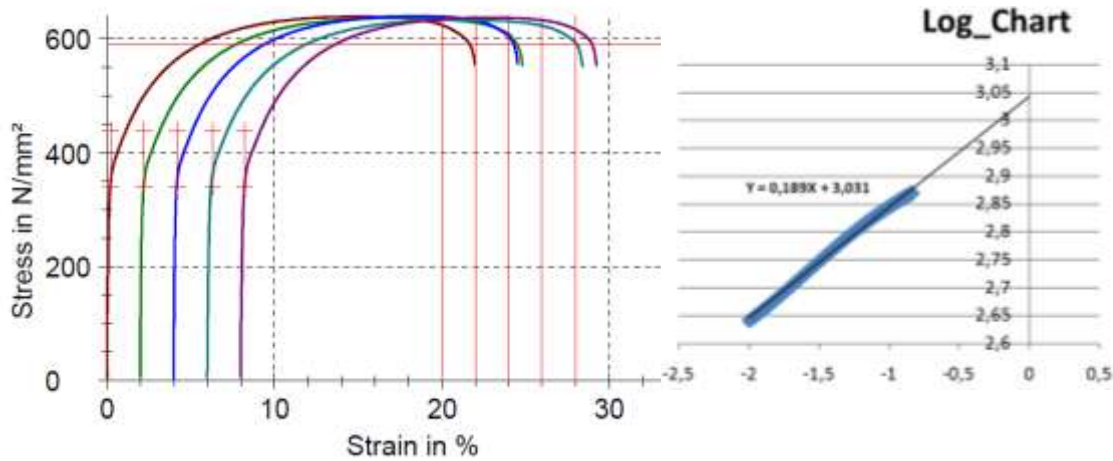


www.autosteel.org



SPRINGBACK COMPANSATION FLOW CHART





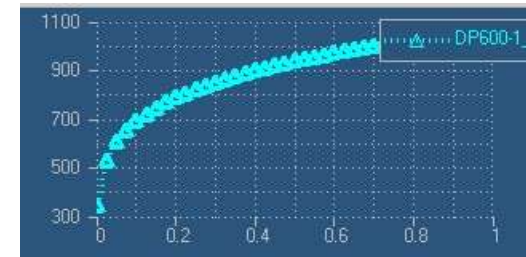
Zwick

$$\sigma = K\varepsilon^n \quad \log \sigma = \log K + n \log \varepsilon$$

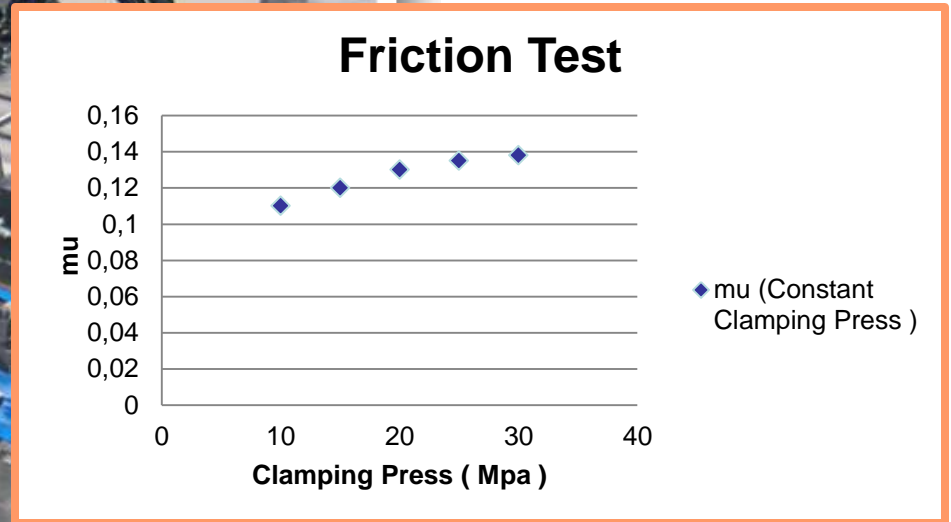
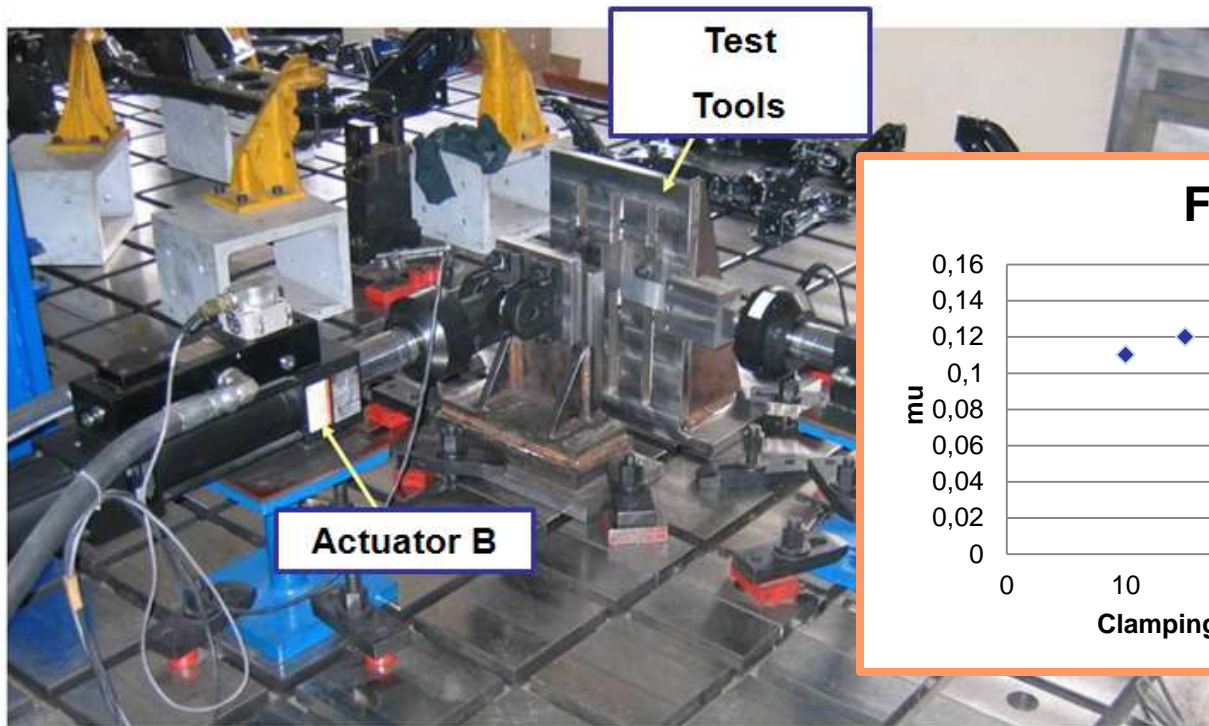
power law
 file

curve: display

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k =	<input type="text" value="1075.627"/>	maximum =	<input type="text" value="1.000"/>
n =	<input type="text" value="1.897e-01"/>		



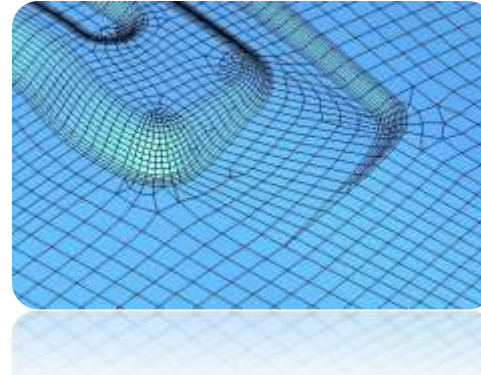
FRICTION



Friction tester was adapted to MTS Test System and friction tests were performed for constant clamping forces.

Tool Mesh Parameters

Minimum edge length:	0.8
Maximum edge length:	6.4
Chordal deviation:	0.05
Fillet angle:	10



Blank Mesh Parameters

Average edge length:	6.4
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Adaptivity Level

/ ADMESH / GLOBAL /

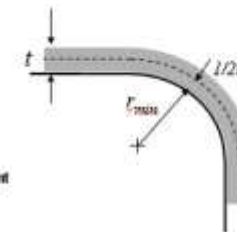
[LevelMax]	[Iadmrule]	[Tdelay]	[Istatcnd]
3	1	0.001	1

MESHING - RULES OF THUMB

◆ Forming Simulation

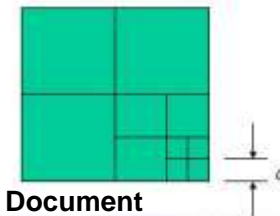
$$d \leq 0.5 \left(r_{\min} + \frac{1}{2}t \right)$$

where d = smallest element size after maximum refinement
 r_{\min} = smallest of fillet radius
 t = blank thickness



◆ Springback Simulation

$$d \leq 0.25 \left(r_{\min} + \frac{1}{2}t \right)$$



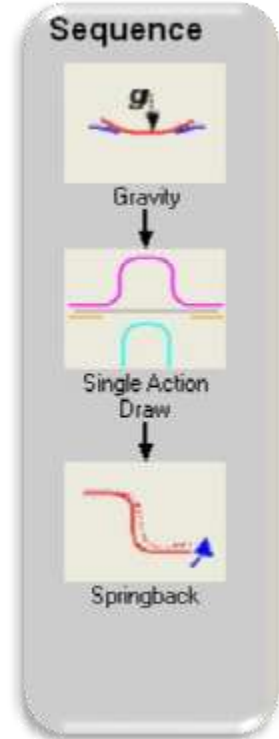
Altair 10.0 Training Document



Modeling - Simulation Setup



Operations



Build and setup tool from DIE surface

Blank:

Blank1

t:

0.800 mm

Binder Source:

Elements

Build and setup tool from PUNCH surface

Clearance:

10.0 %

Machine type:

Single acting

Invert tool:

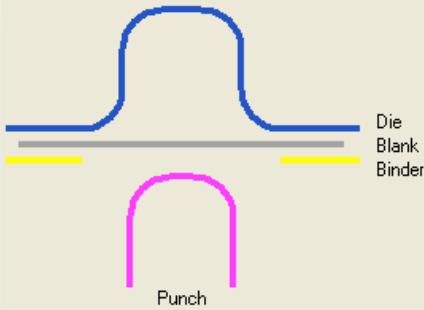


Build

Reject

Close

Hyperform Auto Process



Die
Blank
Binder

Punch

Draw beads: No
Symmetry/Constraints: No
Draw direction: -z
Motion type: Velocity

Animation Control: [Stop] [Previous] [Next] [Play]

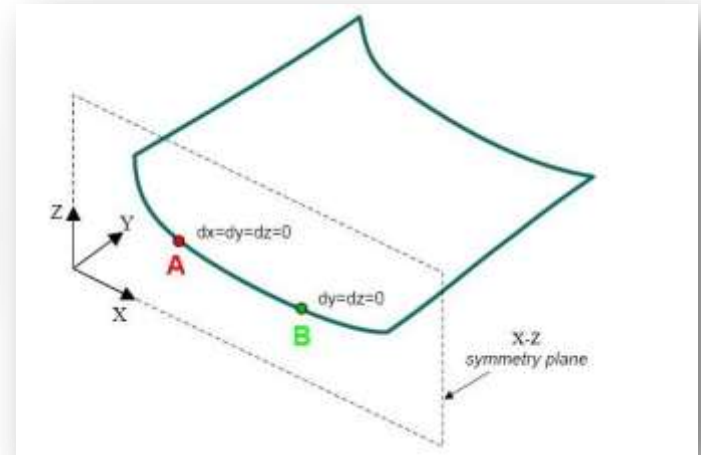
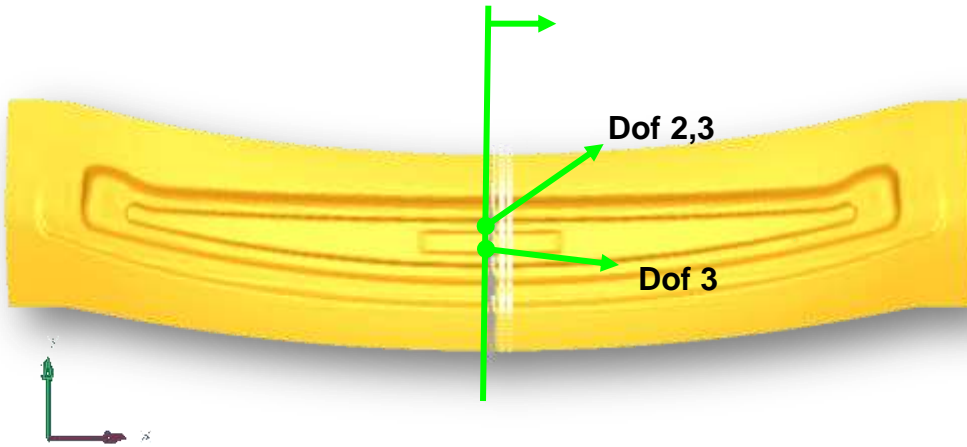
Name	Source	Component				
Blank1	HF	blank	DP600_1	0.8		
Die	HF	die	25	1000	35	3000
Punch	HF	punch	0.0			
Binder	HF	binder	Force	460000		

Table 1

Gas Cylinder Pressure - Binder Force Chart

Gas cylinder pressure	Binder Force at 0 mm strok	Binder force at 35 mm strok
150 bar	460.000 N	526.000 N

Symmetry Constraint (dof 1,5,6)



Altair 10.0 Training Document

- trimming
- springback

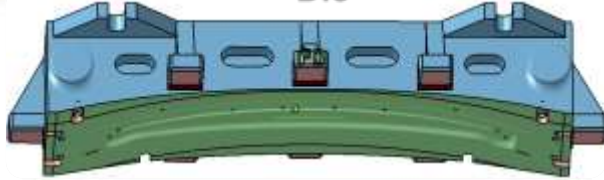
constraints:

nodes

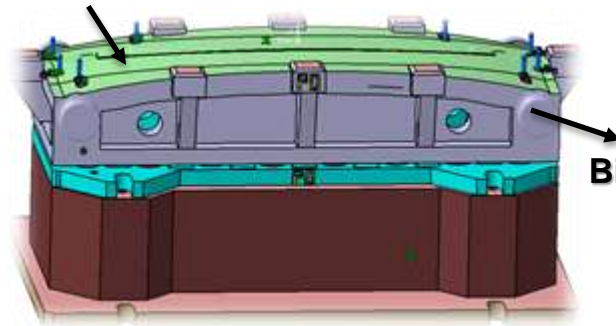
- dof1
- dof2
- dof3
- dof4
- dof5
- dof6

Stamping Experiments

Die



Punch

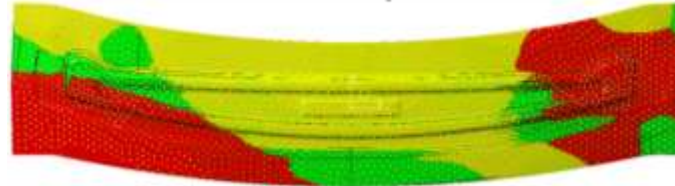


Binder

Atos Digitizing System



Scanned part



Stamped parts



**Comparison of Cad-Data with
Experimental Results**

Table 2

Deviation Band	± 0.5 mm	± 1 mm	± 2 mm
Lot1-150bar	%16	%29	%52
Lot2-150bar	%15	%28	%51

Five parts were produced from each material lot, all parts were digitized with Atos system and comparison were made with the reference geometry.



- **KINEMATIC HARDENING MODEL**
- **PRESSURE DEPENDENT FRICTION COEFFICIENT**
- **INTEGRATION POINT MORE THAN 5**



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THANK YOU...

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