One step forming simulation with HyperForm
One step forming simulation with HyperForm

AGENDA

1. ISRINGHAUSEN
2. Simulation in development process
3. Assessing formability
4. Optimization of blank size
5. Mapping of forming results
6. Conclusion
One step forming simulation with HyperForm

1. ISRINGHAUSEN

ISRINGHAUSEN
Seats for Commercial Vehicles

38 Plants in 18 Countries

Market Shares in Europe

- 90 %
- 55 %
- 50 %
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2. Simulation in development process

Structural strength

- Seatbelt anchorage test
- Head impact test
- Sled test
- Stiffness and strength of various seat components
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2. Simulation in development process

Forming simulation

In most cases, experience of the designer is sufficient to ensure formability

→ Little focus on formability simulation in early stage
→ Cooperation with tool-suppliers
Forming simulation

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Advantages of forming simulation in an early stage:

• Early recognition of problem spots
• Cost optimization through reduction of blank size
• Mapping of forming results on crash model
Forming simulation

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Is HyperForm OneStep a useful tool for assessing stamping parts in an early development stage when no knowledge about the final tool is available?
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3. Assessing formability

Reinforcement plate

Cracks in radius area
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3. Assessing formability

Reinforcement plate

Simple model with no settings

• No warning in critical area

• Warning in sub-critical area
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3. Assessing formability

Reinforcement plate

High blankholder-force added

• Warning in critical area

• Warning in sub-critical area
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3. Assessing formability

D-ring bracket
Formability
3. Assessing formability

D-ring bracket

Thinning

- 3.0mm - 3.0mm
- 2.6mm - 2.8mm
- 2.3mm - 2.2mm
- 2.0mm - 1.8mm
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3. Assessing formability

Recliner-bracket
Prototype tool: Wrinkles in area marked with red circle

Problem removed by adding slot in critical area
3. Assessing formability

**Recliner-bracket**
Prototype tool: Wrinkles in area marked with red circle

Problem removed by adding slot in critical area

Simulation shows only marginal improvement

→ Linear forming simulation less accurate for parts formed in more than one step

Formability without slot

Formability with slot
3. Assessing formability

**Recliner-bracket**
Prototype tool: Wrinkles in area marked with red circle

Problem removed by adding slot in critical area

Simulation shows only marginal improvement

→ Linear forming simulation less accurate for parts formed in more than one step

**Thinning without slot**

**Thinning with slot**
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4. Optimization of blank size

Manual optimization

Comparison of blank size of different designs

Original

Optimized
One step forming simulation with HyperForm

4. Optimization of blank size

Manual optimization

Comparison of blank size of different designs

Blank size reduction: 5%

Original

Optimized

Dimensions: 165.10 x 361.41 mm
3.0 degrees about z-axis
Surface area: 59000.4 mm²
Material: S420MC
Thickness: 1.50 mm
Mass: 0.706 kg
Unit cost: $0.61

Dimensions: 164.74 x 161.10 mm
67.0 degrees about z-axis
Surface area: 57140.3 mm²
Material: S420MC
Thickness: 1.50 mm
Mass: 0.676 kg
Unit cost: $0.59
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4. Optimization of blank size

Optimization assisted by HyperForm OneStep

• Suggested cutting-lines added on blank
4. Optimization of blank size

Optimization assisted by HyperForm OneStep

• Suggested cutting-lines added on blank
• Cutting lines displayed on formed part

Blank size reduction: 5%
One step forming simulation with HyperForm

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5. Mapping of forming results

Applying strains from forming process to LS-DYNA crash model

Seatbelt-anchorage test: Recliner bracket has to high plastic deformation
Cold-hardening from forming process not considered
→ Strength of part not realistic
One step forming simulation with HyperForm

5. Mapping of forming results

Applying strains from forming process to LS-DYNA crash model

Effective strain and thickness from forming simulation with HyperForm
OneStep mapped on LS-DYNA crash-mesh

Deformation of part more realistic
→ More realistic overall result
One step forming simulation with HyperForm

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Is HyperForm OneStep a useful tool for assessing stamping parts in an early development stage when no knowledge about the final tool is available?

- Predict formability
  - Correct assumptions needed for good results
  - Good results for parts deep drawn in one step
  - Less accurate results for parts formed in several steps

- Cost optimization through reduction of blank size

- Mapping of forming results on crash models
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Thank you very much for your attention!