11. LS-DYNA Forum, 9.-10. October 2012, Ulm

Advantage of LS-DYNA in the convertible top development

Matthias Rupp, in2p GmbH

Target

Use of CAD and simulation tools for virtual concept validation of convertible tops and saving prototypes.

Content

- Presentation in2p GmbH
- Motivation
- History of virtual product development
- Process: convertible top development
- Textile simulation

Presentation in2p GmbH

Development priorities of in2p GmbH




opening roof systems


concepts and workshops


other industries



body in white

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Motivation

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Motivation

Corny Littmann, former president of FC St. Pauli football club:

„To find security in the insecurity - that encourages creativity."

source: NDR Talkshow

Be honest: In the complex system of a roof system remains always a pinch of uncertainty in the concept development...

... which allows us to be creative.

History of virtual product development

History

Bundesarchiv, Bild 183-22209-0682
Foto: Wittig; TBD | 9. November 1953

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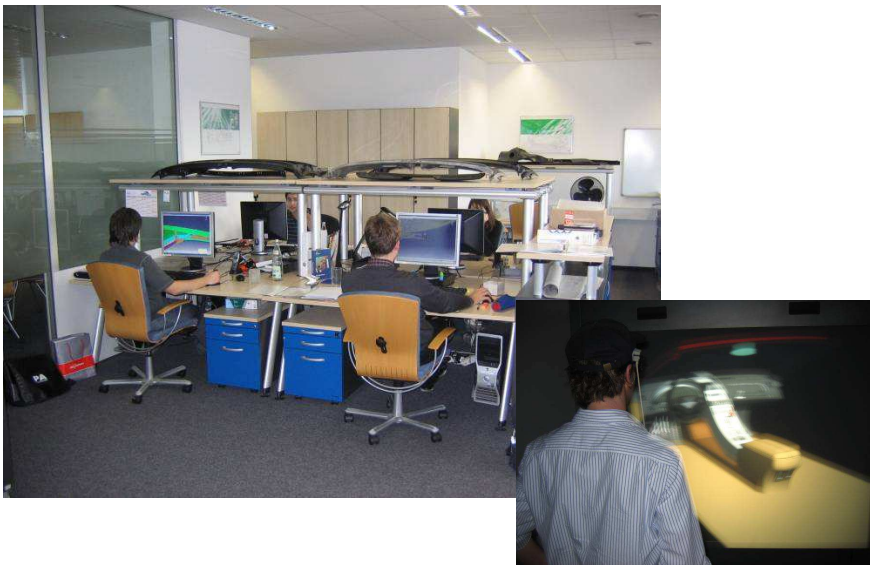
History



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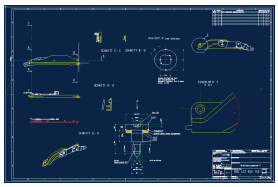

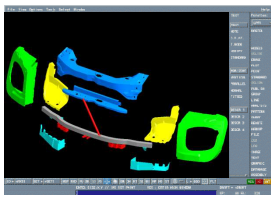

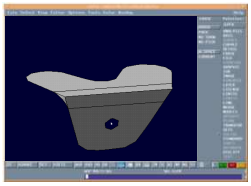

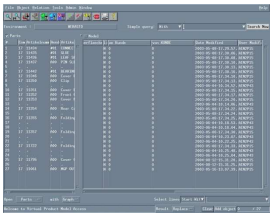

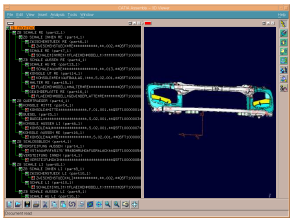

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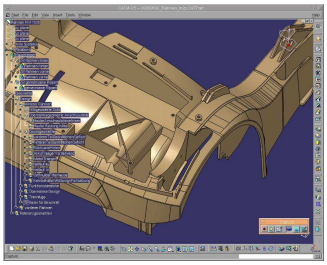

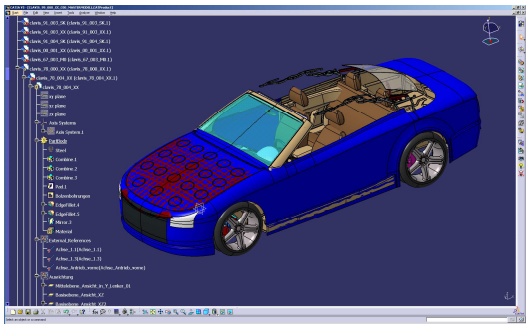

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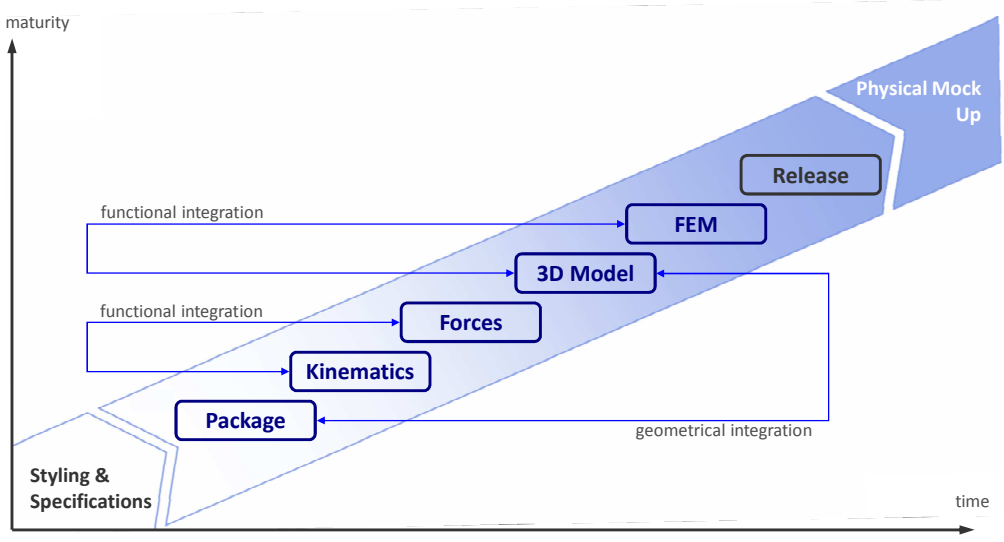
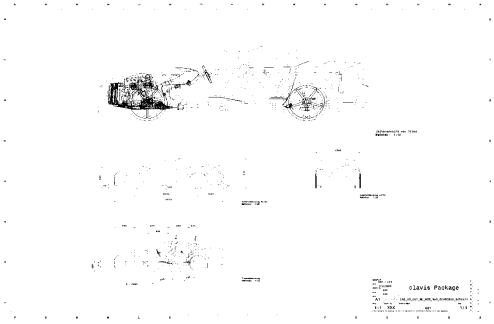
Process: convertible top development

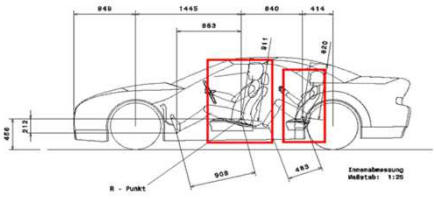
Development steps to safe virtual prototypes



Package



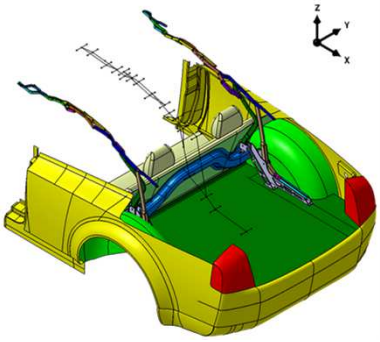
dimensional concept



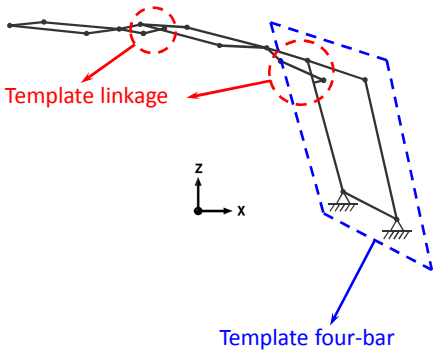
R points

Design of a kinematic

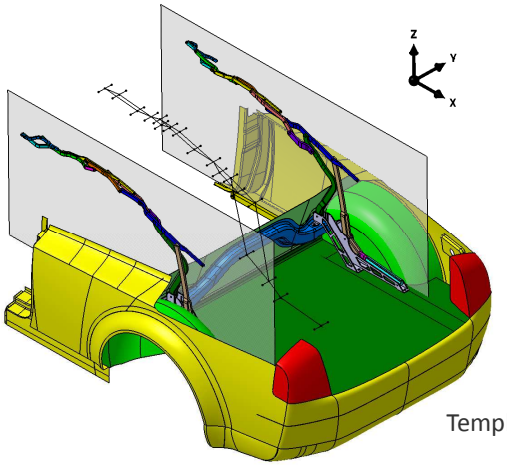
skeleton method



stroke kinematics



Skeleton method



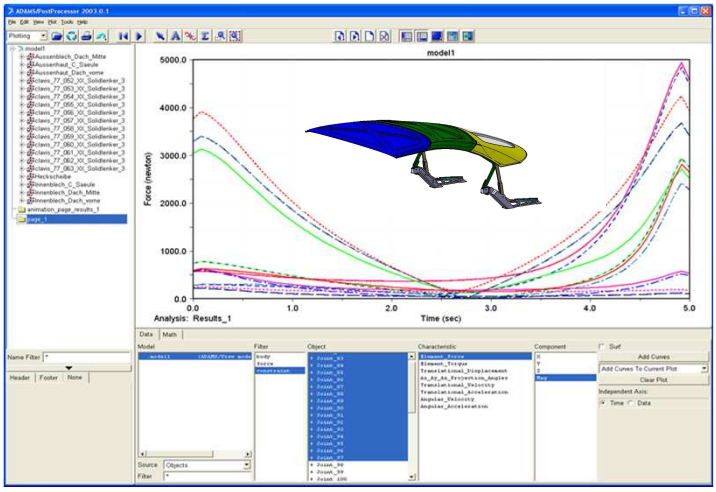
Template stratification

Forces calculation with SimDesigner Enterprise

Functional integration with CATIA V5

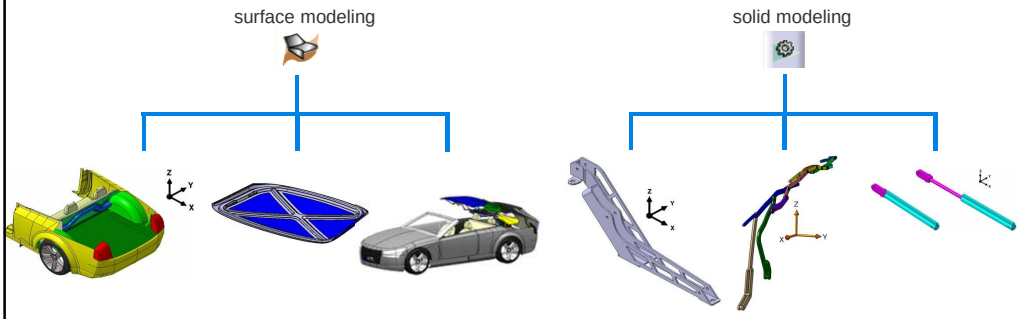
Results:
- Forces
- Moments
- Accelerations
- required driving forces and moments

under influence of :
- Component masses
- Gravitation
- Friction



Presentation of results by Adams PostProzessor

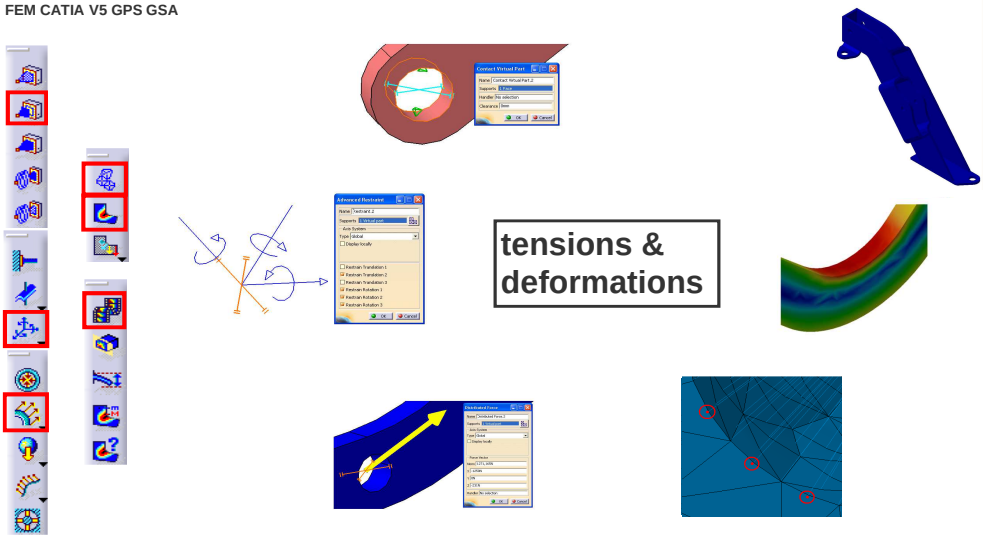
3D modeling with CATIA V5



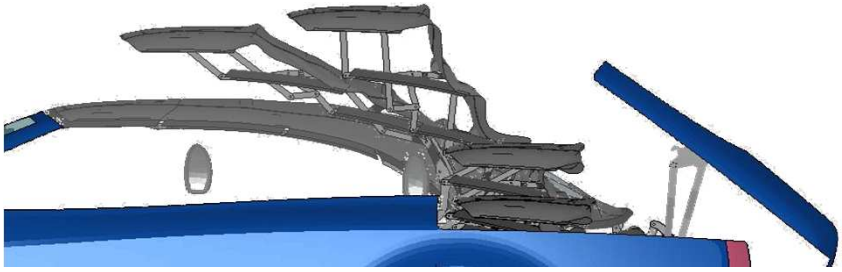
- parametric - associative design
- interface optimized working
- integration of templates

Finite Elemente Method - Calculation

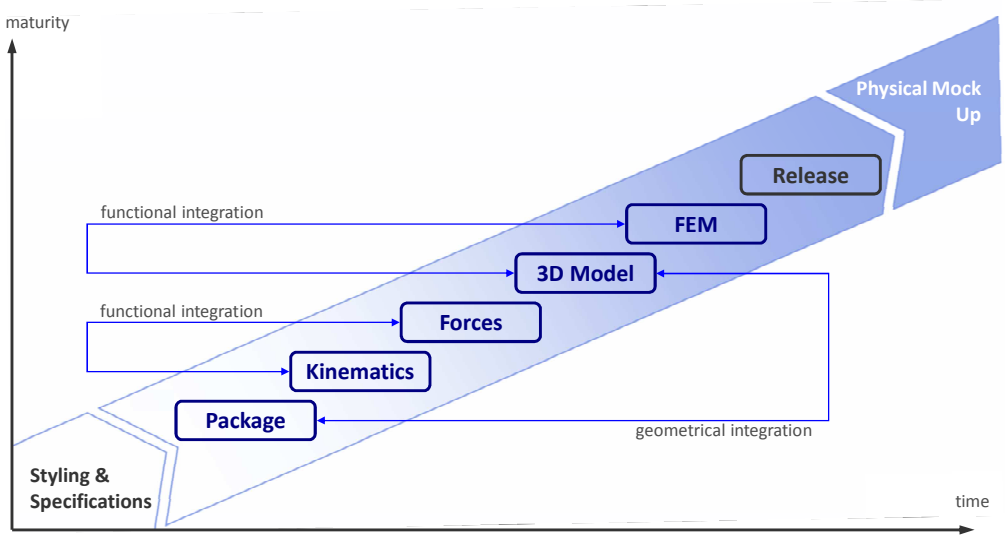
FEM CATIA V5 GPS GSA



Simulation of textile behavior



Development steps to safe virtual prototypes

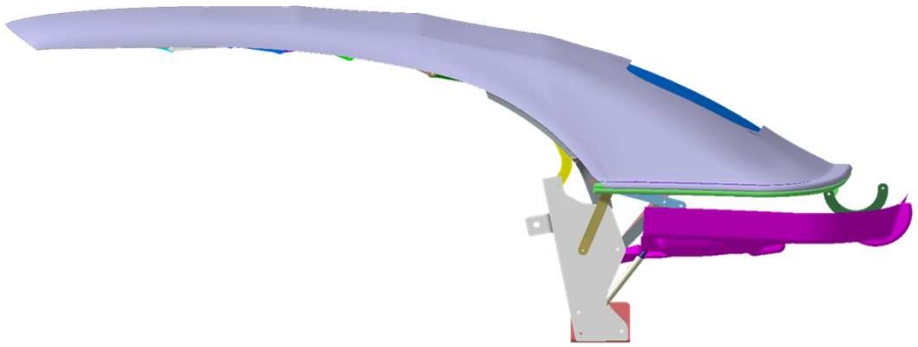


Textile simulation

Supported by:
Federal Ministry of Economics and Technology
on the basis of a decision by the German Bundestag

Textile simulation at in2p – tests

3D data from CATIA



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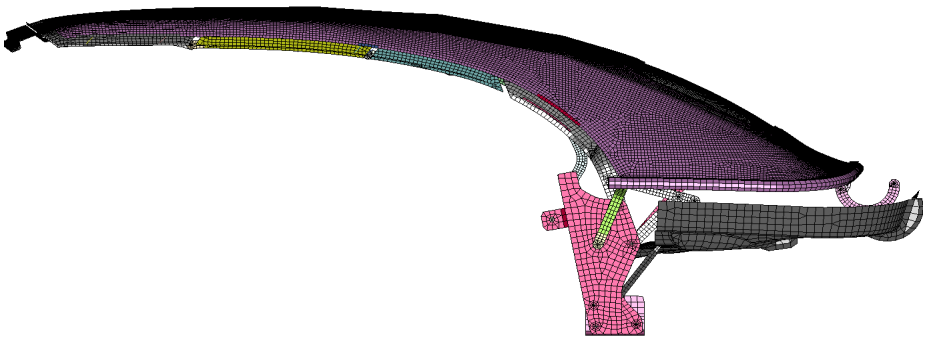
3D data from CATIA – meshed with ANSA



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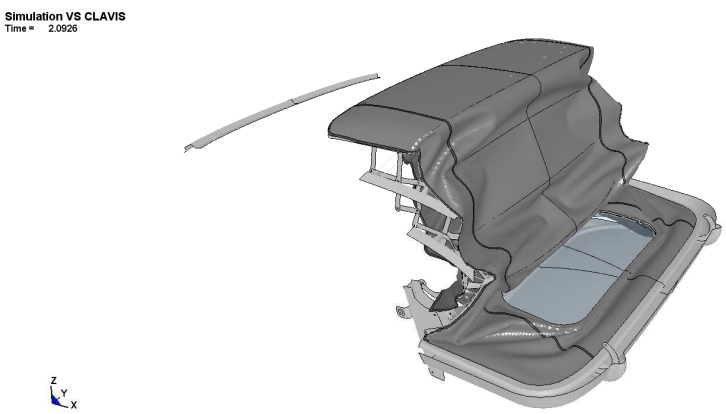
simulation of convertible softtop with LS-DYNA



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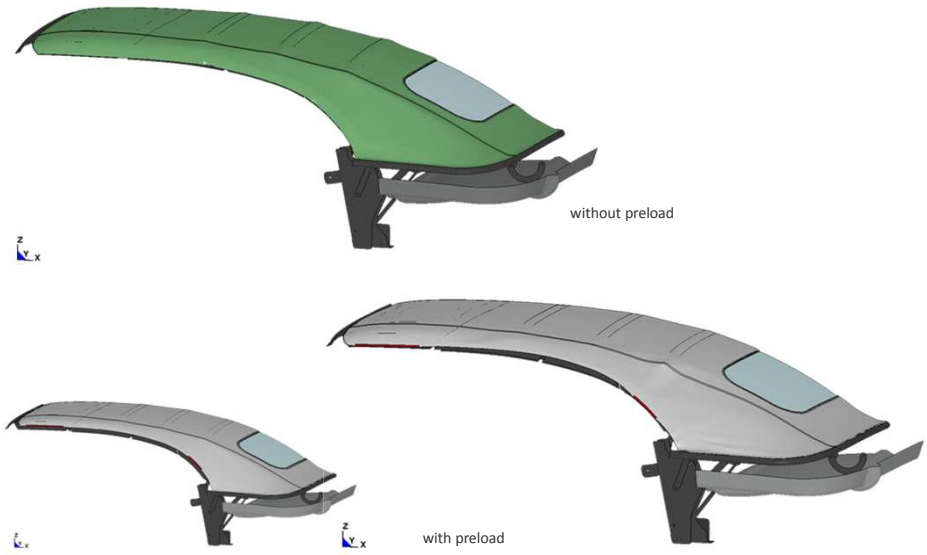
Consideration of textile preload



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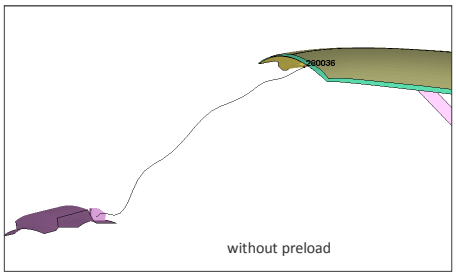
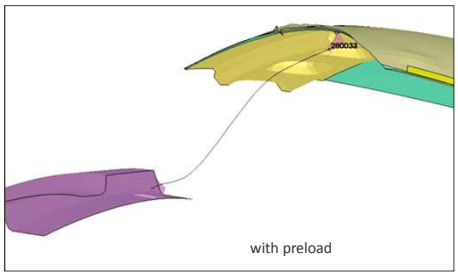
Tracecurve of fixing pin



without preload



with preload

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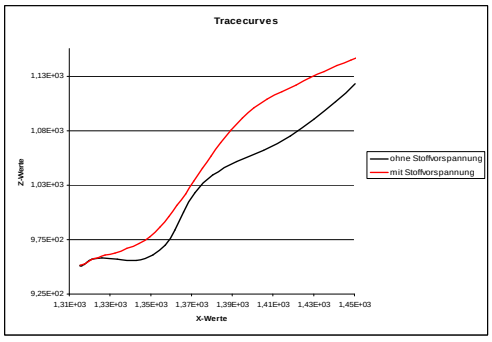
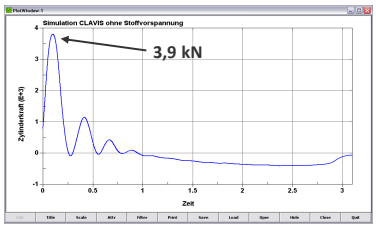
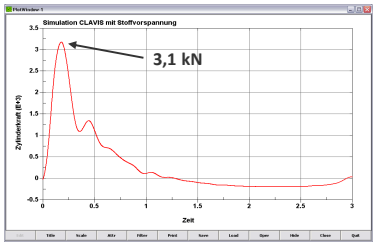
Tracecurve of fixing pin in conjunction with cylinder force







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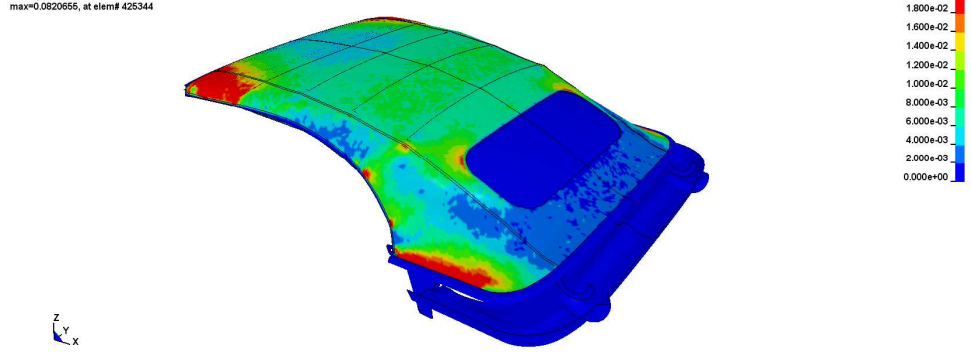
Strains in the top material



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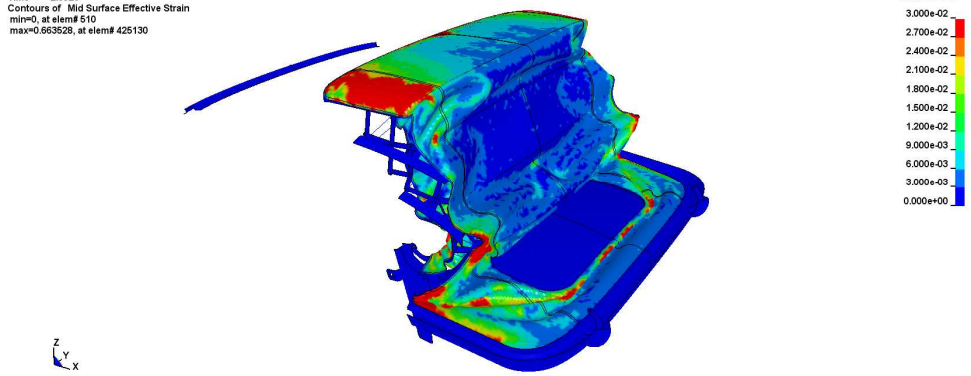
Strains in the top material



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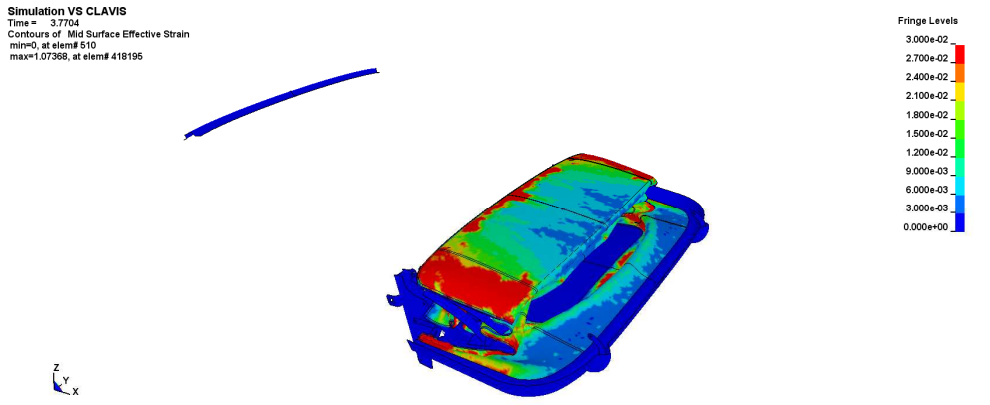
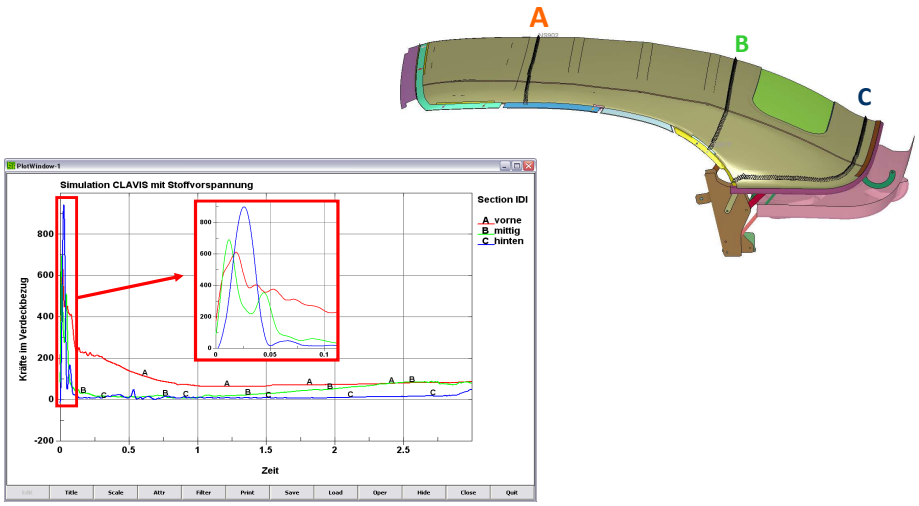
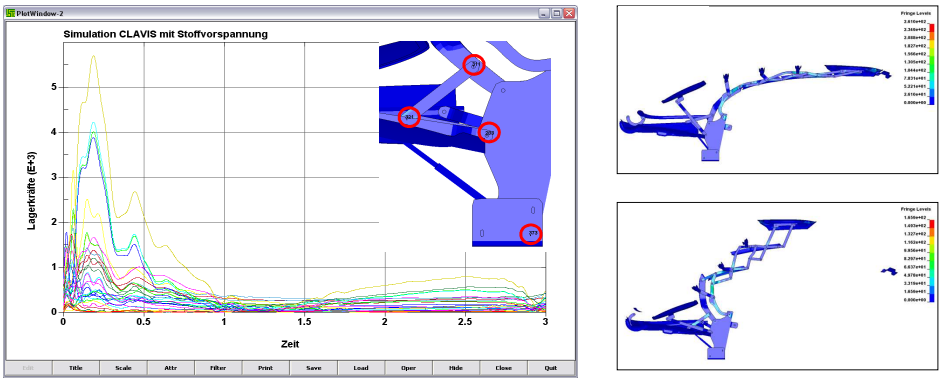
Strains in the top material



Forces in the top material



Tensions in convertible roof frame and bearing forces



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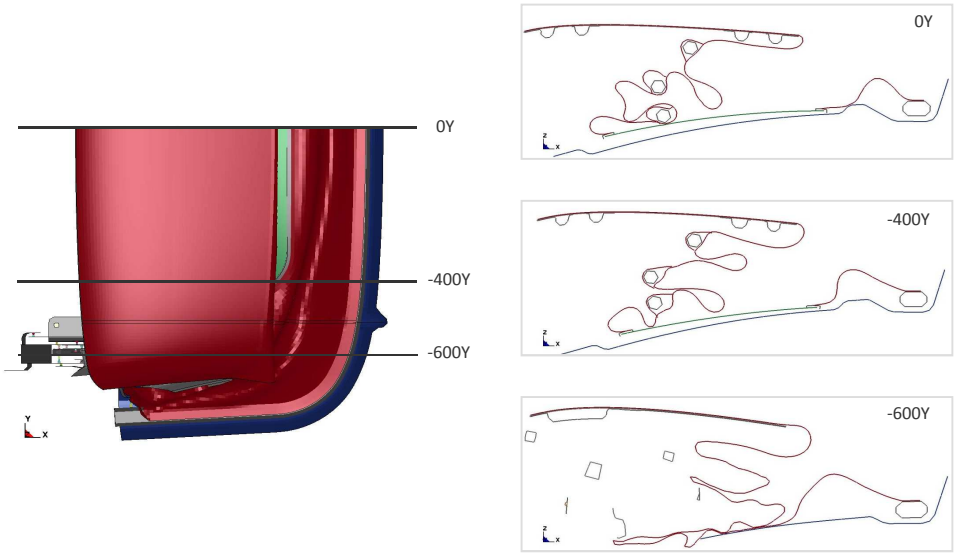
Sections of the convertible top in storage position



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Comparison theory – practice

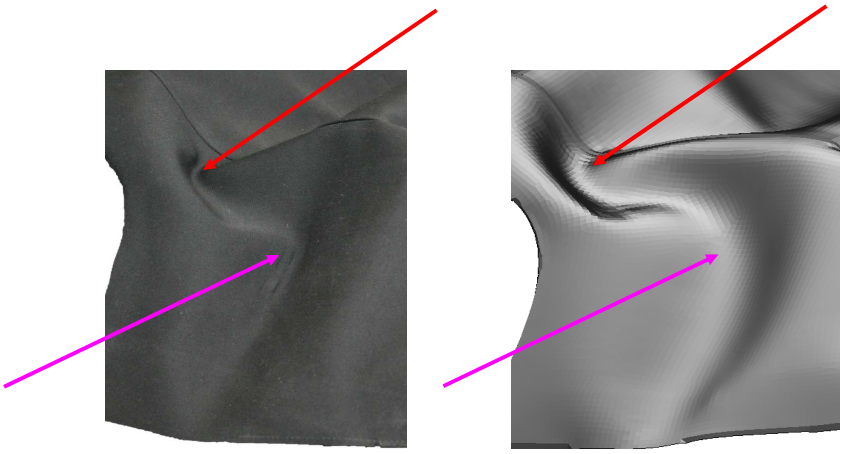

photo prototype

result simulation

Summary - benefits for the developer

The following points can be tested or derived by help of textile simulation:

- fabric lengths
- tension / strain
- fabric connections
- frame elasticities
- intake curves
- closing forces
- seam curves
- dimensioning ropes
- influence of the rear window
- narrow points in the storage
- straps
- pads

→ The developers is given a safe statement to functionality of their roof concepts - even before the first functional prototype is built.

Thank you for your attention.