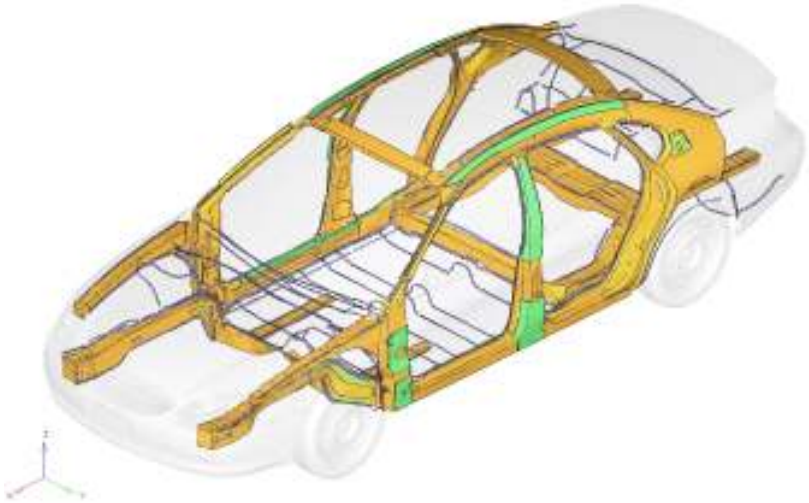
DOW Automotive Systems

POTENTIALS OF POLYMERIC BASED BODY STRUCTURE MATERIALS IN FULL CAR CRASH

POTENTIALE POLYMERBASIERTER KAROSSERIEWERKSTOFFE IM VOLLFAHRZEUG-CRASH



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LS-DYNA Update Forum 2009, 12. November 2009, Filderstadt, Germany

Agenda:

- Motivation and introduction
- Body Structure Solutions material overview
- Scope and demonstrator selection
- Solution setups and modular model build
- IIHS side impact example
- Summary and outlook

Motivation and Introduction

Vehicles of the "next generation" [Mobility, Energy, Regulations, Markets]:

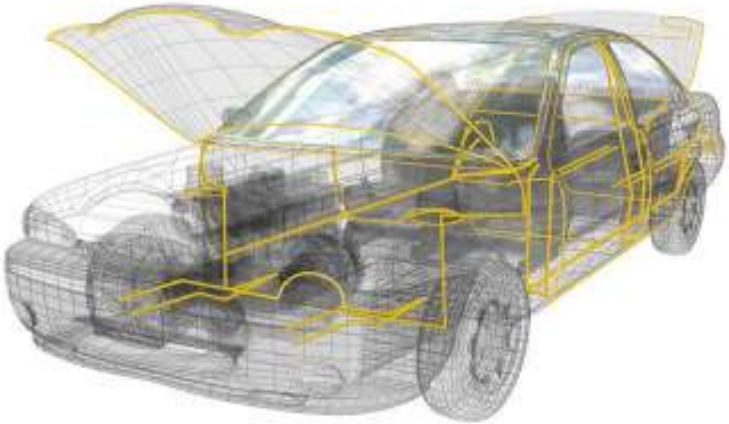
- New package concepts and vehicle architectures
- Module driven vehicle development
- Exploitation of further lightweight potentials by advanced materials
- Implementation of multi-material concepts
- Enabling simulation of advanced materials and joining techniques
- Ensuring active and passive vehicle safety
- Investigation of advanced urban mobility concepts
- Complete redesign of automotive production, esp. for smaller volumes

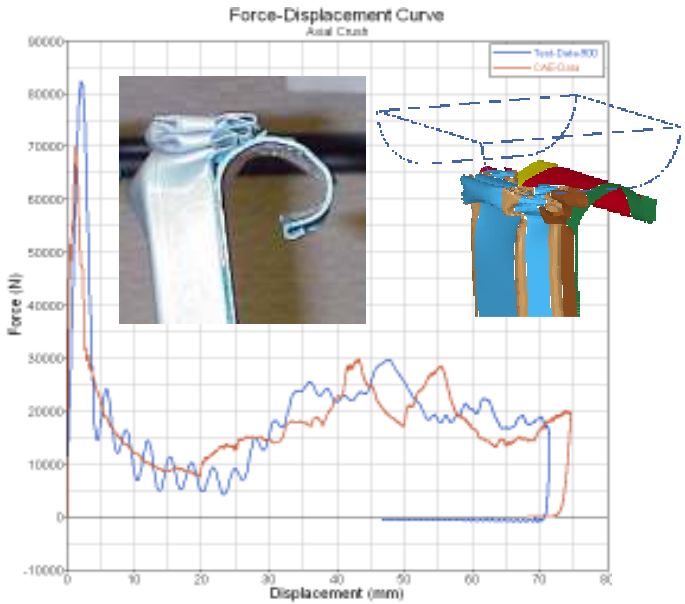
(Source: Prof. S. Gies, Trends and concepts – vehicles of the next Generation, Aachener Body Engineering Days 2009, 22nd September 2009, Aachen, Germany)

Related Polymeric based Application and Solution Development:

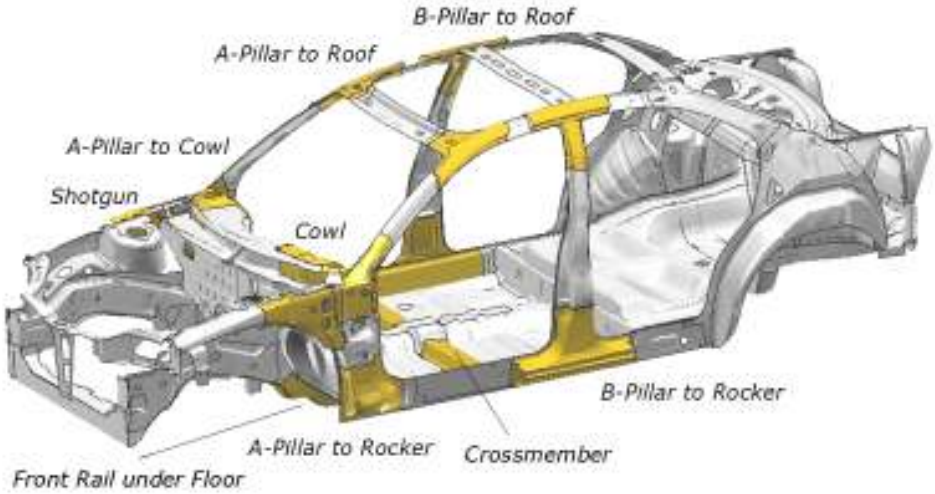
- In general the basic idea of such "next generation" application or solution developments is independent of a specific vehicle
- To explain the advantages and to evaluate the potentials of these polymeric materials, a full vehicle demonstrator is used

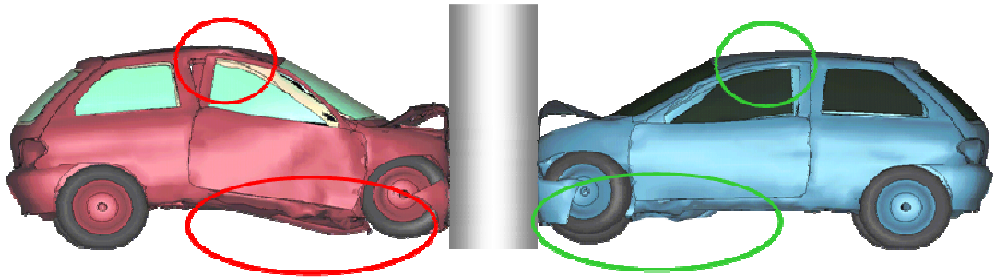
BETAMATE™ Structural Adhesives

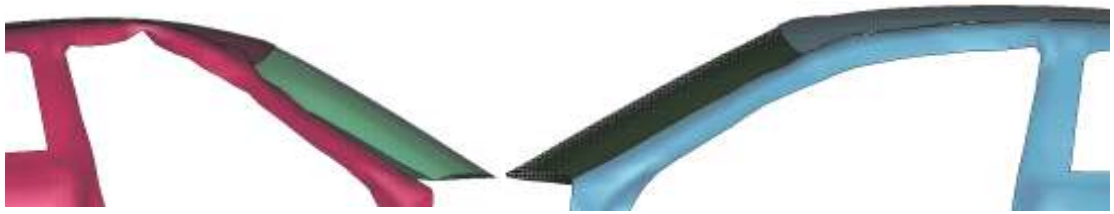




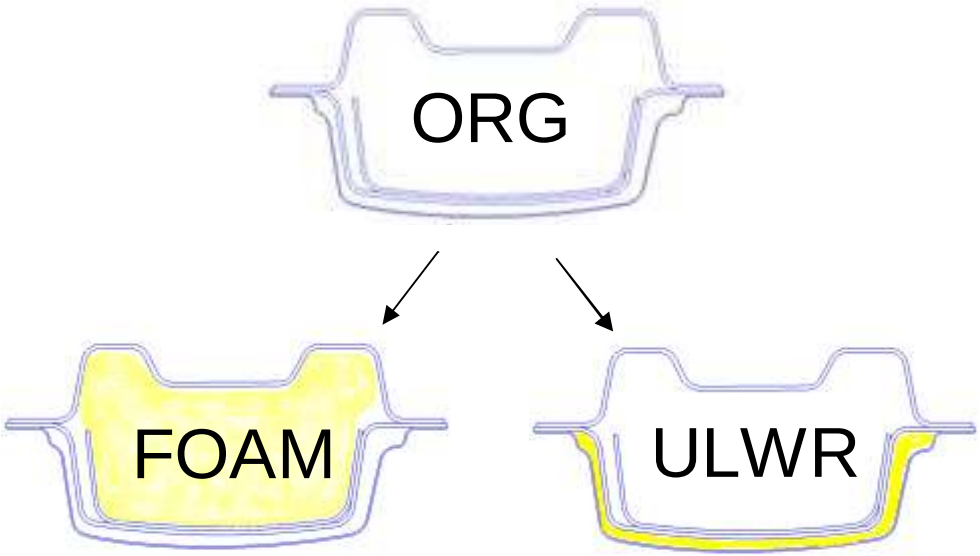
BETAFOAM™ Acoustical and Structural Cavity-Filling Foam

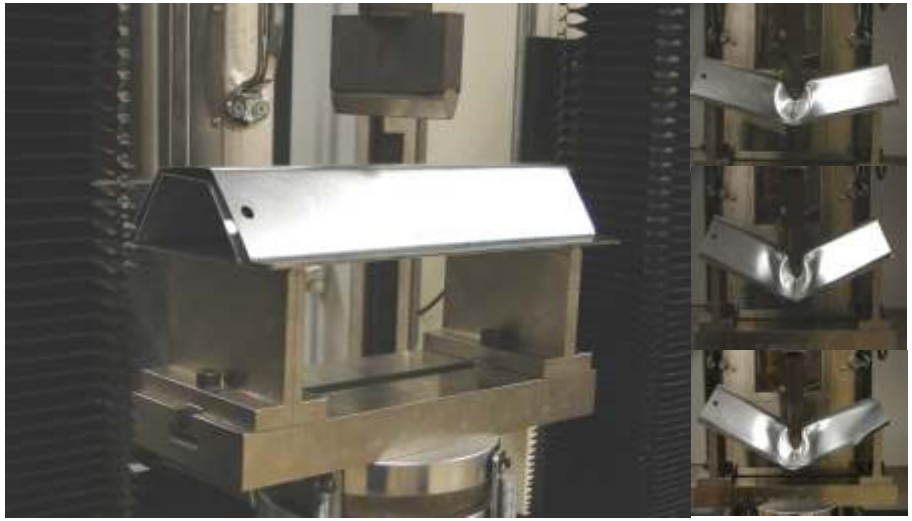




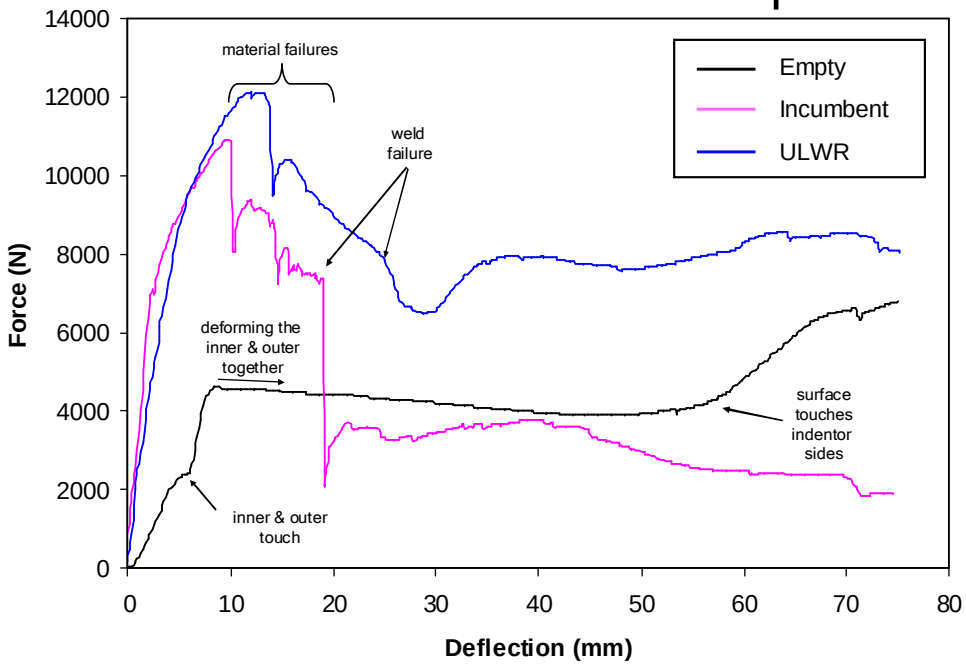


BETAMATE™ Ultra Light Weight Reinforcement





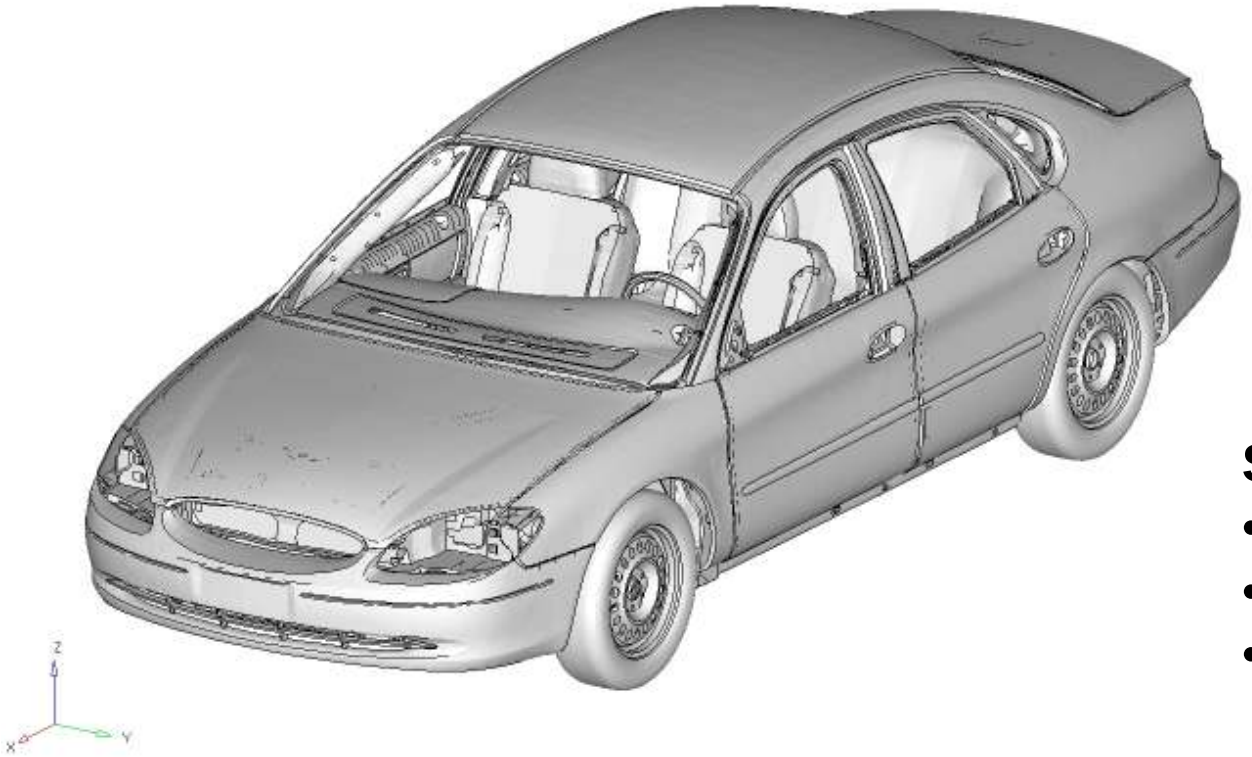
Material & Solution development



SCOPE: Analyze and optimize DOW Body Structure Solutions in a full vehicle environment by using a Demonstrator Car

Why selecting the Ford Taurus 2001 vehicle?

- Mass production mid class sedan vehicle
- 3rd model review with cleanup and refinement (2008)
- Public available from NCAC – National Crash Analysis Center
  http://www.ncac.gwu.edu/vml/models.html

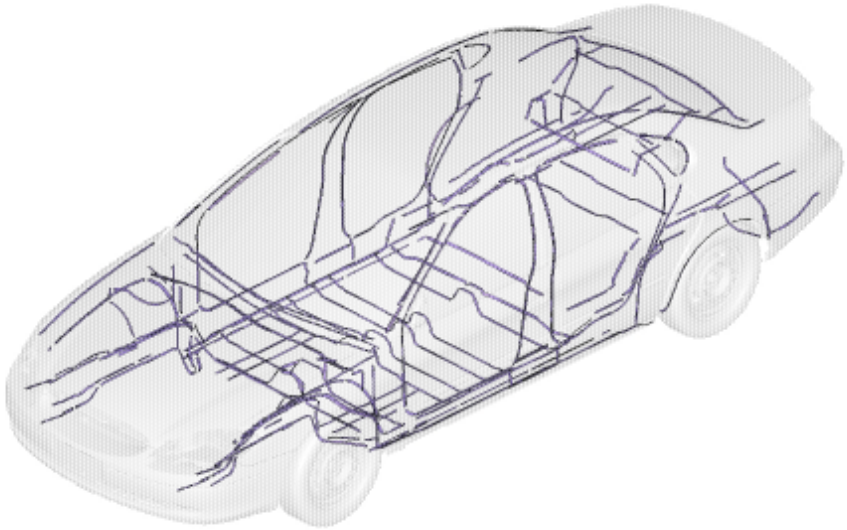


Some CAE facts:

- 1 064 611 elements
- 936 259 nodes
- 795 components

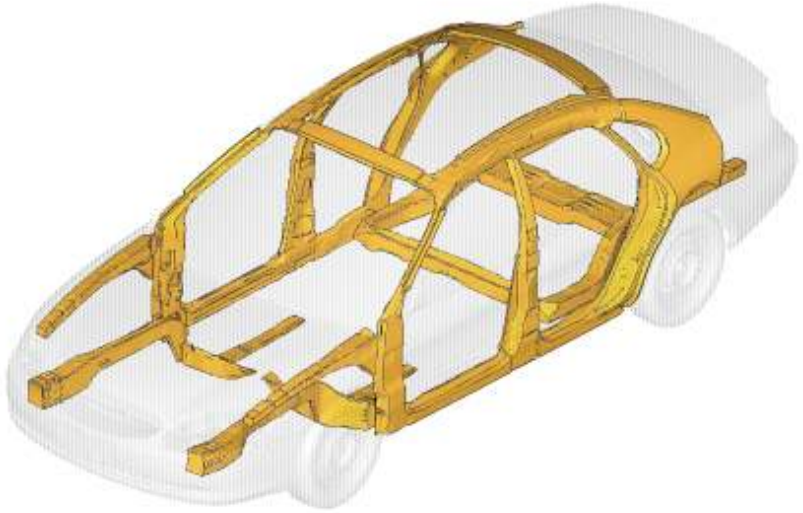
Crash Durable Adhesive Setup:

BETAMATE™ 1496 all length ~100 m



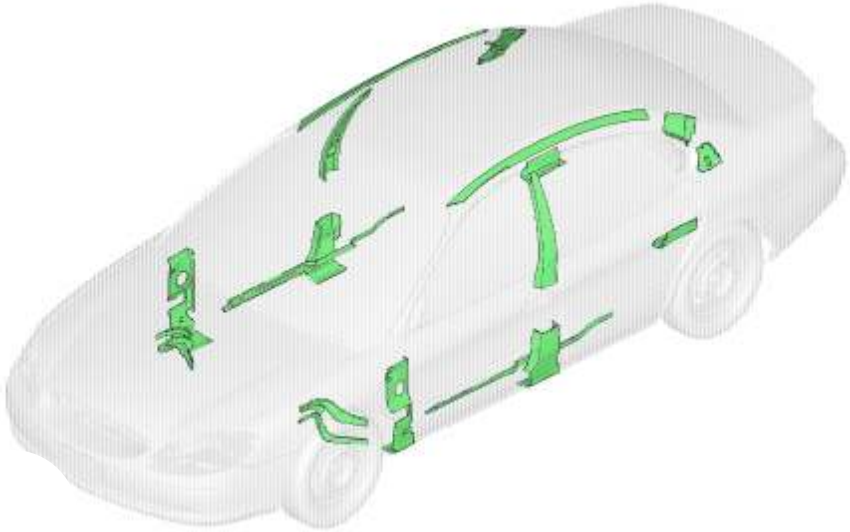
Structural BEATFOAM Setup:

BETAFOAM™ 89100/124 all cavity 82.9 kg



Ultra Light Weight Reinforcement Setup:

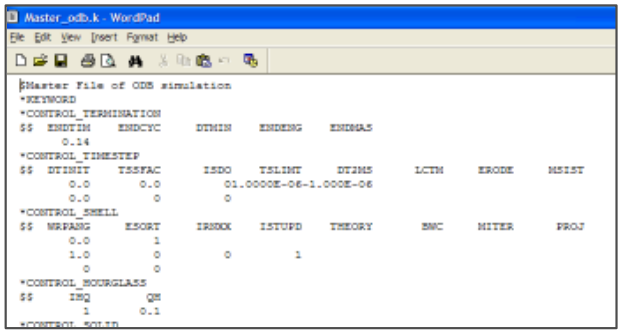
BETAMATE™ ULWR all gap/edge 4.2 kg



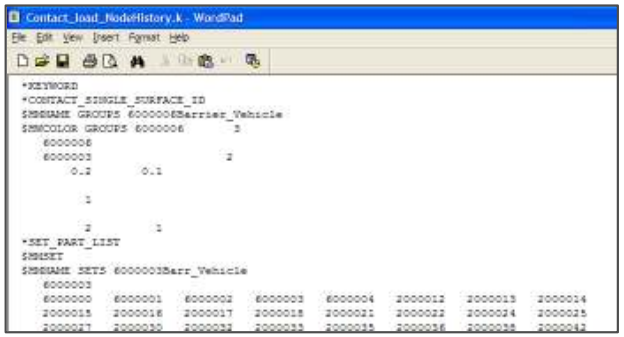
Setups for best case optimization

Modular approach LS-DYNA

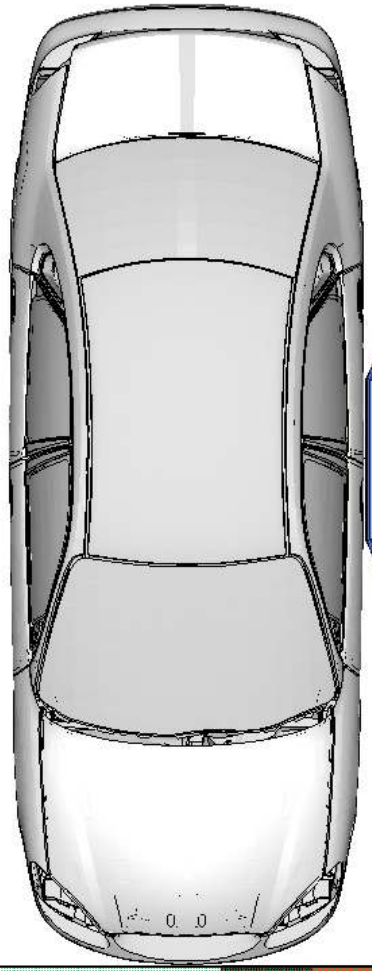
Master and Control file



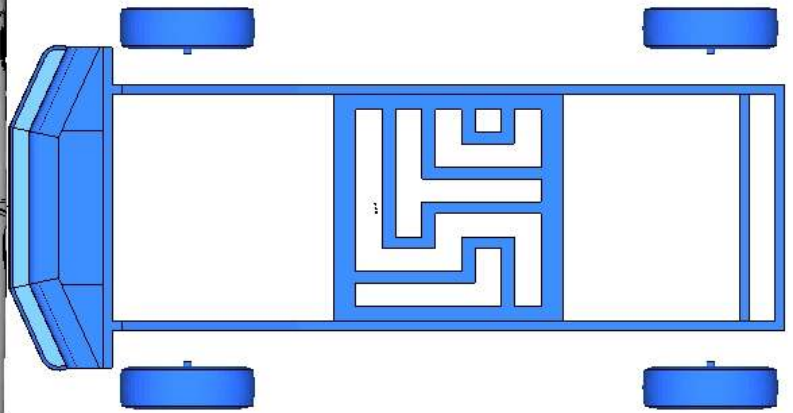
Loadcase, Contact and Output

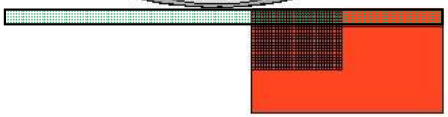


Vehicle Model
Ford Taurus 2001
by NCAC



Insurance Institute for Highway Safety (IIHS) side impact Barrier by LSTC



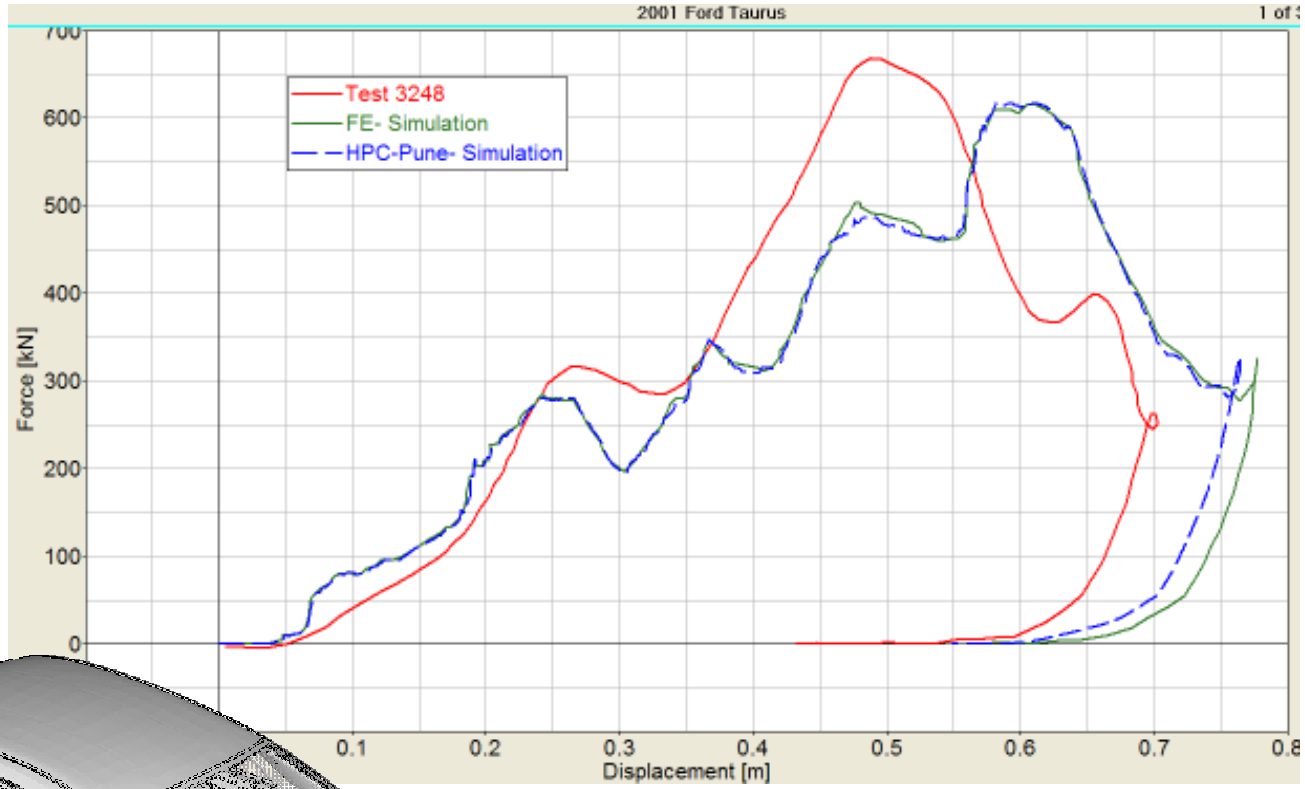


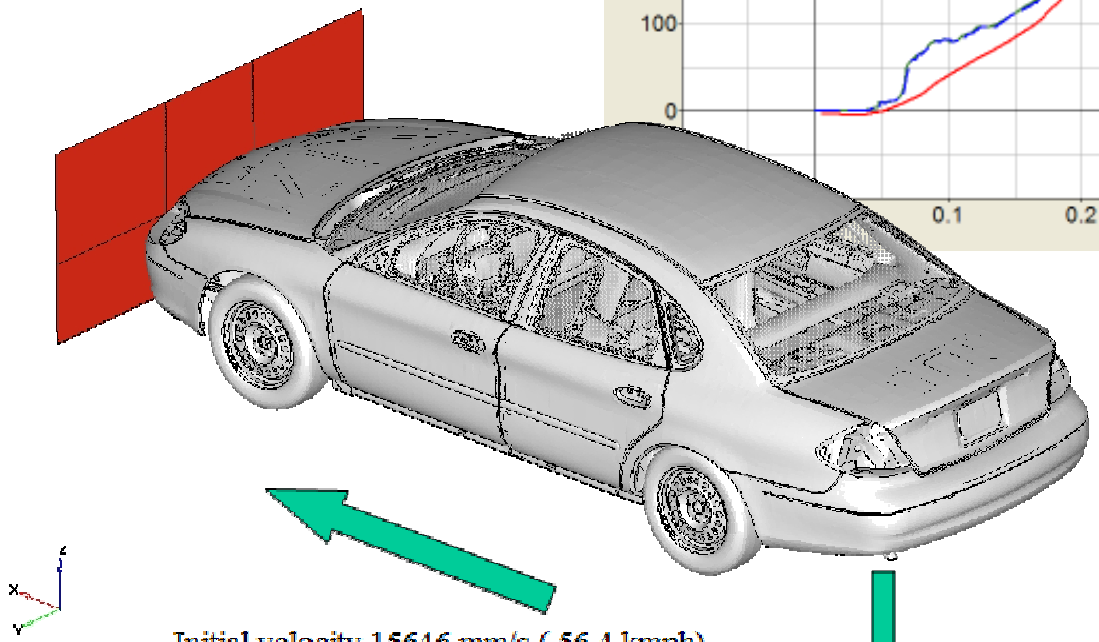
Rigid Barrier by NCAC (Baseline)

Frontal Offset Deformable Barrier (ODB) by LSTC

Baseline Verification

Baseline Original: **NCAC**
LS-DYNA
Version: mpp971s R2
Revision: 7600.1224
Platform: SGI Altix Workstation IA64
OS level: Linux 2.4(64 bit)
Precision: Single precision (I4R4)
Total CPU time: ~ 14 hrs (for 150 ms)
Number of processors: 12

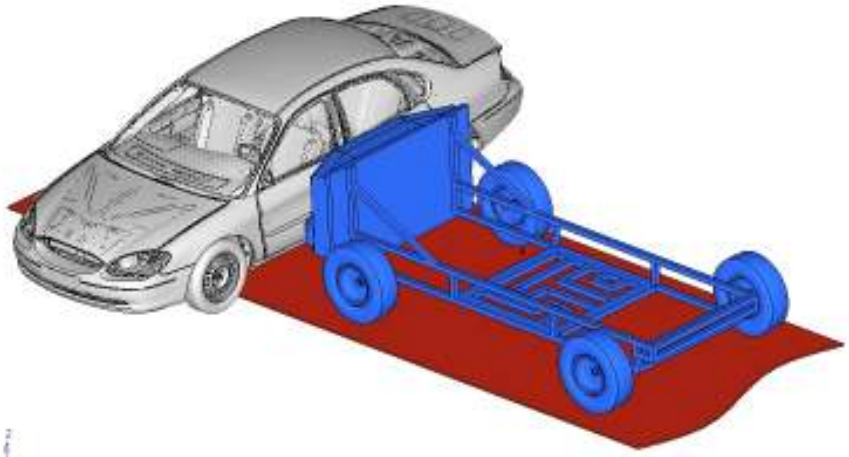


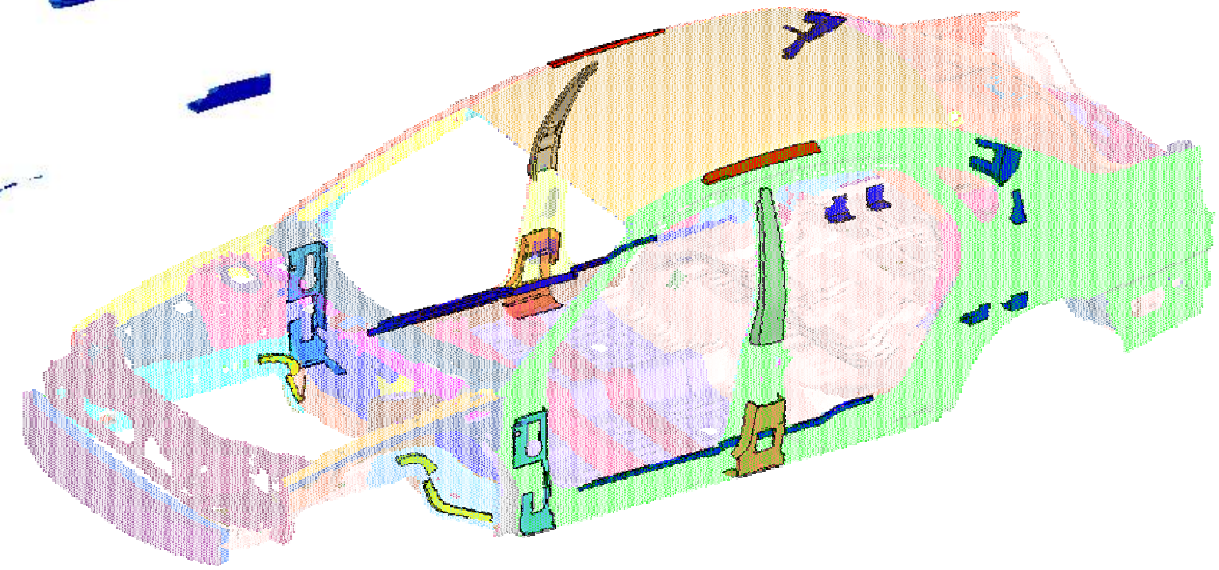


Baseline HM exported: **DOW**
LS-DYNA
Version: mpp971s R2
Revision: 7600.1224
Platform: HPC - Pune, Linux Workstation Intel-Xeon64
OS level: RH EL 4 upd 3 (MPICH 1.2.6)
Precision: Single precision (I4R4)
Total CPU time: ~ 11 hrs
Number of processors: 16

Example: ULWR IIHS Side Impact

Optimization for weight reduction potential





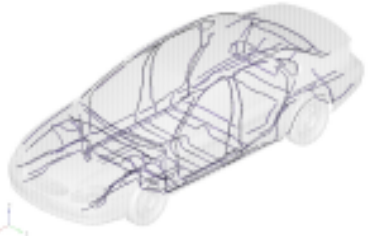
Total Weight: 2.621 kg
(37% weight saved)

B-Pillar Intrusion (ULWR)

Improvement of max. intrusion with ULWR is -10%

B-Pillar Intrusion (CDA)

Improvement of max. intrusion with CDA is - 6%

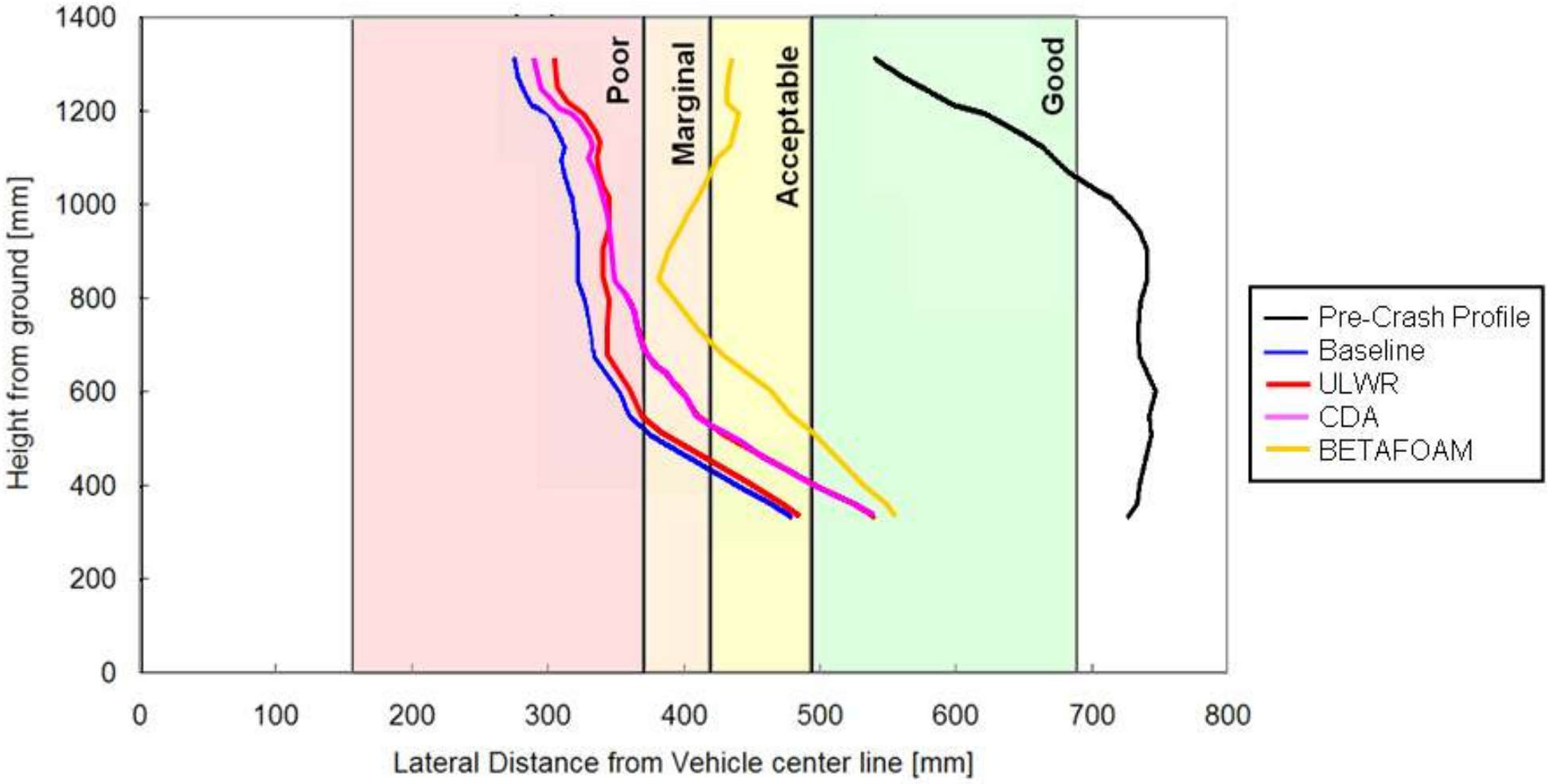


B-Pillar Intrusion (BETAFOAM)

Improvement of max. intrusion with BETAFOAM is -40%

B-Pillar Intrusion (comparing)

reducing max. intrusion: ULWR (10%), CDA (6%), BETAFOAM (40%)



Further optimization of all solutions is ongoing

Summary and Outlook:

- A full vehicle demonstrator (Ford Taurus model year 2001 by the NCAC) is used to examine and optimize the development capabilities of automotive materials and solutions
- The full vehicle model demonstrates qualitative benefits of new material and solution based developments
- Limitations can be seen on the quantitative potential as the vehicle model is from 2001 and not represents latest state-of-the-art design
- Optimization objectives depend on design strategies and performance targets including weight and costs. The demonstrator approach enables to study and present related methods

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- Additional load cases like rear and roof crash as well as the pole impact should be added
- Further optimization strategies should be discussed in cooperation with OEMs and Tiers

DOW Automotive Systems

Plotting Your Course –

Application Development and Engineering

Design conceptualization, material selection, fabrication methodology validation

On-site support at customer facilities ensures our products meet or exceed design and engineering requirements