AN INSIGHT TO THE DEPLOYMENT OF ANSA WITHIN BMW CAE PROCESSES

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KEYWORDS – assembly, batch mesh, welding, process automation

ABSTRACT – Establishing a pre-processing workflow, starting from cad data to the model assembly is a big challenge. The high number of FE simulations as well as their increasing quality requirements lead to the need of reducing time consuming procedures as well as error prone manual interventions. Target of BMW AG is to built an automated and robust process that will lead to the creation of high quality FE models, suitable for the Concept as well as for the Series phase.

This paper gives an insight to some of the key steps of the development phases where BMW AG, in cooperation with BETA CAE Systems S.A., succeeded in drastically reducing the model preparation phase by deploying the capabilities of ANSA.
The presented steps of the development process are:
- Nastran arbitrary cross sections in ANSA
- Batch meshing with ANSA
- Spot weld definition for durability analysis
- Modeling of "door bag" for pressure sensors
- Seat und dummy positioning with ANSA

An insight to the deployment of ANSA within BMW CAE Processes
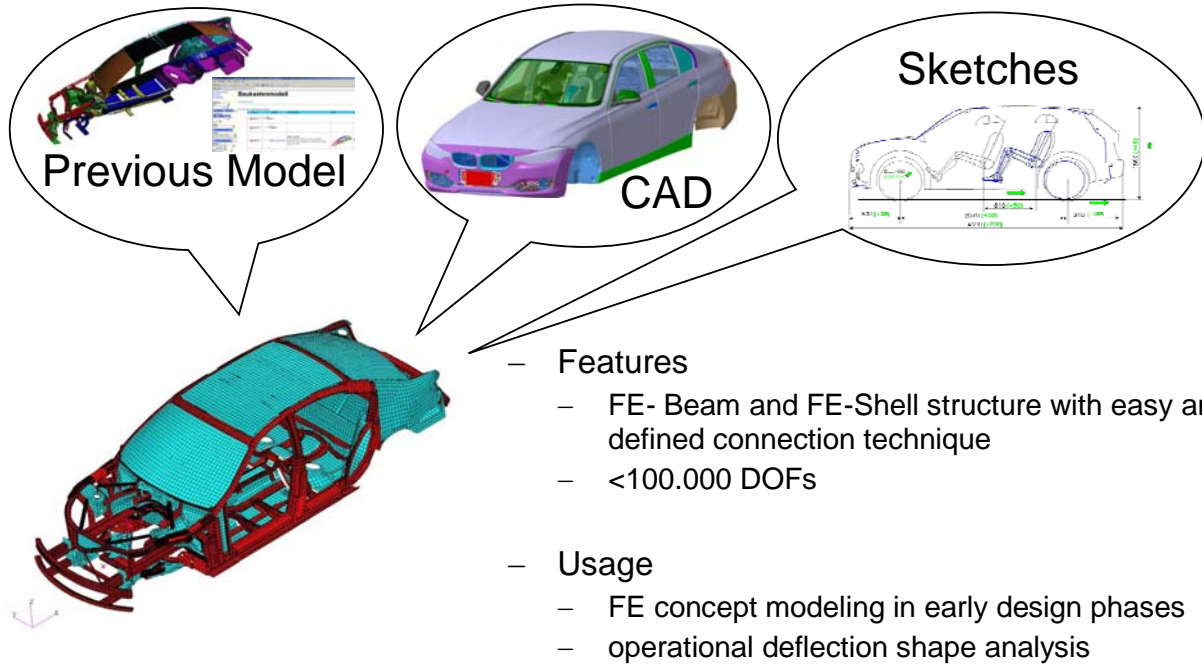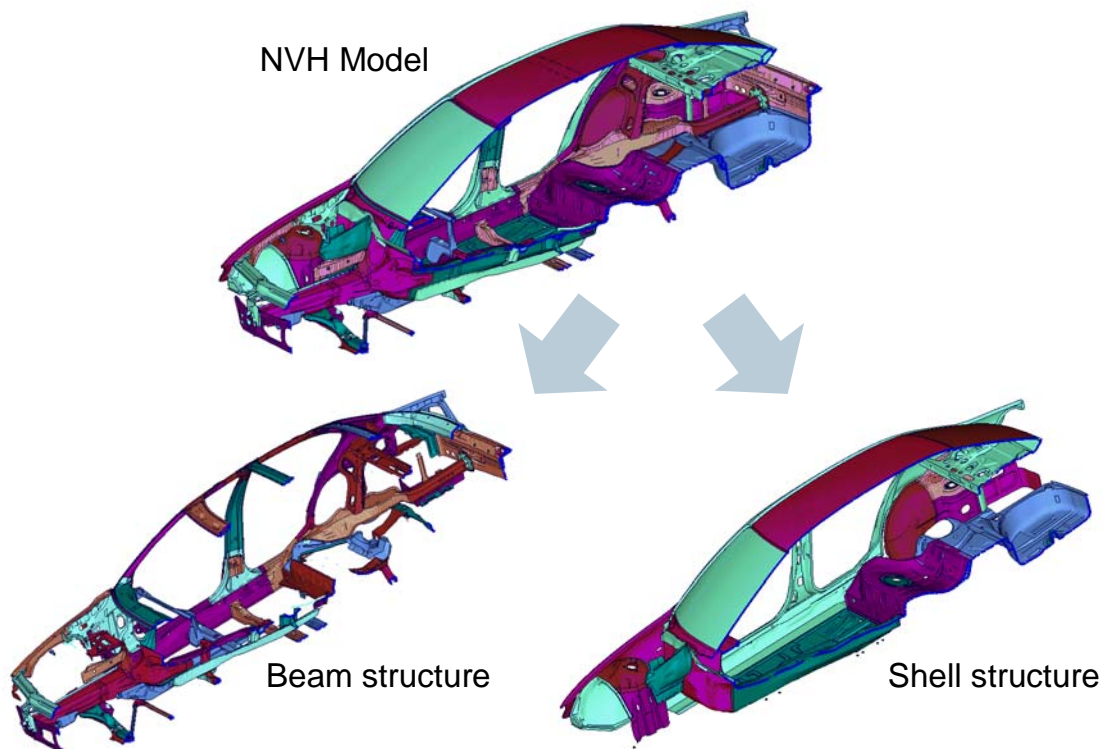

BMW Group

Agenda

This Presentation gives an insight to the deployment
of ANSA within BMW CAE Processes

- Nastran Arbitrary Cross Sections in Ansa
- Batch meshing with Ansa
- Spot weld definition for durability analysis
- Modeling of Door bag for Pressure Sensors
- Seat und Dummy Positioning with Ansa

Nastran Arbitrary Cross Sections in Ansa
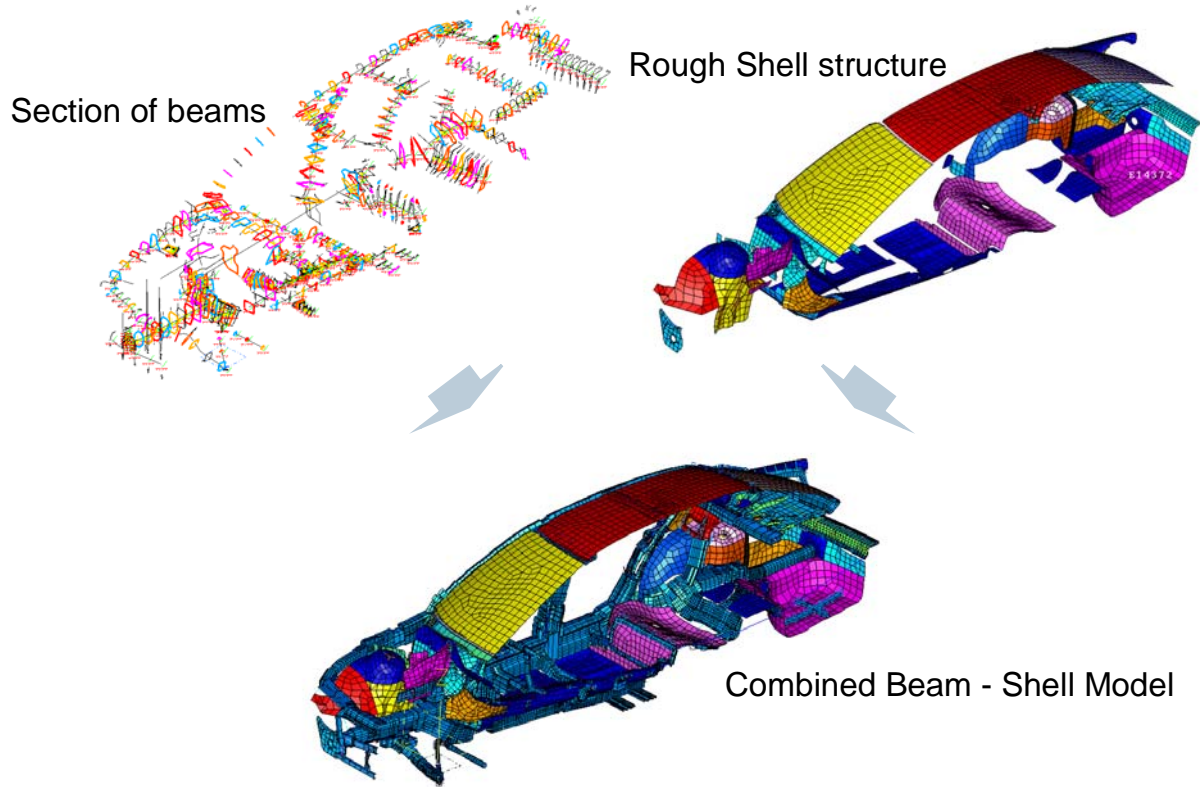## Beam-Shell FE-Model for global dynamic car body stiffness analysis

Sketches

Previous Model

CAD

- Features
  - FE- Beam and FE-Shell structure with easy and defined connection technique
  - <100.000 DOFs

- Usage
  - FE concept modeling in early design phases
  - operational deflection shape analysis

Nastran Arbitrary Cross Sections in Ansa
Example

NVH Model

Beam structure

Shell structure

Nastran Arbitrary Cross Sections in Ansa
Example

Section of beams

Rough Shell structure

Combined Beam - Shell Model

Nastran Arbitrary Cross Sections in Ansa
Section Definition of new Nastran ABS-Section
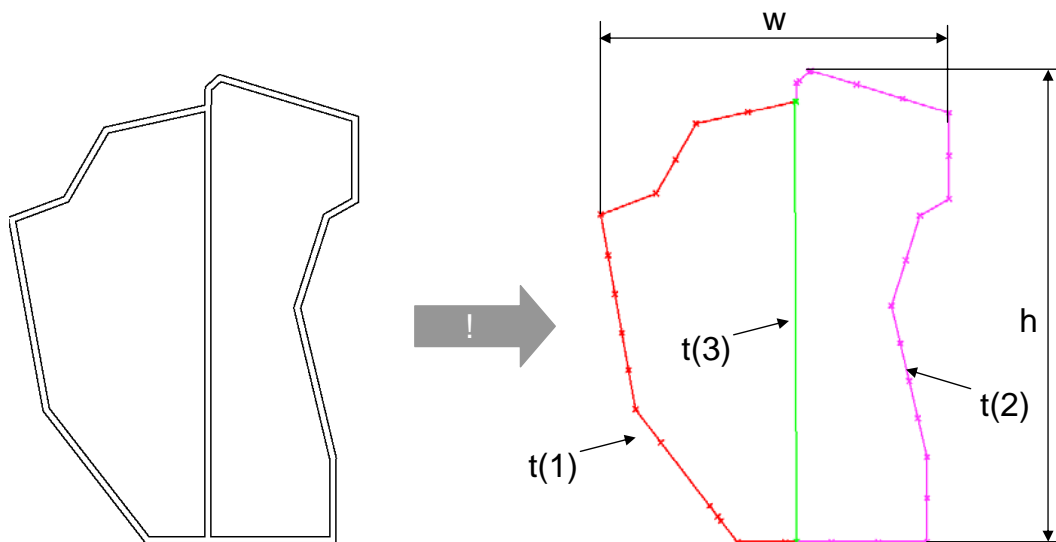
Longitudinal stiffeners with centre line beam cross sections
Design variables: width w, height h, thicknesses t(1), t(2), t(3)

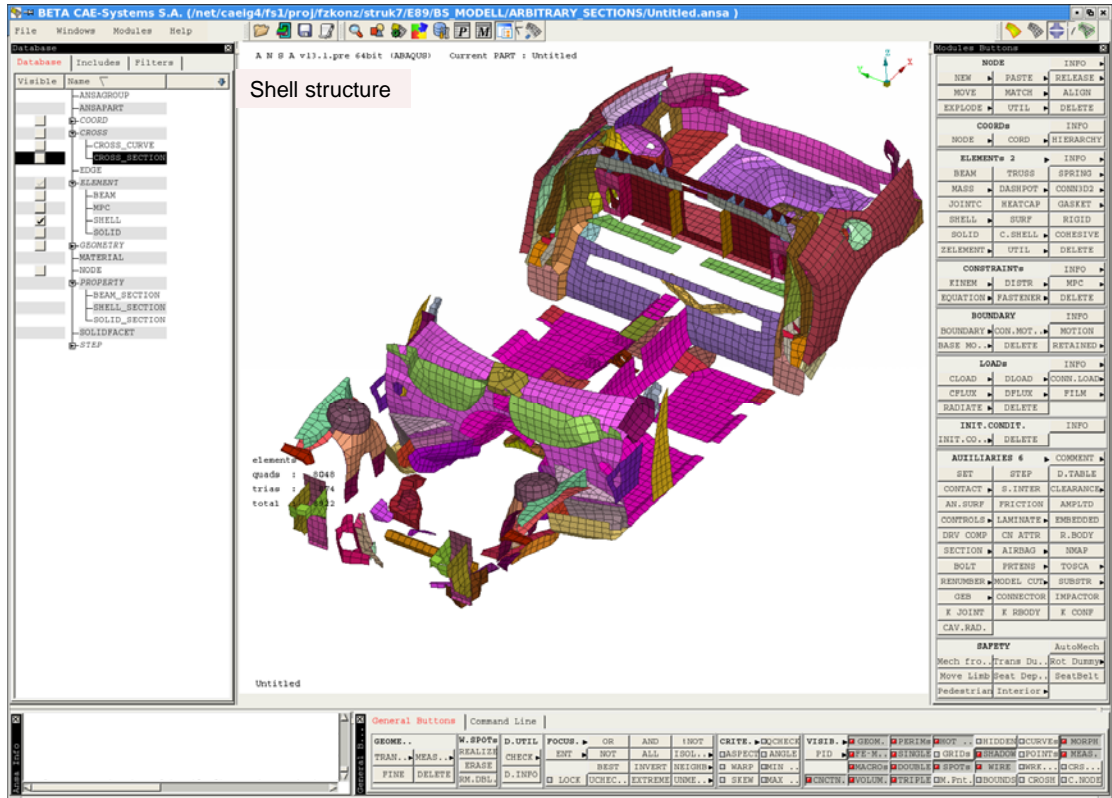# Nastran Arbitrary Cross Sections in Ansa
Section Creation
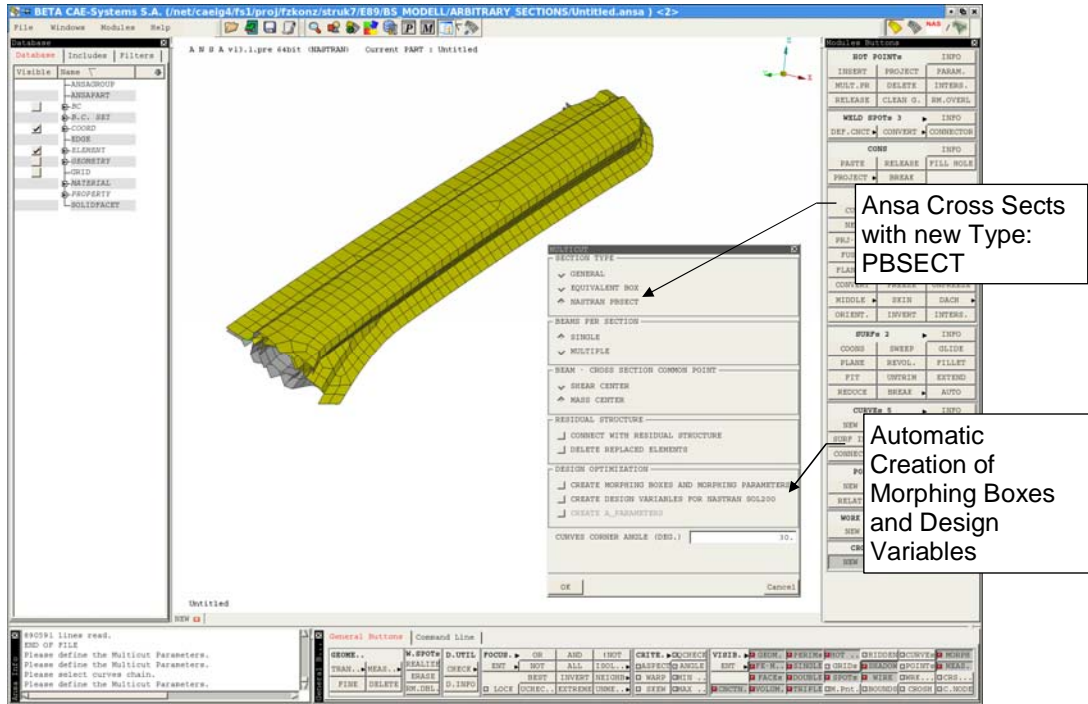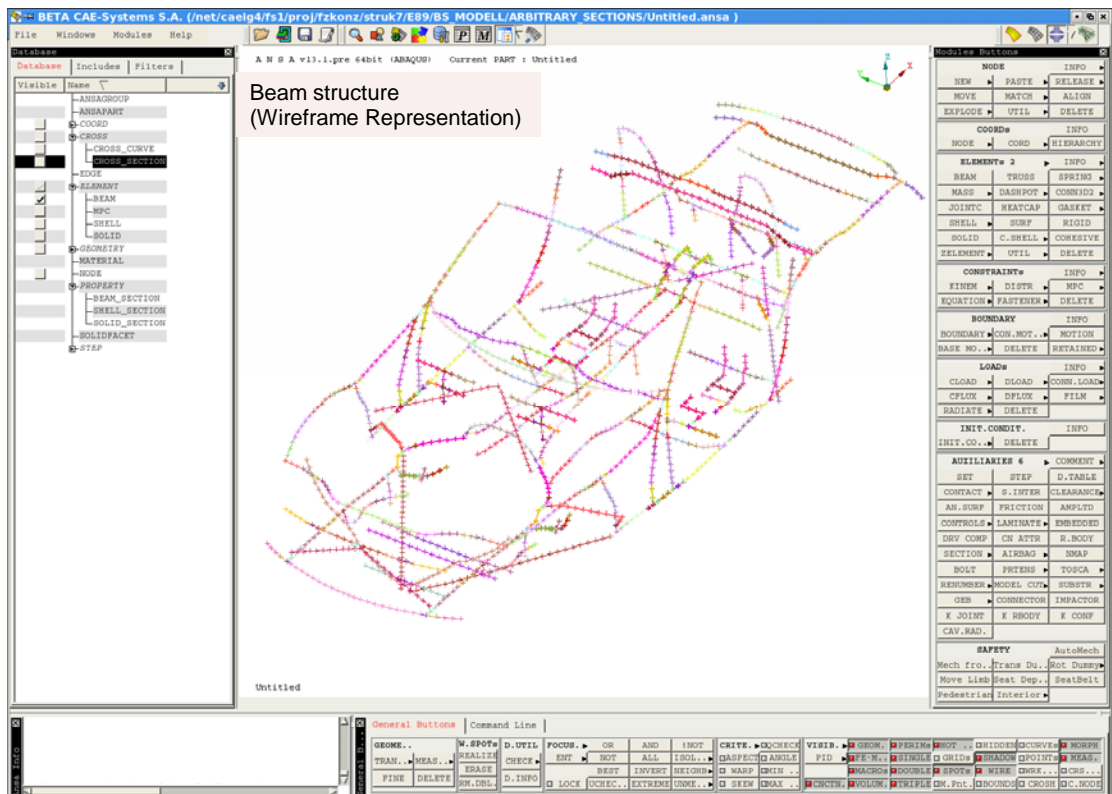
Ansa Cross Sects with new Type: PBSECT

Automatic Creation of Morphing Boxes and Design Variables

Nastran Arbitrary Cross Sections in Ansa
Section View and Editing

Beam structure
(Wireframe Representation)

Nastran Arbitrary Cross Sections in Ansa
Section View and Editing

Shell structure

Nastran Arbitrary Cross Sections in Ansa
Section View and Editing

Combined Beam&Shell structure
(Wireframe Representation)

Nastran Arbitrary Cross Sections in Ansa
Section View and Editing

Combined Beam&Shell structure
(3D-Representation)

Nastran Arbitrary Cross Sections in Ansa
Section View and Editing

Combined Beam&Shell structure
(3D-Representation)
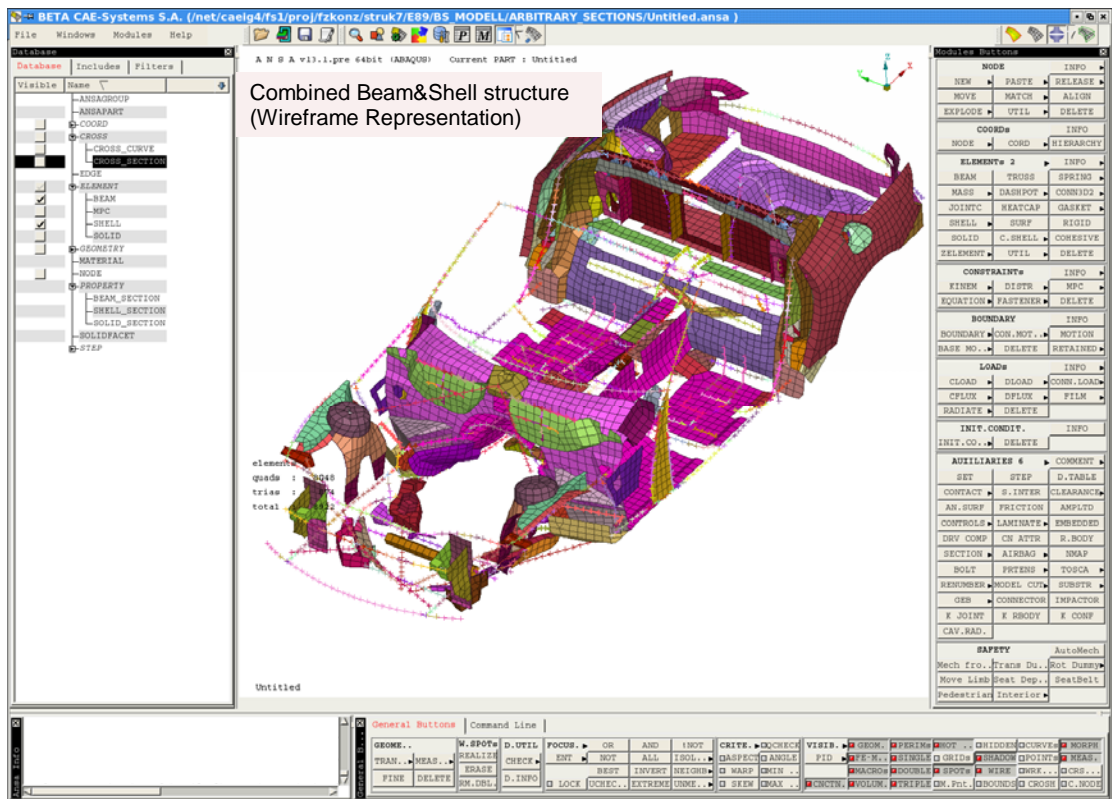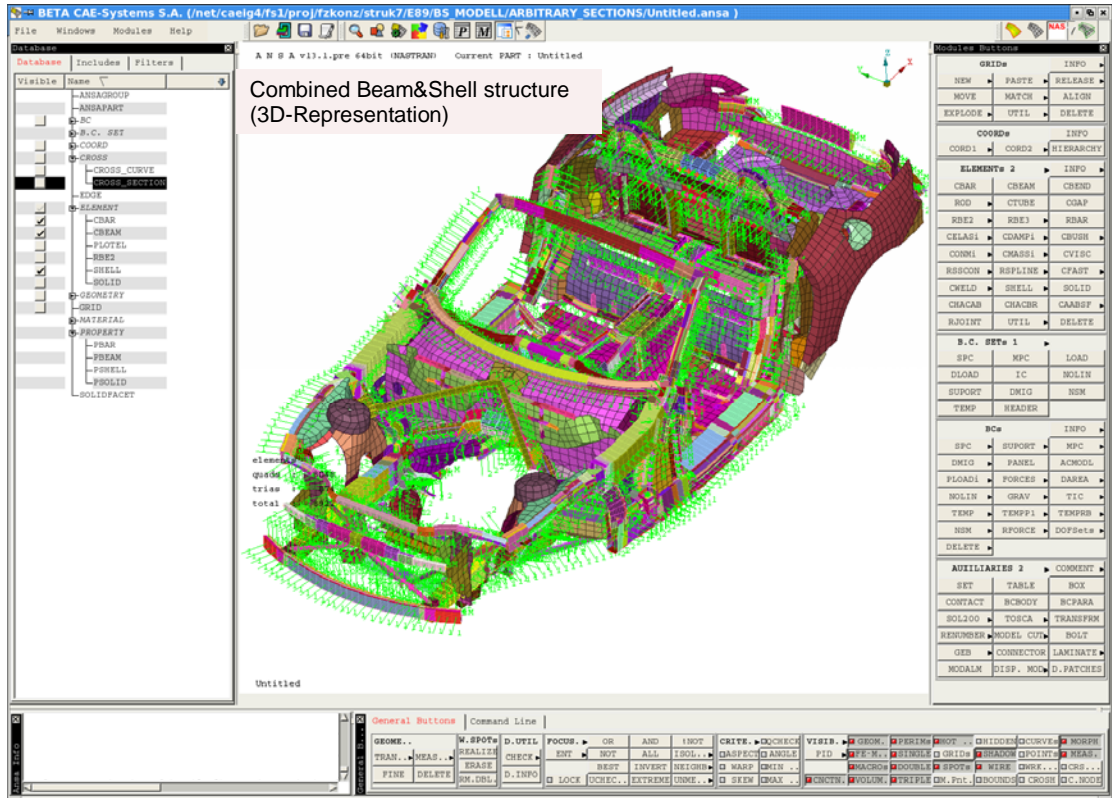
Nastran Arbitrary Cross Sections in Ansa
Section View and Editing
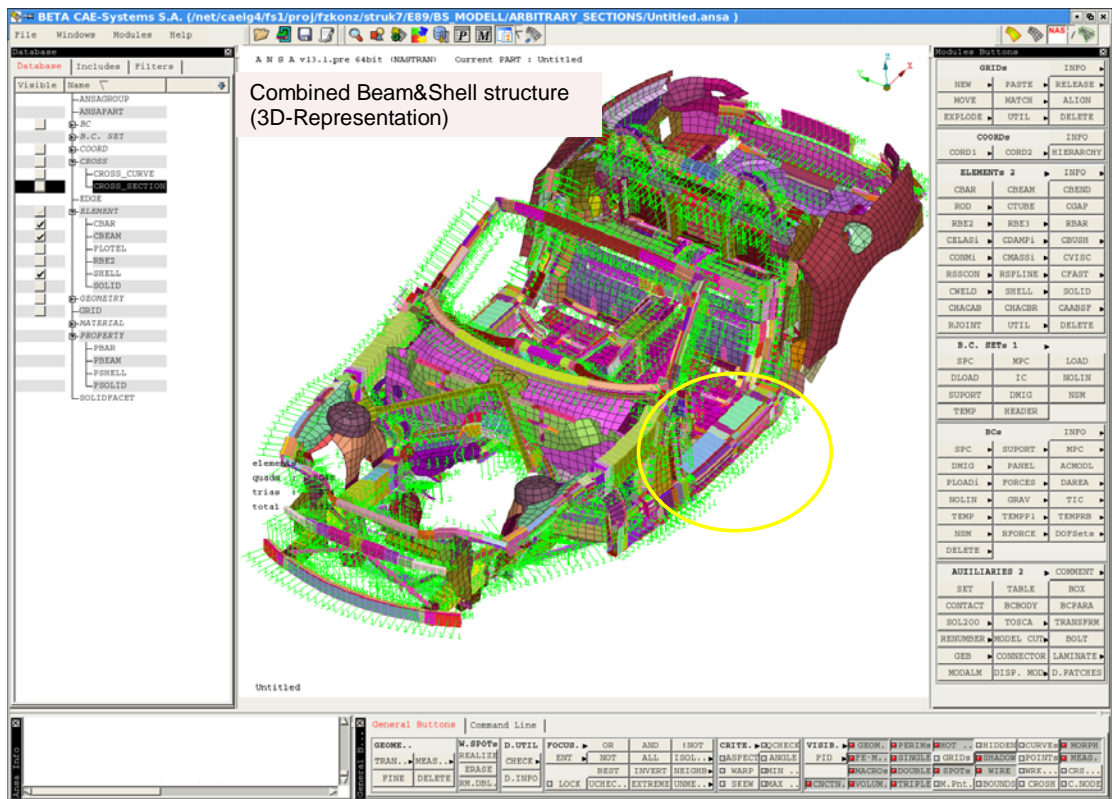
Cross Section
Representation in
Cross Section Module
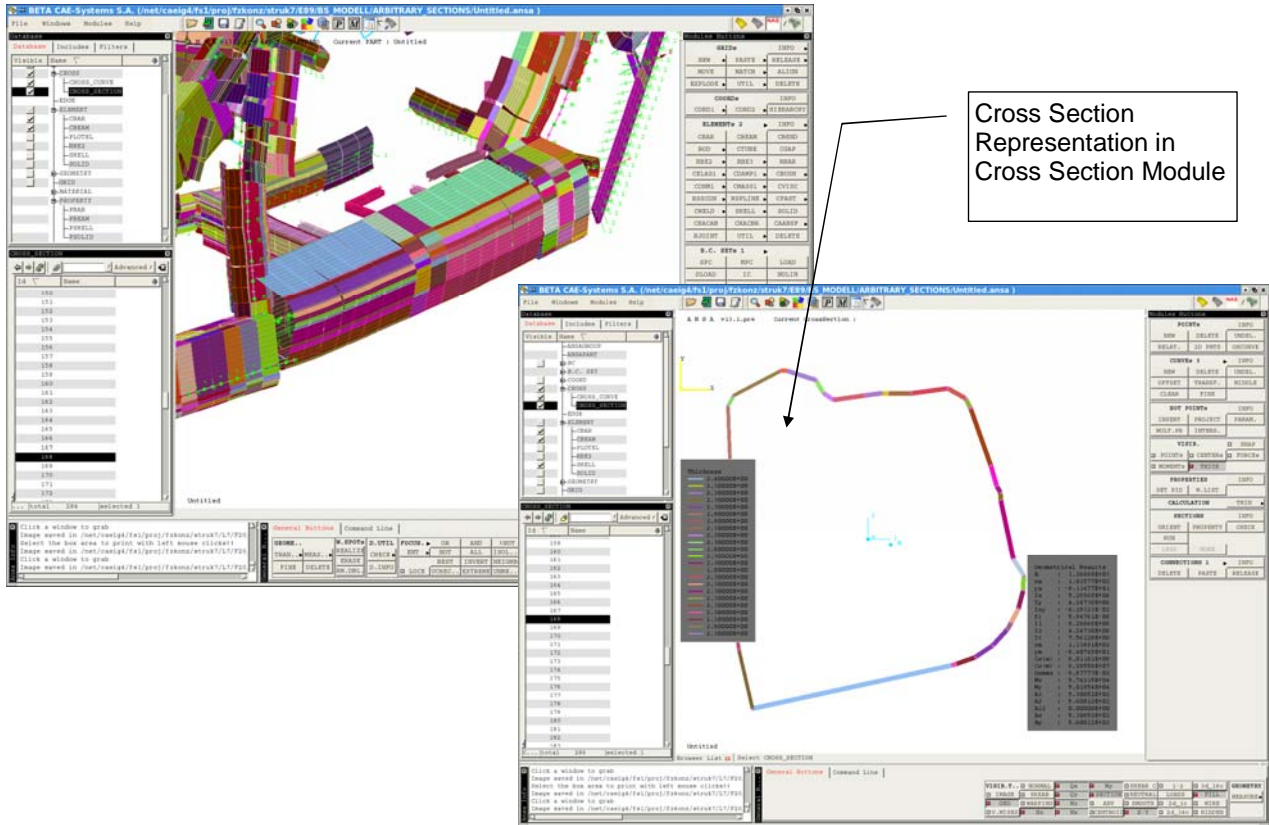
Nastran Arbitrary Cross Sections in Ansa
Conclusion

1. Possibility of complex Section Definition

2. Easy and fast creation of Beam Sections

3. Operational deflection shape analysis

4. Fast running Model

Batch meshing with Ansa
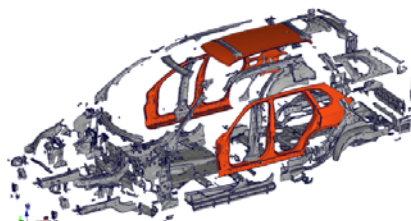## Introduction
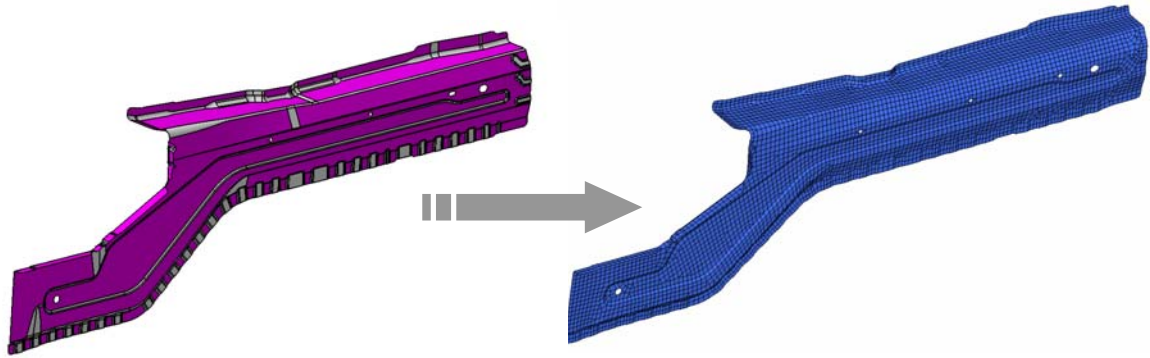
Batch meshing with Ansa
Prozess

- Translation
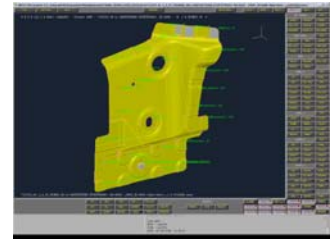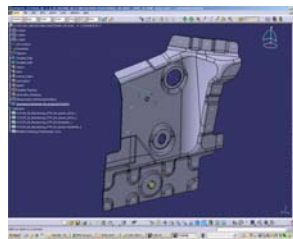
- Meshing

- Transforming
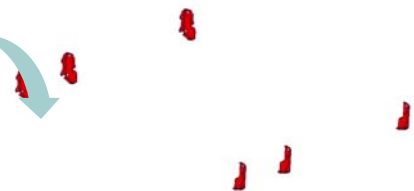
- Assembling

Batch meshing with Ansa
Boundary Conditions

Part list (module list)

Catia V5 or V4 data

FE Net

Transformation Matrix

Batch meshing with Ansa
BMW Numbering Convention

PID module wise (Module AA1= 1100000)
Left Parts ending with 01
Right Parts ending with 02
Middle Parts ending with 00
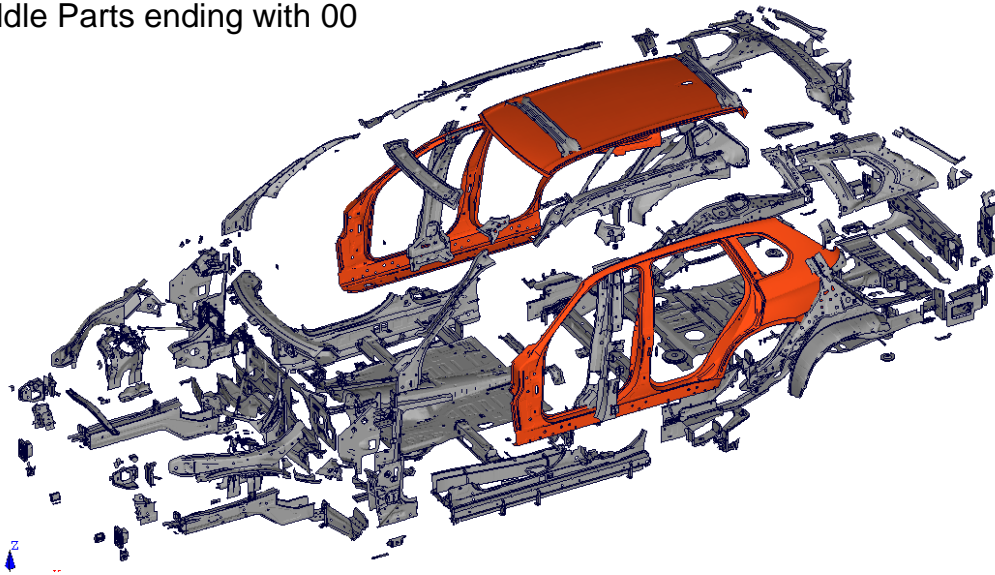
Batch meshing with Ansa
GUI Description: Main Window
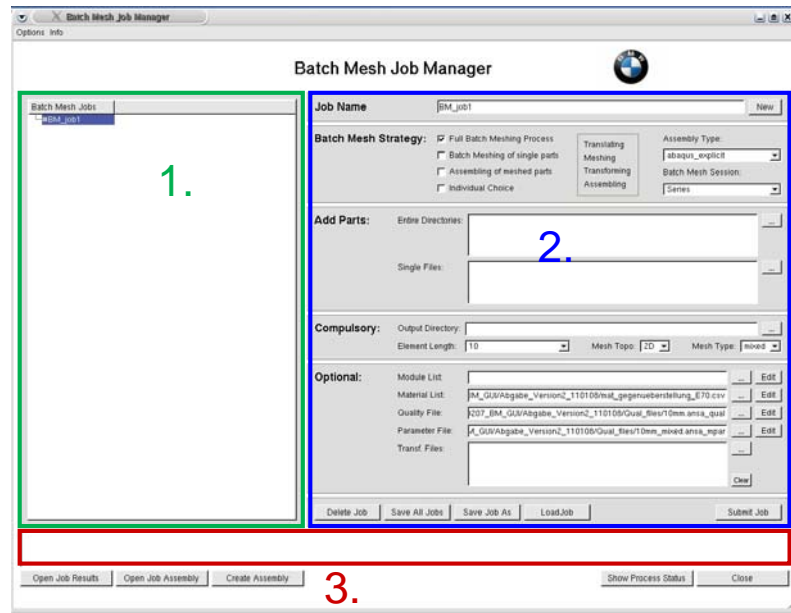
1. Job Tree
2. Job and Part definition
3. Message window

Batch meshing with Ansa
GUI Description: Job Tree
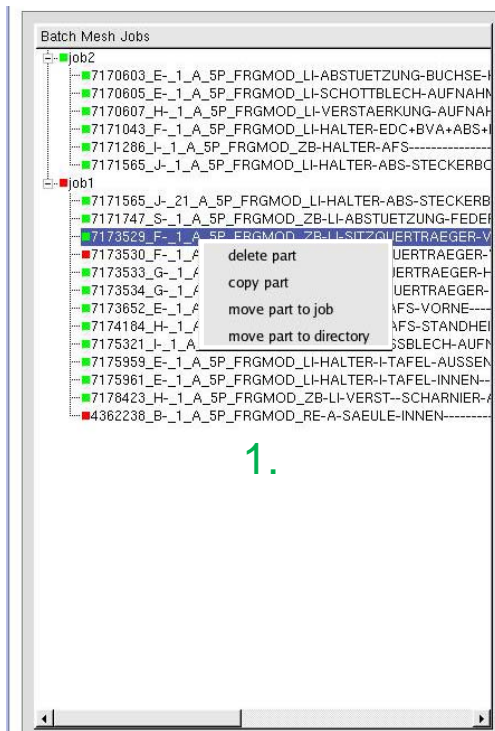
1. Several functions are available through a right mouse button click in the job tree.

2. The active job can be deleted with the 'Delete' button.

3. 'Save All Jobs' saves all jobs with the default file names. With 'Save Job As', it is possible to save the active job with a chosen file name.

   A job is saved as a text file in a special format.

4. Load a previously saved job.

Batch meshing with ANSA
GUI Description: Show Results

Double click to open several actions

Modulliste:

Batch meshing with ANSA
Conclusion

1. Very fast BIW Model creation → less then 40 hours

2. Good overview over the process

3. Handling of more than one batch mesh job

4. Possibility of individual batch mesh strategy →only translation …

5. Stable batch mesh process → usage of equal parameters

Spot weld definition for durability analysis
Position of spot welds

- A sample of three spot weld will
  be meshed.

- Position of spot welds is marked
  with red dots.
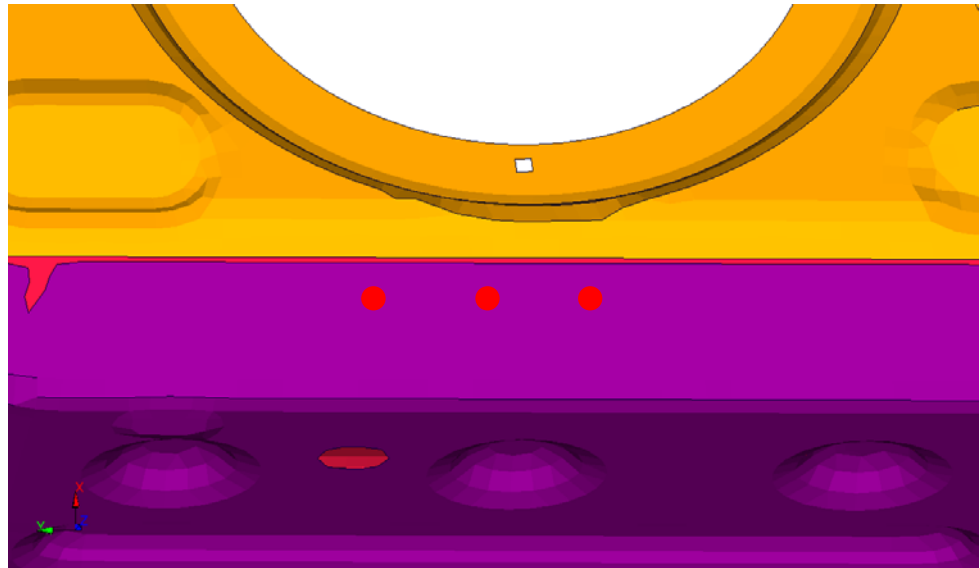
Spot weld definition for durability analysis
Meshed spot welds

- Spot weld type "Spider 2" is used for
  durability analysis.

- Meshing based on spot weld data base

- Whole body will be meshed automatically in ANSA, i.e.
  thousands of spot welds.
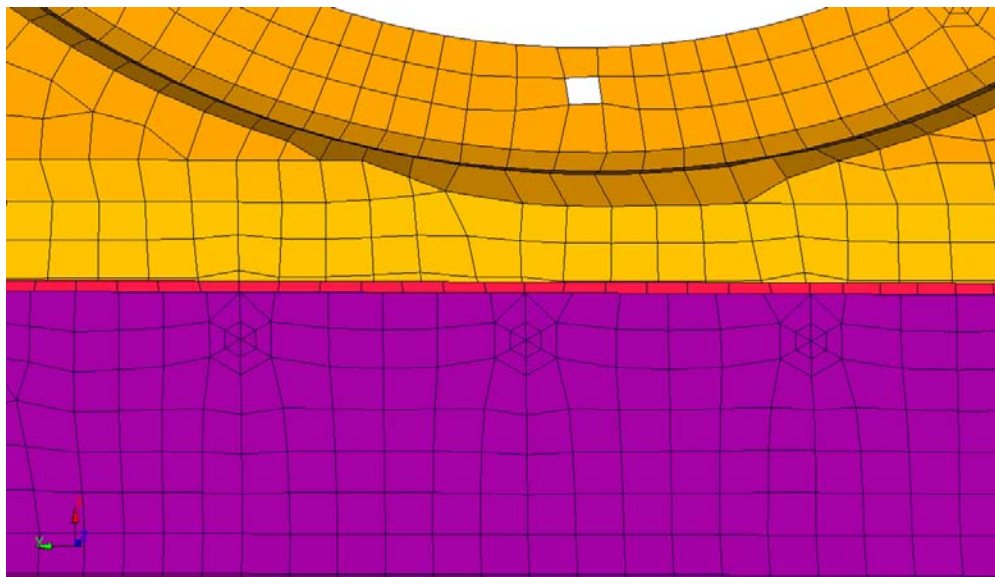
Spot weld definition for durability analysis
Diameter of spot welds

D=6.6mm

- Diameter of spot welds depend on shell thickness.

Id ▽	Name	T	MID1	MID
68	SPOT WELD 6.6 mm PBAR Property			68

Show	Hide	Show Only	New	Edit	Modify	Copy
Delete	Invert Selection	Save List	Reference	Mat Sync	Transparency	Apply

total 511   selected 0
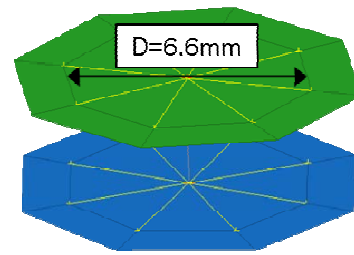
- Single PID for every diameter will be created.
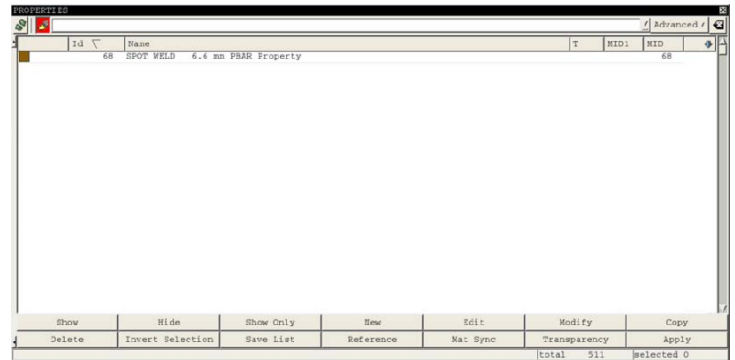
- More than two layers can be connected.
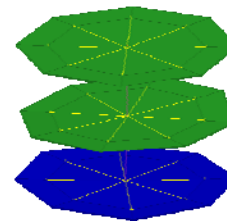
Spot weld definition for durability analysis
Conclusion

1. Automatic spot weld realization in ANSA

2. Automatic mesh manipulation in ANSA

3. Realistic mapping of spot weld behavior

4. Good correlation between calculation and test data

Modeling of "door bag" for pressure sensors
Motivation

…the pressure causes a significant force to the door trim.
…and the pressure signal is used for airbag firing.

→ Analogous airbag door model represents the air pressure in the door
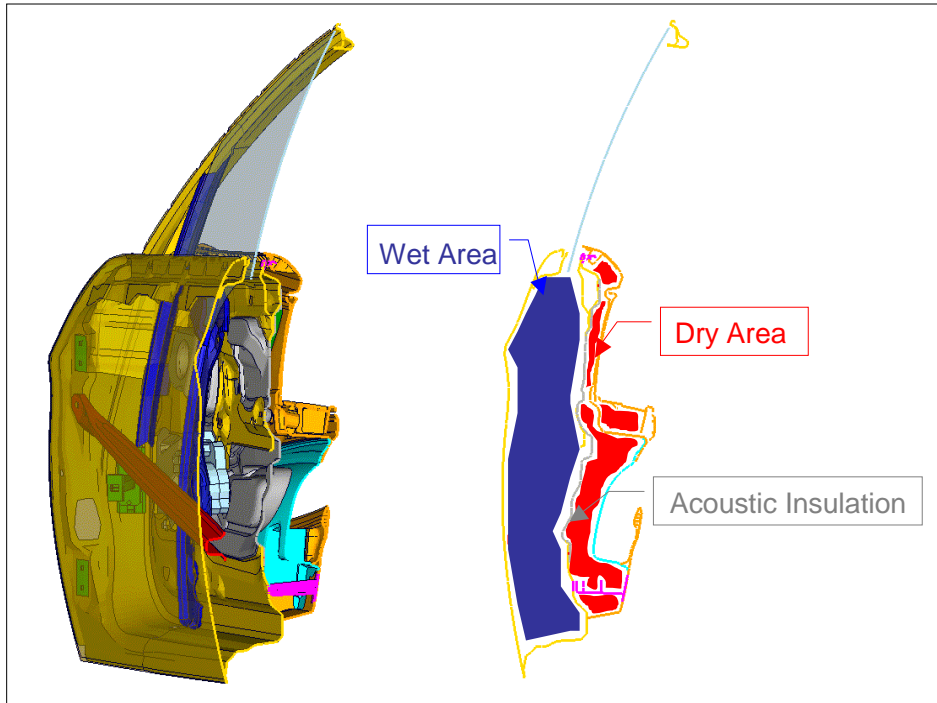
Wet Area

Dry Area

Acoustic Insulation

Modeling of "door bag" for pressure sensors
Geometric boundary conditions

Possible leakage areas

Leakage Wet Area

Possible Leakage

Leakage Dry Area
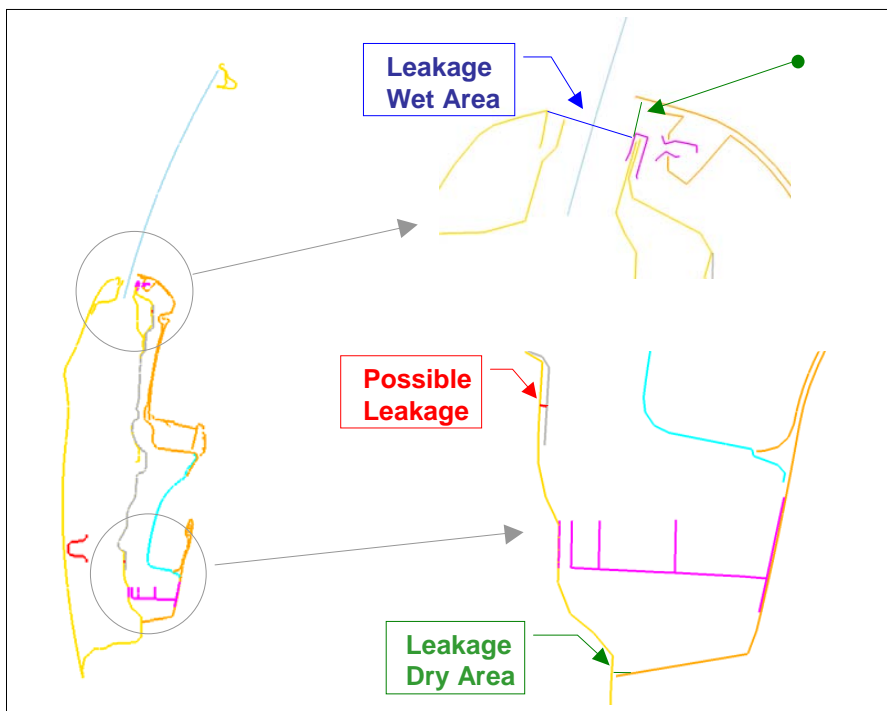
Modeling of Door bag for Pressure Sensors
Geometric Boundary Conditions

Possible leakage areas

Modeling of Door bag for Pressure Sensors
Process Automation
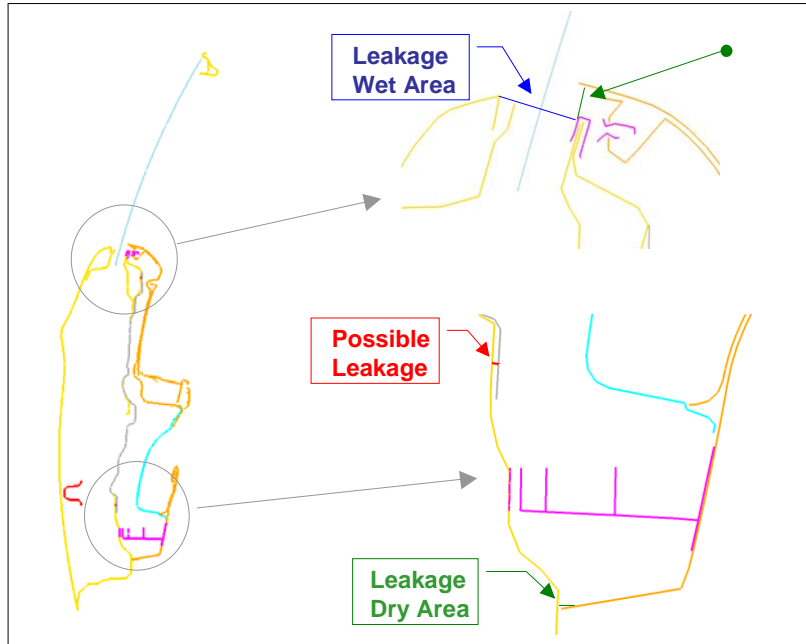
Modeling of Door bag for Pressure Sensors
Process Automation

A N S A v13.0.1 64bit (ABAQUS)   Current PART : P40001;7060061_L1A_LI_TUERAUSSENHAUT_TV_0p75mm

Isolation of the areas to be connected

elements
quads : 10095
trias : 716
total : 10811

only_2parts.ansa

Modeling of Door bag for Pressure Sensors
Process Automation

A N S A v13.0.1 64bit (ABAQUS)   Current PART : P40001;7060061_L1A_LI_TUERAUSSENHAUT_TV_0p75mm

Select one half

elements
quads : 10095
trias : 716
total : 10811

only_2parts.ansa

Modeling of Door bag for Pressure Sensors
Process Automation

A N S A v13.0.1 64bit (ABAQUS)   Current PART : P40001:7060061_L1A_LI_TUERAUSSENHAUT_TV_0p75mm

Select one half

and the other half

elements
quads : 10095
trias : 716
total : 10811

only_2parts.ansa

A N S A v13.0.1 64bit (ABAQUS)   Current PART : P40001:7060061_L1A_LI_TUERAUSSENHAUT_TV_0p75mm

elements
quads : 10095
trias : 1758
total : 11853

only_2parts.ansa

Modeling of Door bag for Pressure Sensors
Process Automation

A N S A v13.0.1 64bit (ABAQUS)   Current PART : P40001;7060061_L1A_LI_TUERAUSSENHAUT_TV_0p75mm

preview of the surface
elements that enclose the
cavity

elements
quads : 10095
trias : 1758
total : 11853

only_2parts.ansa

Modeling of Door bag for Pressure Sensors
Process Automation

A N S A v13.0.1 64bit (ABAQUS)   Current PART : P40001;7060061_L1A_LI_TUERAUSSENHAUT_TV_0p75mm

Create the gap for the leakage

elements
quads : 10095
trias : 1758
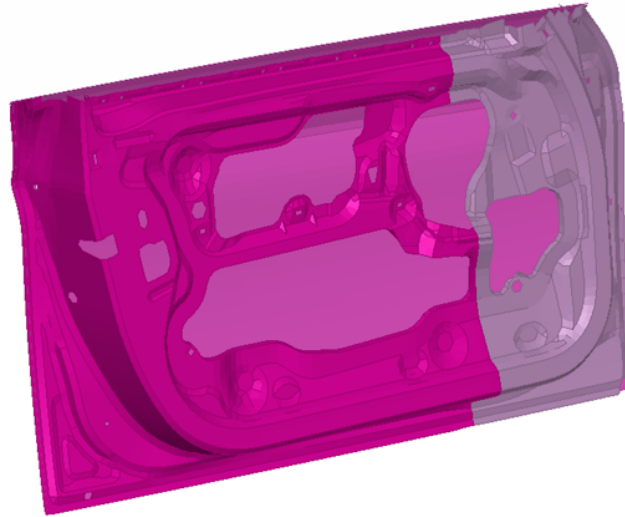total : 11853

only_2parts.ansa

Modeling of Door bag for Pressure Sensors
Process Automation

A N S A v13.0.1 64bit (ABAQUS)   Current PART : P40001;7060061_L1A_LI_TUERAUSSENHAUT_TV_Op75mm

Create the gap for the leakage

Selecte Exchange Regions

Width of gap :   0.1

OK   Cancel

elements
quads : 10095
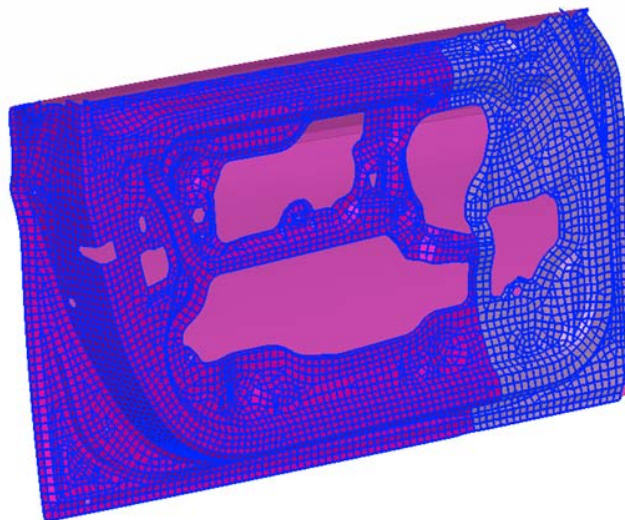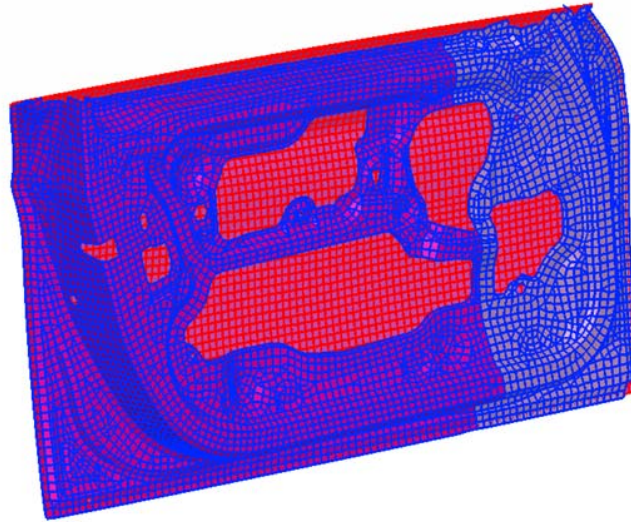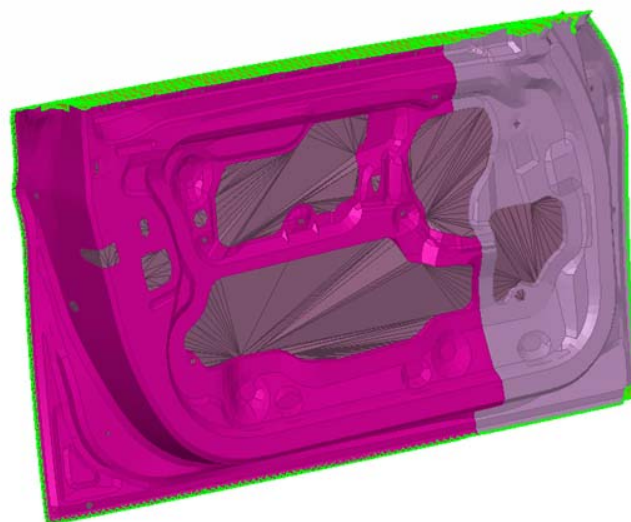trias : 1758
total : 11853

only_2parts.ansa

Modeling of Door bag for Pressure Sensors
Process Automation

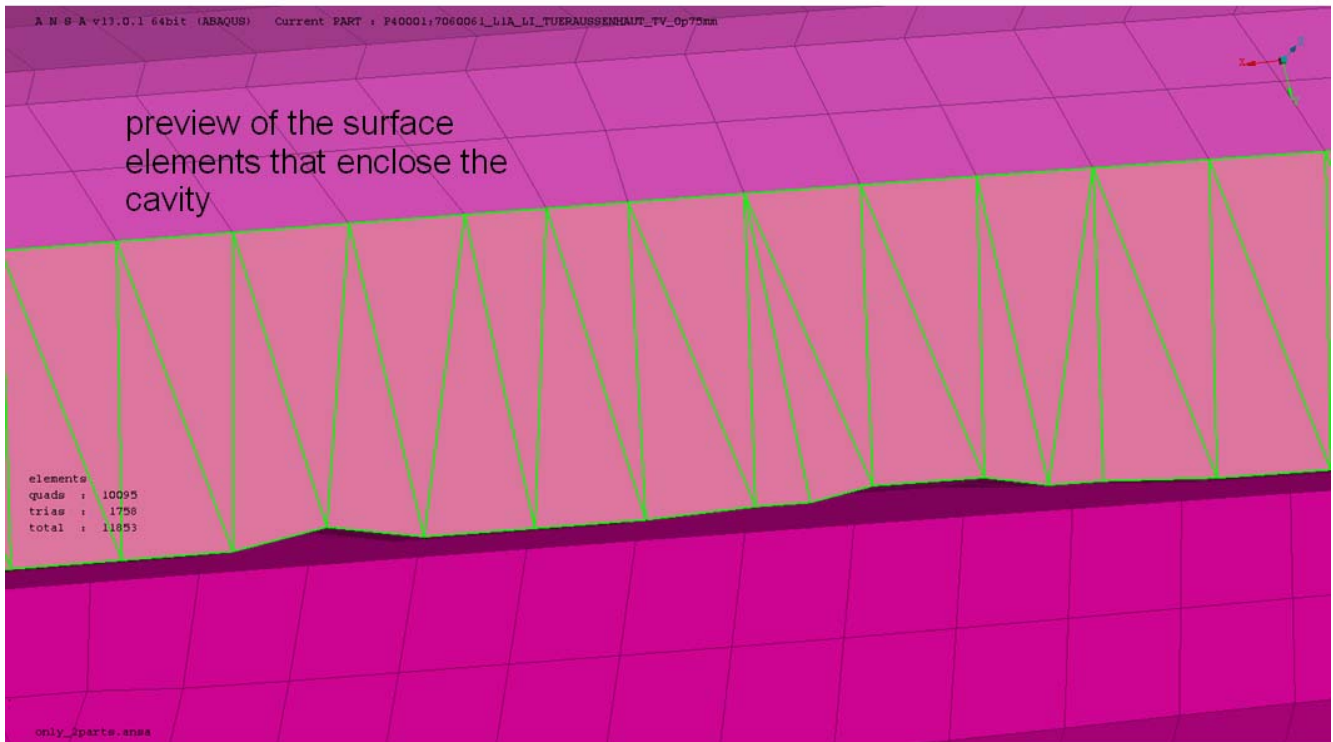A N S A v13.0.1 64bit (ABAQUS)   Current PART : P40001;7060061_LI_LI_TUERAUSSENHAUT_TV_Op75mm

and all the respective keywords get created

Database

| Database | Includes | Filters |

Visible	Name	Number
	ANSAGROUP	3
	ANSAPART	14
	EDGE	
✓	ELEMENT	24459
✔	ELSURFACE	11939
	SHELL	12520
	FLUID	6
	FLUID CAVITY	2
	FLUID EXCHANGE	2
	FLUID EXCHANGE PROPERTY	2
	GEOMETRY	3
	WPLANE	3
	MATERIAL	4
	NODE	13221
	PROPERTY	15
	SET	56
	STEP	1

elements
quads : 1C
trias : 1
total : 11

only_2parts

```
**    Chamber Trockenraum
**
*Nset, Nset=Chamber_trocken_refnode
 4499999,
**
*Surface, Name=Chamber_trocken_surf, Type=ELEMENT
 P44510;Chamber_Wall_close,          SNEG
 P44511;Nullschalen_Klebung,         SNEG
 P44512;Nullschalen_kleb_rohbau,     SNEG
 P44513;Chamber_Wall_rohbau,                   SNEG
 P44514;Chamber_Wall_loecher,                  SNEG
 P44520;Tuer_druck_bag_trocken,      SPOS
 P44521;Nullschalen_trocken,         SPOS
 P44522;Nullschalen_tv_rohbau,       SPOS
 P44523;Nullschalen_close_tv_rbau,   SPOS
 P44529;Nulschal_Scheib_troc_oef,    SPOS
 P44530;Nullschalen_Scheib_trock,    SPOS
*Fluid cavity, Name=Ch_Bag_trocken, Ambient pressure= 1.013000e-01,
  Ref node=Chamber_trocken_refnode, Ambient temperature= 2.960000e+02,
  Surface=Chamber_trocken_surf, Behavior=INIT_GAS_Bag47001, Adiabatic
**
```

Modeling of Door bag for Pressure Sensors
Conclusion

1. Better structure correlation between calculation and test data

2. Pressure Signal is used for layout of Airbag firing

3. More realistic Dummy Values

4. Very good correlation of the pressure signal between calculation and test data
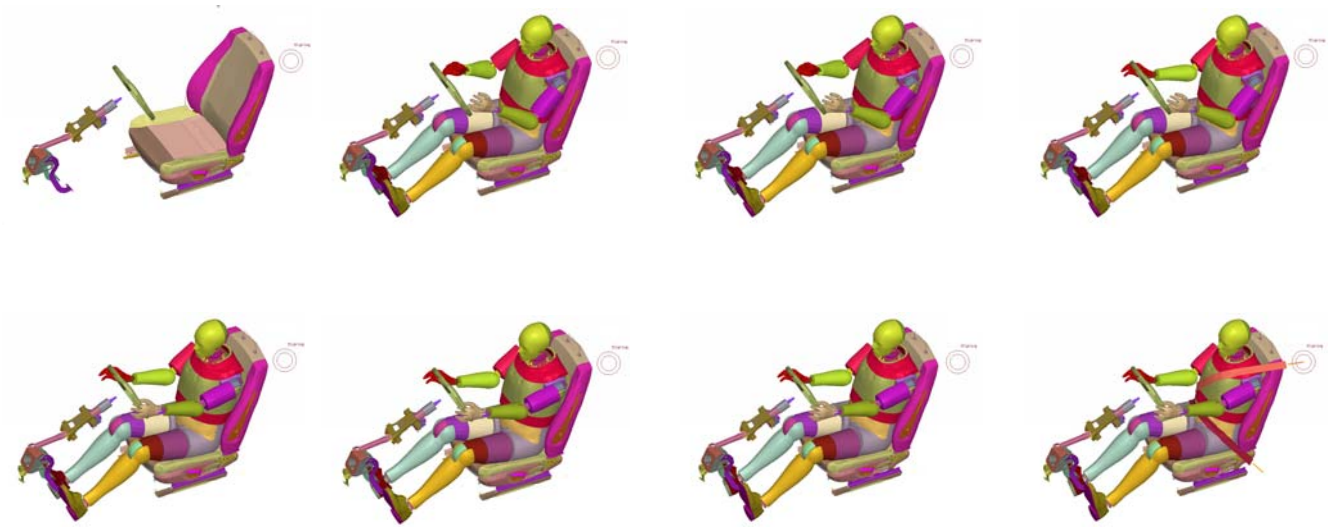

Seat und Dummy Positioning with Ansa
Advanced preprocessing features

- Specific dummy features
- Easy combination of multiple mechanisms
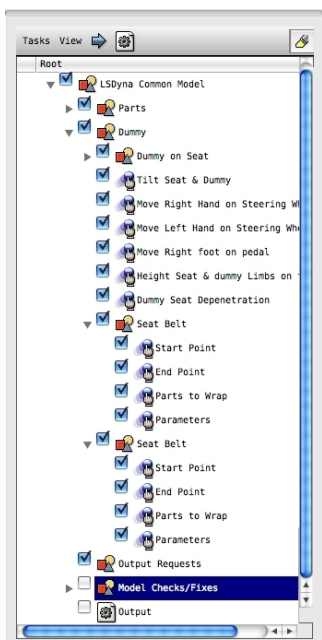- Choice to output only transformations with NMAP keyword

Seat und Dummy Positioning with Ansa
Process Automation

Seat und Dummy Positioning with Ansa
Process Automation

ANSA Task Manager

Seat und Dummy Positioning with Ansa
Conclusion

1. Fast Positioning of Dummies

2. Possibility of Positioning complex kinematic structures

3. A lot of possible application areas → e.g. Driveline Positioning

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An insight to the deployment of ANSA within BMW CAE Processes
Summary

- Ansa makes a large contribution to the improvement in efficiency of the BMW Processes

- The shown examples are only a small part of the BMW activities

- In the future the cooperation with BETA will be intensified to further improve potential efficiency

→ Switch the Batch mesh Process to Version 13.0.2

→ Automatic relaxation of the connection technique in the Batch Meshing Process

→ Automatic multi beam mesh and mesh manipulation