

A 3D wireframe car model is shown from a front-three-quarter perspective, positioned on a dark, low-poly ground plane. The car's body is rendered with a fine grid of lines, while the interior and wheels are solid. The background consists of various light blue and white geometric shapes, creating a stylized, abstract landscape. The overall scene is set against a dark blue gradient background.

**Ground breaking
Simulation Solutions**

physics on screen

Addressing the challenge of late design stage optimization: A passenger car side impact case.

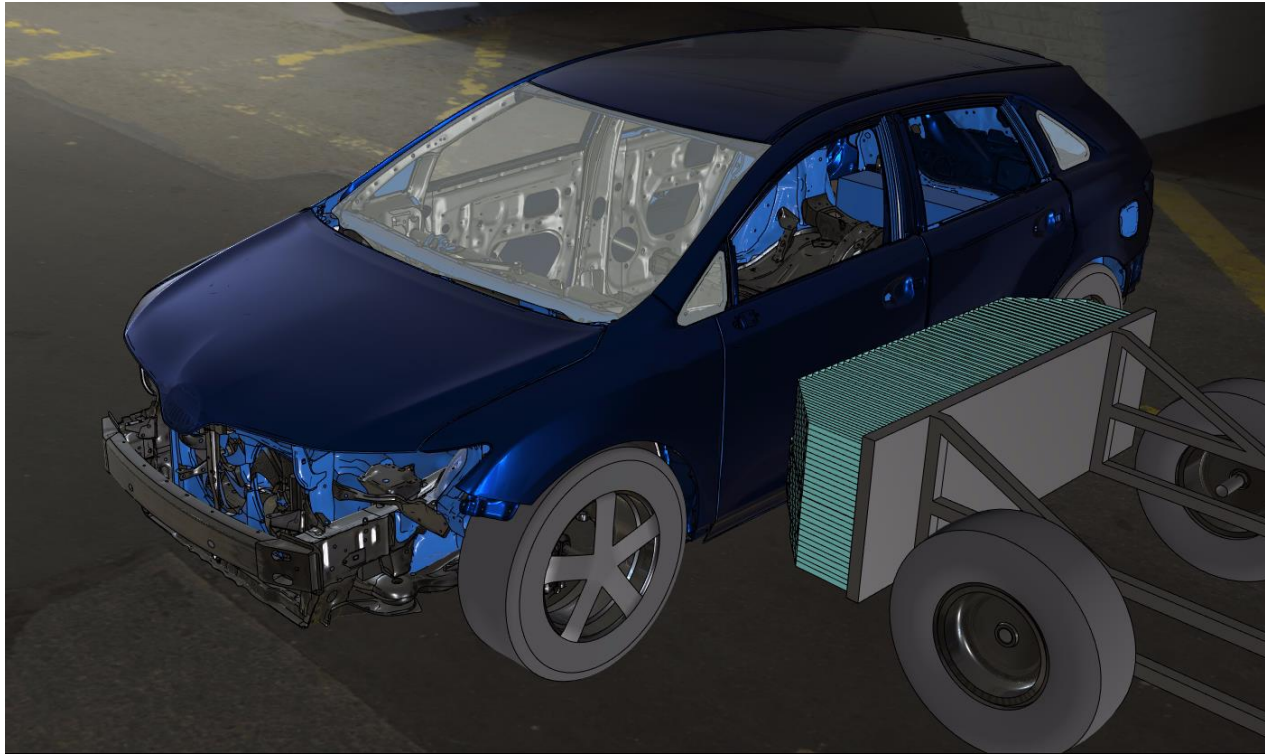
Evangelia Eleftheria Ioannou
Spyridon Garifallidis
Michael Tryfonidis

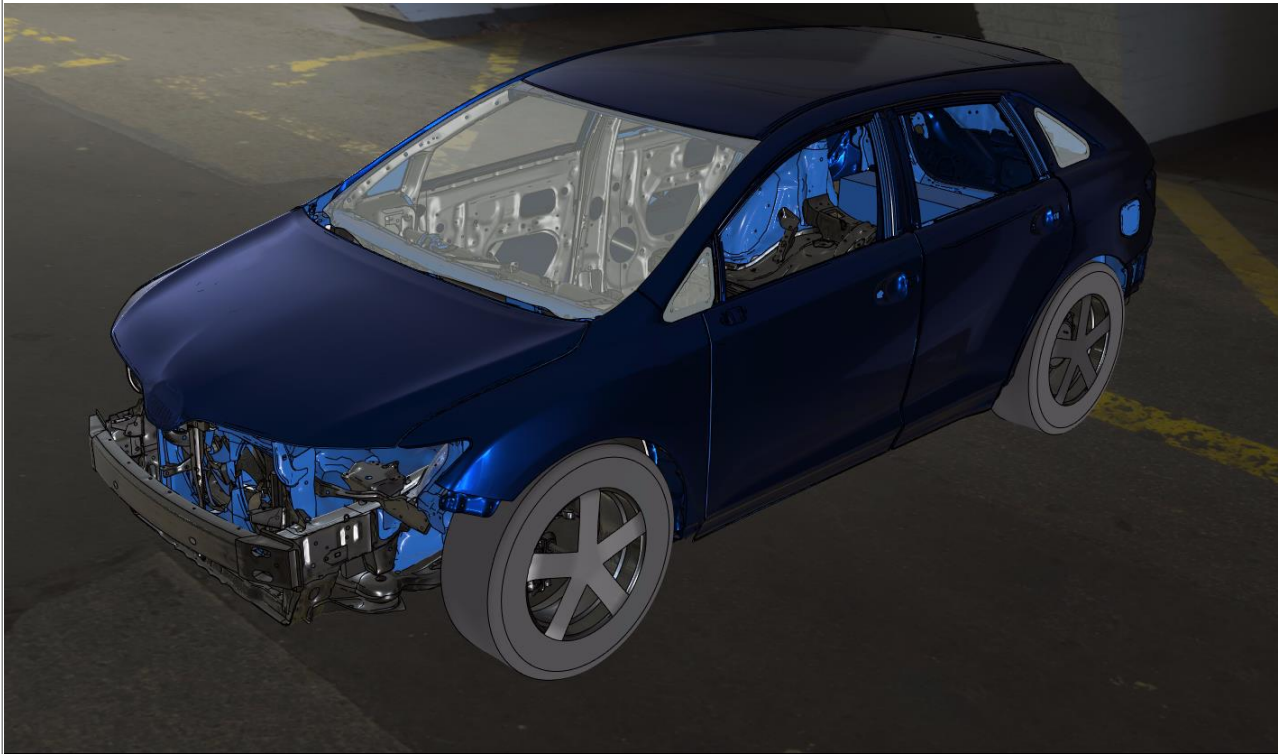
Contents

- Motivation
- Set-up
- Execution
- Conclusions

Motivation

- Side impact





Motivation

- Side impact
- The part in focus

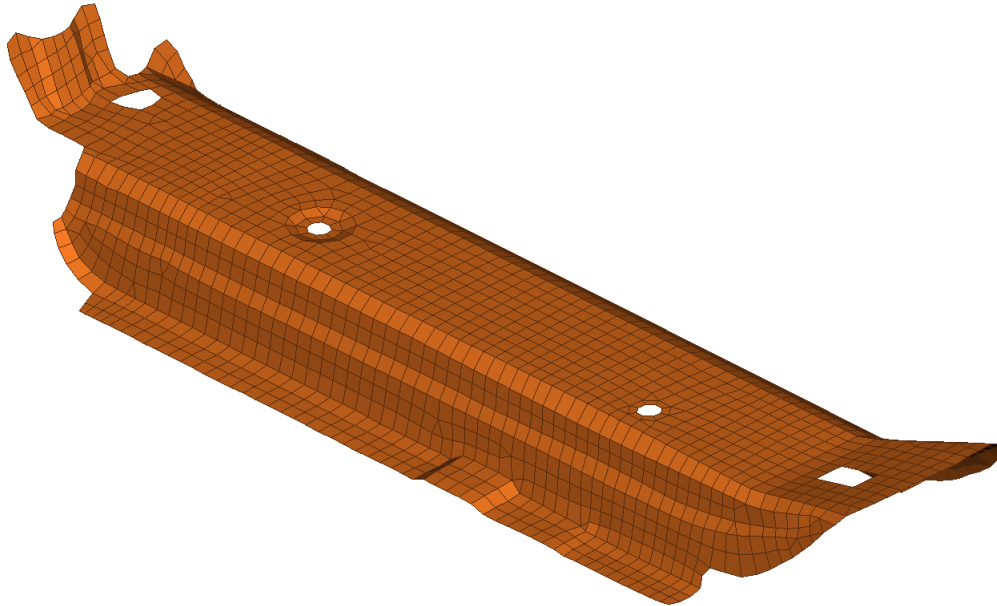
Part Name: Rear_Front_Floor_Cross_Member_LH

Part Id: 17802

Thickness: 2.0 mm

Material: CR240LA

Version: AC_03



Motivation

- Side impact
- The part in focus
- CAD-Requirements

Part Name: Rear_Front_Floor_Cross_Member_LH

Part Id: 17802

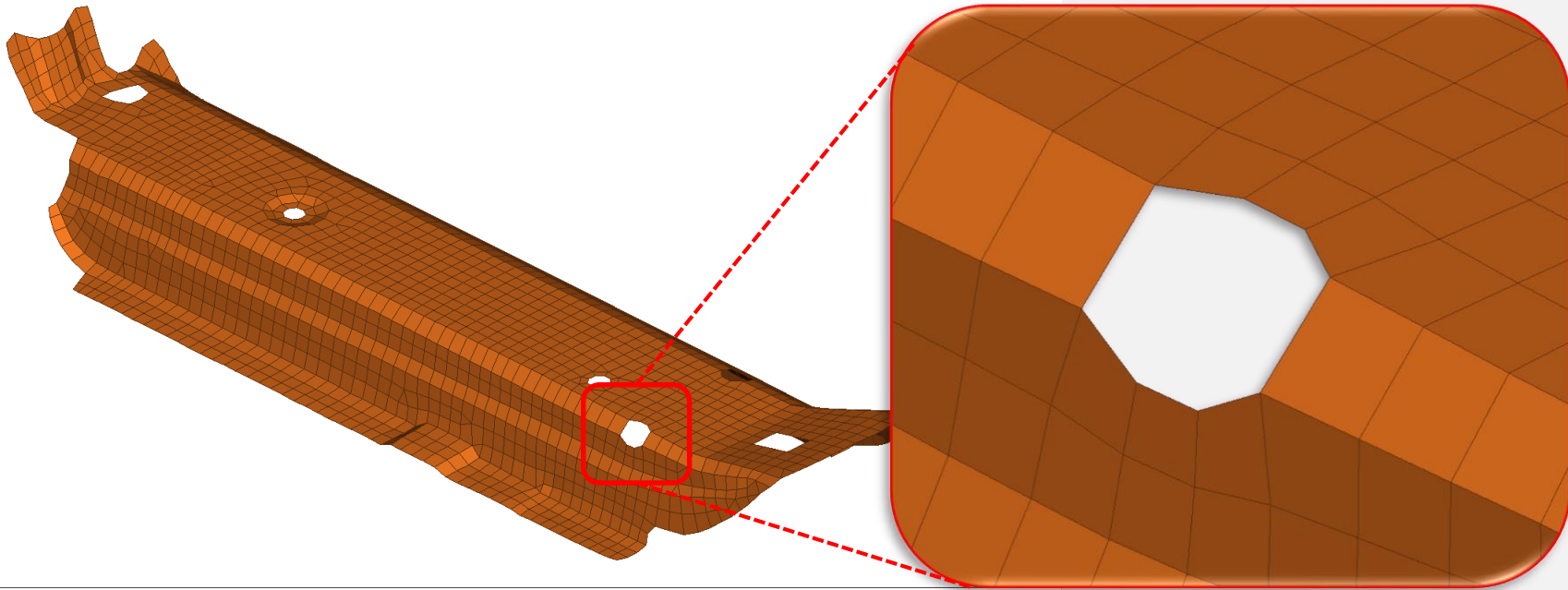
Thickness: 2.0 mm

Material: CR240LA

Version: AC_03

Motivation

- Side impact
- The part in focus
- CAD-Requirements



Part Name: Rear_Front_Floor_Cross_Member_LH

Part Id: 17802

Thickness: 2.0 mm

Material: CR240LA

Version: AC_03

CAE-Assignment:

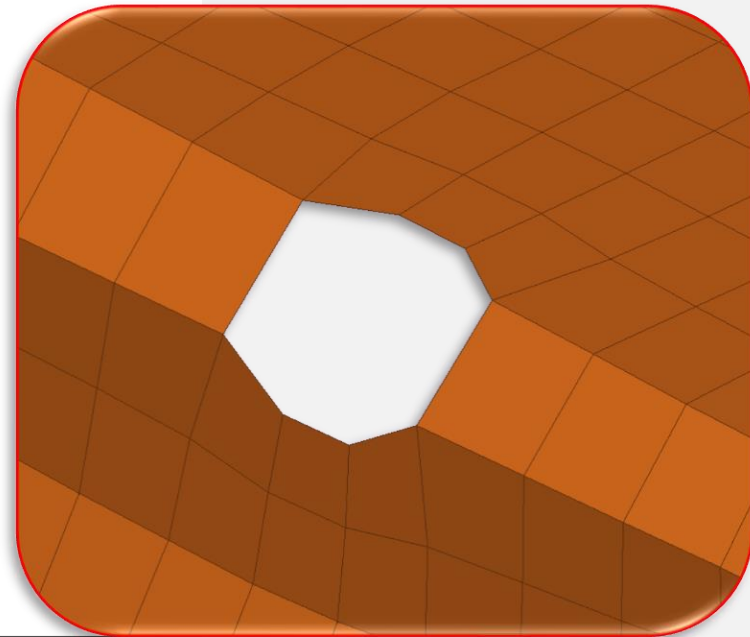
- Can the Crash behavior be affected, by introducing and adjusting these holes and if yes how?

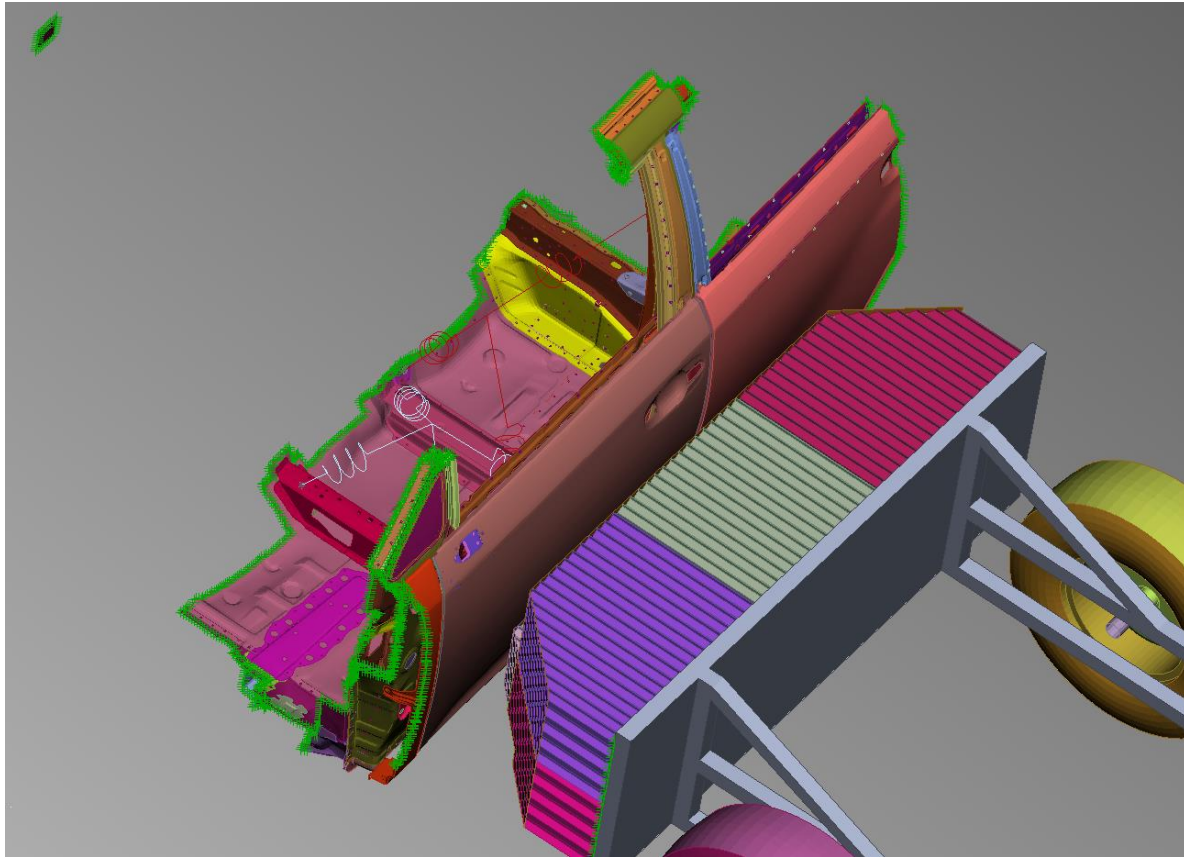
Guidelines:

- Late product-phase: Stamp tool & die has been ordered
- Position or number could still be adjusted, without affecting the cost
- If amount of holes increases, they have to be exact copies though

Motivation


- Side impact
- The part in focus
- CAD-Requirements





Set-up

- Sub structuring



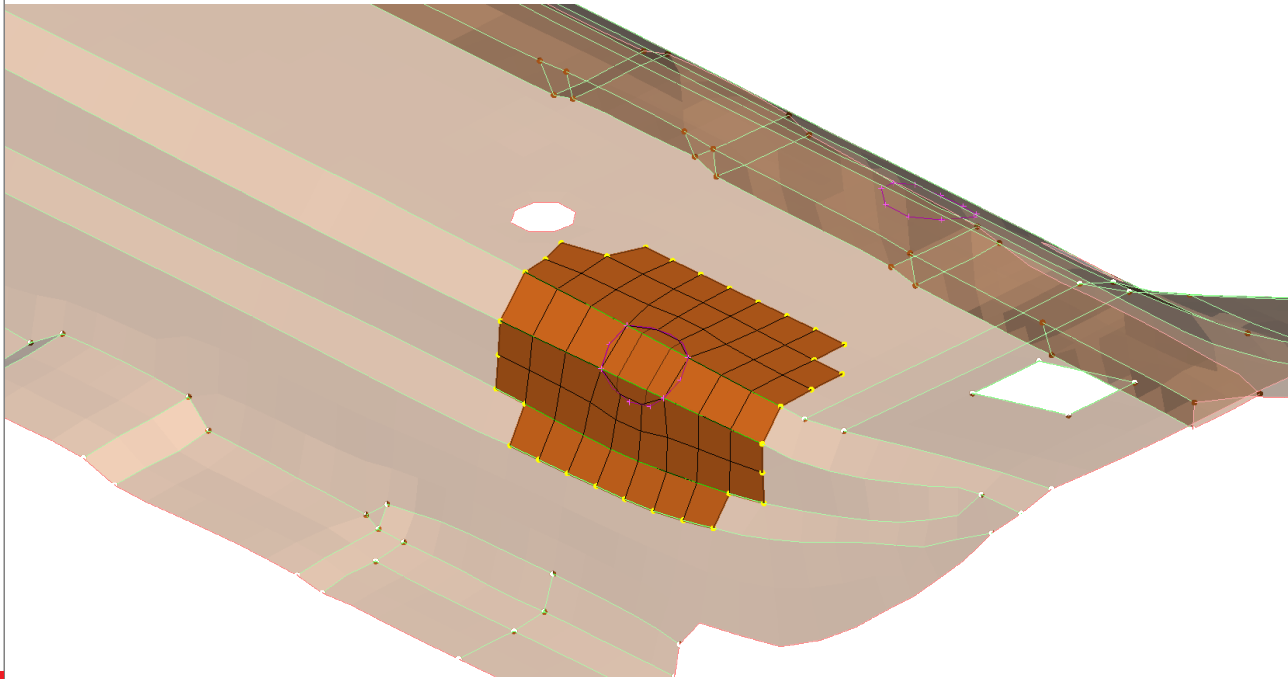
Simulation time reduced
from 12 hrs -> 3 hrs

Set-up

- Sub structuring

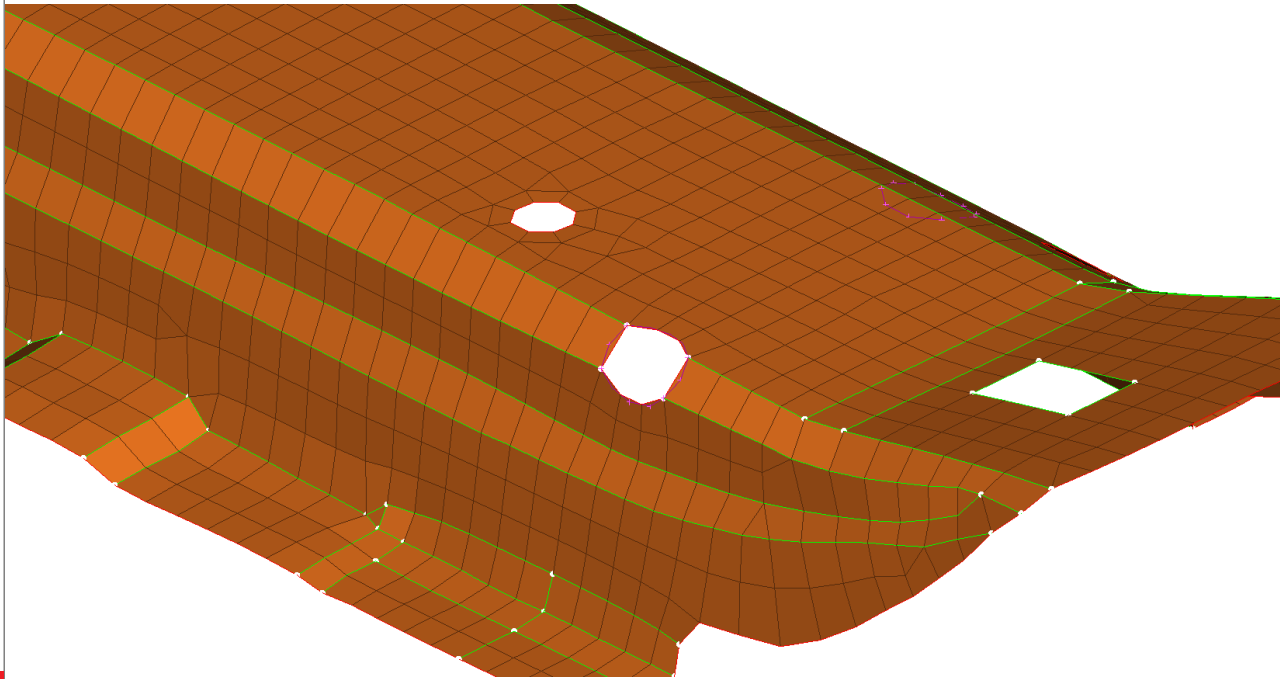
Set-up

- Sub structuring
- Create Openings



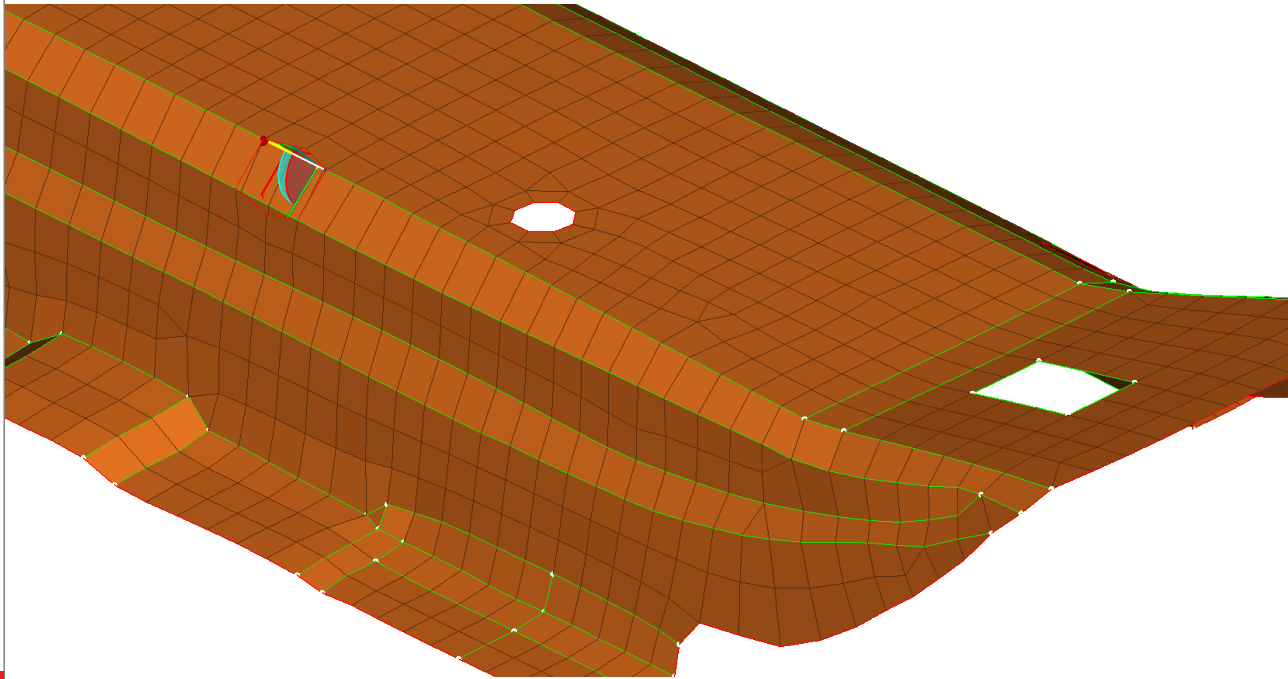
Set-up

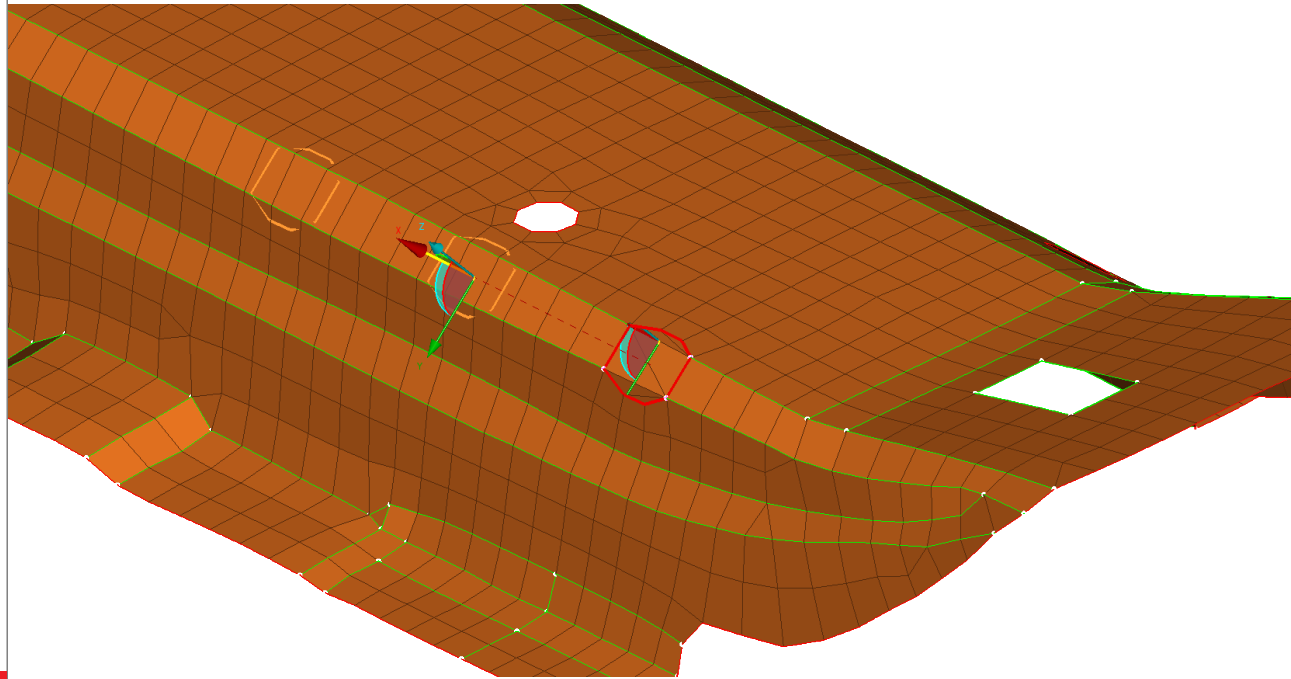
- Sub structuring
- Create Openings



Set-up

- Sub structuring
- Create Openings
- Modify Position

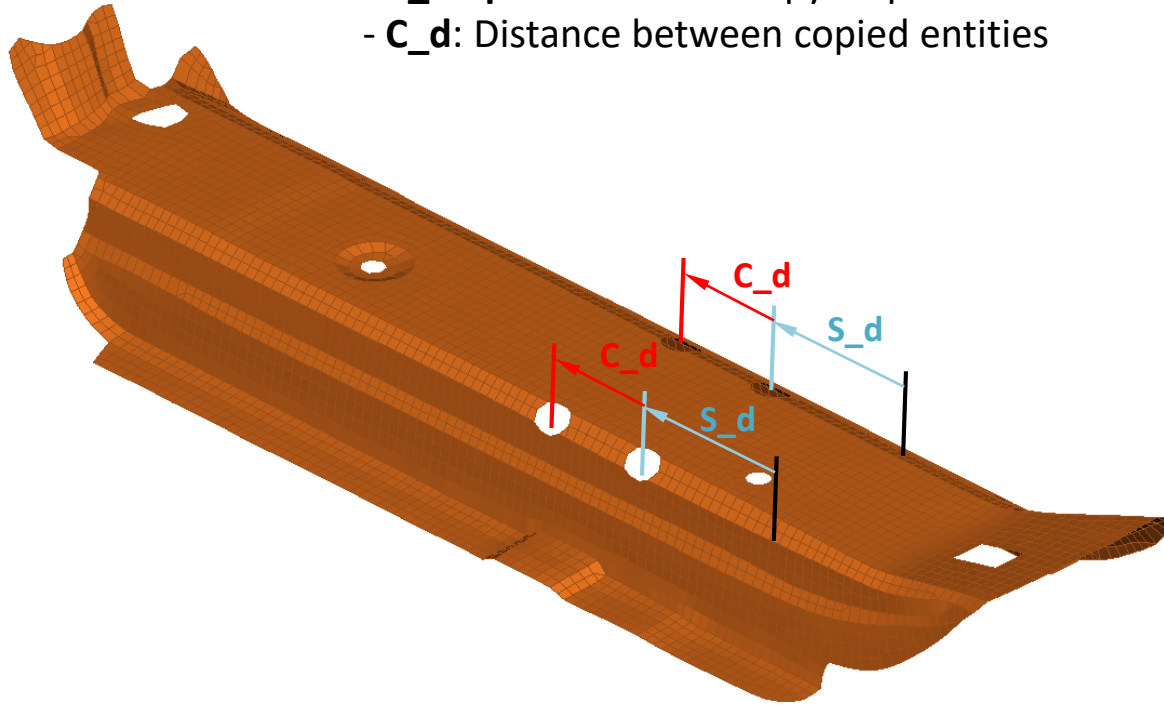




Set-up

- Sub structuring
- Create Openings
- Modify Position
- Generate copies

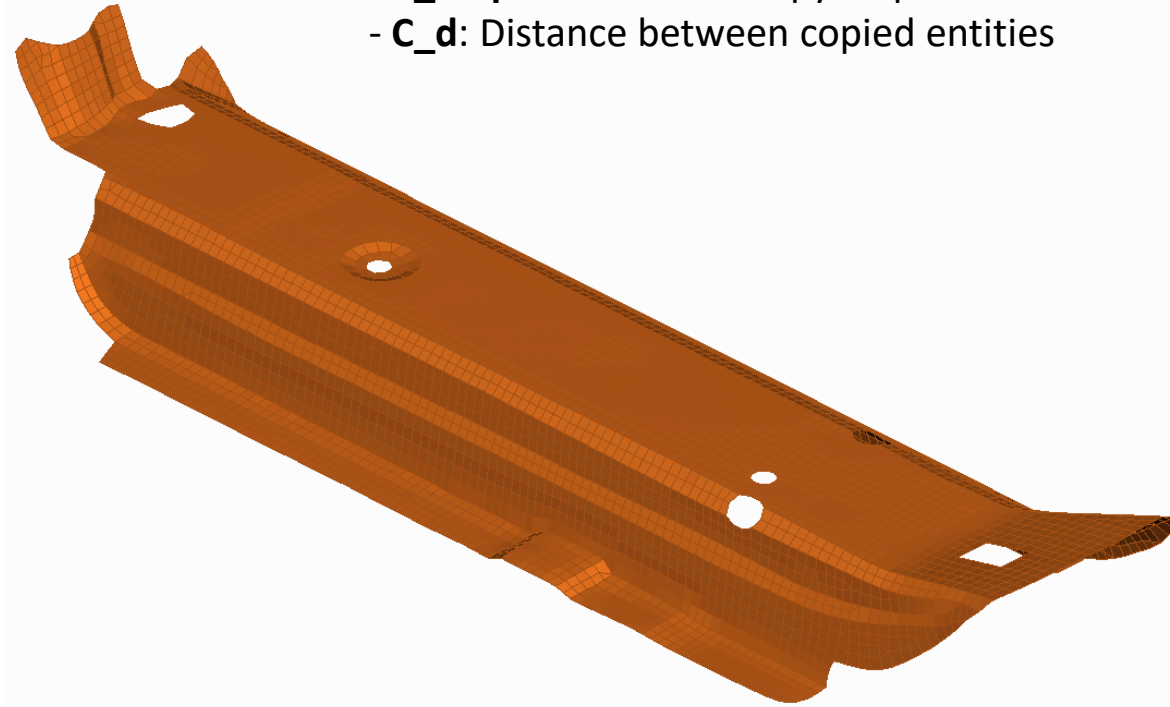
- S_d : Slide distance of the first hole with respect to the outer end of the rail
- C_Steps : Number of copy steps
- C_d : Distance between copied entities



Set-up

- Sub structuring
- Create Openings
- Modify Position
- Generate copies
- Design Variables

- **S_d**: Slide distance of the first hole with respect to the outer end of the rail
- **C_Steps**: Number of copy steps
- **C_d**: Distance between copied entities

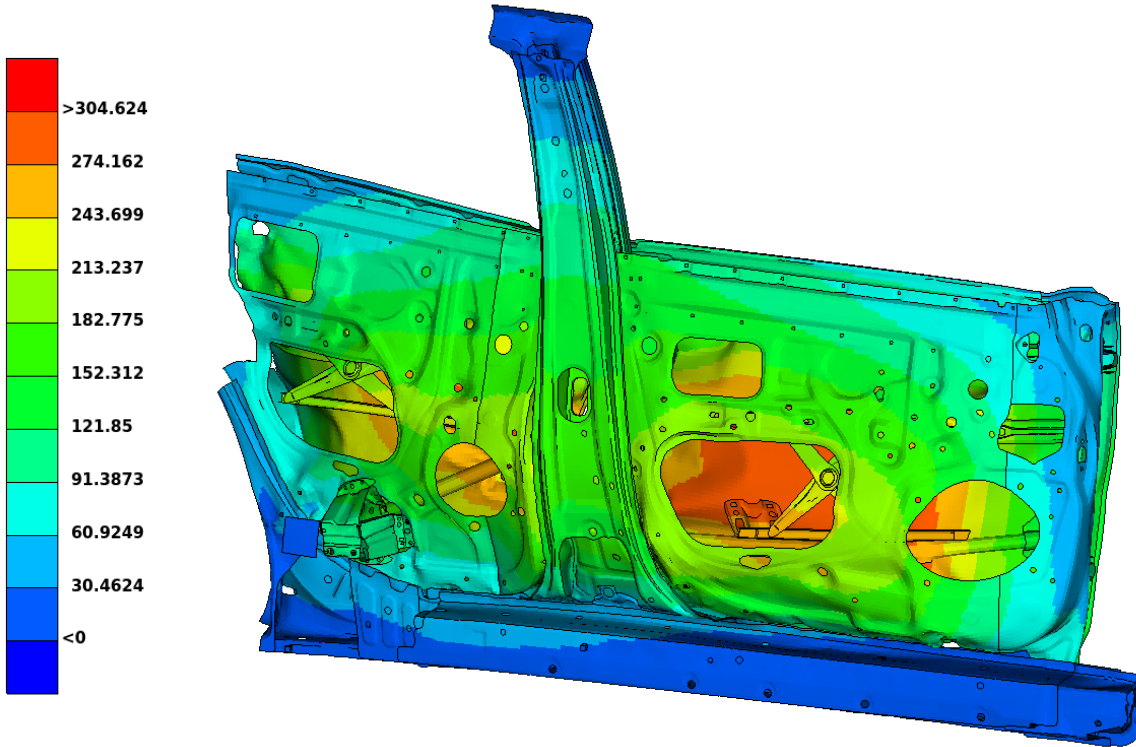


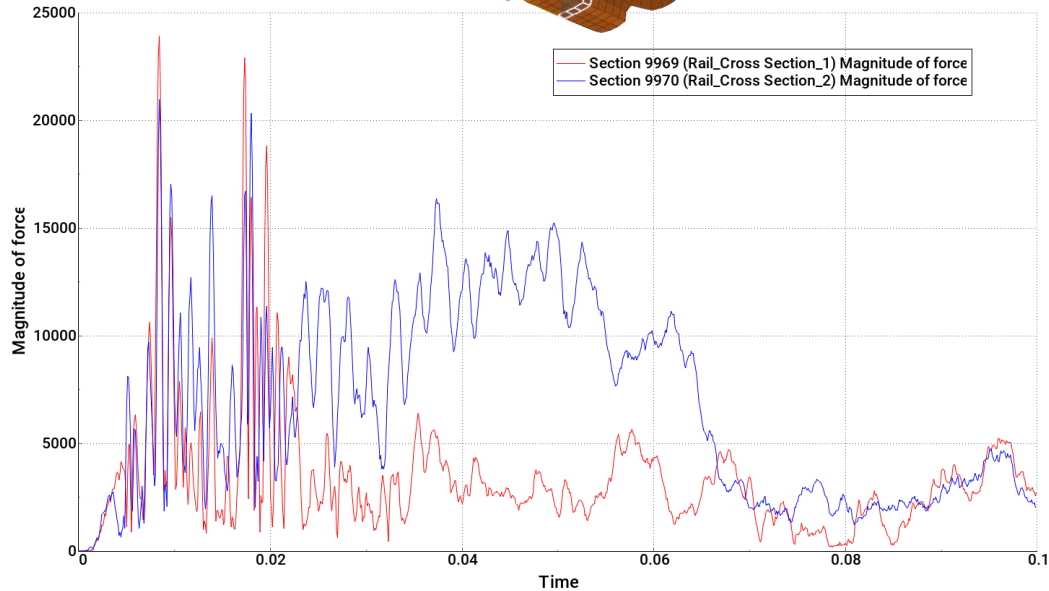
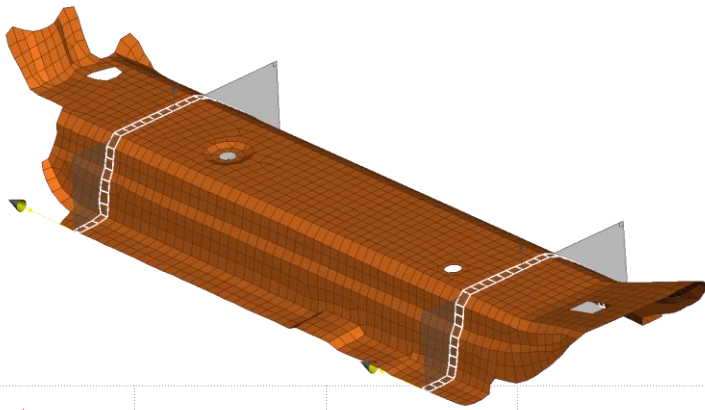
Set-up

- Sub structuring
- Create Openings
- Modify Position
- Generate copies
- Design Variables

Responses and Constraints

a) Side intrusion measured at time step = 55 ms





Responses and Constraints

a) Side intrusion measured at time step = 55 ms

b) Maximum cutting forces at two predefined cross sections

Responses and Constraints

a) Side intrusion measured at time step = 55 ms

b) Maximum cutting forces at two predefined cross sections

c) 30 experiments, input values based on Uniform Latin Hypercube algorithm

The screenshot displays the Optimization Tool interface with the following sections:

- Workflow:** OPTIMIZATION_TASK_1
- Design variables:**

ID	Name	TYPE	RANGE	Current Value	Min Value	Max Value	Step Value	Discrete Values
1	SLIDE	REAL	BOUNDS	36.	36.	358.		
2	COPY_Distance	REAL	BOUNDS	36.	36.	358.		
3	COPY_Steps	INT	LIST	0.	0.	2.		0,1,2
- Responses Ansa & Meta:**

ID	Name	RESULT	ID	Meta response	Value
		No "Responses" task item found!		No "Post-Processing" task item found or no results calculated	
- Constraints:**

Name	Expression	Operator	Lim
Constraint_1	SLIDE + (COPY_Steps + 1)*18 + COPY_Steps*(COPY_Distance-18) - 9	<	358

Additional interface elements include a tree view on the left showing the task structure (Pre-Processing, SLIDE, COPY_Distance, COPY_Steps, Solver, Post-Processing) and a 'Baseline run' button at the bottom.

S_d (mm)	C_d (mm)	C_steps	FMAX (N)		Intrusion (mm)
			Cross_Section_1	Cross_Section_2	
229.2	0	0	23190	36708	303.6113
36	0	0	23047	37307	304.8051
132.6	0	0	23115	37325	305.0854
68.2	0	0	23219	37038	303.739
325.8	0	0	23425	37528	305.222
197	0	0	23229	37922	305.6985
293.6	0	0	23368	37220	304.4949
261.4	0	0	23580	37145	305.2634
164.8	0	0	23188	37256	305.5045
100.4	0	0	23345	36611	305.134
97.33333	97.33333	1	23233	37989	306.1422
82	266	1	23608	37802	304.9146
112.6667	174	1	23270	38991	305.2245
189.3333	36	1	23093	37084	304.2296
51.33333	112.6667	1	23051	36864	305.3419
66.66667	189.3333	1	23387	38428	305.7364
36	296.6667	1	23312	36921	305.7946
128	66.66667	1	23122	36988	304.4564
235.3333	82	1	23340	36805	305.2579
204.6667	128	1	23185	37061	303.6004
158.6667	51.33333	1	23158	36676	304.1765
151	82	2	23411	37477	303.9883
59	45.2	2	23014	37035	303.5841
123.4	77.4	2	23288	37836	306.3053
95.8	36	2	23154	36886	305.127
155.6	95.8	2	23528	37095	303.8123
192.4	72.8	2	23762	37222	304.6375
40.6	109.6	2	23174	37247	304.3216
54.4	132.6	2	23206	37226	304.0098
183.2	54.4	2	23463	38552	305.0328
77.4	91.2	2	23304	38494	305.9359

Outcome

Small influence of all three design variables to all responses.

Calculated differences are:

- intrusion = 2.72 mm (0.88 %)
- Fmax CS1 = 6 %
- Fmax CS2 = 3 %

Investigation outcome

- The investigation proved that the insertion of holes will have no decisive impact to the measured variables

Effort invested

- Total Simulation time ~100 hrs
- Preparation of the experiments took ~3hrs user time:
 1. Sub-structuring (~2hrs), by far the toughest task
 2. Setup feature related parameters
 3. Setup optimization task

Remarks:

- Setup proved accessible to the non-experienced user
- Opt-scenario can be easily extended/adjusted
- Overall, very limited user time involved

Conclusions & Remarks



BETA^B
SIMULATION SOLUTIONS

Stay connected

www.beta-cae.com





Stay connected