

4th European HTC
Versailles October 27th – 29th, 2010



*CAE Methods in the Development Process
of GRIMME Root Crop Harvesters*

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Abstract

GRIMME decided to work with the Hyper Works products to ensure competitive advantages in the field of potato and sugar beet technology. Based on an example of a self propelled sugar-beet harvester should a size optimization with "Optistruct" show the opportunities to reduce weight of the structure.



Welcome to GRIMME



*Simulation and Instrumentation
Department*



*Size Optimization of a
root crop harvester*

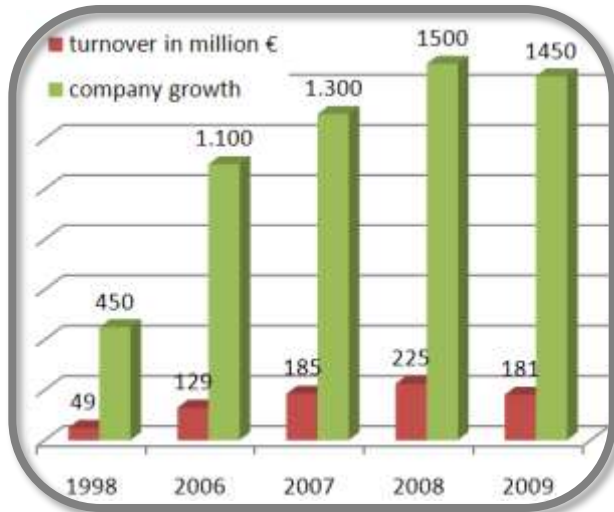
- *FE-model*
- *Optimization*
- *Results*
- *Next Steps*

Welcome to Grimme

Foundation in 1861

Damme (Germany, Lower Saxony)

Employee: 1450 (2009)



Grimme Group

Grimme Landmaschinenfabrik GmbH & Co. KG

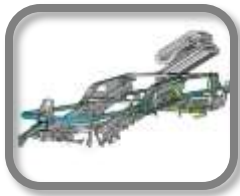
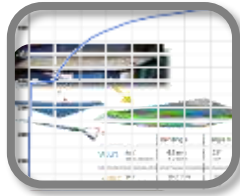
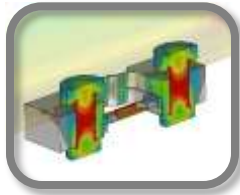
Spudnik Equipment Company LLC

Ricon GmbH Vertriebsgesellschaft

Grimme Solutions

Internorm Kunststofftechnik GmbH & Co.KG

Simulation and Instrumentation Department



start-up: 2006

FEM

2 application engineers for FEM
1 design draftsman for meshing only
6300 GWUs
1 ANSYS Structural License

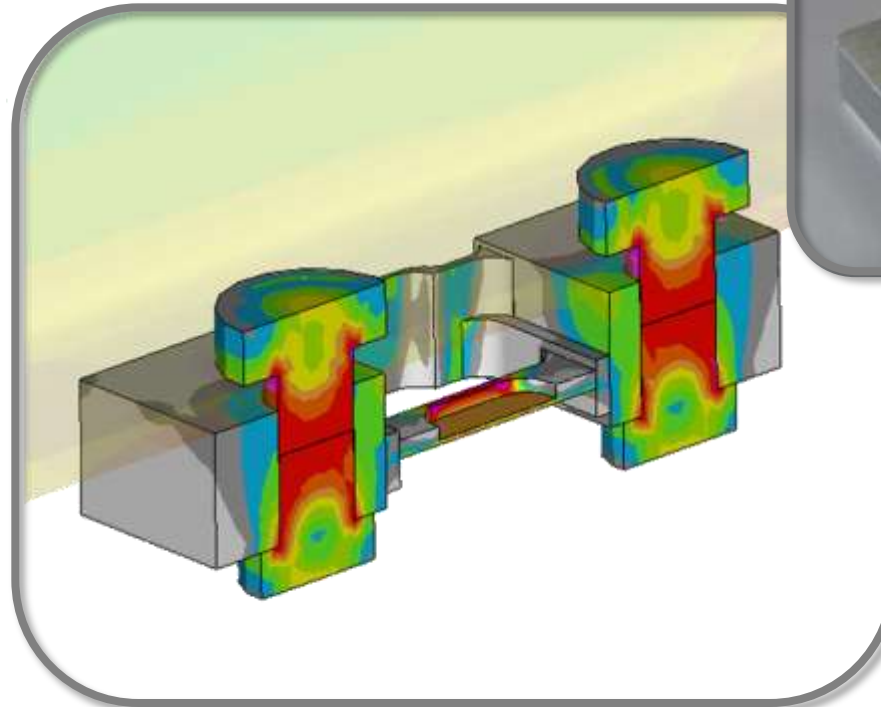
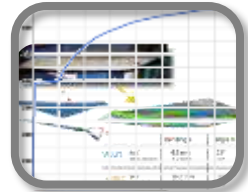
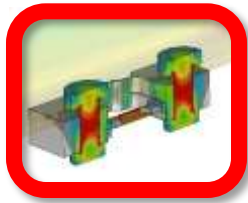
MBS

2 application engineers
2 SIMPACK Licenses

Instrumentation

2 technicians in
measurement technology

Finite Element Method



Contacts and bolt pretension
(Strain gauge application)

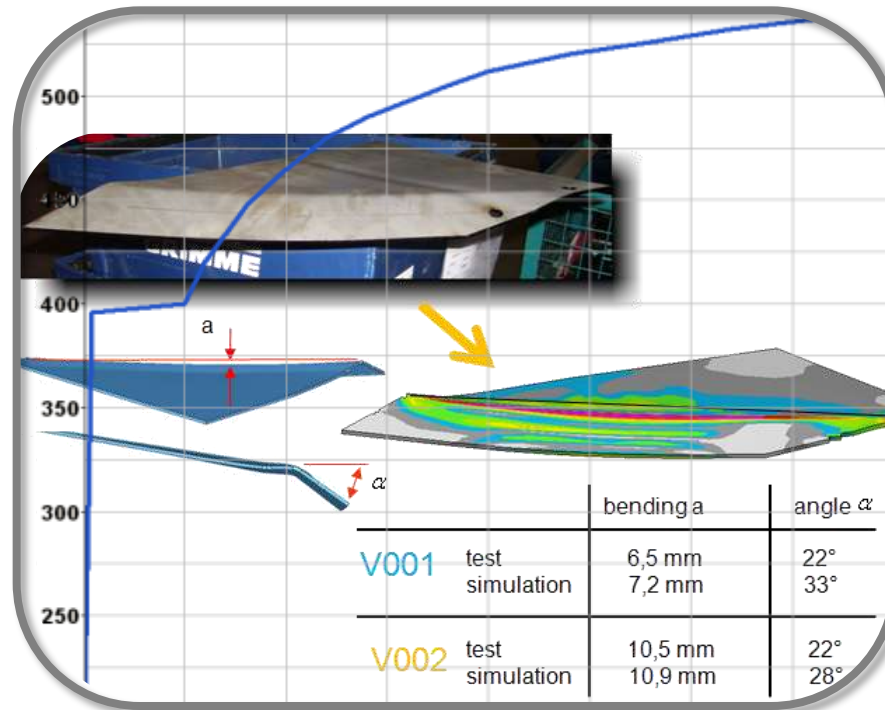
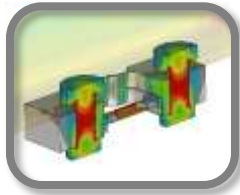


ANSYS User Profile

Contact Manager
was improved in
HM10.0

Complete handling
of FE-Model by
UNSU_PREP7 and
UNSU_END Control
Cards is possible

Finite Element Method



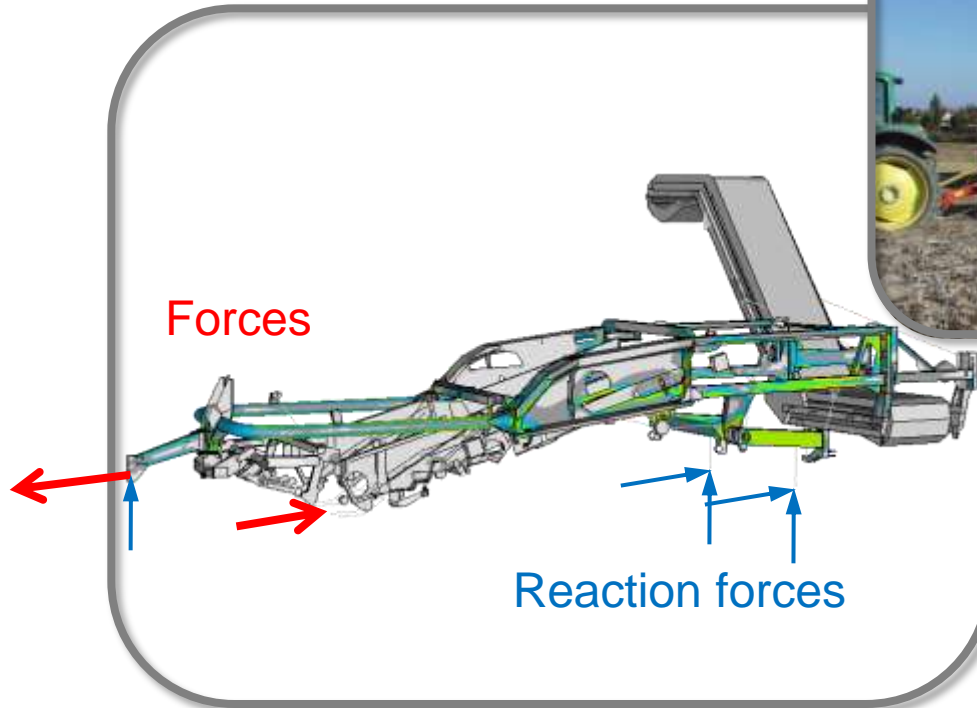
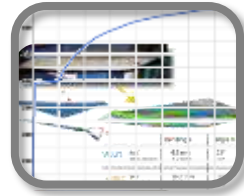
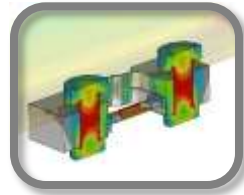
Calculation of required press capacity

Review elastic recovery

Helpfull in finding loads that must have been acted

Plastic strain with multilinear material law
(*Bending and creasing in two directions*)

Finite Element Method

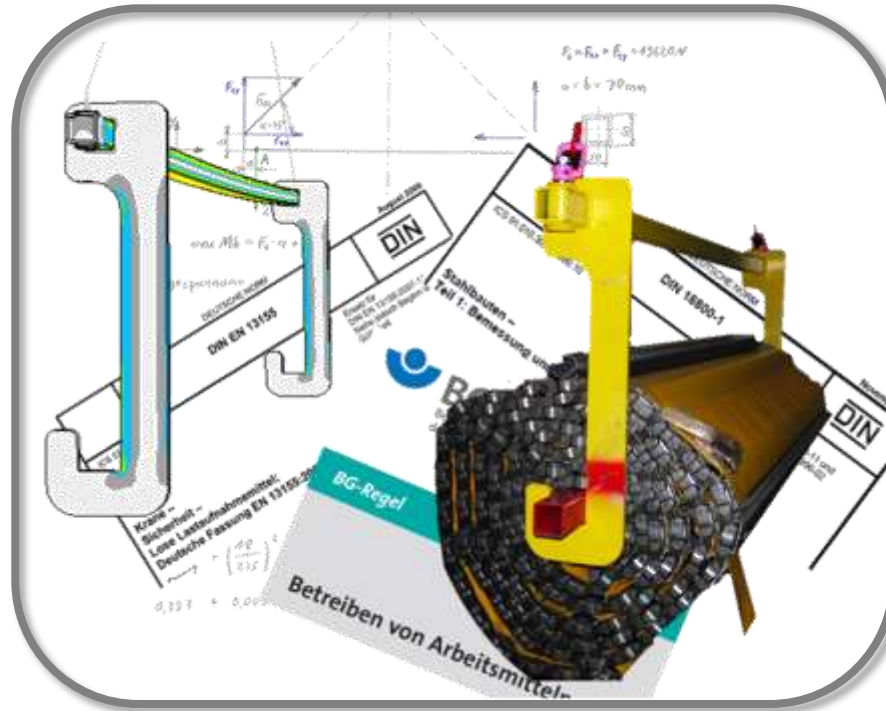
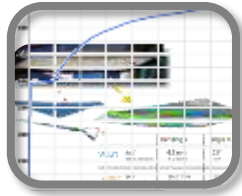
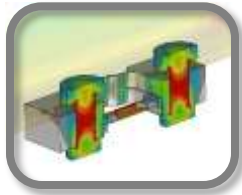


Global stress distribution (linear)

Large models can be managed clearly

Linear analysis of overall structures

Finite Element Method



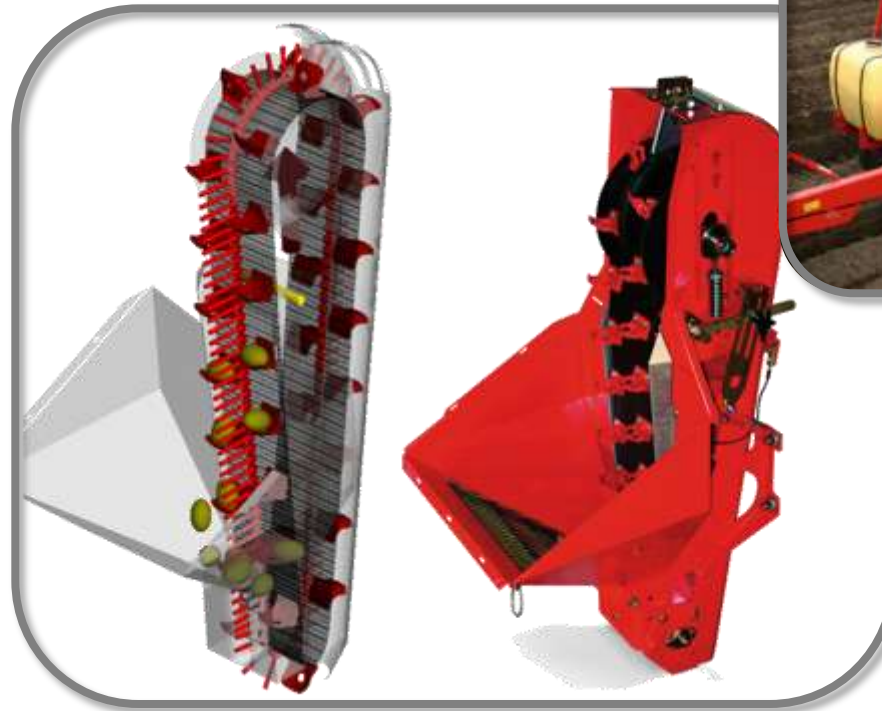
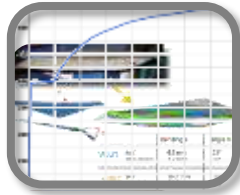
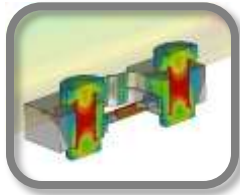
Construction according to applicable regulations

Calculation of section forces

Assure by hand calculations

Non-fixed load lifting attachments

Finite Element Method



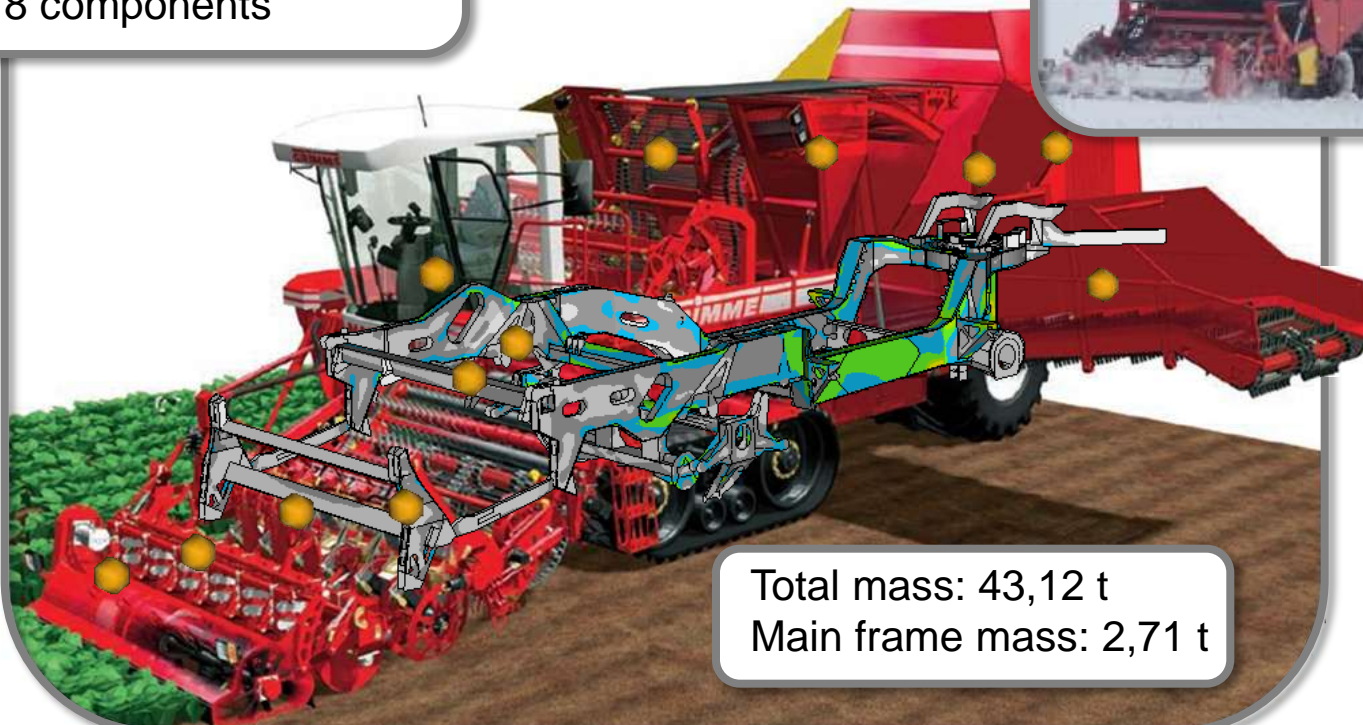
Meshes for MBS (SIMPACK)
*(Surfaces meshed with trias
are used in SIMPACK)*

To illustrate
geometry with low
memory
requirements

To analyze contact
situations with the
„polygonal contact
model“

Problem Definition

FE – Model Maxtron 620
44500 nodes
40392 shell elements
218 components



Total mass: 43,12 t
Main frame mass: 2,71 t

Loadcases

Different static loadcases where chosen.
For example:

- vertical acceleration $1.5 \times 9.81 \text{ m/s}^2$
- torsion to the left and to the right side
- horizontal deceleration of 3 m/s^2
- propelling forces
- forces from hydraulic cylinders

to ensure accuracy of the expected loads :

To take measurements:

- *Strain gauges*
- *Pressures and moments*
- *Velocities and accelerations*

Discussions with construction engineers:

- *Cracks in the past?*
- *FE-results of the individual loadcases plausible?*

From ANSYS to Optistruct

Converter:

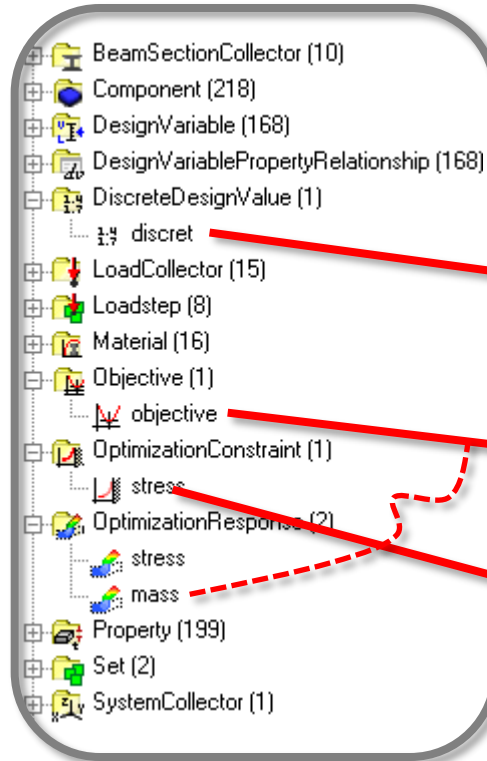
Ansys to Optistruct Convert...

Auto Property creation

Comp Name	Comp Id	Prop on Comp	Prop Id
30_0800_SCI	1	PSHELL	1
30_1000_ANI	2	PSHELL	2

Necessary for creating design variables

All but 1D Elements



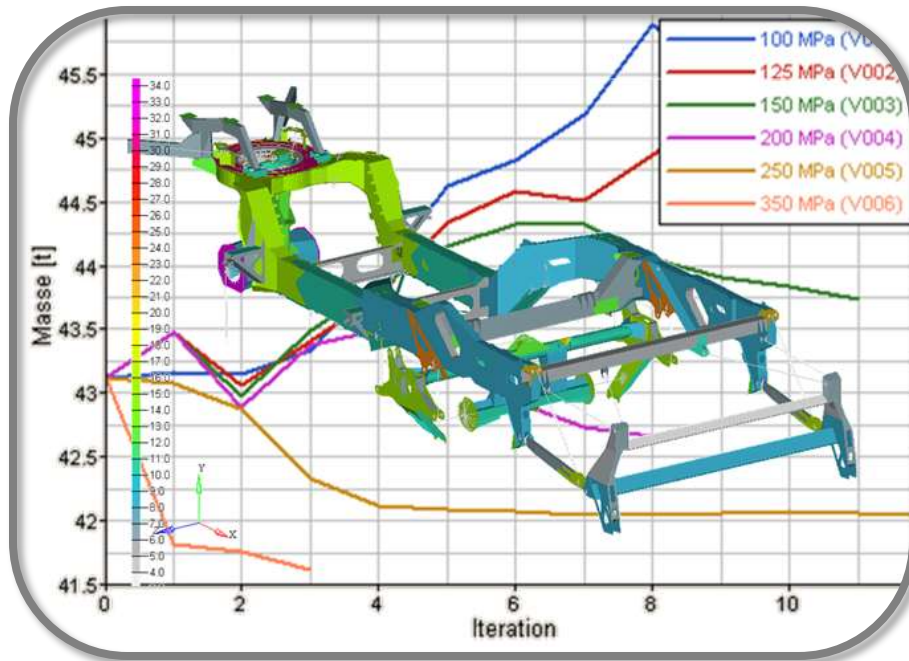
Thicknesses from 2mm to 35mm by increment 1

Minimize mass

Upper bound (von mises stress)

Results

Complex post-processing in co-operation with the construction engineers
 Every Component, every critical area has to be considered.



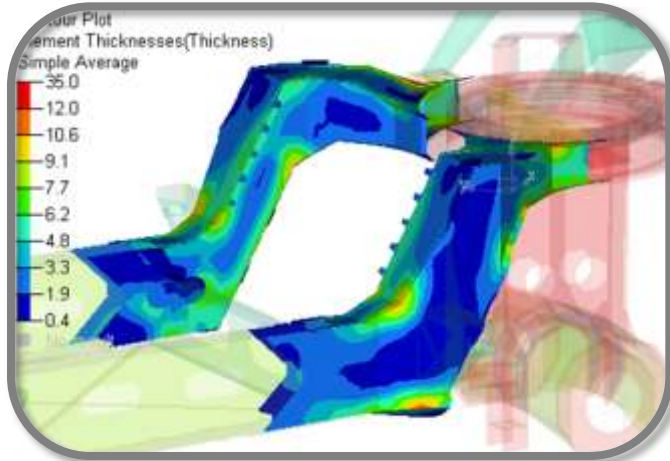
Property Name	Wands Gewicht		Änder [%]	Wands Gewicht		Gewicht ersparnis
	vorher	vorher [kg]		nachher	nachher	
1 030_0800_SCHRAEGBLECH-LINKS_1	8,0	35,486	-37,5	5,0	22,179	13,307
2 030_1000_ANSCHRAUBPLATTE_1	10,0	8,920	-30,0	7,0	6,244	2,676
3 030_0600_SEITENPLATTE_1	6,0	9,203	16,7	7,0	10,740	-1,537
4 030_0600_SEITENPLATTE_2	6,0	16,584	-16,7	5,0	13,814	2,770
5 030_0500_HALTER_1	5,0	1,581	0,0	5,0	1,581	0,000
6 030_1200_LASCHE_1	12,0	2,909	0,0	12,0	2,909	0,000
7 030_0800_GECKBLECH-VORNE_2	8,0	3,184	0,0	8,0	3,184	0,000
8 030_0800_KONSOLE-LINKS-VORNE	6,0	20,574	-33,3	4,0	13,723	6,851
9 030_0800_FUSS-HINTEN-LINKS_1	8,0	3,834	0,0	8,0	3,834	0,000
10 030_0800_AUFLAGE-RECHTS_1	8,0	2,556	0,0	8,0	2,556	0,000
11 030_0500_VERSTAERKUNG-RECHTS	5,0	2,601	0,0	5,0	2,601	0,000
12 030_0500_VERSTAERKUNG-RECHTS	5,0	2,601	0,0	5,0	2,601	0,000
13 030_0800_OBERGURT-VORNE-RECHT	8,0	16,364	25,0	10,0	20,455	-4,091
14 030_0800_VORDERWAGEN-AUSSEN	8,0	74,410	-50,0	4,0	37,205	37,205
15 030_0800_UNTERBAND-VORNE-RECHT	8,0	8,750	-12,5	7,0	7,656	1,094
16 030_0800_VORDERWAGEN-INNEN-F	8,0	43,047	-37,5	5,0	26,904	16,143

The thicknesses of 50 components have been reduced at the end.

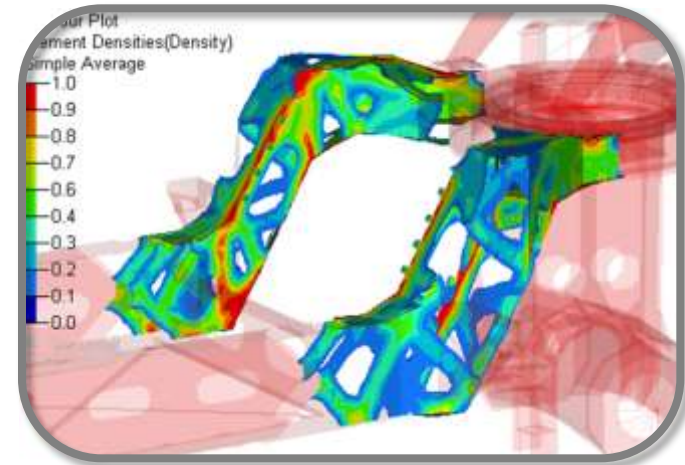
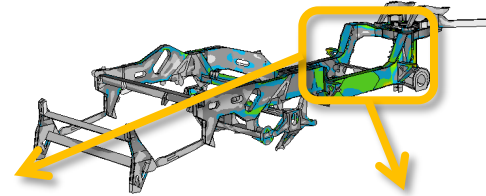
The mass of the main frame structure could be reduced to 2.3t. This means an improvement of 16 %.

Next Steps

Additional optimization methods:



Free Size Optimization



Topology Optimization

Apply this procedure to other Grimme products



Questions?

Thank you for your attention!