

# FEMFAT Workshop Tips & Tricks

Dominik Hofmann  
FEMFAT Support & Sales

June 21

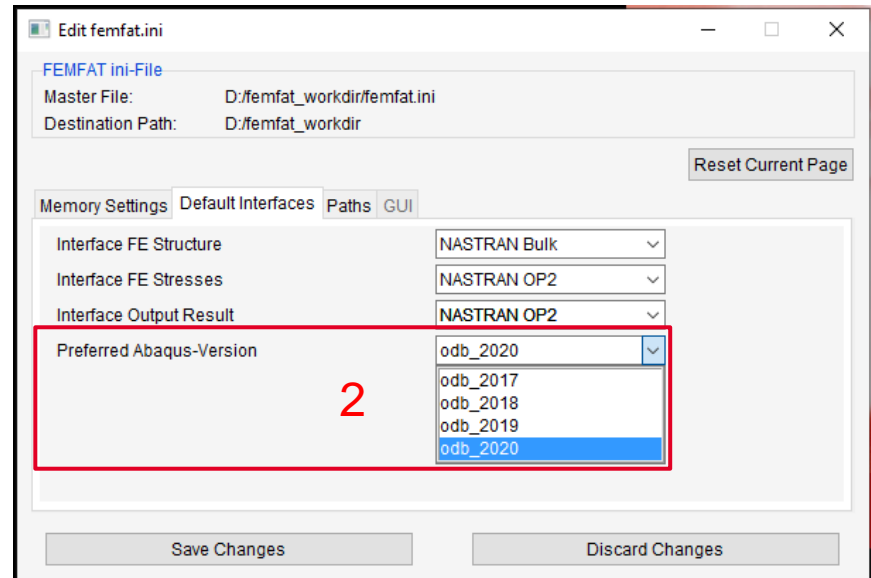
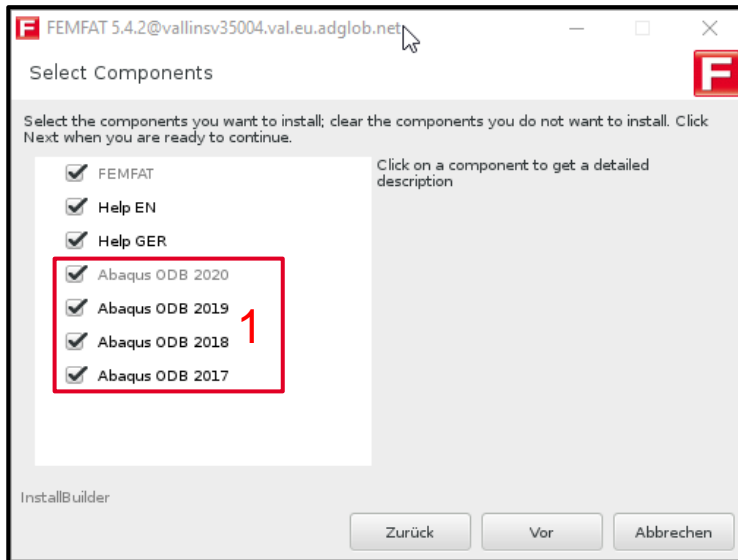
- FEMFAT
  - Handling
    - Automatic odb selection
    - Batch Job Flexibility
    - Group generation on the base of min/max values
    - Filter for groups
    - Result Manager
  - Information Output:
    - Stress selection output in protocol file
      - WELD root/toe export
    - Output SPOT detailed results
  - Visibility
    - Haigh Diagram Update with cycle numbers
    - Load Spectra for „Detailed Results“ Group
    - Rainflow Matrix Viewer

# Optimization of the workflow in FEMFAT

## FEMFAT HANDLING

# FEMFAT handling: Support of Multiple ABAQUS odb-Versions

- FEMFAT recognizes automatically the version of an ABAQUS odb-File
  - No time-consuming upgrade of the odb-file is necessary, if the version is installed
1. During the installation process the needed ABAQUS versions can be selected
  2. At FEMFAT start preferred version can be selected in the drop-down box



- `.../bin/femfat -job=meinJob.ffj -dsp=autoxvfb`
- `.../bin/femfat -job meinJob.ffj -dsp autoxvfb`
- `.../bin/femfat -job meinJob.ffj -dsp=autoxvfb`
- `.../bin/femfat -job=meinJob.ffj -dsp autoxvfb`

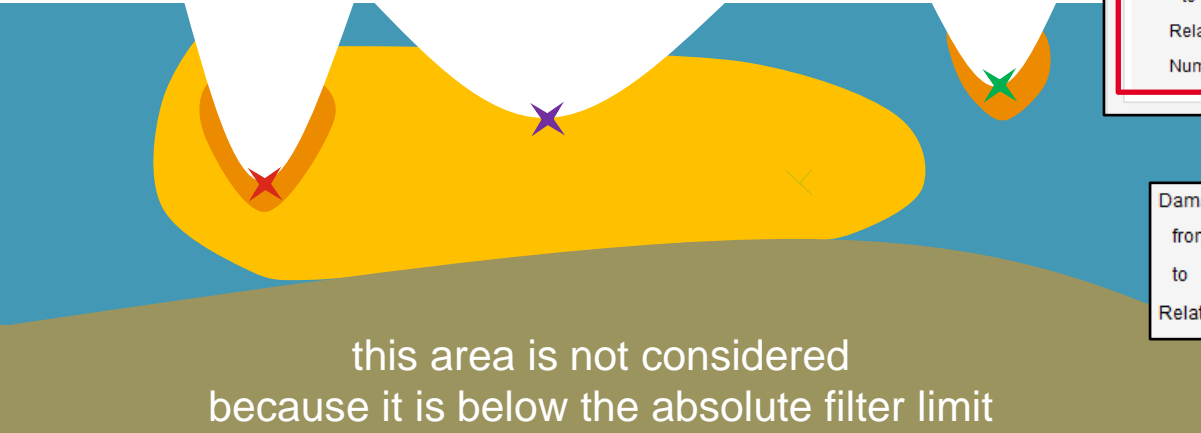
- **Batch Job Flexibility**

Different writing possibilities can be used to create a batch file and start several FEMFAT jobs.

# FEMFAT handling: Create a group based on Local Max/Min Values of Damage/Safety (for Base Material)



**INPUTS:**  
Absolute filter limit  
Relative filter limit for critical area: e.g. 50% of local extrema  
Number of required extrema: e.g. 10



Create/Modify Group Entries

Nodes Nodes Based on... Elements

Based on Damage Values / Safety Factors  
from 0.000e+00 to 0.000e+00  
 only most critical node per SPOT nugget

Based on Isothermal Nodal Temperature [°C]  
from 20.00 to 20.00

Based on Local Critical Areas

Damage / Safety Factor  
from Minimum  
to Maximum

Relative limit for size of local area 50.0000 [%]  
Number of relative extrema 10

Damage / Safety Factor

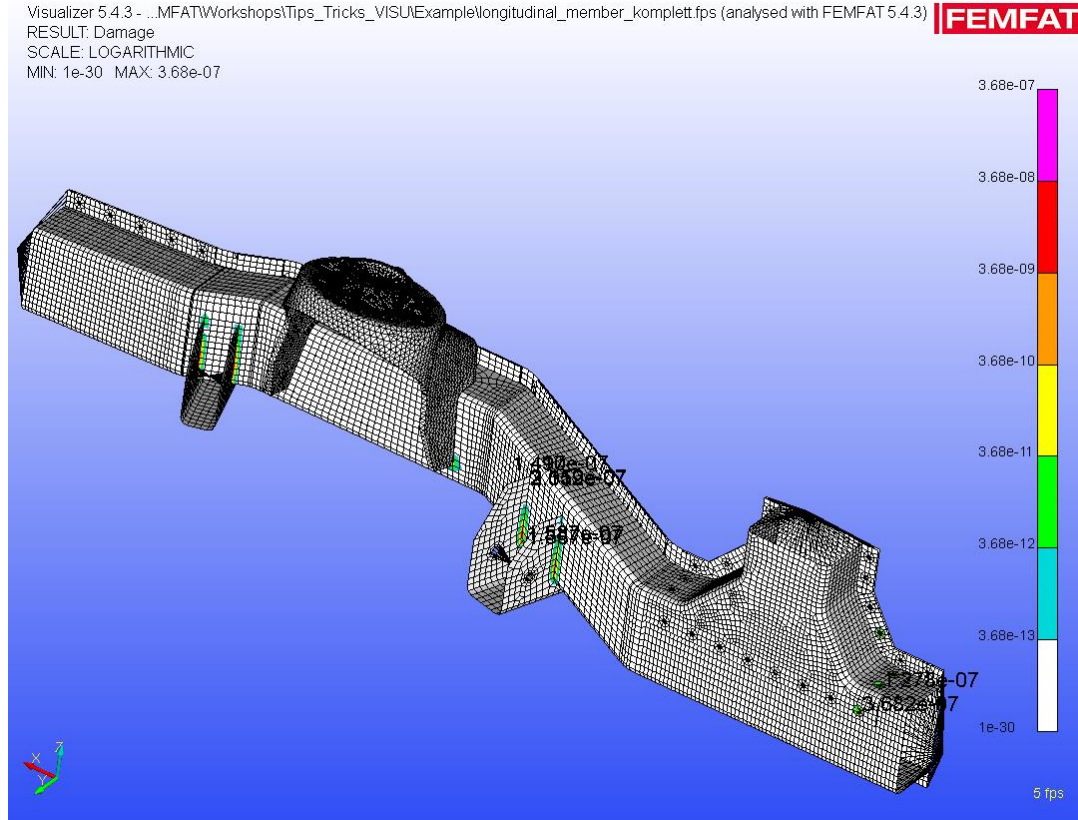
from Value 0.0000

to Minimum

Relative Factor / Divisor of critical result 50.0000

# FEMFAT handling: Display Nodes of Local Critical Areas in VISUALIZER

10 most damaged areas...





# FEMFAT handling: Output Table of Nodes with Local Critical Areas in the Report File (\*.pro)

**Report Items**

General Input Data

- Header
- General Input Data
- Specimen Material Data
- Influence Factors

Structural Node Data

Damage Data/Safety Factors:  Top  Bottom

Max. Damage Component:  Top  Bottom

Stress Gradient:  Top  Bottom

Mean Stress Rearrangement:  Top  Bottom

- Surface Roughness
- Technological Size
- Tempering Condition
- Temperature
- Range of Dispersion (10% to 90%)

WELD Specific Output

- Local Direction Specific Information
- Notch Factor Specific Information

SPOT Specific Output

- Critical Results for All Sheets

Local Extrema in Areas

- Based on Local Critical Areas:

Damage / Safety Factor

from:

to:

Relative limit for size of local area:  [%]

Number of relative extrema:

The entries are analogous to the group menu and are treated the same internally. However, all variables are decoupled and independent of the entries in the group menu.

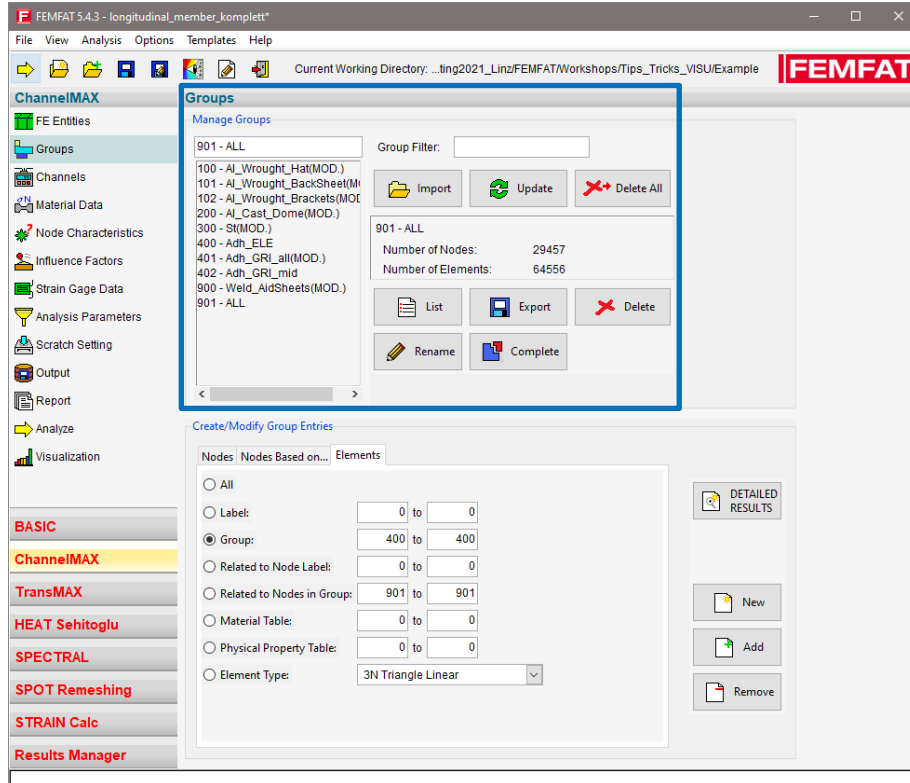
Critical Locations:

Location	NodeLab	Damage	Result Pos.	Rel.Str.	Grad Stress	Ampl.	Mean Stress	LocFatigLim
1	28900	3.012e-07	top / surf	0.7991	14.6742	-0.4386	16.7477	
2	26555	1.490e-07	top / surf	0.9568	14.1787	-0.4212	18.0631	
3	28879	8.278e-08	top / surf	0.8604	12.9091	-1.7163	17.7825	
4	26177	4.313e-08	top / surf	0.6986	10.4038	0.0527	15.7199	
5	26499	3.936e-08	top / surf	0.4406	9.3050	-0.9626	13.9098	
6	27956	1.856e-08	top / surf	0.8709	9.9829	-0.3220	17.3014	
7	26174	1.402e-09	top / surf	0.5363	5.5343	0.3690	14.2652	
8	29320	4.472e-10	top / surf	0.5843	4.8101	0.0000	14.7911	
9	10306	1.455e-13	top / surf	0.6939	35.2048	0.0000	87.1839	
10	6900	5.628e-14	bot / trans	0.5423	42.3054	-1.3647	100.2624	

End - Critical Locations



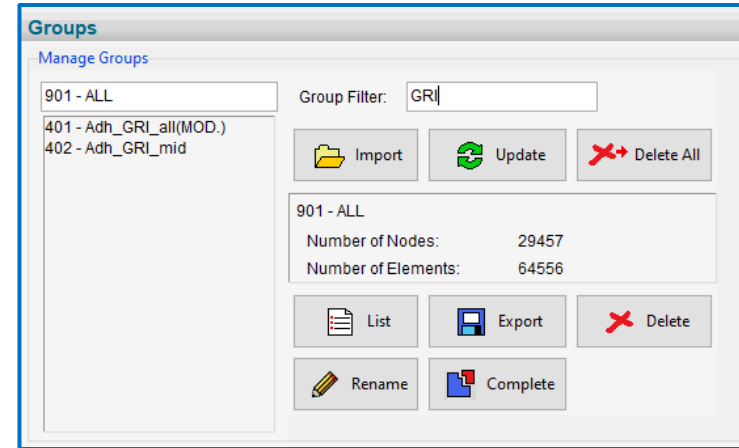
# FEMFAT handling: find the right Group with the new Filter



- Group Filter

Filter group entries by string (case insensitive, incl. wildcards) or use <REGULAR EXPRESSION> syntax, examples:

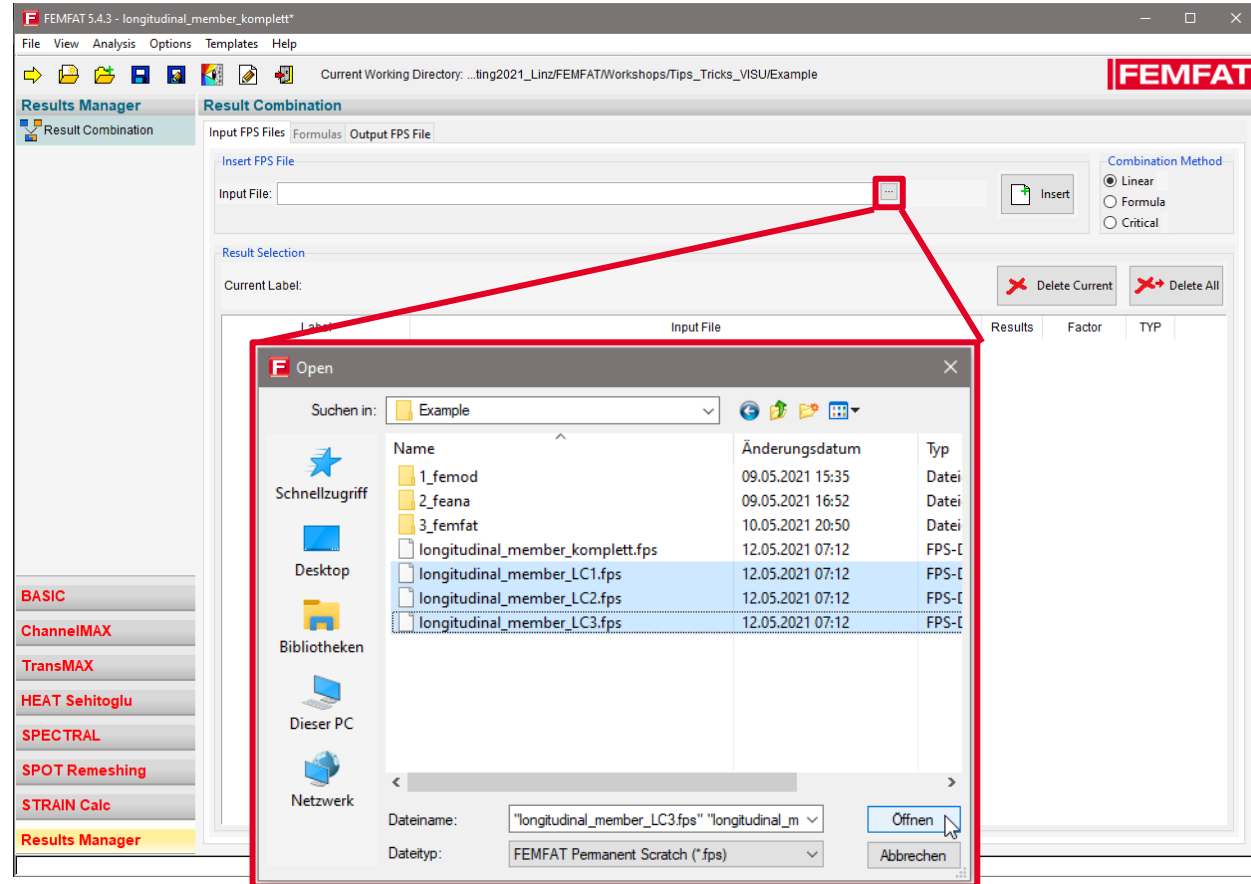
^2	starts with	2
r\$	ends with	r
9[12]	matches	91 or 92



Works in all areas where  
groups can be selected

# FEMFAT handling: multiple file import in the Result Manager

- Select more than one fps-file in the selection dialog



# FEMFAT handling: upgraded Result Manager „Formula“ combination method

- Results Manager: Enhanced ‘Formula’ Combination Method
  - The user can control the determination of the critical assessment point (e.g. at welding seams: weld toe, weld root, top or bottom, etc.).
  - Useful functionality for WELD sensitivity analysis.

## Result Combination

Input FPS Files Formulas Output FPS File

### Formula Definition

Name	Formula	Critical Result	Critical Position from
User def 1	[File_1:Damage_M]mod]*3	Max	Formula Output Result
User def 2	[File_2:Stress_Ampl.]	Max	Formula Output Result
User def 3		Max	Formula Output Result
User def 4		Max	Formula Output Result
User def 5		Max	Formula Output Result
User def 6		Max	Formula Output Result
User def 7		Max	Formula Output Result

Templates Help

- Elastomere\_Analysis\_Settings
- GL\_2010
- WELD\_Sensitivity\_Damage\_all
- WELD\_Sensitivity\_Damage\_gap
- WELD\_Sensitivity\_Damage\_inclination\_angle
- WELD\_Sensitivity\_Damage\_penetration\_degree
- WELD\_Sensitivity\_Damage\_seam\_thickness

Formula Output Result

- Formula Output Result
- All Input Files
- All Files in Formula
- File\_1
- File\_2
- Formula Output Result

**Formula Output Result:** The critical layer will be determined from the formula result after combination.

**All Input Files:** The critical layer will be determined from the most critical result of all input files before combination.

**All Files in Formula:** The critical layer will be determined from the most critical result of all files used in the formula before combination.

**Selected File:** The critical layer will be determined from the most critical result of the selected file before combination.

# FEMFAT information output: stress selection output in report file \*.pro



## ----- F E M F A T   A N A L Y S I S   P R O T O C O L -----

Program : FEMFAT  
Version : 5.4.3  
Date : Mon May 10 21:23:23 2021  
Analysis Content : Fatigue Analysis on FE-Structures  
Notice : Multiaxial loading  
(ChannelMAX - channel based Multi-AXiality)  
Comment :

## General Input Data of Current Analysis -----

FE-Input File  
...inz/FEMFAT/Workshops/Tips\_Tricks\_VISU/Example/1\_femod/longitudinal\_member.nas

Label of analysed group ..... 901  
ALL

Channel Definition (MAX Input File)  
User defined

Number of channels ..... 12  
Number of samples ..... 41  
Number of rainflow-classes ..... 64  
Channel 1: Load-factor ..... 1.0000E+00  
Channel 2: Load-factor ..... 1.0000E+00  
Channel 3: Load-factor ..... 1.0000E+00  
Channel 4: Load-factor ..... 1.0000E+00  
Channel 5: Load-factor ..... 1.0000E+00  
Channel 6: Load-factor ..... 1.0000E+00  
Channel 7: Load-factor ..... 1.0000E+00  
Channel 8: Load-factor ..... 1.0000E+00  
Channel 9: Load-factor ..... 1.0000E+00  
Channel 10: Load-factor ..... 1.0000E+00  
Channel 11: Load-factor ..... 1.0000E+00  
Channel 12: Load-factor ..... 1.0000E+00

Stress Selection: Automatic  
Grey Cast Irons, Epoxy Adhesives, Elastomers (NR):  
Normal Stress in Critical Plane  
Other materials : Scaled Normal Stress in Critical Plane

Specimen Material Data  
=====

- Stress selection output in protocol file

Stress Selection: Automatic

Grey Cast Irons, Epoxy Adhesives, Elastomers (NR):

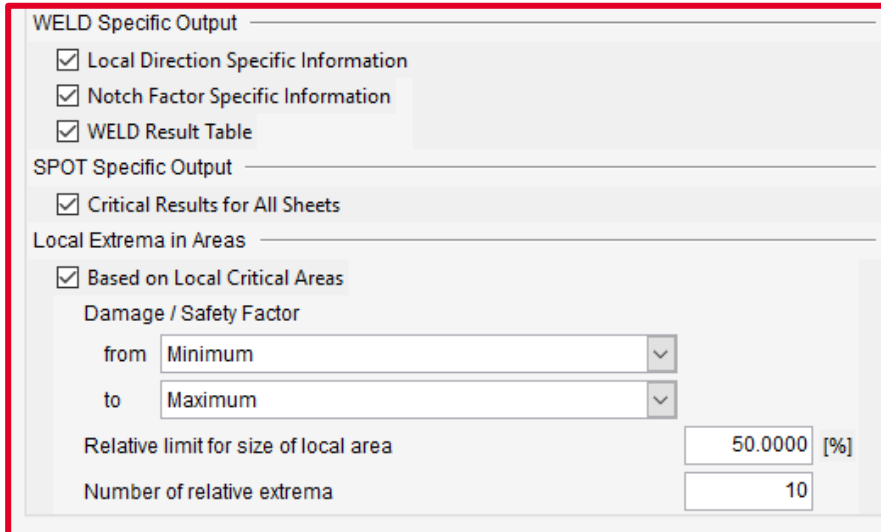
Normal Stress in Critical Plane

Other materials : Scaled Normal Stress in Critical Plane

Specimen Material Data  
=====

# FEMFAT information output: activation of WELD result table, SPOT critical results and local critical areas

- Go to the „Report“ section to get the maximum information output for your
  - WELD and SPOT Specific Output
  - Local Extreme Areas



WELD Specific Output

- Local Direction Specific Information
- Notch Factor Specific Information
- WELD Result Table

SPOT Specific Output

- Critical Results for All Sheets

Local Extrema in Areas

- Based on Local Critical Areas

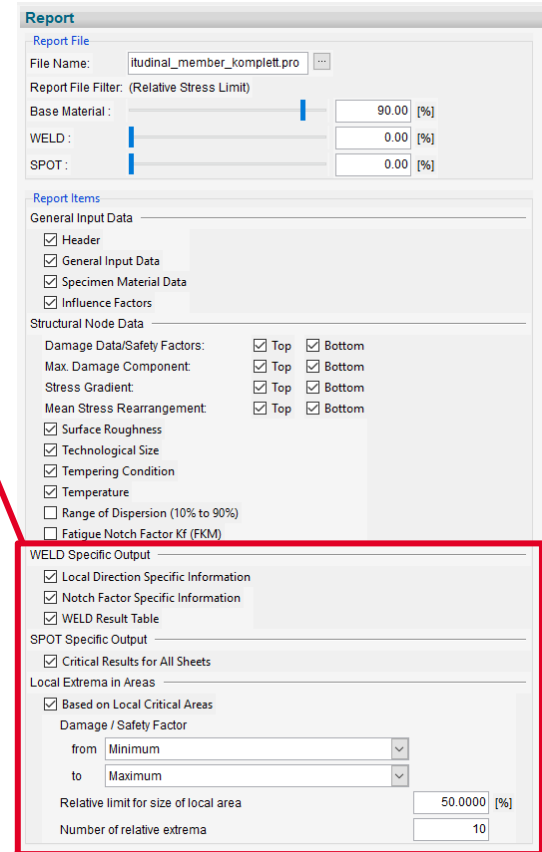
Damage / Safety Factor

from

to

Relative limit for size of local area

Number of relative extrema



Report

Report File

File Name:

Report File Filter: (Relative Stress Limit)

Base Material:

WELD:

SPOT:

Report Items

General Input Data

- Header
- General Input Data
- Specimen Material Data
- Influence Factors

Structural Node Data

Damage Data/Safety Factors:  Top  Bottom

Max. Damage Component:  Top  Bottom

Stress Gradient:  Top  Bottom

Mean Stress Rearrangement:  Top  Bottom

- Surface Roughness
- Technological Size
- Tempering Condition
- Temperature
- Range of Dispersion (10% to 90%)
- Fatigue Notch Factor Kf (FKM)

WELD Specific Output

- Local Direction Specific Information
- Notch Factor Specific Information
- WELD Result Table

SPOT Specific Output

- Critical Results for All Sheets

Local Extrema in Areas

- Based on Local Critical Areas

Damage / Safety Factor

from

to

Relative limit for size of local area

Number of relative extrema

# FEMFAT information output: WELD root/toe output in report file \*.pro

- Stress selection output in protocol file
  - WELD root/toe output for detailed information for the analysed WELD seams
  - Can be found on the end of the file

Visualizer 5.4.3 - L:\FEMFAT\_21\_Usermeetings\_Konferenzen\_ALLERin\_Bearbeitung\Usermeeting2021\_Lin2\FEMFAT\Workshops\_Tips\_Tricks\_VISU\Example\longitudinal\_member\_komplett.fps (analysed with FEMFAT 5.4.3)

File View Options Tools Welding Help

Result Selector

Category: FEMFAT Results

Main Results

- Damage M/mod
  - 1/Damage
  - Rel.Str.Grad
  - Log10 Damage
  - Log10 1/Dam.
  - 6th Root Dam
- Stress
  - Stress Ampl.
  - Mean Stress
  - Str. Ratio R
  - atan(Sm/Sa)
  - LocFatigLim
- General Influence Factor:
  - IF FL Rough.
  - IF FL T.Size

Show Results

- Base material
- WELD seams (Shell)
- SPOT joints
- LAMINATE

Result Position

Shell/Boundary Layer

Critical

Weld Results

- Critical Mid/End
- Critical Root/Toe
- Critical Component

Spot Main Results

Critical (Nugget)

Apply

Test Course Dist: 1

Load structure data.

Nodes: 29457 Elms: 64556 Groups: 11 Weldseams: 0

**FEMFAT**

3.68e-07

3.68e-08

3.68e-09

Node Label: 6177  
 Damage M/mod: 1.587e-07  
 1/Damage: 6.303e+06  
 Rel.Str.Grad: 0  
 Log10 Damage: -6.8  
 Log10 1/Dam.: 6.8  
 6th Root Dam: 0.07358  
 Stress Ampl.: 88.47  
 Mean Stress: 0  
 Str. Ratio R: -1  
 atan(Sm/Sa): 0  
 LocFatigLim: 108.2  
 IF FL Stat.: 1  
 IF FL Temp.: 0.99

Most crit. finite weld seam (From,To) : 6177,5195  
 Damage: 1.587e-07  
 Most important ElemLab: 12125  
 Type: 206  
 Node Attribute: 100  
 Notch Factor: 6.453  
 Position: NWWTOP

Node	Damage	Critical Element	Type	Position	Notch Factor	Attribute
6177	1.587e-07	12125	206	Middle/Root/Top	6.45	C100

Damage	Element	Type	Position	Notch	Stress Ampl.	Notch Mean Stress	Fatigue Limit	Crit. Stress
1.913e-16	2303	203	Middle/Toe /Top	4.83	0.33	61.67	Tau (Shear)	
4.161e-09	5264	201	Middle/Root/Top	50.64	0.00	108.19	Sig_normal	
1.816e-16	5767	203	Middle/Toe /Top	9.62	-1.37	108.40	Sig_normal	
8.008e-11	6691	201	Middle/Root/Top	30.68	0.00	108.19	Sig_normal	
1.234e-09	12120	206	Middle/Root/Top	46.39	0.00	108.19	Sig_normal	
5.061e-14	12120	206	Middle/Toe /Bot	18.96	-1.29	108.38	Sig_normal	
1.587e-07	12125	206	Middle/Root/Top	88.47	0.00	108.19	Sig_normal	
4.079e-12	12125	206	Middle/Toe /Bot	30.35	-2.02	108.49	Sig_normal	

Joint: 32  
 CenterLab: 23222  
 Location: bottom  
 Angle: 0  
 Elem Label: 70332  
 Prop ID: 1001100  
 std\_rivet\_stress\_fatigue\_steel

# FEMFAT information output: SPOT joints output in report file \*.pro

## • Stress selection output in protocol file

- SPOT joints output for detailed information for the analysed SPOT connections
- Can be found on the end of the file

Node Label: 23175  
 Damage M/mod: 3.682e-07  
 1/Damage: 2.716e+06  
 Rel.Str.Grad: 1.025  
 SPOT detailed Res: 3.682e-07  
 Log10 Damage: -6.434  
 Log10 1/Dam.: 6.434  
 6th Root Dam: 0.08466  
 Stress Ampl.: 98.62  
 Mean Stress: 10.38  
 Str. Ratio R: -0.8095  
 atan(Sm/Sa): 6.009  
 LocFatigLim: 114  
 IF FL Stat.: 1

Joint: 32  
 CenterLab: 23222  
 Location: bottom  
 Angle: 0  
 Elem Label: 70332  
 Prop ID: 1001100  
 std\_rivet\_stress\_fatigue\_steel

```

SPOT Specific Output:
+++ CBAR & CBEAM Rivet +++

Joint 1
Connector Element(s): 70284
Stress based Assessment
  NodeLab   CenterLab   Damage   Loc.   Angle   Amplitude   MeanStress   ElemLab   PropID   FatigueID
  23175     23222      3.682e-07  bottom  0.0     9.862e+01   1.038e+01   70332    1001100  std_rivet_stress_fatigue_steel
  
```



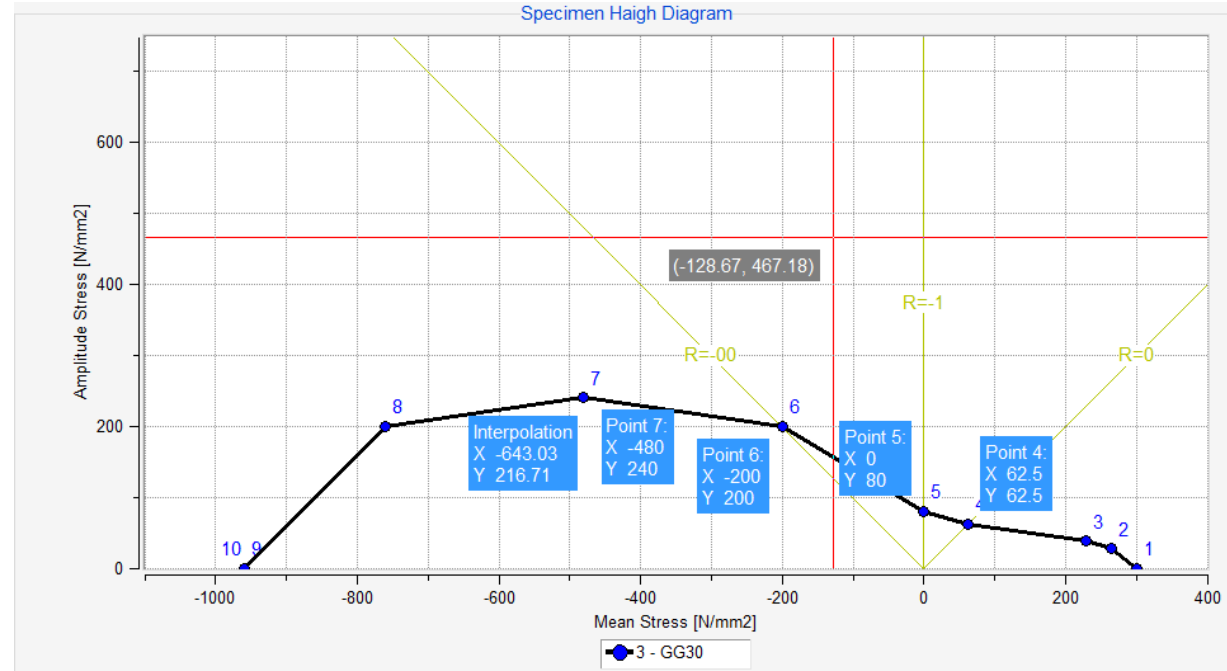
# Optimization of the workflow in FEMFAT

FEMFAT

VISIBILITY DETAILS

# FEMFAT visualizer visibility: S-N and Haigh Diagram detailed values of every positions can be selected

- Display Exact Point Coordinates in the S-N and Haigh Diagram by catching points
- Marker can be fixed
- Position of marker can be changed



# FEMFAT visualizer visibility: Display of Load Spectra for “Detailed Results” Group



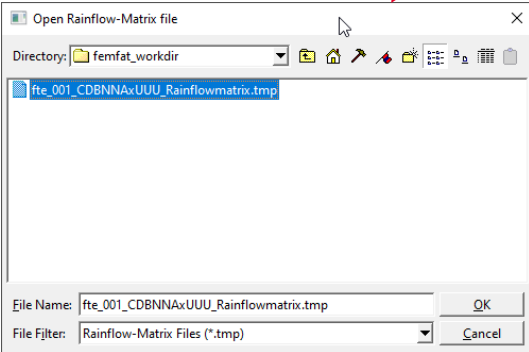
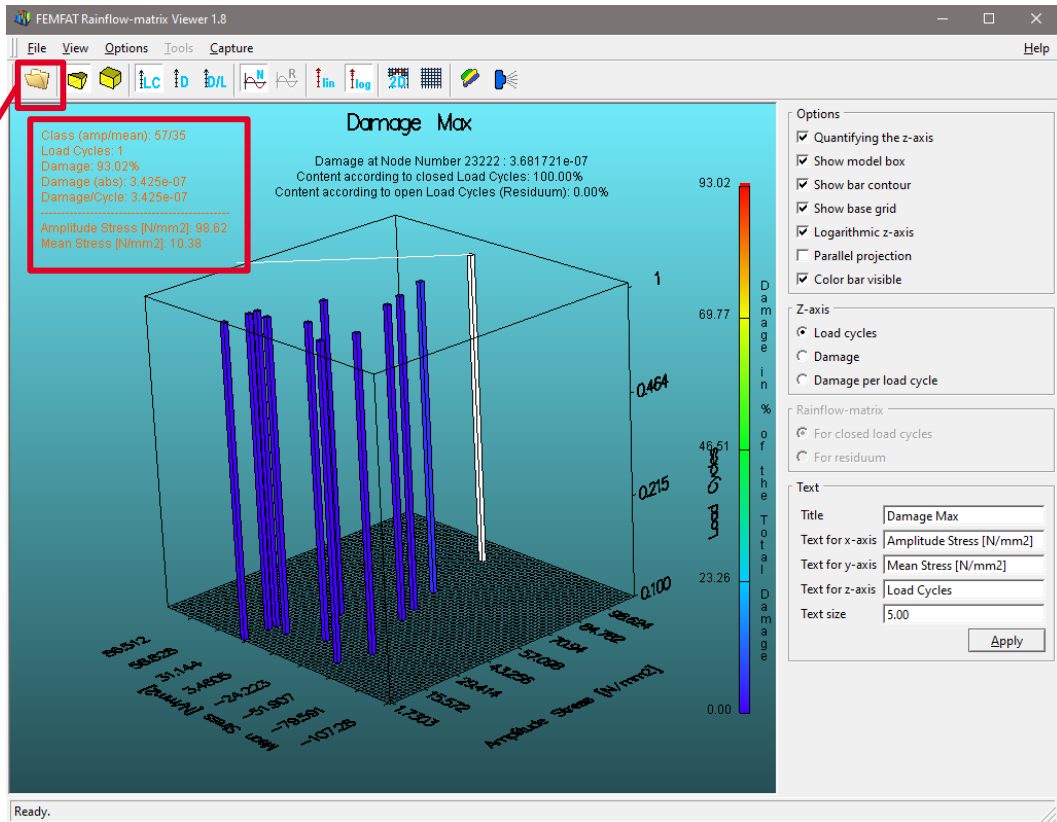
This functionality is upgraded from the most critical node to the „Detailed Results“ Group. The Red bar shows the maximum partial damage of the total damage in the analyse.

The image shows a sequence of three screenshots from the FEMFAT software interface, illustrating the process of displaying load spectra for a specific group.

- Left Screenshot:** The 'Output' panel is active. Under 'Load Spectra', the 'FPS' checkbox is checked and highlighted with a red box. A red arrow points from this box to the 'Visualization' panel.
- Middle Screenshot:** The 'Visualization' panel is active. The 'Charts' section shows the 'S-N' chart selected, also highlighted with a red box. A red arrow points from this box to the zoomed-in chart.
- Right Screenshot:** A zoomed-in view of the 'Local S-N Curve' chart. The y-axis is 'Stress [N/mm2]' on a log scale from 1 to 1000. The x-axis is 'Number of Load Cycles N (-)' on a log scale from 1e+000 to 1e+010. A blue line represents the S-N curve. A red bar is visible at the bottom of the chart, representing the maximum partial damage. A red box highlights this bar with the text 'Red bar: Maximum partial damage'. Below the chart, the 'Operate Specimen S-N Curve' section shows two curves: '1 - 16MnCr5' and 'N14'. The 'DETAILS Results Group Node Label' is set to '14', which is also highlighted with a red box.

# FEMFAT visualizer visibility: more details are available in the Rainflow-matrix Viewer

- Rainflow Viewer can be executed standalone now
- The tmp-file can be imported
- Every available bar can be selected and displays all details in a subwindow



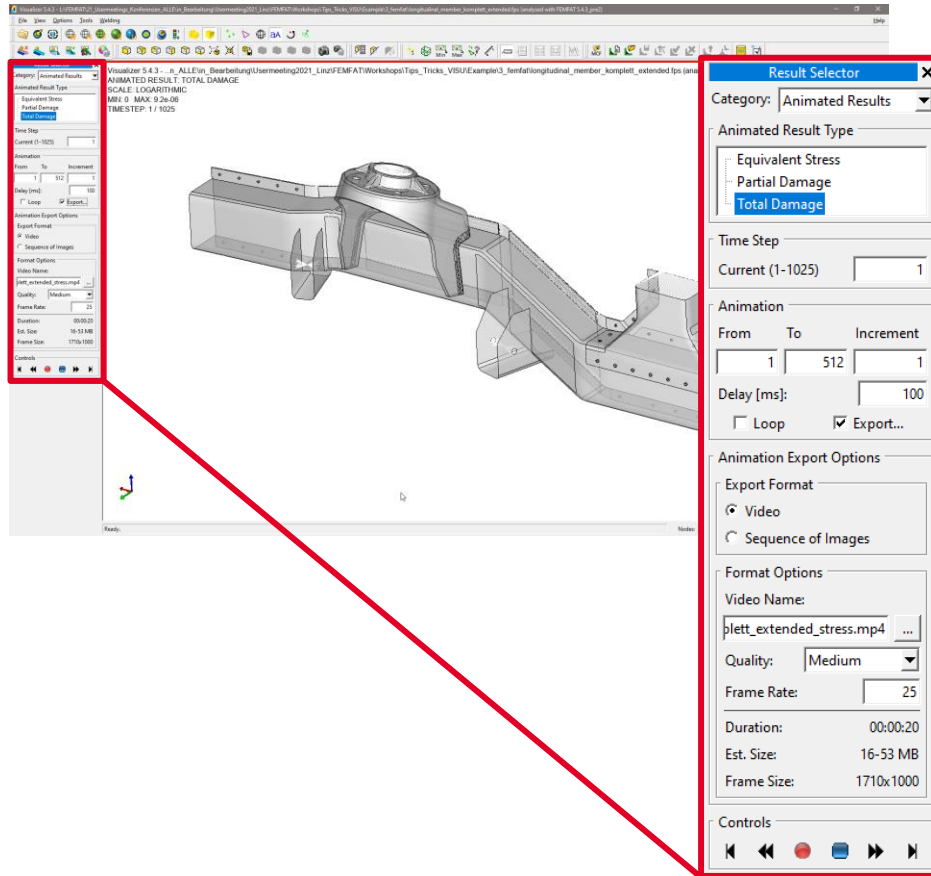
- VISUALIZER
  - Handling
    - Critical Load Case for safety factor
    - Subwindows for more nodes
  - Create
    - Videos of equivalent stress, partial damage and total damage
  - Information Output:
    - Model Definition: Mat, Temp, DAS, Roughness
    - Manuals WELD and WELD modelling guideline included
  - Visibility
    - Weld seams deactivated for deactivated parts
    - New Group handling (2021)
    - Safe the color bar
    - Export (up to) 4k pictures for presentation (2021)
    - Feature lines for better visibility (2021)
    - Transparent mode for better overview (2021)

# Usability optimization in FEMFAT visualizer

FEMFAT

VISUALIZER HANDLING

# FEMFAT visualizer: Create a Video



- Video export for presentation of
  - Equivalent Stress
  - Partial Damage
  - Total Damage



# FEMFAT Tips & Tricks: Create a Video



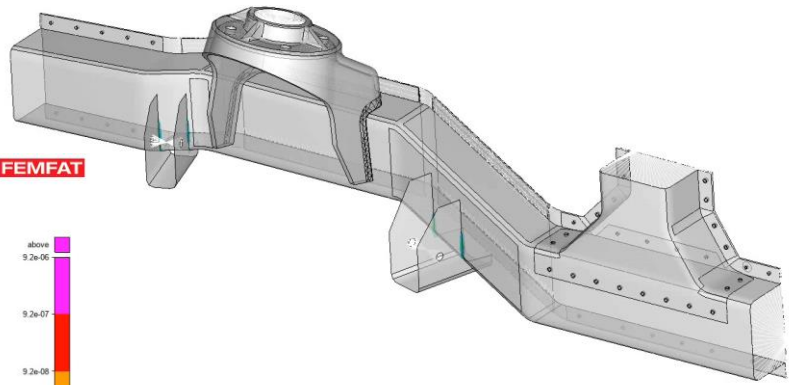
- Example for Partial - and Total Damage

Visualizer 5.4.3 - ...n\_ALLE\in\_Bearbeitung\Usermeeting2021\_Linz\FEMFAT\Workshops\Tips\_Tricks\_VISU\Example\3\_femfat\longitudinal\_member\_komplett\_extended.fps (analysed with FEMFAT 5.4.3\_pre2)

ANIMATED RESULT: PARTIAL DAMAGE  
SCALE: LOGARITHMIC  
MIN: 0 MAX: 1.71e-07  
TIMESTEP: 1 / 1025

FEMFAT

### Partial Damage

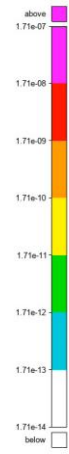
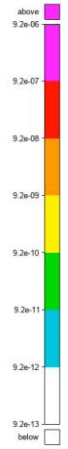
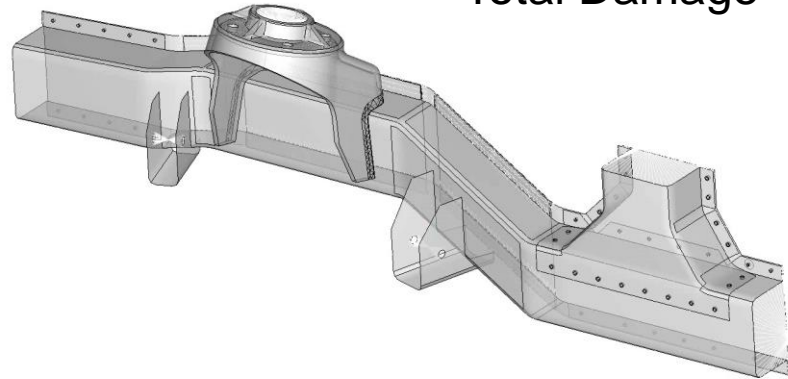


Visualizer 5.4.3 - ...n\_ALLE\in\_Bearbeitung\Usermeeting2021\_Linz\FEMFAT\Workshops\Tips\_Tricks\_VISU\Example\3\_femfat\longitudinal\_member\_komplett\_extended.fps (analysed with FEMFAT 5.4.3\_pre2)

ANIMATED RESULT: TOTAL DAMAGE  
SCALE: LOGARITHMIC  
MIN: 0 MAX: 9.2e-06  
TIMESTEP: 1 / 1025

FEMFAT

### Total Damage



# FEMFAT visualizer: Critical Load Combination - Separate Output of Times for Max/Min Stress



File View Options Tools Welding

Result Selector

Category: FEMFAT Results

Main Results

- Endure\_SF\_A
- 1/SF\_A
- Rel.Str.Grad
- Log10 SF\_A
- Log10 1/SF\_A
- 6th Root SFA

Stress

- Stress Ampl.
- Mean Stress
- Str. Ratio R
- atan(Sm/Sa)
- LocFatigLim

General Influence Factor:

- IF FL Rough.
- IF FL T.Size

Show Results

- Base material
- WELD seams (Shell)
- SPOT joints
- LAMINATE

Result Position

Shell/Boundary Layer

Critical

Weld Results

- Critical Mid/End
- Critical Root/Toe
- Critical Component

Spot Main Results

- Critical (Nugget)

Apply

Test Course Dist: 1

Ready.

Nodes: 29457 Elms: 64556 Groups: 11 Weldseams: 0

Visualizer  
 RESULT: Safety Factor A  
 SCALE: LINEAR  
 MIN: 1.14 MAX: 30

Node Label: 23222  
 Endure\_SF\_A: 1.158  
 1/SF\_A: 0.8633  
 Rel.Str.Grad: 0.8929  
 SPOT detailed Res: 2.839  
 Log10 SF\_A: 0.06382  
 Log10 1/SF\_A: -0.06382  
 6th Root SFA: 1.025  
 Stress Ampl.: 98.32  
 Mean Stress: 10.68  
 Str. Ratio R: -0.804  
 atan(Sm/Sa): 6.2  
 LocFatigLim: 113.9

Time Step Min: 113  
 Time Step Max: 158

Joint: 32  
 CenterLab: 23222  
 Location: bottom  
 Angle: 0  
 Elem Label: 70332  
 Prop ID: 1001100  
 std\_rivet\_stress\_fatigue\_steel

FPS Setting DMA-Column Setting Result Modification Module Specific

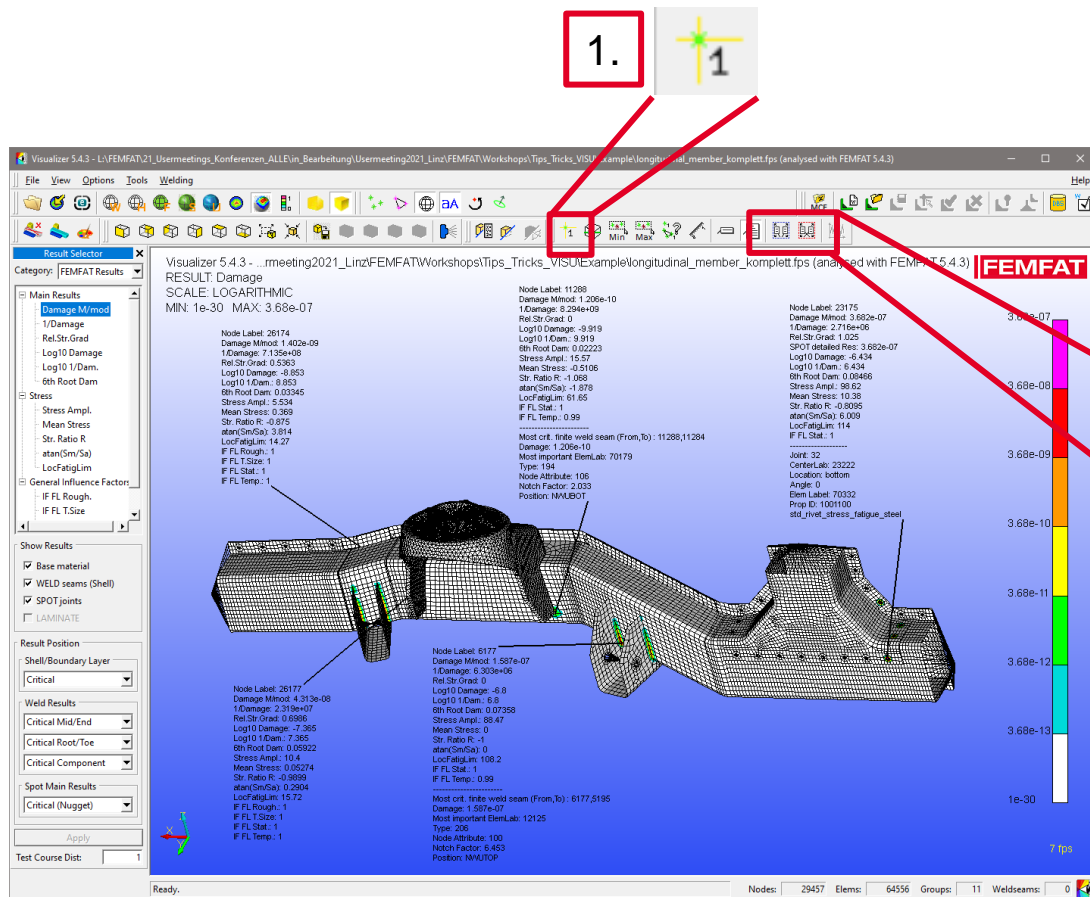
Number of Scratch Results: 14   Deselect All

Main Results (7)	Stress (5)	General Factors1 (0)	General Factors2 (0)	Surface (0)	Misc. (2)	Node Charact. (0)
<input checked="" type="checkbox"/> Miscellaneous <ul style="list-style-type: none"> <li><input type="checkbox"/> Normal Vector of Critical Cutting Plane (X,Y,Z)</li> <li><input type="checkbox"/> Secondary Dendrite Arm Spacing SDAS</li> <li><input checked="" type="checkbox"/> Time Step with Minimum Stress for Safety Analysis</li> <li><input checked="" type="checkbox"/> Time Step with Maximum Stress for Safety Analysis</li> <li><input type="checkbox"/> SPOT Force based: Critical Vector (X,Y,Z)</li> </ul>						

**FEMFAT 2021**

Separate output of time for max. and min. stress

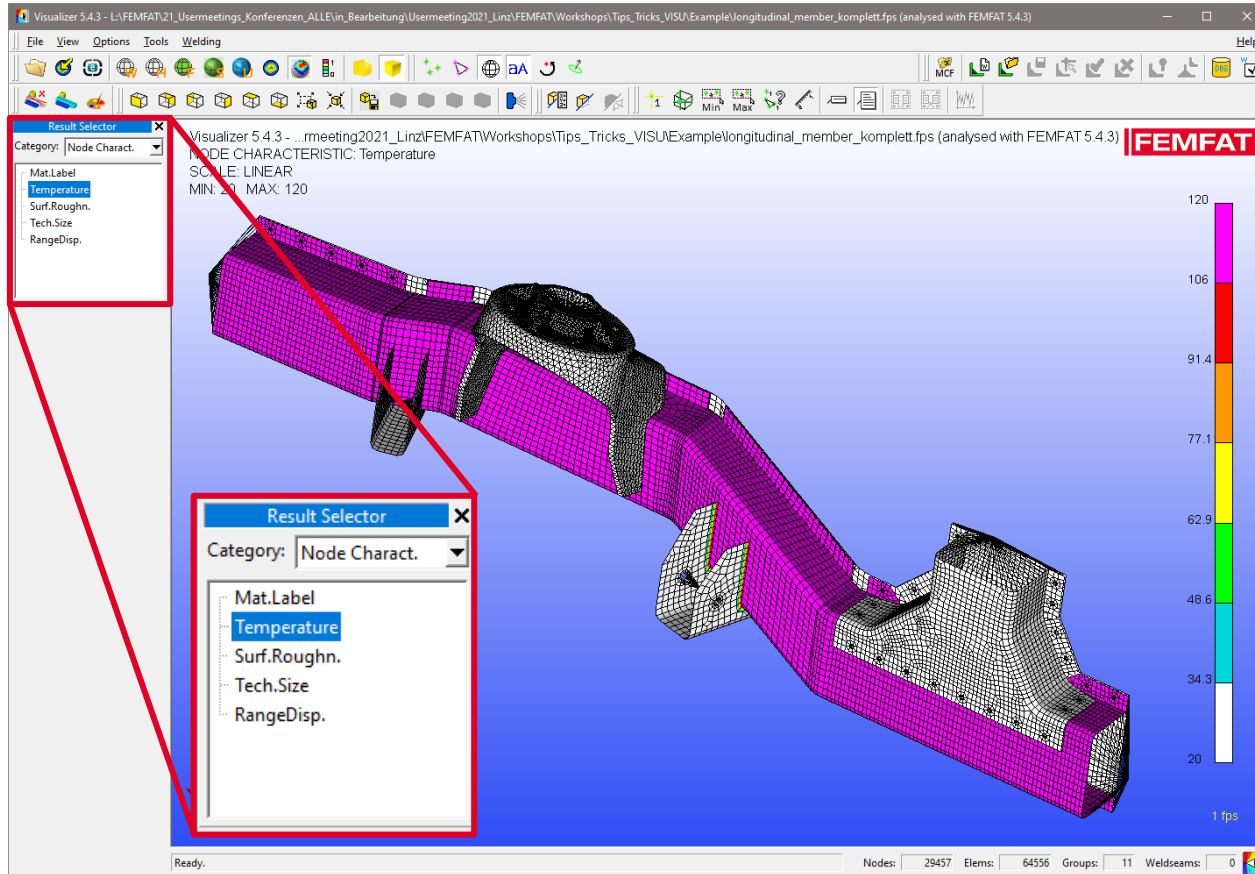
# VISUALIZER handling: Add and Rearrange Multiple Subwindows



2.	Add Subwindow
	Add all Subwindows
	Delete Subwindow
	Configure Subwindows
	Create a Group
	New Weldseam (S)
	Modify a Weldseam (M)
	Show/hide all Weldseams
	End of Weldseam Definition (E)
	Show History
Select/Deselect Node (N)	
Deselect all Nodes	
Rotation Center (D)	
Select/Deselect Element	
Deselect all Elements	
Done	

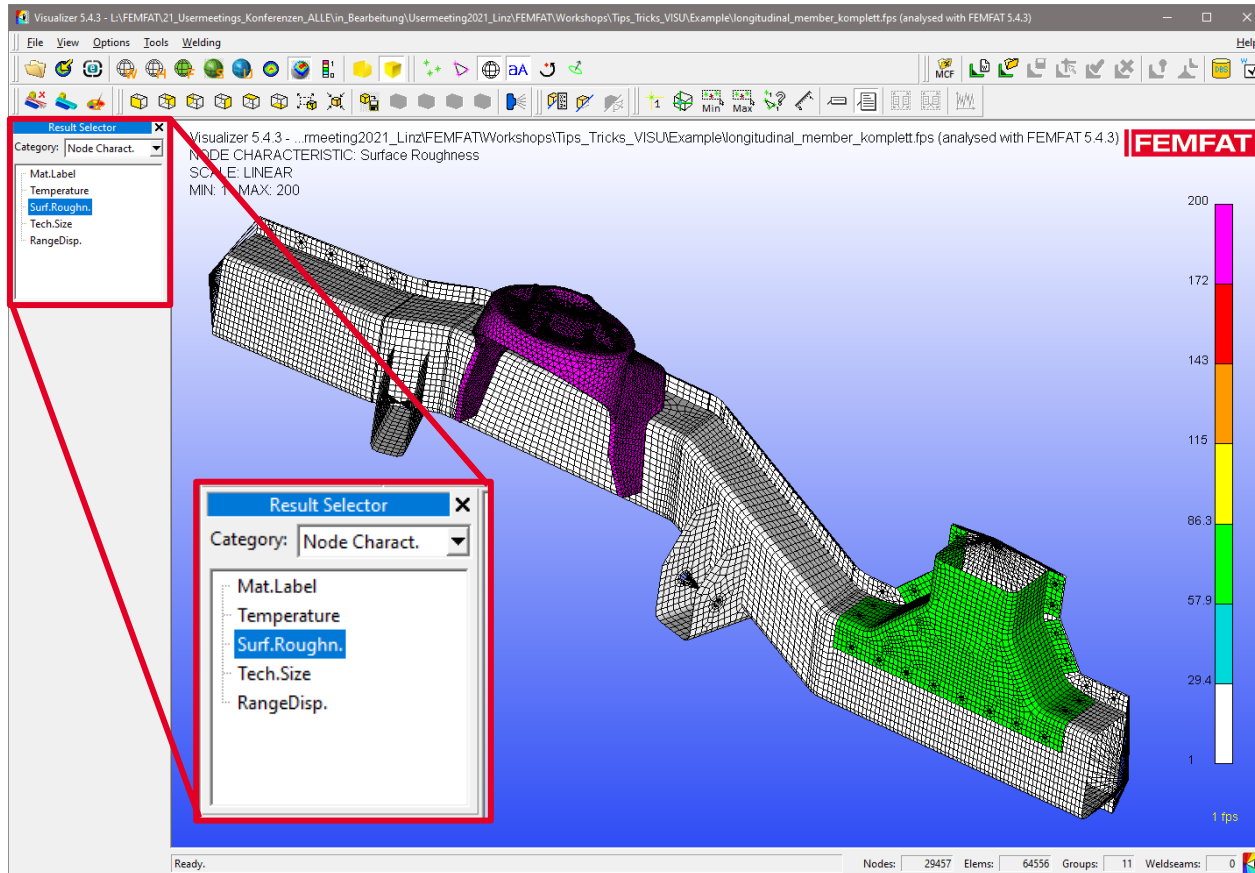
1. Select nodes
2. Add all subwindows (right mouse button)
3. Rearrange (according to node or current positions)

# FEMFAT visualizer: Information Output



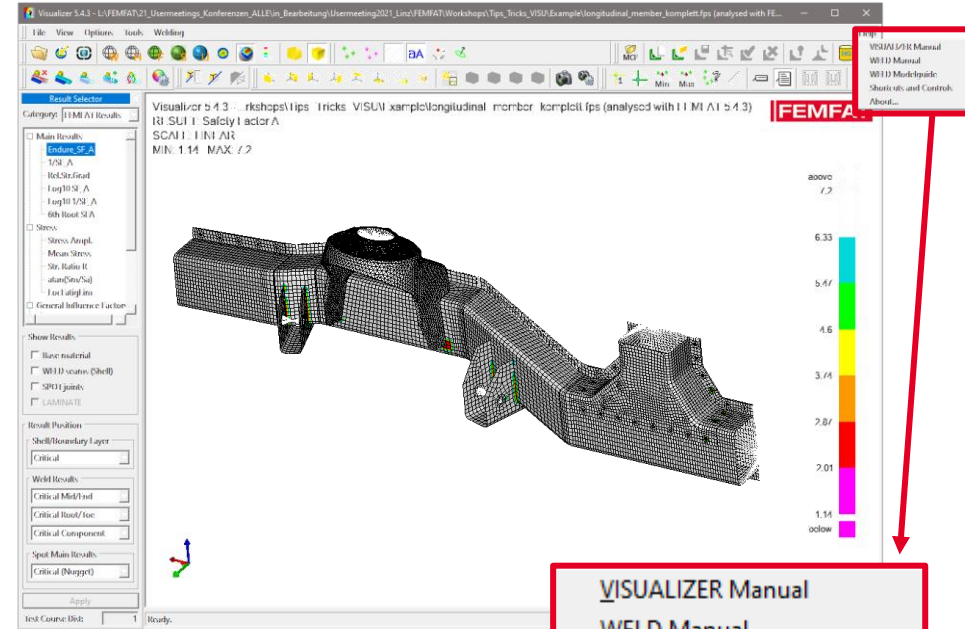
- **Modell Definition:**
- Mat Label
- **Temperatur**
- Surf. Roughn.
- Tech. Size
- RangeDisp.

# FEMFAT visualizer: Information Output



- **Modell Definition:**
- Mat Label
- Temperatur
- **Surf. Roughn.**
- Tech. Size
- RangeDisp.

# VISUALIZER handling: WELD and VISUALIZER Manuals have been added for faster help



When you click on help you will find the manuals of the...

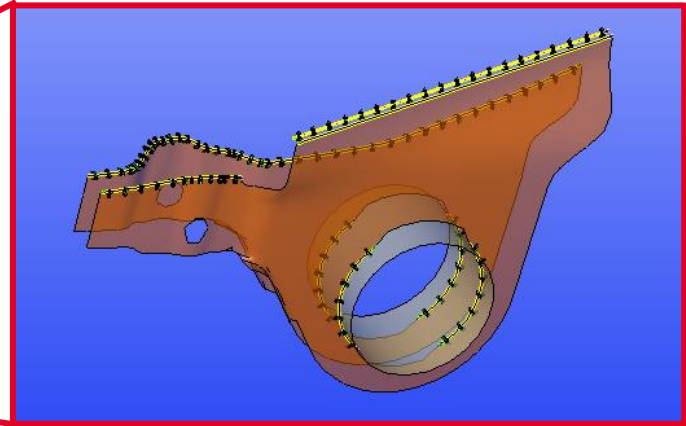
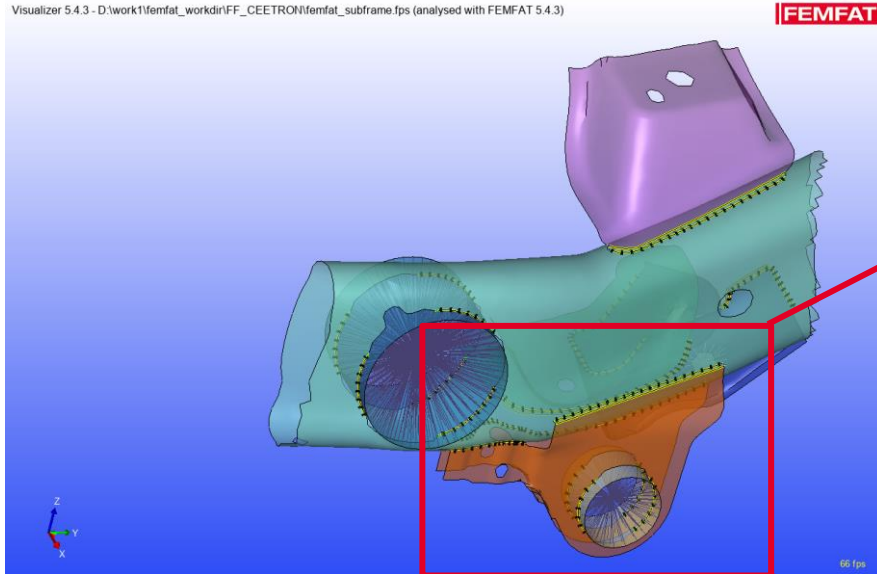
- VISUALIZER
- WELD Manual
- WELD Modelguide

... and „Shortcuts and Controls“ can be found as well.

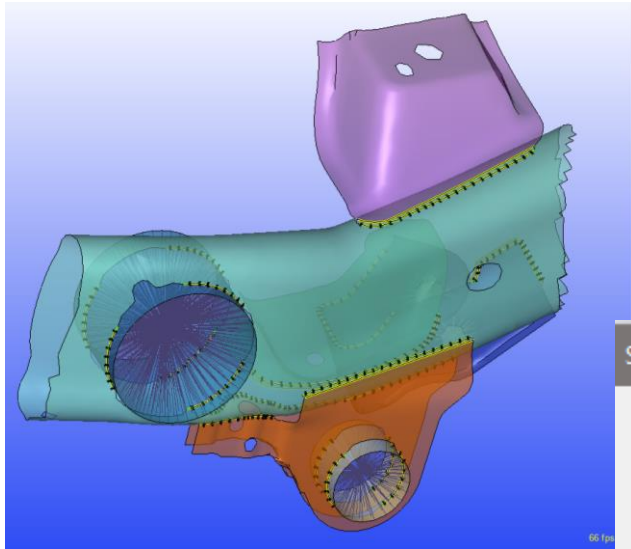


# FEMFAT visualizer: visibility of weld seams

- When parts are deactivated VISUALIZER automatically removes weld seams which do not belong to the visible parts

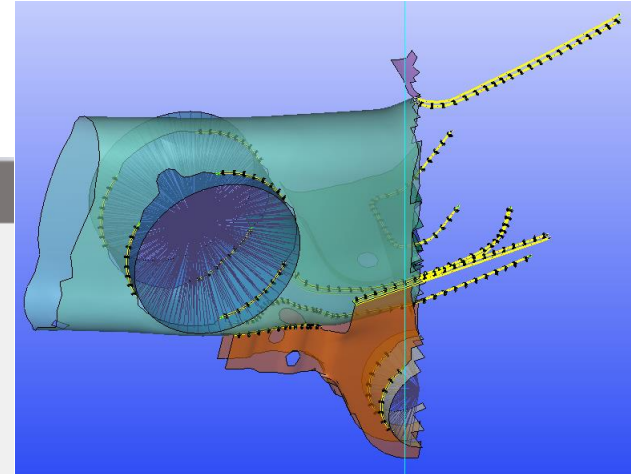




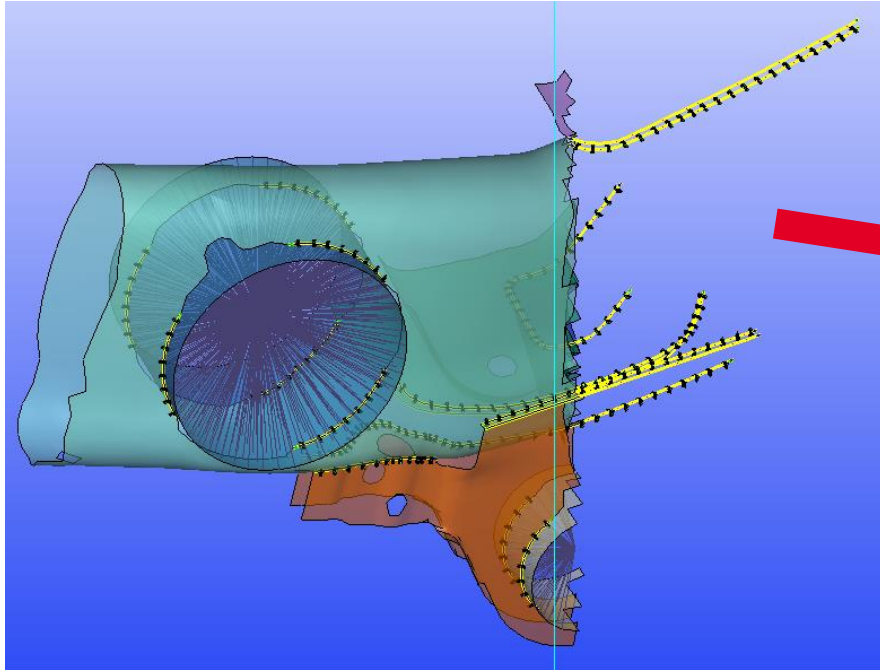


## Selection Properties

- Select all nodes/elements
    - Include free nodes
  - Select nodes/elements on model surface
  - Select visible nodes/elements on model surface
- 
- Nodes
    - Add connected elements
  - Elements
    - Add connected nodes

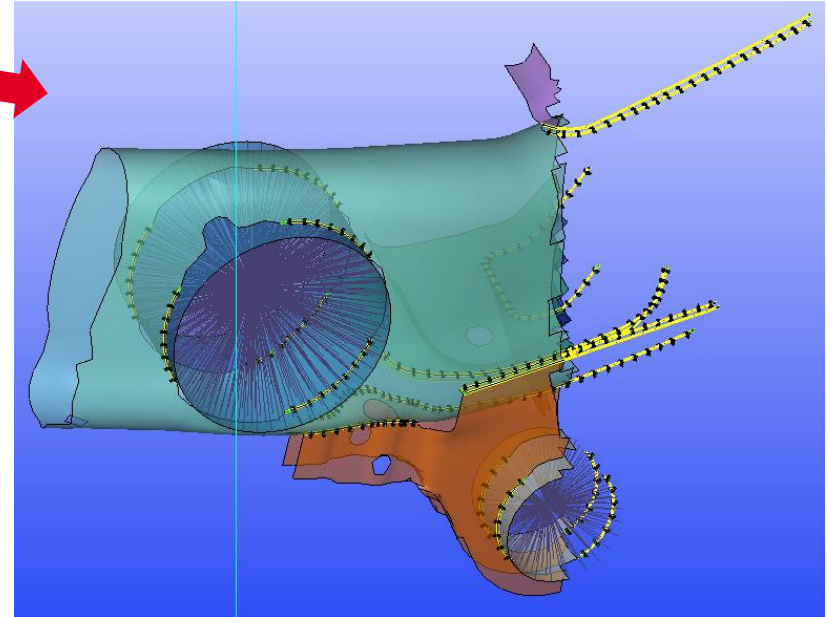


- **Show/Hide selection...**
  - More specific groups can be generated by selection properties function

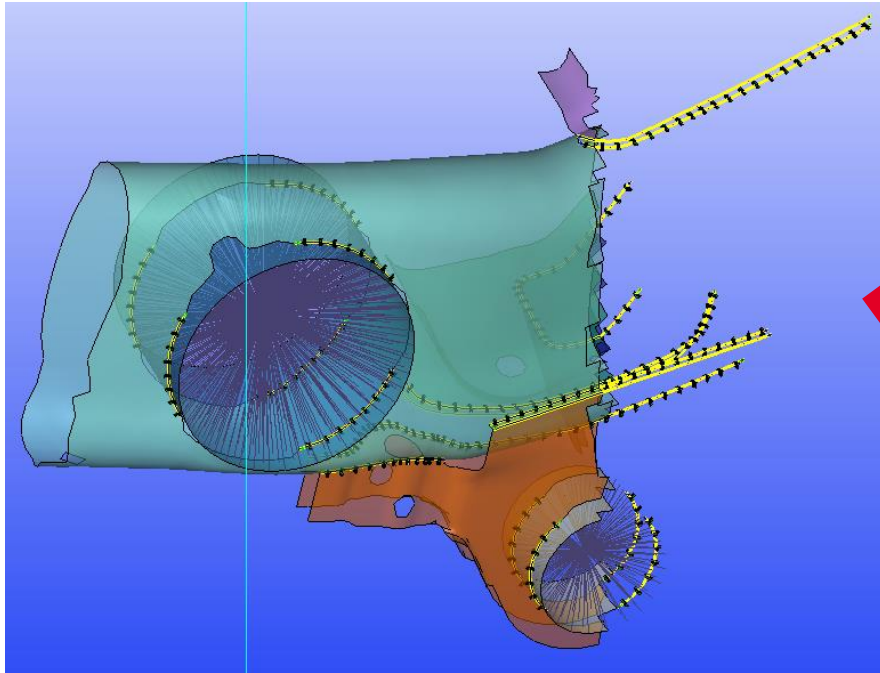


- **Add neighbour elements to section...**

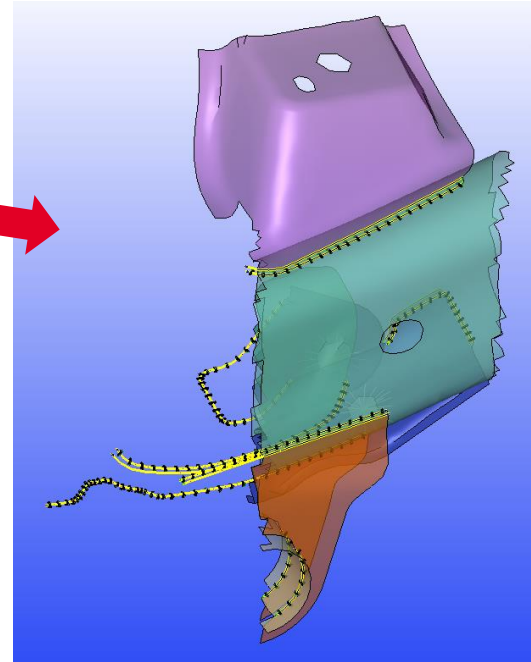
- helps increasing the selected elements where needed with a rectangular



# FEMFAT visualizer: new view handling



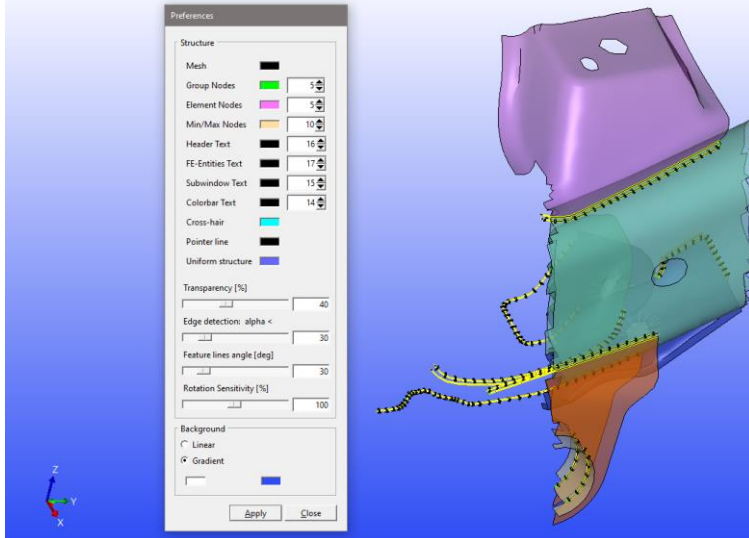
- **Invert show/hide status...**
  - flips the selection of the model completely



# FEMFAT visualizer: new view handling

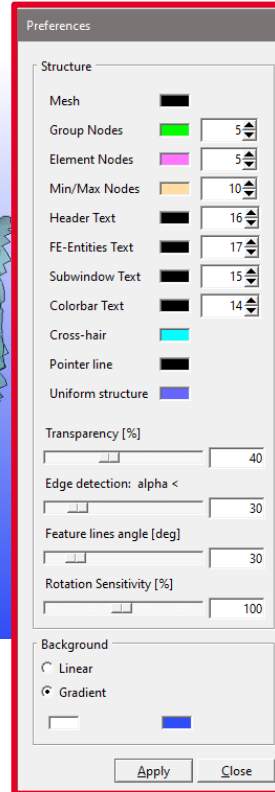


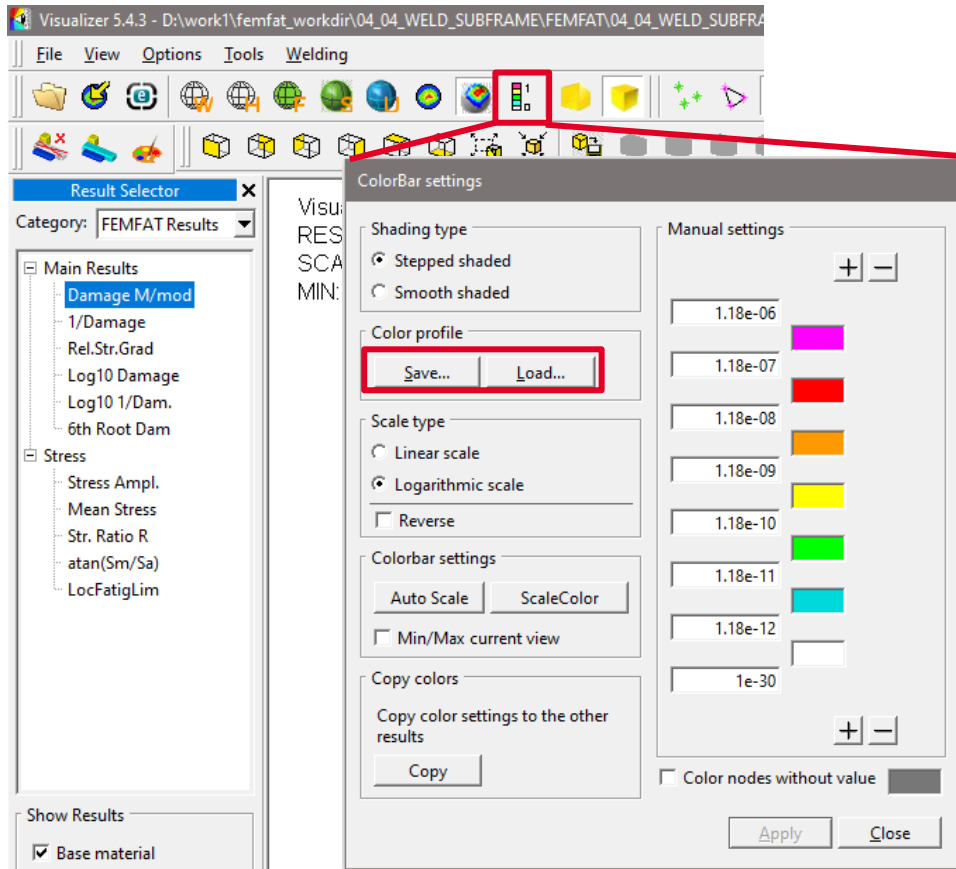
Visualizer 5.4.3 - D:\work1\mfemfat\_workdir\FF\_CEETRON\mfemfat\_subframe.fps (analysed with FEMFAT 5.4.3)



- **Preference Dialog...**

- All settings regarding colors, transparency, feature line angle, rotation sensitivity,... can be fixed





- Safe/Load the color bar

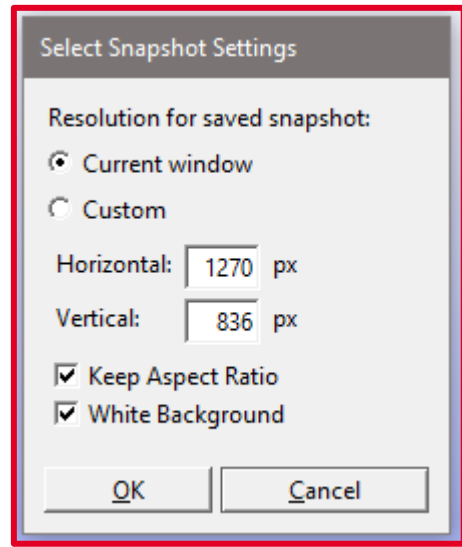
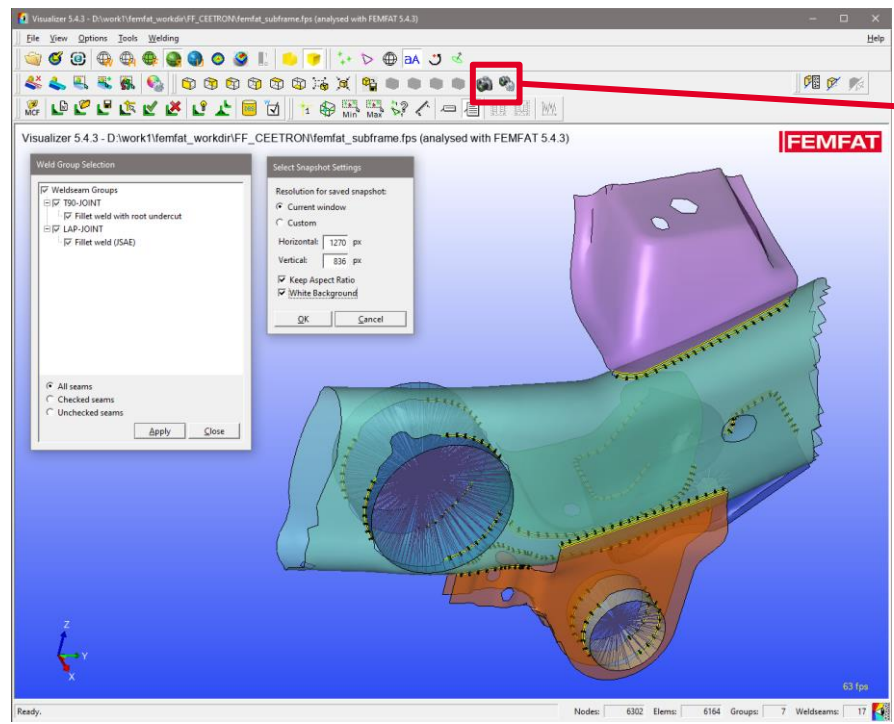
In color bar settings the individual color bar can be exported and imported in every session.

This makes it possible to use the same colors and values for every evaluation.

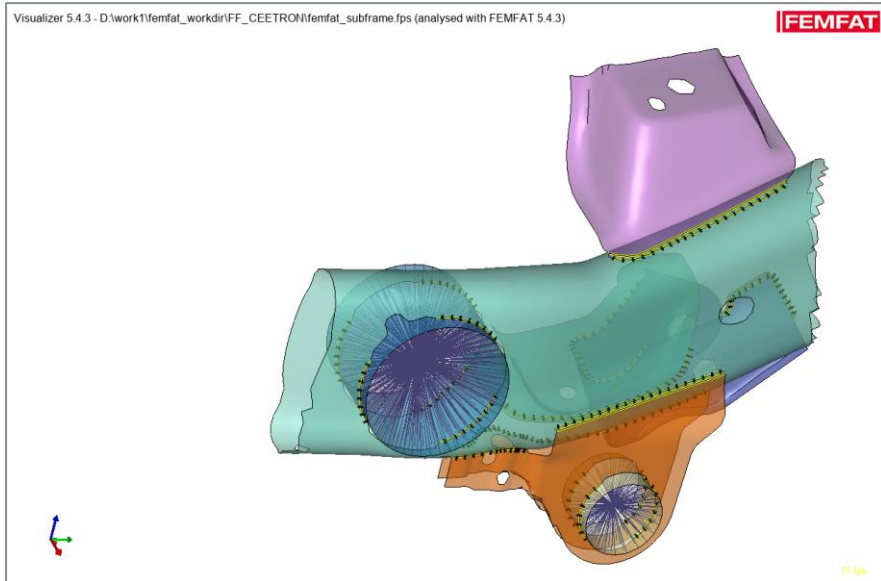
# FEMFAT visualizer 2021: picture export (up to) 4k



- Export „Snapshot“(up to) 4k pictures for presentation (2021)



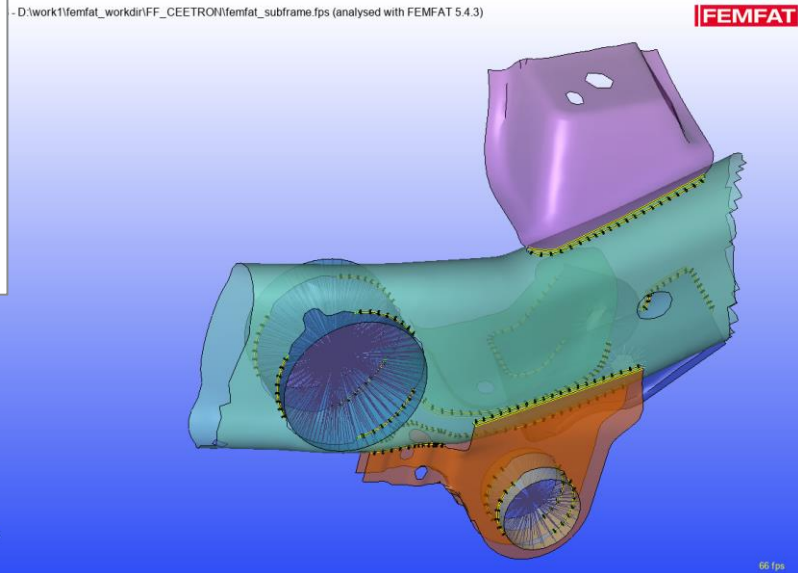




With „White Background“ setting

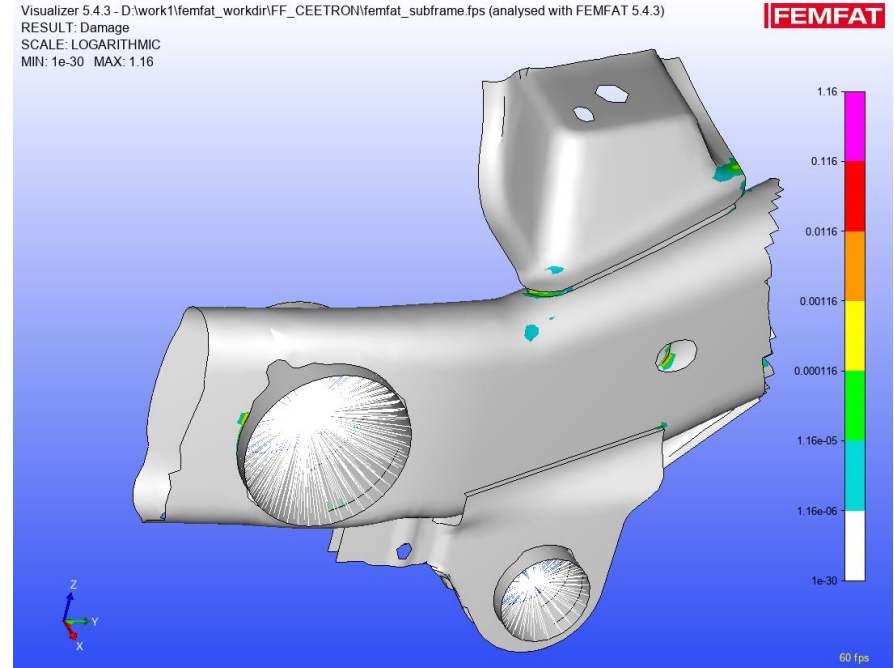
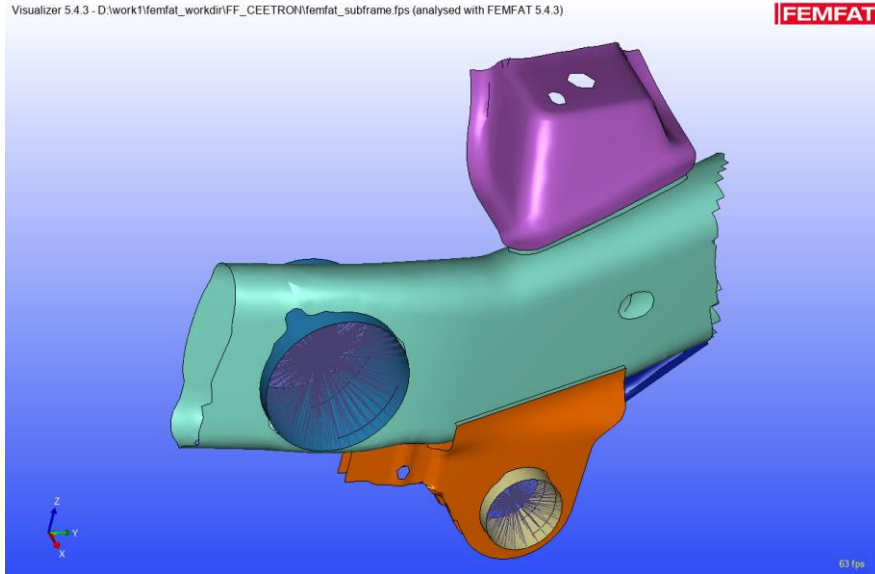
- Snapshot setting with/without background color

Without „White Background“ setting





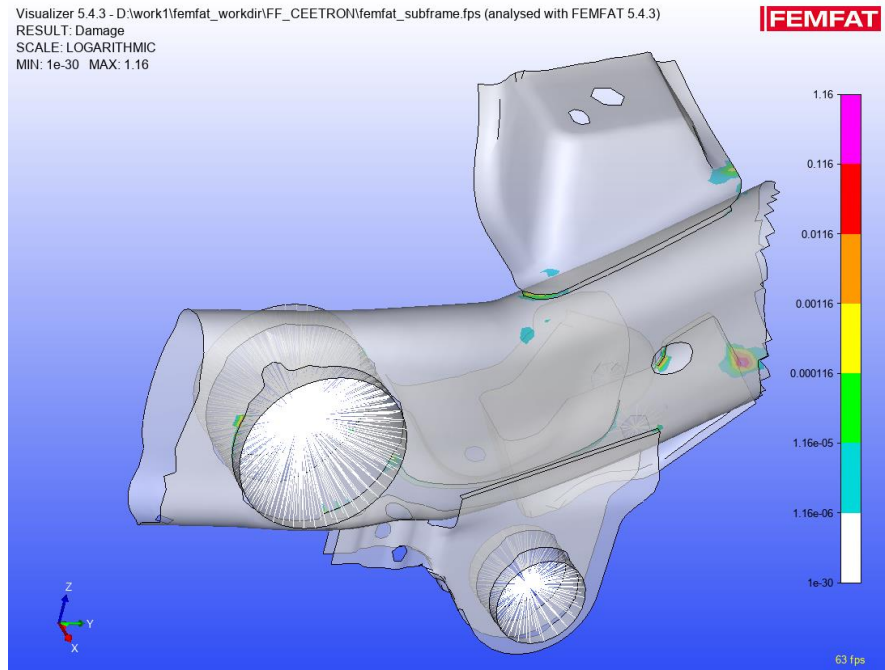
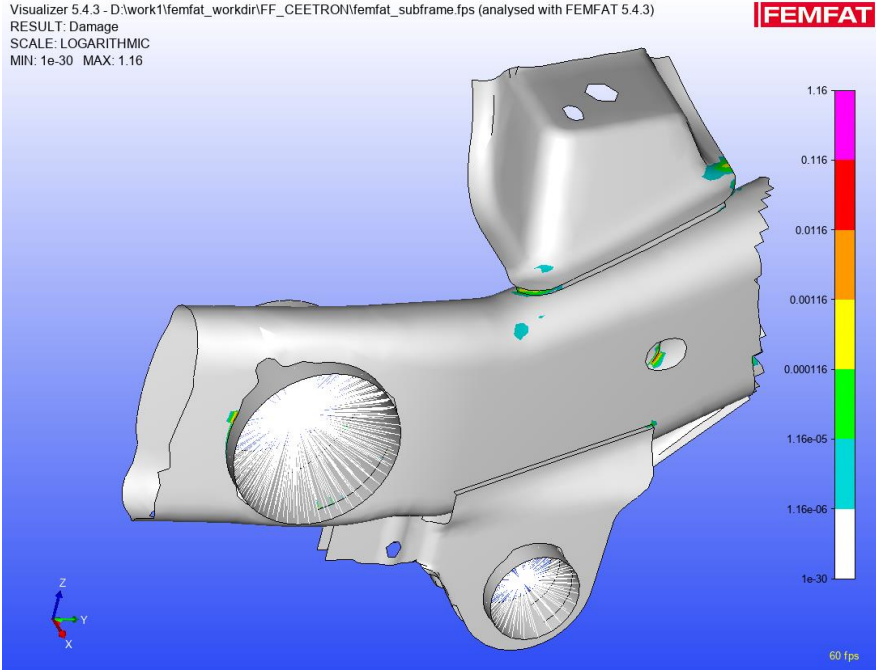
- Feature lines for better/easier model overview (2021)



# FEMFAT visualizer: visibility



- Transparent mode for better overview (2021) Groups ...





DRIVING **EXCELLENCE.**  
INSPIRING **INNOVATION.**