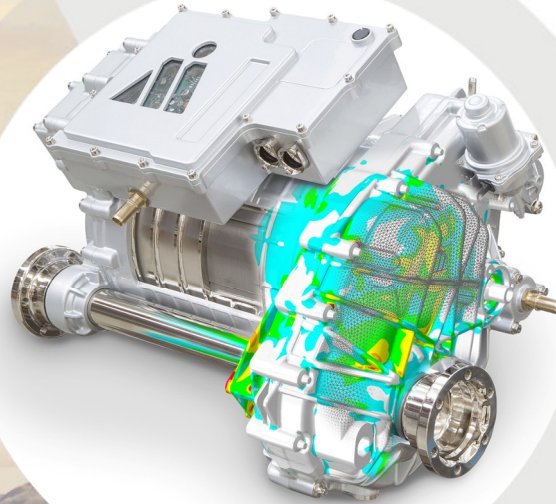




Tips & Tricks

New Features in FEMFAT
Axel Werkhausen

May 2023 / Author: ECS St. Valentin

A horizontal banner with a dark background. It features a complex, glowing blue wireframe structure on the right side, resembling a 3D model of a mechanical part. On the left side, there are several bright red, glowing lines that appear to be part of a simulation or stress analysis, radiating outwards.

FAQs from FEMFAT Support

FEMFAT 2023 live – Tips & Tricks



- Some of our new features are customer requests.
Some are implemented, because we see the benefits for a high percentage of users

„Clean up“ for the Material dialog

Multimaterial file – one file = all materials of your project in one *.ffd file

Material assignment + multimaterial file = Import and assignment in one *.fma

Materials in FEMFAT visualizer – check and define groups

How to call templates in batch-mode

FEMFAT weld sensitivity analysis works also in batch-mode now

How to keep your comments in the job-file

Temperature dependent material characterization for some aluminum available

Material Generator Redesigned and Extended for SFRP -> Workshop on Friday

Templates for FKM Fatigue Analyses available -> Workshop on Friday

The New (exact) Sequence Influence from New FEMFAT plast Method ->
Workshop on Friday

Clean up the material dialog



☐ Hide unused material data

Header Lines

Material and Specimen Name: S420M_FKM2020

Remarks: Strain data: Calculated from S-N Curve

Data Source: Source: Material Generator MATGEN (Copyright EC

General Data

Linear Static Data

Young's Modulus X-Direction: 210000.00 [N/mm2]

Young's Modulus Y-Direction: 210000.00 [N/mm2] (not used for analysis)

Young's Modulus Z-Direction: 210000.00 [N/mm2] (not used for analysis)

Coefficient of Hardening: 0.00 (not used for analysis)

Exponent of Hardening: 0.00 (not used for analysis)

Modulus of Traverse Elasticity: 0.00 [N/mm2] (not used for analysis)

Elongation at Rupture A5: 19.00 [%]

Brinell Hardness: 0.00 [HB] (not used for analysis)

Multilinear Young's Modulus (not used for analysis)

Cyclic Stabilized Data

Strength Data

Header Lines of S-N Data

General S-N Data

Type Dependent S-N Data

Damage Accumulation (optional)

Casting Data (optional)

☒ Hide unused material data

Header Lines

Material and Specimen Name: S420M_FKM2020

Remarks: Strain data: Calculated from S-N Curve

Data Source: Source: Material Generator MATGEN (Copyright EC

General Data

Linear Static Data

Young's Modulus X-Direction: 210000.00 [N/mm2]

Elongation at Rupture A5: 19.00 [%]

Cyclic Stabilized Data

Strength Data

Header Lines of S-N Data

General S-N Data

Type Dependent S-N Data

Damage Accumulation (optional)

Casting Data (optional)

User defined Haigh Diagram (optional)

Properties at High Temperature (optional)

Defect Definition (optional)

Parameters for Stress Gradient Influence (optional)

Parameters for Technological Size Influence (optional)

Multimaterial-File



„SingleMaterial“-Format:

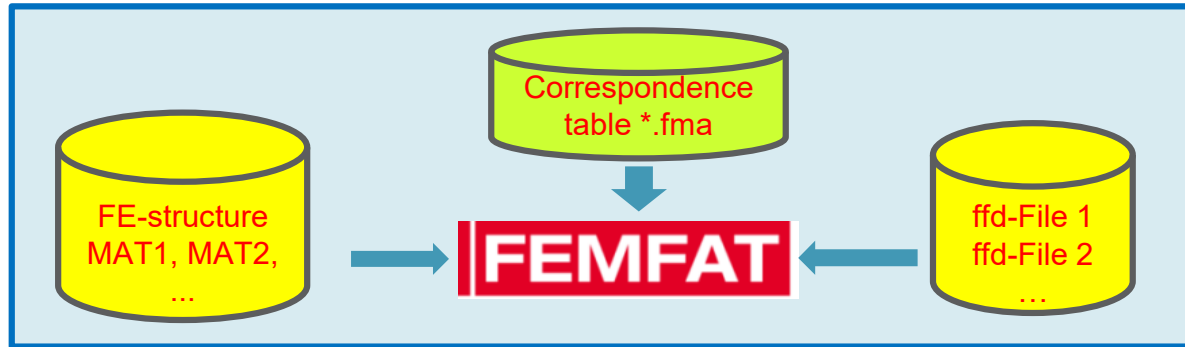
```
-1
201
Dataset201-Info
-1
-1
218
Dataset218-Info
-1
-1
223
Dataset223-Info
-1
-1
218
Dataset218-Info
-1
```

```
MAT===
#comment
-1
201
Dataset201-Info
-1
-1
218
Dataset218-Info
-1
-1
223
Dataset223-Info
-1
-1
218
Dataset218-Info
-1
MAT===comp234
# comment
-1
201
Dataset201-Info
-1
-1
218
Dataset218-Info
-1
-1
223
Dataset223-Info
-1
```

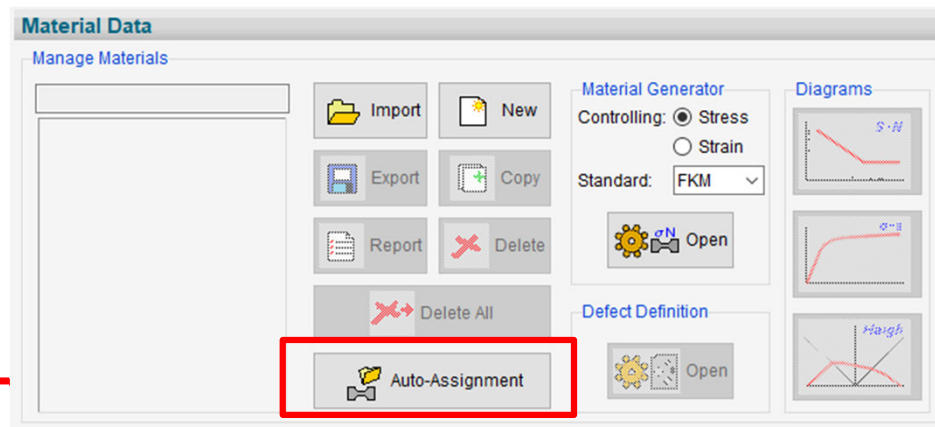
„MultiMaterial“-Format:

- **MAT===** as an identifier in **column 1-6** to identify the start of a new material in the file.
Descriptor in column 7+ will be used to identify the material for the *.fma-file
- **#** in **first column** indicate the comment line.
Not to be placed in the datasets but inbetween!
- **Empty lines (CR)** can be placed everywhere, but also not in the dataset, but inbetween.
- Only the first dataset of duplicates (e.g. 218 in first file) will be used. (no pop-up windows to accept the dataset)

Material data can be assigned to MID or PID automatically using a correspondance table (*.fma)



- Import material correspondence table *.fma.
- Loading all ffd-Files automatically.
- Automatic assignment of materials to nodes at elements with MID/PID according to the correspondence table.
- Supported FE-interfaces:
NASTRAN BDF & OP2, ANSYS CDB, MEDINA BIF, I-DEAS MS UNV
- Other Interface: Import of multiple material files without assignment



Material correspondence table *.fma-file

Example

Material Database Path (\$MatDBPath): C:\MaterialData

#	MID	PID	FEMFAT material file (.ffd)	Material description	Comment
#	1		EN-GJL-250_HEAT_FKM2002.ffd	Grey Cast Iron	
		2	EN-AC-21100_sand_casting_FKM2002.ffd	Aluminum	
	2, 3; 4		multiMat_projectXY.ffd MAT===comp234		
	5-6	6	EN-MC-MgAl4RE2_casting_FKM2000.ffd		

FEMFAT material assignment table format (fma-file)

A path for quick access to your material database

```
Material Database Path ($MatDBPath): C:\Users\werkh\Desktop\Projekte\SimCon_2021\materials
SPOT automatic assignment: OFF          # ON/OFF for activating/deactivating this feature
WELD automatic assignment: OFF          # ON/OFF for activating/deactivating this feature
#      MID      |    PID    | FEMFAT material file (.ffd)          | Material description | Comment
# -----
|          |    3     | $MatDBPath\DP500_FAT_IMAB.ffd        | mat_for PID3       |
|          |    6     | $MatDBPath\St14_3_FAT_IMAB.ffd        | mat_for PID6       |
|          | 7-13     | $MatDBPath\ZStE250.ffd                | mat_for PID7-13    |
|          | 14,21    | $MatDBPath\zste340.ffd                | mat_for PID14 21   |
|          |    26    | $MatDBPath\h340LA.ffd                 | mat_for PID26      |
```

```
1 -1
2 201
3 STEYR-FILE 2.0
4 Material Properties ZSTE250
5 ZStE250
6 (ungenormtes Material)
7 Last change: Heizeneder 2006-08
8 -1
9 -1
10 218
11 
12 Strain data: Calculated from S-N Curve
13 Source: Material Generator MATGEN (Copy
14 0 3000E+000 0000E+000 0000E+000
```

Is only used if
descriptor in dataset
218 is empty

Automatic material assignment for WELD and SPOT nodes can be treated different than base material.



Material Database Path (SMatDBPath):

SPOT automatic assignment: OFF # ON/OFF for activating/deactivating this feature

WELD automatic assignment: OFF # ON/OFF for activating/deactivating this feature

#	MID	PID	FEMFAT material file (.ffd)	Material description	Comment
1		2	EN-GJL-250_HEAT_FKM2002.ffd		
2,3;4			EN-AC-21100_sand_casting_FKM2002.ffd		
5-6		6	EN-E295_FKM2002.ffd		
			EN-MC-MgAl4RE2_casting_FKM2000.ffd		

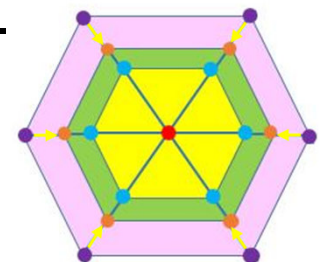
SPOT AUTOMATIC ASSIGNMENT SWITCH (SPOT automatic assignment:): This parameter is optional and the default value is OFF

At SPOT extended nuggets the SPOT automatic assignment will transfer the assigned material at the outer nugget node in row 2 to the outer nugget node in row 1 (which is connected via an edge and to which no material has previously been assigned) after processing the automatic assignment table.

WELD AUTOMATIC ASSIGNMENT SWITCH (WELD automatic assignment:): This parameter is optional and the default value is OFF

The WELD automatic assignment will copy the neighboring material assignment (no WELD and SPOT nodes) to the nodes of the welding seams where no material was assigned before.

- Control switches for automatic material assignment at WELD and SPOT nodes.
- **ON**: Material assignment to WELD/SPOT nodes was done after the assignment to the base material nodes.
- **OFF** or hashtag (**#**): no material assignment to WELD/SPOT nodes will be done.
- **WELD**: The material of the surrounding base material nodes was checked and those with lowest fatigue strength will be assigned to the WELD node.
- **SPOT**: For Extended Nugget model, the material of outer nugget nodes was copied to neighbouring inner nugget nodes.



Check material definition in VISUALIZER



Node Characteristics

Group Selection

- 10 - ALL
- 2 - TMP
- 3 - TMP1
- 4 - AUGÉ
- 5 - TMP2
- 6 - ELEM_POST
- 7 - ELEM_FEMFAT
- 8 - NDS_FEMFAT
- 9 - ELEM+NDS_FEMFAT

Group Filter:

10 - ALL

Number of Nodes: 1828

Number of Elements: 1118

Check Node Label:



FPS Setting for Visualizer Display

- ☒ Material
- ☐ Temperature
- ☐ Surface Roughness
- ☐ Technological Size
- ☐ Range of Dispersion

Assign Node Material/Characteristics

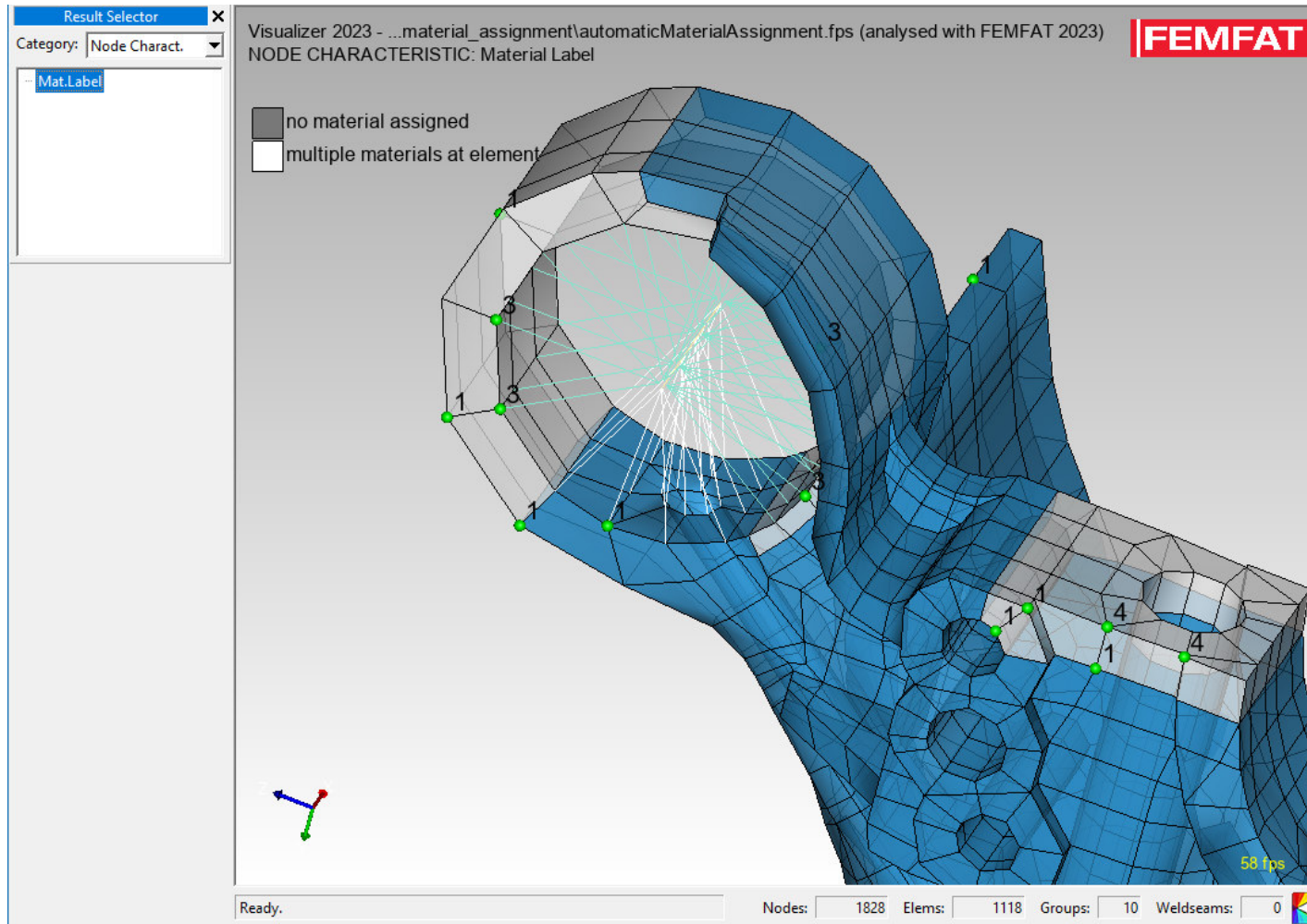
Material:

Surface Roughness:

Technological Size at 3D Nodes:

Range of Dispersion (10% to 90%):

Check material definition in VISUALIZER



Call Templates in batch-mode



- Problem occurred from WELD sensitivity templates. The final question „Do you want to calculate the sensitivity factors automatically?“ was waiting for your „OK“ – this is now (in batch) automatically answered with „yes“.
- In addition to the lines from the template itself, also the correct call of the template is mentioned in comment lines:

```
setValue {} {} DISTANCETESTCOURSE 1.0
#COM =====
# ---START OF ANALYSIS---
setValue {} {} StartAnalysisLoop
# -----
#COM
#COM ::source /DevelUsers/bruck/mybuilds/femfat/head/f6140_sensitiv/templates/WELD_Sensitivity_Damage_gap.ffj
#COM
setValue {} {} GUI_Group:OperatorAttrib 4
setValue {} {} GUI_Group:NodeColorFrom 100
setValue {} {} GUI_Group:NodeColorTo 109
setValue {1 {{setValue {} {} GUI_Group:Name Group_for_Sensitivity_Analysis}} {setValue {} {} GUI_Group:Name Group_for_Se
setValue {} {} GUI_Group:OperatorAttrib 1
setValue {} {} GUI_Group:Add
```

WELD Sensitivity analyses in Batch-mode



- Works like explained before in ***FEMFAT 2023***

WELD_Sensitivity_Damage_all.ffj

WELD_Sensitivity_Damage_gap.ffj

WELD_Sensitivity_Damage_inclination_angle.ffj

WELD_Sensitivity_Damage_penetration_degree.ffj

WELD_Sensitivity_Damage_seam_thickness.ffj

Keep your Comments in ffj-Files



- To keep your essential explanations in the jobfile, mark it by #COM

```
setValue {} {} SurvivalProbability 50
setValue {} {} AnalysisFilterLimitScale 0 0.00
setValue {} {} ReadMaxStressData
setValue {} {} GUI_Analyze:NumberOfParallelJobs 1
#COM =====
#COM      Analysis Settings
#COM =====
#COM
#COM : General Factors
#COM
setValue {} {} GradientComputationMethodChannelMAX 16; #COM 16:FEMFAT 2.4  33:Vector Reconstruction  34:Vector Reconstruction reduced
setValue {} {} InfluenceStressGradientEnduranceLimit 1
setValue {} {} InfluenceStressGradientSlopeCycleLimit 1
setValue {} {} InfluenceStressGradientMethod 16; #COM 2:IABG  6:Stieler  16:FEMFAT 2.4  17:FKM-Guideline
setValue {} {} InfluenceMeanStressEnduranceLimit 1
setValue {} {} InfluenceMeanStressMethod 24; #COM 17:FKM-Guideline (mod.)  24:FEMFAT 4.1  39:User defined  44:M = const., FKM-Guideline
```

Complemented Aluminum materials



FF2023_ReleaseNot... x		
39 / 56 96,2%		
11.1 New or modified materials in the database		
V 2022.1	EN-AW-5052_O_FKM2002.ffd AA-5052_O_FKM2002.ffd JIS-A5052P_O_FKM2002.ffd	Correction of the alternating endurance strength at the "Type Dependent S-N Data"
V 2023	EN-GJL-100_FKM2012.ffd ASTM-A48-20B_FKM2012.ffd JIS-FC100_FKM2012.ffd	Correction of the compressive pulsating endurance strength
Aluminum materials complemented with temperature dependent material data (Young's Modulus, Ultimate Strength, Yield Strength, Elongation at Rupture) according to "Properties of Aluminum Alloys", J. Gilbert Kaufmann, 2002 Remark: The temperature dependency of the alternating endurance strength was defined according to the German FKM-Guideline 2020. For the elongation at rupture a new ffd-dataset 425 was included. This dataset is still not used by FEMFAT now.		
	EN-AC-42000_T6_mold_casting_FKM2002.ffd AA-A356.0_T6_mold_casting_FKM2002.ffd JIS-AC4C_T6_mold_casting_FKM2002.ffd	Temperature dependent material data
	EN-AC-42000_T6_precision_casting_FKM2002.ffd AA-A356.0_T6_precision_casting_FKM2002.ffd JIS-AC4C_T6_precision_casting_FKM2002.ffd EN-AC-42000_T6_sand	

The background of the entire image is a dark field filled with numerous bright red, diagonal lines that resemble laser beams or light trails, creating a sense of motion and energy.

ii MAGNA

Forward. For all.

In the bottom right corner, there is a blue wireframe grid pattern, similar to a technical drawing or a digital mesh, which adds a technological or architectural feel to the composition.