fe-safe 2024
WHAT'S NEW?

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fe-safe 2024 GA

GA.1 Support for 2024 Abaqus ODB files

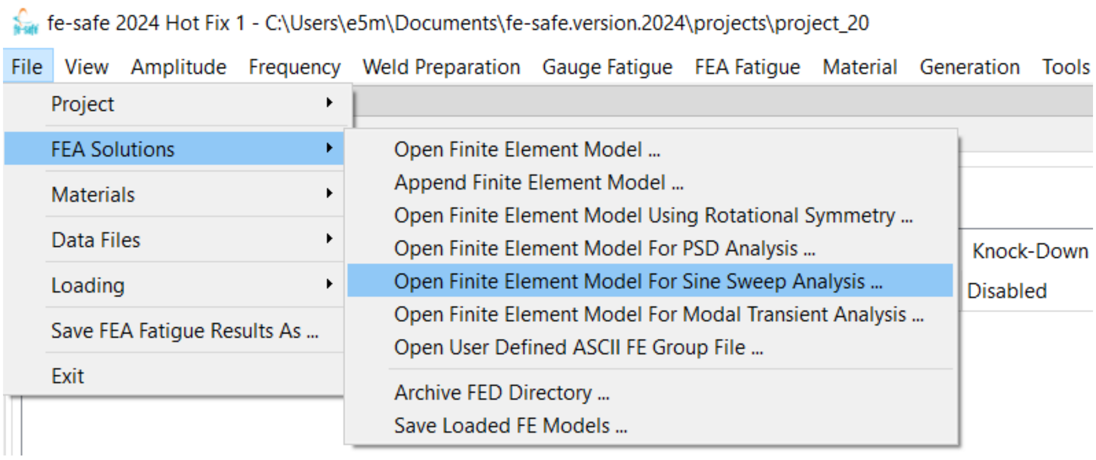
fe-safe 2024 FD01 (FP.2405)

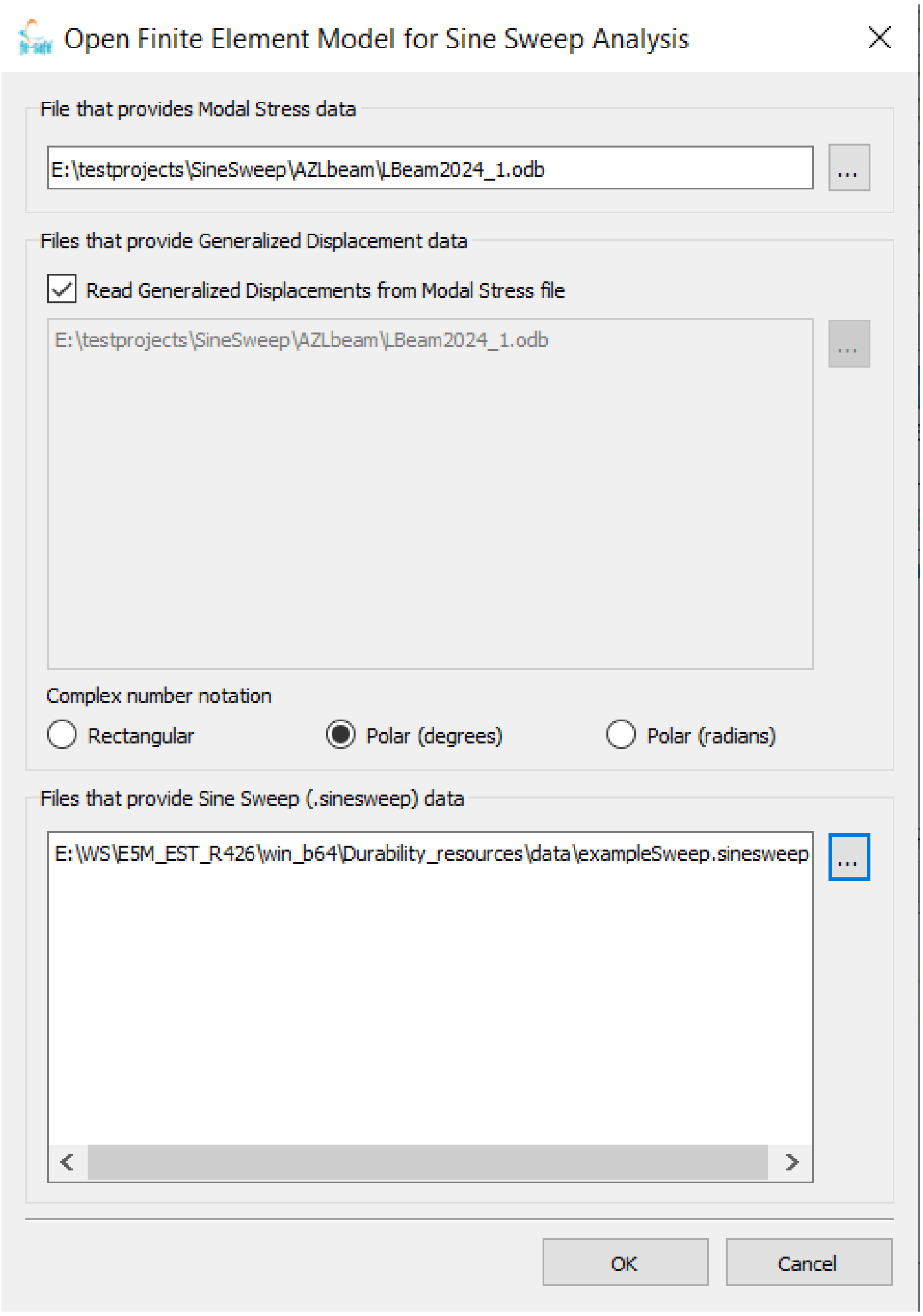
FD01.1 Sine Sweep

Many automotive manufacturers do not have accurate fatigue loading data for the mechanical components they build. In such cases the solution is to design in compliance with particular guidelines or rely on simplified tests that are able to cover the worst case scenarios. The Sine Sweep Vibration Test is one of those simplified tests that can be used to assess the component's durability, particularly with respect to the eigenfrequencies of the structure. In a sine sweep test the base excitation input consists of a single frequency at any given time, but the frequency itself varies with time. It may begin at a low frequency and then sweep up to a high frequency, be maintained for a while, then be reduced again. The new Sine Sweep fatigue analysis is in the frequency domain, like the random vibration (PSD) capability. The generalized displacements (aka modal coordinates) and modal stresses obtained from a harmonic analysis are combined with the definition of the base excitation sweep amplitudes to obtain a frequency amplitude response function, which is then integrated over to obtain the total damage.

Creating a sine sweep job

A Sine Sweep analysis is defined in a similar way to a random vibration analysis, using a specialized FEA Solution Open option as indicated below. This leads to a similar dialog to the random vibration analysis, but a .sineweep text file is supplied instead of the PSD file. This consists of a header defining total sweep time, rate type (linear or log), and optional units; followed by a table of frequency-amplitude pairs defining the sweep and the input acceleration amplitudes. An example is given below, with specification details in the User Guide.





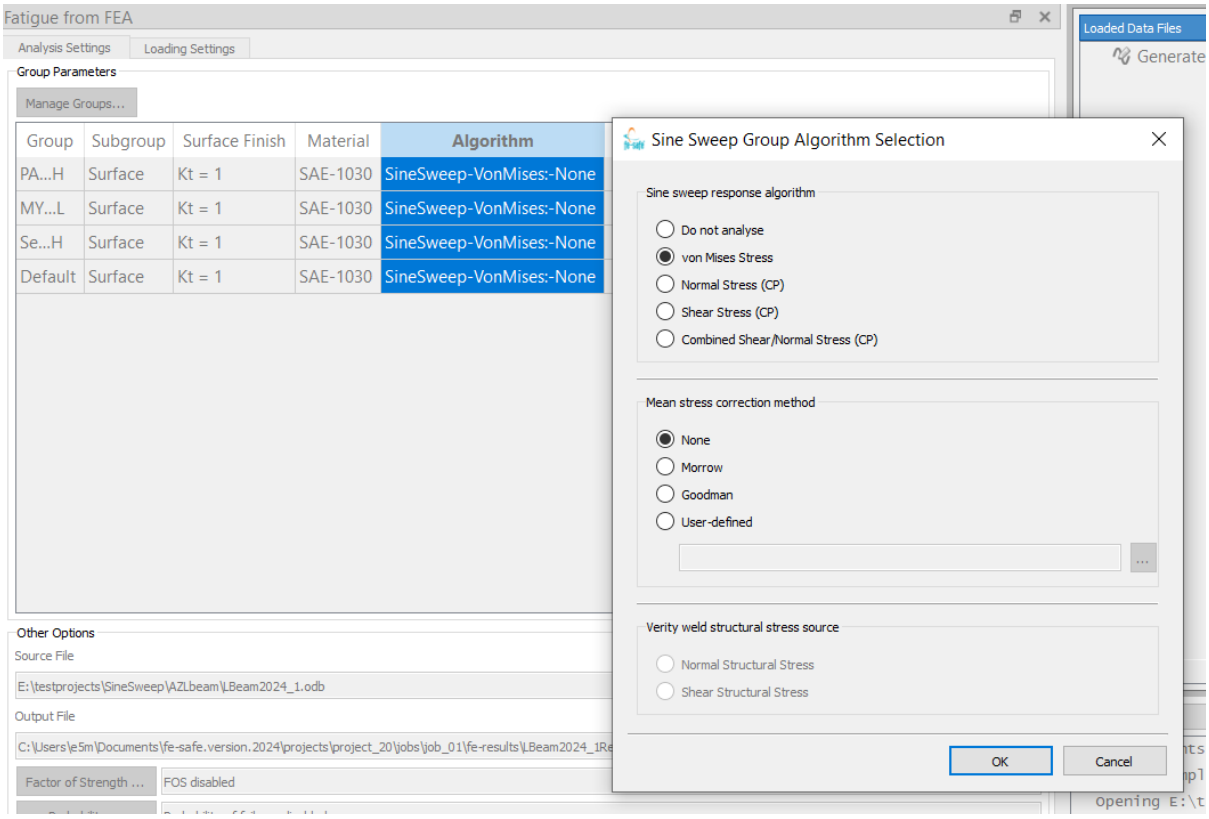
Sine Sweep response algorithm selection

The response function analysis options are similar to the random vibration, and are selected through a specialization of the group algorithm menu:

- Von Mises
- Normal Critical Plane
- Shear Critical Plane
- Combined Shear and Normal Critical Plane

A residual stress can also be defined, and a mean stress correction selected for it.

If a weld group is analysed, then a special response function based on the structural stress is used (similar to with random vibration), using either the normal or shear structural stress as selected.



Sweep Definition Example

An example of the .sinesweep definition file is shown below, giving header information followed by frequency/acceleration inputs from 0.5 to 200Hz. See User Guide for further details on header options.

```
Exposure time: 1200s
LogSweep
Frequency units: Hz
Acceleration units: m_s2
0.5 0.01
1    0.25
5    0.5
10   1.0
50   1.0
100   1.0
150     0.5
175 0.1
200 0.0
```

FD01.2 DTMF with TCD

The DTMF algorithm and plug-in algorithms can now be used with Critical Distance (TCD) calculations.

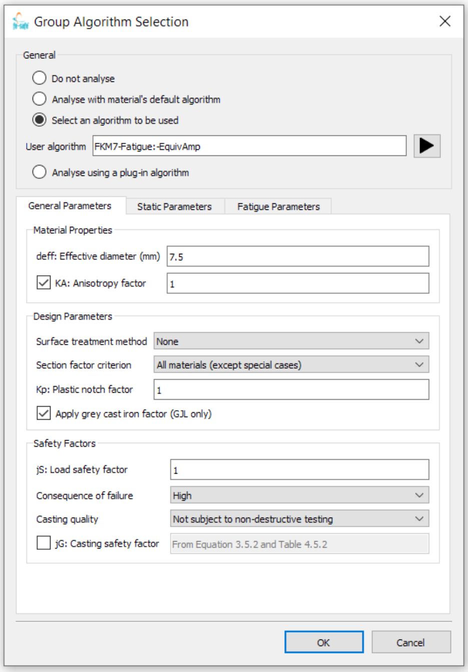
FD01.3 FKM7

The FKM fatigue assessment algorithm has been updated to comply with the latest 7th Edition of FKM Guideline, ‘Analytical Strength Assessment of Components Made of Steel, Cast Iron and Aluminum Materials’.

In addition to fatigue assessment of non-welded components, you can now carry out the static assessment of non-welded components, where a static assessment is performed at each turning point of the fatigue loading.

The material databases distributed with fe-safe have been updated according to the 7th Edition. Materials can be selected from either the ‘FKM_Fe.dbase’ (for steel/iron) or ‘FKM_Al.dbase’ (for aluminium) material databases.

Many of the parameters used in static and fatigue assessments can be set through the Group Algorithm Selection dialog.



fe-safe 2024 FD04 (FP.2432)

FD04.1 Legacy Feature Deprecation

The following legacy features are deprecated and will produce a warning when used. These features will be removed in the next major release.

Legacy settings in macros:

- [use legacy planes]
- [old stress based BM material approximation]
- [disable failed directional cosine to XYZ] or keyword DISABLEDCXYZ

FEA Fatigue >> Analysis Options >> Legacy settings:

- Run legacy TCD method. Used to perform TCD analysis using a slower and more restricted method.
- Allow quadratic interpolation in TCD. Used to disallow quadratic interpolation for second order elements in TCD analysis.
- Use legacy spot weld stresses. Used to analyse spot welds without a critical plane analysis. Macro setting: [use legacy spot weld stresses]
- Pre-apply equivalent structural stress function to the full history. Reverts to old behavior rather than the current behavior which is to compute equivalent structural stress on the extracted structural stress cycles. Macro setting: [legacy equivalent structural stress]
- Use legacy Verity LU decomposition for weld structural stress. Macro setting: [use verity LU decomposition]

FEA Fatigue >> ABAQUS ODB Interface Options:

- Allow ODB files with multiple parts and instances. Used to disable ODB instance support. Macro setting: [enable instance support]

Define a fatigue loading without using a LDF file:

- Macro Keywords: LOADINGTYPE, SEQFILE, SPECTRUM, transitions, NumSigs, sigNum*, sigName*, dssNum*

- Macro settings [loading mode], [loading (legacy)]

FD04.2 fe-safe/Rubber upgrade

A new version of the fe-safe/Rubber plug-in, designated 20240618, has been applied.

Plane-search

fe-safe/Rubber is a plane-based algorithm. In previous versions, two plane-searches were available:

- a rectangular search, using equal intervals of spherical polar coordinates; and
- a triangular search, which divides the space of critical planes into triangles of equal area. This was the default.

In this version, the less efficient rectanglar plane-search has been withdrawn. The following associated settings are therefore obsolete:

- Damage Sphere: Type (1=RECT, 2=TRI)
- Damage Sphere: RECT N[phi]
- Damage Sphere: RECT N[theta]

A tabulation of life over the plane-search may be output to <output_name>DAMAGESPHERE.log and, in this version, the columns for minimum and maximum cracking energy density have been removed.

Crack growth rate table

A tabulation of the crack growth rate may be output to file <output_name>VERIFYFCGR.log. In this release, verification only uses the cyclic crack growth model, so the following columns have been removed:

- Quasi-Static Crack Growth Rate (`QSCGR`)
- Total Fatigue Crack Growth Rate (`TotalFCGR`)

Crack Energy Density table

A tabulation of the Crack Energy Density may be output to file <output_name>CEDHISTORY.log. In this version, engineering stresses have been replaced with Cauchy stresses.

Numerical changes

A new method of numerical integration has been introduced, which is both faster and more accurate. Minor changes in results may be observed as a consequence.

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Dassault Systèmes
175 Wyman Street
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02451-1223
USA

Europe/Middle East/Africa
Dassault Systèmes
10, rue Marcel Dassault
CS 40501
78946 Vélizy-Villacoublay Cedex
France

Asia-Pacific
Dassault Systèmes K.K.
ThinkPark Tower
2-1-1 Osaki, Shinagawa-ku,
Tokyo 141-6020
Japan