



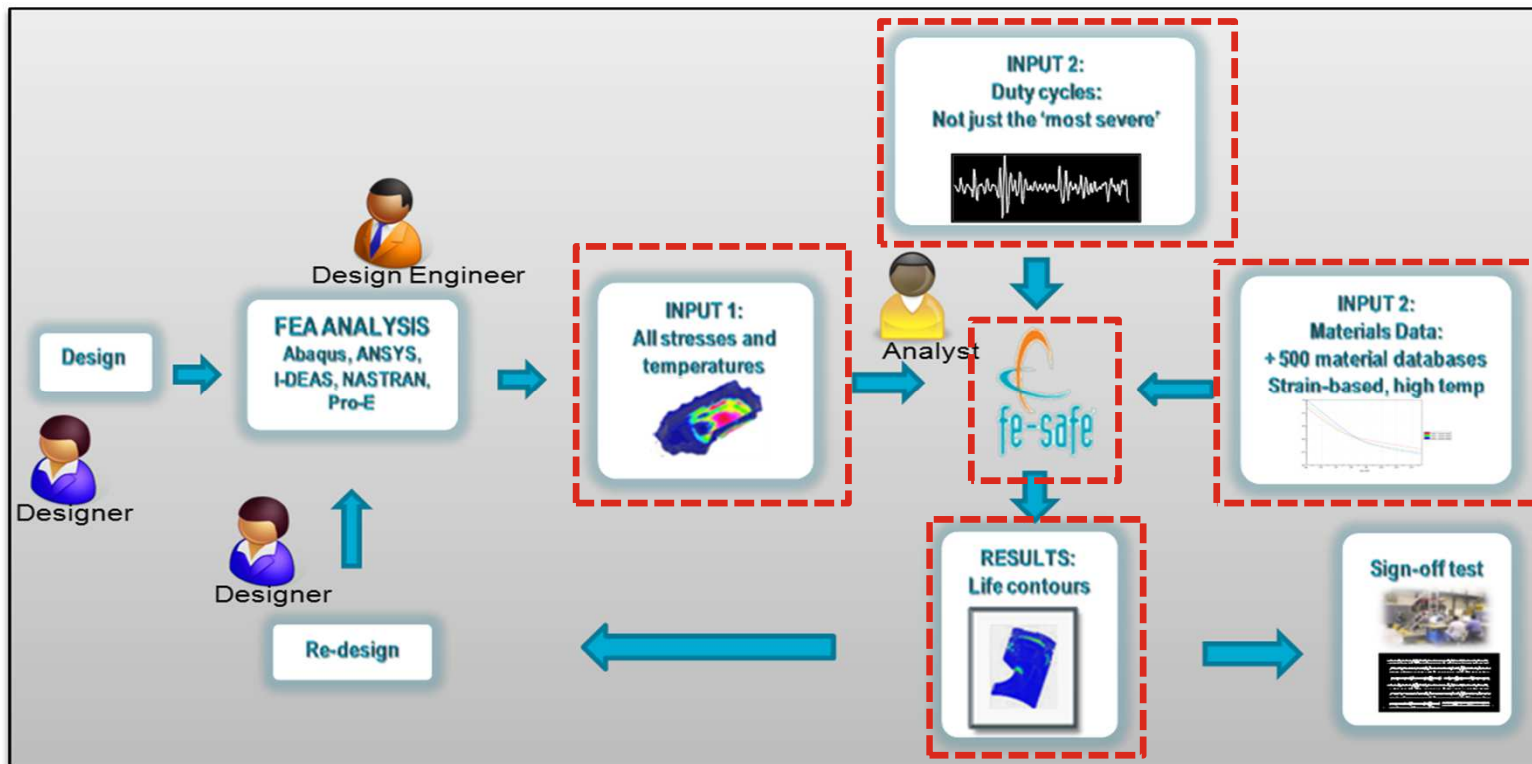
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## fe-safe ANSYS Workbench Solution Applied to Powertrain Components

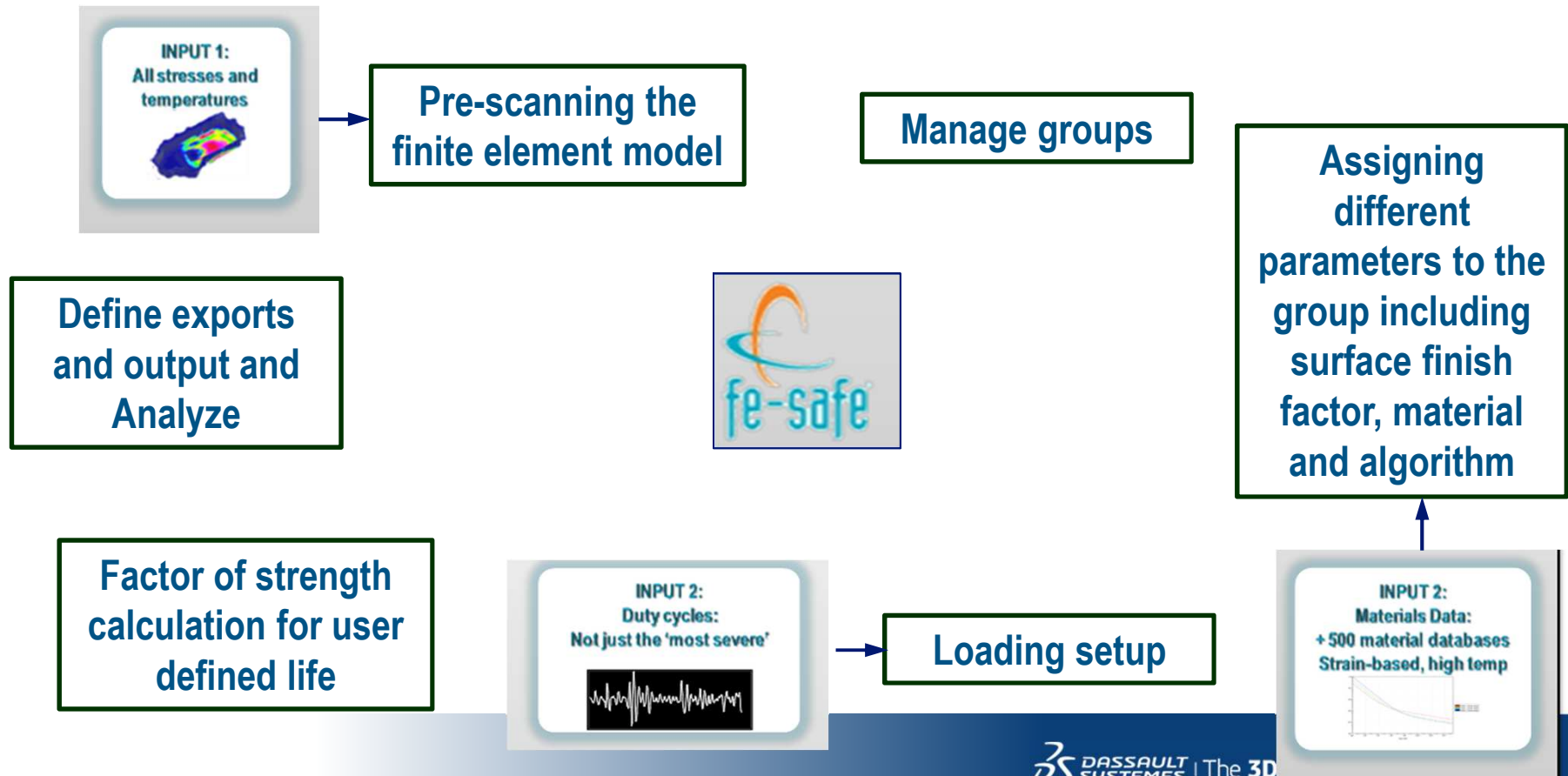
fe-safe UGM, October 19 2016

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# The fatigue analysis process



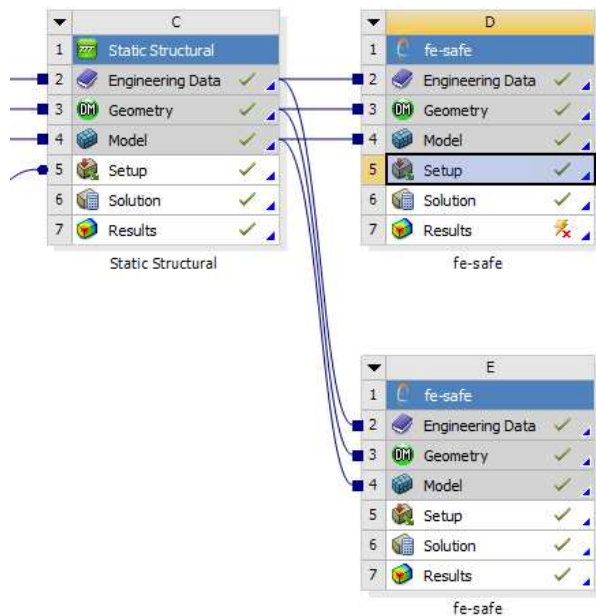
# The fatigue analysis process



## fe-safe Workbench – general design

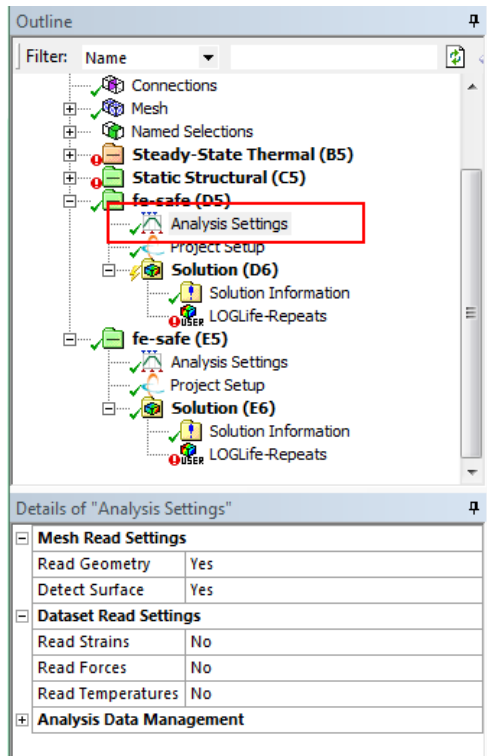
- The fe-safe ANSYS Workbench extension is designed to allow simple workflows to be setup and executed without starting an fe-safe GUI session.
- For more advanced workflows, the user can open an fe-safe GUI session from ANSYS Mechanical (“Advanced Setup”).
- In all workflows, the fe-safe analysis groups are based on either geometry selections or named selections. When coupled with automatic material assignment, this greatly streamlines the fatigue analysis setup.

# fe-safe Workbench features – Project Schematic



- Each column (C, D and E) is a Workbench *system*
- Systems D and E are fe-safe systems, which both read the results (RST) file from Static Structural system C
- Systems D and E are independent of each other and have their own fatigue results
- Like other Workbench systems, Systems D and E will be re-solved when System C is re-solved

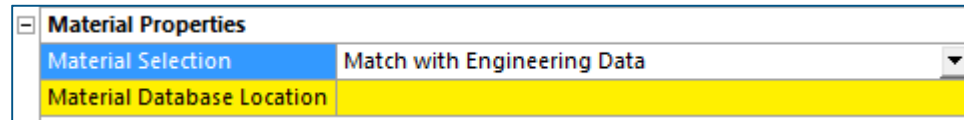
# fe-safe Workbench features – Basic Setup



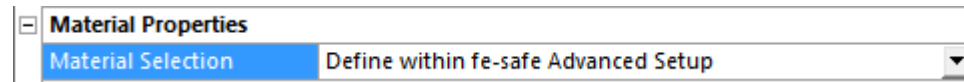
- Like other Workbench systems, setup of the fe-safe system is performed within ANSYS Mechanical, and each system has its own item within the setup tree
- Settings that tell fe-safe what to read from the ANSYS solution are available under “Analysis Settings”

## fe-safe Workbench features – Materials

- fe-safe is not directly compatible with the materials ANSYS provide in Engineering Data – fatigue properties are usually not present.
- Instead, materials assignments in ANSYS can be automatically matched (by name) to fe-safe compatible materials in a \*.dbase file. The user must indicate to ANSYS which \*.dbase file to use.



- Alternatively, the user can make “manual” material assignments in the fe-safe GUI.



# fe-safe Workbench features – Analysis Scope

- The scope of the fatigue analysis can be restricted using the normal scoping tools in ANSYS Mechanical. Bodies and named selections can be selected, and fe-safe will limit the fatigue analysis to those regions.

Fatigue Analysis Scope	
Scoping Method	Geometry Selection
Geometry	

Fatigue Analysis Scope	
Scoping Method	Named Selection
Named Selection	

- Alternatively, all named selections can be used. This allows the user to carry out complex group setup within the fe-safe GUI.

Fatigue Analysis Scope	
Scoping Method	All Named Selections



# fe-safe Workbench features – Fatigue Loading

- Simple single-block dataset-sequence loadings can be configured within ANSYS Mechanical.

Loading Block	
System	Static Structural (C5)
Step Sequence	1,2,3
Increment Sequence	All
Scale	1
Repeats	1

- The steps that make up the sequence can be specified (or special targets like “All” or “Last” can be used).
- The LDF file will be automatically generated based on these settings. For more complex loadings, Advanced Setup must be used.

# fe-safe Workbench features – Other Properties

- Surface finish properties can be controlled in ANSYS Mechanical. These are applied to every analysis group. For finer control, Advanced Setup should be used.

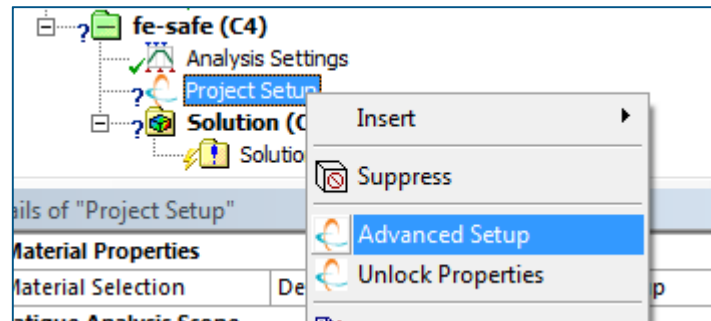
Surface Properties	
Define Surface By	Kt Value
Kt Value	1

- FOS analyses can be also be configured directly in the ANSYS Mechanical properties.

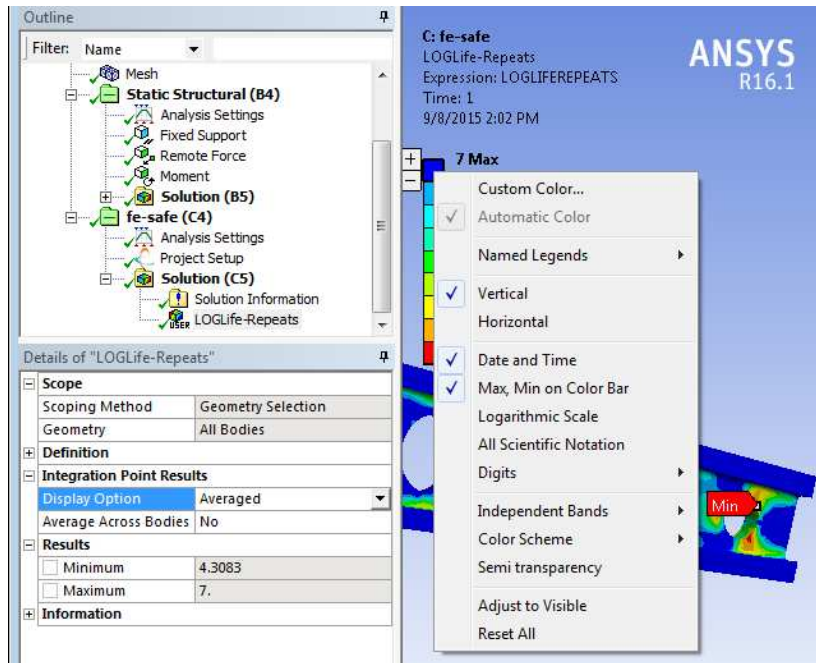
FOS Properties	
Perform FOS Calculations	Specify Design Life
Design Life	1000
Apply Corrections To Safety Factors	Disabled

# fe-safe Workbench features – Advanced Setup

- The “Advanced Setup” mode can be used to further refine the analysis setup. This opens the standard fe-safe application, and automatically defines the analysis groups based on the choices made in Workbench.



# fe-safe Workbench features – Results

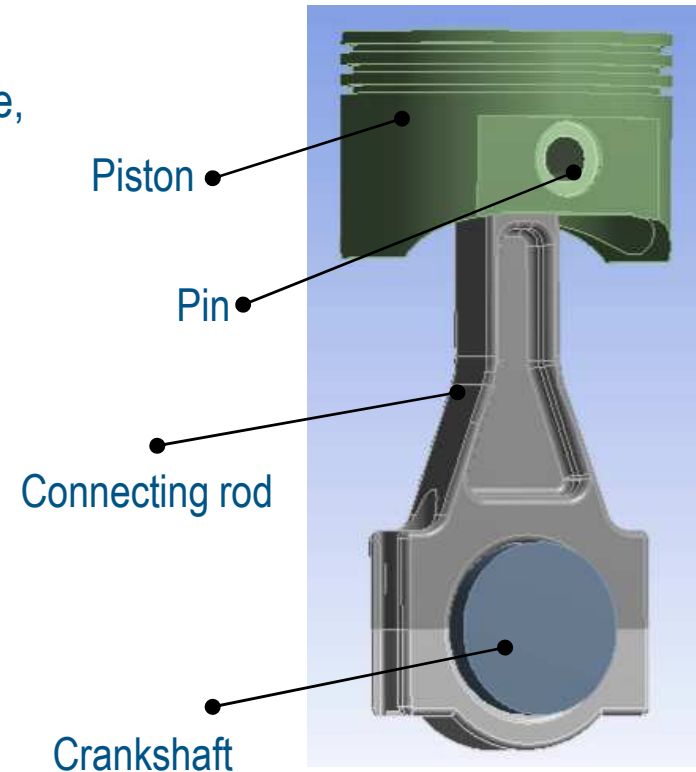


- By default, the fe-safe Workbench extension will always produce a Log-Life Repeats contour when the system is solved. The colour scheme needs to be manually reversed in Workbench.
- If extra export contours are selected in “Advanced Setup”, they will be available for viewing under the “Solution” item when analysis completes.
- The fe-safe log can be viewed in the “Solution Information” item.

# fe-safe Workbench – Applied to powertrain applications

In most modern vehicles, the powertrain includes the engine, transmission, drive shaft, differentials and what is known as the final drive.

Modern engines place greater requirements on cylinder components and in particular the power cell assemblies, are under subject to constant efforts to increase overall efficiency, e.g., by reducing weight of the power cell assemblies and/or increasing pressures and temperatures associated with engine operation.



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