Knowledge Base

Information

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Abaqus/CAE plug-in to efficiently assign section properties, element types, and meshes to a large number of parts

Portfolio / Domain: SIMULIA Abaqus Unified FEA / SIMULIA Abaqus Unified FEA
Product: SIMULIA Abaqus/CAE

QUESTION

I have an Abaqus/CAE model with a large number of parts and instances. I would like to quickly assign section properties, element types, and mesh each part from a central location. Is there a tool that can make these processes more efficient?

ANSWER

(The following applies to Abaqus Version 6.10 and later)

An application for this purpose is described below. The Part Manager Extension (PME) allows you to assign section properties, element type and formulation, and to mesh multiple parts in a manager-like dialog. This tool is intended to facilitate the aforementioned operations. It is not meant to automatically mesh complex or challenging parts. A suggested usage is for models with dozens, or even hundreds, of fairly uniform parts.

Installation

To install the plug-in, save the attached archive file to one of the following directories:

abaqus_dir\abaqus_plugins where *abaqus_dir* is the Abaqus parent directory

home_dir\abaqus_plugins where *home_dir* is your home directory

current_dir\abaqus_plugins where *current_dir* is the current directory

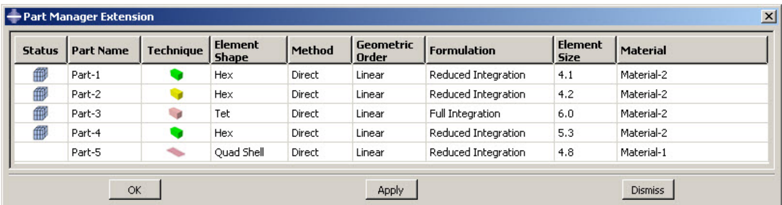
Note that if the abaqus_plugins directory does not exist in the desired path, it must be created. The *plugin_dir* directory can also be used, where *plugin_dir* is a directory specified in the abaqus_v6.env file by the environment variable **plugin_central_dir**. You can store plug-ins in a central location that can be accessed by all users at your site if the directory to which **plugin_central_dir** refers is mounted on a file system that all users can access. For example,

plugin_central_dir = r'\\fileServer\sharedDirectory'

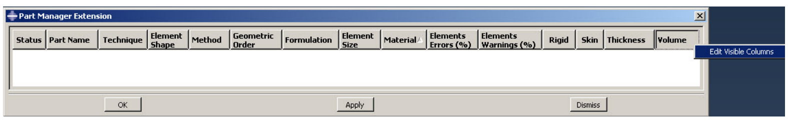
On Windows platforms, right click on the archive file and select **WinZip → Extract to here**. On Linux platforms, type **unzip pme.zip** at the command prompt. A folder named abq_Pme and a file named pme_plugin.py will be extracted. Note that the plug-in will not function properly if this procedure is not followed.

Usage

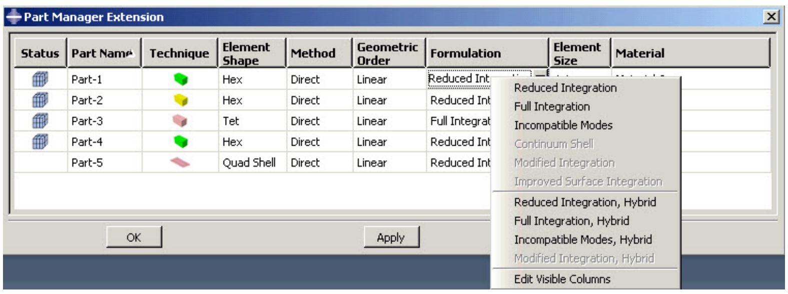
PME can be launched from the **Part** or **Assembly** modules. When activated, the plug-in lists all parts available in the current model, along with section properties, element shape, and part and mesh information. Select **Plug-ins→Tools→Part Manager Extension...** to invoke the following dialog:



Because of the size of the table, only 9 columns are shown by default. Visible columns can be modified by using the right-mouse button (RMB) command **Edit Visible Columns**. Shown below are all available columns:



PME uses RMB functionality extensively, and most menus and operations are available this way. For example, the **Formulation** column contains a large number of menus, as shown below.



The menu above is activated when selecting one cell, or the header cell of the column. If the header cell is selected, all the cells in that column are automatically selected; if the command is then submitted, it will be applied to all the cells.

Sorting is also available through the left mouse button. Select any column to sort. Use sorting and the multiple selection functionalities to quickly apply the values to various cells in the PME dialog table.

In addition, you can suppress or resume any part. This will suppress or resume the corresponding assembly instance (if it exists). These RMB commands are only available in the **Status**, **Part Name** or **Technique** columns.

Column Description

Status

A blank cell means no mesh exists for this part.

The icon means the part is meshed. You can change attributes of this part but the change will only be applied the next time the dialog is submitted.

The icon means the instance has been suppressed.

The icon means meshing failed with the given controls. Note that a previous mesh may still exist in the part.

"Skip" means the part will be skipped when meshing.

"Don't Skip" resumes the Status to its previous value.

Part Name (non-editable)

Name of the part.

Technique (non-editable)

Shows the default meshing technique for a particular part when PME is first launched. This column does not change when meshing technique is changed (either from PME or the Mesh module). This is useful as a reference to know which meshing technique (usually structured hex mesh) can still be used for any given part.

The icon means 3D solid, free.

The icon means 3D solid, structured.

The icon means 3D solid, swept.

The icon means 3D shell, free.

The icon means 3D shell, structured.

Element Shape

Select from **Hex**, **Tet** or **Quad Shell** to specify the element shape. If **Quad Shell** is selected for a 3D part, then you must select a surface that will act as the bottom surface. A top surface will be determined, then a mid-surface created and meshed with quads from the two surfaces.

Method

Select this option to determine how the part will be meshed

Direct - The part will be meshed as requested in **Element Shape**

Virtual Topology - Assigns automatic virtual topology (with default settings) to the part. The part will then be meshed with hex elements if possible. If not, tet elements will be used.

Extrude - Generates a new mesh part by extruding from a user-selected bottom surface and extruding through a thickness. This is useful for parts that may have started out as flat pieces and were formed into complex geometries.

Automatic - Tet meshes only. PME will mesh with the provided controls. If unable, the element size is reduced until a mesh is achieved. This iteration is performed a maximum of five times. After five attempts, virtual topology is applied and another meshing attempt is performed.

Geometric Order

Select linear or quadratic for the element geometric order.

Formulation

Select the formulation type. This refers to the element type and gives a grouped subset of the options available in the **Mesh** module. Possible values are **Reduced Integration (Hybrid)**, **Full Integration (Hybrid)**, **Incompatible Modes (Hybrid)**, **Continuum Shell**, **Modified Integration (Hybrid)**, and **Improved Surface Integration**. Depending on the **Element Shape**, some options may not be available.

Element Size

Enter the element size.

Material

Select the material to be assigned to each part.

Element Errors (%) (non-editable)

Percentage of elements that contained errors after default analysis checks performed by Abaqus/CAE.

Element Warnings (%) (non-editable)

Percentage of elements that contained warnings after default analysis checks performed by Abaqus/CAE.

Rigid

Turns the part into a rigid part. Note that a reference point is automatically created at a default location. Same meshing technique is still applied to the part.

Skin

Apply skins to all the exterior surfaces of a solid, rigid part.

Thickness

Enter shell thickness.

Volume (non-editable)

Total element volume for the part.

Notes

Surface Selection

Surface selection occurs for the **Element Shape** and **Method** columns. Once a surface is selected, it will remain selected, even if the part does not require a surface anymore. If further changes are done to the part, the previous surface is automatically used unless you re-select (for example, using the **Pick Bottom Surface** option) the surface.

Temporary Part

When selecting **Quad Shell** (under **Technique**) or **Extrude** (under **Method**), please note that a temporary part is created and meshed. If an instance of the original part exists in the assembly, it will be replaced by the meshed instance of the temporary part. This temporary part will not be displayed in the manager list of the PME dialog. You can, though, select it from the **Part:** drop-down menu and review it. Also note that in the PME dialog, the original part **Technique** will still refer to the original part, not the temporary part.

The temporary part will contain a suffix in its name. By default it is _mp. If this syntax creates a conflict, please edit the file pmeConstants.py and change the value of the variable partSuffix. This variable is available at the top of the file and you can edit with any text editor.

If the **Technique** or **Method** entry is changed and a temporary part is no longer needed, the existent temporary part will be deleted.

PME meshes the parts at part-level. Therefore, independent instances will not be meshed. Also, although having dependent instances for each part is suggested it is not a requirement. The tool will still mesh each part. It will not be able to do any assembly-level operation such as replacing an instance.

PME uses customData to store information. This allows data to be persistent between sessions. The first time a database is loaded, it does not check if a mesh already exists. Thus, the table status may be blank for meshed parts. After PME is submitted for the first time, it will track each part's mesh status.

The **Element Size** and **Thickness** columns cannot be edited. These columns launch another dialog, therefore the RMB menus are not available.

Columns **Part Name**, **Technique**, **Element Errors**, **Element Warnings**, and **Volume** are non-editable.

The Suppress/Resume instance functionality is not the same as the "Skip" functionality. One suppresses the instance but still meshes the part. "Skip" does not mesh the part but does not affect the instance.

Limitations

1. The plug-in will not work if the part instances available in the assembly do not have corresponding parts. Such part instances must be removed before using the plug-in.
2. If a user suppresses or resumes a part instance from the model tree in Abaqus/CAE, the status will not be updated in the Part Manager Extension plug-in.
3. If a part has a suppressed status (red cross) in the Part Manager Extension plug-in dialog, the plug-in will not mesh the part.
4. When there are several part instances in the model database a delay can be observed in launching the plug-in from the plug-in menu.

Disclaimer

The attachments to this article are subject to certain usage conditions. Please click here for details.

Revision History

04 May 11	Release 1.1-1

KEYWORDS **plug-in, plugin, 4794**

ATTACHMENT

answer_4794_pmeicondeactivated.png
answer_4794_fig1.jpg
answer_4794_fig3.jpg
answer_4794_pmeiconshellstructured.png
answer_4794_fig2.jpg
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