

Knowledge Base

Information

QA Article: QA00000008126e
 Applicable Level: 6.9
 1)
 Last Update Date: 31.10.2020
 Rating:
 Views: 880



Abaqus/CAE plug-in to calculate A, B, and D matrices and equivalent extension and bending moduli for composite lay-ups

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

QUESTION

My model includes composite laminate definitions, and I would like Abaqus/CAE to print out the A, B, and D laminate stiffness matrices. Can this be done?

ANSWER

(The following applies to Abaqus 6.9 and higher.)

Abaqus/CAE does not directly calculate A, B, and D matrices. However, a plug-in utility that extends the functionality of Abaqus/CAE is attached to this Answer. This eliminates the need for parsing the analysis data file for the shell stiffness matrices.

Installation and Usage

Native CAE plug-ins are included with the Abaqus/CAE installation. External plugins (those installed after installation of Abaqus/CAE) should not be put inside the Abaqus/CAE installation. To install the plug-in, save the attached archive file to one of the following directories:

```
home_dir\abaqus_plugins
current_dir\abaqus_plugins
```

where *home_dir* is your home directory and where *current_dir* is the current directory.

The *plugin_dir* directory can also be used, where *plugin_dir* is a directory specified by the environment variable **plugin_central_dir**. This parameter is used to define a specific directory where plugins are stored. This is typically a central location accessed by all users at your site if the directory is mounted on a file system that all users can access. **plugin_central_dir** can be defined in the *abaqus_v6.env* file or the Abaqus solver *custom_v6.env* file. For example,

```
plugin_central_dir = '\\fileServer\share\AbaqusPlugins'
```

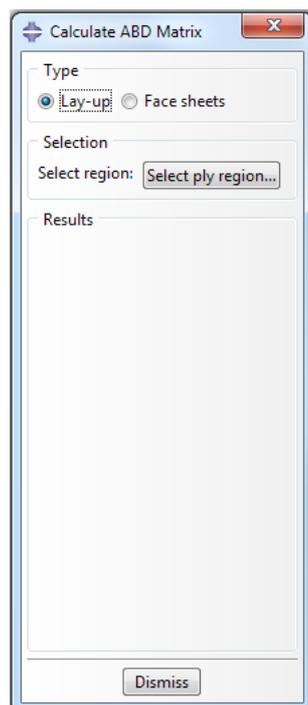
On Windows platforms, right click on the archive file and select **WinZip** → **Extract to here**. On Linux platforms, type **unzip abdMatrix.zip** at the command prompt. Folders named *abq_AbdMatrix* and a file named *abdMatrix_plugin.py* will be extracted. Note that the plug-in will not function properly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

Usage

The utility works by selecting a region where a composite layup has been defined and printing out the A, B, and D matrices.

Note: A geometry set containing the surface or volume associated with the composite layup must exist for the plug-in to operate. For example, if conventional shell elements are being used, a set containing the surface on which the shells will be meshed must be created before the plug-in is launched.

It is launched from the **Property** module only. Select **Plug-ins** → **Tools** → **Calculate ABD Matrix...** to open the following dialog:



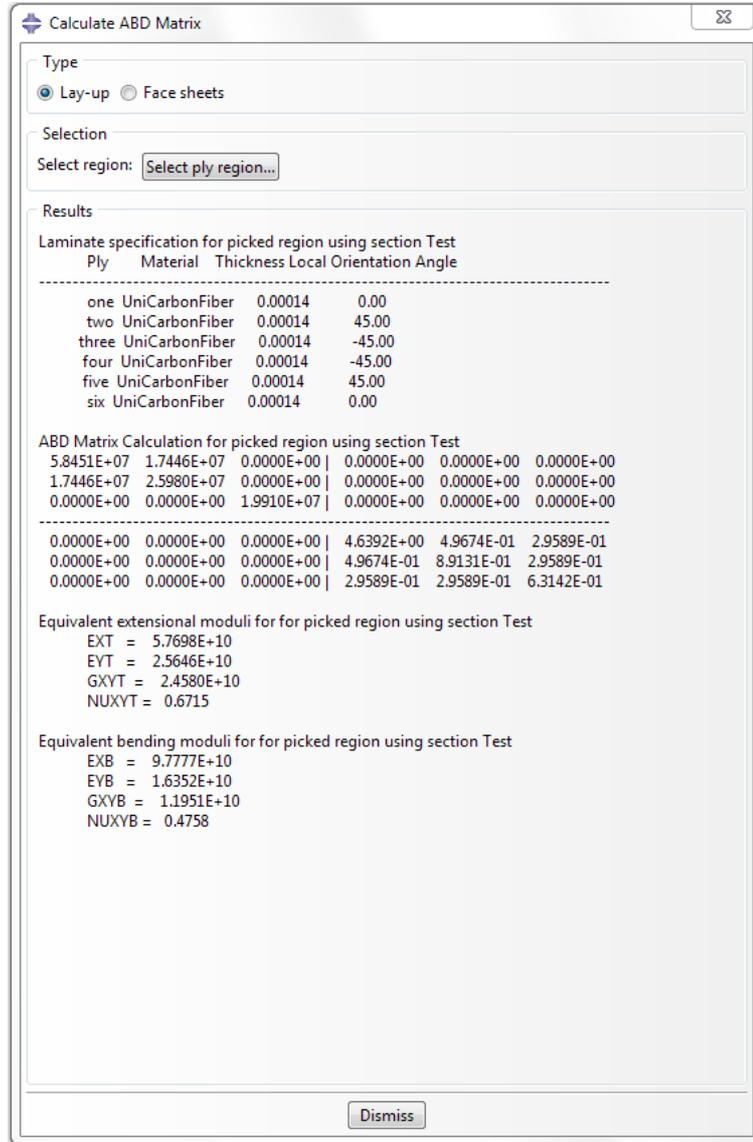
For **Type**, select **Lay-up** or **Face sheets**. Selecting **Lay-up** will calculate the stiffness matrices for the entire composite. Selecting **Face sheets** calculates the stiffness matrices, but it expects a "sandwich" construction; thus, after selecting

the region from the viewport, the utility will post a new dialog box with the different plies found for this region. You must select a ply to act as the "core" and press **OK**. The utility will then run twice: once to calculate the matrices for the plies above the core and once for plies below.

Click on **Select** to select a face or region for either the lay-up or face sheet. Upon viewport selection, the utility will automatically calculate the A, B, and D matrices and list the output in both the **Results** area and the command line interface (CLI).

Output

An example of the output given in the **Results** area is shown below:



The sequence of plies from the selected region is listed at the top. In the middle of the results print out, the four 3x3 matrices (A, B, B^T and D) are given. As a convenience, the equivalent extension and bending moduli are also made available if the laminate stacking sequence is symmetric.

Notes

1. For lay-up definitions, all plies are included - regardless of if they are turned on or off, and without consideration for which section you may want.
2. A ply lay-up definition takes precedence over a section assignment.
3. If multiple lay-up or section assignments have been applied, the last one is used.
4. Offset values supported are TOP, BOTTOM, MIDDLE and specified. Distribution and FROM GEOMETRY are not supported.

Revision History

02 Sep 10	Release of Release 1.1-1
19 Nov 12	Fixed a bug with composite layup angle.
15 March 16	Release of version 1.2-1 (Added support for anisotropic and orthotropic material properties)
5 May 2016	Release of version 1.2-2 (Fixed bugs related to picking parts in viewport)
16 Jan 17	Release of version 1.2-3 Generalization of calculation of equivalent properties. Earlier versions assumed symmetric and balanced stacking sequences.

Disclaimer

The attachments to this article are subject to certain usage conditions. Please [click here](#) for details.

KEYWORDS composite, lamina, laminate, sandwich, 4531

ATTACHMENT [answer_4531_fig1a.png](#) [abdMatrix.zip](#) [answer_4531_fig2b.png](#)

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