**midplane**

Computes the midplane strains and curvatures

**Inputs**

- **tplies** - Thickness of each ply
- **nplies** - Number of plies
- **[A]** - Extensional stiffness matrix
- **[B]** - Coupling stiffness matrix
- **[D]** - Bending stiffness matrix
- **[NM]** - Mechanical forces acting on laminate
- **[MM]** - Mechanical moments acting on laminate
- **[NT]** - Fictitious thermal forces acting on laminate
- **[MT]** - Fictitious thermal moments acting on laminate
- **[NC]** - Fictitious moisture forces acting on laminate
- **[MC]** - Fictitious moisture moments acting on laminate

**Outputs**

- **[eps0]** - Midplane strains
- **[kappa]** - Midplane curvatures

**Calling the Function**

```
[eps0, kappa] = midplane(A, B, D, NM, MM, NT, MT, NC, MC)
```

**Testing File**

Click [here](#) to see a testing file for using the function *midplane*

**Example**

**Inputs:**

**Extensional Stiffness Matrix:**

<table>
<thead>
<tr>
<th></th>
<th>23710000</th>
<th>13410000</th>
<th>14640000</th>
</tr>
</thead>
<tbody>
<tr>
<td>13410000</td>
<td>23710000</td>
<td>14640000</td>
<td></td>
</tr>
<tr>
<td>14640000</td>
<td>14640000</td>
<td>15010000</td>
<td></td>
</tr>
</tbody>
</table>

**Coupling Stiffness Matrix:**

<table>
<thead>
<tr>
<th></th>
<th>1.0e+03 *</th>
<th>1.3400</th>
<th>0.0000</th>
<th>-0.5334</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3400</td>
<td>0.0000</td>
<td>1.3400</td>
<td>0.5334</td>
<td></td>
</tr>
<tr>
<td>0.0000</td>
<td>0.5334</td>
<td>0.0000</td>
<td>0.0000</td>
<td></td>
</tr>
</tbody>
</table>
Bending Stiffness Matrix:

\[
\begin{bmatrix}
0.2907 & 0.1443 & 0.1641 \\
0.1443 & 0.2907 & 0.1641 \\
0.1641 & 0.1641 & 0.1630
\end{bmatrix}
\]

Mechanical Forces:

\[
\begin{bmatrix}
4 \\
5 \\
15
\end{bmatrix}
\]

Mechanical Moments:

\[
\begin{bmatrix}
7 \\
8 \\
11
\end{bmatrix}
\]

Fictitious Thermal Forces:

\[
\begin{bmatrix}
6787 \\
6787 \\
-3361
\end{bmatrix}
\]

Fictitious Thermal Moments:

\[
\begin{bmatrix}
0.1538 \\
-0.1538 \\
-0.0000
\end{bmatrix}
\]

Fictitious Moisture Forces:

\[
\begin{bmatrix}
14900000 \\
14900000 \\
-7632000
\end{bmatrix}
\]

Fictitious Moisture Moments:

\[
\begin{bmatrix}
349.2000 \\
-349.2000 \\
-0.0000
\end{bmatrix}
\]

Outputs:

Extensional Stiffness Matrix:

\[
\begin{bmatrix}
2.9220 \\
2.9133 \\
-5.5769
\end{bmatrix}
\]

Coupling Stiffness Matrix:

\[
\begin{bmatrix}
1.0e+03 * \\
8.7460 \\
-8.7920 \\
0.1425
\end{bmatrix}
\]
**Description**

Outputs the midplane strains as well as curvatures in vector form:

\[ \{\varepsilon_{0x} \, \varepsilon_{0y} \, \varepsilon_{0xy}\} \text{ and } \{\kappa_{x} \, \kappa_{y} \, \kappa_{xxy}\} \]