Stiffness Matrix for Tens Elem

\[ [k] = \frac{AE}{L} \cdot \begin{bmatrix}
\frac{1}{2} & 0 & 0 & -\frac{1}{2} \\
0 & \frac{1}{2} & 0 & 0 \\
0 & 0 & 1 & 0 \\
-\frac{1}{2} & 0 & 0 & \frac{1}{2}
\end{bmatrix} \]

\( [k] \) is in Global Coord. Sys.
\( L \) = Const
\( m = \text{Singed} \)

\( \delta \) = L

STEP L MODEL.

1.2 are free
1.3, 2.3 are fixed (suppressed)
form 6M \( \delta \) for each element.

ELEM 1:

\[ \delta = \frac{1}{4} \]

ELEM 2:

\[ \delta = \frac{1}{4} \]

ELEM 3:

\[ \delta = \frac{1}{4} \]
In Summary:

\[[u_0]_3 = \frac{1}{q} \begin{bmatrix} 1 & 2 & 3 & 4 \\ 4 & 1 & 2 & 3 \\ 3 & 4 & 1 & 2 \\ 2 & 3 & 4 & 1 \end{bmatrix}\]

\[[K]_{kl} = \frac{1}{q} \begin{bmatrix} 2 & 3 & 4 & 5 \\ 3 & 2 & 5 & 4 \\ 4 & 5 & 2 & 3 \\ 5 & 4 & 3 & 2 \end{bmatrix}\]

\[[K]_{de} = \frac{1}{q} \begin{bmatrix} 2 & 3 & 4 & 5 \\ 3 & 2 & 5 & 4 \\ 4 & 5 & 2 & 3 \\ 5 & 4 & 3 & 2 \end{bmatrix}\]

\[\text{Structural Stiffness Matrix}\]

\[\begin{bmatrix} 2 & -1 & -1 & -1 \\ -1 & 2 & -1 & -1 \\ -1 & -1 & 2 & -1 \\ -1 & -1 & -1 & 2 \end{bmatrix}\]

\[\{\kappa\} \cdot \{u\} = \{P\}\]

\[\begin{bmatrix} 2 & 3 & 4 & 5 \\ 3 & 2 & 5 & 4 \\ 4 & 5 & 2 & 3 \\ 5 & 4 & 3 & 2 \end{bmatrix} [u_0] + [K]_{de} \cdot [u_0] = \{P\}\]

\[\begin{bmatrix} 2 & 3 & 4 & 5 \\ 3 & 2 & 5 & 4 \\ 4 & 5 & 2 & 3 \\ 5 & 4 & 3 & 2 \end{bmatrix} [u_0] + [K]_{de} \cdot [u_0] = \{P\}\]
\[
\frac{1}{4} \begin{bmatrix} 2 & -1 \\ -1 & 5 \end{bmatrix} \cdot \begin{bmatrix} U_{1} \\ U_{2} \end{bmatrix} + \frac{i}{4} \begin{bmatrix} -1 & -\sqrt{3} & 0 & -\sqrt{3} \\ -4 & 0 & \sqrt{3} & -\sqrt{3} \end{bmatrix} \begin{bmatrix} U_{3} \\ U_{4} \\ \vdots \end{bmatrix} = \begin{bmatrix} P_{1} \\ P_{2} \end{bmatrix}
\]

\[
\mathbf{K}_{ff} U_{f} + \mathbf{K}_{ss} U_{s} = \mathbf{P}_{f}
\]

\[
\begin{bmatrix} P_{1} \\ P_{2} \end{bmatrix} = \begin{bmatrix} 10 \\ 0 \end{bmatrix}
\]

\[
\frac{1}{4} \begin{bmatrix} 2 & -1 \\ -1 & 5 \end{bmatrix} \begin{bmatrix} U_{1} \\ U_{2} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix} = \mathbf{P}
\]

\[
\Rightarrow \begin{bmatrix} U_{1} \\ U_{2} \end{bmatrix} = \begin{bmatrix} 2.2.2 \\ 4.4 \end{bmatrix}
\]