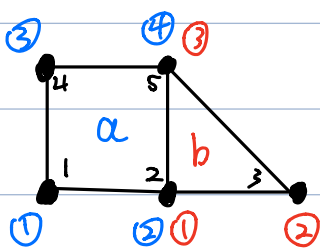


1a



$$[K^a] = \begin{bmatrix} k_{11} & k_{12} & k_{13} & k_{14} \\ k_{21} & k_{22} & k_{23} & k_{24} \\ k_{31} & k_{32} & k_{33} & k_{34} \\ k_{41} & k_{42} & k_{43} & k_{44} \end{bmatrix}$$

$$[K^b] = \begin{bmatrix} k_{11} & k_{12} & k_{13} \\ k_{21} & k_{22} & k_{23} \\ k_{31} & k_{32} & k_{33} \end{bmatrix}$$

$$[K] = \begin{bmatrix} k_{11} & k_{12} & 0 & k_{13} & k_{14} \\ k_{21} & k_{22} & k_{12} & k_{23} & k_{24} \\ 0 & k_{21} & k_{22} & 0 & k_{23} \\ k_{31} & k_{32} & 0 & k_{33} & k_{34} \\ k_{41} & k_{42} & k_{32} & k_{43} & k_{44} \end{bmatrix}$$

1b

$$\{P_{FEF}\} = \int_A h [N]^T dA$$

Rectangle

$$P_{FEF} = Ah \begin{bmatrix} \frac{1}{4} \\ \frac{1}{4} \\ \frac{1}{4} \\ \frac{1}{4} \end{bmatrix} \begin{matrix} \textcircled{1} & 1 \\ \textcircled{2} & 2 \\ \textcircled{3} & 4 \\ \textcircled{4} & 5 \end{matrix}$$

Triangle

$$P_{FEF} = Ah \begin{bmatrix} \frac{1}{3} \\ \frac{1}{3} \\ \frac{1}{3} \end{bmatrix} \begin{matrix} \textcircled{1} & 2 \\ \textcircled{2} & 3 \\ \textcircled{3} & 5 \end{matrix}$$

$$P_{FEF} = P_{FEF} + P_{FEF} = Ah \begin{bmatrix} \frac{1}{4} \\ \frac{1}{4} + \frac{1}{3} \\ \frac{1}{3} \\ \frac{1}{4} \\ \frac{1}{4} + \frac{1}{3} \end{bmatrix} = Ah \begin{bmatrix} \frac{1}{4} \\ \frac{7}{12} \\ \frac{1}{3} \\ \frac{1}{4} \\ \frac{7}{12} \end{bmatrix}$$

1c

$$[K^a] = 4 \times 4$$

$$[K^b] = 3 \times 3$$

$$[K] = 5 \times 5$$

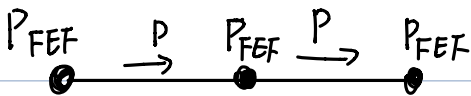
1d

For  $[P_{FEF}]$ : boundary condition of the Problem

For  $[P]$ : Heat / Flow Production within the element.

Heat:

Flow:



1e

Because it doesn't list nodes ccw. doesn't even cw. Which means nothing is in the correct order, not even the opposite order. It's just chaos.

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Matlab Code

4c,

The boundary conditions should be modified to Temp &  $q$ , according the setting of the problem. But it's very similar to the stress BCs.

4d.

Generally the same, but need to use the corresponding  $K_e$  equation.

4e.

Need to put the points into the  $P_F$  part of  $P$  if they are in the range of the problem set.

4f & 4g & 4h & 4i

Constructing the corresponding equations, no major things need to be changed.

5.

Because for elasticity problems, each node/element will have more degree of freedom (i.e. tensor), so the mesh is more important than problem above.