EGN 3420 – Sum '11

HMWK #4 – DUE FRI JULY 8

VERIFY THE LINEAR EQUATIONS FOR 8.10 AND 8.14, ED 3. A) SOLVE EACH BY "backslash operator" and inverse matrix method. B) CHECK YOUR ANSWERS BY SUBSTITUTING INTO $AX = b$.

8.10 The problem can be written in matrix form as

$$\begin{bmatrix} 0.866025 & 0 & -0.5 & 0 & 0 & 0 \\ 0.5 & 0 & 0.866025 & 0 & 0 & 0 \\ -0.866025 & -1 & 0 & -1 & 0 & 0 \\ -0.5 & 0 & 0 & 0 & -1 & 0 \\ 0 & 1 & 0.5 & 0 & 0 & 0 \\ 0 & 0 & -0.866025 & 0 & 0 & -1 \end{bmatrix} \begin{Bmatrix} F_1 \\ F_2 \\ F_3 \\ H_2 \\ V_2 \\ V_3 \end{Bmatrix} = \begin{Bmatrix} 0 \\ -2000 \\ 0 \\ 0 \\ 0 \\ 0 \end{Bmatrix}$$

MATLAB can then be used to solve for the forces and reactions,

```
clc; format short g
A = [0.866025 0 -0.5 0 0 0;
0.5 0 0.866025 0 0 0;
-0.866025 -1 0 -1 0 0;
-0.5 0 0 0 -1 0;
0 1 0.5 0 0 0;
0 0 -0.866025 0 0 -1];
b = [0 -2000 0 0 0 0]';
F = A\b

F =
        -1000
       866.03
      -1732.1
            0
          500
         1500
```

Therefore,

$F_1 = -1000$ $F_2 = 866.025$ $F_3 = -1732.1$ $H_2 = 0$ $V_2 = 500$ $V_3 = 1500$

8.14

$$\begin{bmatrix} 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 1 & -1 & 0 \\ 0 & 0 & -1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & -1 \\ 0 & R_{52} & -R_{32} & 0 & -R_{54} & -R_{43} \\ R_{12} & -R_{52} & 0 & -R_{65} & 0 & 0 \end{bmatrix} \begin{Bmatrix} i_{12} \\ i_{52} \\ i_{32} \\ i_{65} \\ i_{54} \\ i_{43} \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ V_1 - V_6 \end{Bmatrix}$$

or substituting the resistances

$$\begin{bmatrix} 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 1 & -1 & 0 \\ 0 & 0 & -1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & -1 \\ 0 & 10 & -10 & 0 & -15 & -5 \\ 5 & -10 & 0 & -20 & 0 & 0 \end{bmatrix} \begin{Bmatrix} i_{12} \\ i_{52} \\ i_{32} \\ i_{65} \\ i_{54} \\ i_{43} \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 200 \end{Bmatrix}$$

This system can be solved with MATLAB,

```
clc; format short g
R12=5;R52=10;R32=10;R65=20;R54=15;R43=5;
V1=200;V6=0;
A=[1 1 1 0 0 0;
0 -1 0 1 -1 0;
0 0 -1 0 0 1;
0 0 0 0 1 -1;
0 R52 -R32 0 -R54 -R43;
R12 -R52 0 -R65 0 0]
B=[0 0 0 0 0 V1-V6]'
I=A\B
```

```
A =
     1     1     1     0     0     0
     0    -1     0     1    -1     0
     0     0    -1     0     0     1
     0     0     0     0     1    -1
     0    10   -10     0   -15    -5
     5   -10     0   -20     0     0
B =
     0
     0
     0
     0
     0
   200
I =
    6.1538
   -4.6154
   -1.5385
   -6.1538
   -1.5385
   -1.5385
```

$i_{21} = 6.1538$ $i_{52} = -4.6154$ $i_{32} = -1.5385$ $i_{65} = -6.1538$ $i_{54} = -1.5385$ $i_{43} = -1.5385$

Here are the resulting currents superimposed on the circuit: