Computer Implementation 1.13 *(Matlab)* *Complete solution of a heat flow problem (p. 53)*

By combining procedures discussed in earlier implementations, here we present a complete *Matlab* based solution for the heat flow model. This implementation can be used as template to analyze any other two dimensional heat flow problem.

MatlabFiles\Chap1\SquareDuctHeatEx.m

```
% Heat flow through a square duct example
kx=1.4; ky=1.4; Q=0;
nodes=[0,0; 20,0; 20,30; 0,10; 10,10]/100;
lmm =[1,2,5; 2,3,5; 3,4,5; 1,5,4];

K=zeros(5); R = zeros(5,1);
% Generate equations for each element and assemble them.
for i=1:4
    lm = lmm(i,:);
    [k, r] = HeatTriElement(kx, ky, Q, nodes(lm,:));
    K(lm, lm) = K(lm, lm) + k;
    R(lm) = R(lm) + r;
end
% Add the term beacuse of convection on side 1 of element 2
h=27;Tinf=20; lm = lmm(2,:);
[kh, rh] = ConvectionTerm(1,h,Tinf,nodes(lm,:));
K(lm, lm) = K(lm, lm) + kh
R(lm) = R(lm) + rh

% Nodal solution and reactions
[d, reactions] = NodalSoln(K, R, [1,4], [300; 300])
results=[];
for i=1:4
    results = [results; HeatTriResults(nodes(lmm(i,:),:), d(lmm(i,:)))];
end
results
```

```
>> SquareDuctHeatEx

K =

          1.4            0            0         -0.7         -0.7
            0       4.5667       1.5833            0         -2.1
            0       1.5833       3.5167         0.35         -1.4
         -0.7            0         0.35         3.15         -2.8
         -0.7         -2.1         -1.4         -2.8            7


R =

     0
    81
    81
     0
     0


d =

          300
```

```
       93.547
       23.844
          300
       182.83


reactions =

       82.017
       231.41


results =

       192.13      -1032.3      -139.41
       100.07      -1125.2      -232.34
       168.89      -1171.7      -209.11
       260.94      -1171.7            0
```