Example 2.1

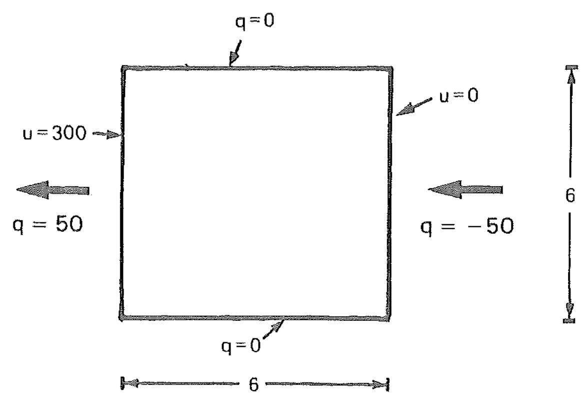
The following example illustrates how the code can be used to analyse a simple potential problem. Consider the case of a square close domain of the type shown in figure 2.7, where the boundary has been discretized into 12 constant elements with 5 internal points.

The input statements are as follows:

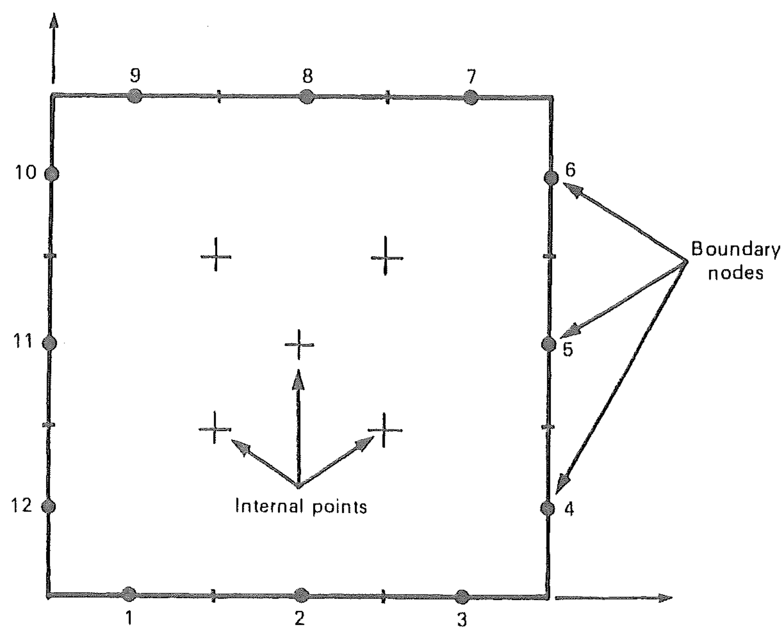
HEAT FLOW EXAMPLE (DATA)

```
 HEAT FLOW EXAMPLE (12 CONSTANT ELEMENTS)
12 5
0. 0. 2. 0. 4. 0. 6. 0. 6. 2. 6. 4.
6. 6. 4. 6. 2. 6. 0. 6. 0. 4. 0. 2.
1 0
1 0
1 0
0 0
0 0
0 0
1 0
1 0
1 0
0 300
0 300
0 300
2. 2. 2. 4. 3. 3. 4. 2. 4. 4.
```

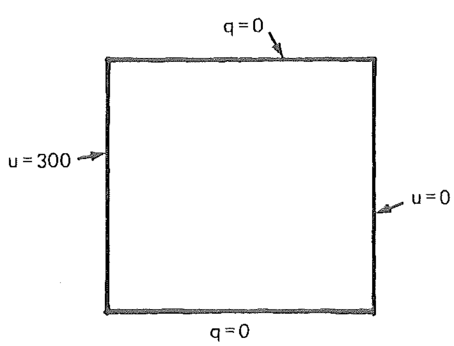
The results are printed out as follows.



(a) Definition of the Problem



(b) Discretization into elements and internal nodes



(c) Boundary conditions

Figure 2.7 Simple potential problem

HEAT FLOW EXAMPLE (OUTPUT)

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HEAT FLOW EXAMPLE (12 CONSTANT ELEMENTS)

DATA

 NUMBER OF BOUNDARY ELEMENTS = 12
 NUMBER OF INTERNAL POINTS WHERE THE FUNCTION IS CALCULATED =  5

 COORDINATES OF THE EXTREME POINTS OF THE BOUNDARY ELEMENTS

POINT         X               Y
   1      .00000E+00      .00000E+00
   2      .20000E+01      .00000E+00
   3      .40000E+01      .00000E+00
   4      .60000E+01      .00000E+00
   5      .60000E+01      .20000E+01
   6      .60000E+01      .40000E+01
   7      .60000E+01      .60000E+01
   8      .40000E+01      .60000E+01
   9      .20000E+01      .60000E+01
  10      .00000E+00      .60000E+01
  11      .00000E+00      .40000E+01
  12      .00000E+00      .20000E+01

 BOUNDARY CONDITIONS

 NODE       CODE        PRESCRIBED VALUE
   1          1            .00000E+00
   2          1            .00000E+00
   3          1            .00000E+00
   4          0            .00000E+00
   5          0            .00000E+00
   6          0            .00000E+00
   7          1            .00000E+00
   8          1            .00000E+00
   9          1            .00000E+00
  10          0            .30000E+03
  11          0            .30000E+03
  12          0            .30000E+03
*******************************************************************************************

RESULTS

 BOUNDARY NODES

       X               Y              POTENTIAL    POTENTIAL DERIVATIVE

   .10000E+01      .00000E+00      .25225E+03      .00000E+00
   .30000E+01      .00000E+00      .15002E+03      .00000E+00
   .50000E+01      .00000E+00      .47750E+02      .00000E+00
   .60000E+01      .10000E+01      .00000E+00     -.52962E+02
   .60000E+01      .30000E+01      .00000E+00     -.48771E+02
   .60000E+01      .50000E+01      .00000E+00     -.52962E+02
   .50000E+01      .60000E+01      .47750E+02      .00000E+00
   .30000E+01      .60000E+01      .15002E+03      .00000E+00
   .10000E+01      .60000E+01      .25225E+03      .00000E+00
   .00000E+00      .50000E+01      .30000E+03      .52969E+02
   .00000E+00      .30000E+01      .30000E+03      .48737E+02
   .00000E+00      .10000E+01      .30000E+03      .52969E+02
 INTERNAL POINTS

       X               Y              POTENTIAL        FLUX X          FLUX Y

   .20000E+01      .20000E+01      .20028E+03      -.50303E+02     -.14976E+00
   .20000E+01      .40000E+01      .20028E+03      -.50303E+02      .14974E+00
   .30000E+01      .30000E+01      .15001E+03      -.50215E+02     -.40360E-05
   .40000E+01      .20000E+01      .99740E+02      -.50306E+02      .14564E+00
   .40000E+01      .40000E+01      .99740E+02      -.50306E+02     -.14564E+00
*******************************************************************************************
```

Notice the excellent agreement of the results with the exact solution given in figure 2.7(a)), when the coarseness of the mesh and the simplicity of the model are considered. On the two vertical sides the fluxes are close to -50 and 50 as expected and on the horizontal sides the value of the potential is similar to the analytical solution which varies linearly from 300 on the left hand side to 0 on the right. The accuracy of the internal point results is however even more remarkable and this is due to the way in which these results are computed using formula (2.32), i.e. they are like a weighted average of the boundary values.