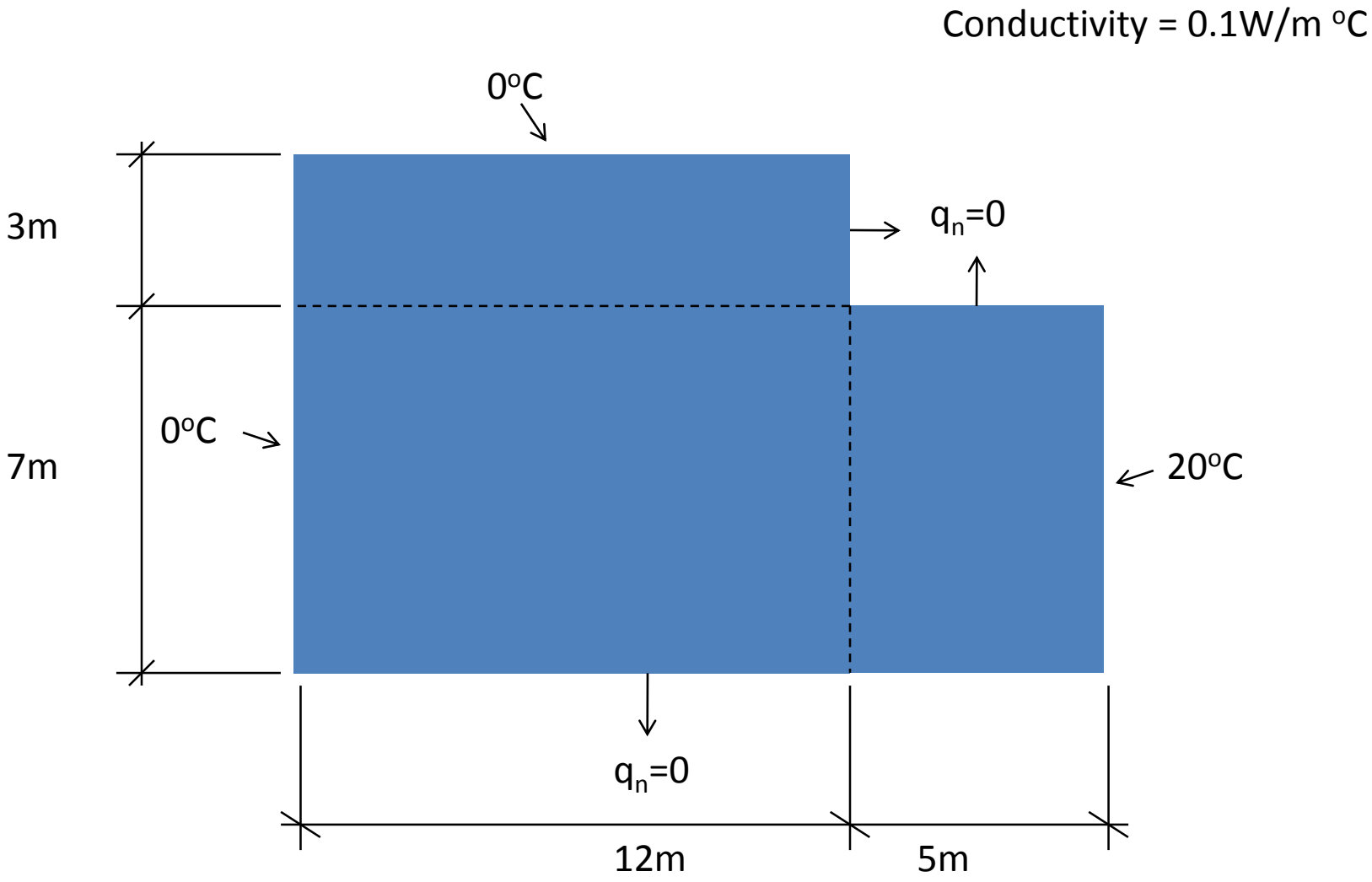
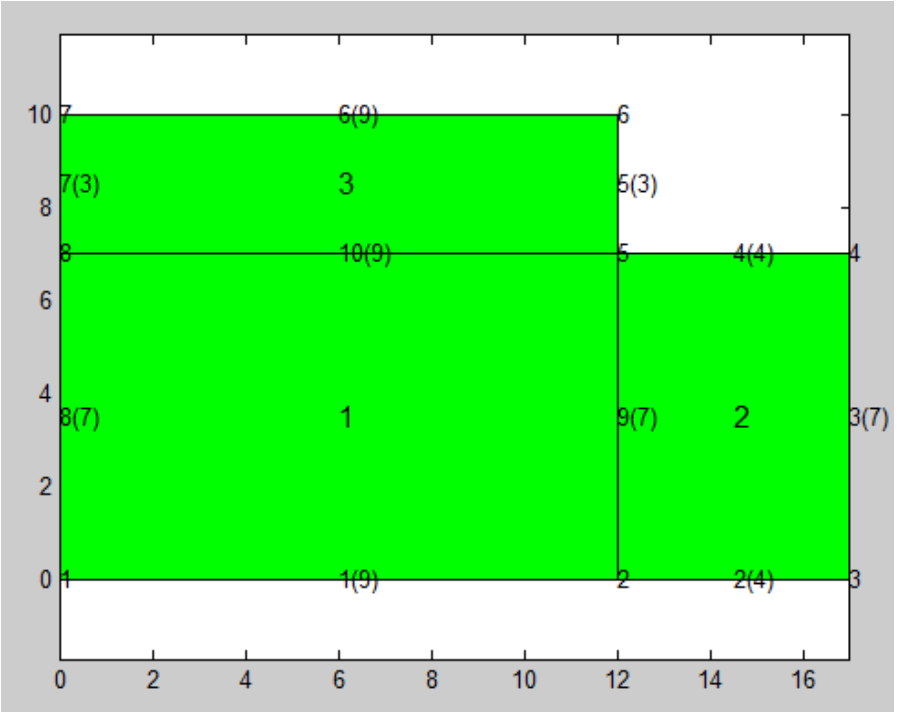
2D Heat Flow



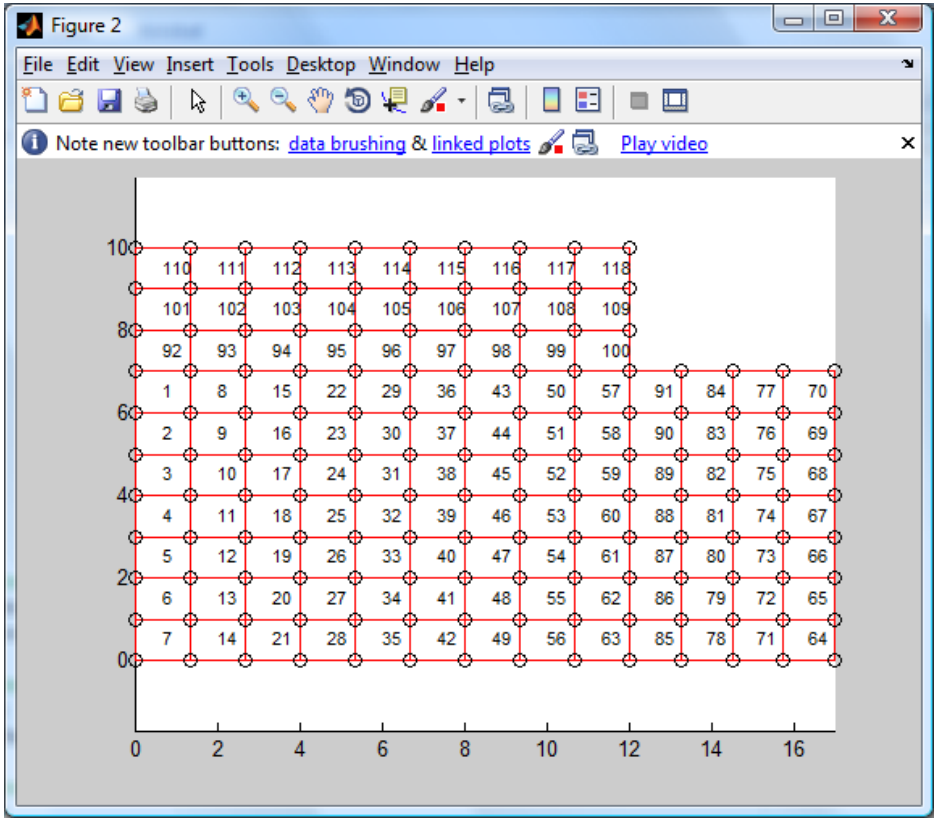
Define the geometry

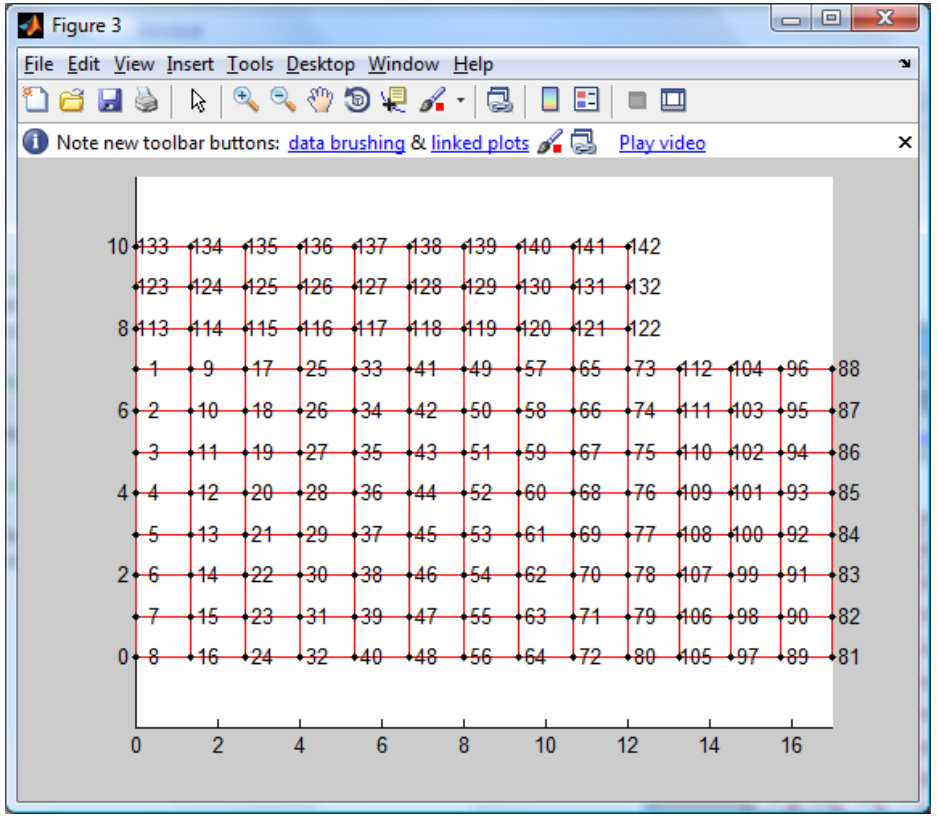
```
% Define the geometry
% Define the vertex coordinates
Vertices = [
0 0
12 0
17 0
17 7
12 7
12 10
0 10
0 7 ];
%
% Define the line segments from vertex numbers
Segments = [
1 2
2 3
3 4
4 5
5 6
6 7
7 8
8 1
2 5
8 5];
% Define the surfaces from the segment numbers
Surfaces=[
    1 9 10 8
    2 3 4 9
    10 5 6 7];
% Define the number of elements on each segment
Seed = [ 9, 4, 7, 4, 3, 9, 3, 7, 7, 9];
%
Segp=[Seed];
nen=4;
dofsPerNode=1;
mp=[ dofsPerNode, nen];
% Draw the geometry
geomdraw2(Vertices,Segments,Surfaces,Segp,mp)
```



Create the mesh

```
% Generate the element mesh
[Coord Edof Dof meshdb ]=strMeshgen(Vertices,Segments,Surfaces,Segp,mp);
% Generate the element coordinates
[Ex,Ey]=coordxtr(Edof,Coord,Dof,nen);
%
% Draw the element mesh with numbering of the elements
figure(2)
eldraw2(Ex,Ey,[1 4 1],Edof(:,1));
%
% Draw the element mesh with numbering of the degrees of freedom
figure(3)
eldraw2(Ex,Ey,[1 4 0]);
text(Coord(:,1),Coord(:,2),num2str(Dof(:)))
```



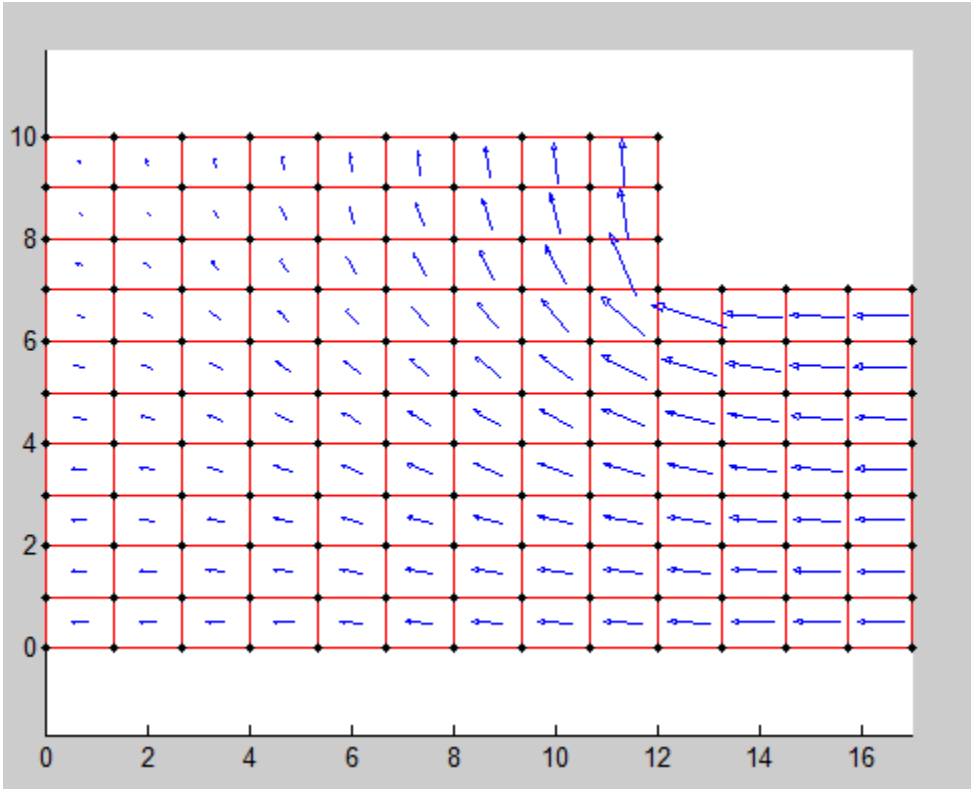


Create element stiffness, assemble, create bc's and solve

```
%%
% Create element stiffness, assemble to global stiffness, create bc's
% and solve the equation system
%
ep=[1];
D=eye(2)*0.1;
nel=size(Edof,1);
ndof=max(Edof(:));
%
K=sparse(ndof,ndof);
f=sparse(ndof,1);
%
% Create element stiffness and assemble to global stiffness
for i=1:nel
  Ke=flw2qe(Ex(i,:),Ey(i,:),ep,D);
  K=sparse_assem(Edof(i,:),K,Ke);
end
%
% Determine degrees of fredom along segments for boundary conditions
bc1=extrSeg([3]',meshdb,1);
bc2=extrSeg([6 7 8]',meshdb,1);
%
% Define boundary conditions
bc=[bc1, ones(length(bc1),1)*20; bc2, ones(length(bc2),1)*0];
%
% Solve equation system for unknown temperatures
[a,r]=solveq(K,f,bc);
```

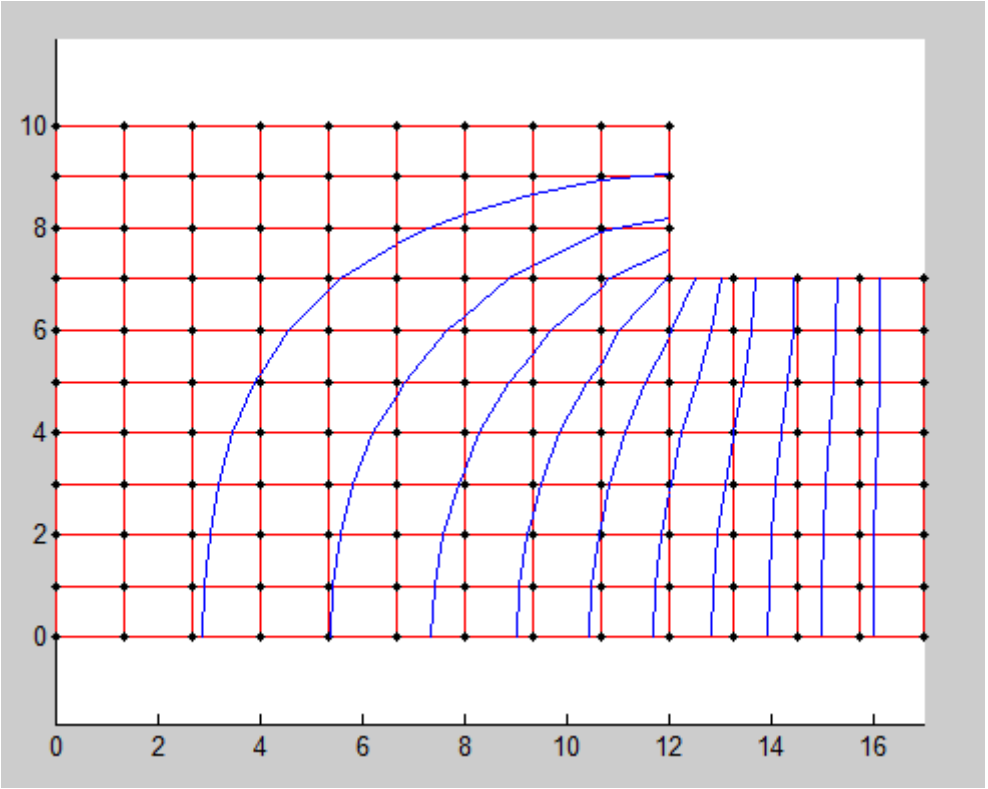
Calculate element fluxes and plot them

```
%%
% Extract temperature vector for each element
Ed=extract(Edof,a);
%
% Calculate element fluxes and temperature gradient
for i=1:nel
   [Es(i,:),Et(i,:)]=flw2qs(Ex(i,:),Ey(i,:),ep,D,Ed(i,:));
end
%
% Plot the element fluxes as arrows in elements
figure(4)
eldraw2(Ex,Ey,[1 4 0]);
[sfac]=elflux2(Ex(100,:),Ey(100,:),Es(100,:));
elflux2(Ex,Ey,Es,[1 2],sfac);
%
```



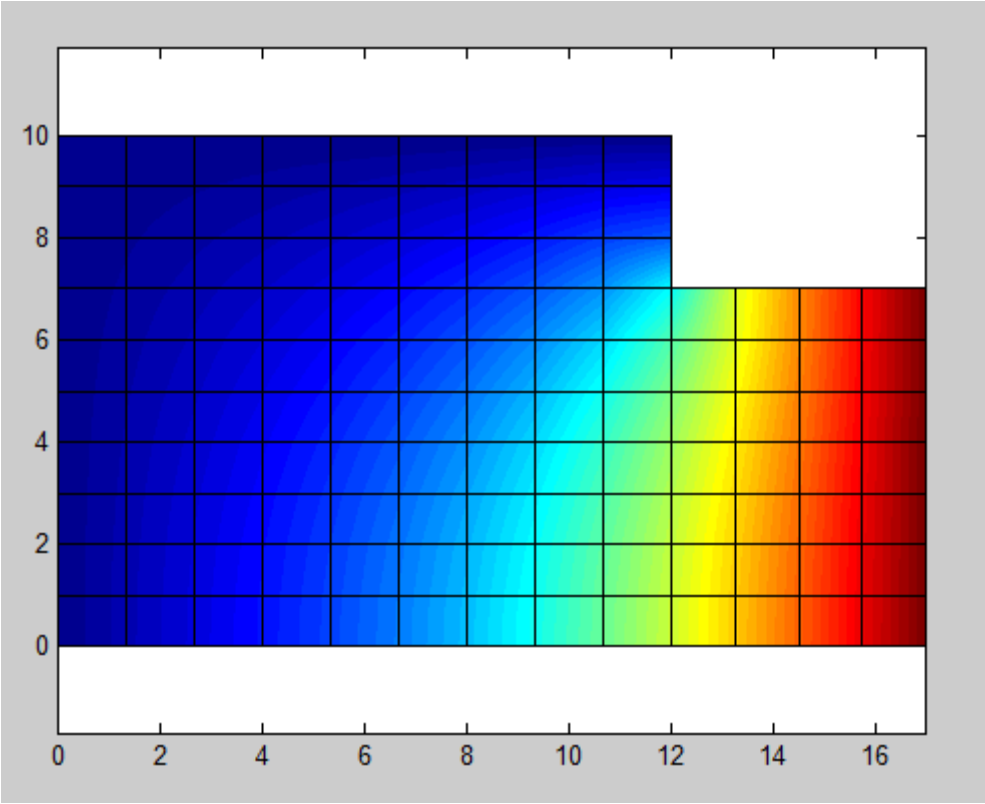
Plot isolines of the temperature

```
%%
% Plot isolines of the temperature
figure(5)
eldraw2(Ex,Ey,[1 4 0]);
eliso2(Ex,Ey,Ed,10,[1 2 1]);
```



Plot colors of the temperature values

```
%%
% Draw a filled colourful figure of temperature distribution
figure(6)
fill(Ex',Ey',Ed')
axis('equal')
```



Mesh Commands

- geomdraw2(Vertices,Segments,Surfaces,Segp,mp)

- [Coord Edof Dof meshdb]=strmeshgen(Vertices,Segments,Surfaces,Segp,mp);

- bc1=extrSeg([3]',meshdb,1)
- bc1=extrPoint([3]',meshdb,1)