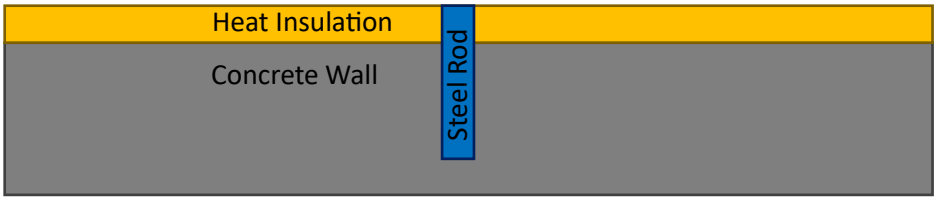
Quick Tutorial *Tiny*FEM

Tutorial Solving the Heat Equation

Problem description:

- A steel rod is puncturing the heat insulation into a concrete wall:
- Temperature inside set to 20° C and h = 4 W/m²K (equal to R = 0.25 m²K/W)
- Temperature outside set to 0°C and h = 25 W/m²K (equal to R = 0.04 m²K/W)



Start

- Start main.py (or executable)
- Click GEOMETRY

Geometry

Polygon 0

1. Click ADD (First polygon is automatically added without nodes)
2. Select Node: 0
3. Set values X: -3, Y: -1
4. Click UPDATE (Polygon nodes section)

5. Click ADD
6. Select Node: 1
7. Set values X: 3, Y: -1
8. Click UPDATE

9. Click Add
10. Select Node: 2
11. Set values X: 3, Y: 0
12. Click UPDATE

13. Click Add
14. Select Node: 3
15. Set values X: 0.1, Y: 0 (Triangle should appear)
16. Click UPDATE

17. Click Add
18. Select Node: 4
19. Set values X: 0.1, Y: -0.75
20. Click UPDATE

21. Click Add
22. Select Node: 5
23. Set values X: -0.1, Y: -0.75
24. Click UPDATE

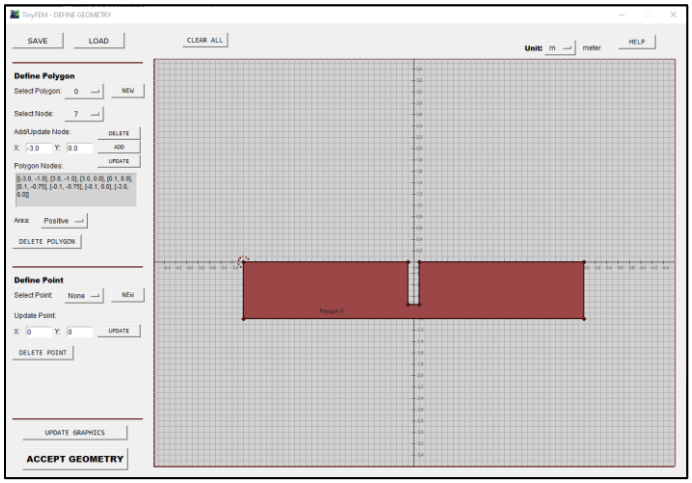
25. Click Add
26. Select Node: 6
27. Set values X: -0.1, Y: 0
28. Click UPDATE

29. Click Add
30. Select Node: 7
31. Set values X: -3, Y: 0
32. Click UPDATE

First Polygon finished

Polygon Nodes Info field:

[[-3.0, -1.0], [3.0, -1.0], [3.0, 0.0], [0.1, 0.0], [0.1, -0.75], [-0.1, -0.75], [-0.1, 0.0], [-3.0, 0.0]]



Polygon 1

1. Click NEW (Define Polygon section)
2. Select Polygon 1
3. Click Add
4. Select Node: 0
5. Set values X: -0.1, Y: 0
6. Click UPDATE

7. Click Add
8. Select Node: 1
9. Set values X: -0.1, Y: -0.75
10. Click UPDATE

11. Click Add
12. Select Node: 2

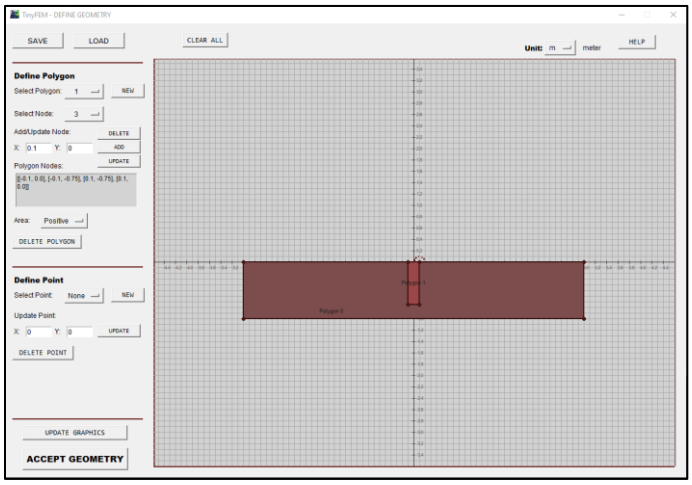
13. Set values X: 0.1, Y: -0.75
14. Click UPDATE

15. Click Add
16. Select Node: 3
17. Set values X: 0.1, Y: 0
18. Click UPDATE

Second Polygon finished

Polygon Nodes Info field:

[[-0.1, 0.0], [-0.1, -0.75], [0.1, -0.75], [0.1, 0.0]]



Polygon 2

- Click NEW (Define Polygon section)
- Select Polygon 2

Repeat similar to Polygon 0 and 1 for nodes:

Node 0: X: -0.1, Y: 0.0

Node 1: X: 0.1, Y: 0.0

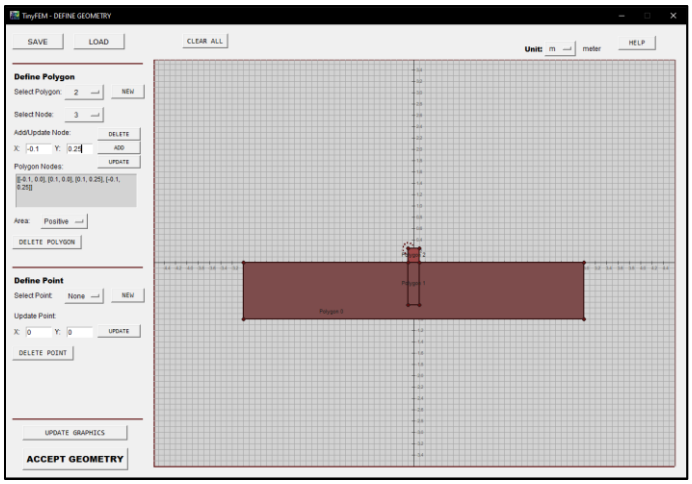
Node 2: X: 0.1, Y: 0.25

Node 3: X: -0.1, Y: 0.25

Polygon 2 finished

Polygon Nodes Info field:

[[-0.1, 0.0], [0.1, 0.0], [0.1, 0.25], [-0.1, 0.25]]



Polygon 3

- Click NEW (Define Polygon section)
- Select Polygon 3

Repeat similar to Polygon 0 and 1 for nodes:

Node 0: X: -3, Y: 0

Node 1: X: -0.1, Y: 0

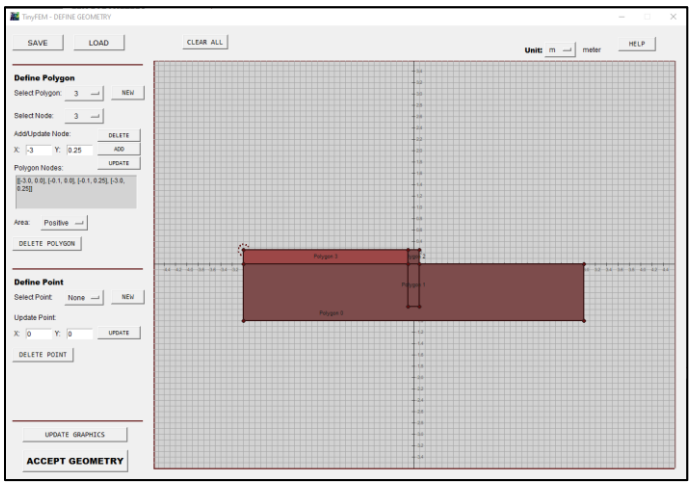
Node 2: X: -0.1, Y: 0.25

Node 3: X: -3, Y: 0.25

Polygon 3 finished

Polygon Nodes Info field:

[[-3.0, 0.0], [-0.1, 0.0], [-0.1, 0.25], [-3.0, 0.25]]



Polygon 4

- Click NEW (Define Polygon section)
- Select Polygon 4

Repeat similar to Polygon 0 and 1 for nodes:

Node 0: X: 0.1, Y: 0

Node 1: X: 3, Y: 0

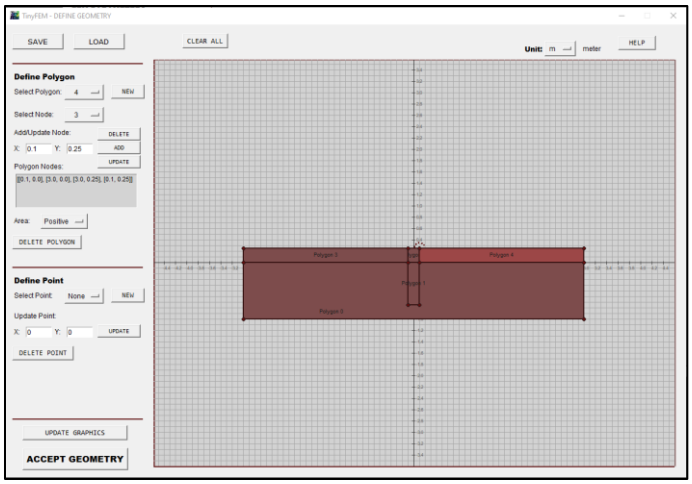
Node 2: X: 3, Y: 0.25

Node 3: X: 0.1, Y: 0.25

Polygon 4 finished

Polygon Nodes Info field:

[[0.1, 0.0], [3.0, 0.0], [3.0, 0.25], [0.1, 0.25]]



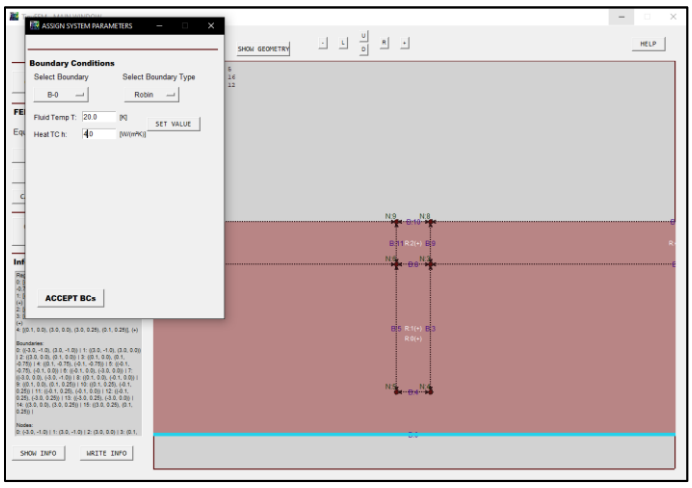
Finish Geometry

- Optional: Click SAVE
- Click ACCEPT GEOMETRY

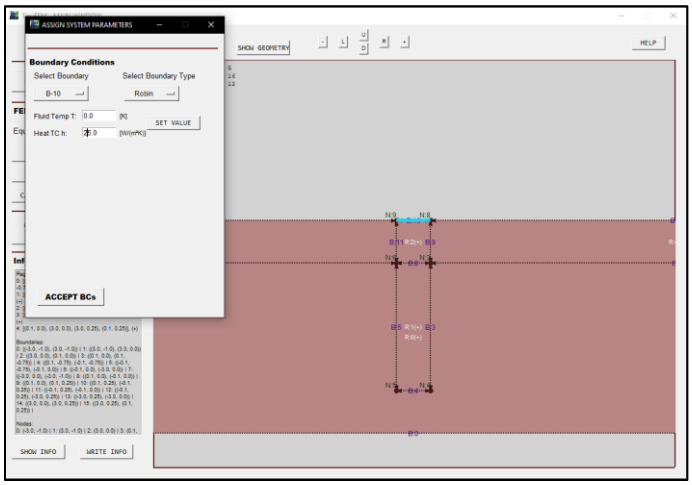
Parameters

(You can click on -/+ L/U/D/R for better view in Main Window)

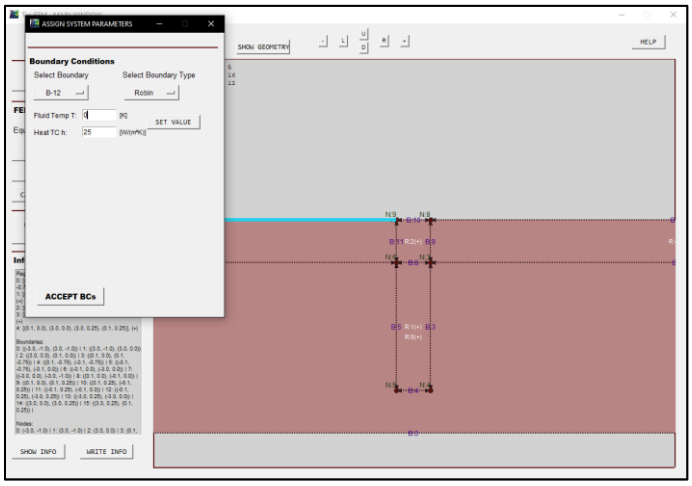
- Click BOUNDARY CONDITIONS (MAIN WINDOW)
- Select Boundary: B-0 (Boundary Conditions Window)
- Select Boundary Type: Robin
- Set Fluid Temp T: 20, Heat TC h: 4
- Click SET VALUE



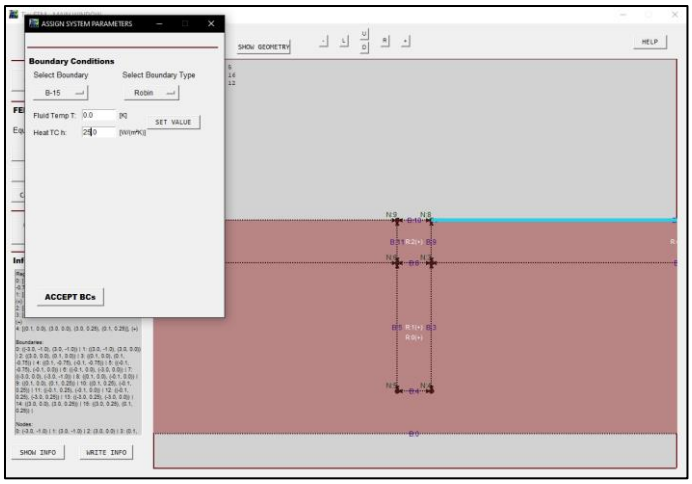
- Select Boundary: B-10
- Select Boundary Type: Robin
- Set Fluid Temp T: 0, Heat TC h: 25
- Click SET VALUE



- Select Boundary: B-12
- Select Boundary Type: Robin
- Set Fluid Temp T: 0, Heat TC h: 25
- Click SET VALUE



- Select Boundary: B-15
- Select Boundary Type: Robin
- Set Fluid Temp T: 0, Heat TC h: 25
- Click SET VALUE

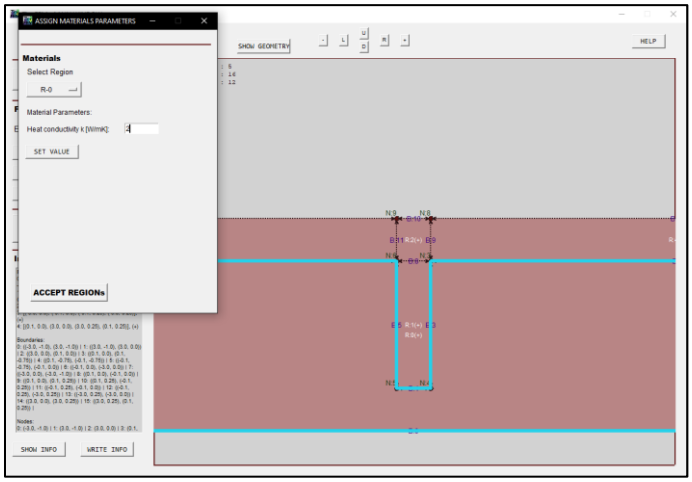


Finish Boundary Definition

- Click ACCEPT BCs

Material Parameters

- Click MATERIAL PARAMETERS (Main Window)
- Select Region: R-0
- Set Heat conductivity k: 2
- Click SET VALUE



Repeat similar to Region R-0:

R-1: k: 45

R-2: k: 45

R-3: k: 0.03

R-4: k: 0.03

Finish Region Parameters

- Click ACCEPT REGIONs

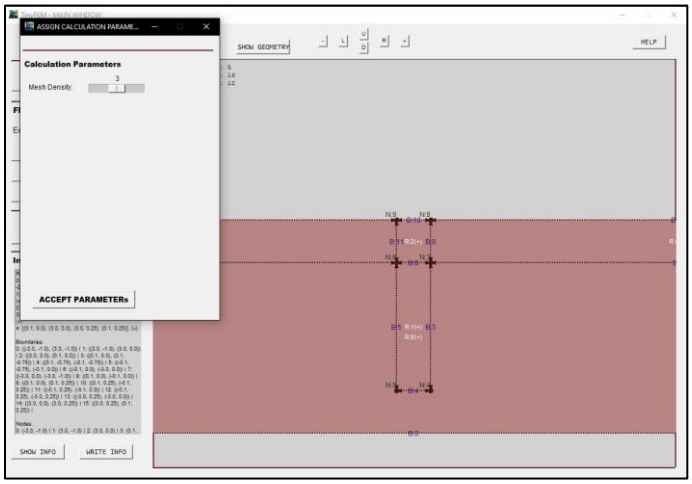
Calculation Parameters

Click CALCULATION PARAMETERS (Main Window)

Select Mesh Density: 3

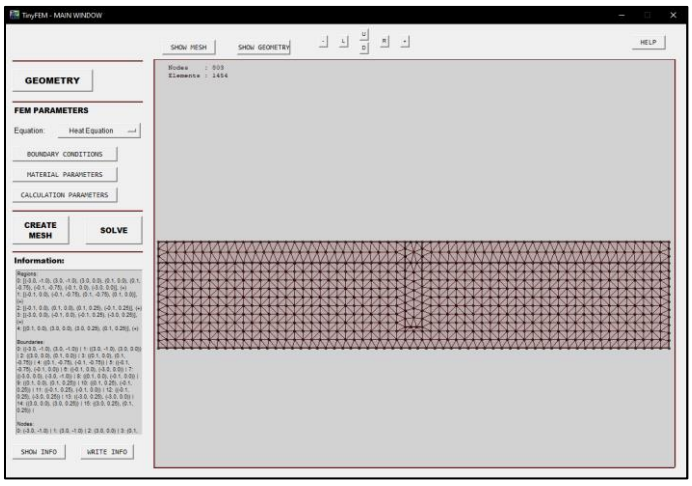
Finish Calculation Paramters

- Click ACCEPT PARAMETERs



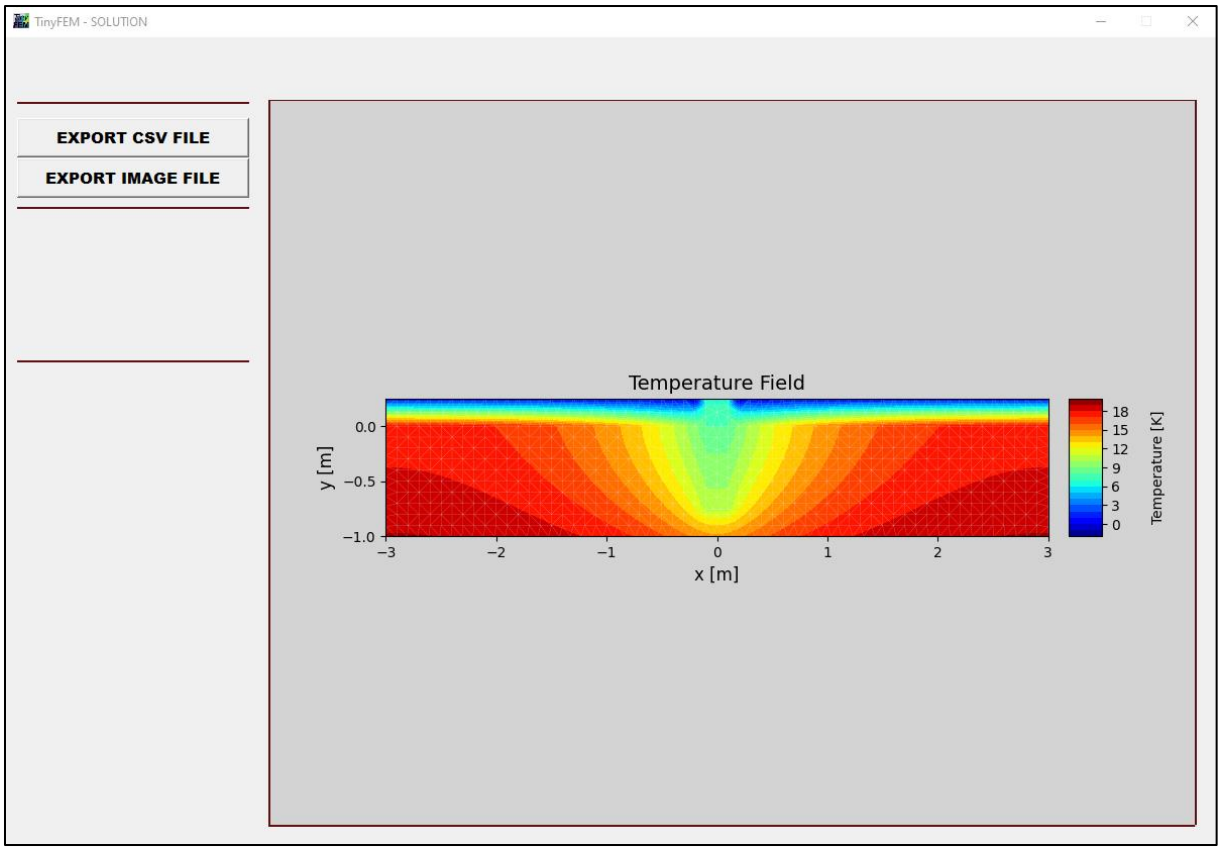
Mesh Creation

- Click CREATE MESH (Main Window): Info window for mesh creation appears
- Wait till info window for mesh creation disappears again
- Optional: Click SHOW MESH (Main Window) to check mesh



Solution

- Click SOLVE (Main Window): Solution Window appears
- Optional: Click EXPORT CSV FILE for exporting file
- Optional: Click EXPORT IMAGE FILE for exporting image file (into root directory)



Additional Info:

- You can change material parameters and boundary parameters without recreating mesh
- If you change geometry all parameters have to be reentered and mesh recreated
- Click SHOW INFO (Main Window) for current calculations parameters