TTNP01 – Problem of STEFAN with lumpés elements - QUAD9

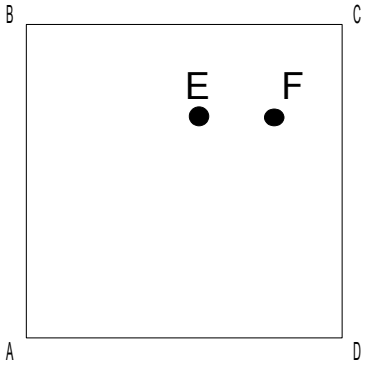
Summary:

This case test validates modeling PLAN_DIAG in non-linear thermics in the case of a thermal shock.

The got results are compared with an analytical solution.

1 Problem of reference

1.1 Geometry



The square is in space $[0.,4.]\times[0.,4.]$.

Coordinates of the points (m) :

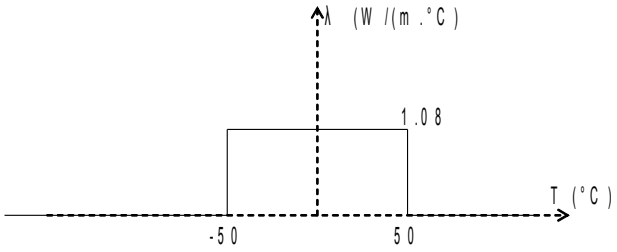
$A:(0.,0.)$
$B:(0.,4.)$
$C:(4.,4.)$
$D:(4.,0.)$
$E:(2.,3.)$
$F:(3.,3.)$

Group of e-mail:

LAB : segment AB
LBC : segment BC
LCD : segment CD
LDA : segment AD

1.2 Properties of material

- Conduction



- Enthalpy

Temperature $(°C)$	Enthalpy (J)
-50.	0
-0.25	49.75
-0.15	120,010

50.	169,860

1.3 Boundary conditions and loadings

$T=-45\,°C$ of $t=0\,sec$ with $t=10\,sec$

1.4 Initial conditions

$T=0\,°C$ with $t=0.\,sec$

2 Reference solution

2.1 Reference variables

The solution is deduced from the following publication (chapter 4, “Numerical examples”):
Solidification problems by the boundary element method. Nicholas ZABARAS and S MUKHERJEE. Int Newspaper of Solids Structures. Pergamon. Vol. 31, No 12/13, pp. 1829-1846, 1994

2.2 Result of reference

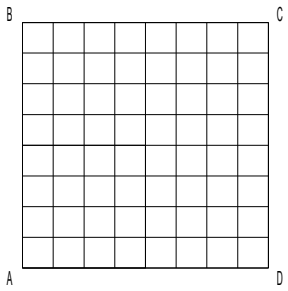
$t(s)$	Points	Size $(°C)$	Reference
1	F	$TEMP$	-11.8
2	F	$TEMP$	-29.9
3	F	$TEMP$	-34.7
4	F	$TEMP$	-36.7

1	E	$TEMP$	0
2	E	$TEMP$	-18.1
3	E	$TEMP$	-25.2
4	E	$TEMP$	-29.3

3 Modeling A

3.1 Characteristics of modeling A

Modeling PLAN_DIAG :



Many nodes	289			
Many meshs	96	That is to say:		
			SEG3	32
			QUAD9	64

3.2 Results

$t(s)$	Not	Size (°C)	Reference
1	$F(N157)$	$TEMP$	-11.8
2	$F(N157)$	$TEMP$	-29.9
3	$F(N157)$	$TEMP$	-34.7
4	$F(N157)$	$TEMP$	-36.7
1	$E(N198)$	$TEMP$	0
2	$E(N198)$	$TEMP$	-18.1
3	$E(N198)$	$TEMP$	-25.2
4	$E(N198)$	$TEMP$	-29.3

4 Summary of the results

Results got in the case of a thermal modeling PLAN_DIAG are satisfactory.