

WTNV111 – Heat flux on a Summarized saturated porous environment

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One considers a three-dimensional problem of thermal in a saturated porous environment.

This test consists in studying the effect of the application of a flux of temperature on the upper face of the model on the distribution of the temperature in the element. One limits first under investigation time step. One blocks the pressure and the displacements.

The studied models are 2D plane (DPQ8 and DPTR6) and 3D voluminal (HEXA20) with a linear behavior.

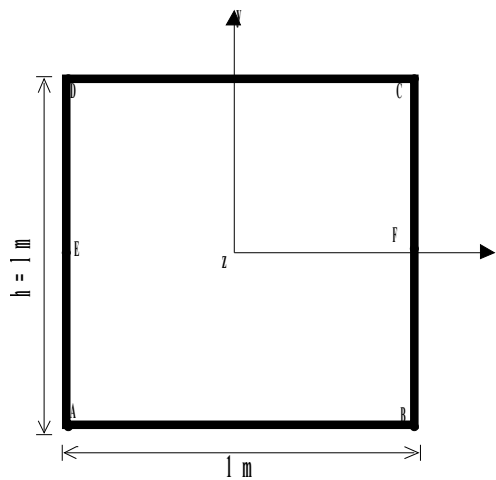
The reference solution is then the solution of a computation in pure thermal (THER_LINEAIRE) with Code_Aster.

1 Problem of reference

1.1 Presentation

One studies in this case test the pure thermal behavior of a porous environment saturated by only one fluid: water in its liquid phase. It acts in *Code_Aster* of a modelization THM . The associated constitutive law of the fluid is of type LIQU_SATU .

1.2 Geometry



Coordinated of the points (m) :

$$\begin{array}{ll} A: -0,5 & -0,5 \\ B: 0,5 & -0,5 \\ C: 0,5 & 0,5 \\ D: -0,5 & 0,5 \end{array}$$

1.3 Properties of the solid

material	Density ($kg.m^{-3}$)	2×10^3
	Young Modulus drained $E(Pa)$	$225. \times 10^6$
	thermal	0.
	Poisson's ratio Coefficient of thermal expansion of Thermal (K^{-1})	$8. \times 10^{-6}$
solid	homogenized Conductivity ($W.K^{-1}.m^{-1}$)	1.7
	Derived from conductivity homogenized compared to the temperature	0.
Coefficients of homogenization	Coefficient of Biot	10^{-12}
	Porosity	0.4
homogenized Coefficients	Density ($kg.m^{-3}$)	1.6×10^3
	Heat with constant stress ($J.K^{-1}$)	2.85×10^6

1.4 Boundary conditions and loadings

- complete Element:
 - displacements $u_x=0.0\text{ m}, u_y=0.0\text{ m}, u_z=0.0\text{ m}$.
 - pressure of the fluid $PRE1=0.0\text{ Pa}$
- lower Face:
 - temperature $T=273\text{ K}$
- Upper face:
 - heat flux $FLUN=0.5\text{ J.s}^{-1}.\text{m}^{-2}$

1.5 Initial conditions

the fields of displacement, pressure, temperature is initially all null, but the reference temperature is not null. It is worth $T_0=273\text{ K}$.

2 Reference solution

2.1 Method of calculating used for the reference solution

the reference solution is the solution of a computation in pure thermal (`THER_LINEAIRE`) with *the code_Aster*.

2.2 Reference variable

TEMP : temperature

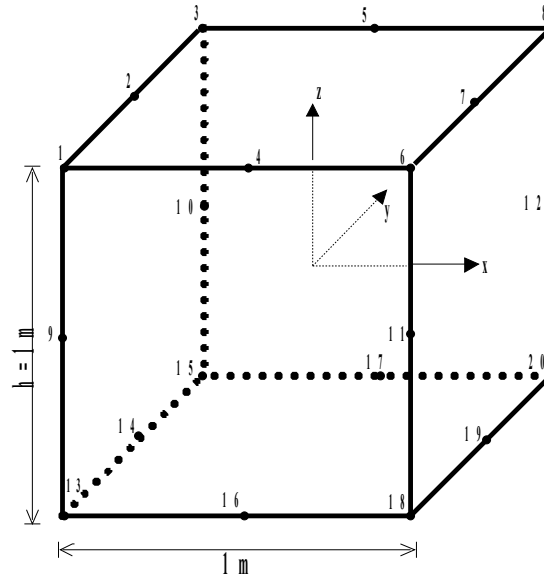
2.3 Quantity and result of reference

Not	Standard of value	Time (s)	Reference (°C)
<i>C, D</i>	<i>TEMP</i>	10^{13}	2.9412×10^{-1}
<i>A, B</i>	<i>TEMP</i>	10^{13}	$\approx 0.$

3 Modelization A

3.1 Characteristic of the voluminal modelization

A Modelization: 3D_THM



1 nets HEXA20 of modelization 3D_THM : THM_HEX20

3.2 Result of the modelization A

Discretization in time: only one time step large: 10^{13} s .

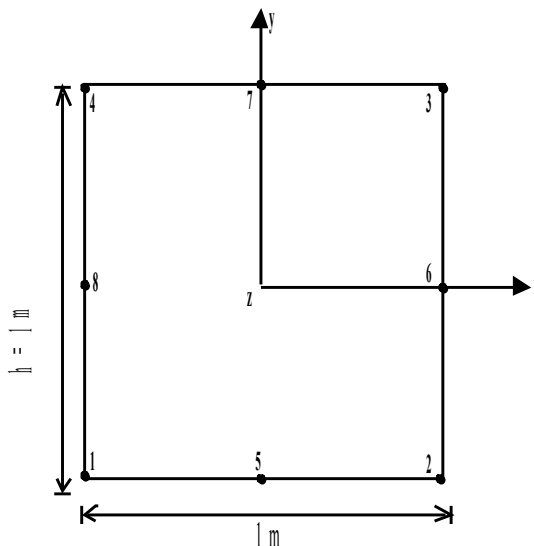
The time scheme is implicit ($\vartheta = 1$) .

Standard	node of value	Time (s)	Reference ($^{\circ}C$)	Tolerance
NO1	TEMP	10^{13}	2.9412×10^{-1}	1. %
NO20	TEMP	10^{13}	$\approx 0.$	10^{-6}

4 Modelization B

4.1 Characteristic of the modelization B

plane Modelization: D_PLAN_THM



1 nets DPQ8 of modelization D_PLAN_THM : THM_DPQ8

4.2 Result of the modelization B

Discretization in time: only one time step large: 10^{13} s .

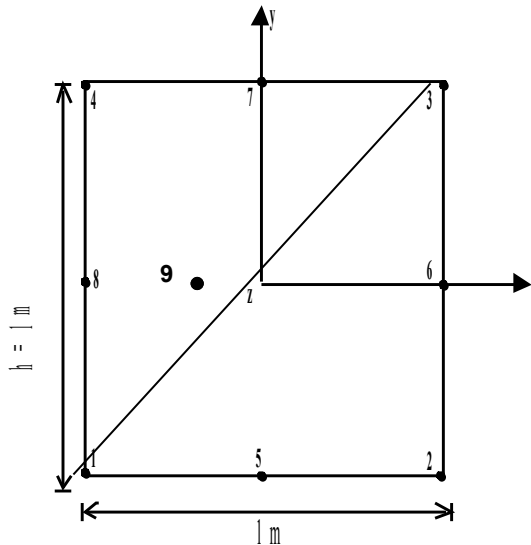
The time scheme is implicit ($\vartheta = 1$) .

Node/Not	Standard of Value	Time (s)	Reference ($^{\circ}C$)	Tolerance
N3 / C	TEMP	10^{13}	2.9412×10^{-1}	1. %
NI / A	TEMP	10^{13}	$\approx 0.$	10^{-6}

5 Modelization C

5.1 Characteristic of the modelization C

plane Modelization: D_PLAN_THM



2 meshes DPTR6 of modelization D_PLAN_THM : THM_DPTR6

5.2 Result of the modelization C

Discretization in time: only one time step large: $10^{13} s$.

The time scheme is implicit ($\vartheta = 1$).

Node/not	Standard of Value	Time (s)	Reference ($^{\circ}C$)	Tolerance
N3 / C	TEMP	10^{13}	2.9412×10^{-1}	1. %
N1 / A	TEMP	10^{13}	$\approx 0.$	10^{-6}

6 Summary of the results

the variations observed between the reference solution and the solution Code_Aster are very weak. It there thus a good agreement of the results.