

MTLP102 - Metallurgical calculation for a steel with taking into account of the size of grain

Summary:

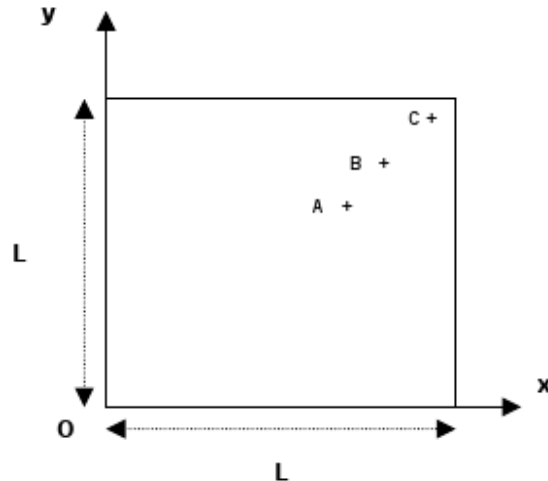
The purpose of this test is to in the case of observe the evolution of the size of grain according to the change of temperature a steel.

The size of grain is calculated with the nodes A , B and C by the operator `CALC_META`.

1 Problem of reference

1.1 Geometry

Section of the bar



It is about an infinite bar with square section of with dimensions $L=0.05\text{ m}$.

1.2 Material properties

The properties materials are described by the following parameters:

(Steel 16MND5)

$$\rho C_p = 5260000 \text{ J.m}^{-3} . \text{ } ^\circ\text{C}^{-1}$$

$$\lambda = 33.5 \text{ W.m}^{-1} . \text{ } ^\circ\text{C}^{-1}$$

Coefficients for the metallurgy:

“Standard “TRC

$$AR3 = 830 \text{ } ^\circ\text{C} , \text{ } \alpha = -0.0306$$

$$MS0 = 400 \text{ } ^\circ\text{C} , \text{ } AC1 = 724 \text{ } ^\circ\text{C} , \text{ } AC3 = 846 \text{ } ^\circ\text{C}$$

$$\tau_1 = 0.034 , \text{ } \tau_3 = 0.034$$

$$\lambda_0 = 0.117 , \text{ } qsr = 37500 ,$$

$$D10 = 3.31 , \text{ } wsr = 12860 .$$

1.3 Boundary conditions and loadings

The temperature is imposed on all the bar on times $t=0\text{s}$, 200s , 1100s and 1900s .

$$T(x, y, t=0) = 700 \text{ } ^\circ\text{C}$$

$$T(x, y, t=200) = 900 \text{ } ^\circ\text{C}$$

$$T(x, y, t=1100) = 900 \text{ } ^\circ\text{C}$$

$$T(x, y, t=1900) = 100 \text{ } ^\circ\text{C}$$

1.4 Initial conditions

The following variables are initialized with the following values:

$$\begin{aligned}Z_f(x, y, 0) &= 0.7 \\Z_p(x, y, 0) &= 0.0 \\Z_b(x, y, 0) &= 0.3 \\Z_m(x, y, 0) &= 0.0 \\d(x, y, 0) &= 0.0\end{aligned}$$

2 Reference solution

2.1 Results of reference

The results of reference were got with a previous version of aster. It is about a test of not-regression.

2.2 Uncertainty on the solution compared to the result of not-regression

The value of uncertainty is of 1%.

3 Modeling A

3.1 Characteristics of modeling

The modeling used in the case test is the following one:

Elements 2D 'PLAN' (QUA8)

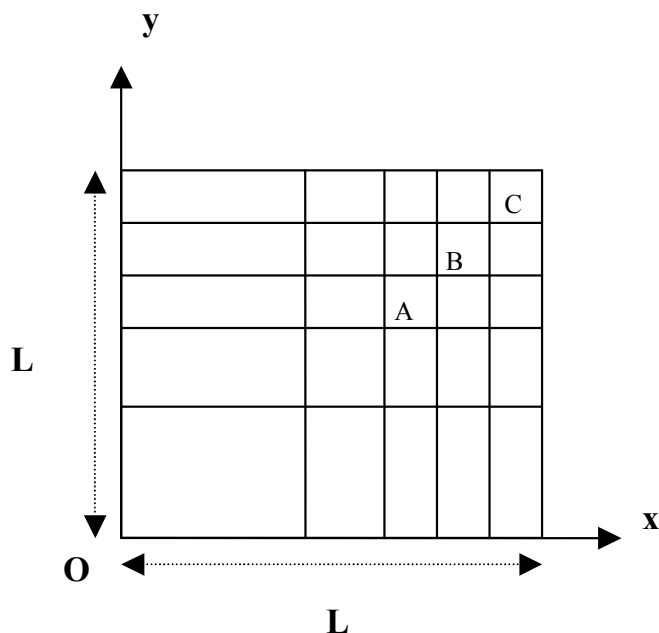


Figure 3.1-a: Geometry and grid of modeling

Cutting: 5 meshes QUAD8 according to the axis of x
 5 meshes QUAD8 according to the axis of y

Nodes:

A : mesh $M13$ node $N39$
 B : mesh $M19$ node $N66$
 C : mesh $M19$ node $N70$

3.2 Characteristics of the grid

Many nodes: 96
Many meshes and types: 25 QUAD8, 20 SEG3.

3.3 Values tested

Identification	Size	Reference
t=200s M19 N66	V5	2.565E-6
t=620s M19 N70	V5	9.43E-6
t=1354s M13 N39	V5	1.34E-5
t=1900s M13 N39	V4	0
t=1900s M19 N66	V3	0.45
t=1900s M19 N70	V1	0,403

$V1$: proportion of the phase ferrite
 $V3$: proportion of the phase bainite
 $V4$: proportion of the phase martensite
 $V5$: austenic size of grain

4 Comments

This case test of not-regression makes it possible to check the coherence of *Code_Aster* of a version on the other with regard to the metallurgy.