Module : Méthode des éléments finis Master I PROPULSION /FMP (2020/2021)

TP : Analyse statique d'une poutre 'Test de Mack-Neal et Harder 1985' par éléments membranaire 2-D sur code Abaqus.

1- Soit à évaluer le déplacement à l'extrémité libre de la poutre console de dimensions Longueur 6 et largeur 0.2 sans unités comme représentée ci-dessous. Une charge P=1 kN est appliquée sur l'extrémité libre de la poutre. Sachant que le module de Young $E=10^7 kN/m^2$ et le coefficient de Poisson v=0.3 et l'épaisseur t=0.1. Maillage demandé : 6x1 et 12x1

2- Même Tp avec un moment M=10 appliqué à l'extrémité libre de la poutre.

La solution analytique de Timoshenko est pour :

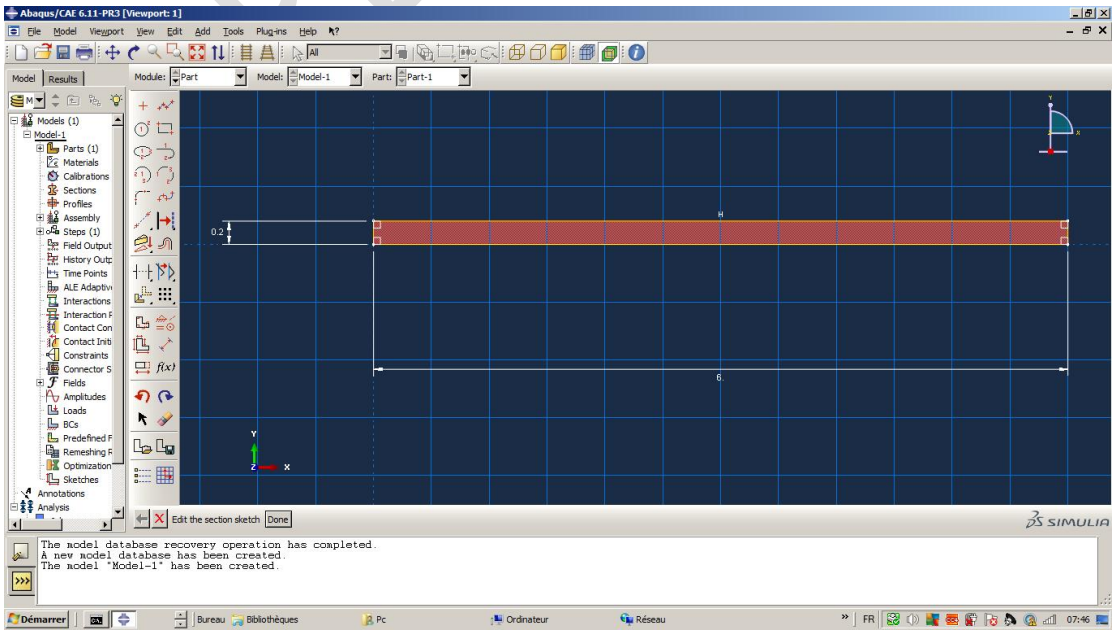
Flexion : 0.270

Cisaillement : 0.1081

Poutre totalement encastrée à gauche et libre à droite

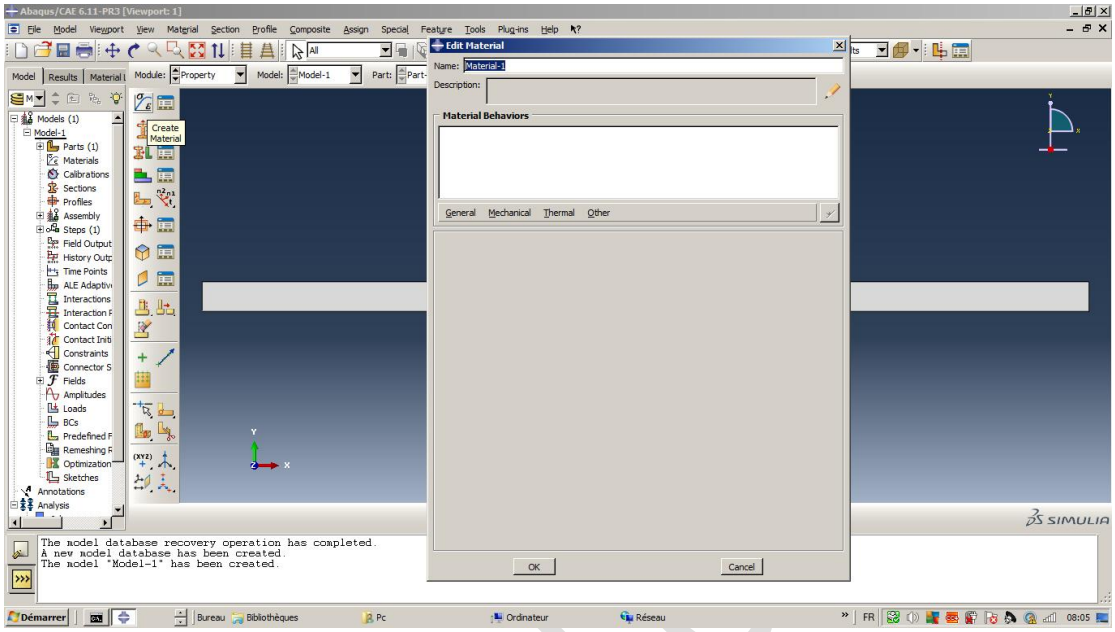
Déroulement du TP sur code Abaqus

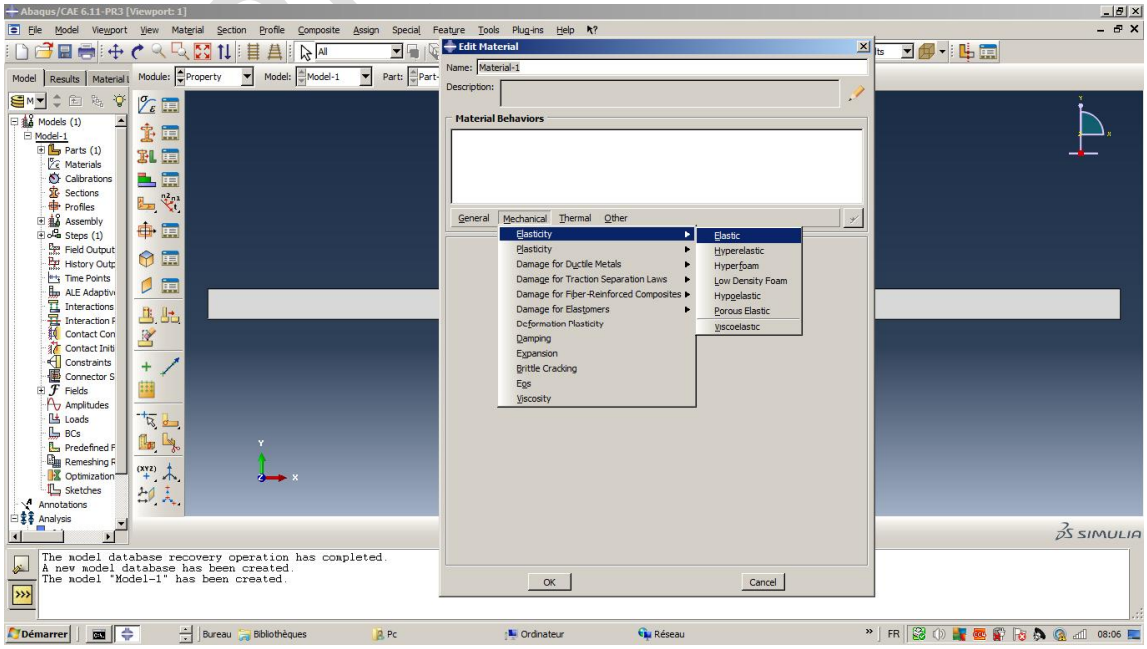
1.Création de part

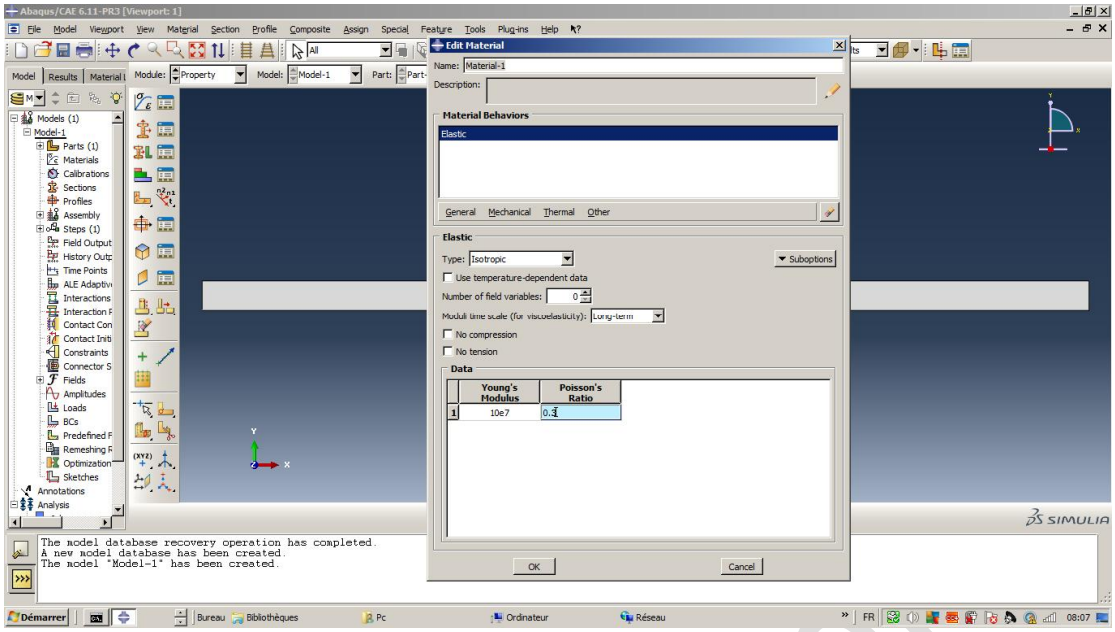


2. Propriété

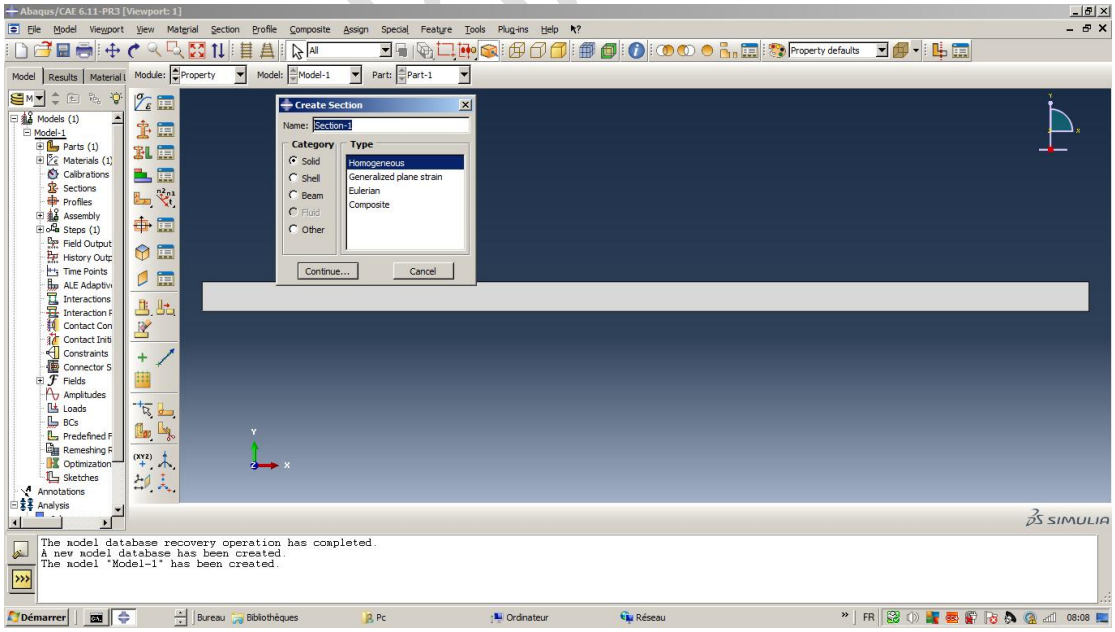
2.1. Création de matériau

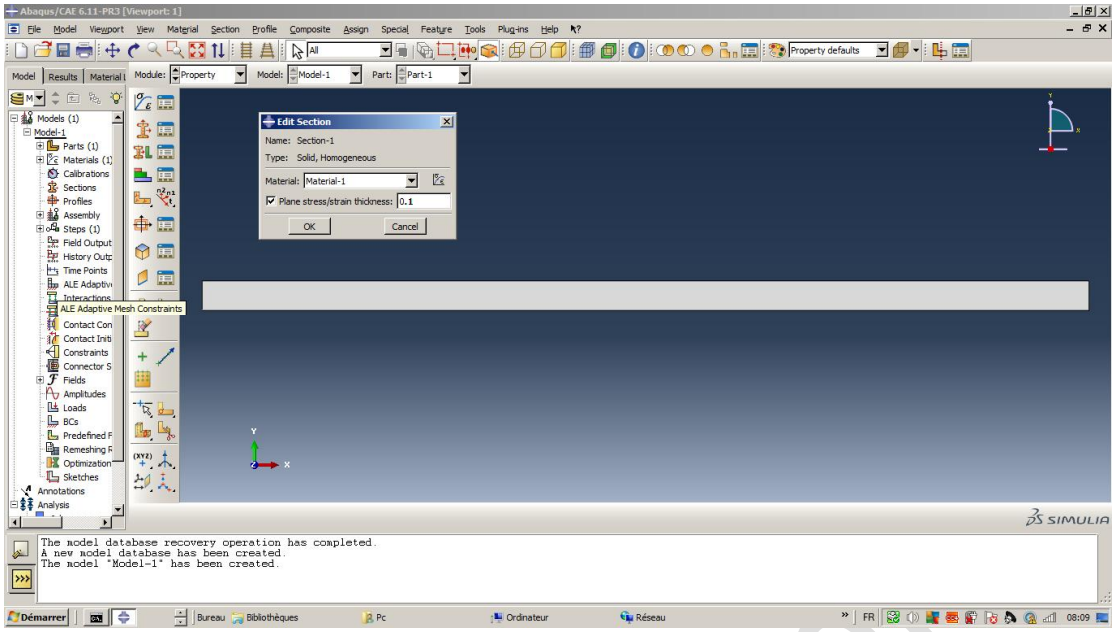




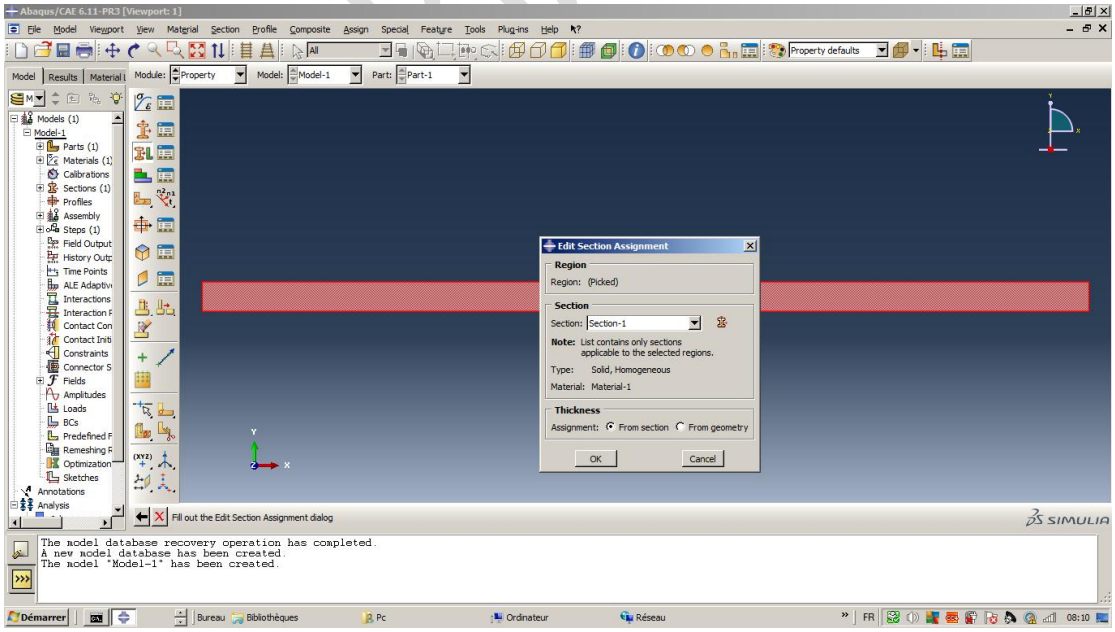


2.2. Création de section

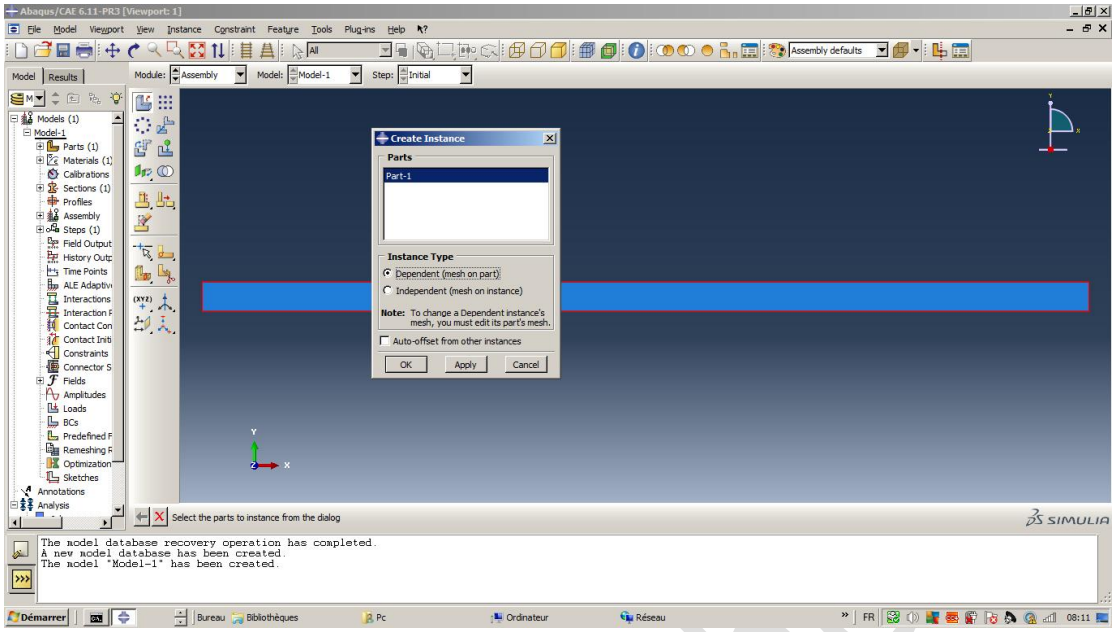




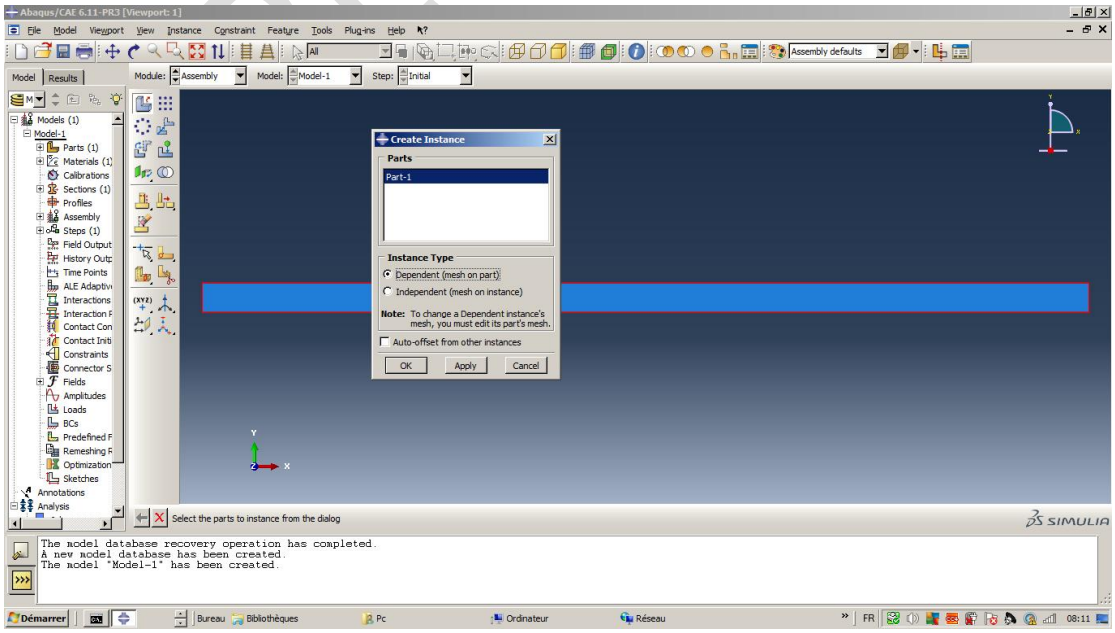
2.3. Assignement de la section

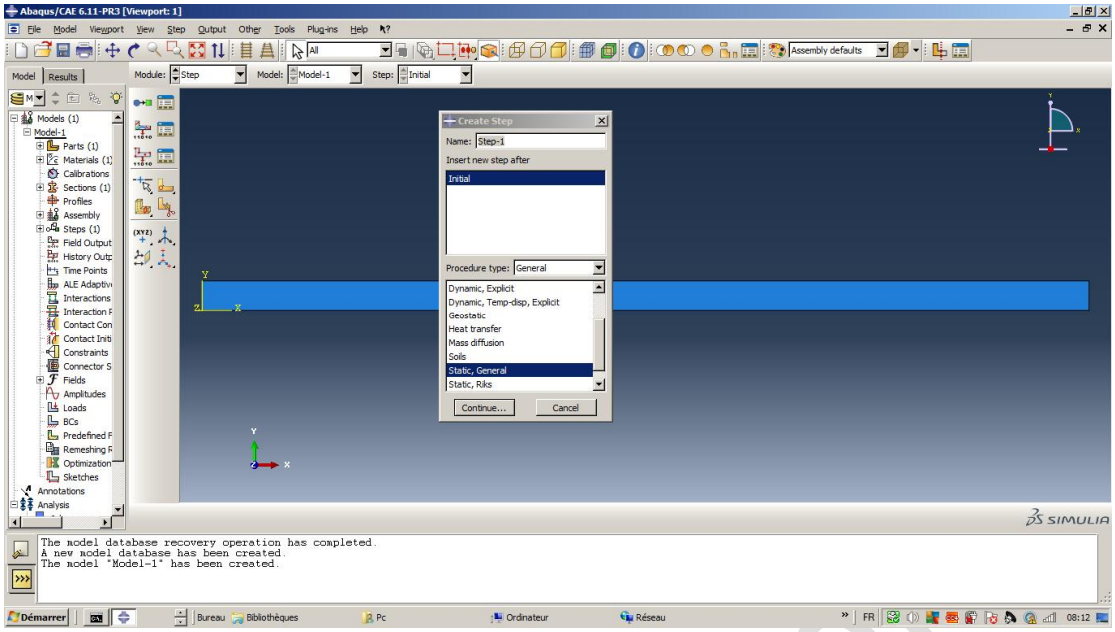


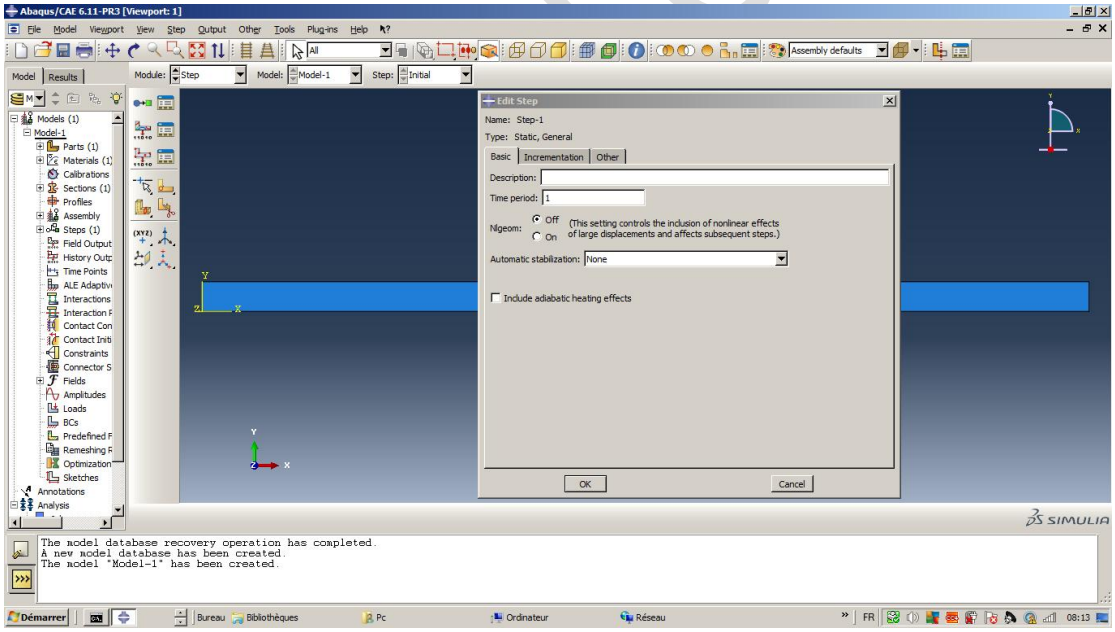
2.4. Assemblage



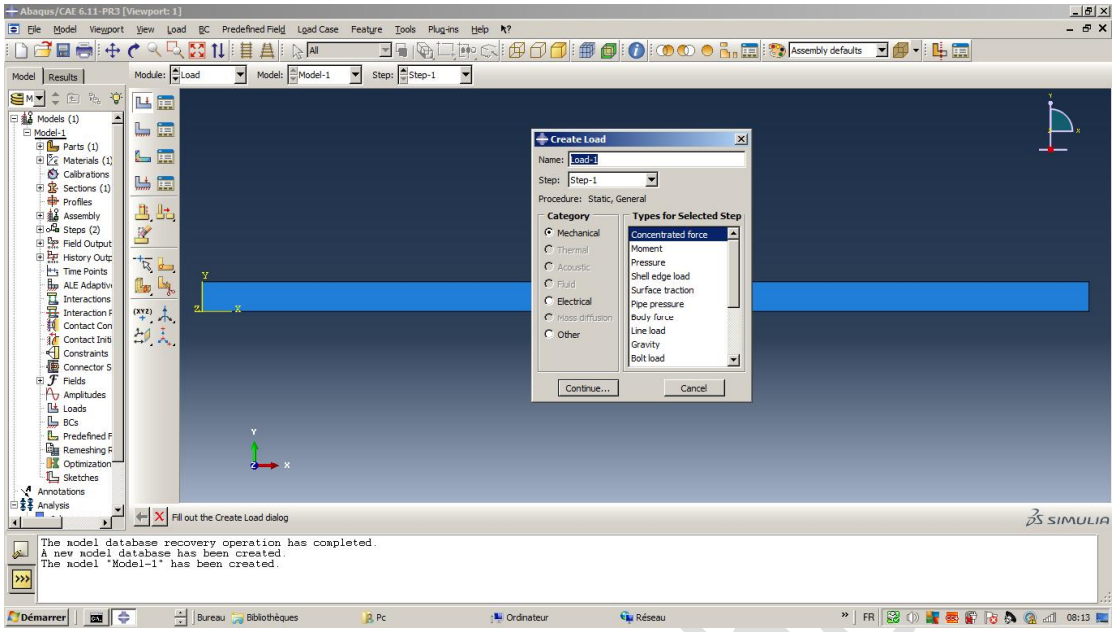
2.5. Step

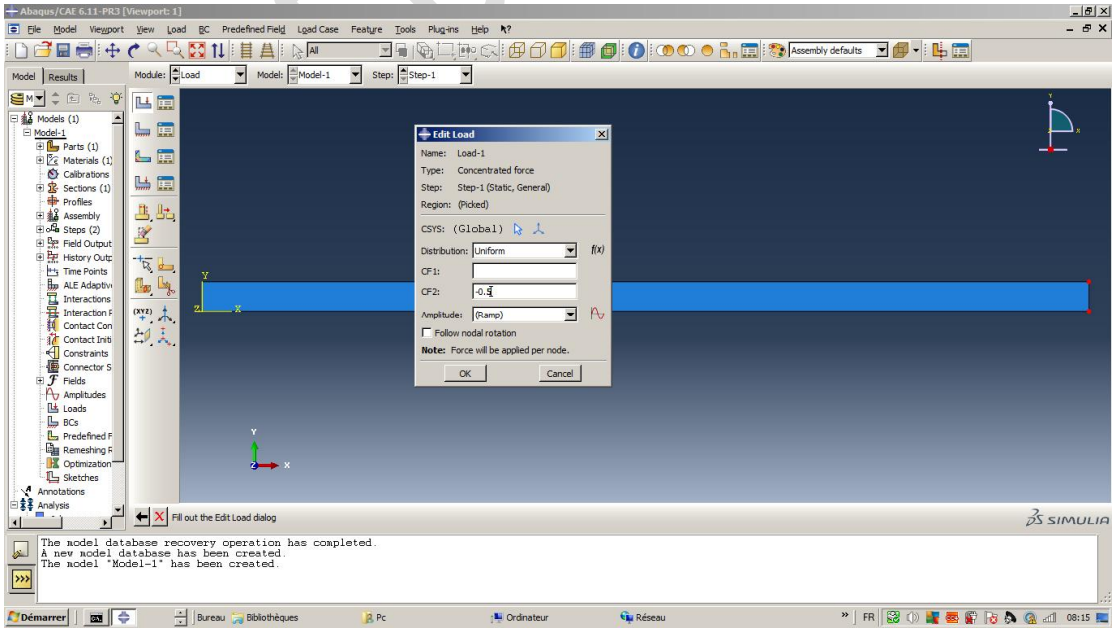


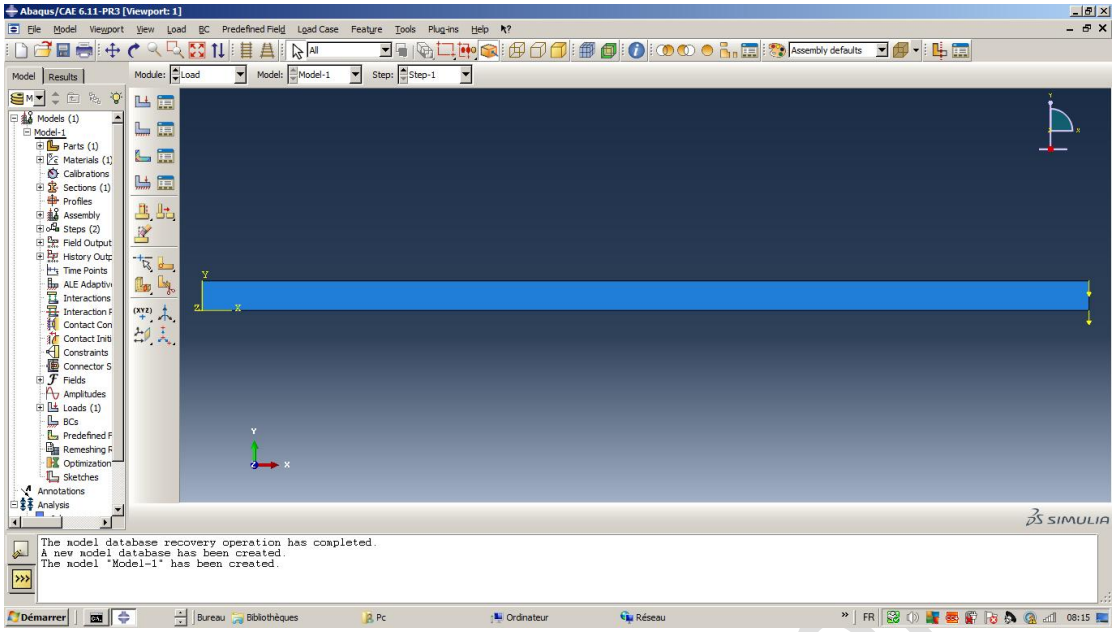

Abaqus/CAE 6.11-PR3 [Viewport: 1]
Create Step
Name: Step-1
Insert new step after
Initial
Procedure type: General
Dynamic, Explicit
Dynamic, Temp-disp, Explicit
Geostatic
Heat transfer
Mass diffusion
Soils
Static, General
Static, Riks
Continue...
Cancel
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.


Abaqus/CAE 6.11-PR3 [Viewport: 1]
Edit Step
Name: Step-1
Type: Static, General
Basic
Incrementation
Other
Description:
Time period: 1
Nlgeom:
Off
On
(This setting controls the inclusion of nonlinear effects of large displacements and affects subsequent steps.)
Automatic stabilization: None
Include adiabatic heating effects
OK
Cancel
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.

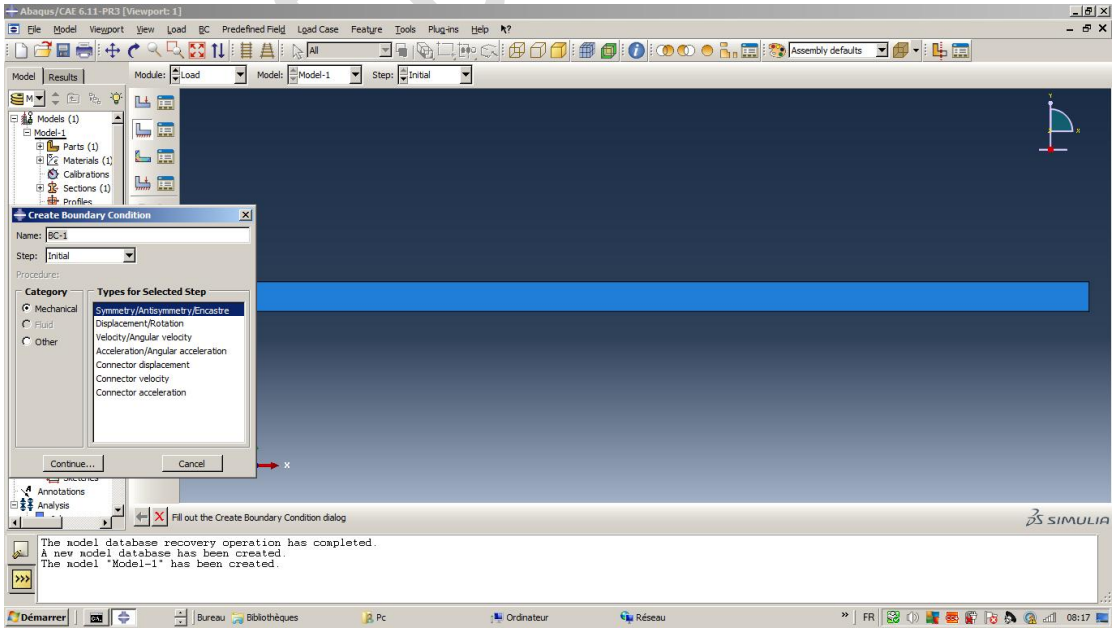
2.6. Load (Chargement)

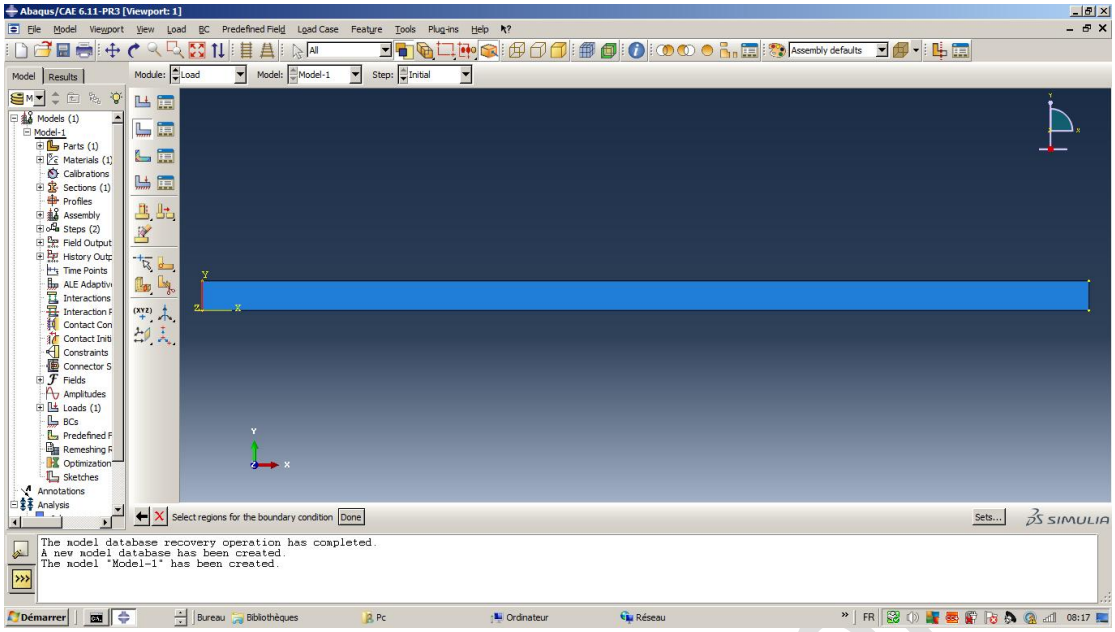


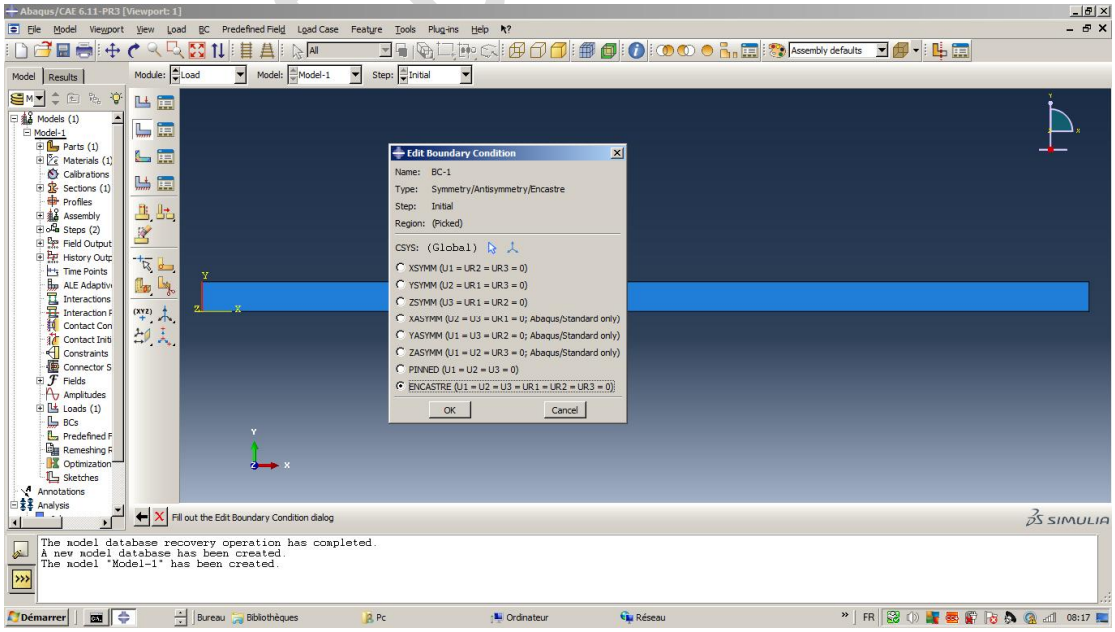


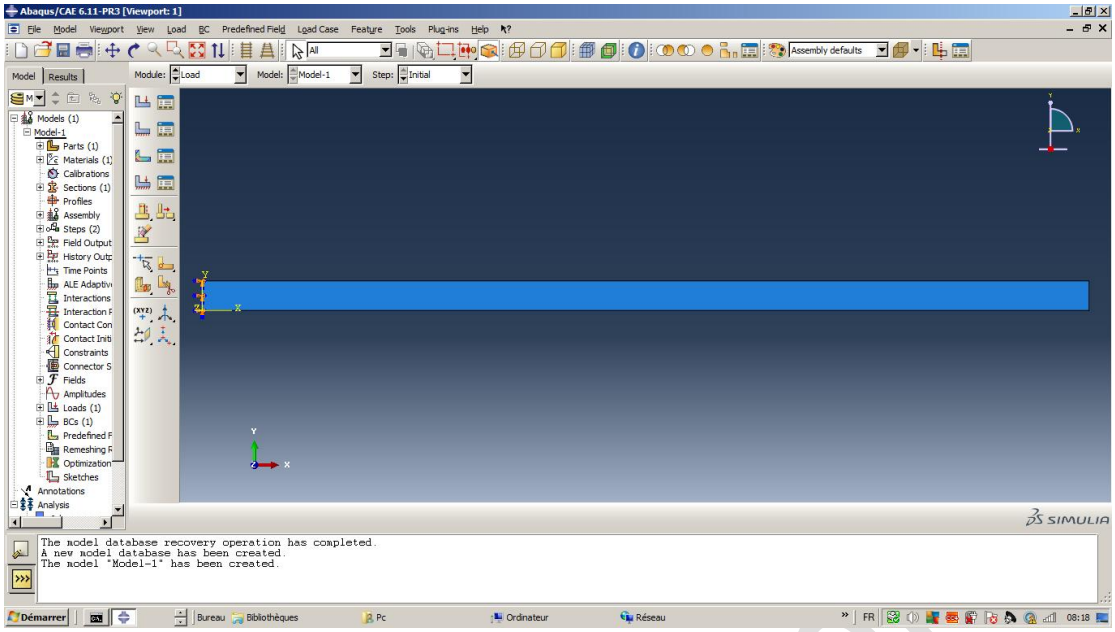


2.6.1. Conditions aux limites

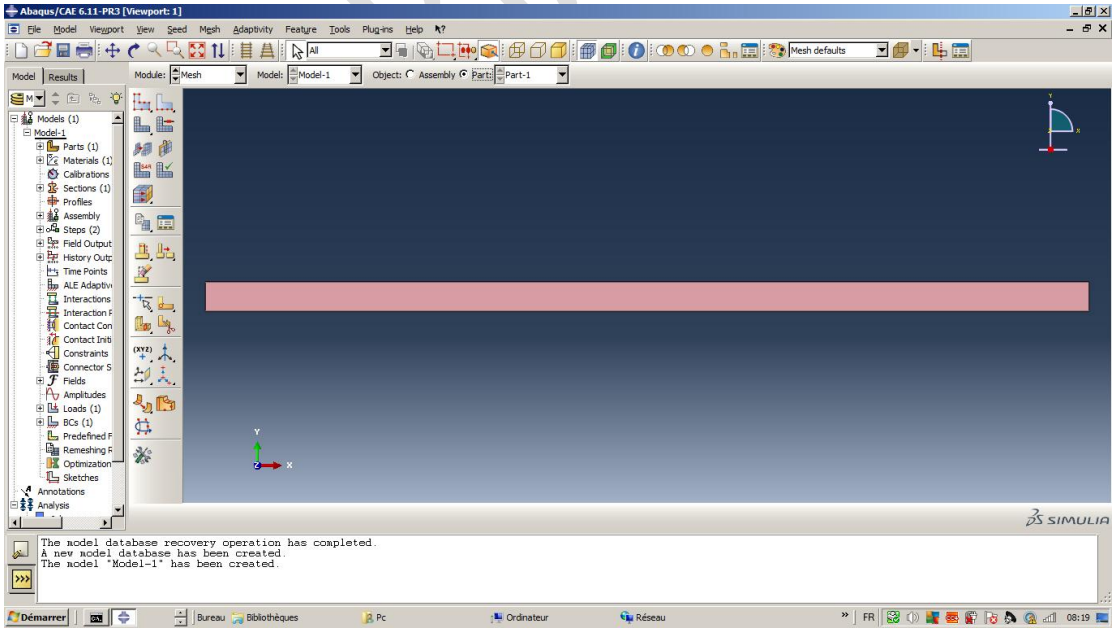


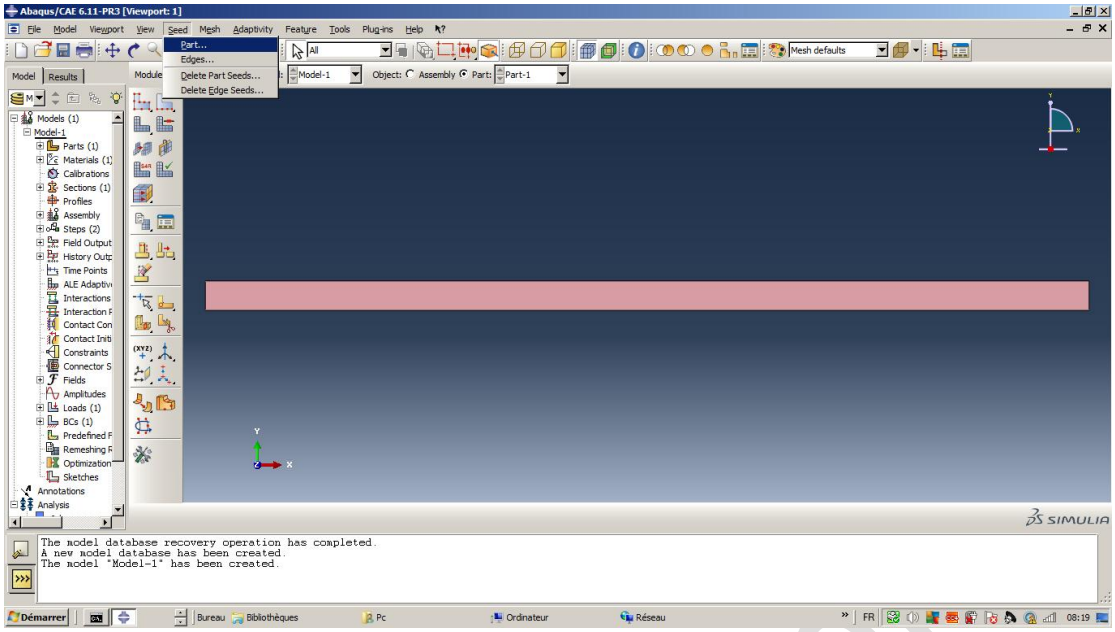

Abaqus/CAE 6.11-PR3 [Viewport: 1]
Select regions for the boundary condition
Done
Sets...
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.

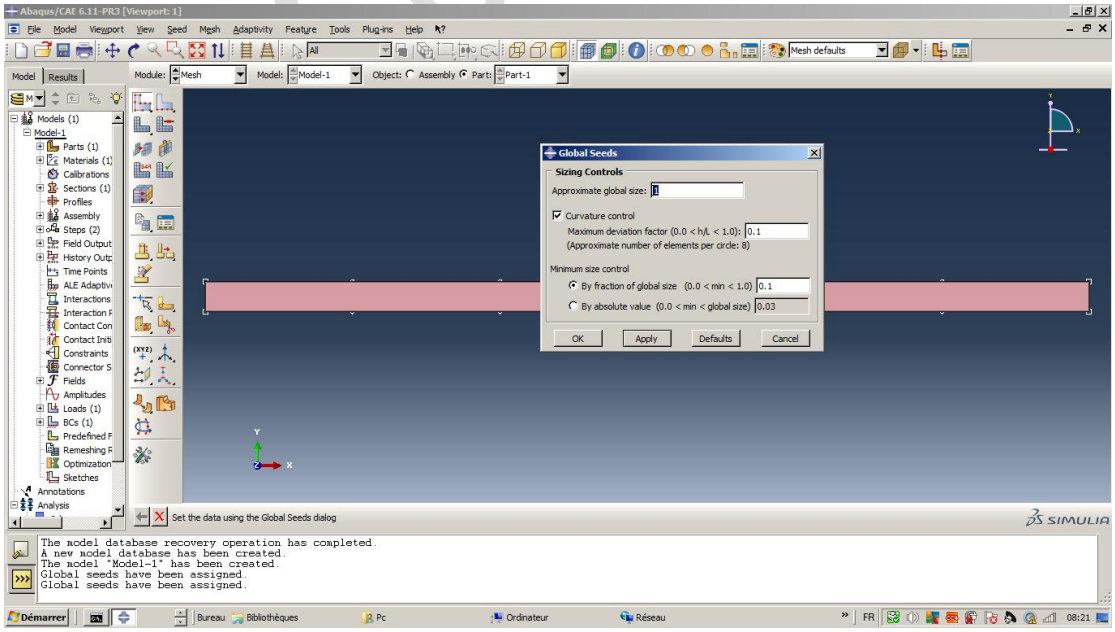

Abaqus/CAE 6.11-PR3 [Viewport: 1]
Edit Boundary Condition
Name: BC-1
Type: Symmetry/Antisymmetry/Encastre
Step: Initial
Region: (Picked)
CSYS: (Global)
XSYMM (U1 = UR2 = UR3 = 0)
YSYMM (U2 = UR1 = UR3 = 0)
ZSYMM (U3 = UR1 = UR2 = 0)
XASYMM (U2 = U3 = UR1 = 0; Abaqus/Standard only)
YASYMM (U1 = U3 = UR2 = 0; Abaqus/Standard only)
ZASYMM (U1 = U2 = UR3 = 0; Abaqus/Standard only)
PINNED (U1 = U2 = U3 = 0)
ENCASTRE (U1 = U2 = U3 = UR1 = UR2 = UR3 = 0)
OK
Cancel
Fill out the Edit Boundary Condition dialog
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.

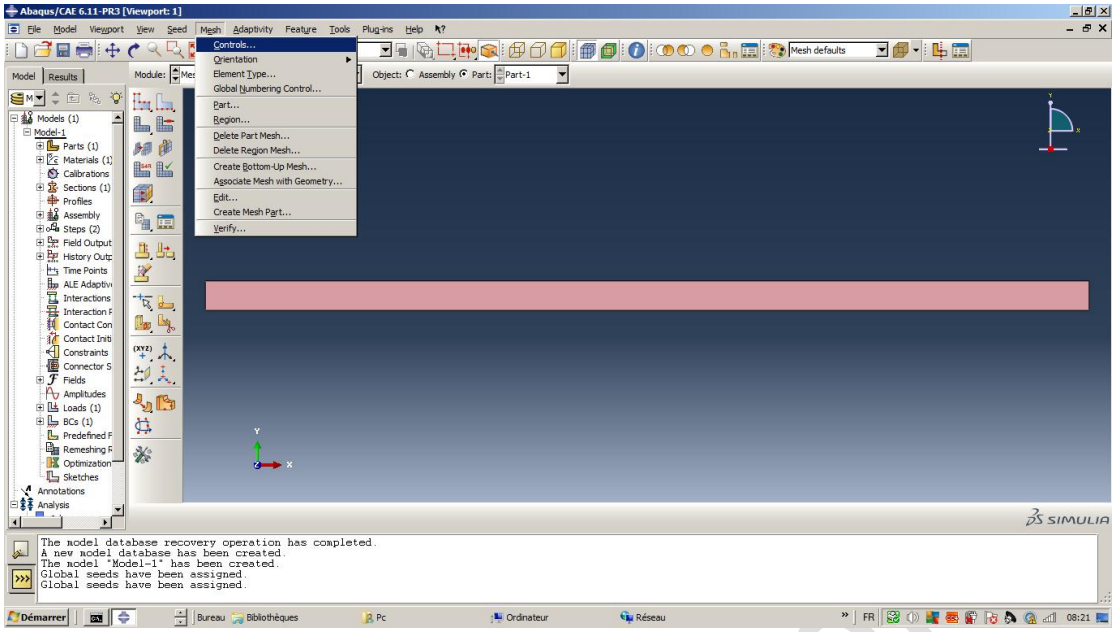


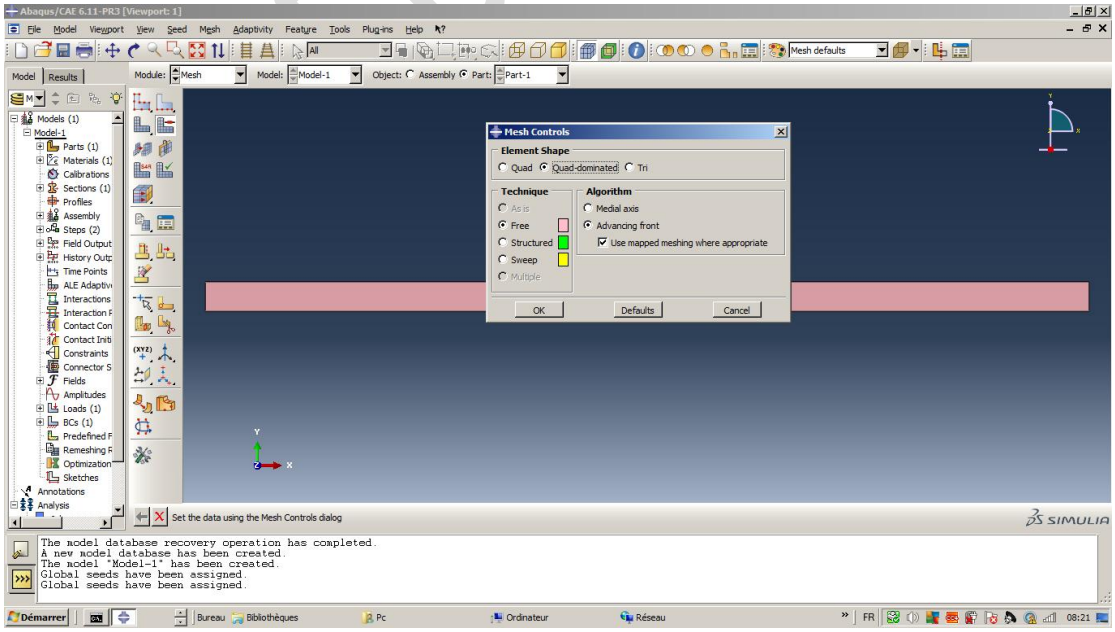
2.7. Mesh (Maillage)

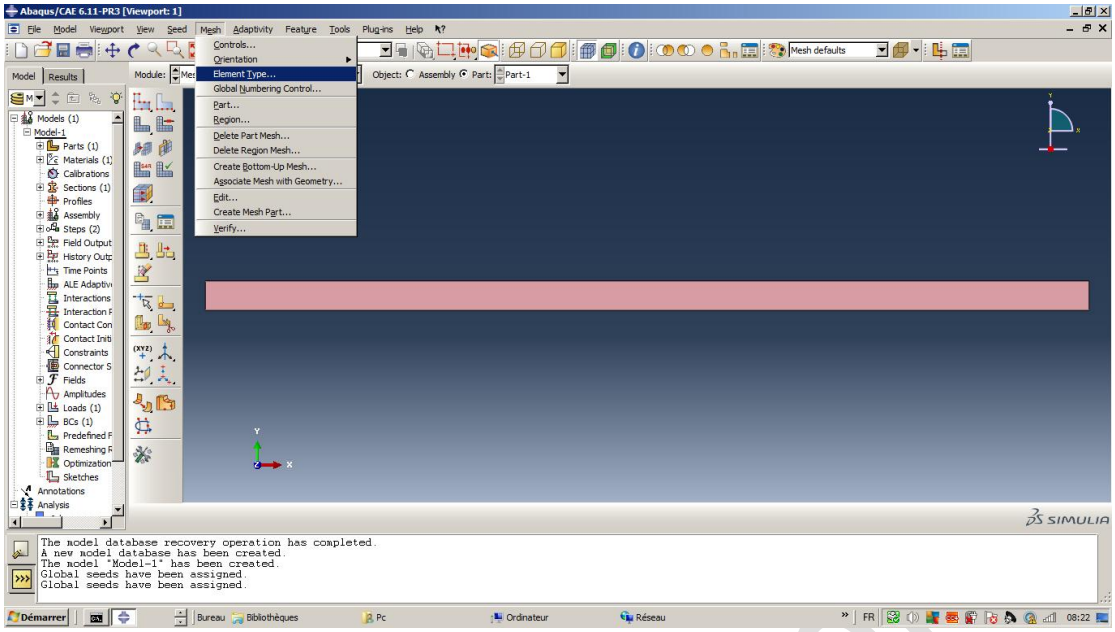



Abaqus/CAE 6.11-PR3 [Viewport: 1]
File Model Viewport View Seed Mesh Adaptivity Feature Tools Plug-ins Help
Part...
Edges...
Delete Part Seeds...
Delete Edge Seeds...
Model Results
Models (1)
Model-1
Parts (1)
Materials (1)
Calibrations
Sections (1)
Profiles
Assembly
Steps (2)
Field Output
History Outp
Time Points
ALE Adaptiv
Interactions
Interaction P
Contact Con
Contact Initi
Constraints
Connector S
Fields
Amplitudes
Loads (1)
BCs (1)
Predefined F
Remeshing R
Optimization
Sketches
Annotations
Analysis
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.
SIMULIA
Démarrer
Bureau Bibliothèques Pc Ordinateur Réseau
FR 08:19

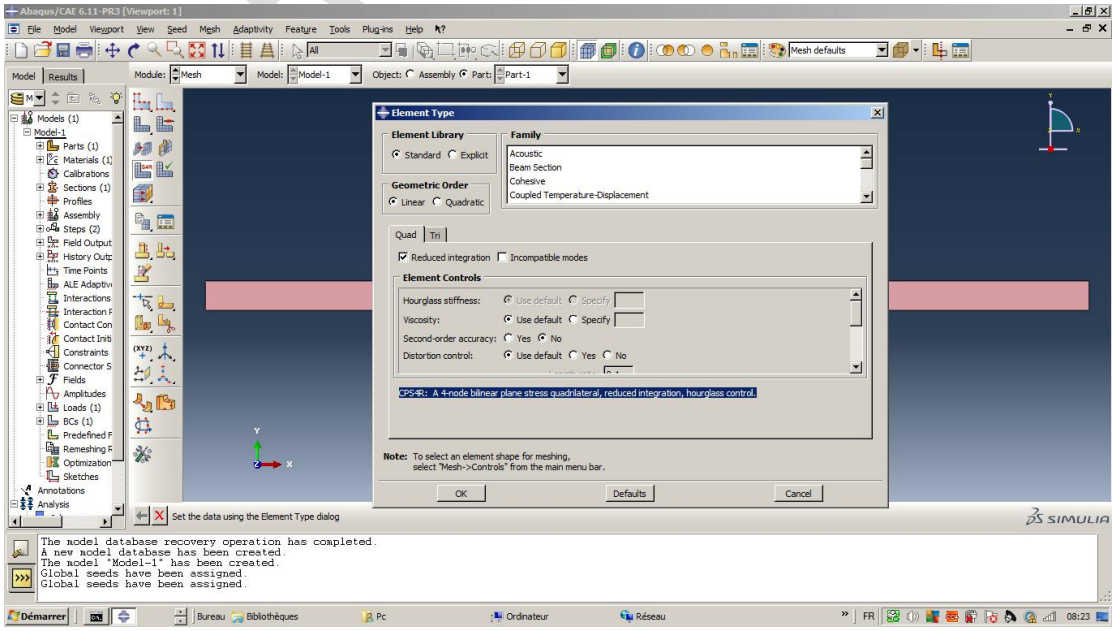

Abaqus/CAE 6.11-PR3 [Viewport: 1]
File Model Viewport View Seed Mesh Adaptivity Feature Tools Plug-ins Help
Module: Mesh
Model Results
Global Seeds
Sizing Controls
Approximate global size:
Curvature control
Maximum deviation factor (0.0 < h/L < 1.0): 0.1
(Approximate number of elements per circle: 8)
Minimum size control
By fraction of global size (0.0 < min < 1.0) 0.1
By absolute value (0.0 < min < global size) 0.03
OK Apply Defaults Cancel
Set the data using the Global Seeds dialog
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.
Global seeds have been assigned.
Global seeds have been assigned.
SIMULIA
Démarrer
Bureau Bibliothèques Pc Ordinateur Réseau
FR 08:21


Abaqus/CAE 6.11-PR3 [Viewport: 1]
File Model Viewport View Seed Mesh Adaptivity Feature Tools Plug-ins Help
Controls...
Orientation
Element Type...
Global Numbering Control...
Part...
Region...
Delete Part Mesh...
Delete Region Mesh...
Create Bottom-Up Mesh...
Associate Mesh with Geometry...
Edit...
Create Mesh Part...
Verify...
Model Results
Module:
Object: Assembly Part: Part-1
Mesh defaults
Models (1)
Model-1
Parts (1)
Materials (1)
Calibrations
Sections (1)
Profiles
Assembly
Steps (2)
Field Output
History Outp
Time Points
ALE Adaptiv
Interactions
Interaction P
Contact Con
Contact Initi
Constraints
Connector S
Fields
Amplitudes
Loads (1)
BCs (1)
Predefined F
Remeshing R
Optimization
Sketches
Annotations
Analysis
SIMULIA
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.
Global seeds have been assigned.
Global seeds have been assigned.
Démarrer
Bureau Bibliothèques Pc Ordinateur Réseau
FR
08:21

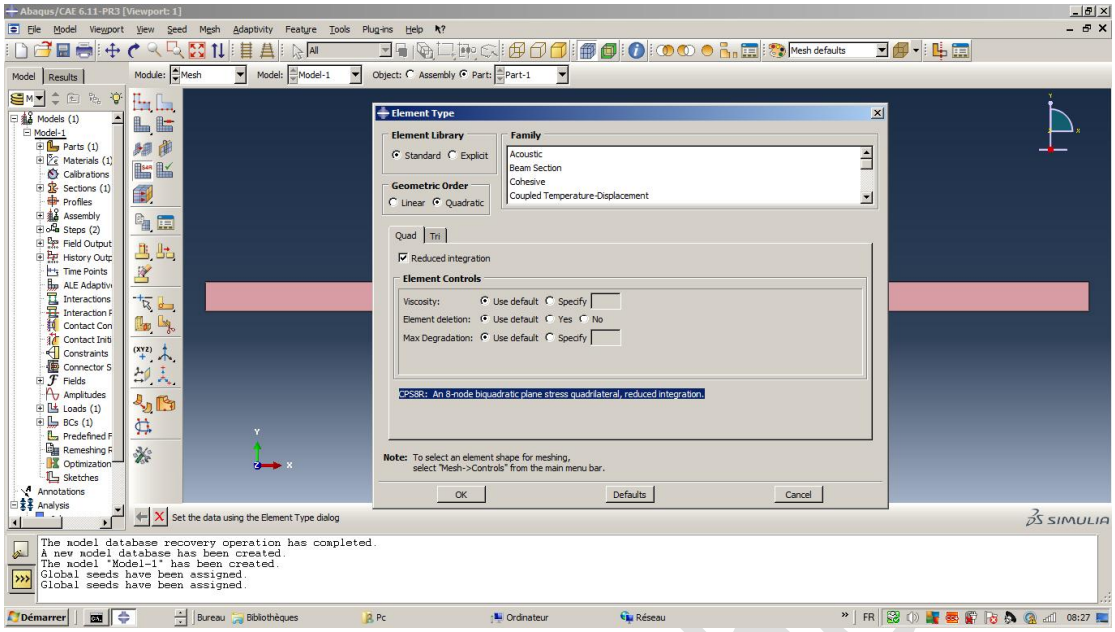

Abaqus/CAE 6.11-PR3 [Viewport: 1]
File Model Viewport View Seed Mesh Adaptivity Feature Tools Plug-ins Help
Model Results
Module: Mesh
Model: Model-1
Object: Assembly Part: Part-1
Mesh defaults
Mesh Controls
Element Shape
Quad Quad-dominated Tri
Technique
As is
Free
Structured
Sweep
Multiple
Algorithm
Medial axis
Advancing front
Use mapped meshing where appropriate
OK Defaults Cancel
Set the data using the Mesh Controls dialog
SIMULIA
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.
Global seeds have been assigned.
Global seeds have been assigned.
Démarrer
Bureau Bibliothèques Pc Ordinateur Réseau
FR
08:21

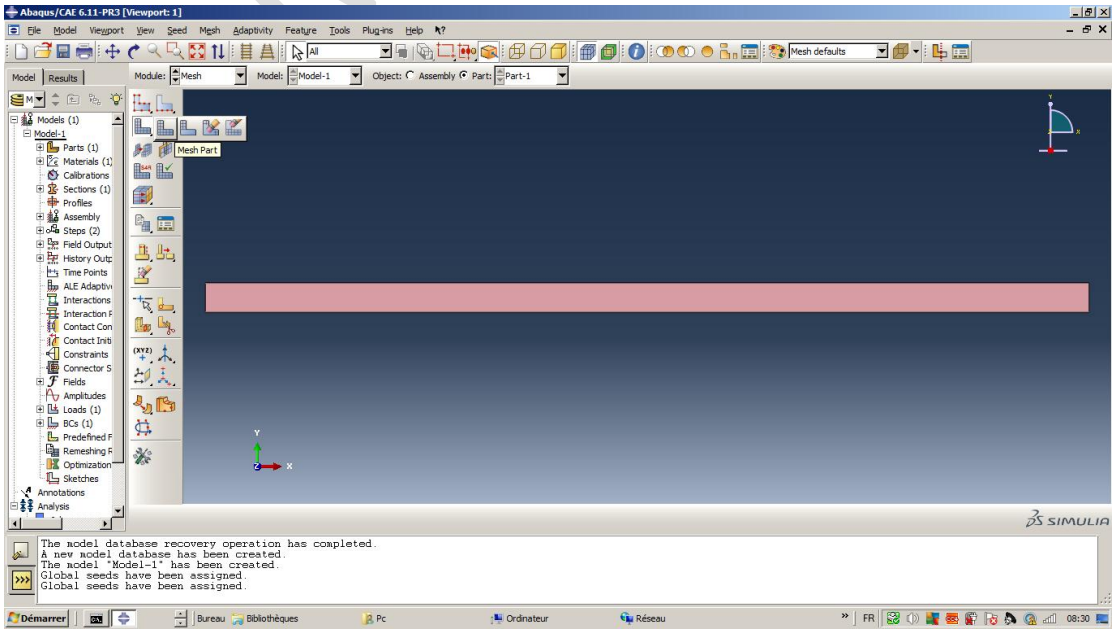


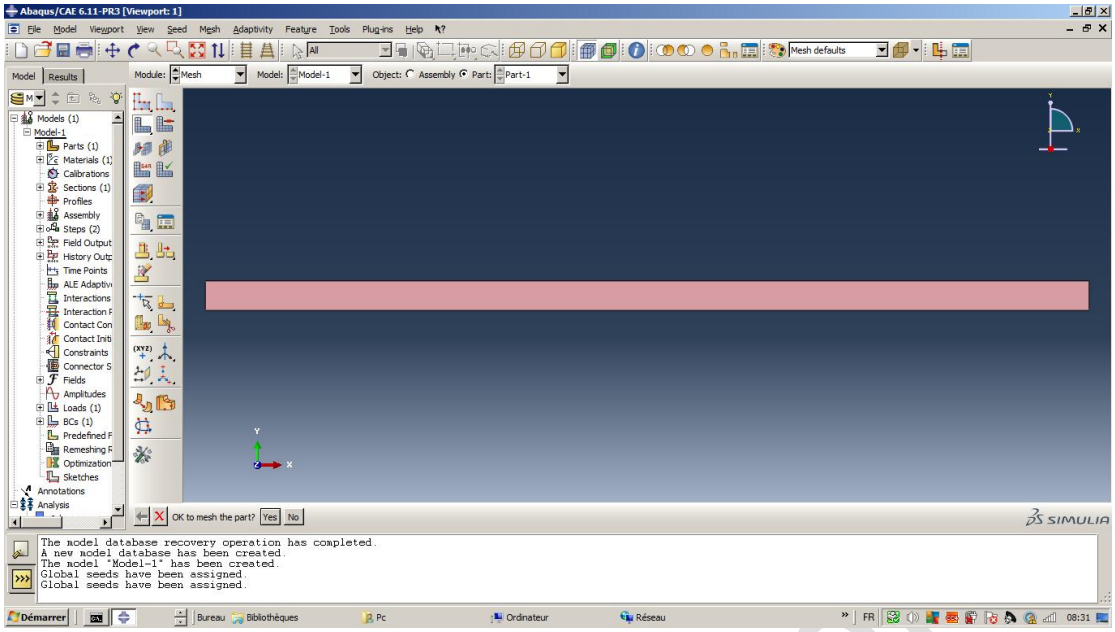
1er cas Eléments linéaires (CPS4R) avec intégration réduite

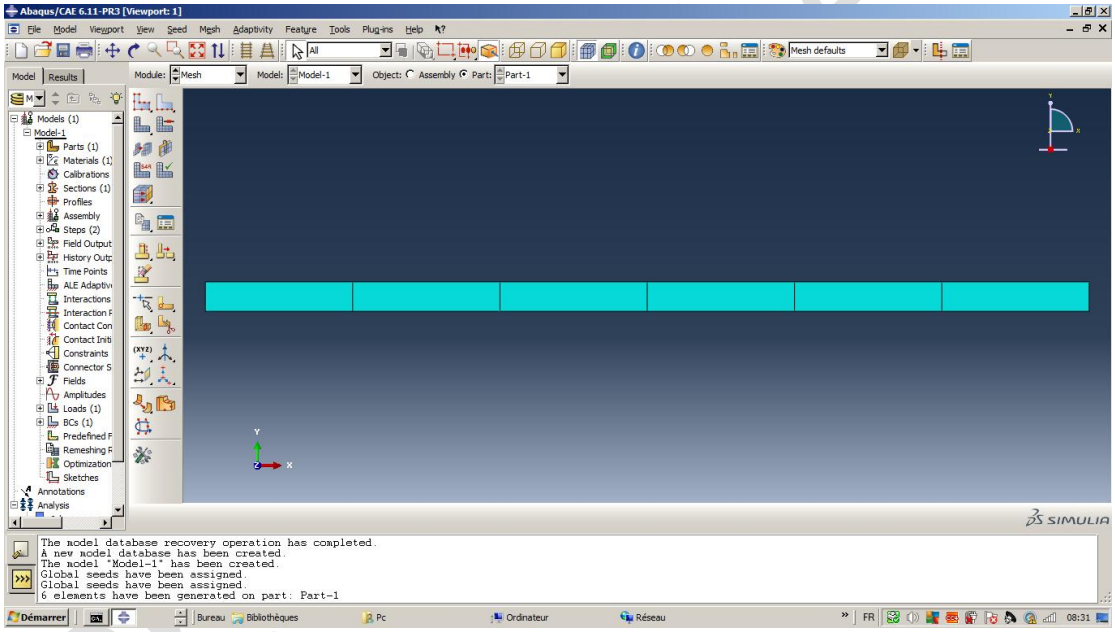


2ème cas : Eléments quadratiques (CPS8R) Avec intégration réduite.

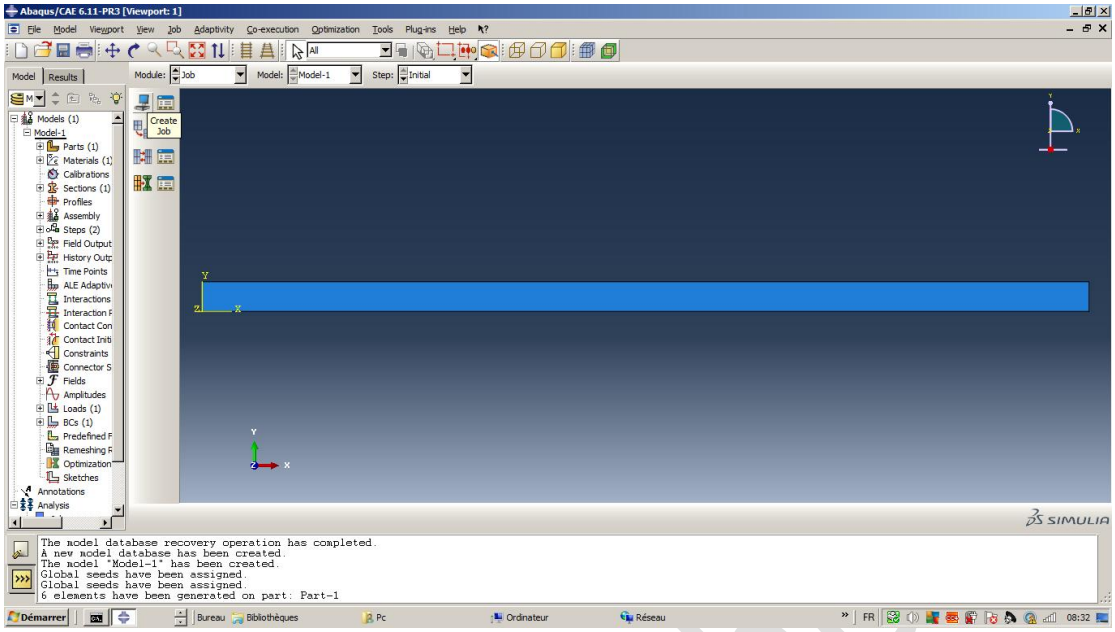


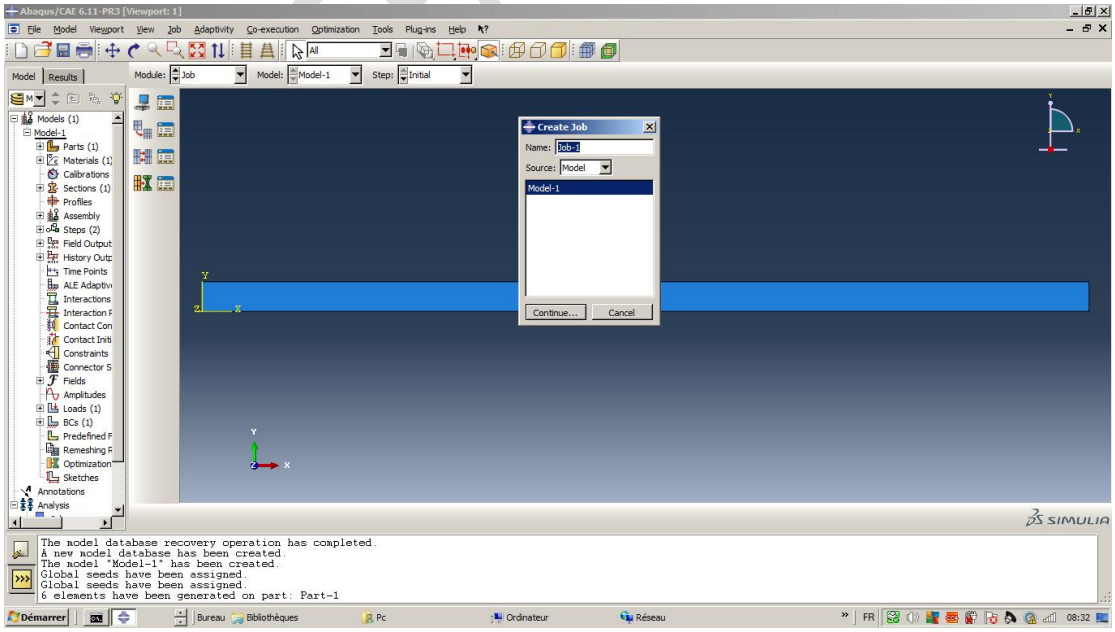


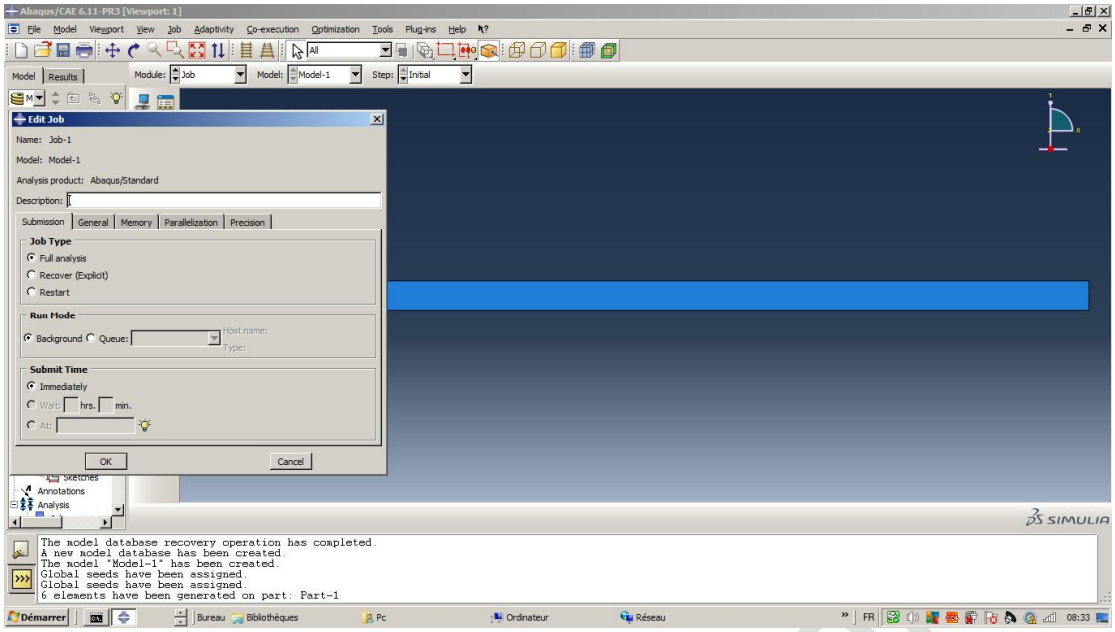

Abaqus/CAE 6.11-PR3 [Viewport: 1]
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.
Global seeds have been assigned.
Global seeds have been assigned.

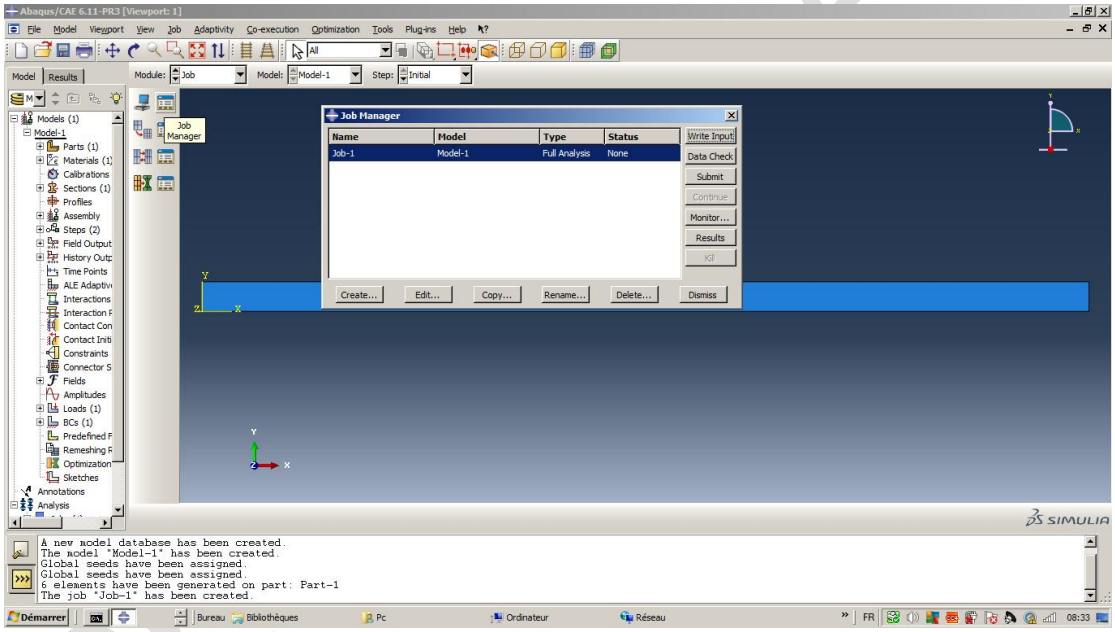

Abaqus/CAE 6.11-PR3 [Viewport: 1]
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.
Global seeds have been assigned.
Global seeds have been assigned.
6 elements have been generated on part: Part-1

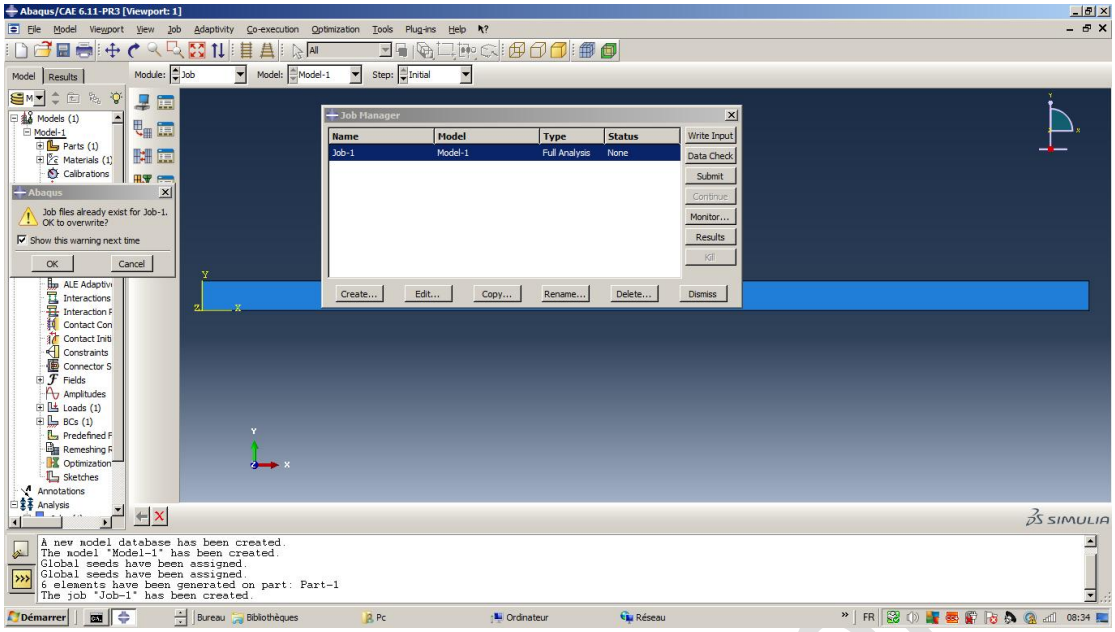
2.8. Création de Job

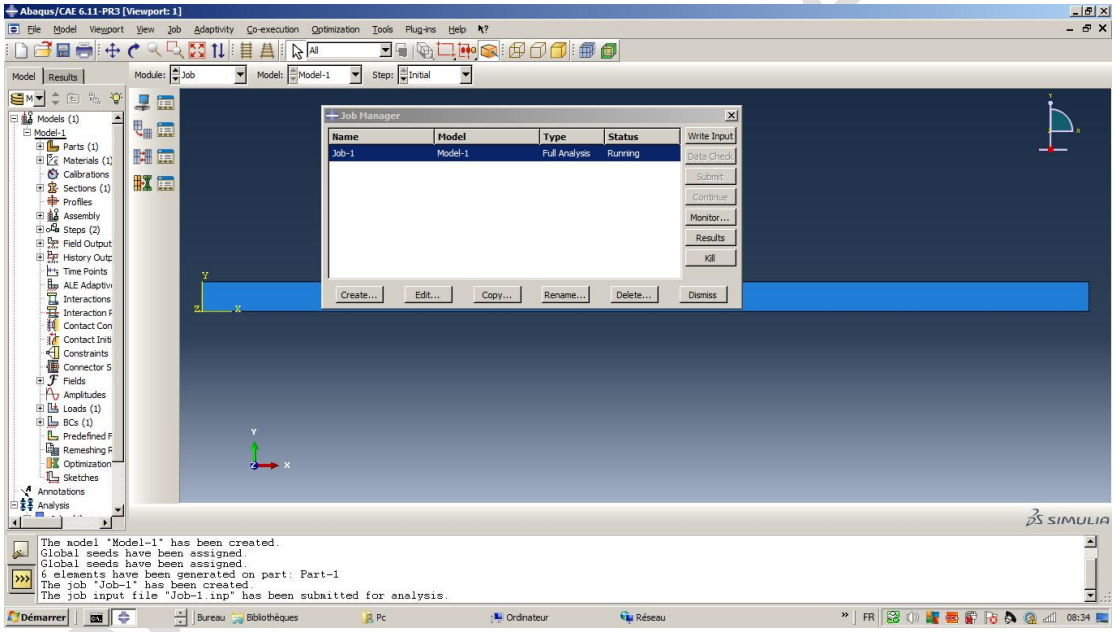


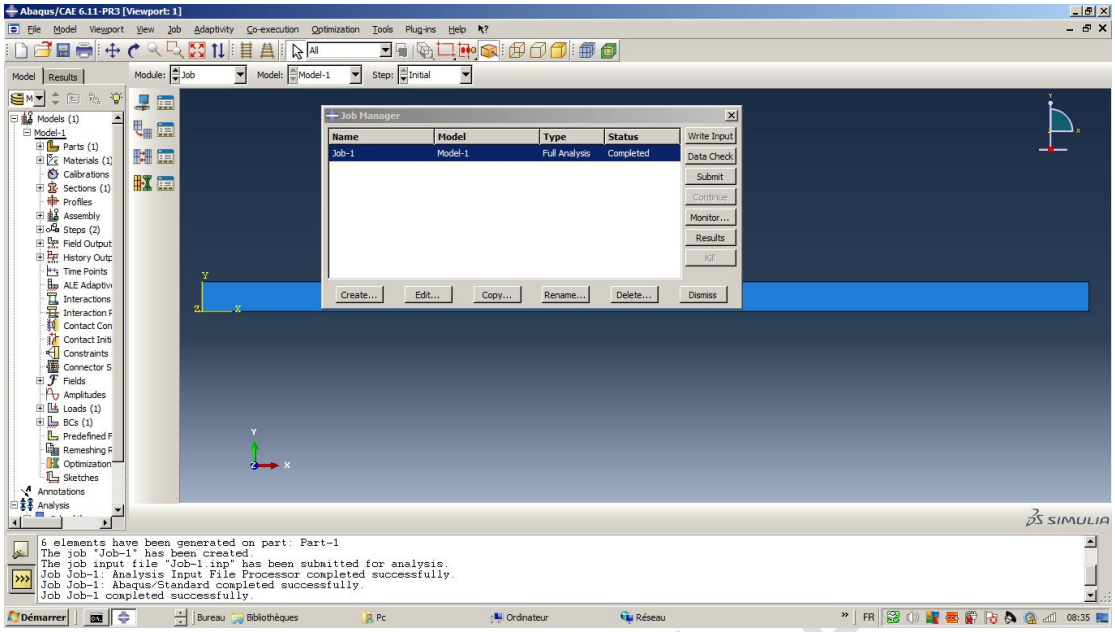



Abaqus/CAE 6.11-PR3 [Viewport: 1]
Edit Job
Name: Job-1
Model: Model-1
Analysis product: Abaqus/Standard
Description:
Submission
General
Memory
Parallelization
Precision
Job Type
Full analysis
Recover (Explicit)
Restart
Run Mode
Background
Queue:
Submit Time
Immediately
Wait: hrs. min.
At:
OK
Cancel
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.
Global seeds have been assigned.
Global seeds have been assigned.
6 elements have been generated on part: Part-1

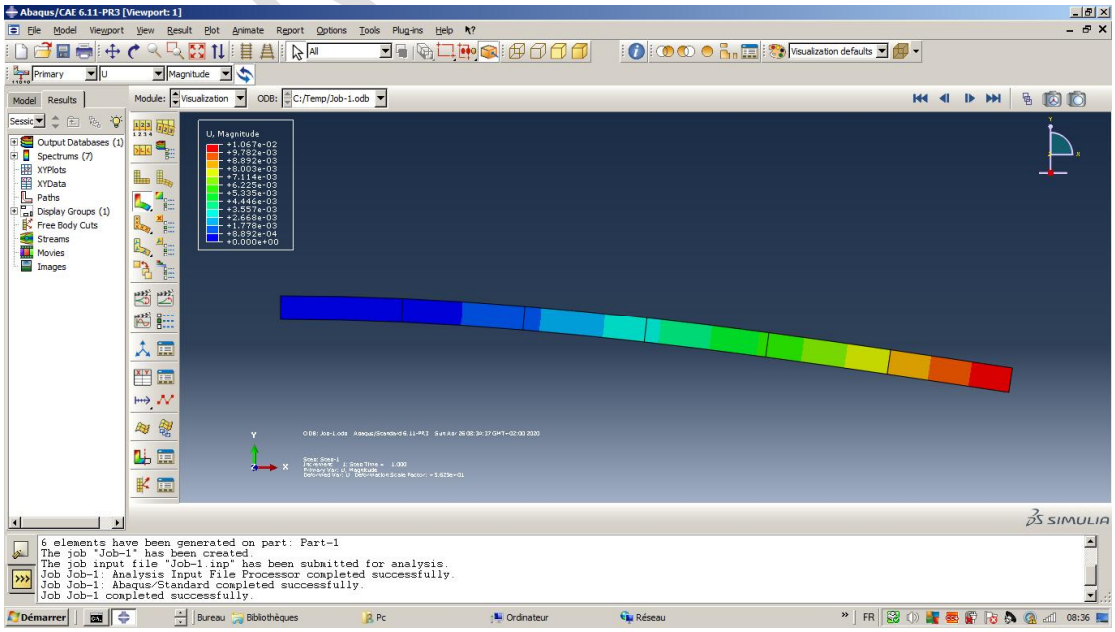

Abaqus/CAE 6.11-PR3 [Viewport: 1]
Job Manager
Name
Model
Type
Status
Job-1
Model-1
Full Analysis
None
Write Input
Data Check
Submit
Continue
Monitor...
Results
Kill
Create...
Edit...
Copy...
Rename...
Delete...
Dismiss
A new model database has been created.
The model "Model-1" has been created.
Global seeds have been assigned.
Global seeds have been assigned.
6 elements have been generated on part: Part-1
The job "Job-1" has been created.


Abaqus/CAE 6.11-PR3 [Viewport: 1]
Job Manager
Name
Model
Type
Status
Job-1
Model-1
Full Analysis
None
Write Input
Data Check
Submit
Continue
Monitor...
Results
Kill
Create...
Edit...
Copy...
Rename...
Delete...
Dismiss
Abaqus
Job files already exist for Job-1.
OK to overwrite?
Show this warning next time
OK
Cancel
A new model database has been created.
The model "Model-1" has been created.
Global seeds have been assigned.
Global seeds have been assigned.
6 elements have been generated on part: Part-1
The job "Job-1" has been created.


Abaqus/CAE 6.11-PR3 [Viewport: 1]
Job Manager
Name
Model
Type
Status
Job-1
Model-1
Full Analysis
Running
Write Input
Data Check
Submit
Continue
Monitor...
Results
Kill
Create...
Edit...
Copy...
Rename...
Delete...
Dismiss
The model "Model-1" has been created.
Global seeds have been assigned.
Global seeds have been assigned.
6 elements have been generated on part: Part-1
The job "Job-1" has been created.
The job input file "Job-1.inp" has been submitted for analysis.



2.9.Visualisation



RESULTATS

La flèche ou le déplacement maximal de cisaillement est de 0.01067. Ici l'épaisseur est de 0.1 donc le résultat sera multiplié par 10 et on aura 0.1067.

Comparons ce déplacement à la solution analytique qui est 0.1081 on peut conclure :

(0.1067/0.1081)x100 = 98.70 c'est-à-dire 98.7% de la solution exacte de Timoshenko est obtenue en utilisant l'élément quadratique CPS8R.