

# Практическая часть:

## «Статический анализ напряженного состояния»

*К концу ключа прикладывается сила 100 Н, а затем здесь же, но в другом направлении добавляется сила величиной 20 Н.*

*Определить напряжения, возникающие в ключе под действием обеих сил.*

Размер гайки под ключ = 10 мм

Конфигурация = шестиугольный

Длина стержня = 7.5 см

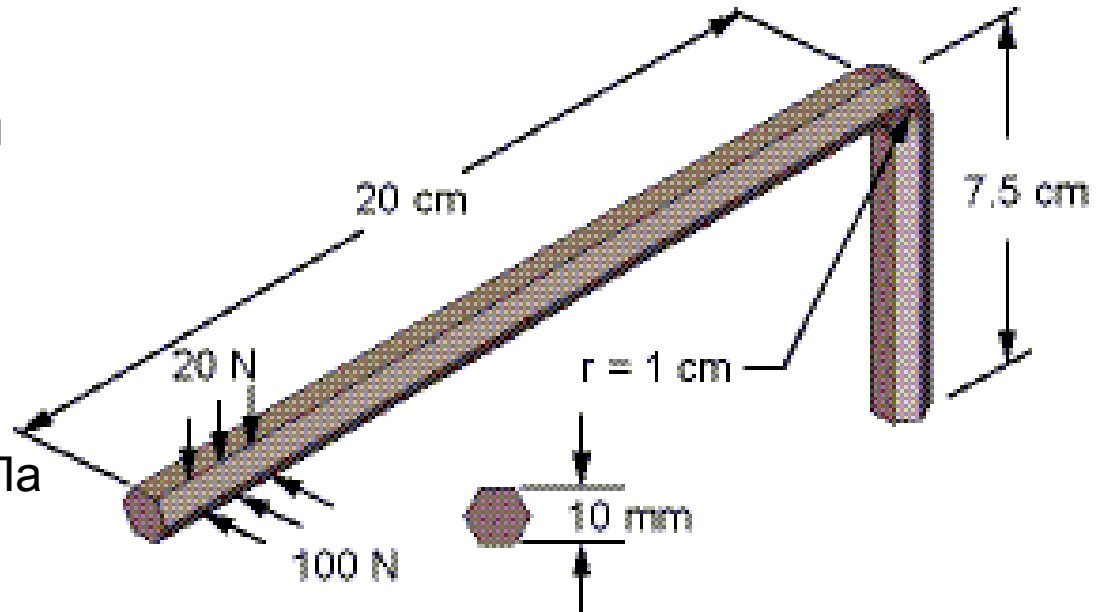
Длина маркера = 20 см

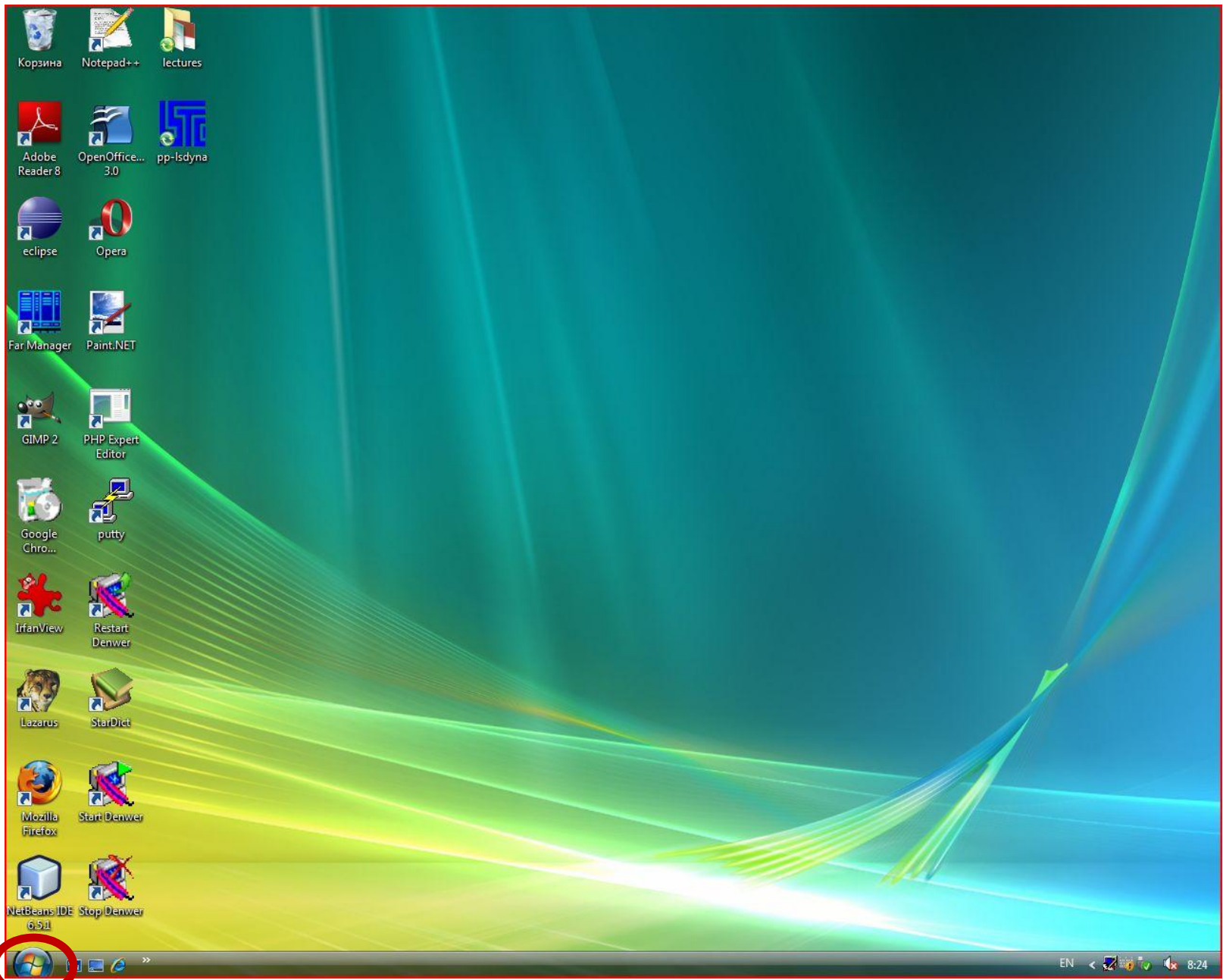
Радиус изгиба = 1 см

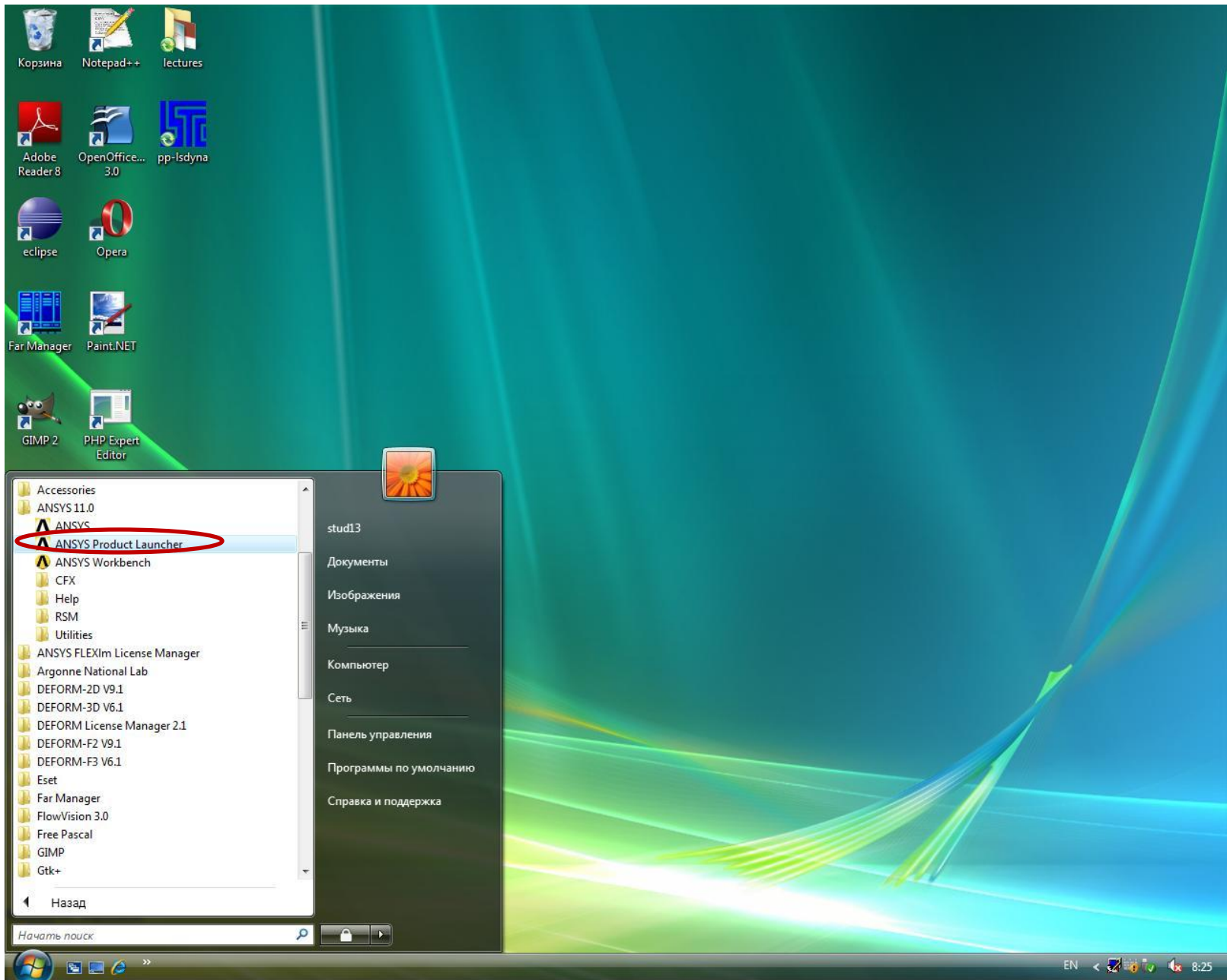
Модуль упругости =  $2.07 \times 10^{11}$  Па

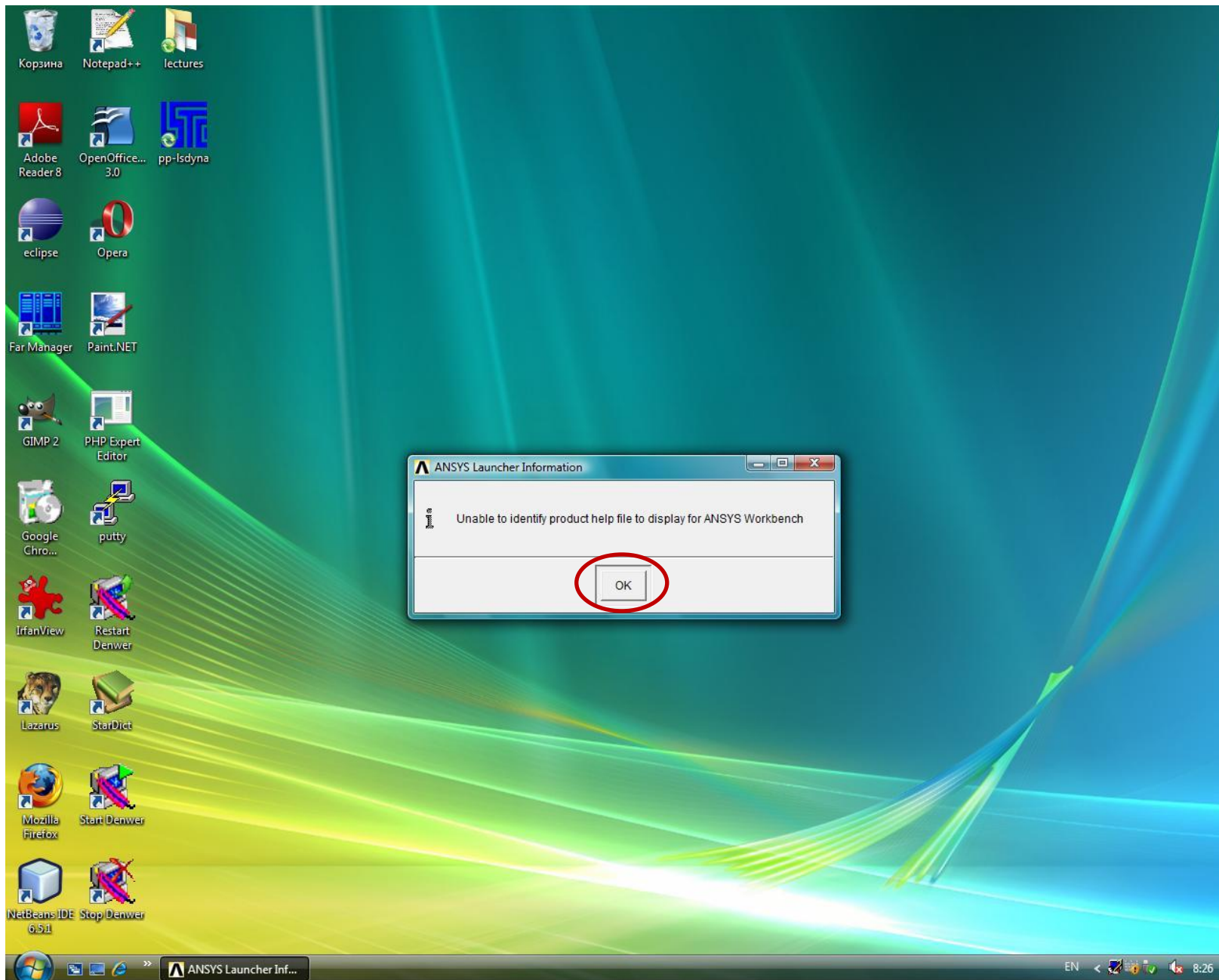
Сила = 100 Н

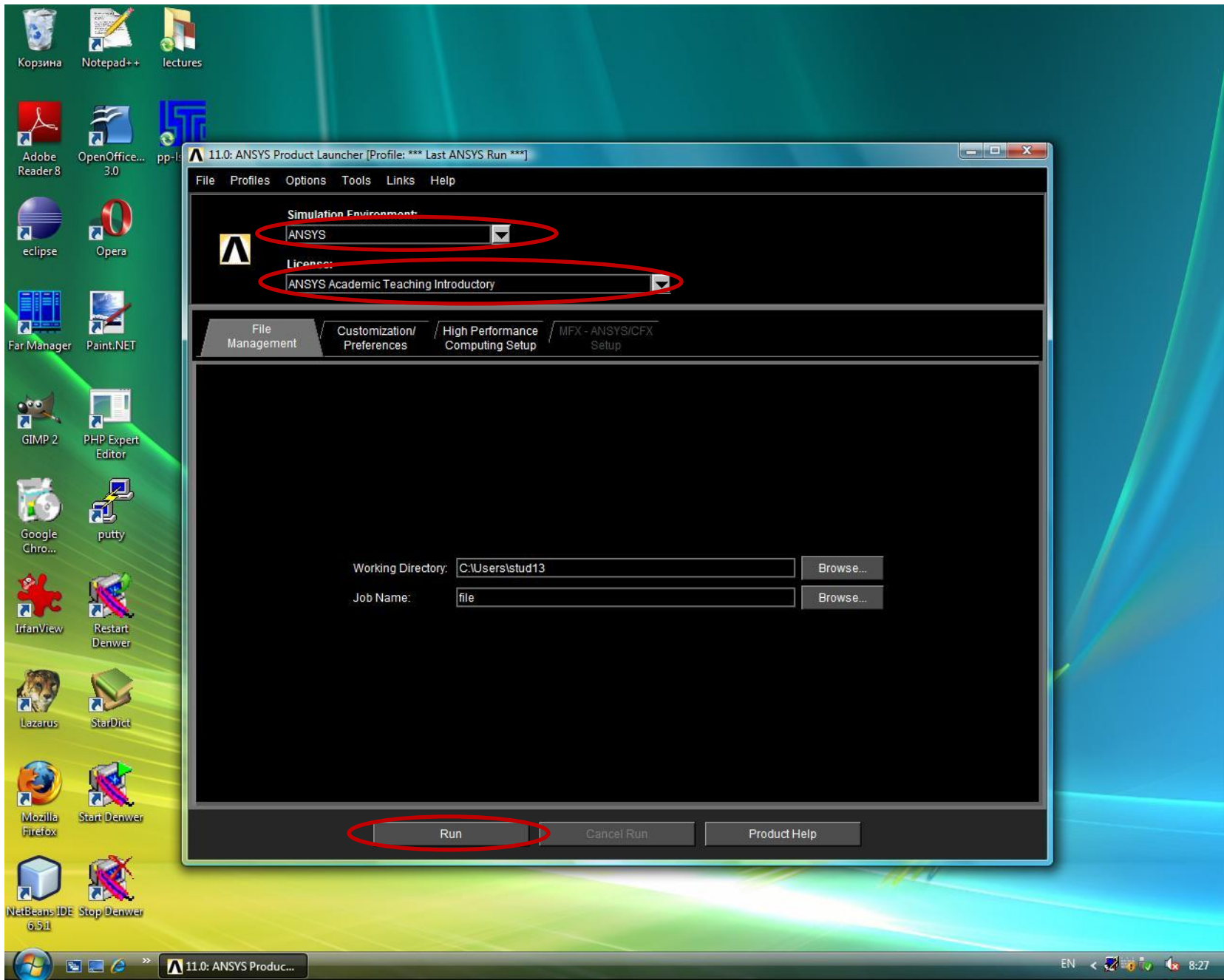
Сила = 20 Н

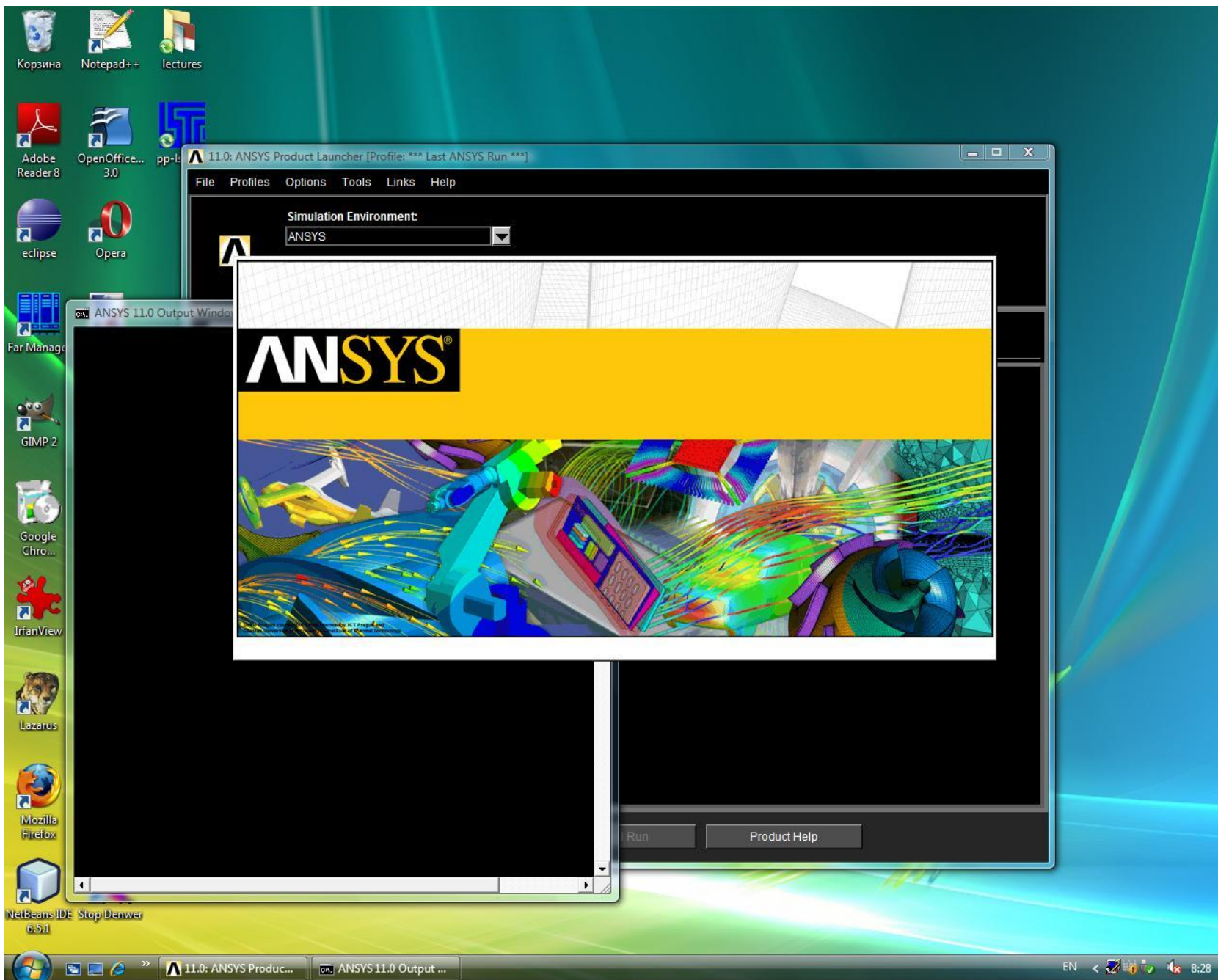


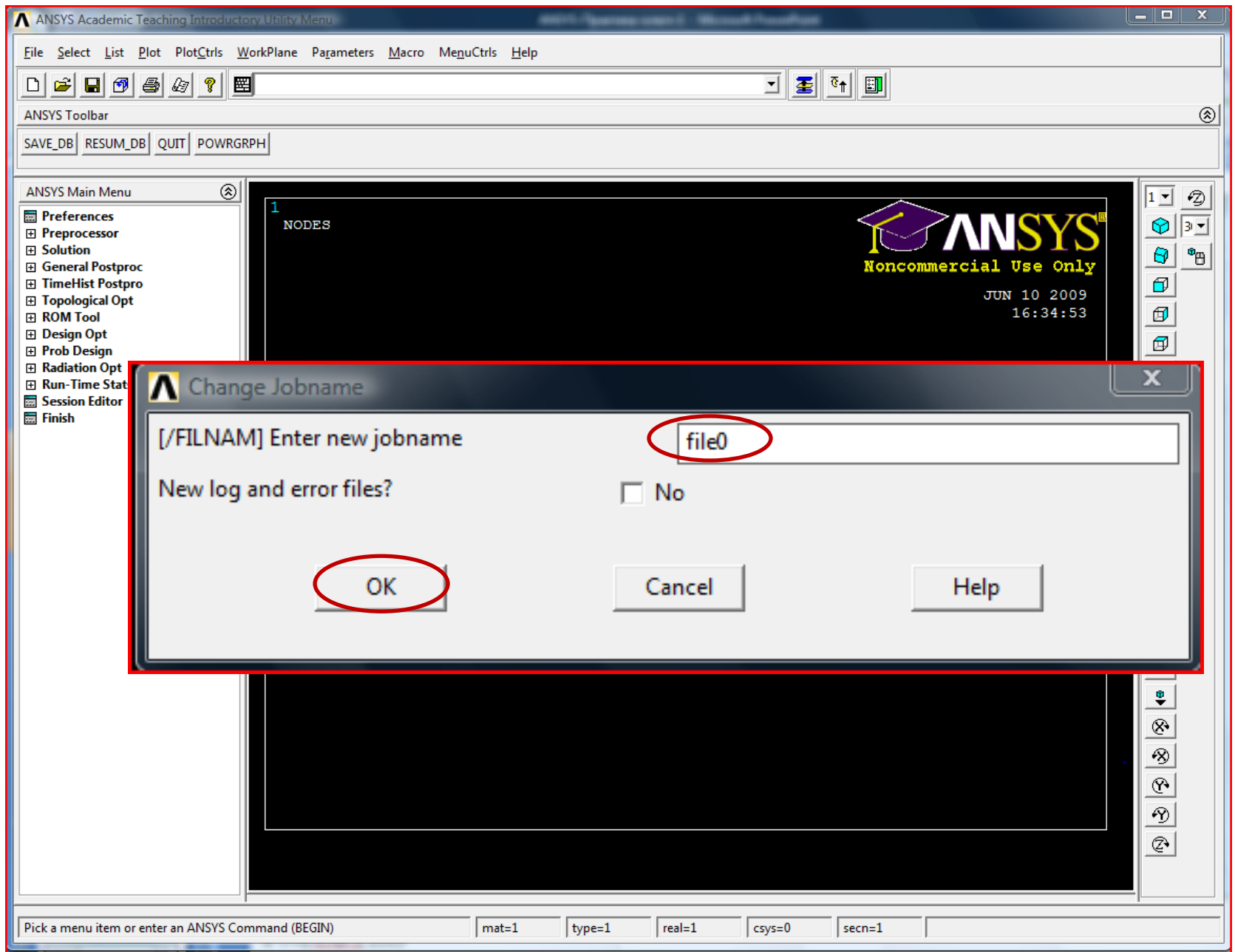


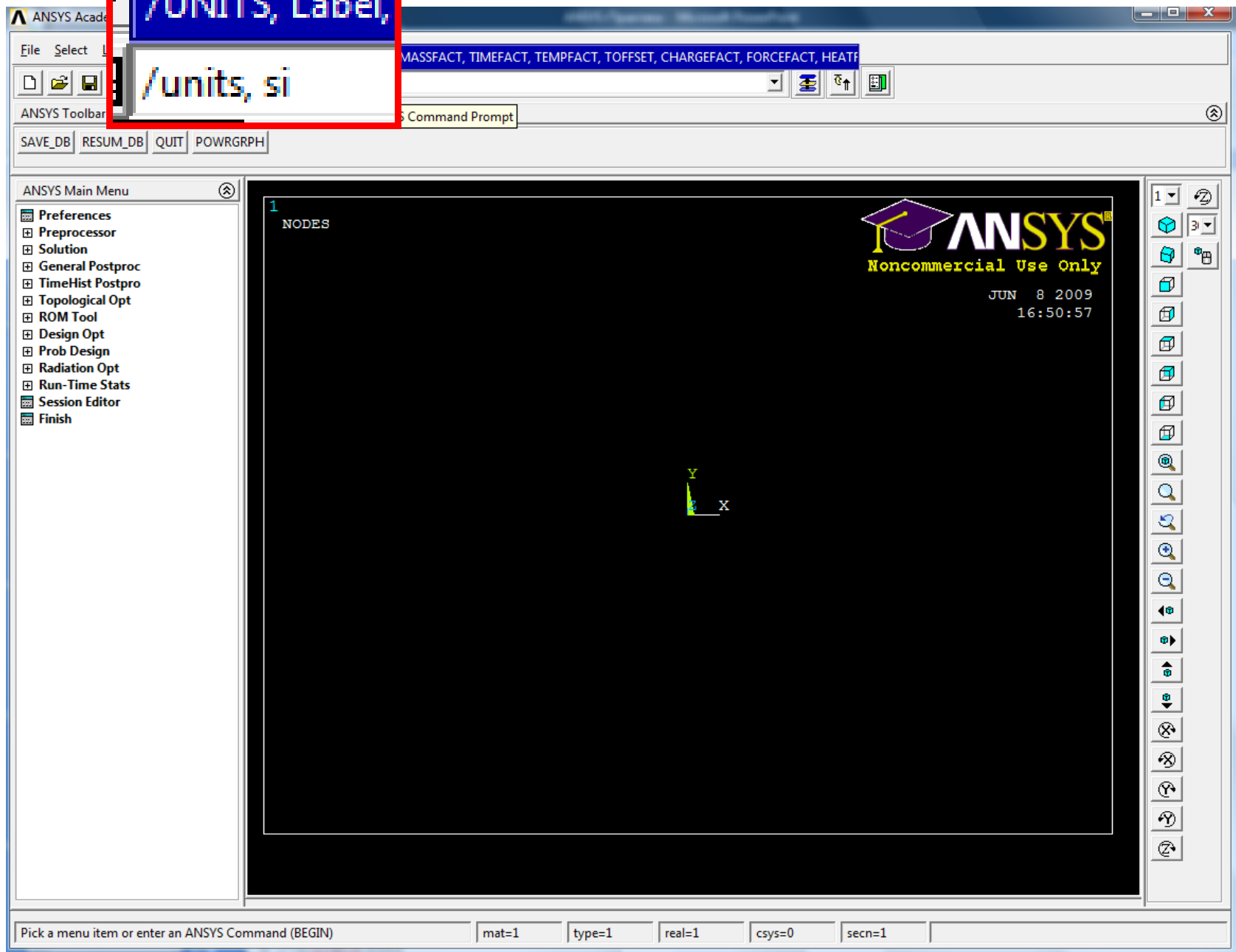








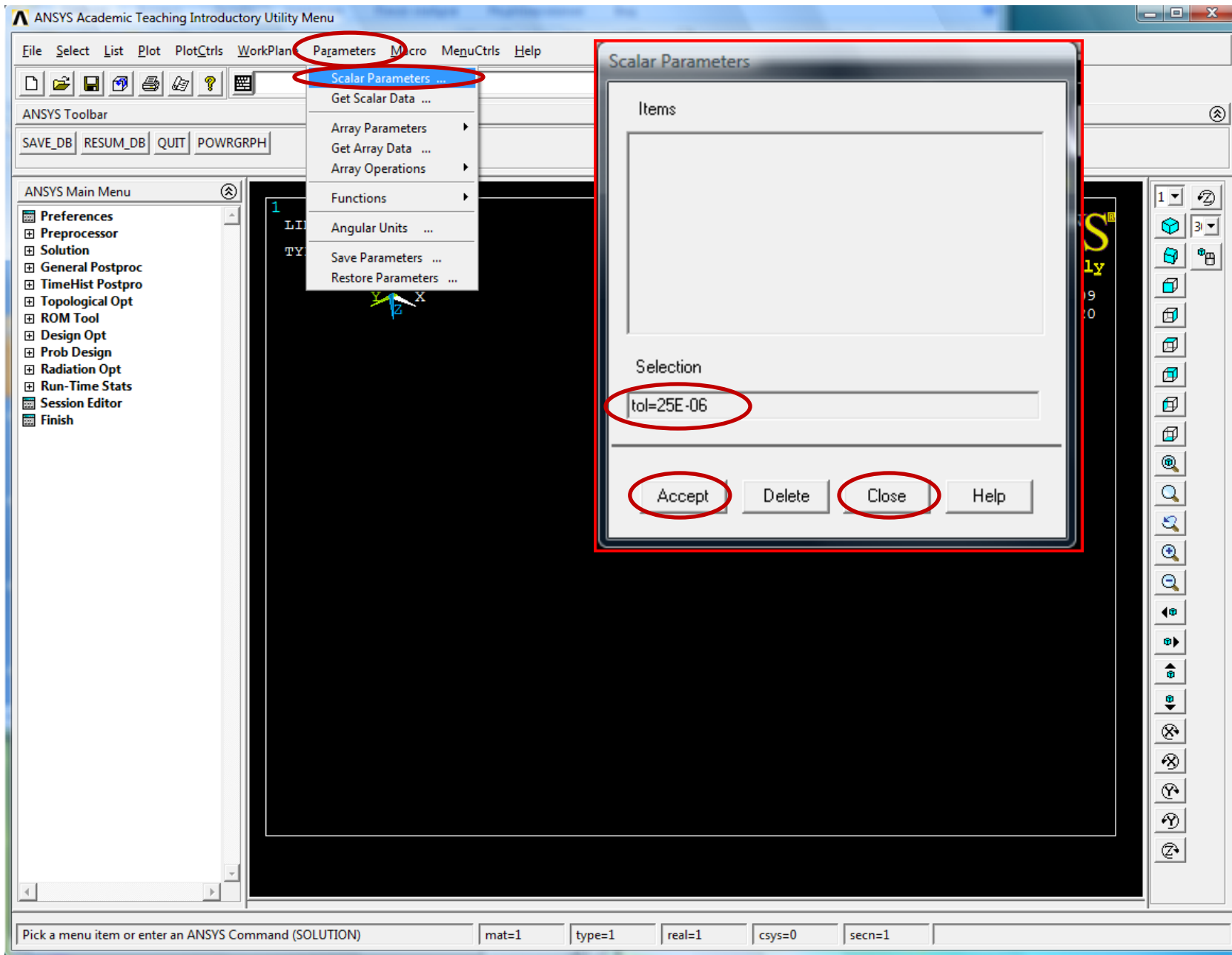


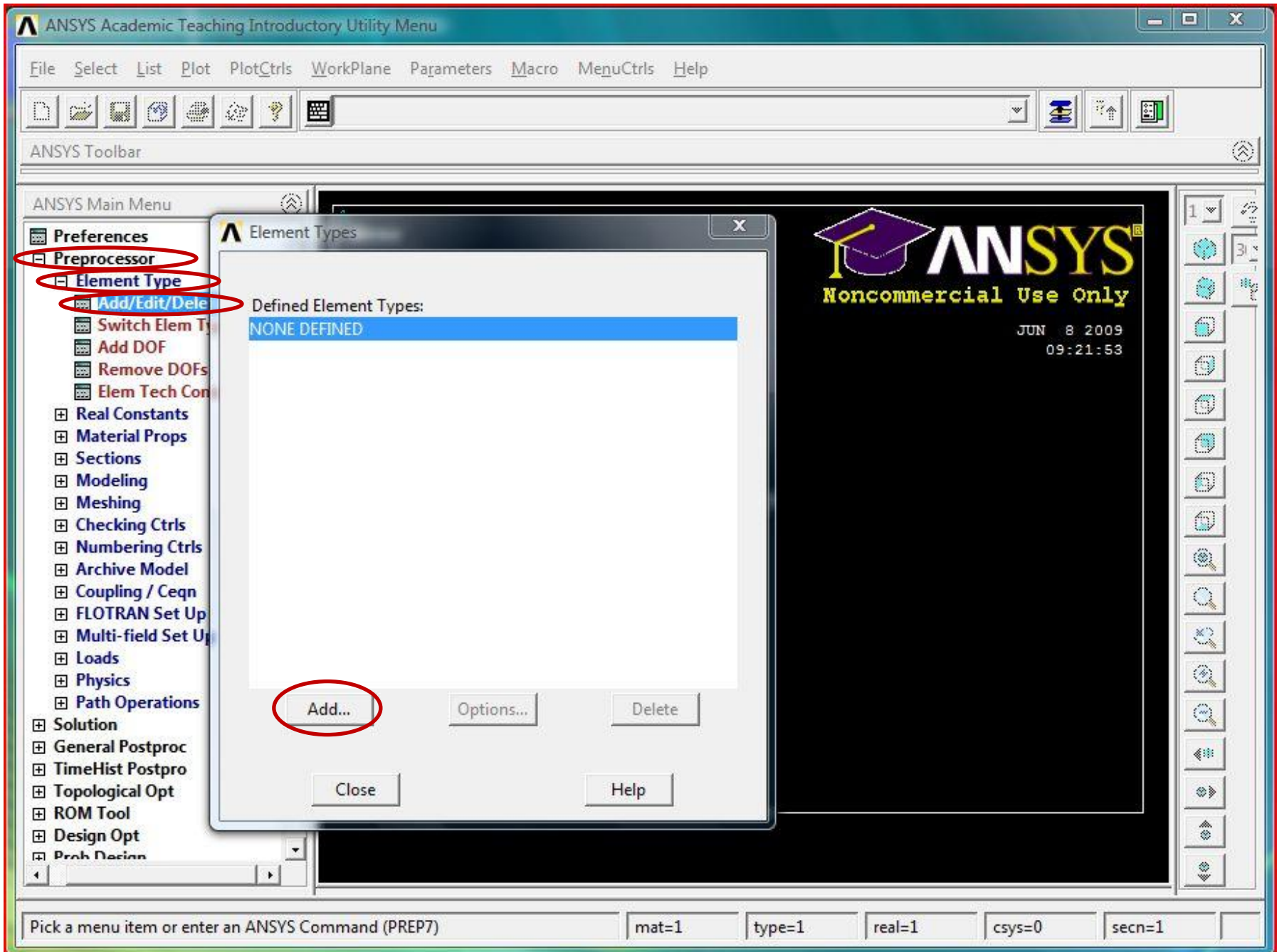


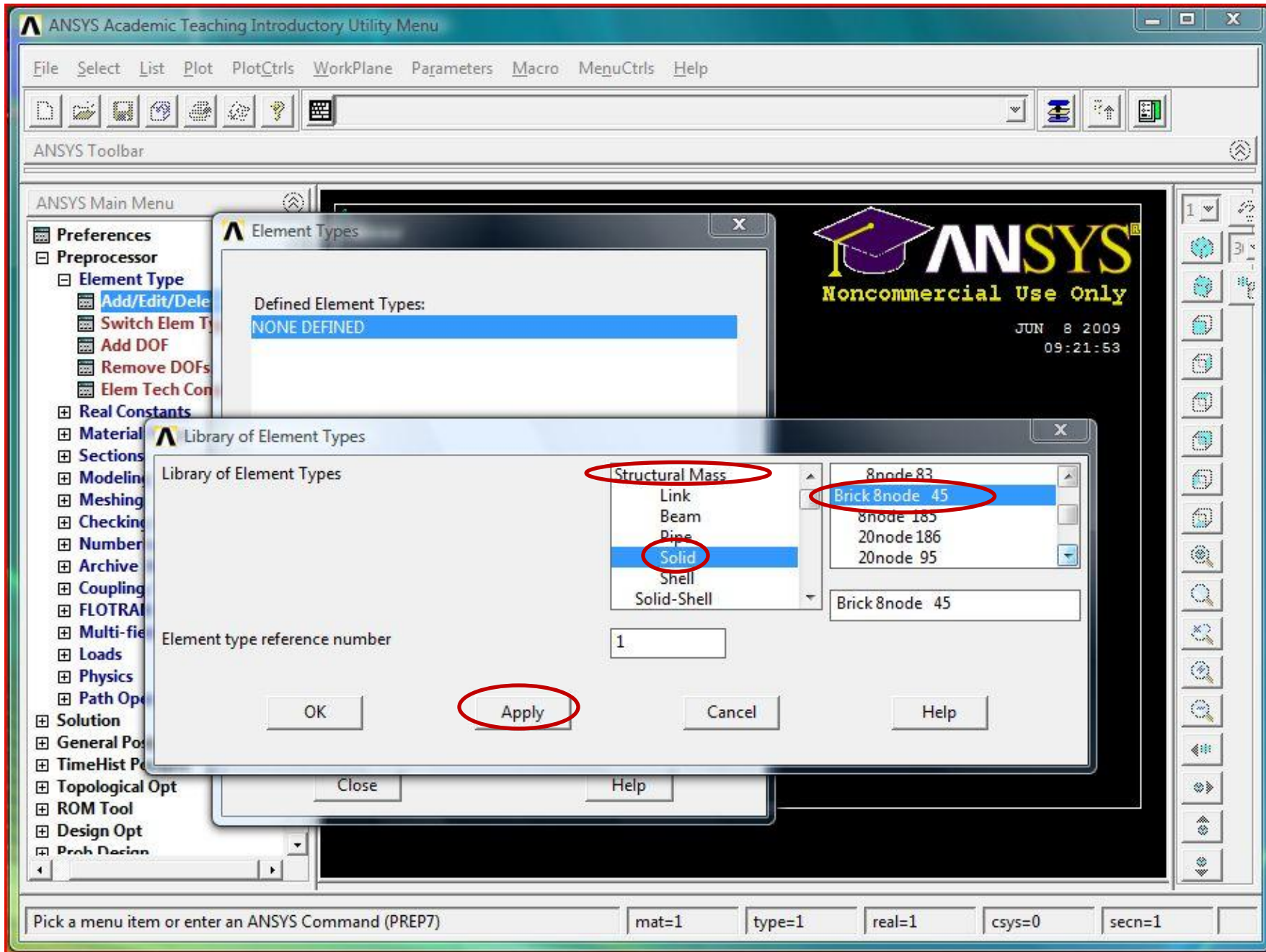
/UNITS, Label,

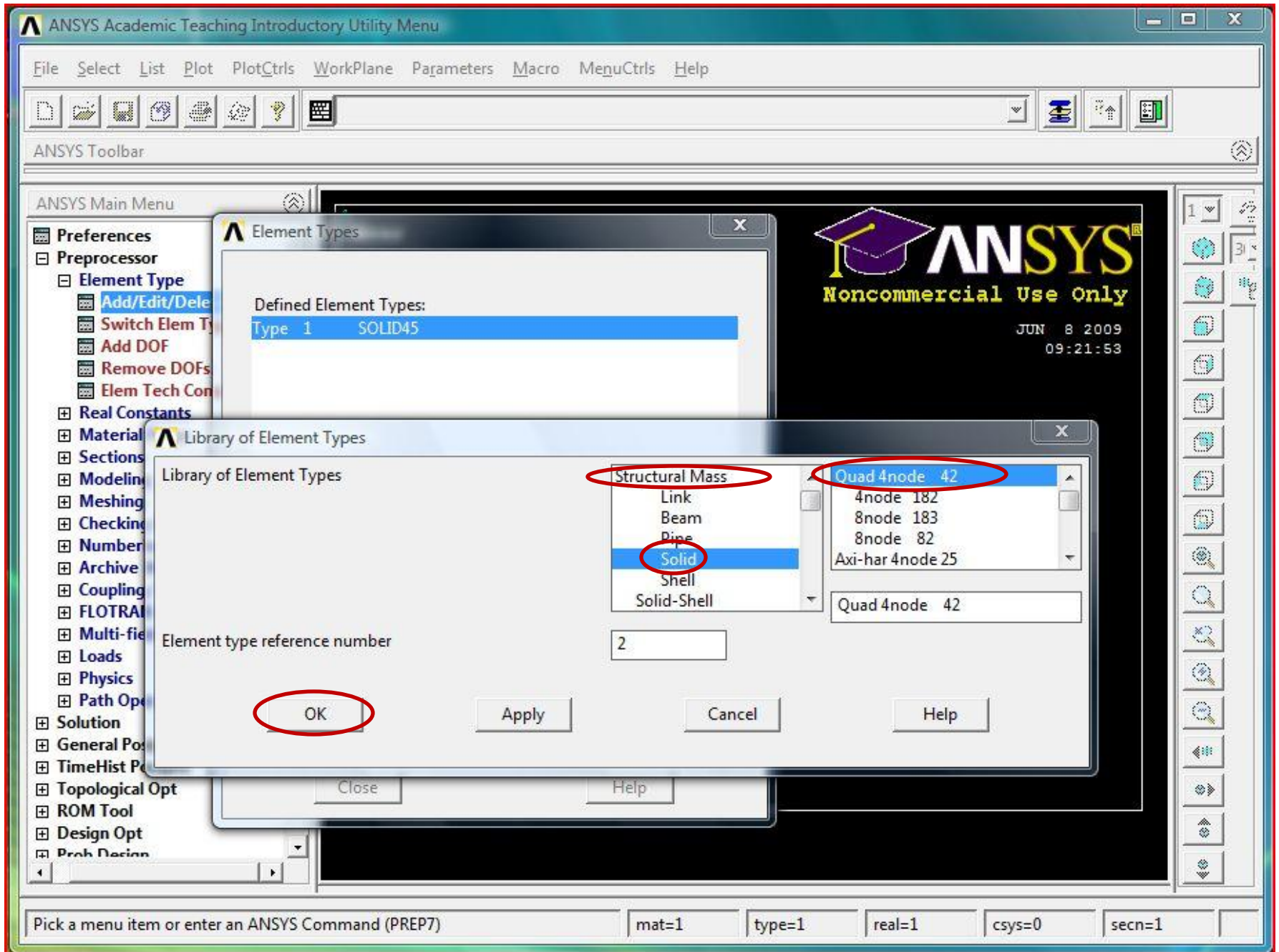
/units, si

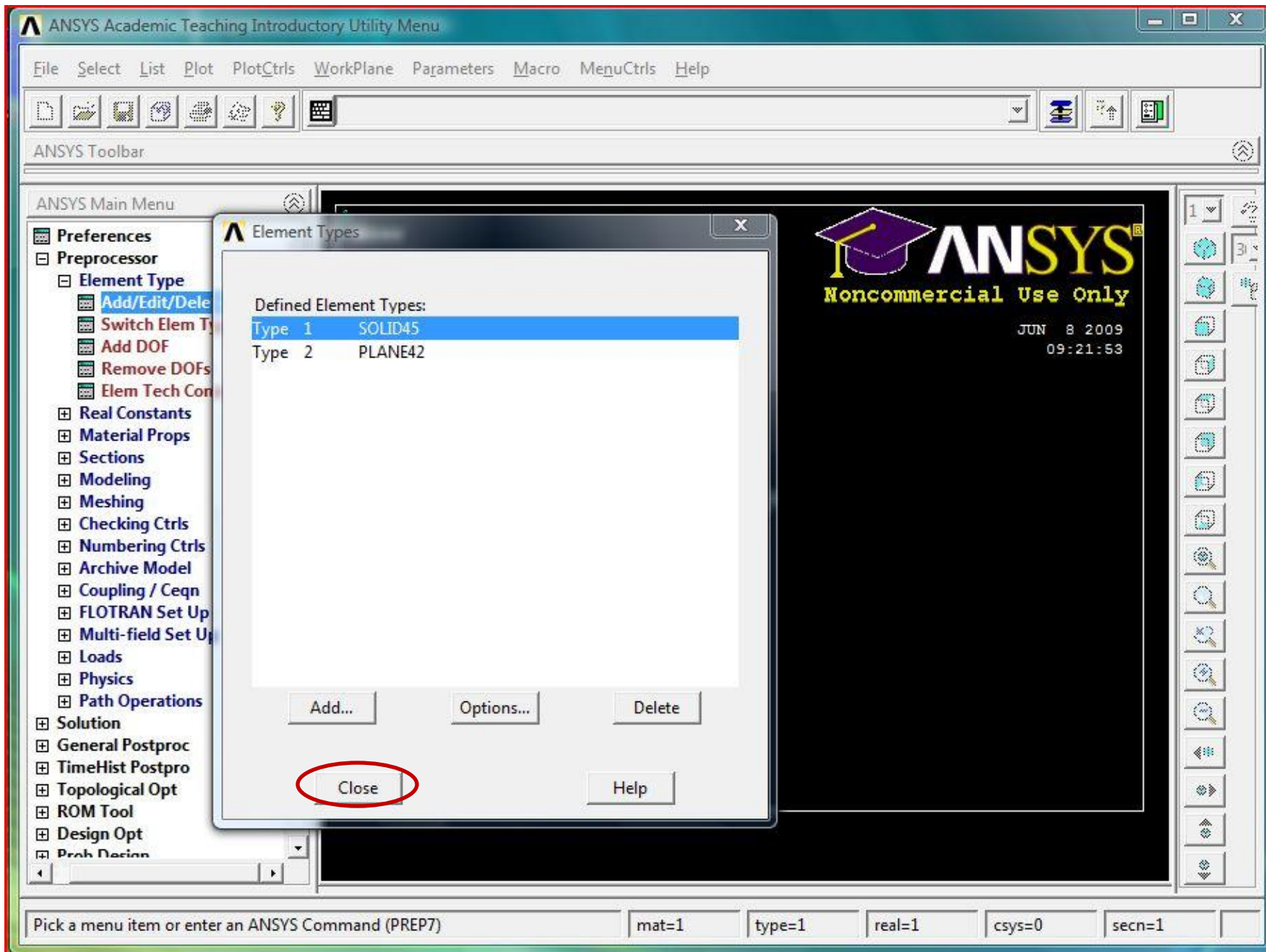


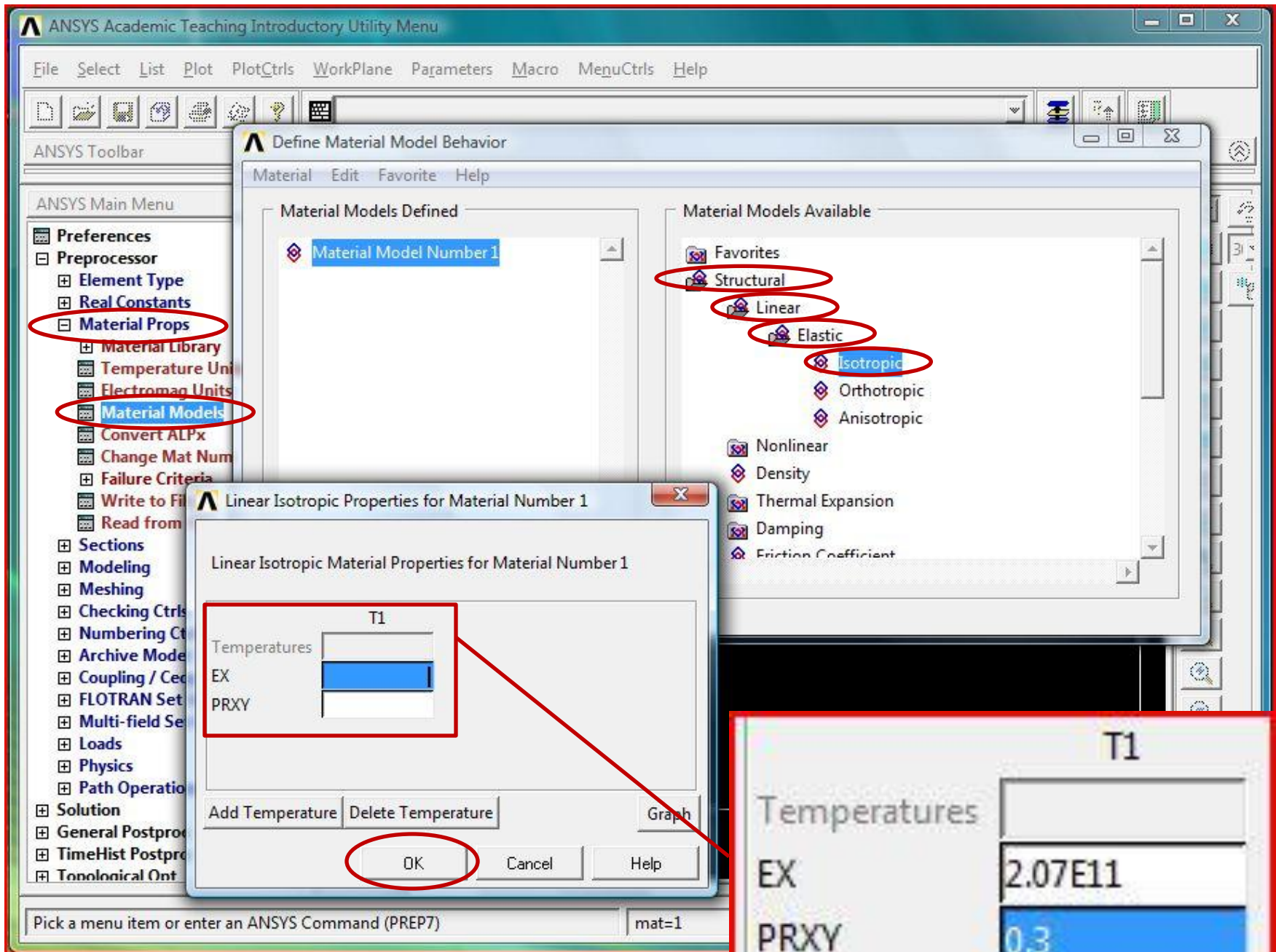


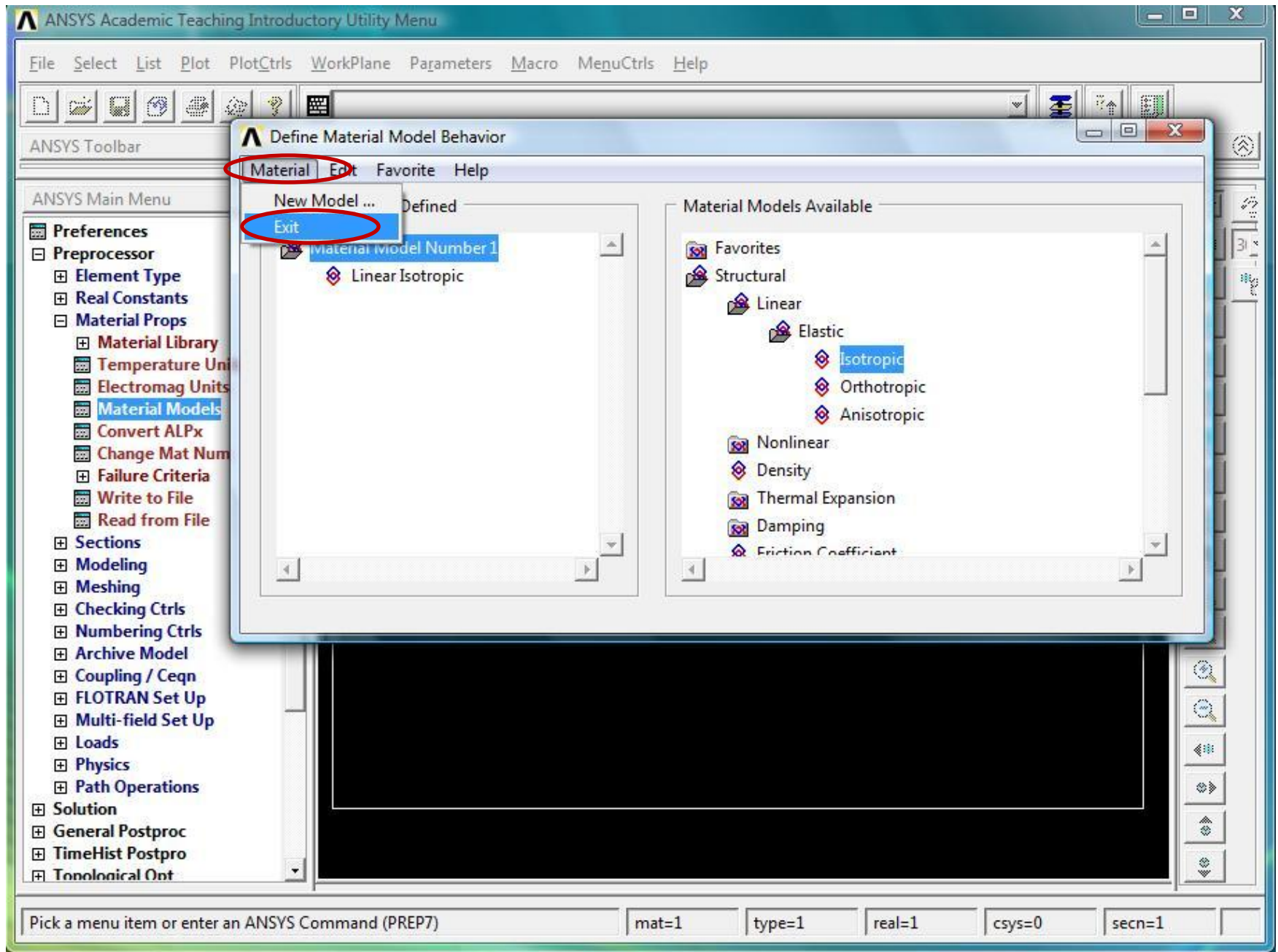






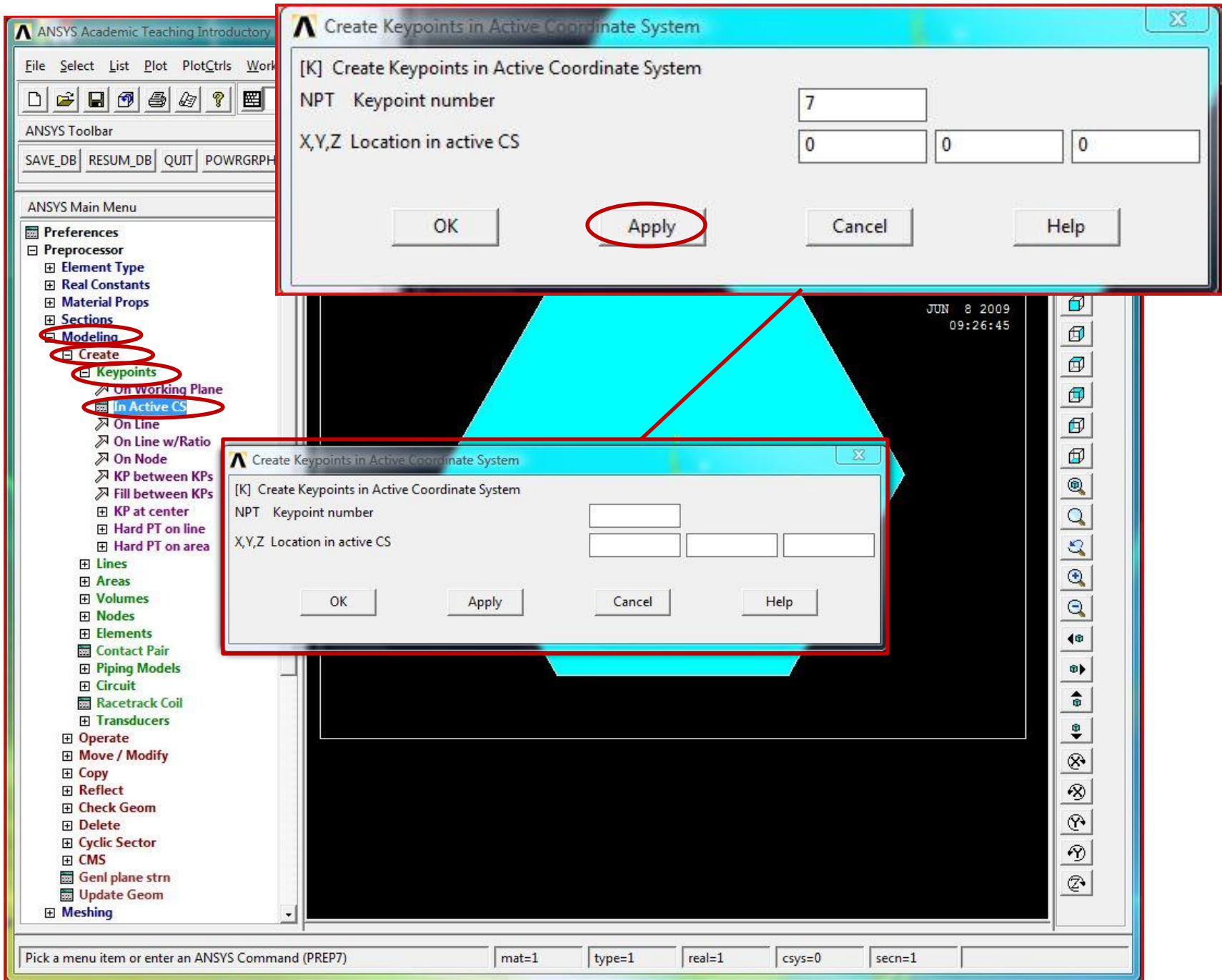


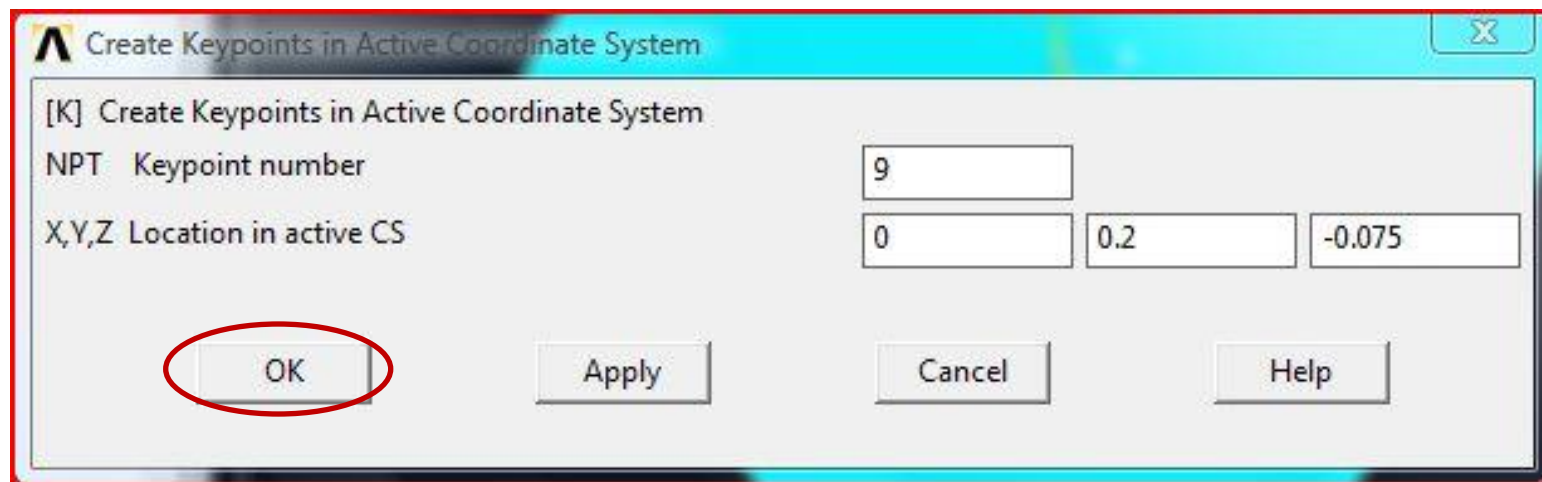
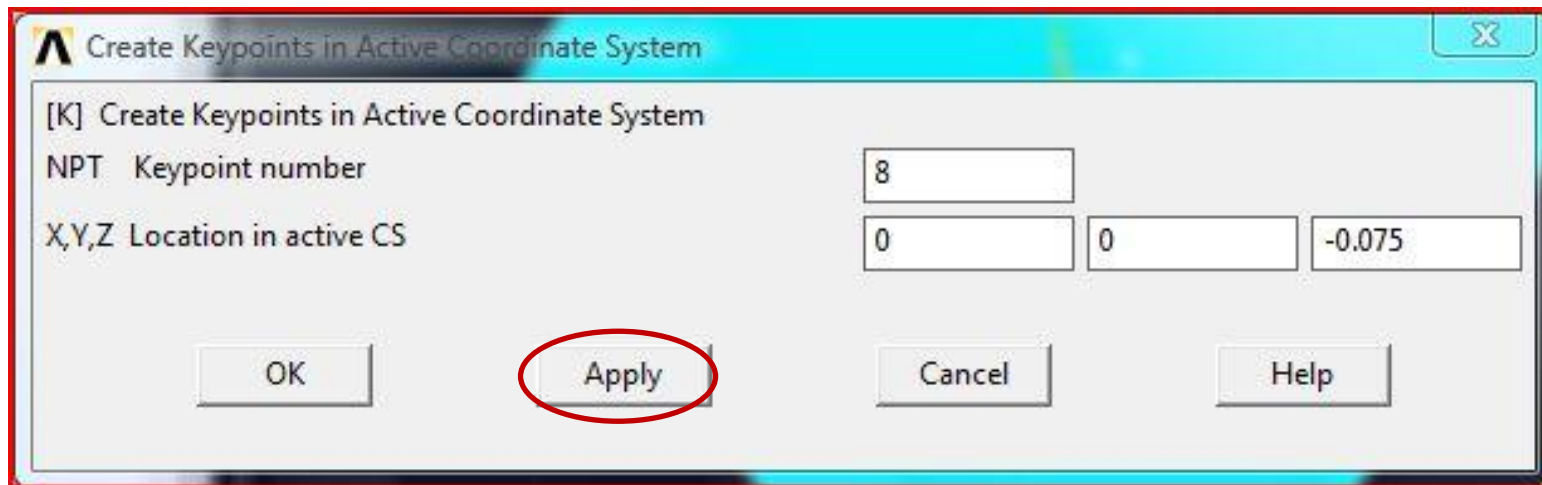


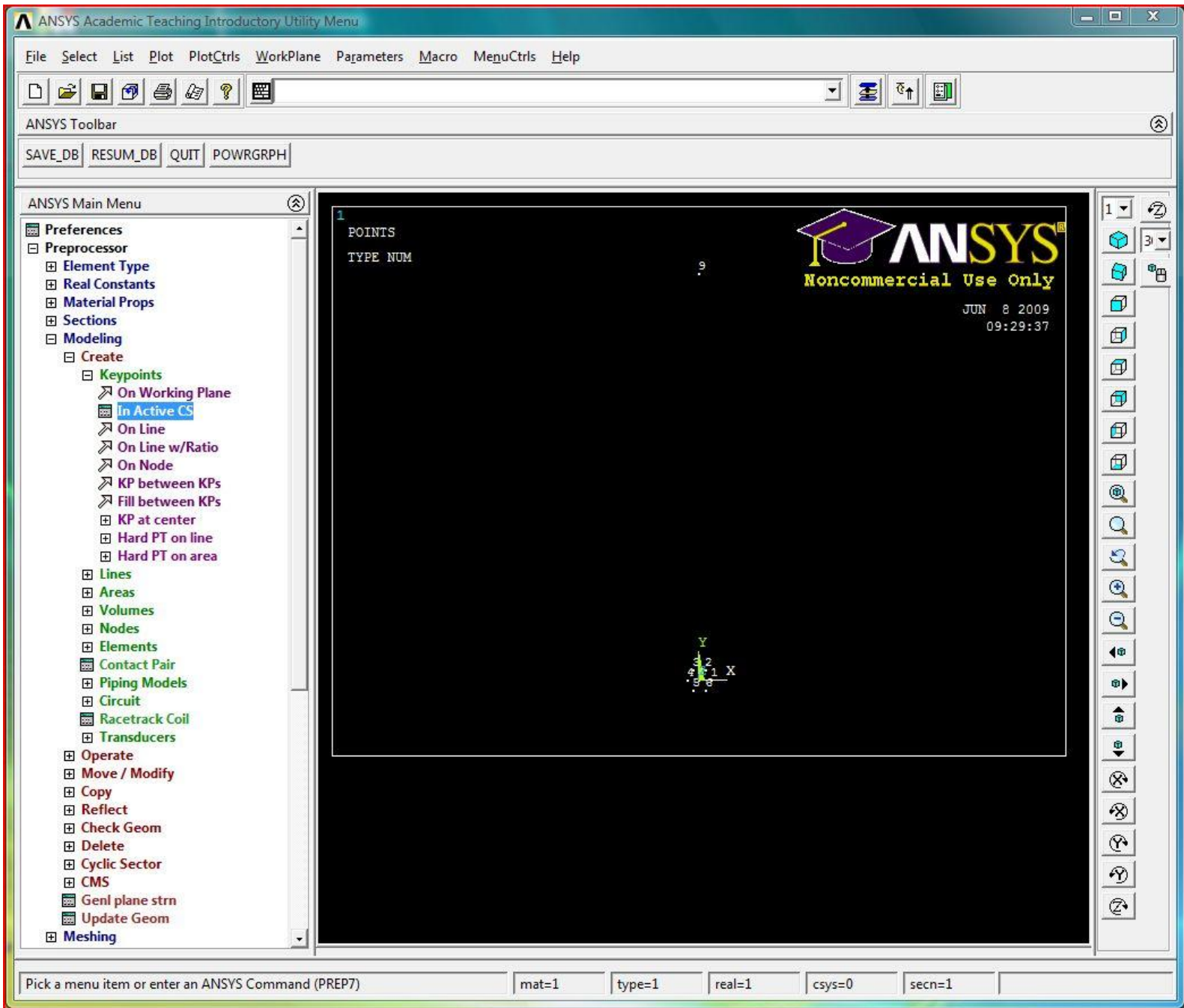


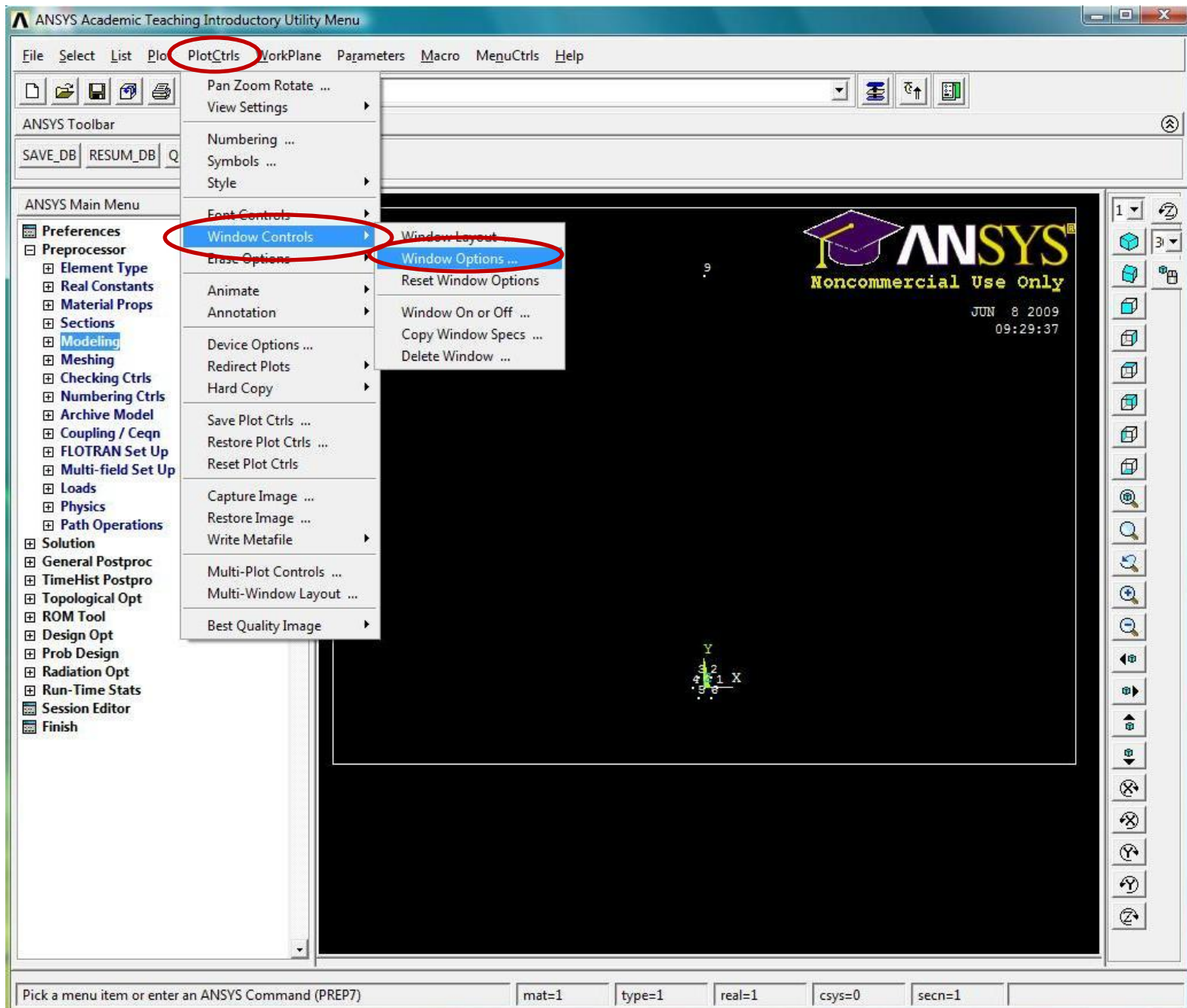


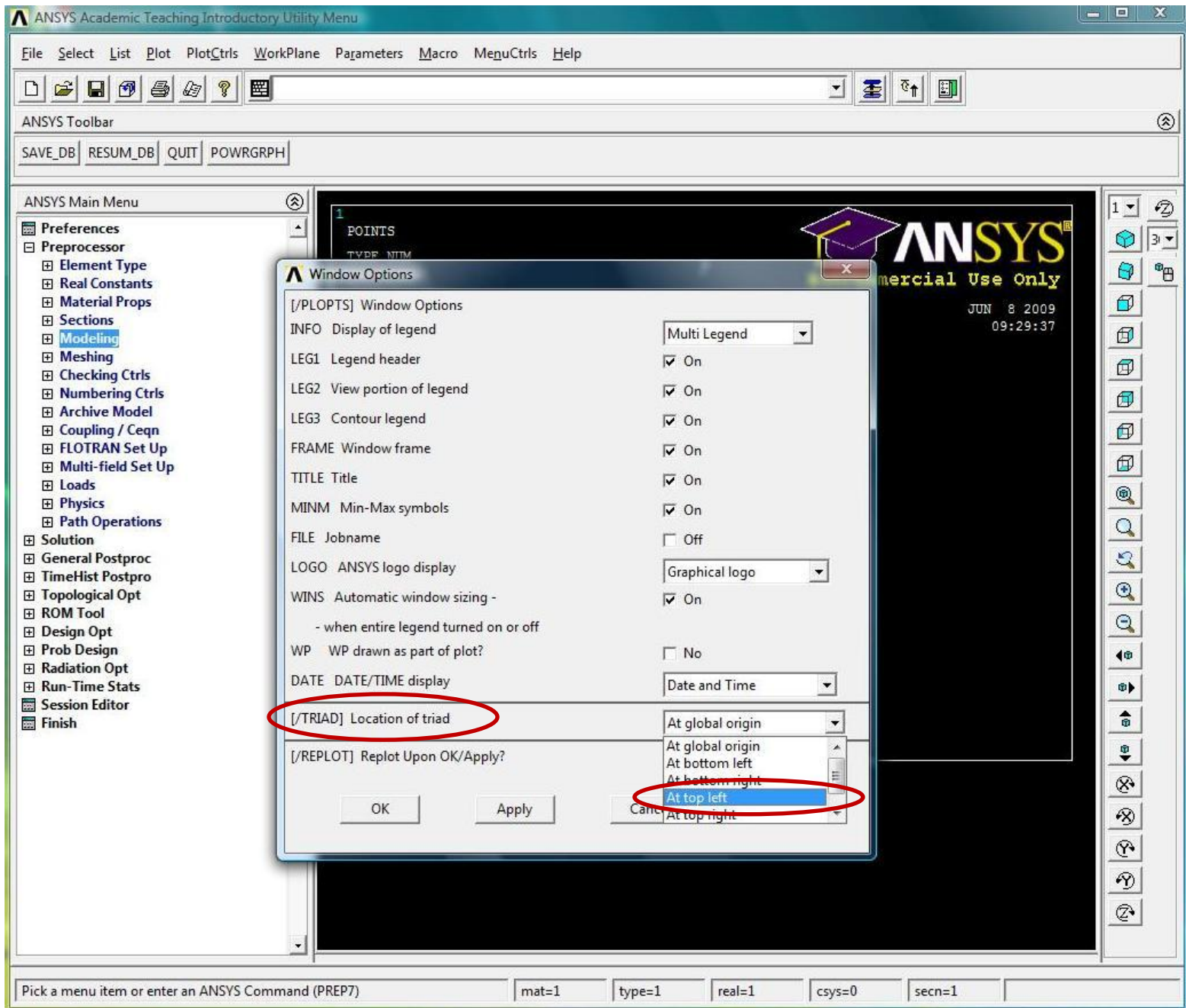


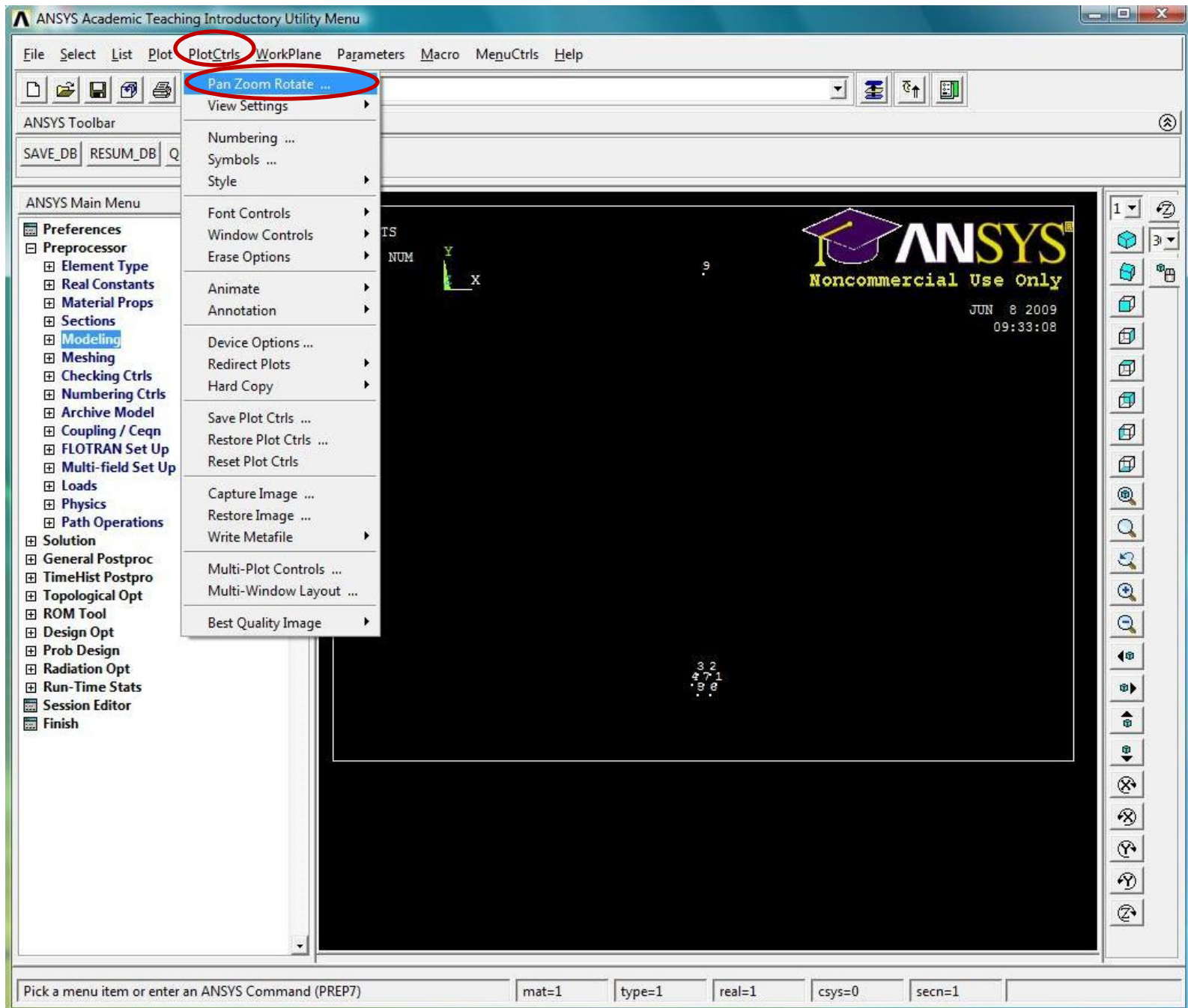


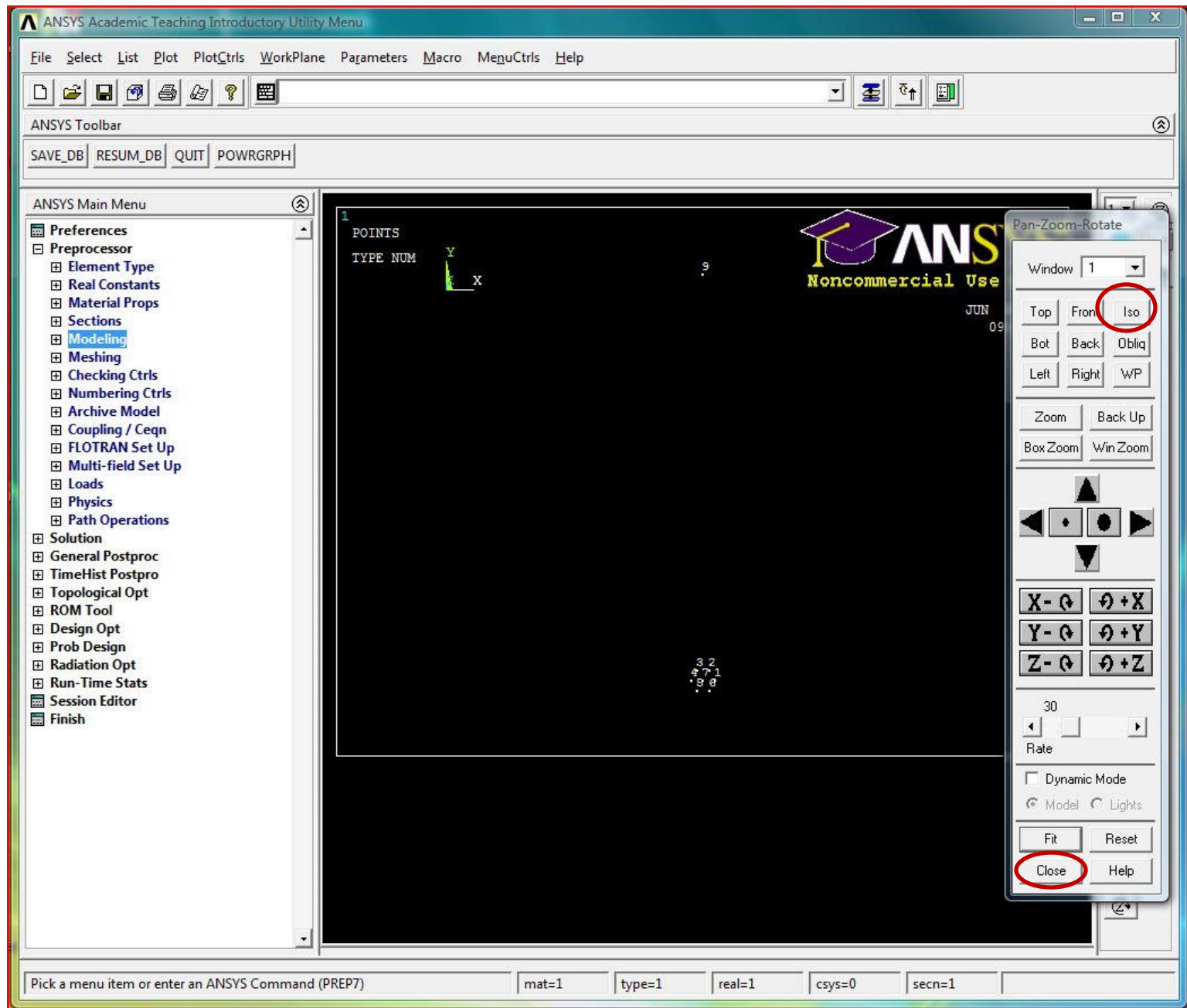


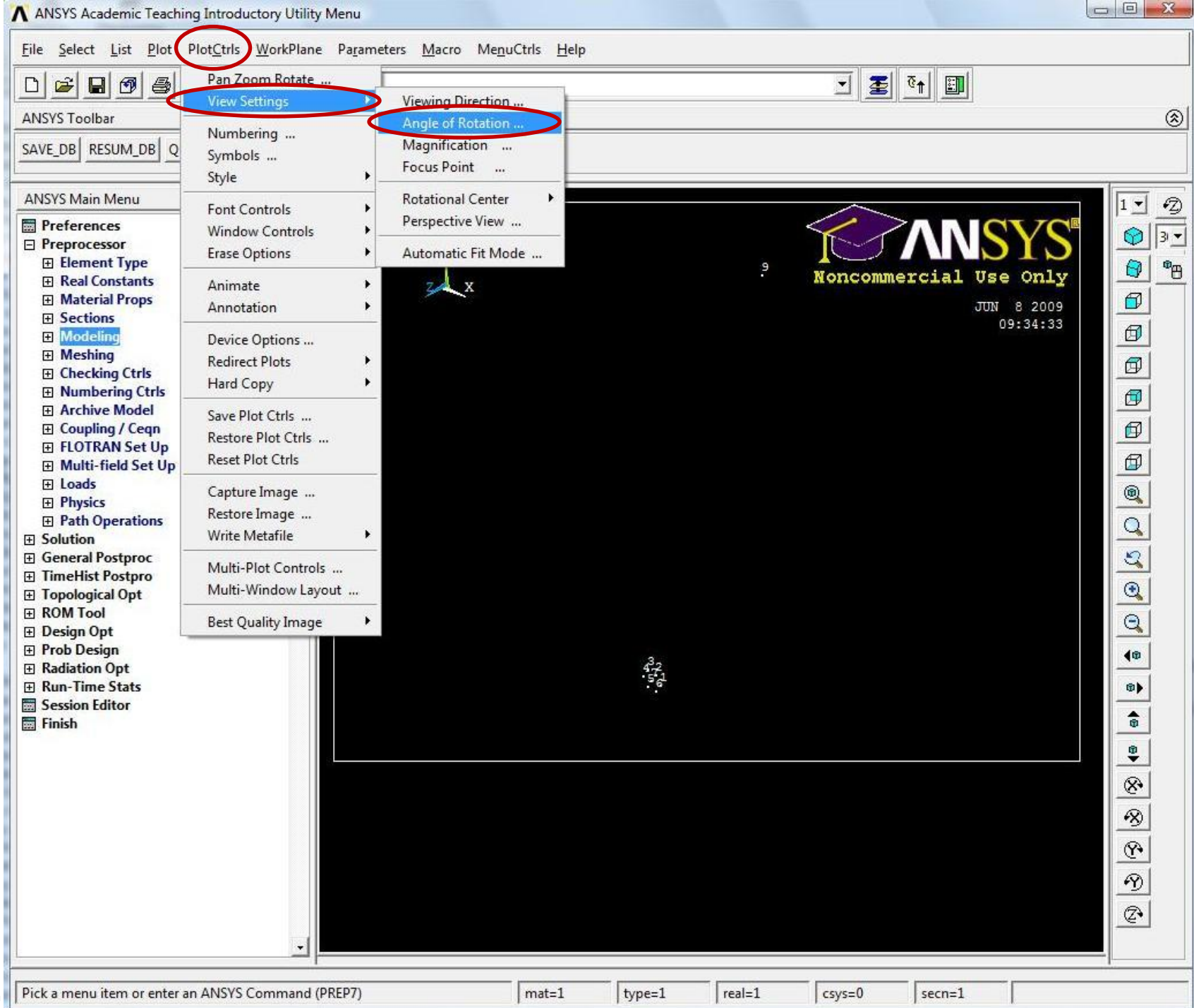




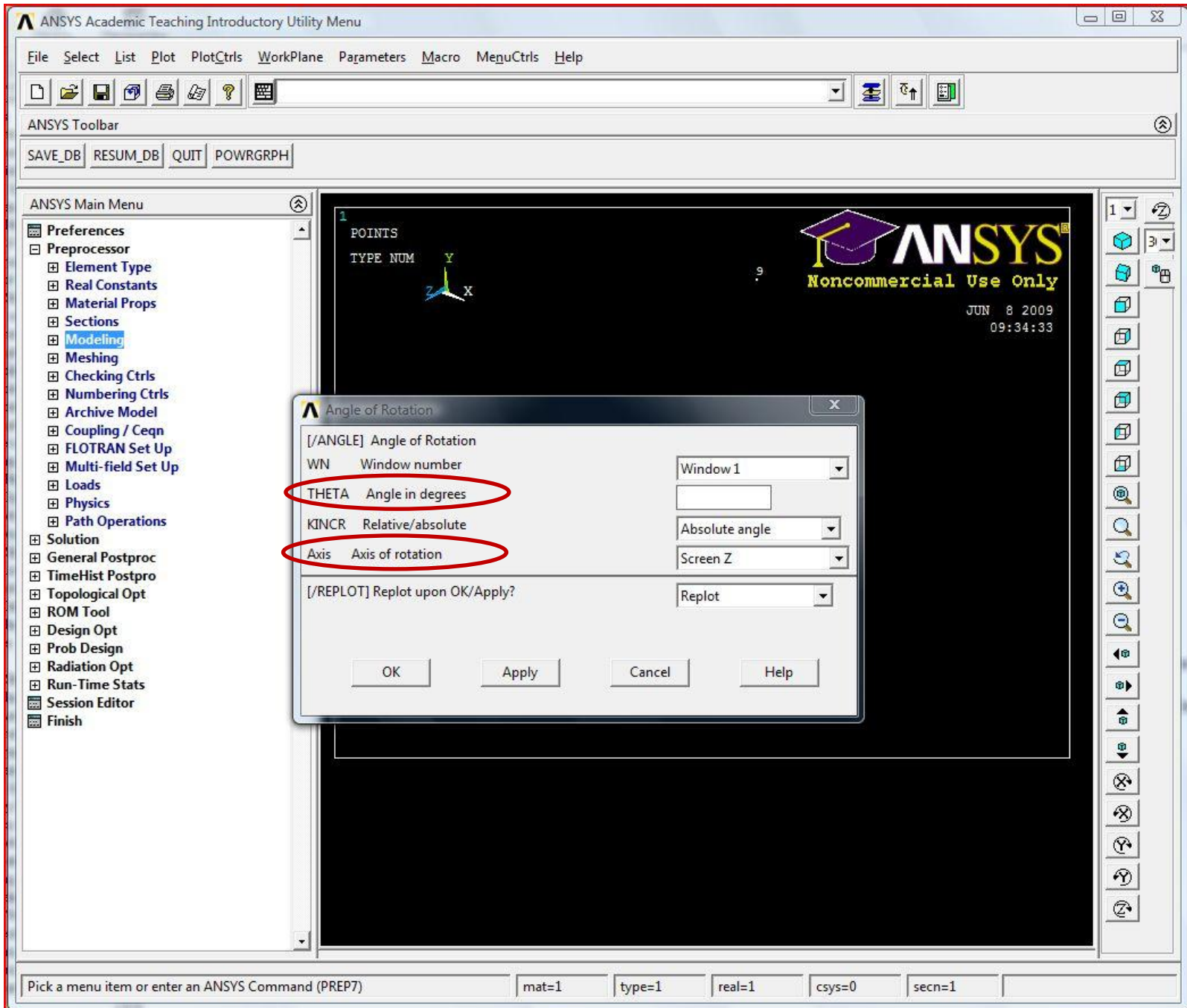


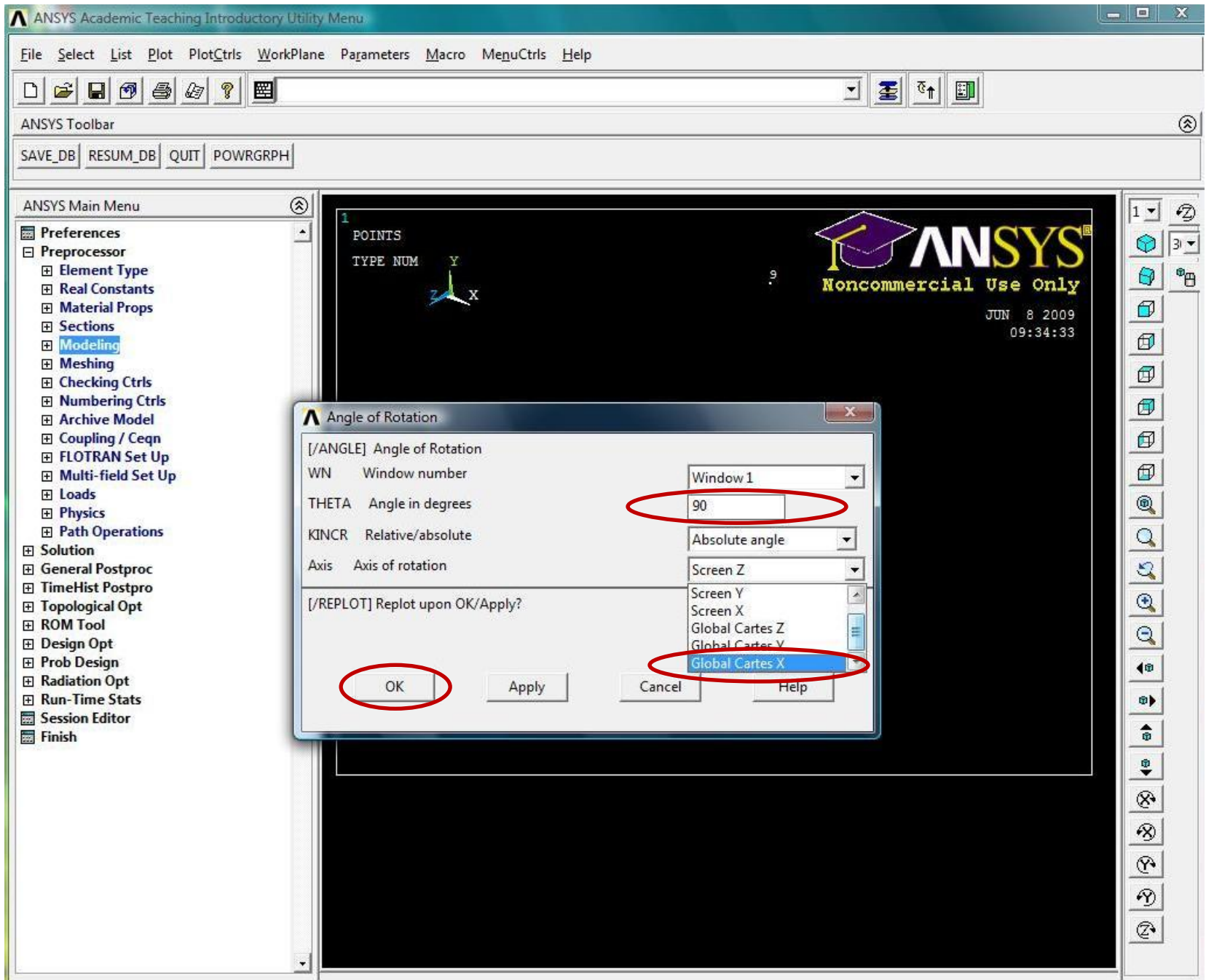




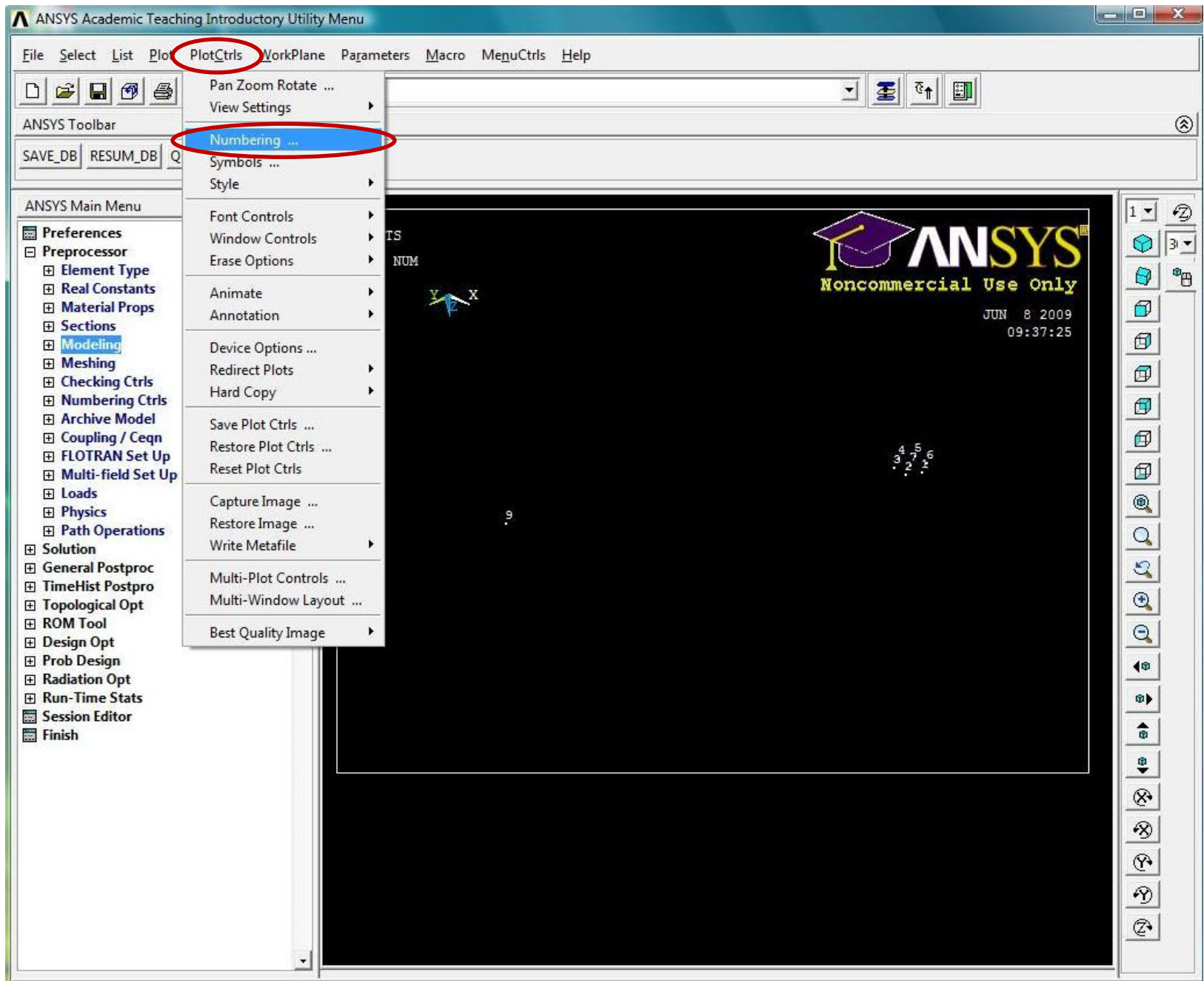


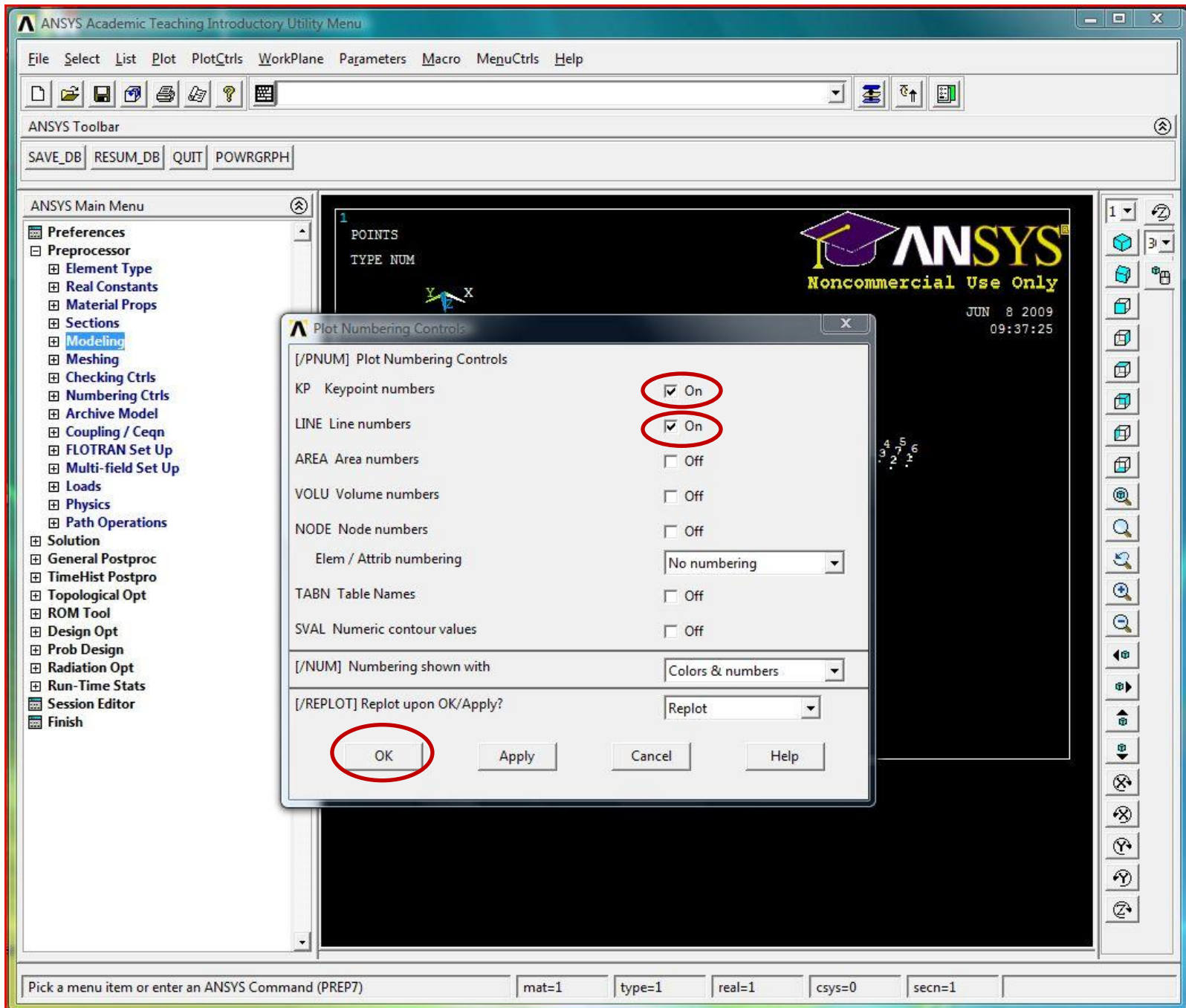












**Preferences**  
Preprocessor  
Element Type  
Real Constants  
Material Props  
Sections  
Modeling  
Create  
Keypoints  
Lines  
Lines  
Straight Line  
In Active Coord  
Overlaid on Area  
Tangent to Line

Create Straight Line  
 Pick  Unpick  
 Single  Box  
 Polygon  Circle  
 Loop  
Count = 0  
Maximum = 2  
Minimum = 2  
KeyP No. =  
 List of Items  
 Min, Max, Inc  
[OK] [Apply]  
[Reset] [Cancel]  
[Pick All] [Help]

1 POINTS  
POIN NUM  
Z Y  
X

Create Straight Line  
 Pick  Unpick  
 Single  Box  
 Polygon  Circle  
 Loop  
Count = 0  
Maximum = 2  
Minimum = 2  
KeyP No. =  
 List of Items  
 Min, Max, Inc  
1  
[OK] [Apply]  
[Reset] [Cancel]  
[Pick All] [Help]

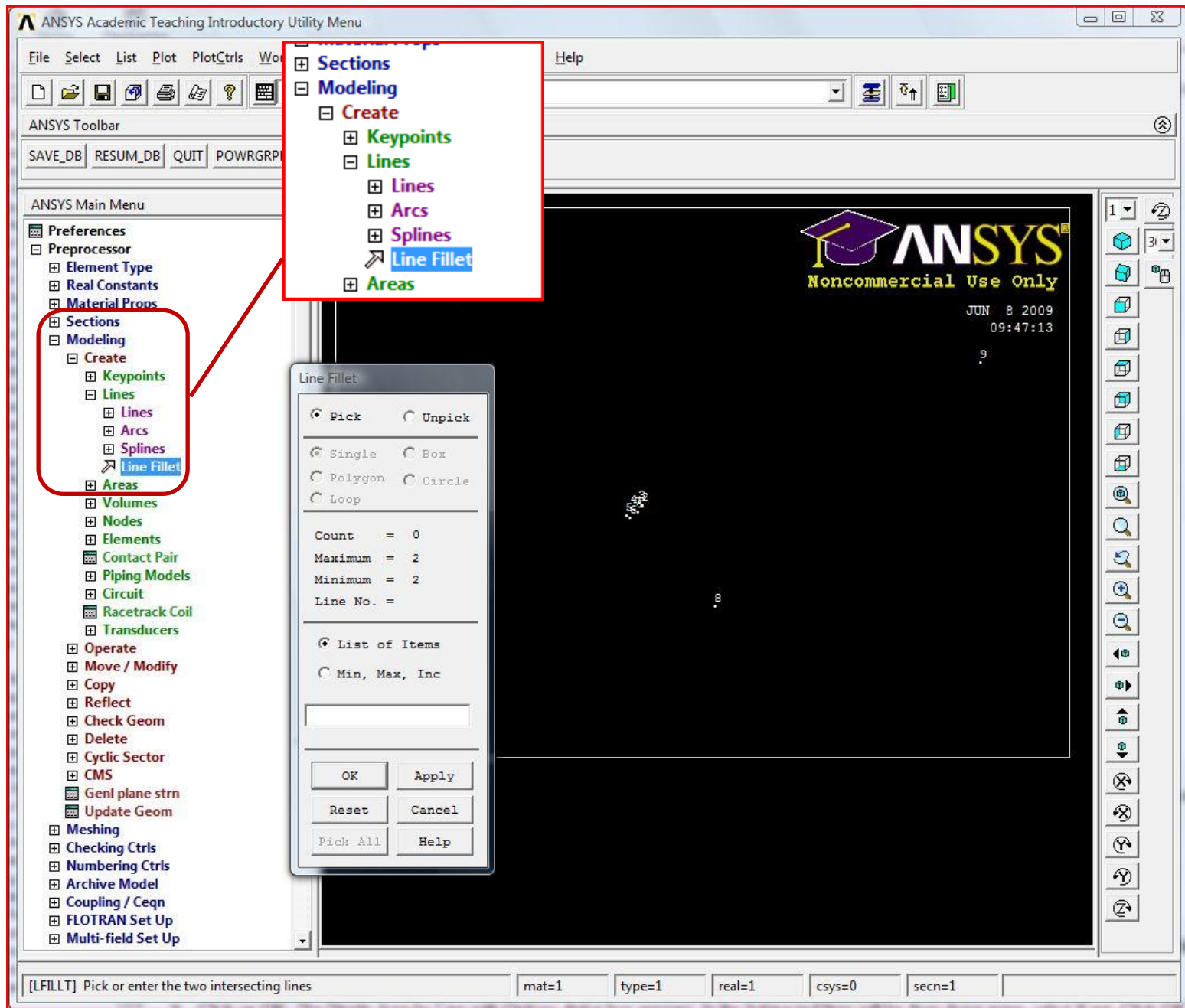
Create Straight Line  
 Pick  Unpick  
 Single  Box  
 Polygon  Circle  
 Loop  
Count = 0  
Maximum = 2  
Minimum = 2  
KeyP No. =  
 List of Items  
 Min, Max, Inc  
4  
[OK] [Apply]  
[Reset] [Cancel]  
[Pick All] [Help]

L8

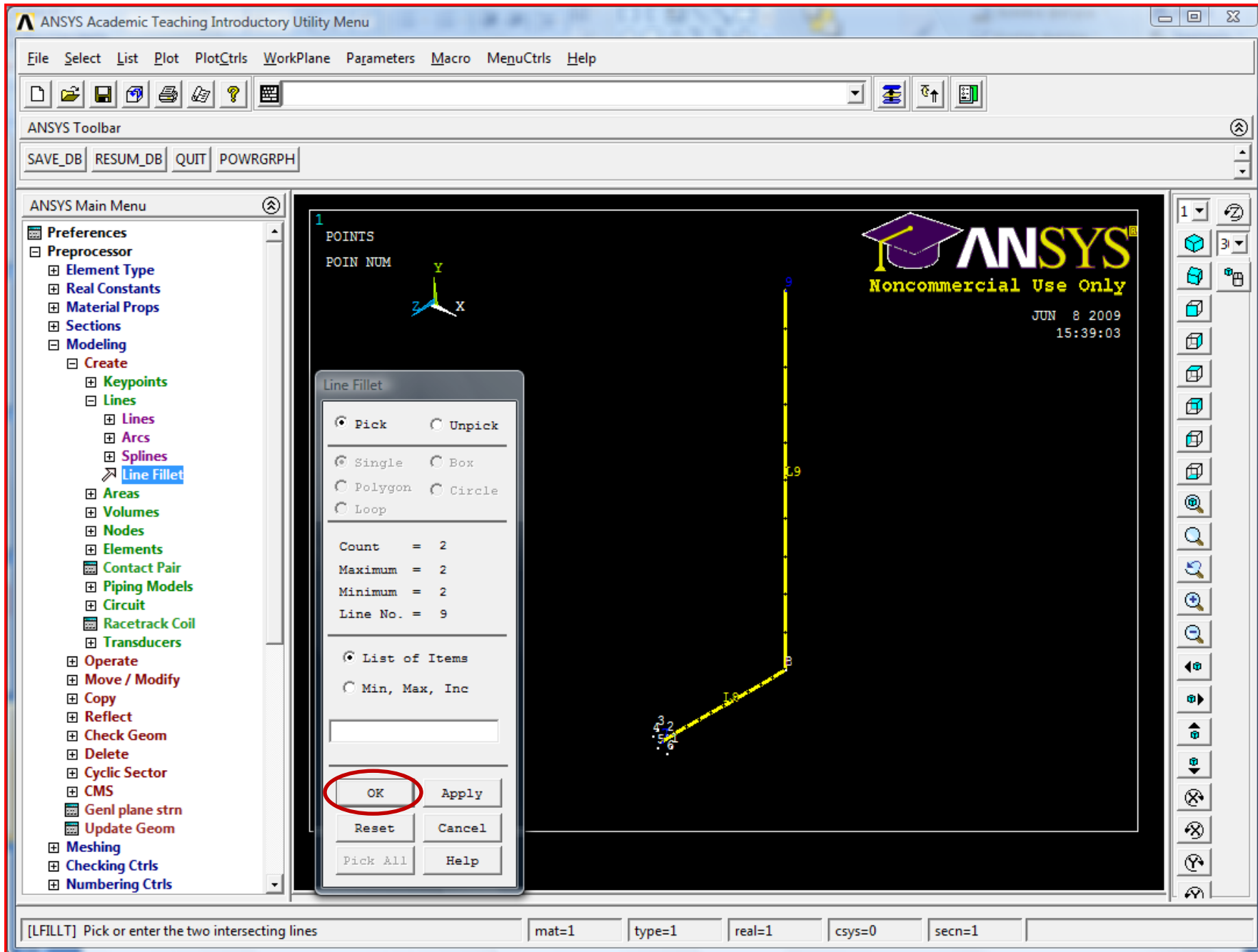
Two side-by-side screenshots of the 'Create Straight Line' dialog box. Both dialogs have the following options:  Pick,  Unpick;  Single,  Box;  Polygon,  Circle;  Loop. Below these are fields for Count = 0, Maximum = 2, Minimum = 2, and KeyP No. =. At the bottom are radio buttons for  List of Items and  Min, Max, Inc. The left dialog has '7' in the input field and the 'Apply' button circled. The right dialog has '8' in the input field and the 'Apply' button circled. Other buttons include OK, Reset, Cancel, Pick All, and Help.

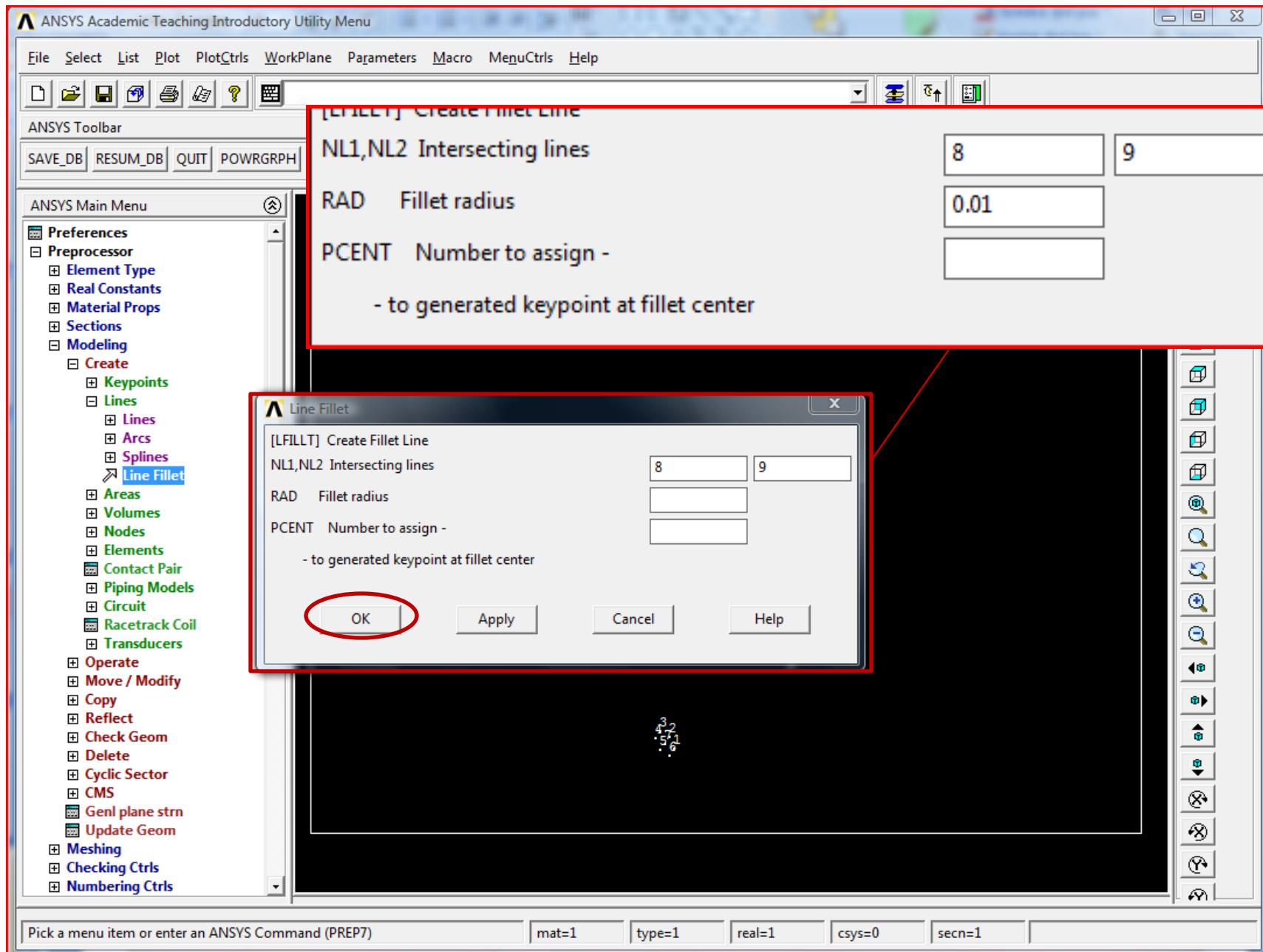
L9

Two side-by-side screenshots of the 'Create Straight Line' dialog box. Both dialogs have the following options:  Pick,  Unpick;  Single,  Box;  Polygon,  Circle;  Loop. Below these are fields for Count = 0, Maximum = 2, Minimum = 2, and KeyP No. =. At the bottom are radio buttons for  List of Items and  Min, Max, Inc. The left dialog has '8' in the input field and the 'Apply' button circled. The right dialog has '9' in the input field and the 'OK' button circled. Other buttons include OK, Reset, Cancel, Pick All, and Help.

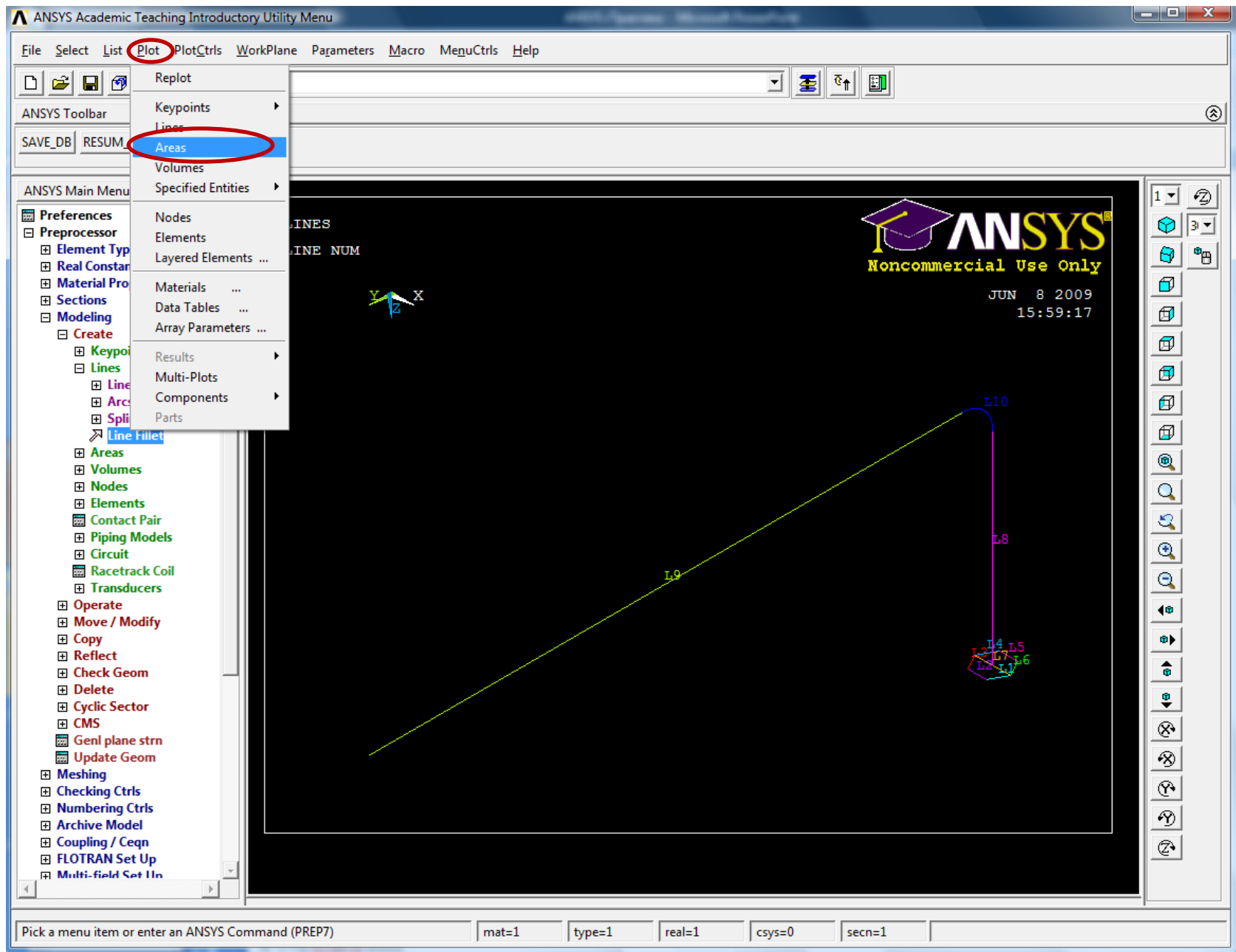


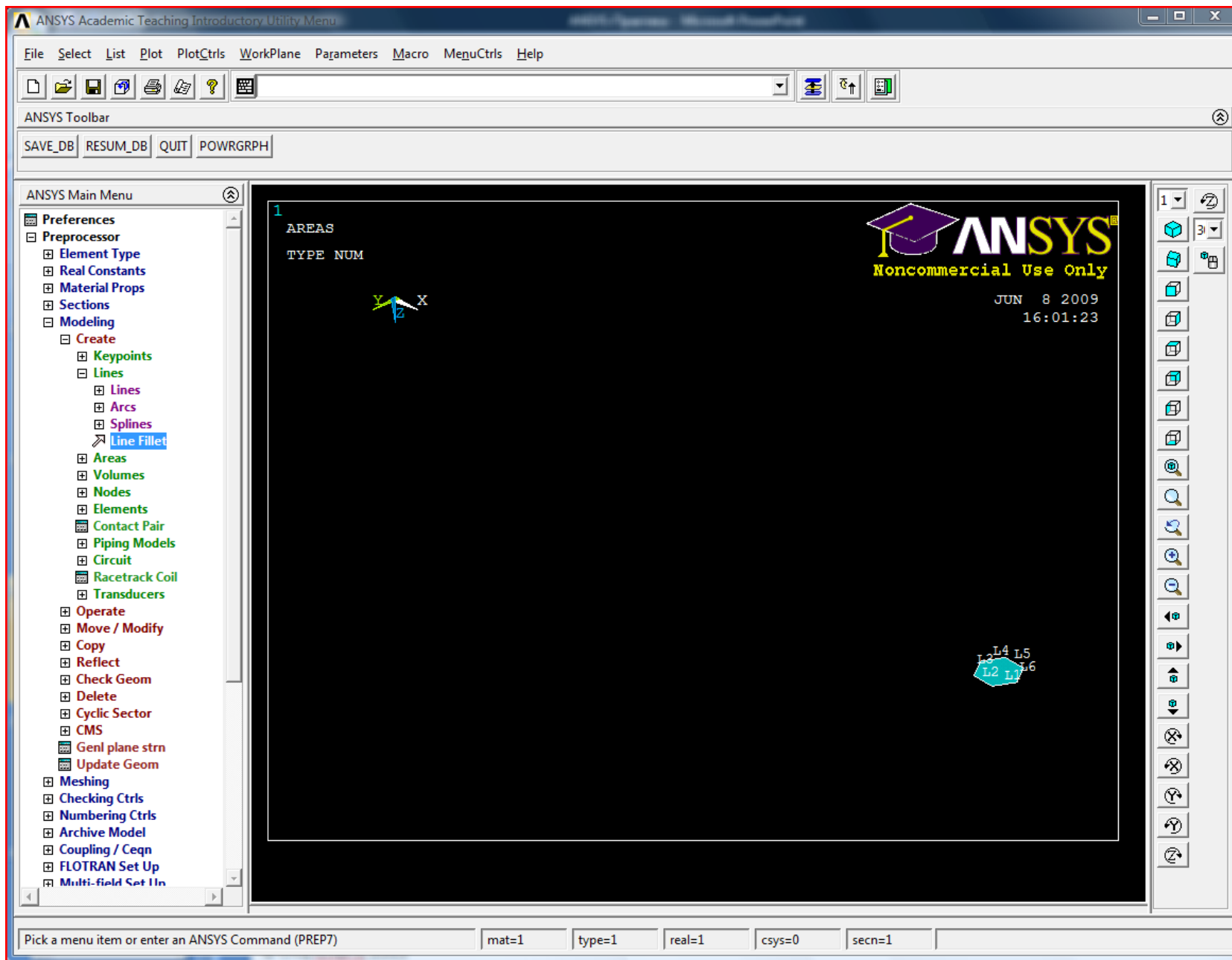


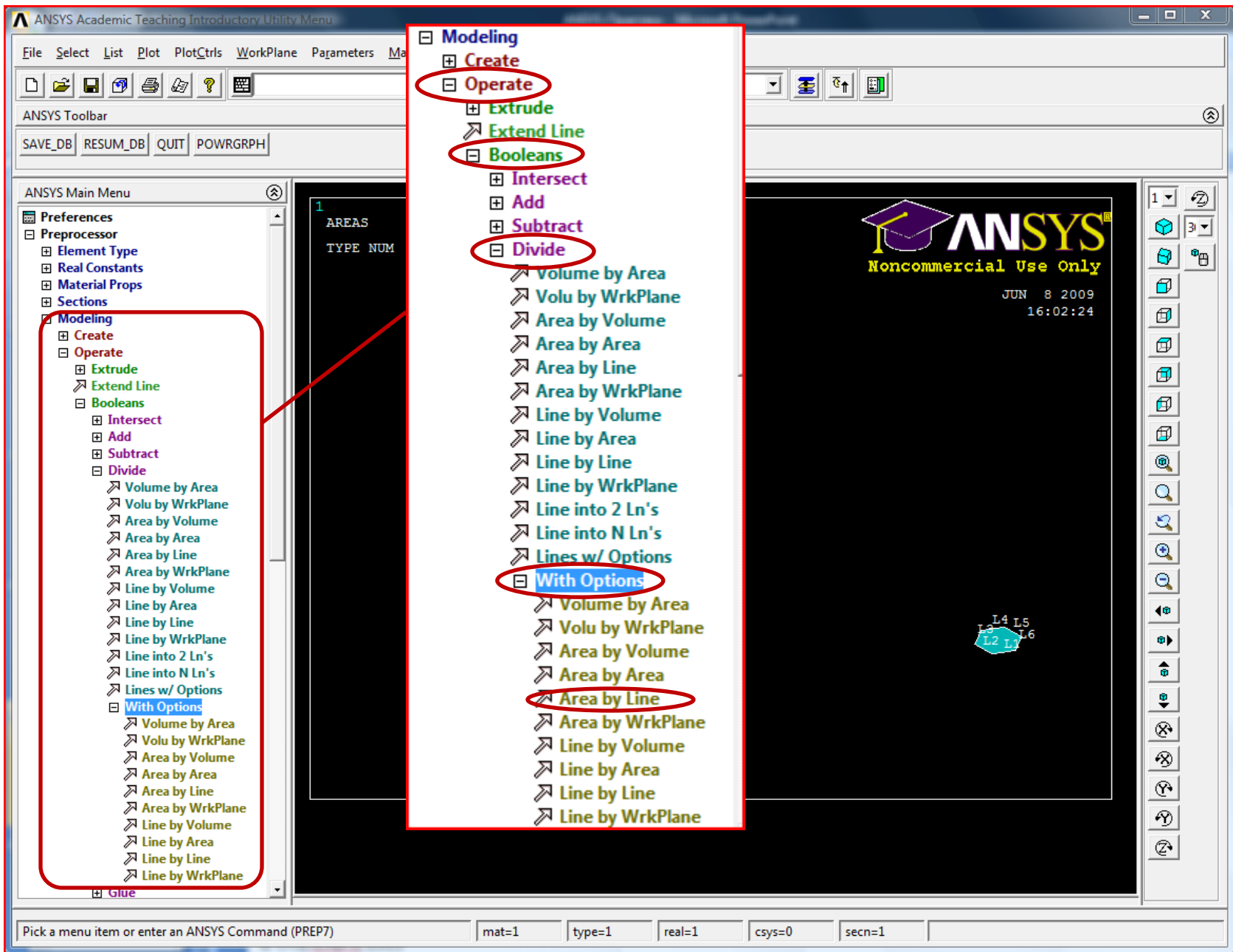


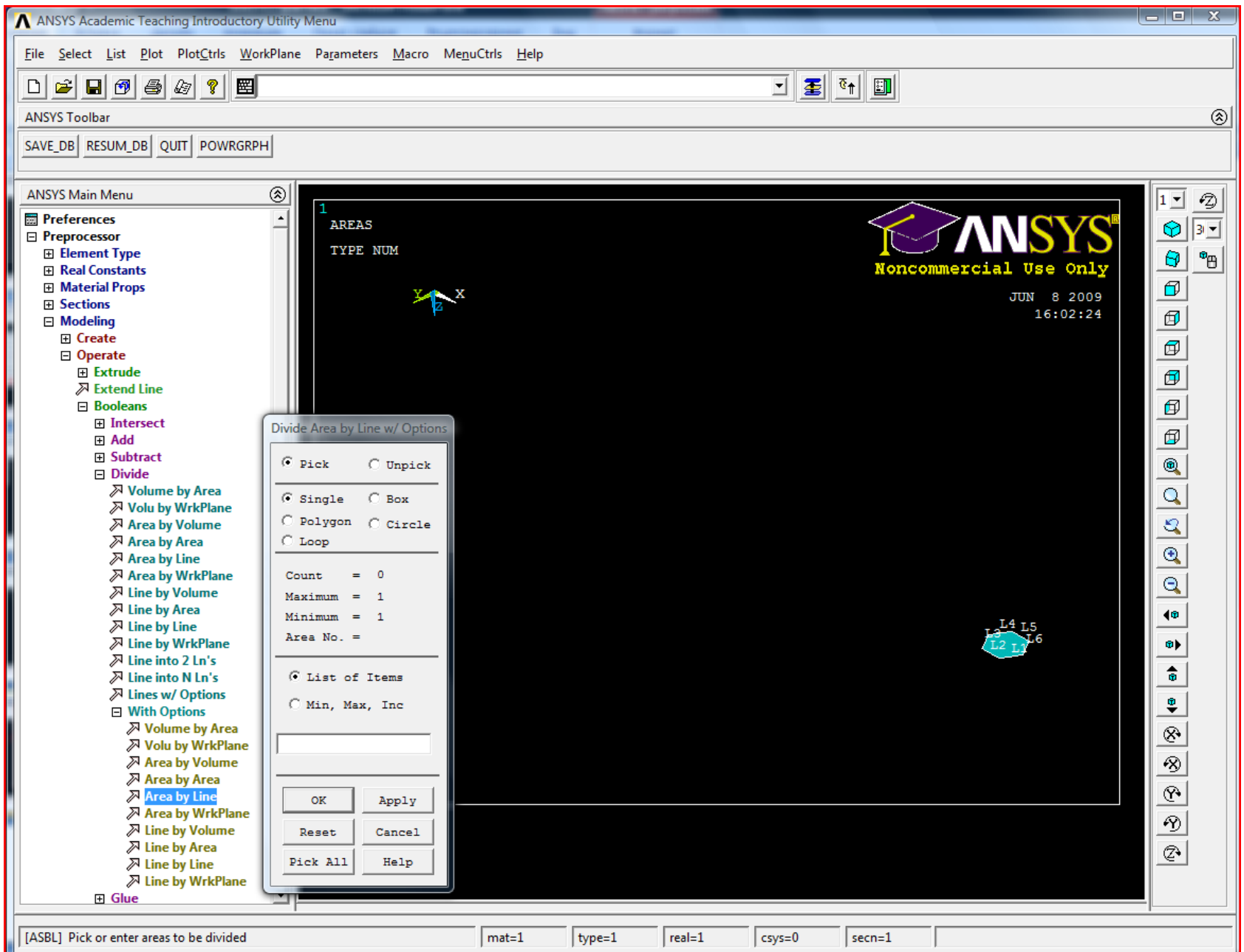


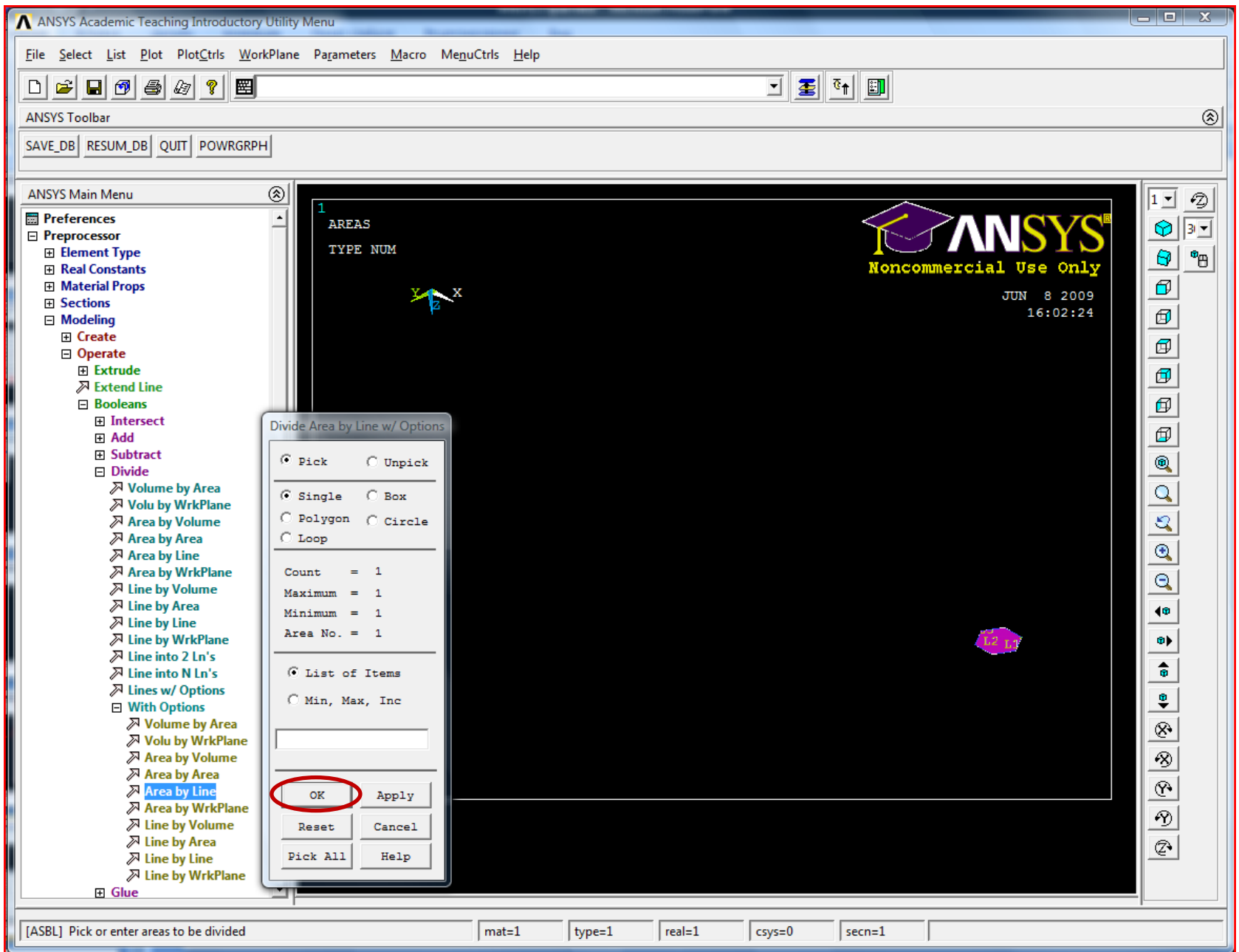




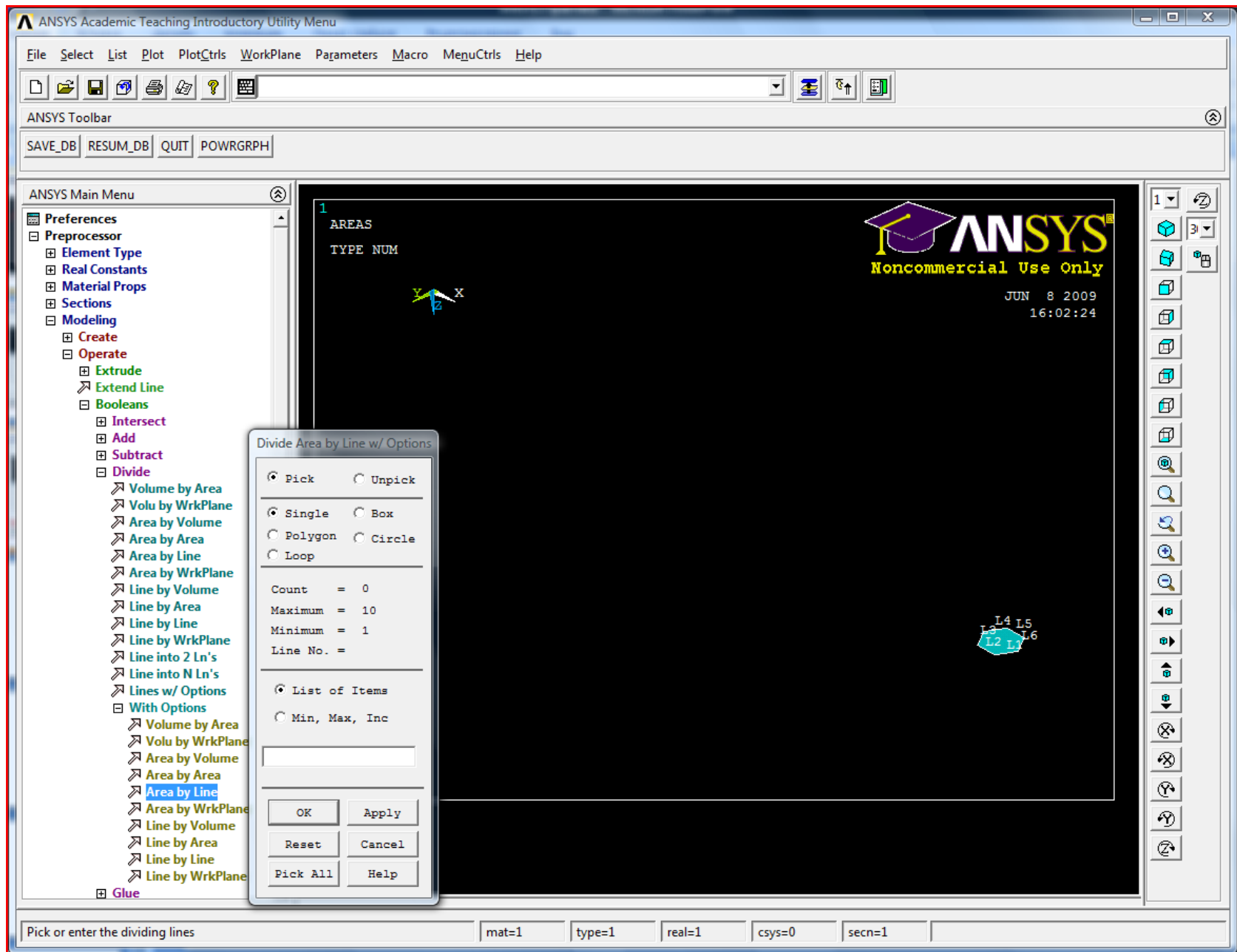


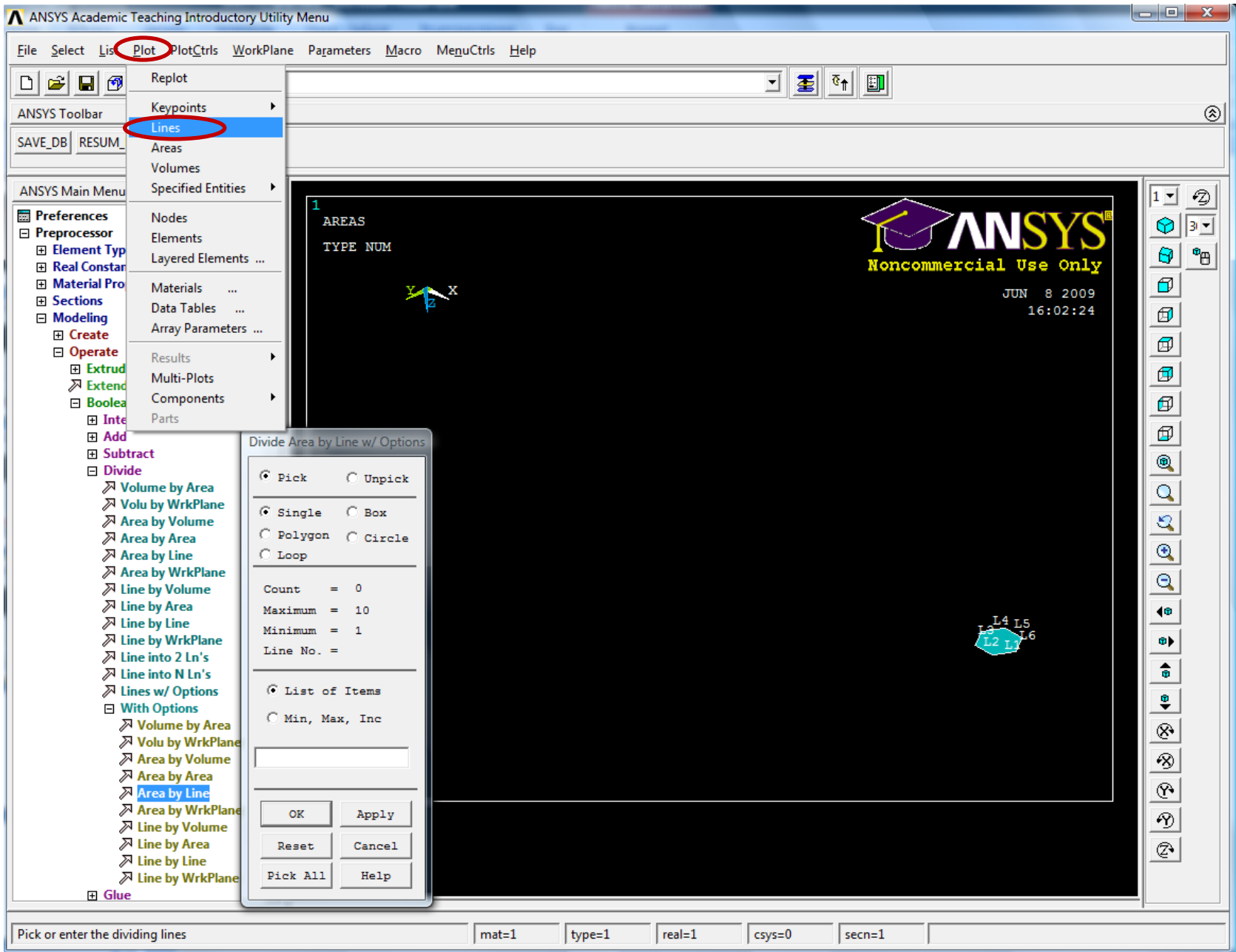


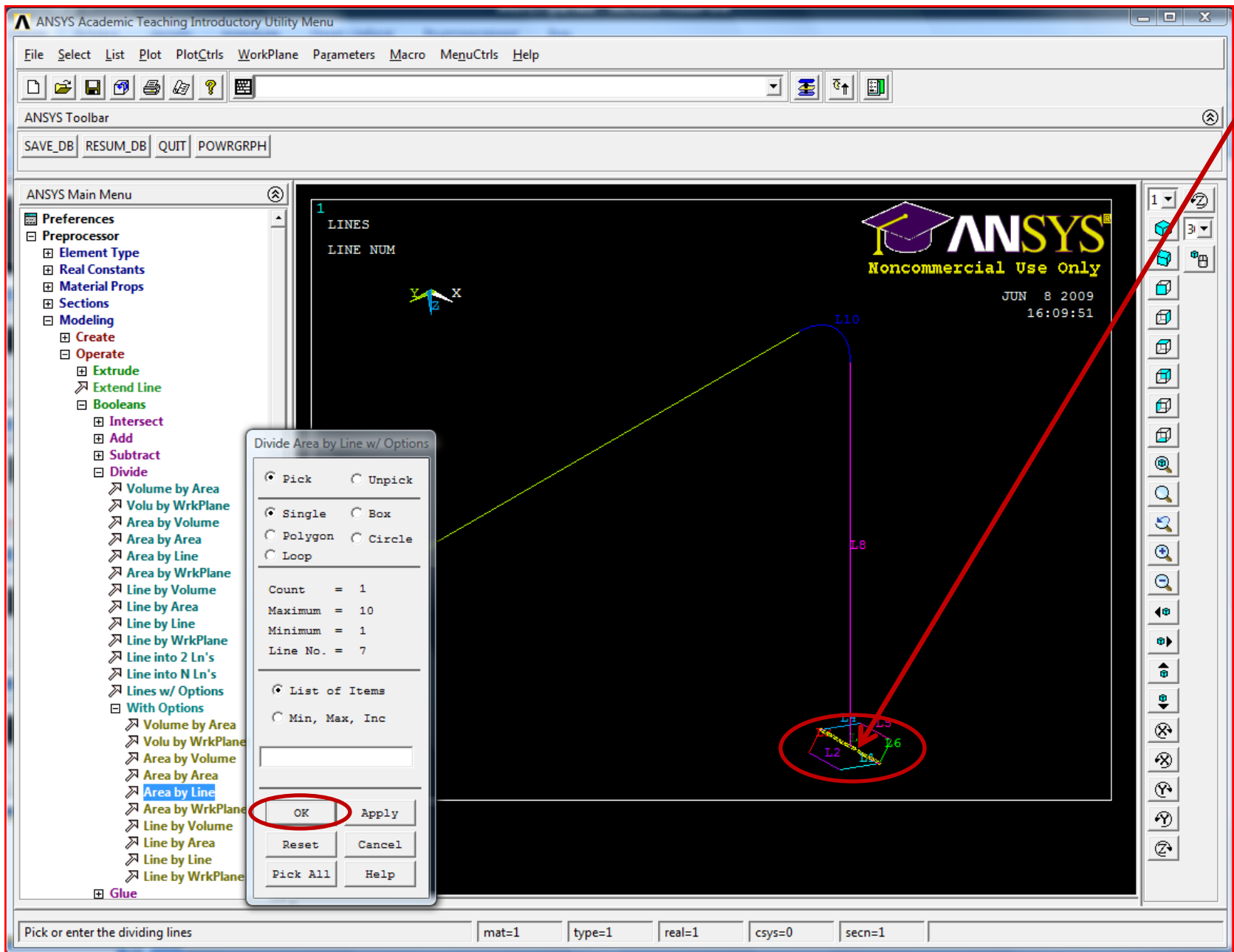


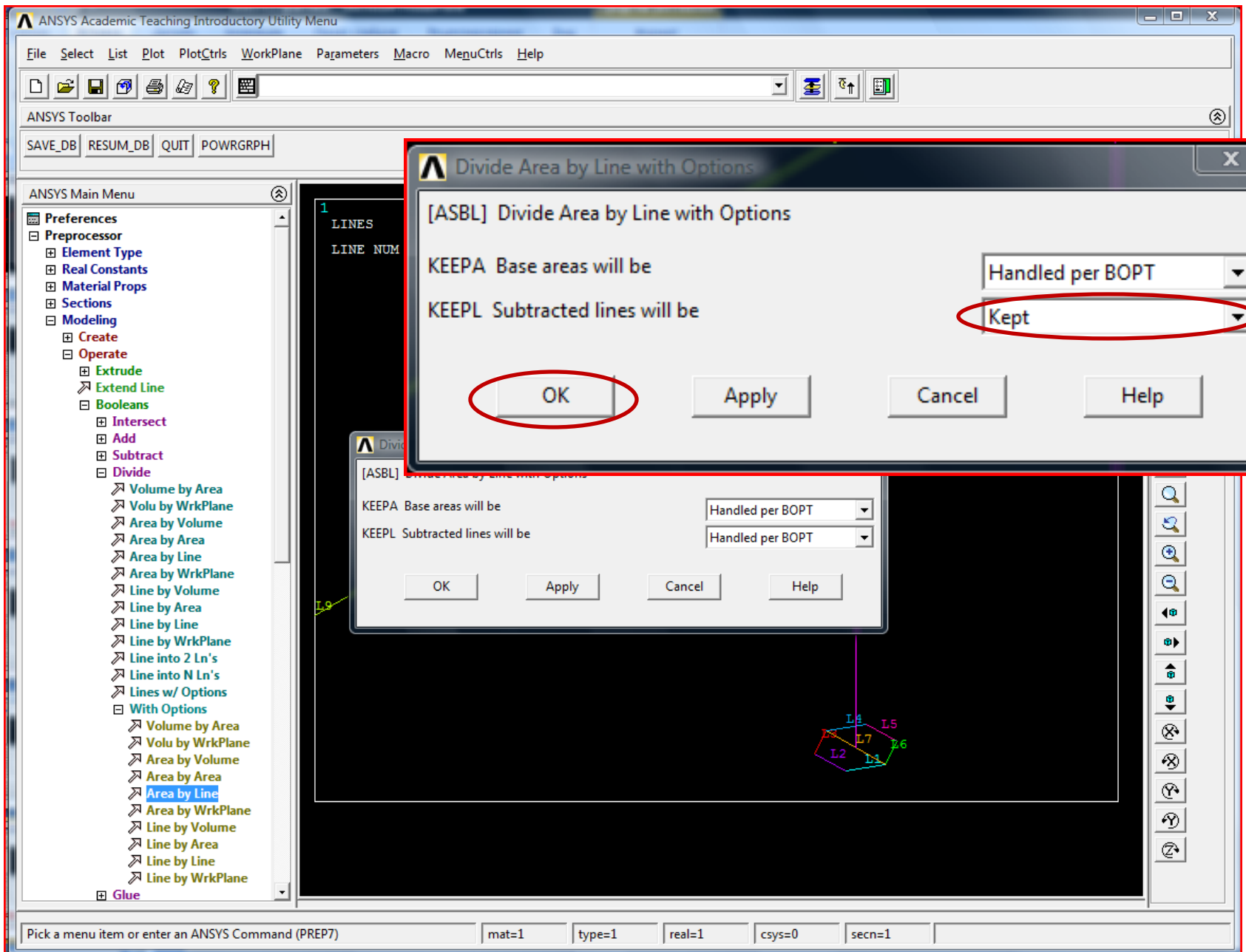


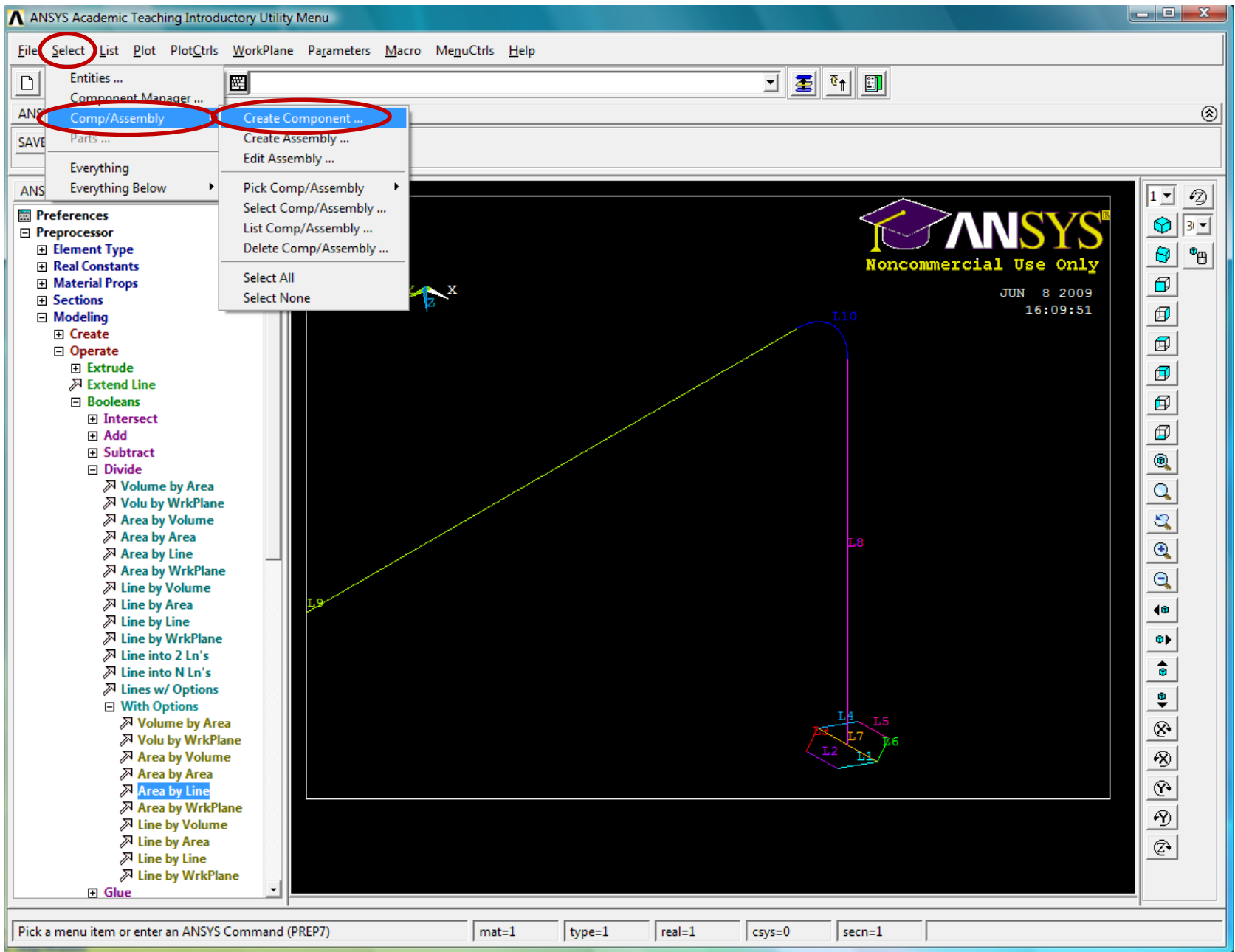
















Element Size on Picked Lines

Pick     Unpick

---

Single     Box  
 Polygon     Circle  
 Loop

---

Count    =    0  
Maximum    =    10  
Minimum    =    1  
Line No.    =

---

List of Items  
 Min, Max, Inc

1, 2, 6

---

OK    Apply  
Reset    Cancel  
Pick All    Help

ENTER

Element Size on Picked Lines

Pick     Unpick

---

Single     Box  
 Polygon     Circle  
 Loop

---

Count    =    0  
Maximum    =    10  
Minimum    =    1  
Line No.    =

---

List of Items  
 Min, Max, Inc

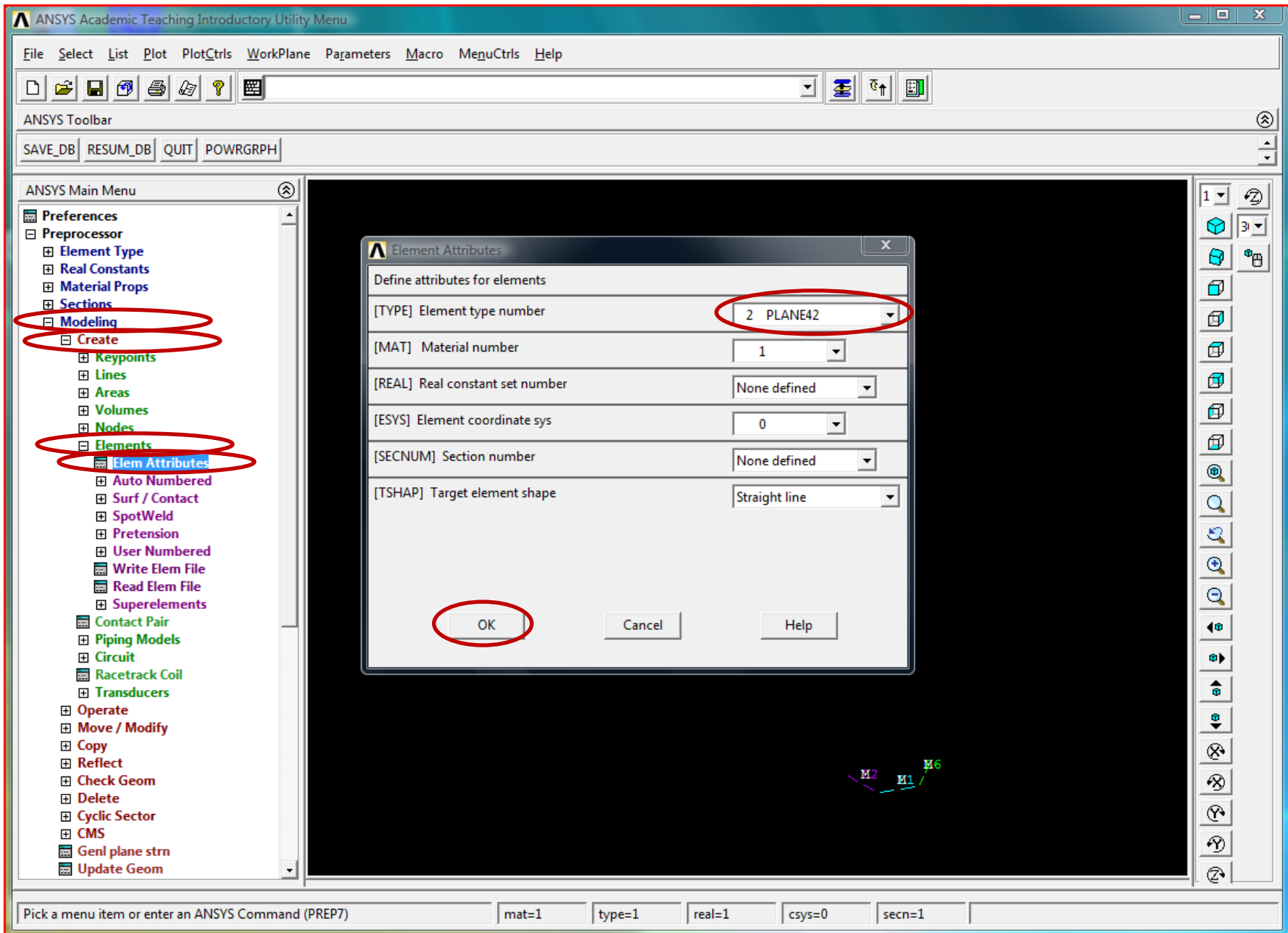
1, 2, 6

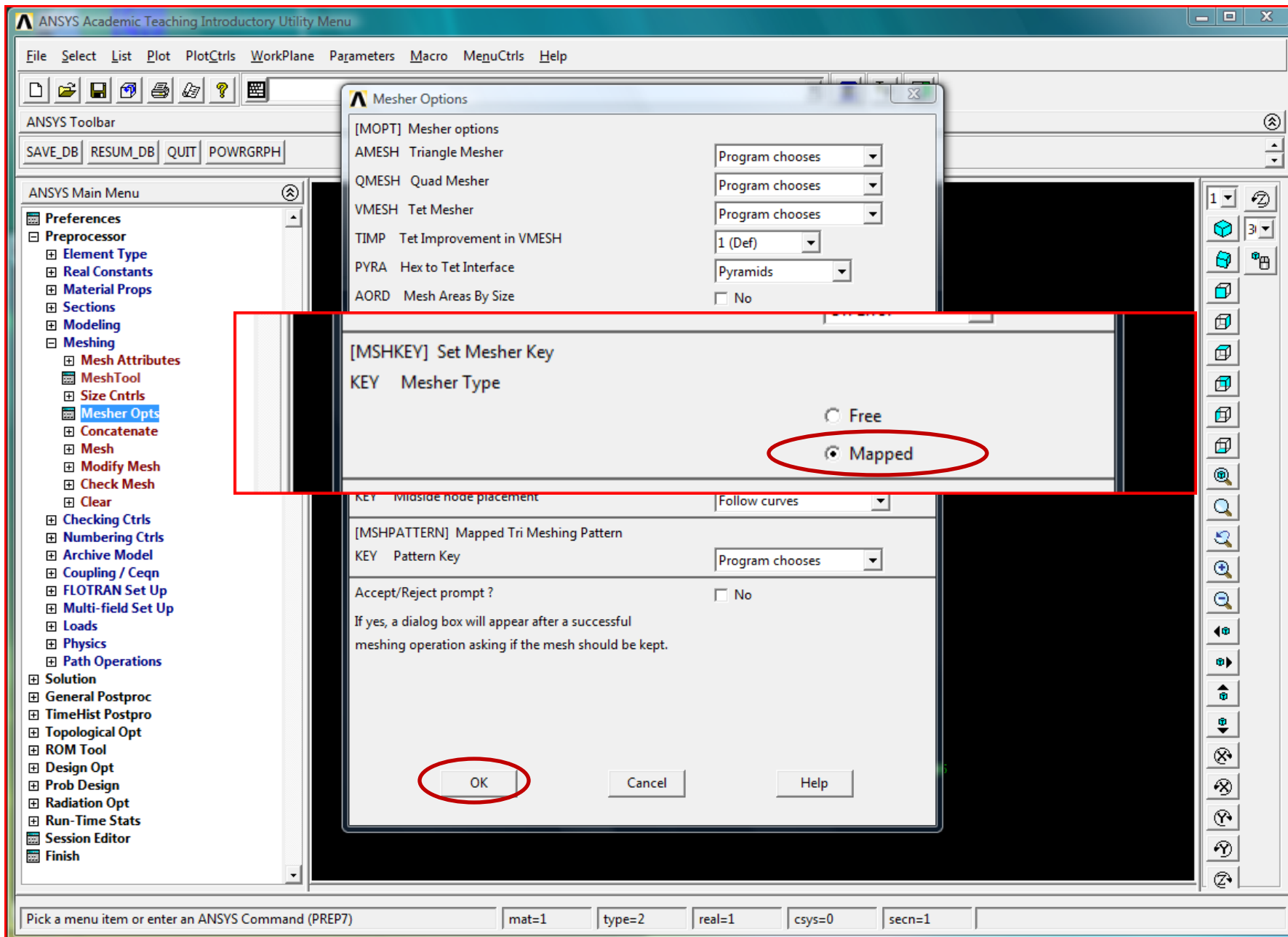
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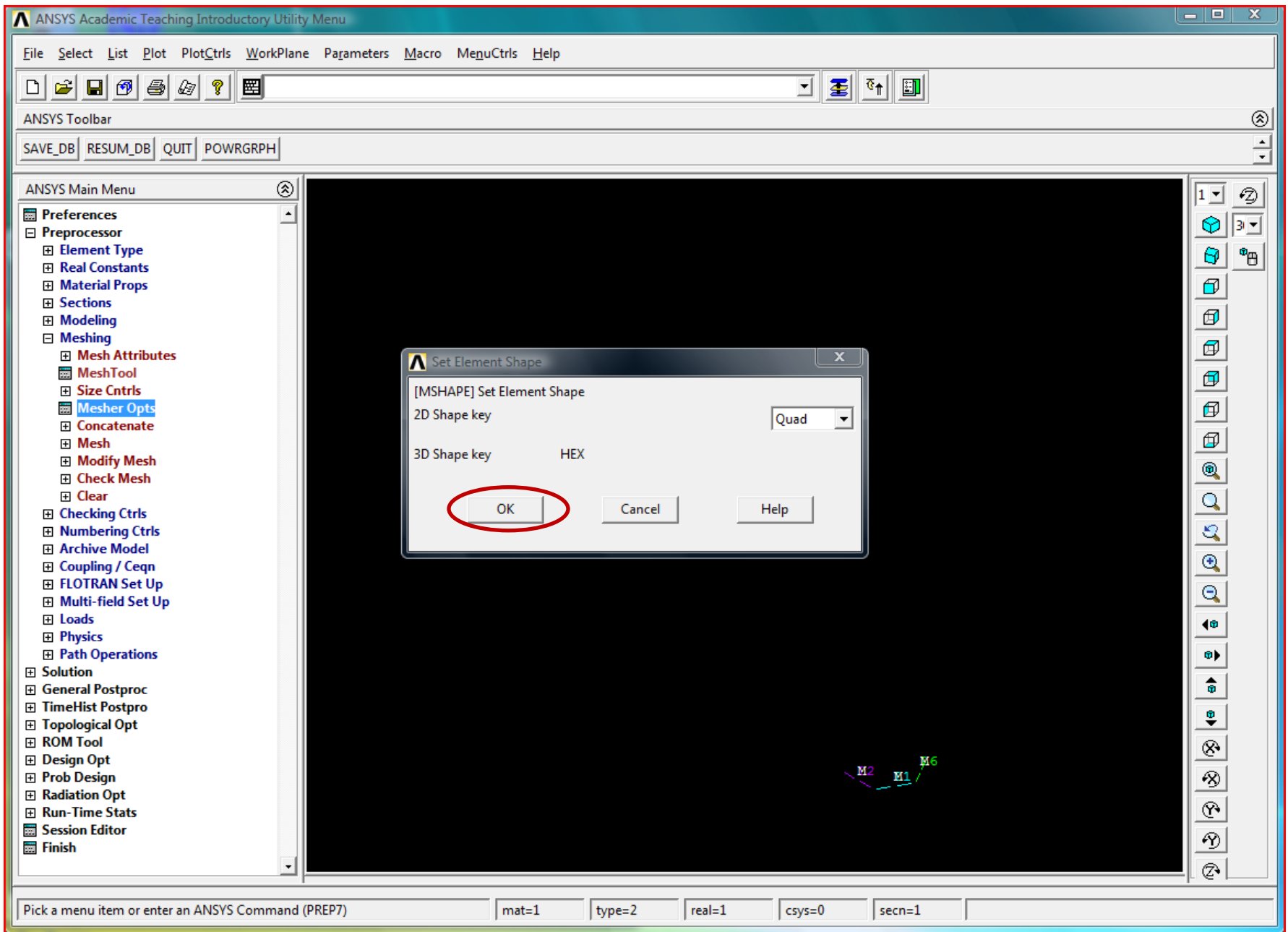
**OK**    Apply  
Reset    Cancel  
Pick All    Help

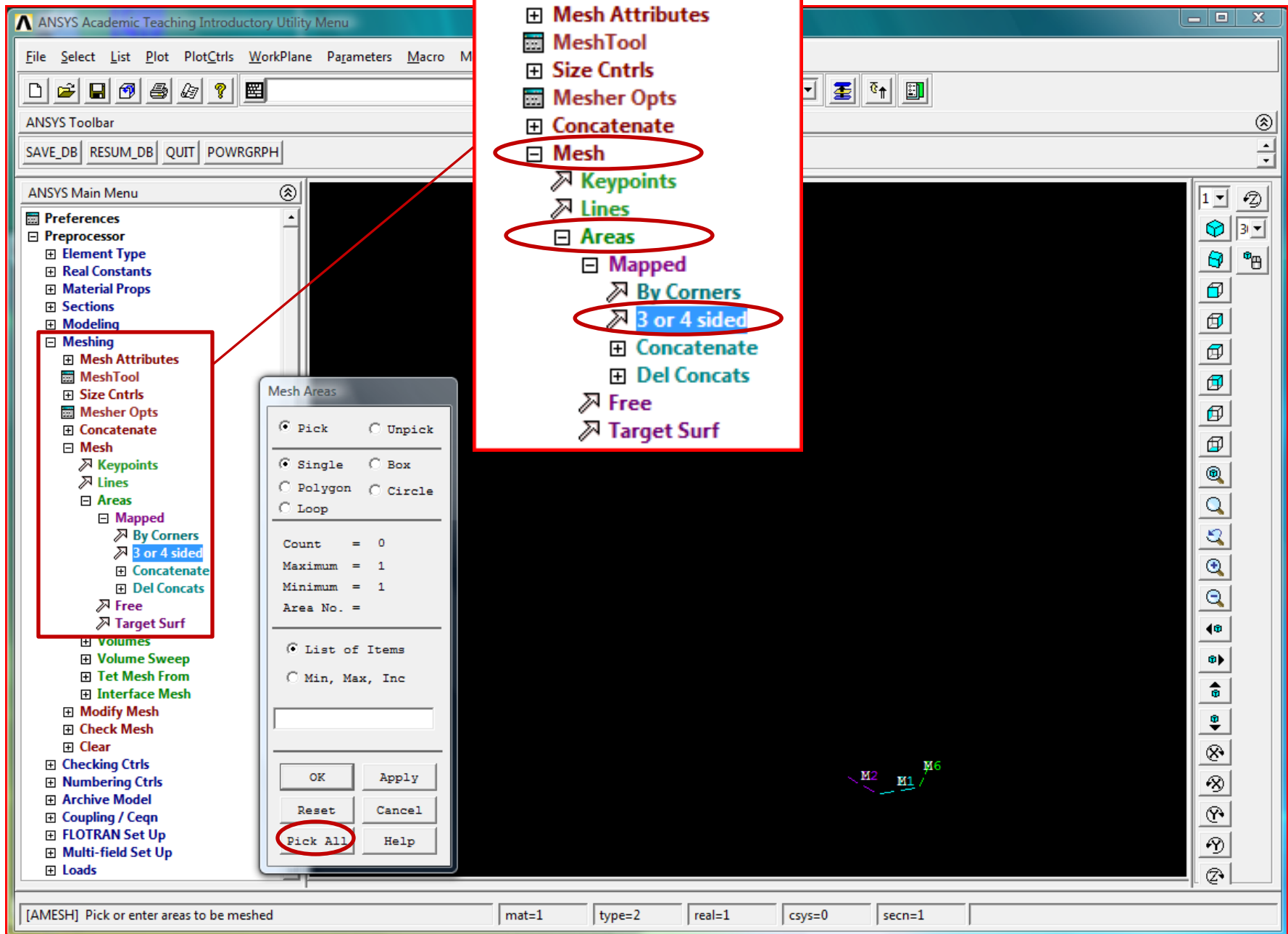




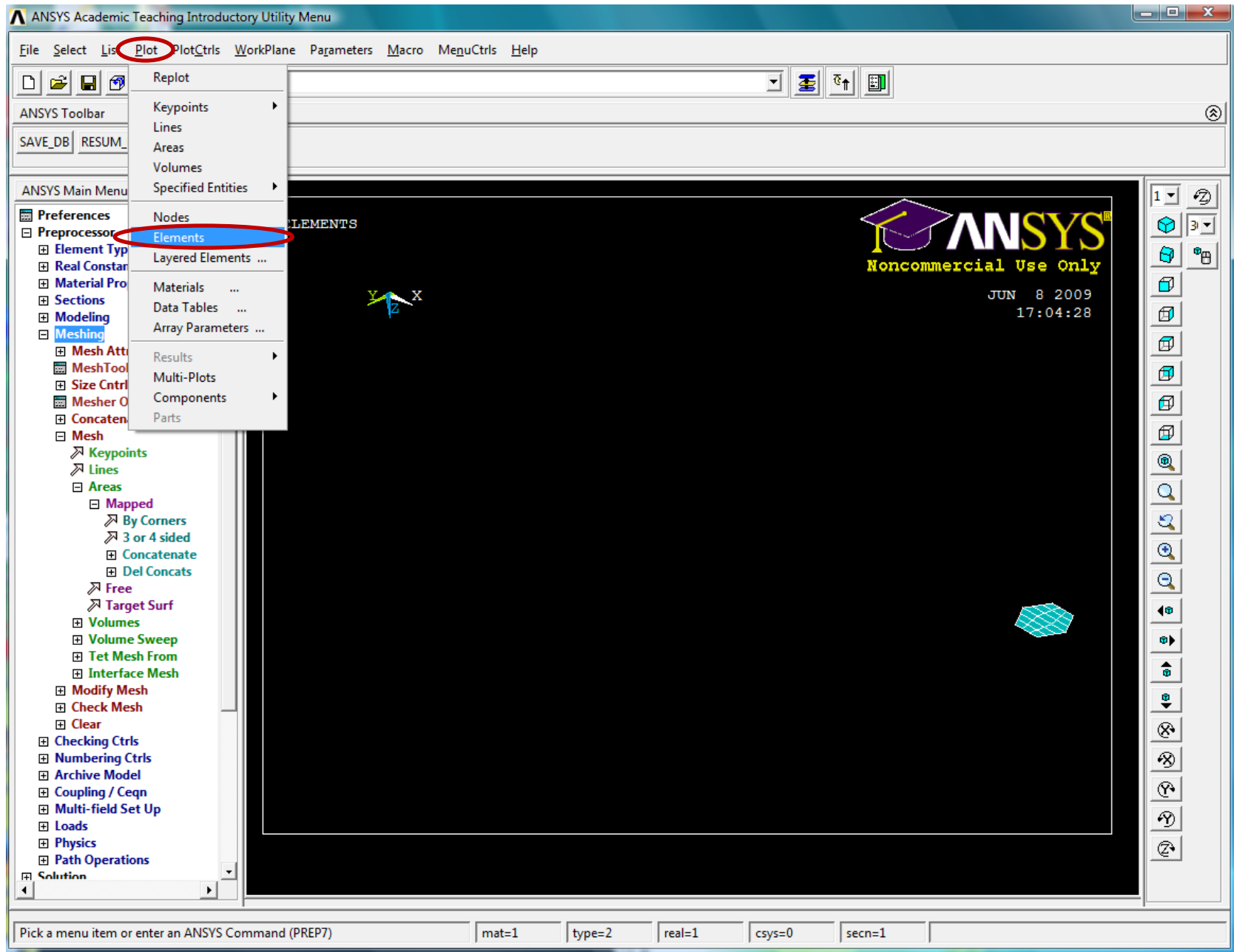


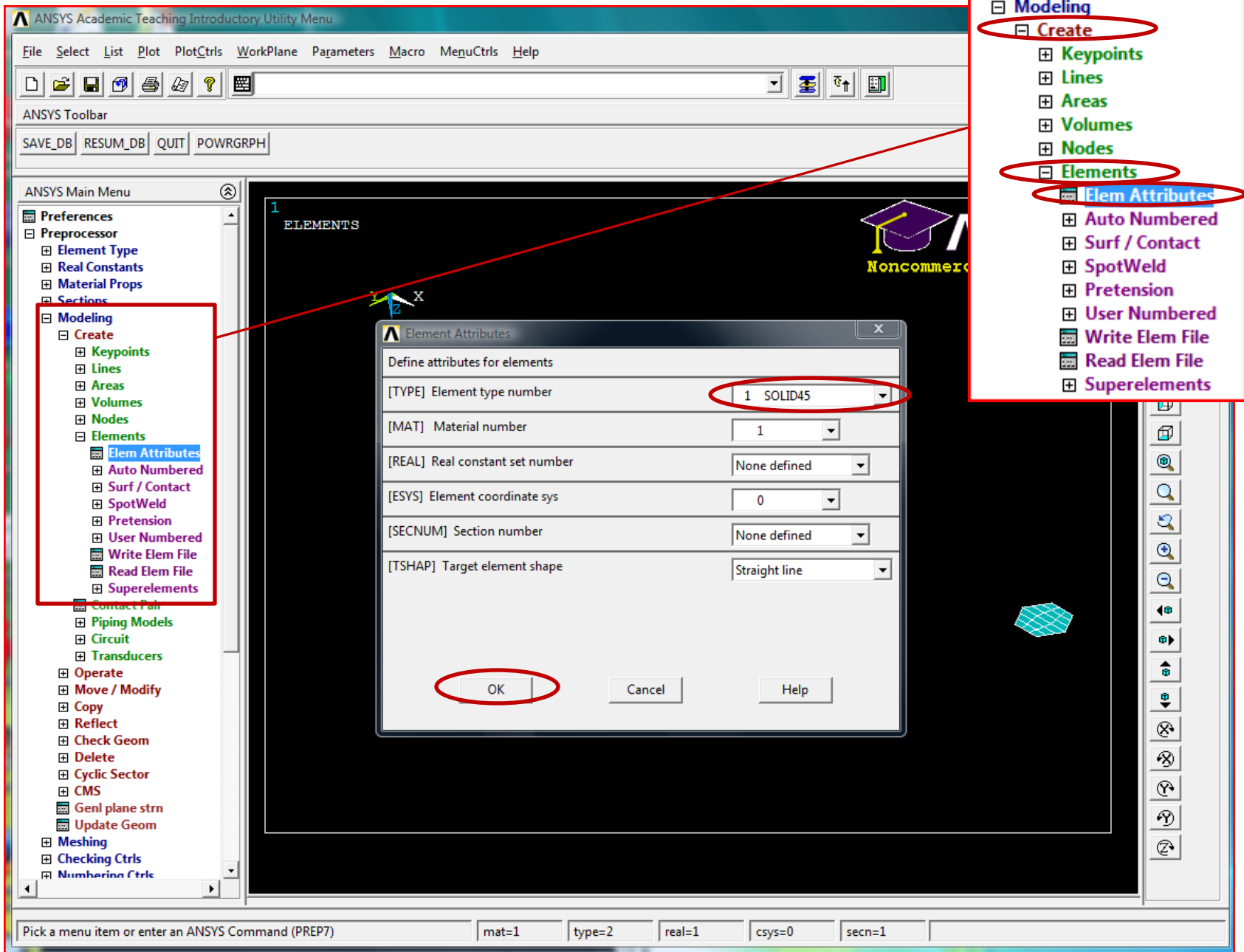




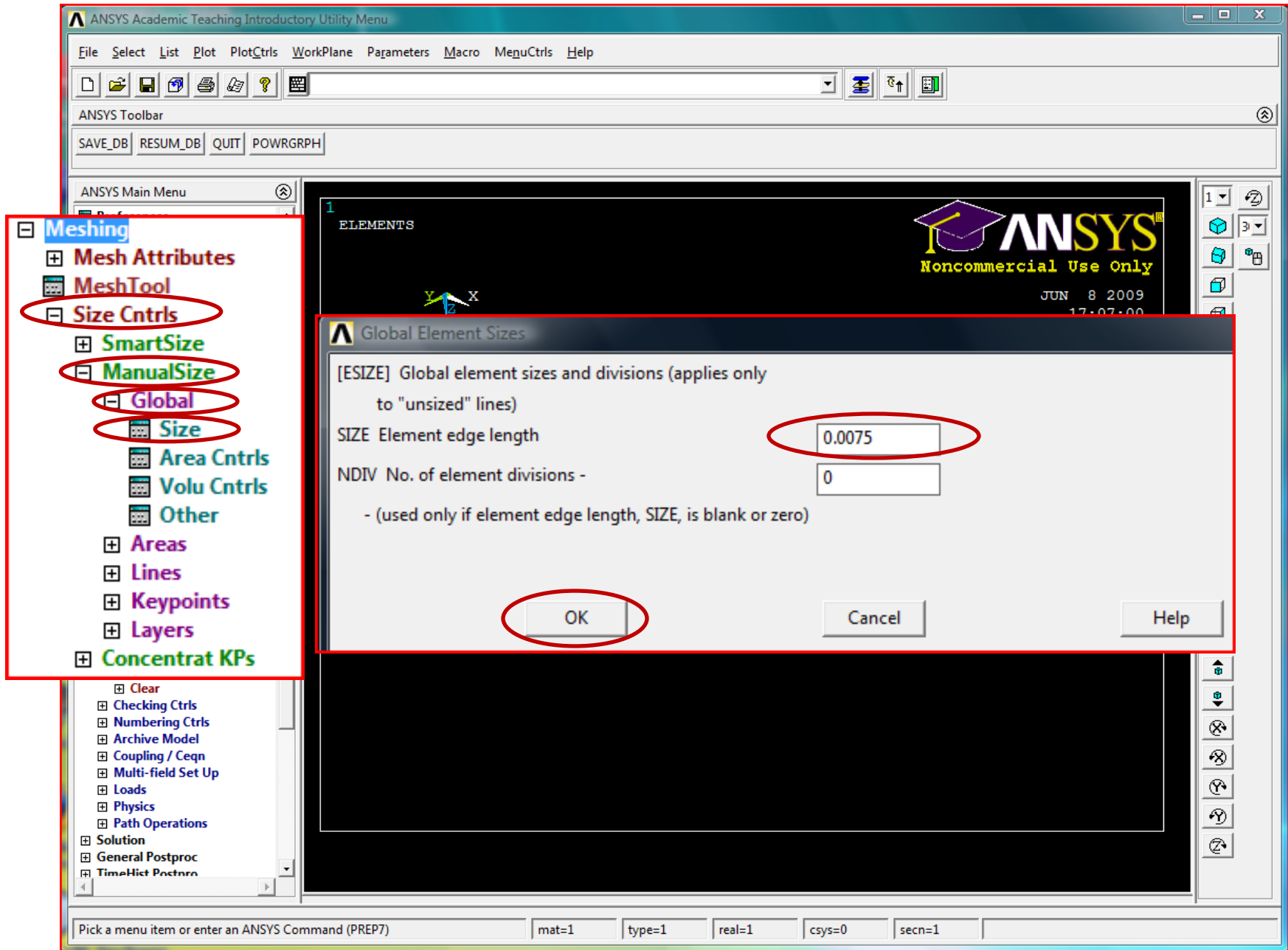


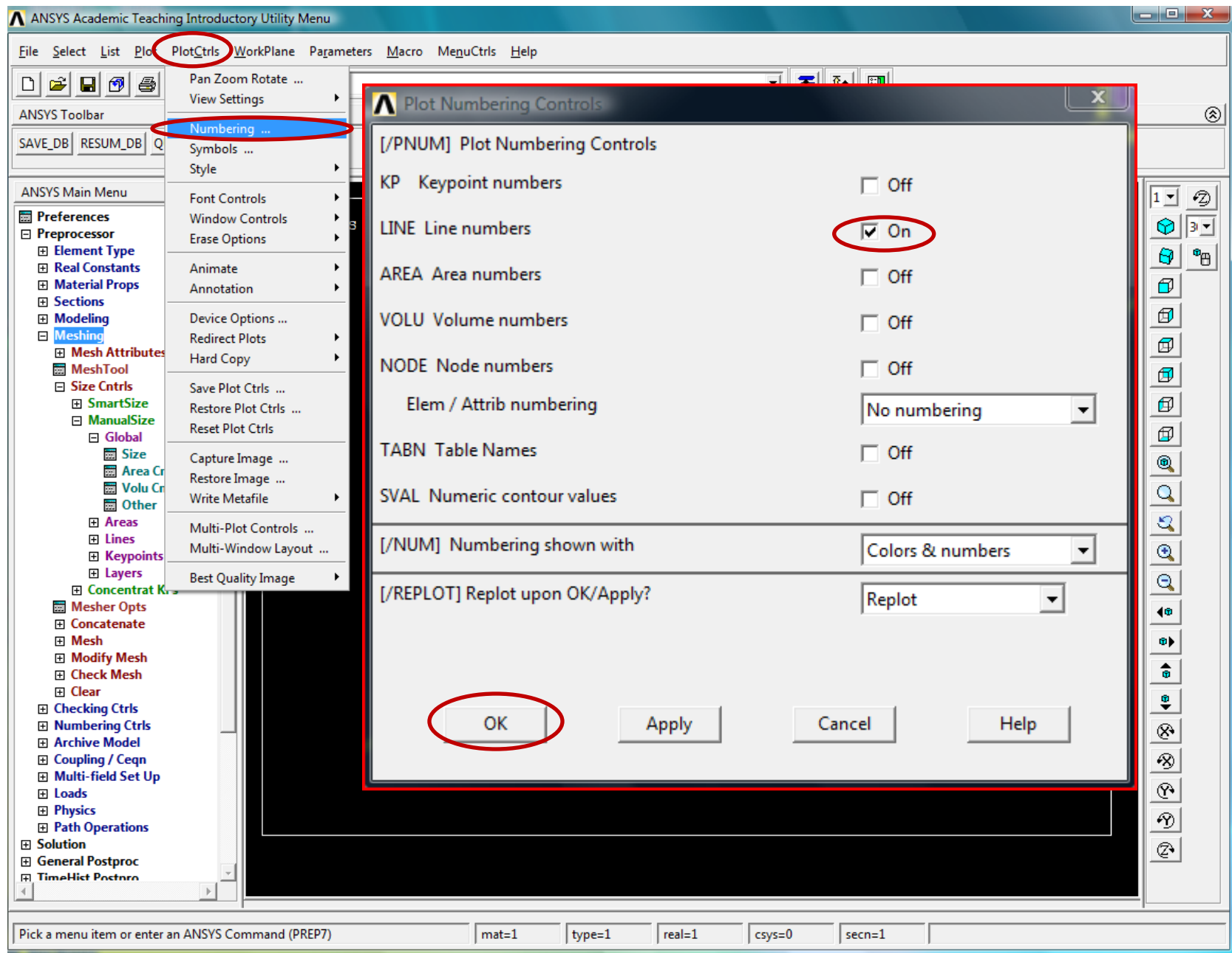


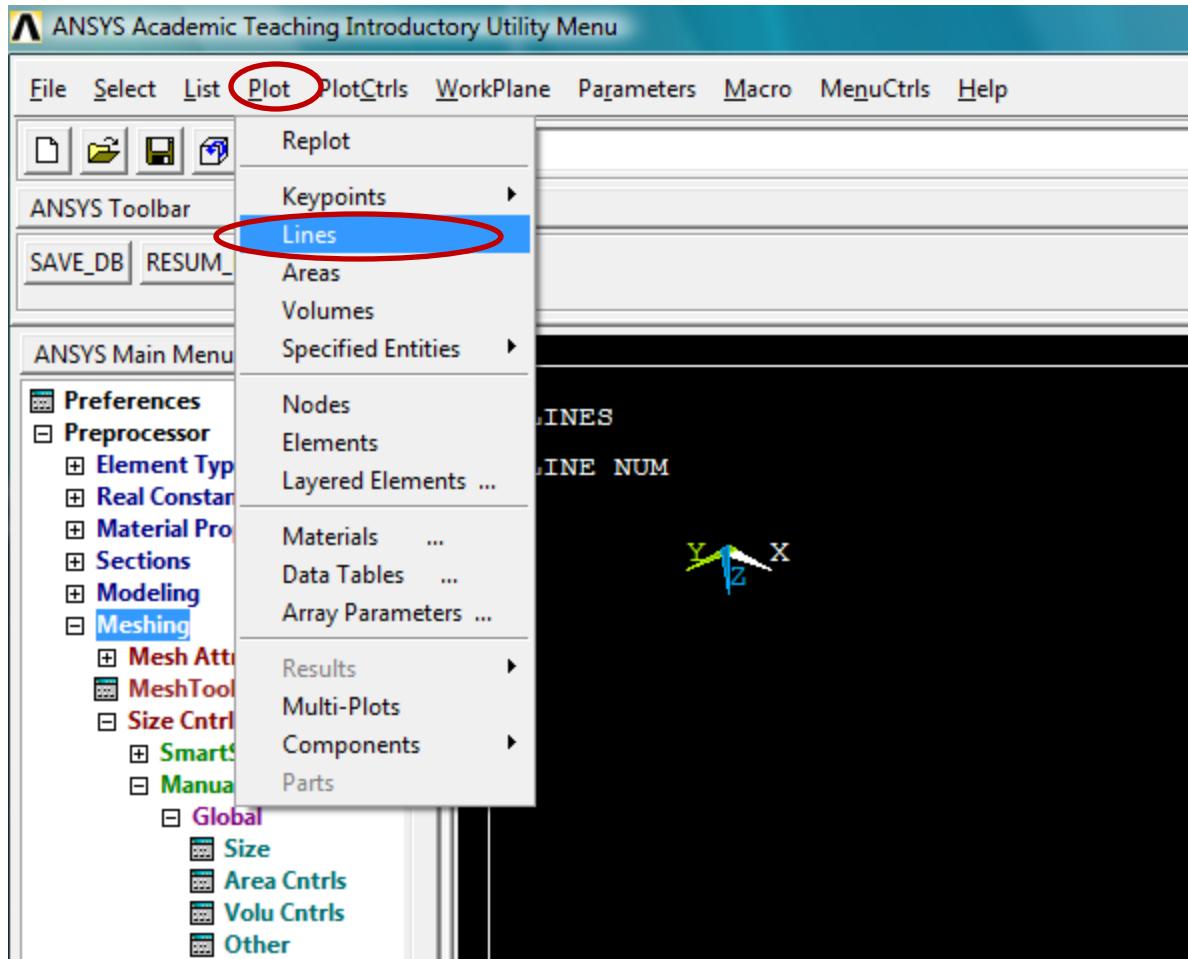




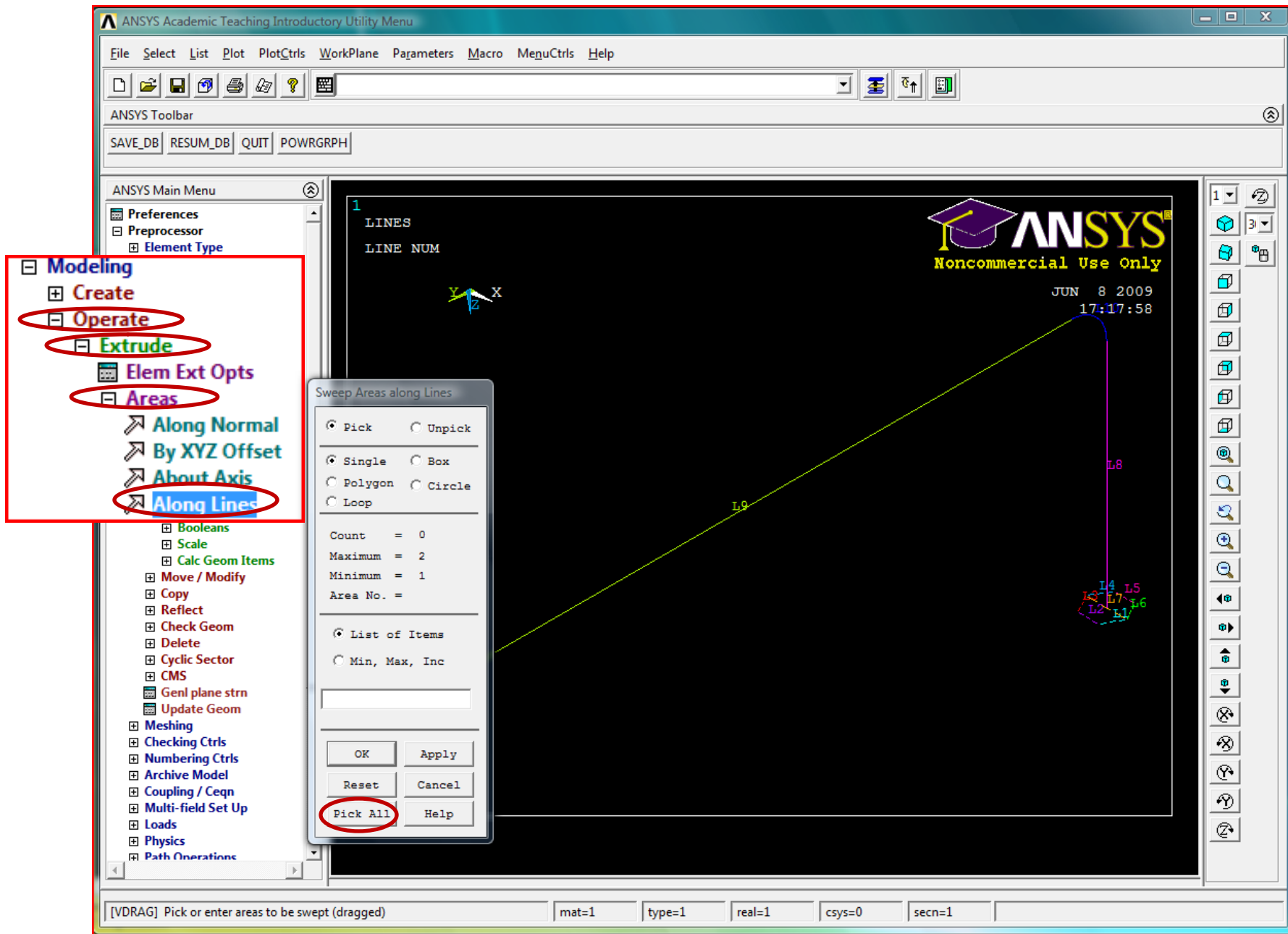




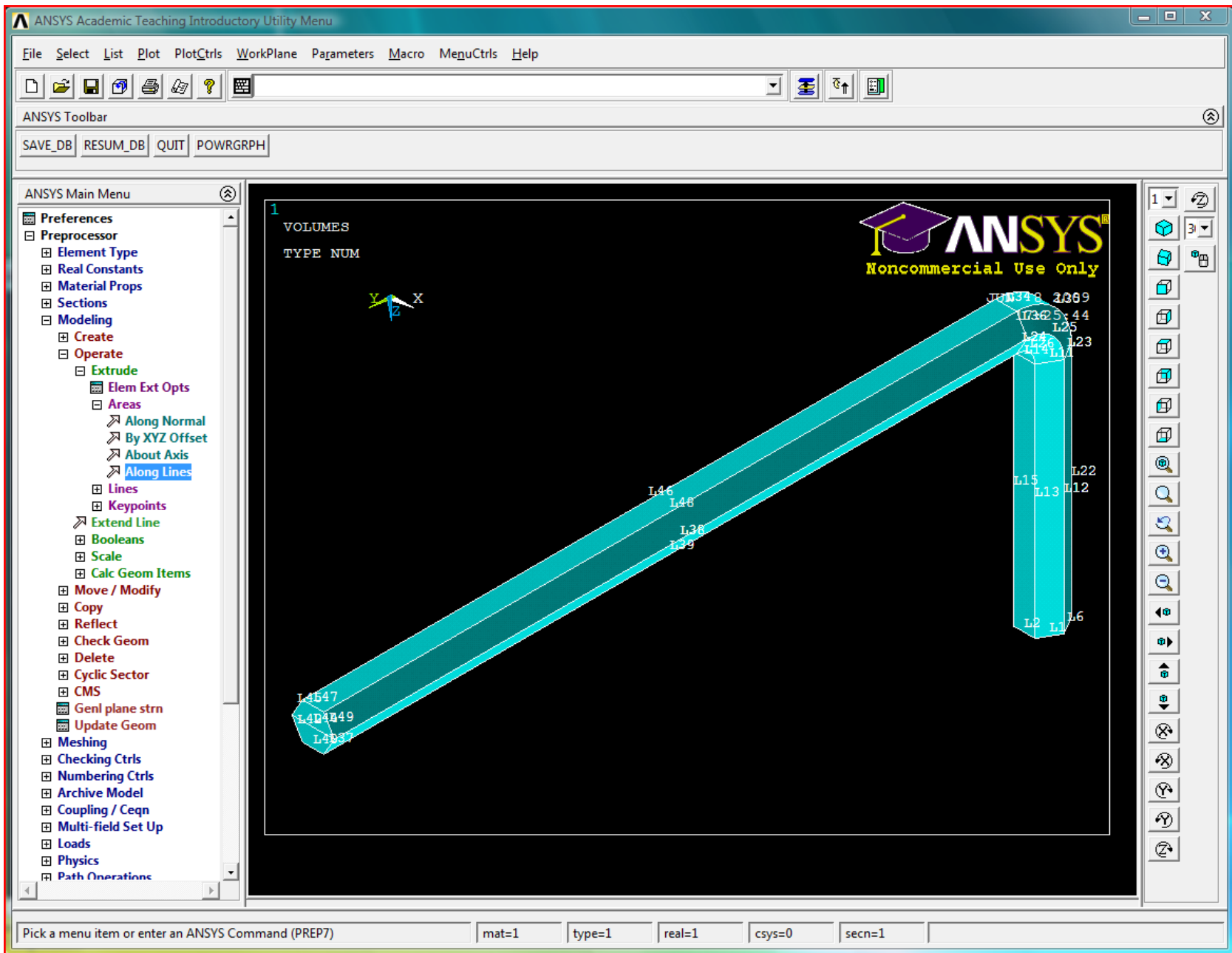


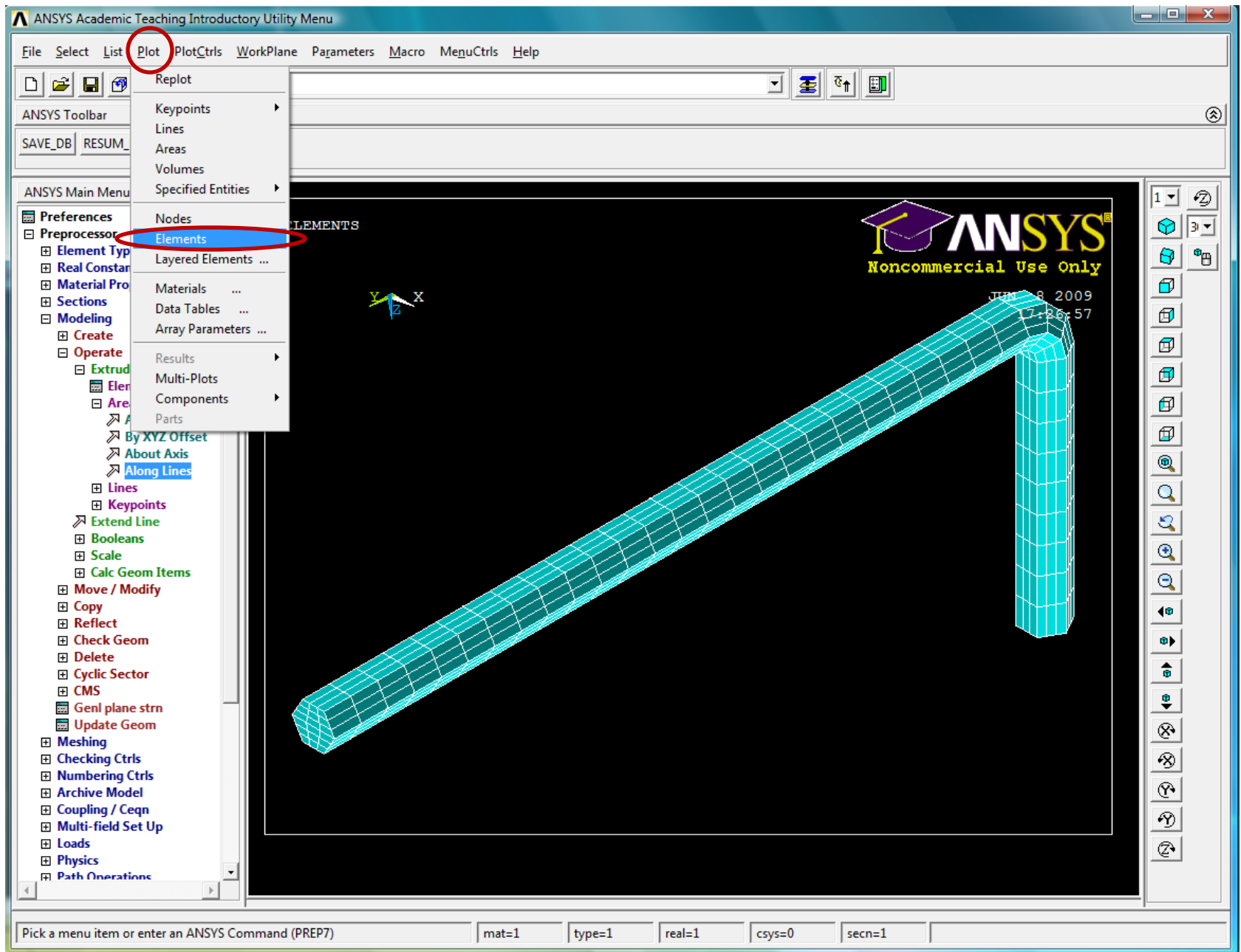




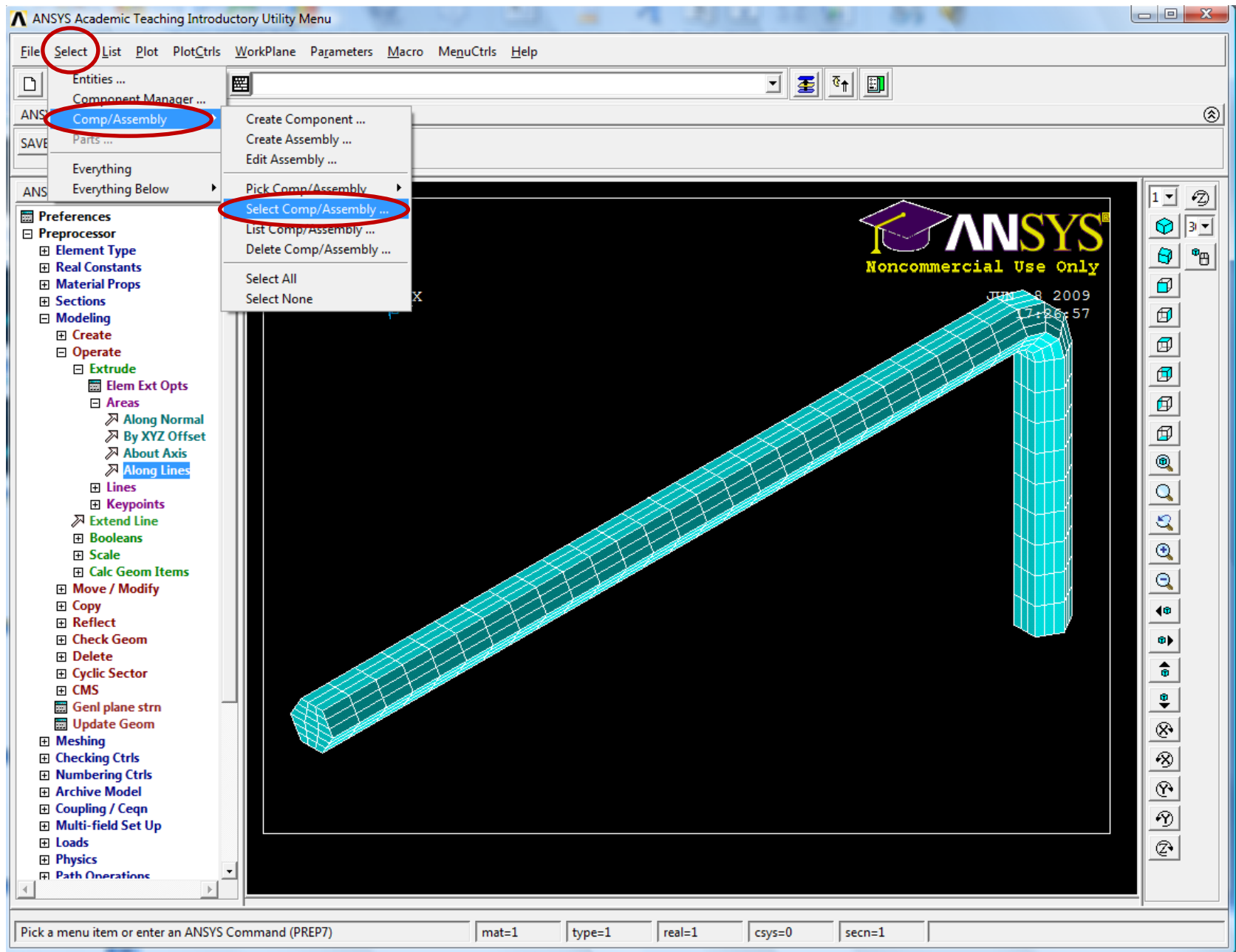




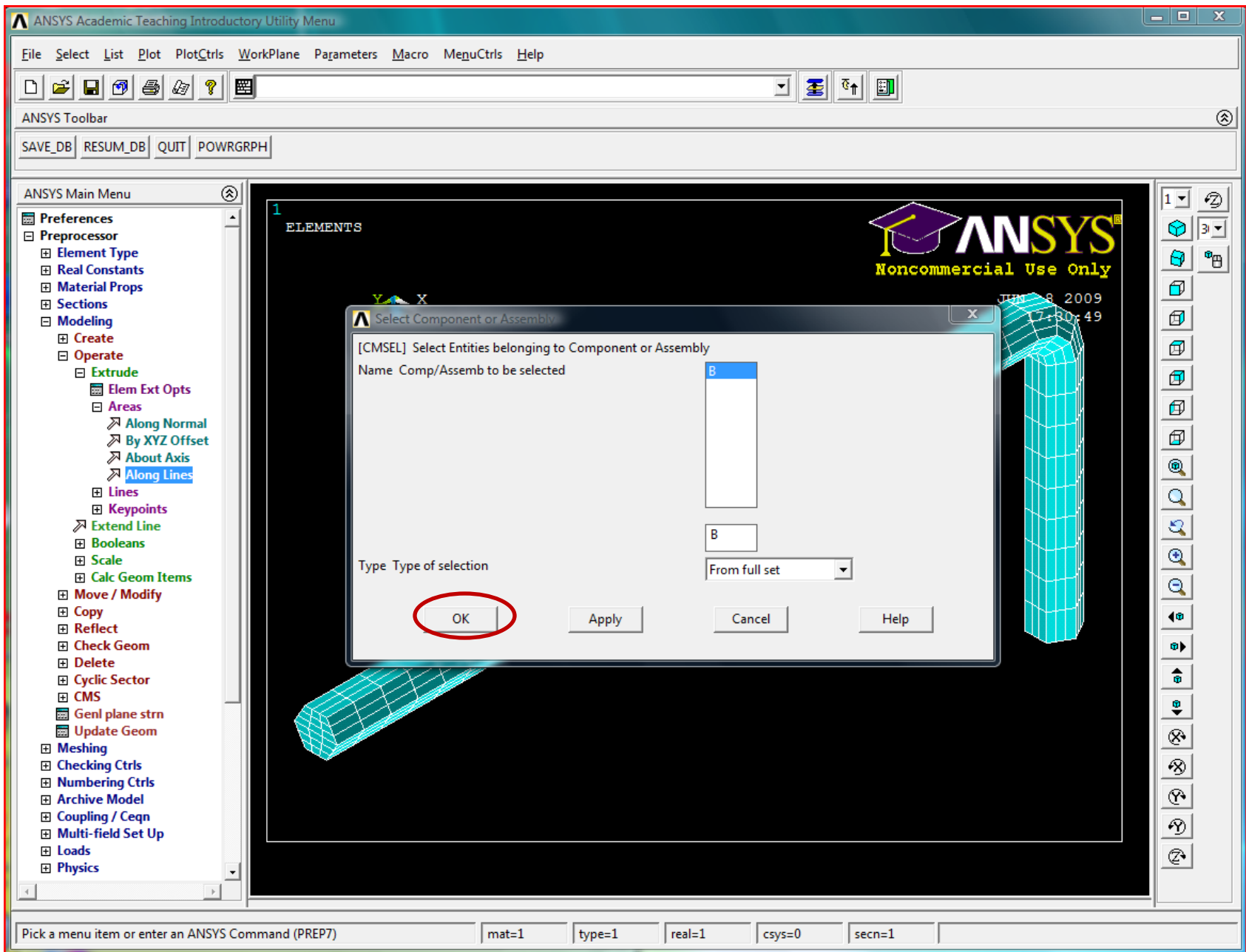


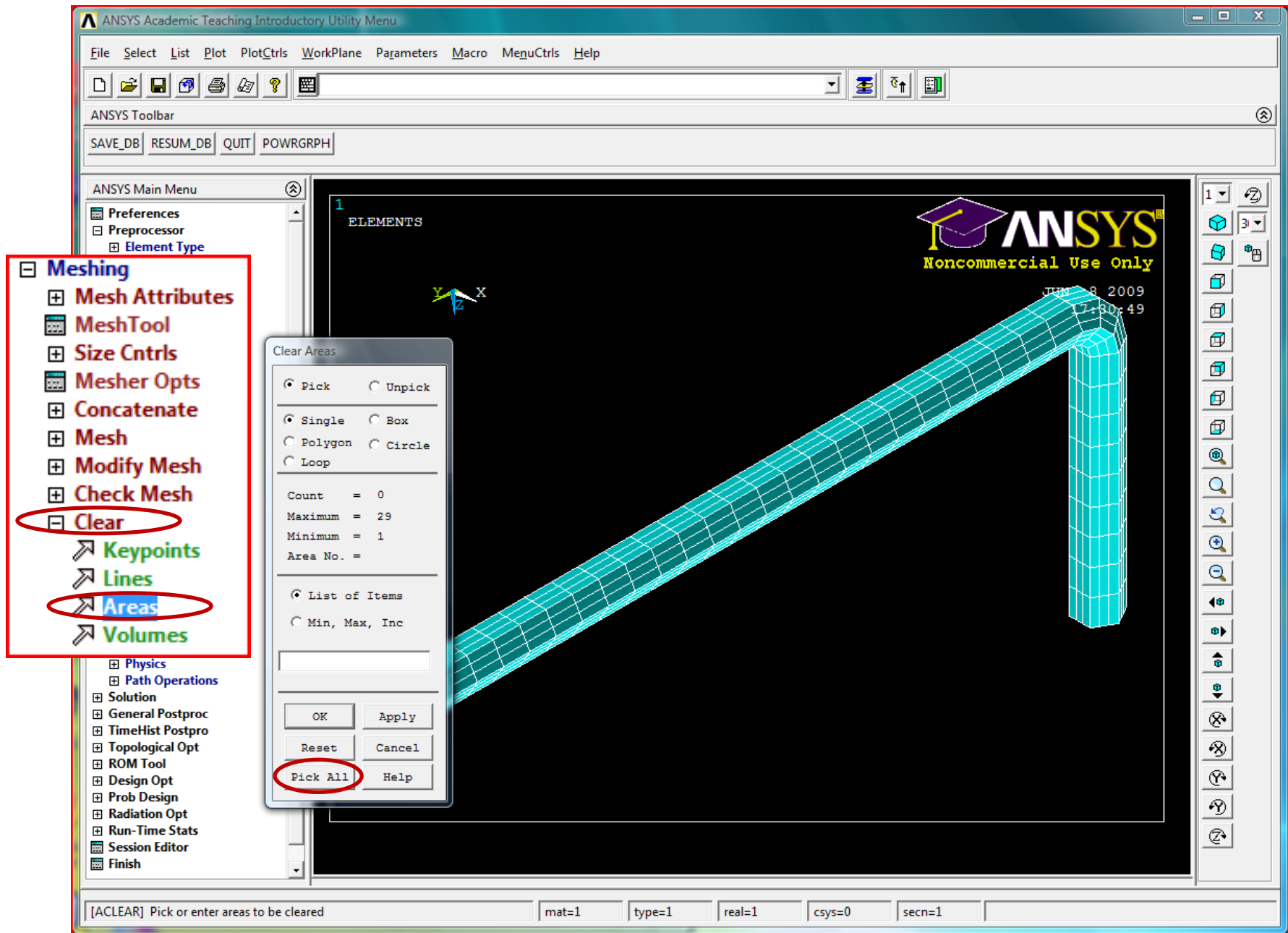


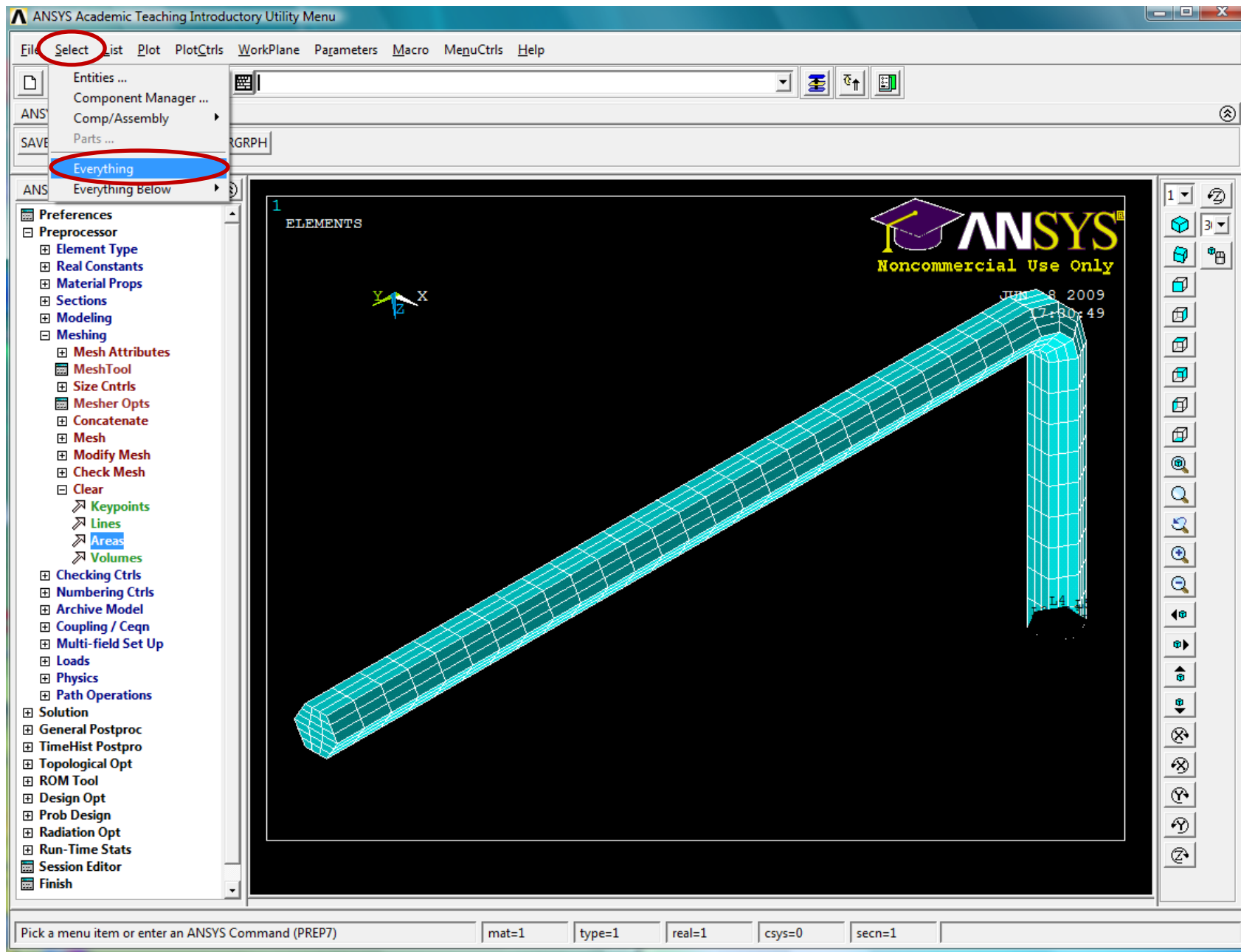


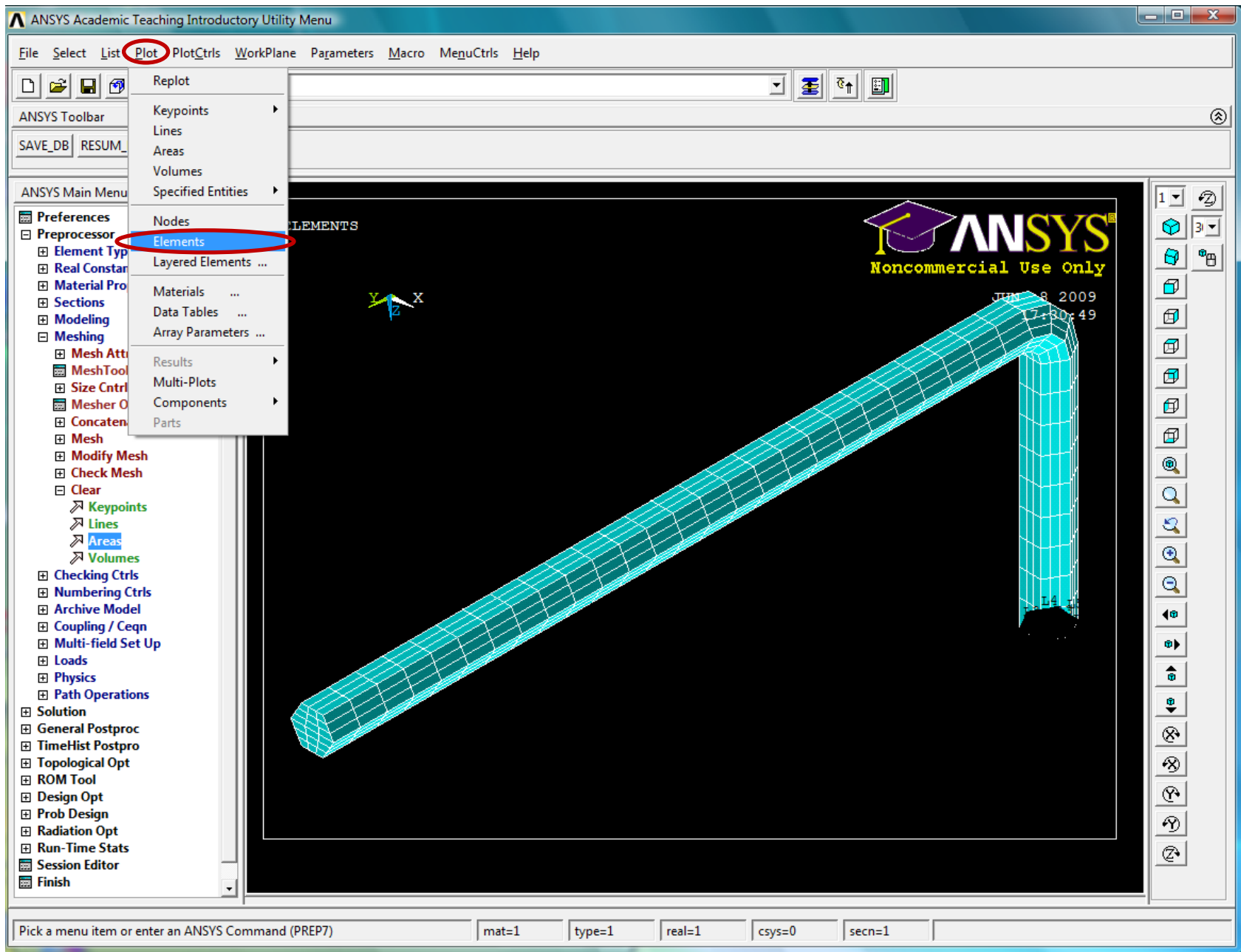


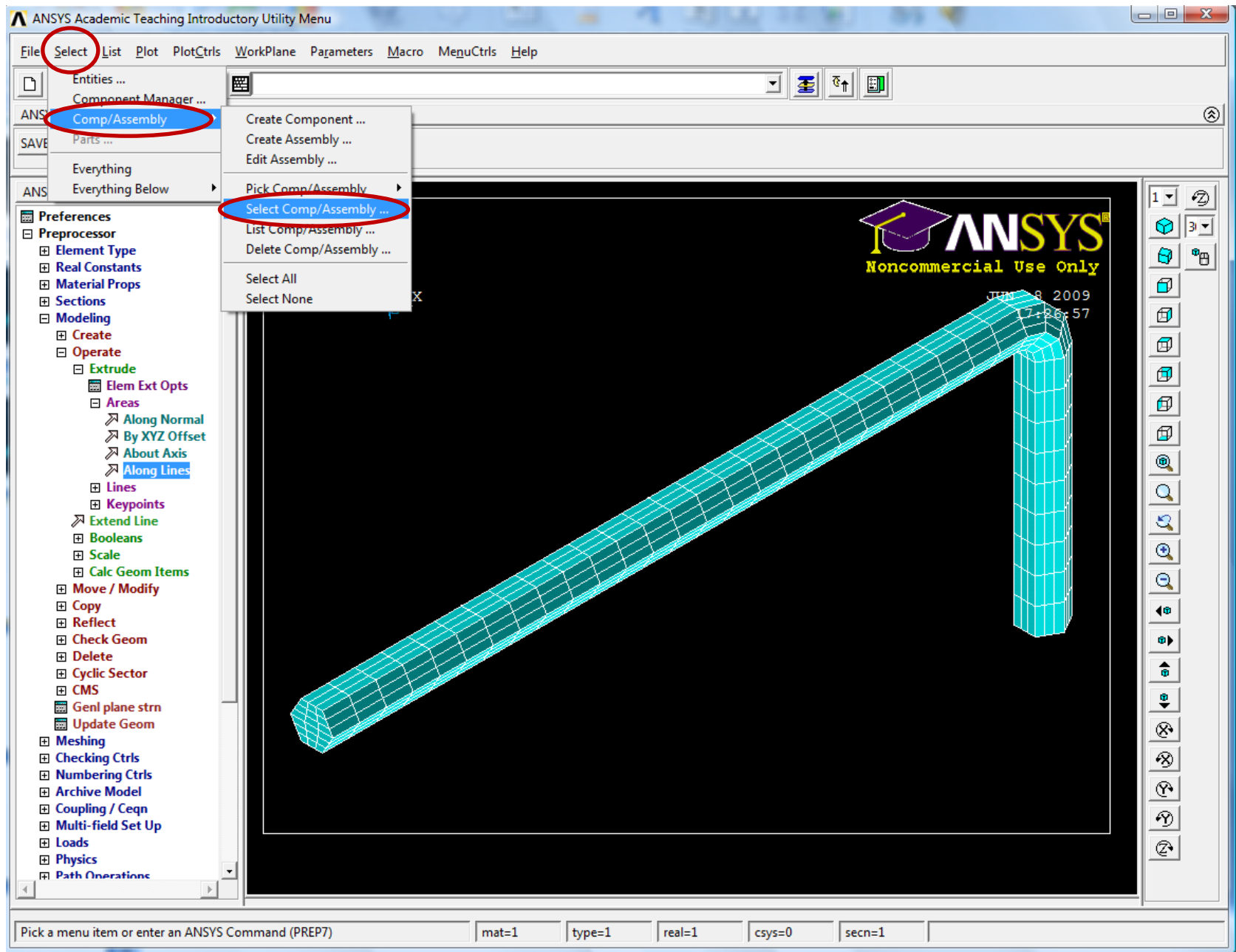






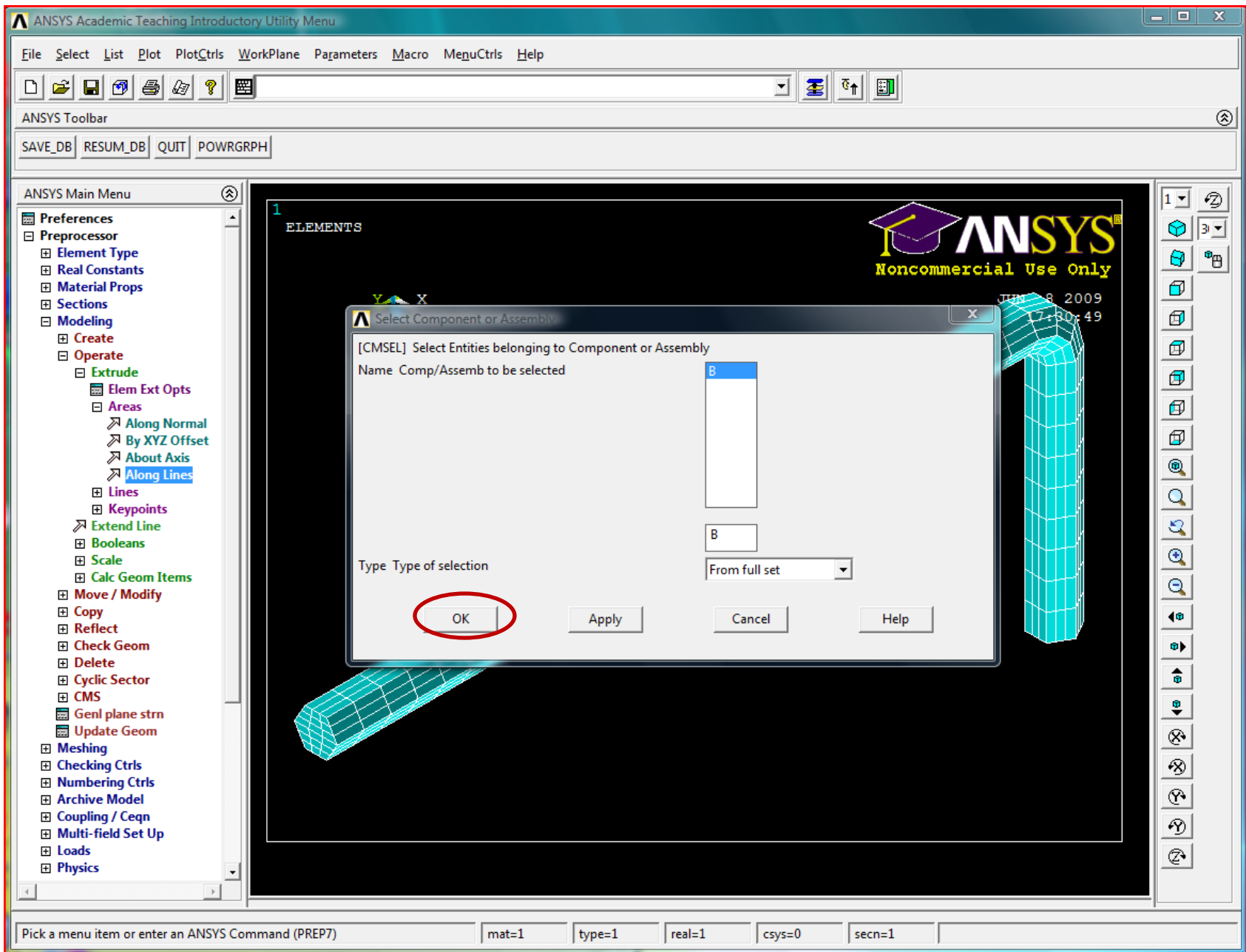


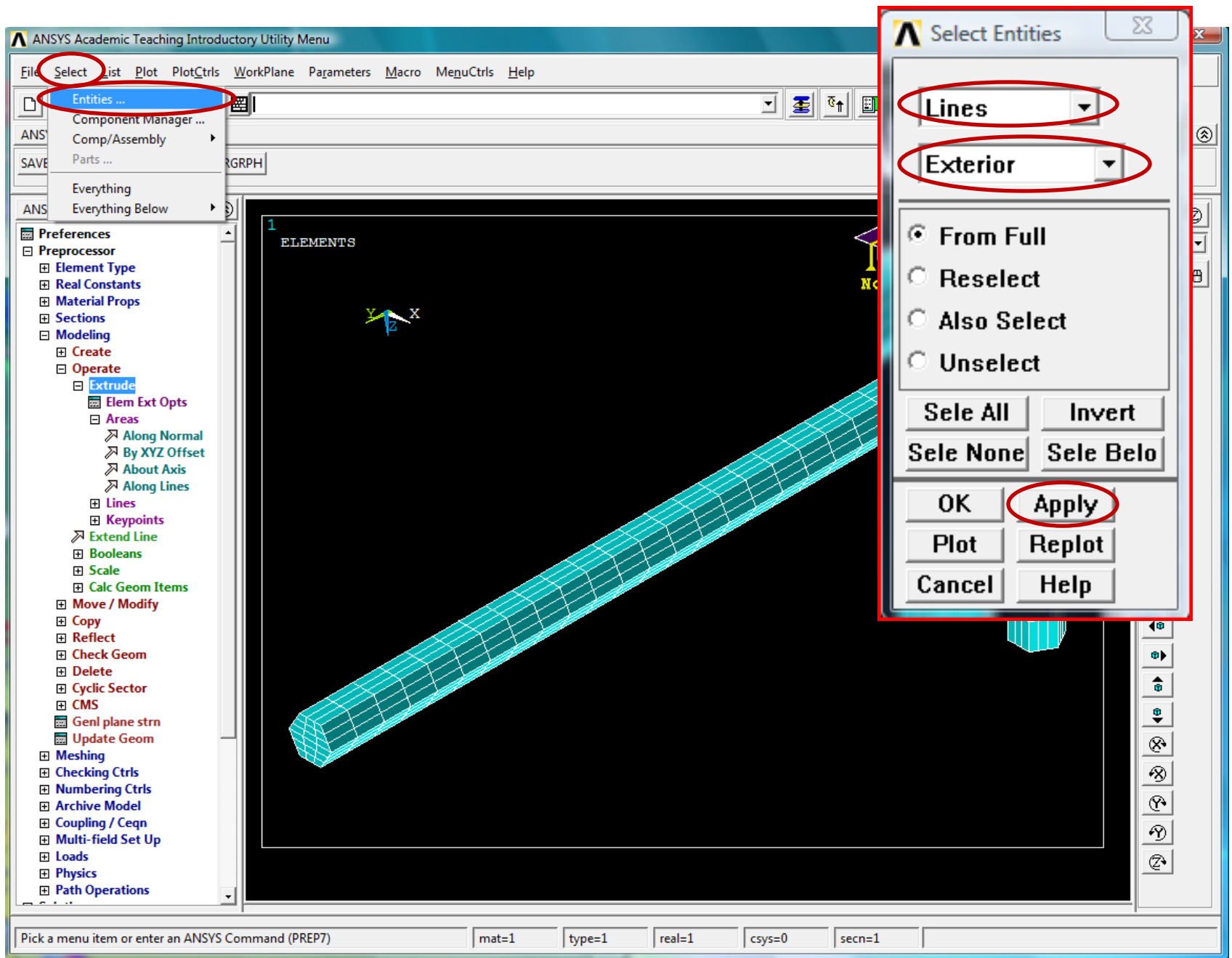


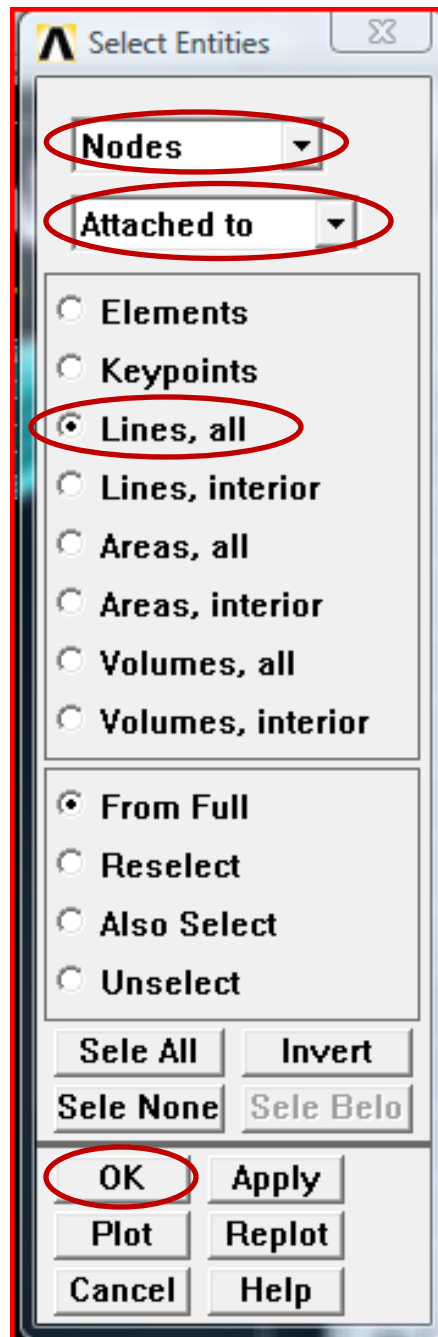


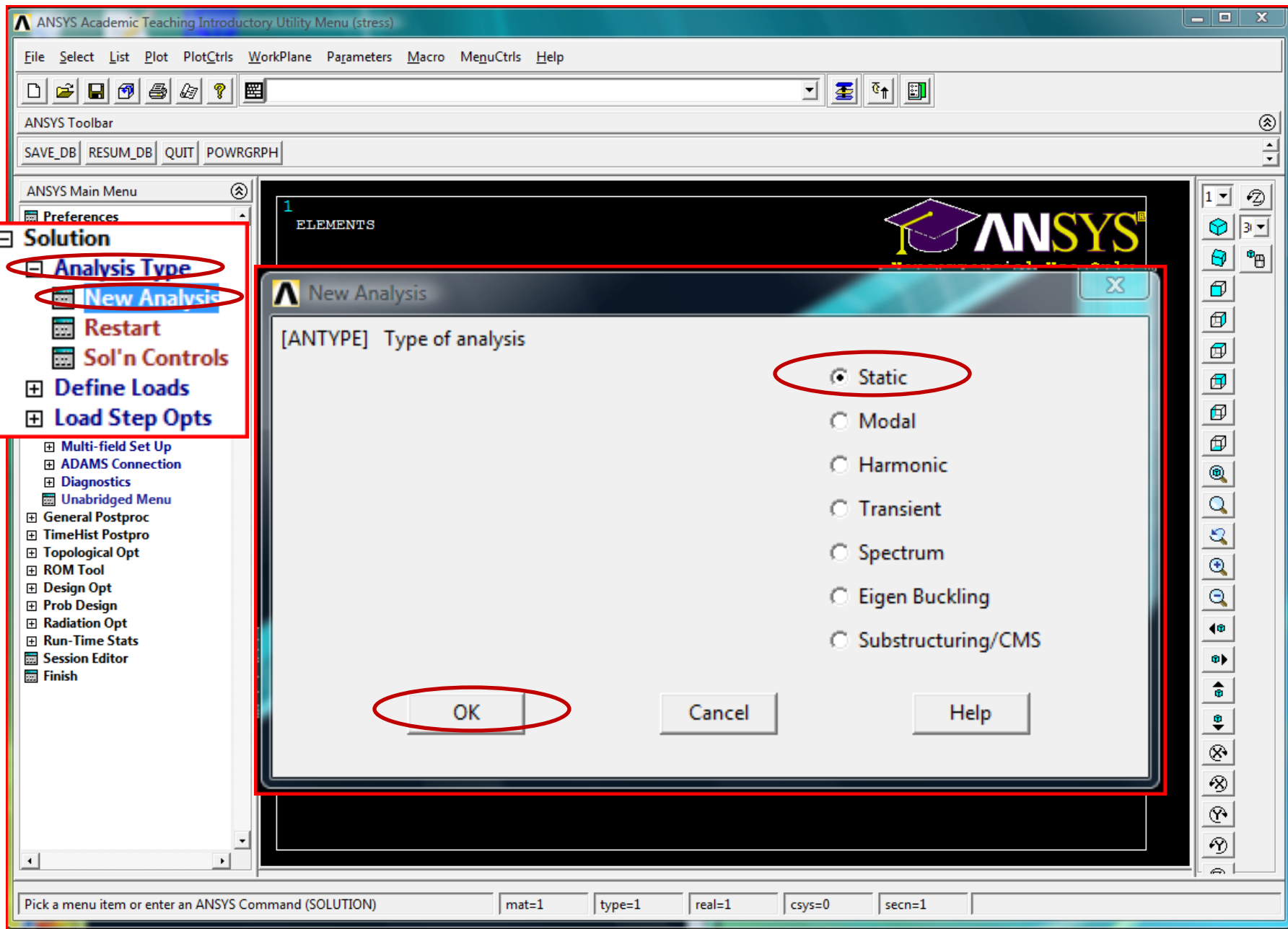


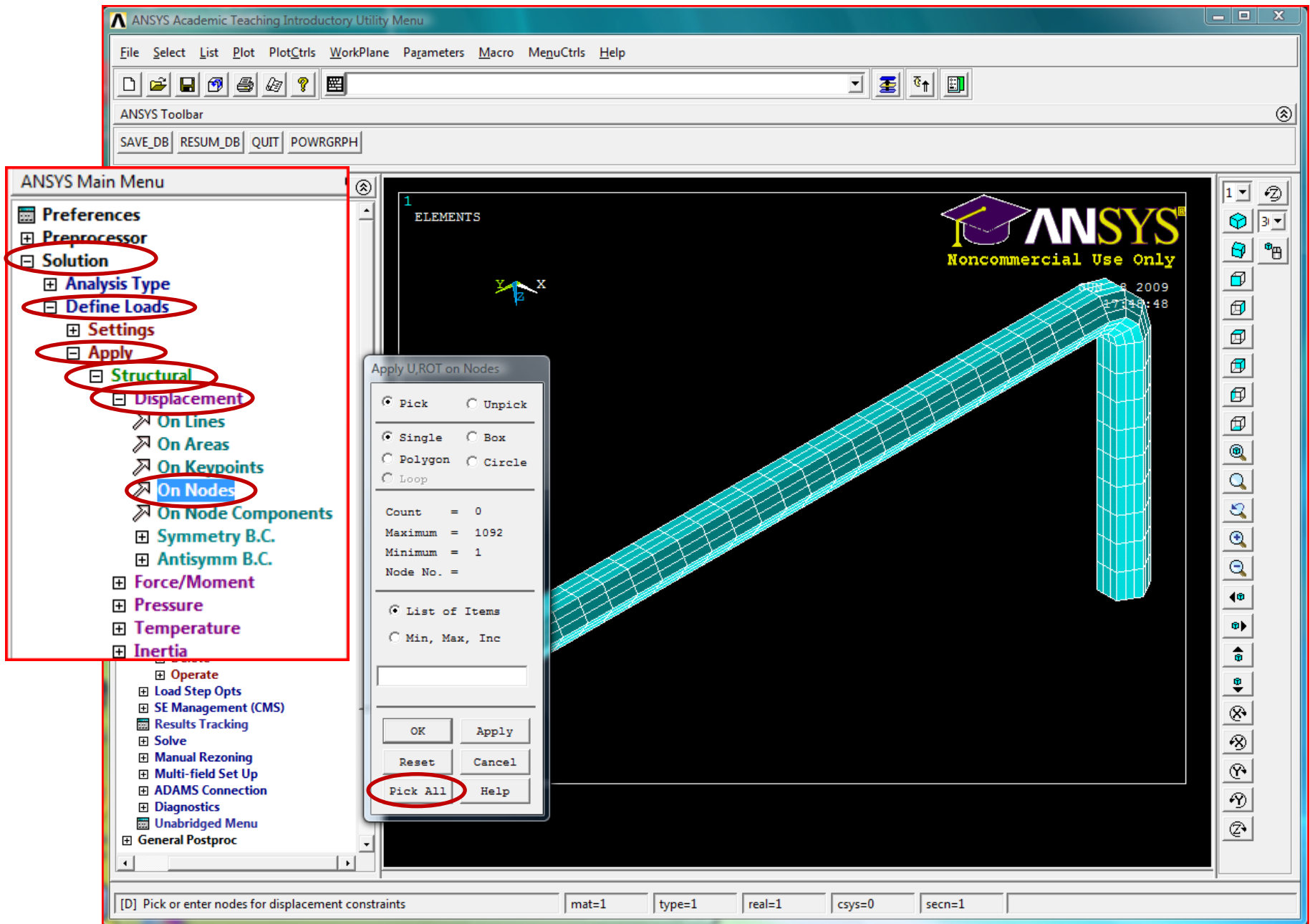


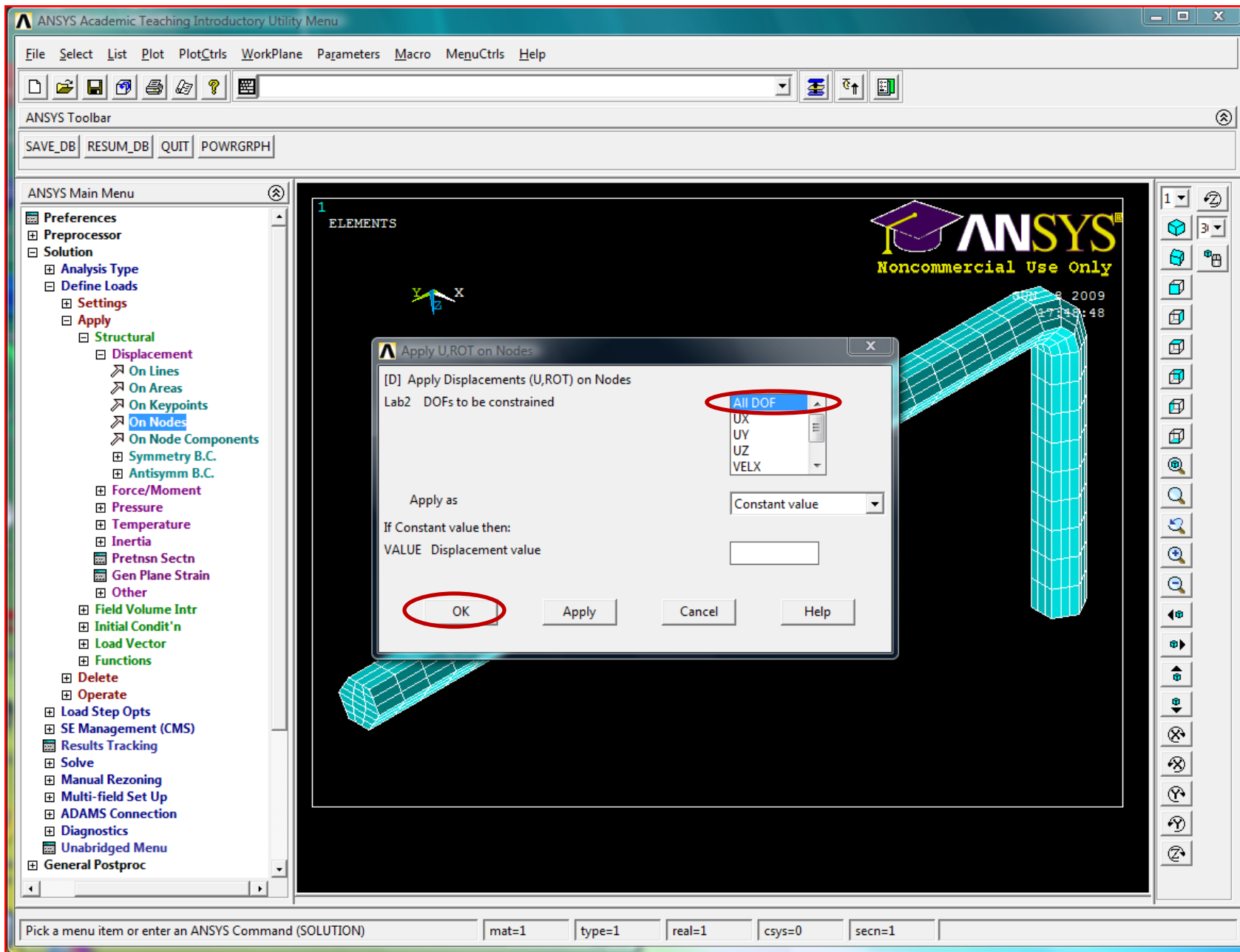


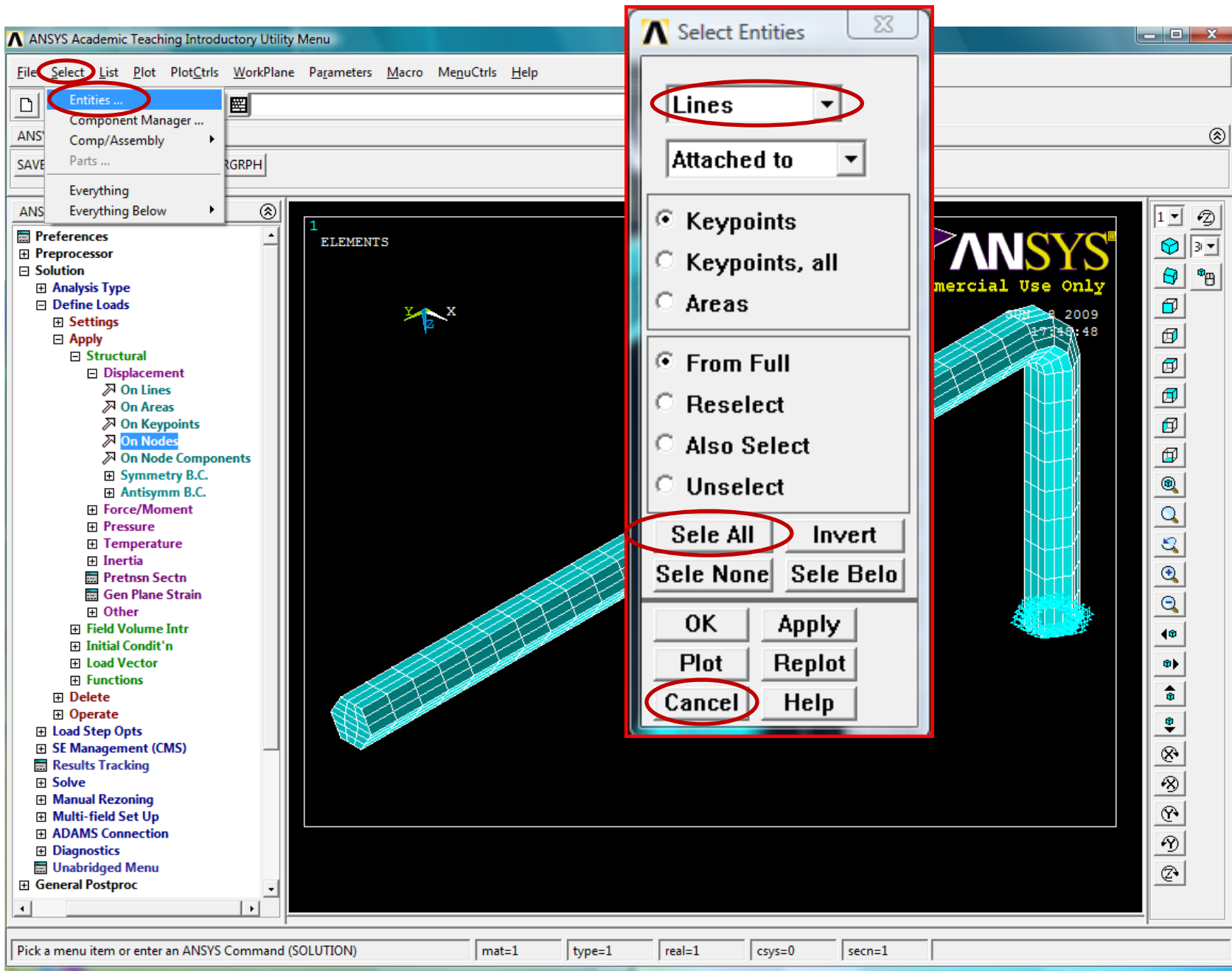












ANSYS Academic Teaching Introductory Utility Menu

File Select List Plot PlotCtrls WorkPlane Parameters

Pan Zoom Rotate ...  
View Settings

ANSYS Toolbar

SAVE\_DB RESUM\_DB Q

ANSYS Main Menu

- Preferences
- Preprocessor
  - Analysis Type
  - Define Loads
    - Settings
    - Apply
      - Structural
        - Displacement
          - On Line
          - On Area
          - On Key
          - On Node
          - Symmetry
          - Antisymmetry
        - Force/Moment
        - Pressure
        - Temperature
        - Inertia
        - Pretension Set
        - Gen Plane
        - Other
      - Field Volume Intra
      - Initial Condition
      - Load Vector
      - Functions
    - Delete
    - Operate
    - Load Step Options
    - SE Management (CMS)
  - Results Tracking
  - Solve
  - Manual Rezoning
  - Multi-field Set Up
  - ADAMS Connection
  - Diagnostics
  - Unabridged Menu
- General Postproc

Numbering  
Symbols ...  
Style

Font Controls  
Window Controls  
Erase Options

Animate  
Annotation

Device Options ...  
Redirect Plots  
Hard Copy

Save PlotCtrls ...  
Restore PlotCtrls ...  
Reset PlotCtrls

Capture Image ...  
Restore Image ...  
Write Metafile

Multi-Plot Controls ...  
Multi-Window Layout ...  
Best Quality Image

Pick a menu item or enter an ANSYS Command (SOLUTION)

Symbols

[/PBC] Boundary condition symbol

- All BC+Reaction
- All Applied BCs
- All Reactions
- None
- For Individual:
- Applied BC's
- Reactions
- Miscellaneous

Individual symbol set dialog(s)  
to be displayed:

[/PSF] Surface Load Symbols

Pressures

Visibility key for shells  Off

Plot symbols in color  On

Show pres and connect as Arrows

[/PBF] Body Load Symbols

None

Show curr and fields as Contours

[/PICE] Elem Init Cond Symbols

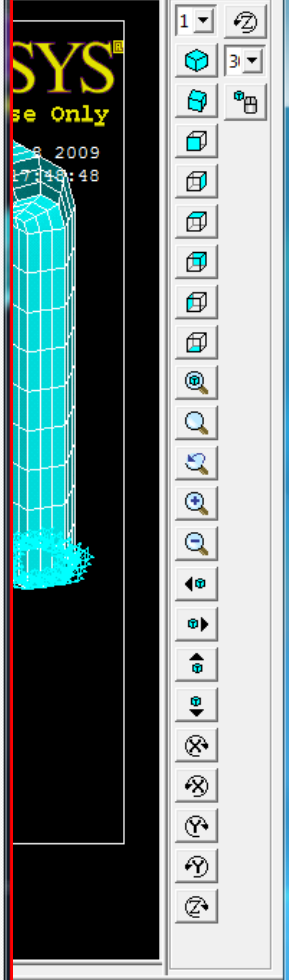
None

[/PSYMB] Other Symbols

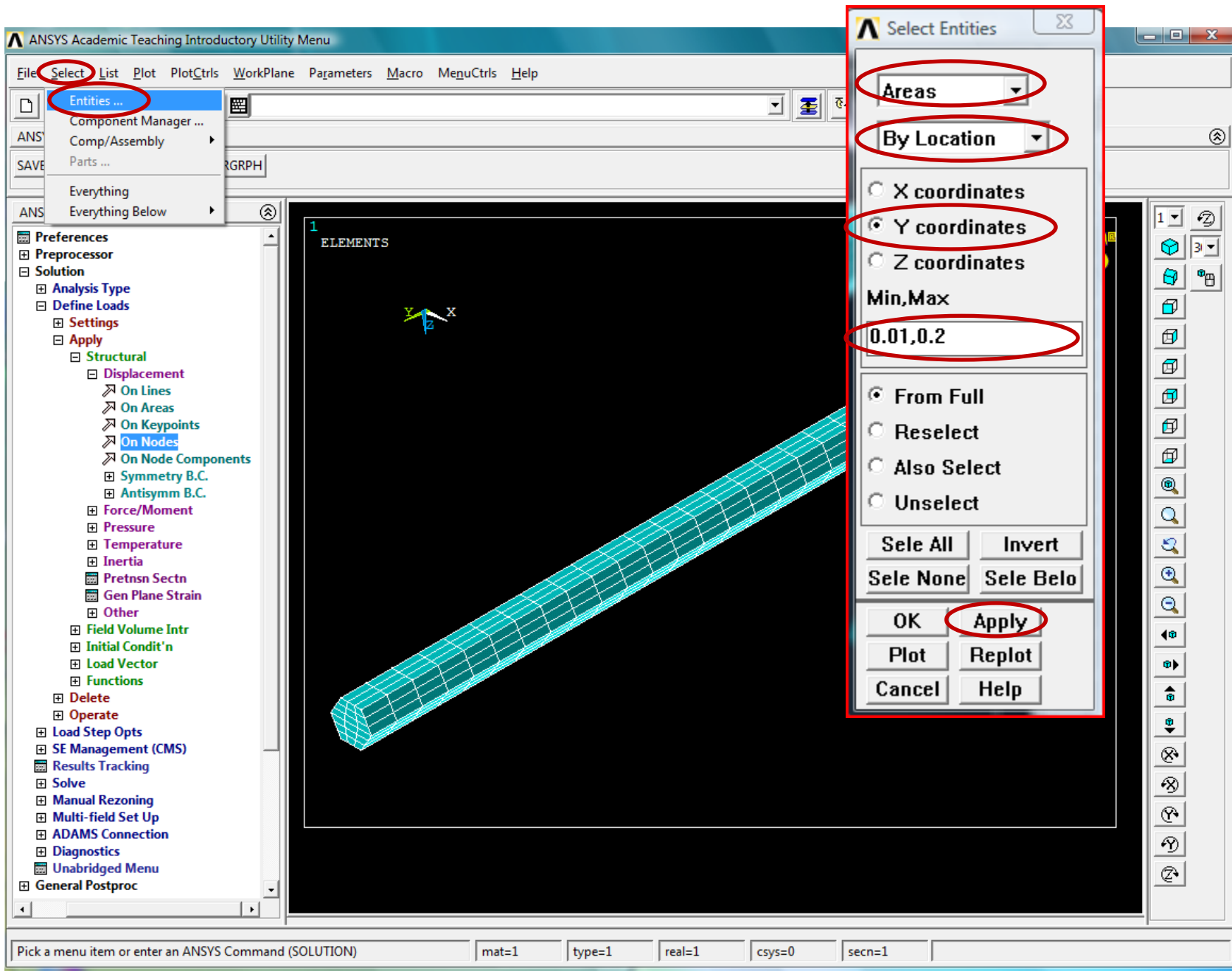
- CS Local coordinate system  Off
- NDIR Nodal coordinate system  Off
- ESYS Element coordinate sys  Off
- LDIV Line element divisions Meshed
- LDIR Line direction  Off
- ADIR Area direction  Off
- ECON Element mesh constraints  Off
- XNODE Extra node at element  Off
- DOT Larger node/kp symbols  On
- LAYR Orientation of layer number 0
- FBCS Force symbol common scale  Off

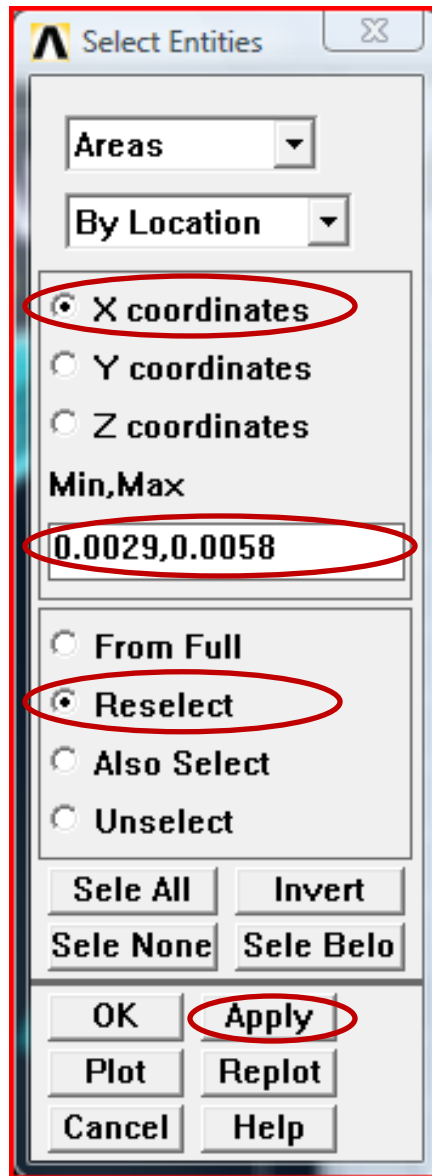
[/REPLO] Replot upon OK/Apply? Replot

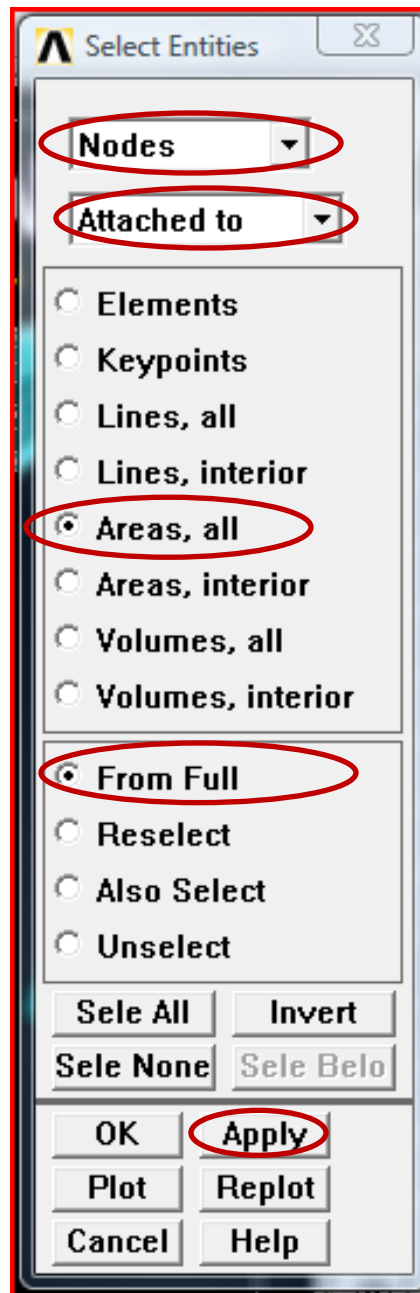
OK Cancel Help

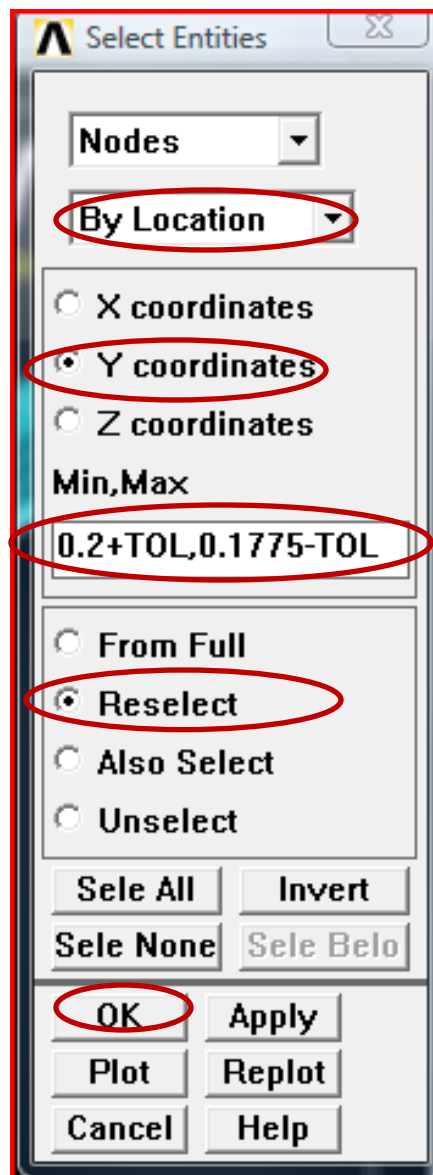


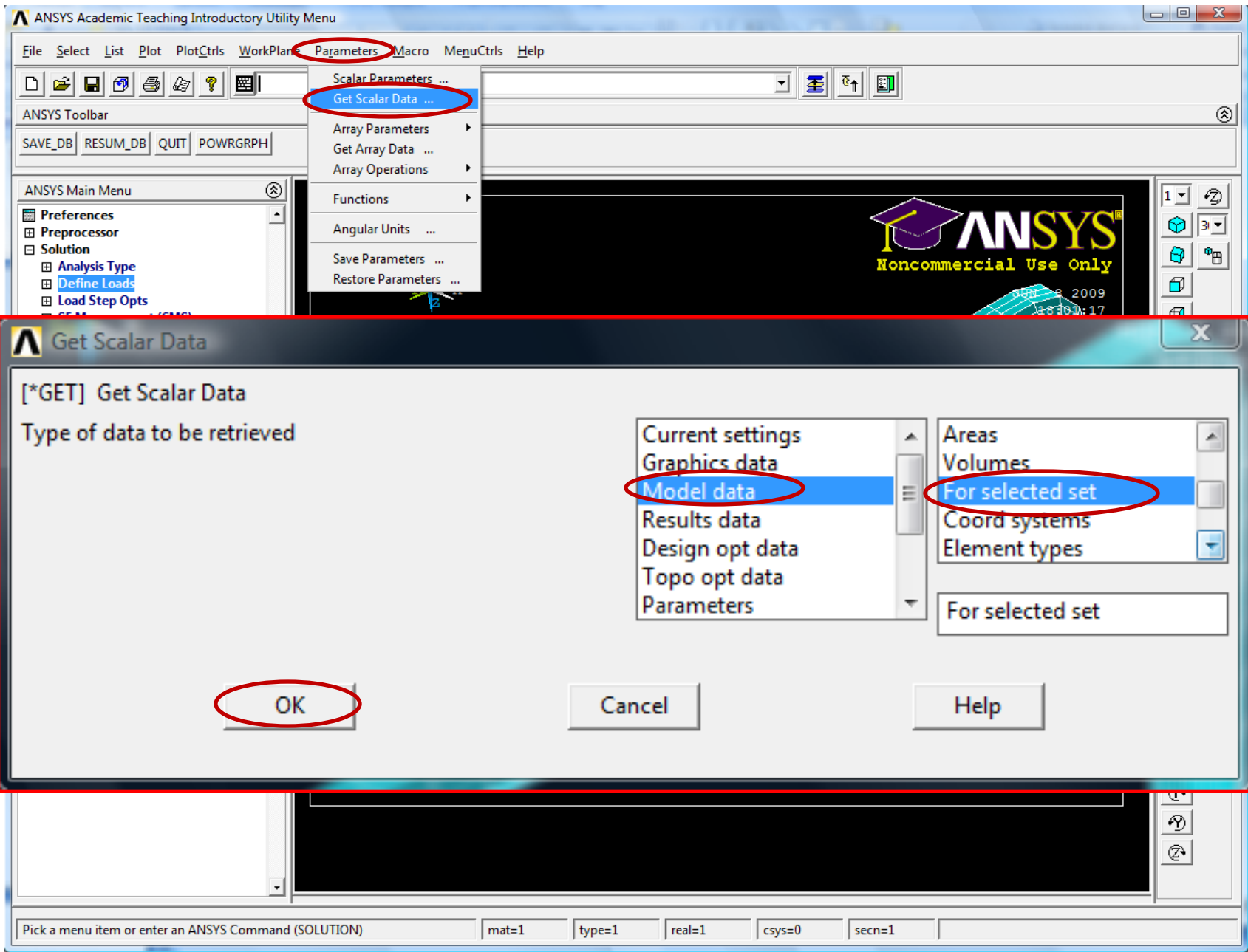


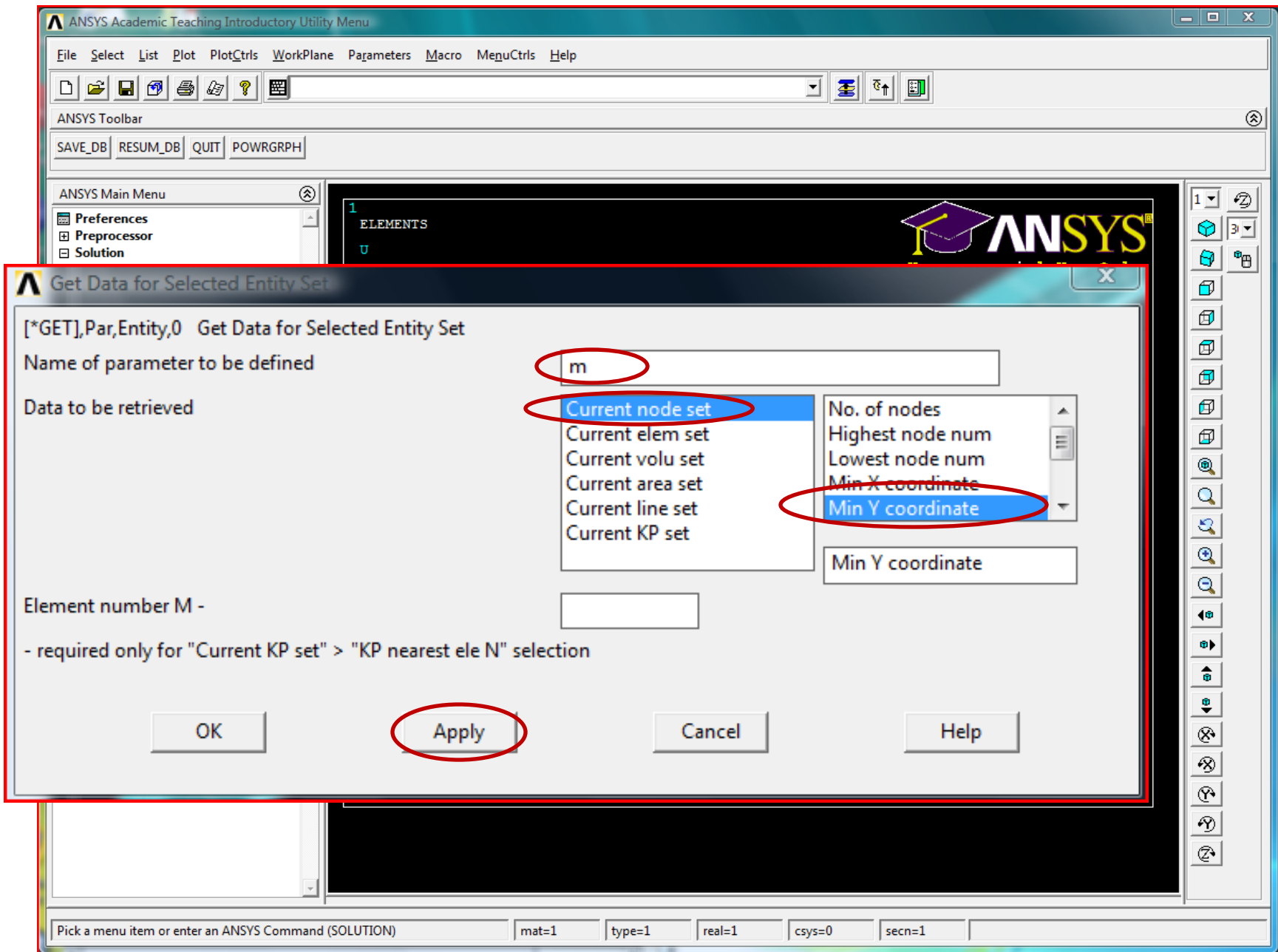


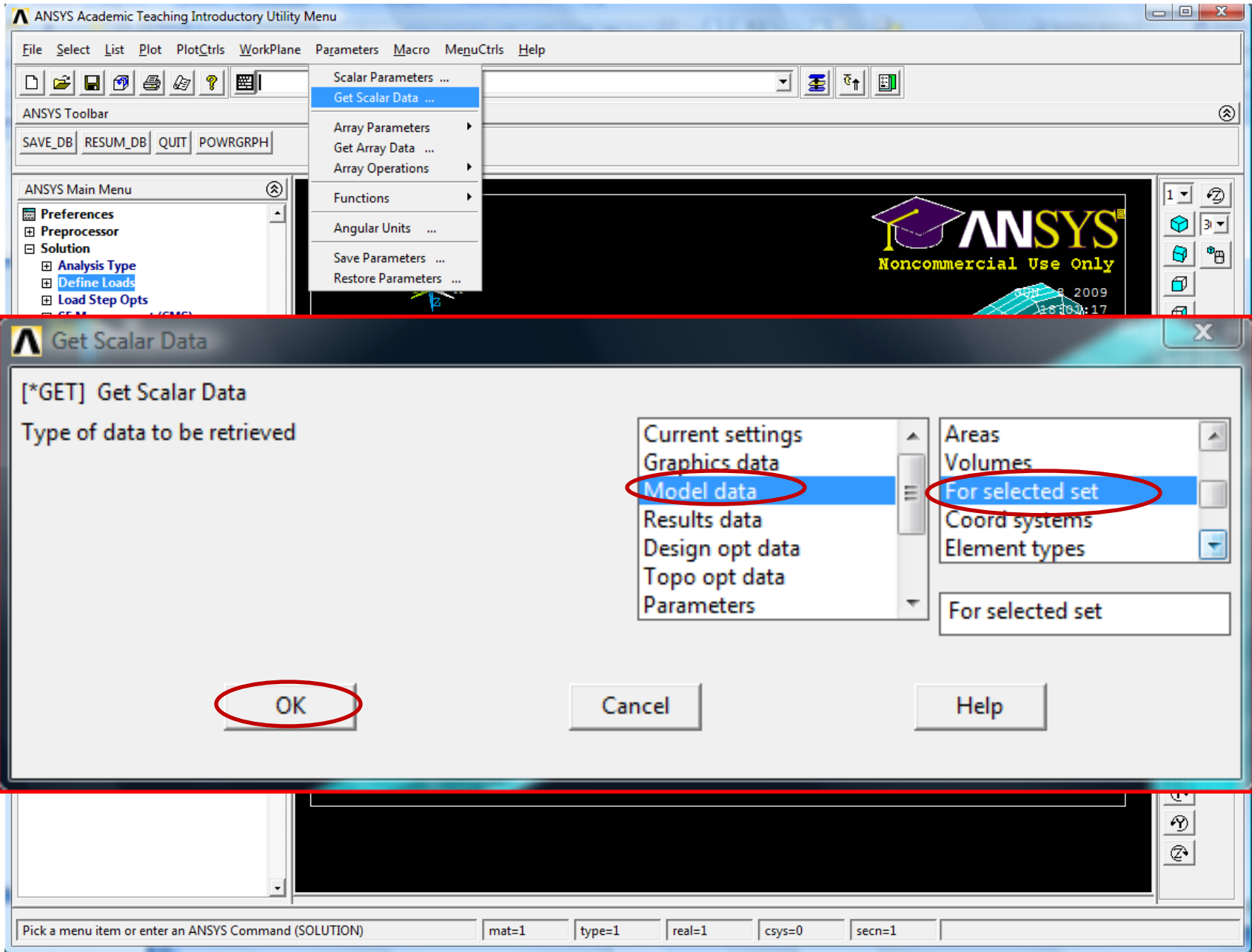


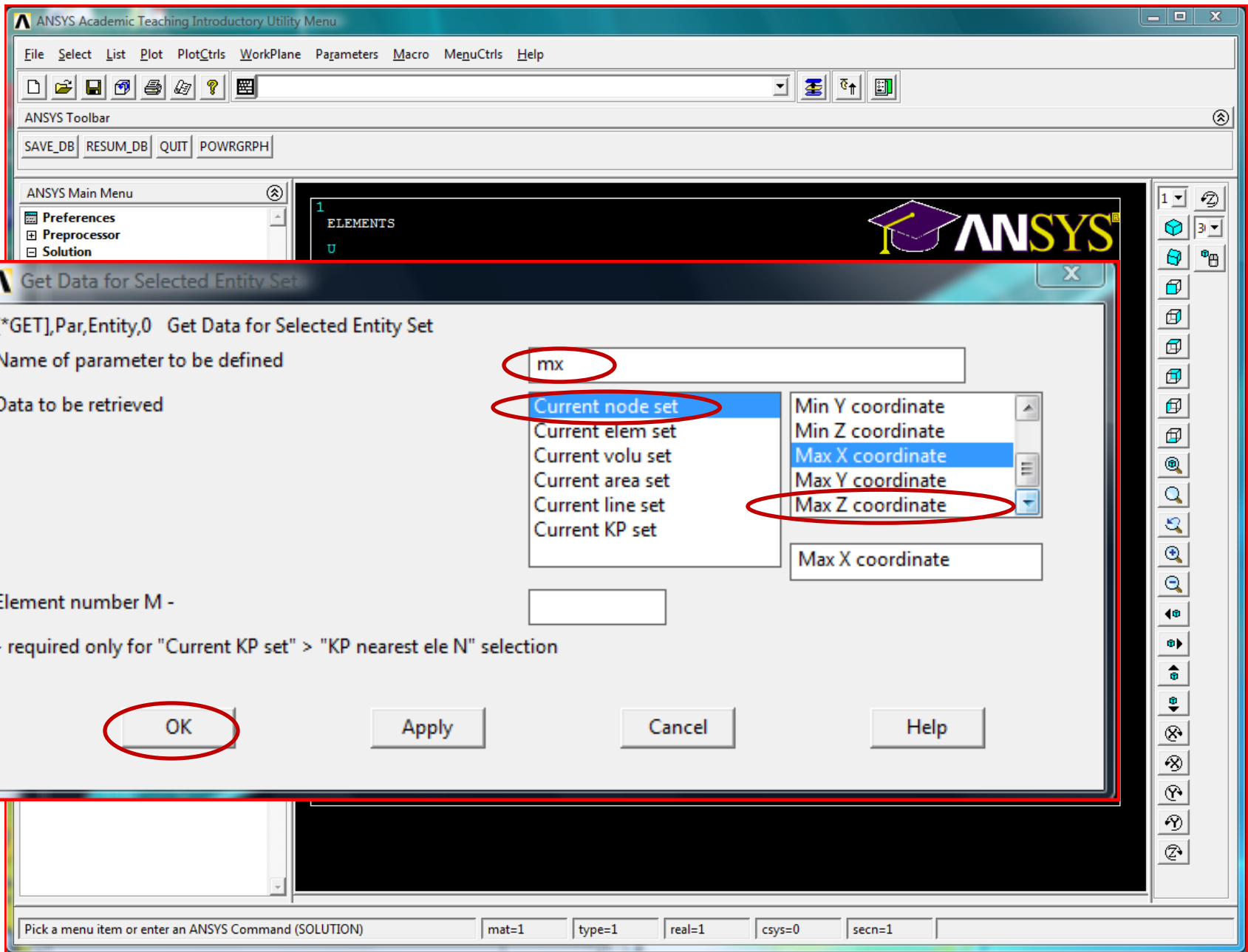




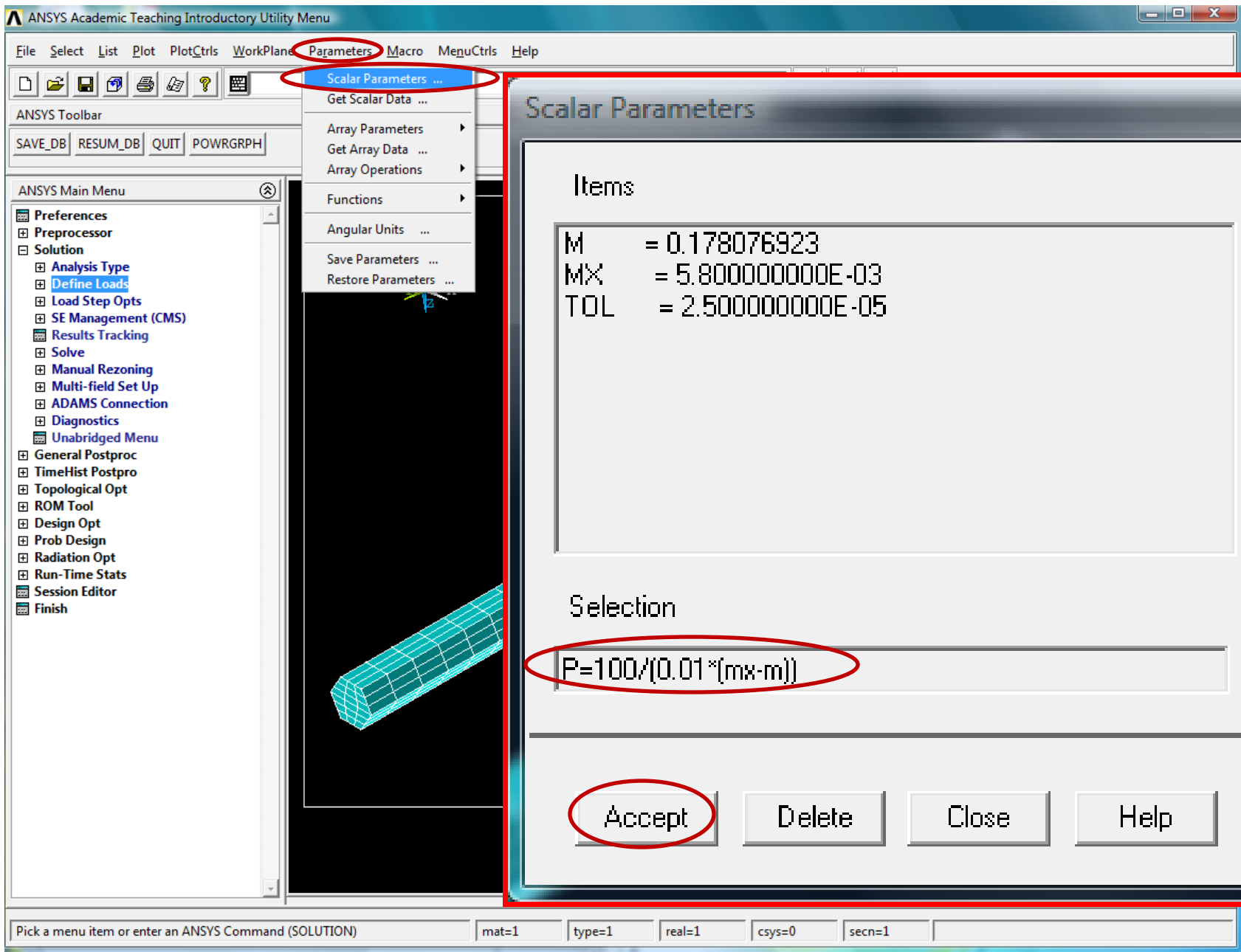


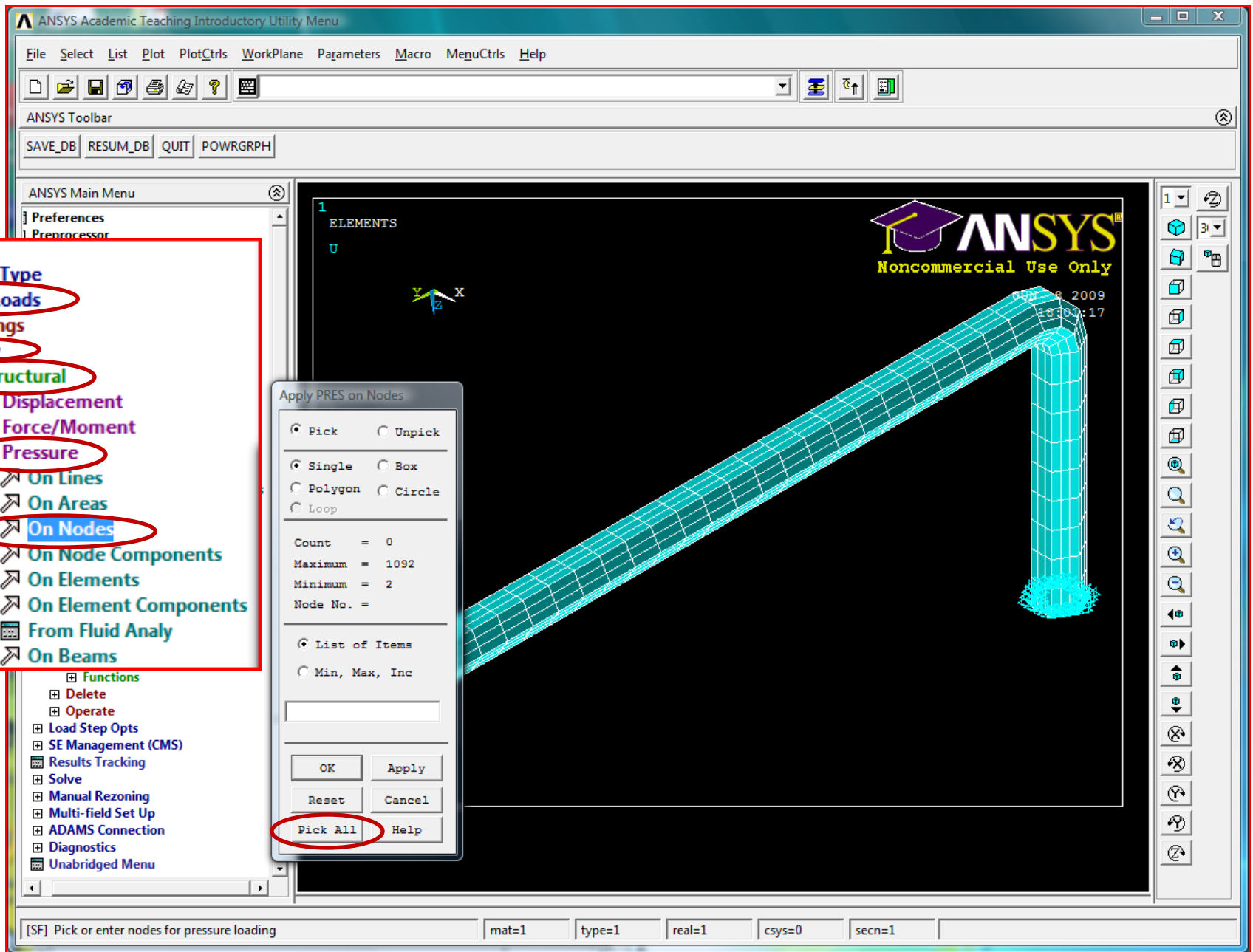


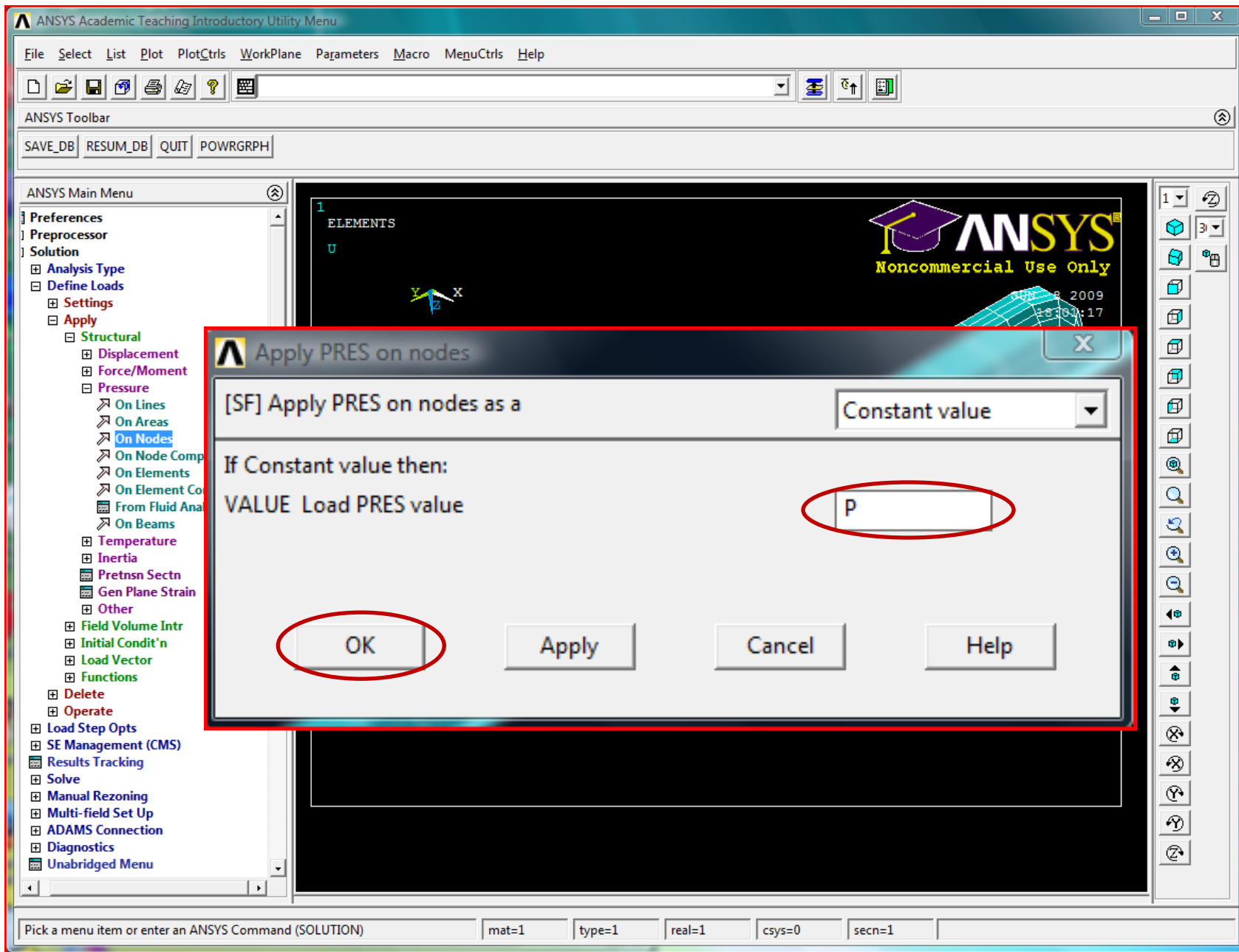




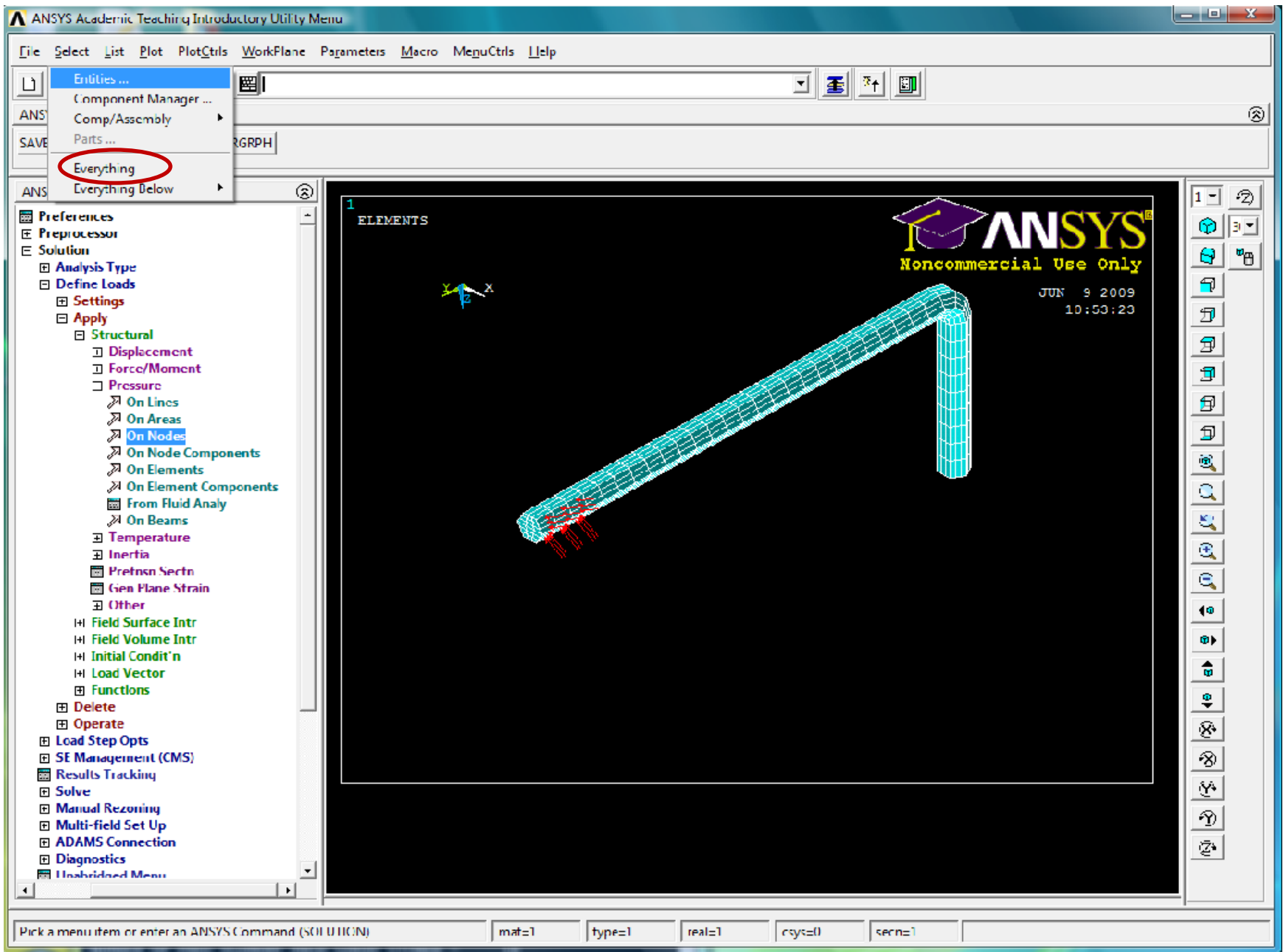


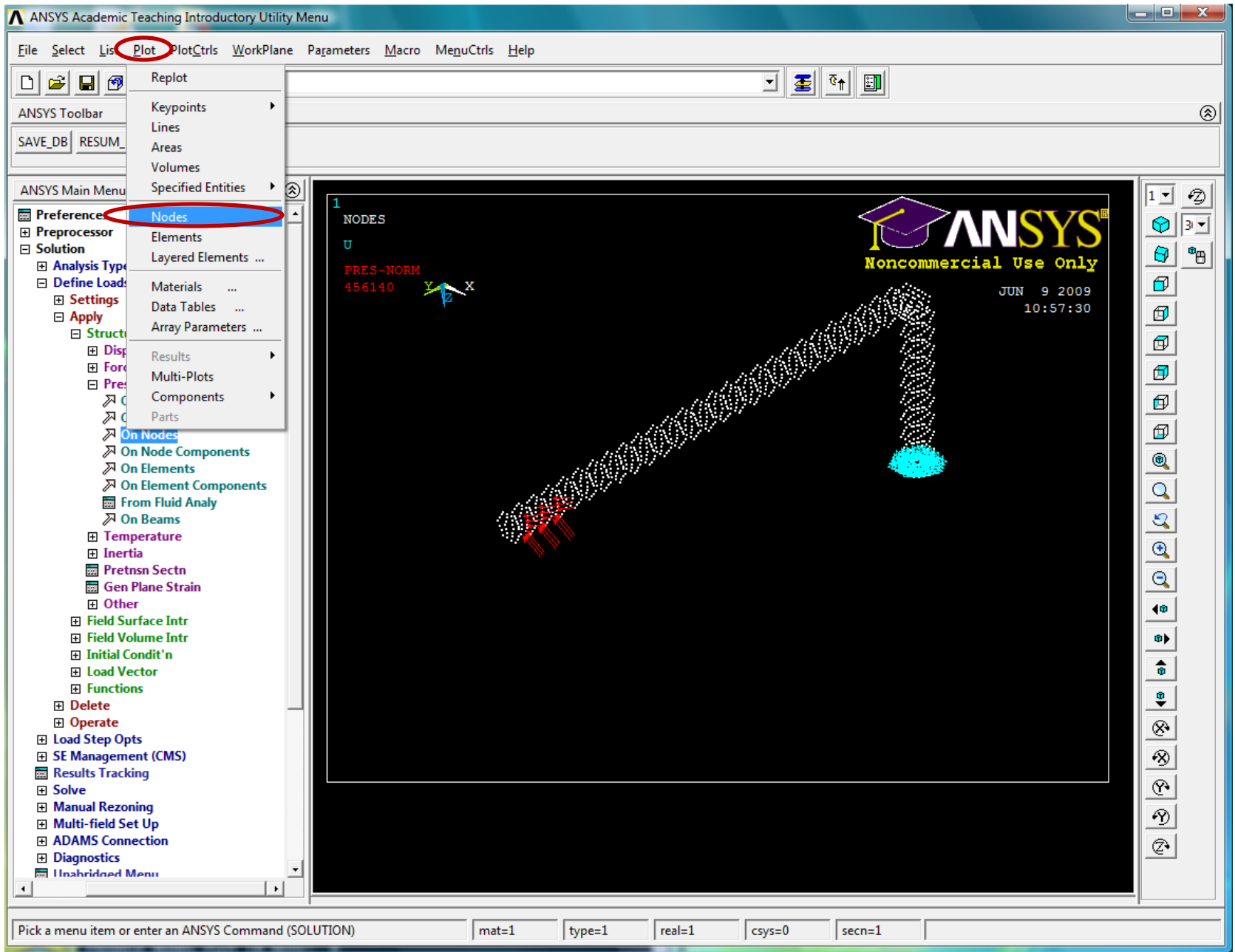


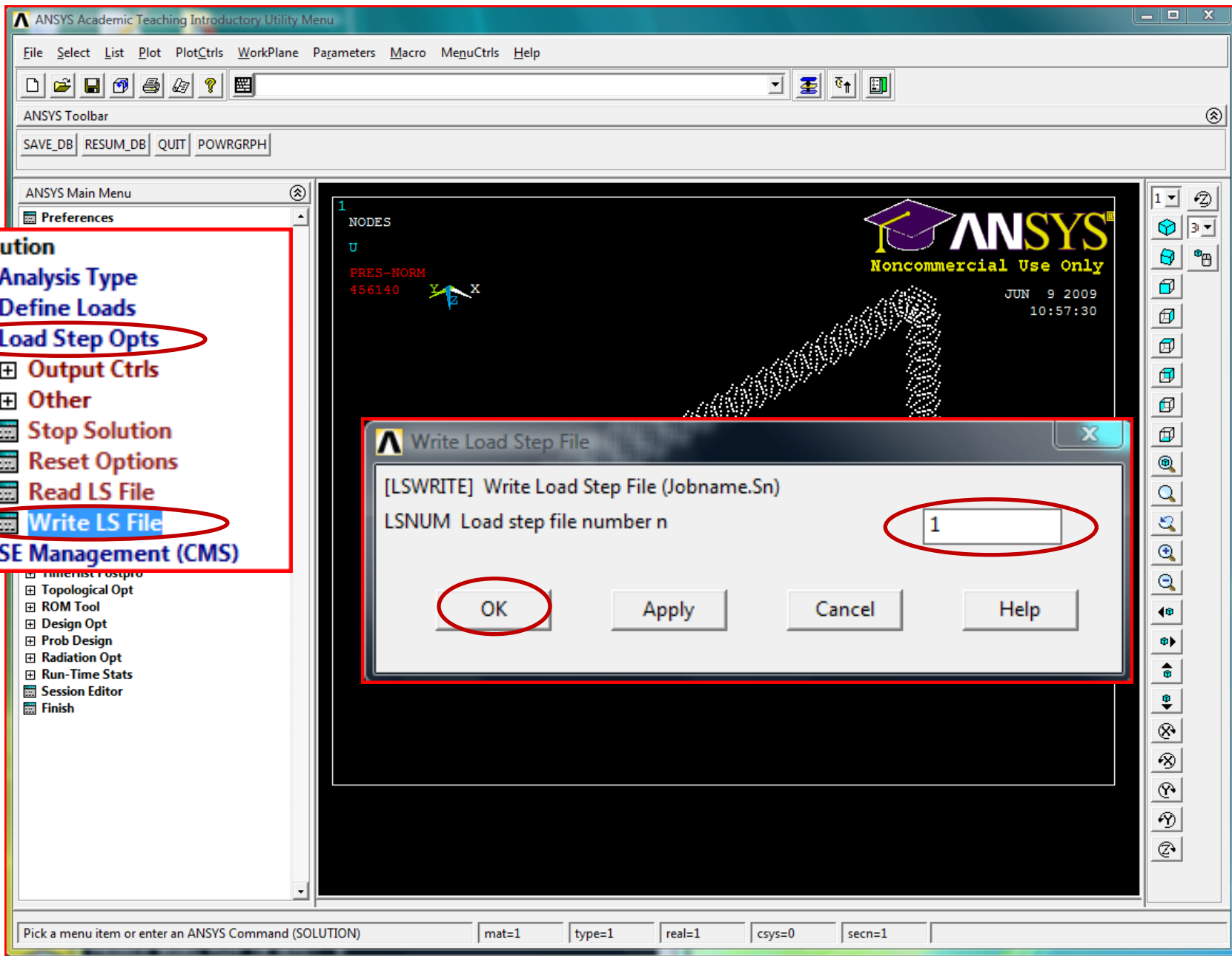














ANSYS Academic Teaching Introductory Utility Menu

File Select List Plot PlotCtrls WorkPlane Parameters Macro MenuCtrls Help

ANSYS Toolbar

SAVE\_DB RESUM\_DB QUIT POWRGRPH

ANSYS Main Menu

- Preferences
- Preprocessor
- Solution
  - Analysis Type
  - Define Loads
  - Load Step Opts
    - Output Ctrls
    - Other
  - Stop Solution
  - Reset Options
  - Read LS File
  - Write LS File
  - SE Management (CMS)
  - Results Tracking
  - Solve
  - Manual Rezoning
  - Multi-field Set Up
  - ADAMS Connection
  - Diagnostics
  - Unabridged Menu
- General Postproc
- TimeHist Postpro
- Topological Opt
- ROM Tool
- Design Opt
- Prob Design
- Radiation Opt
- Run-Time Stats
- Session Editor
- Finish

1  
NODES  
u  
PRES-NORM  
456140

Scalar Parameters

Items

M = 0.178076923  
MX = 0.2  
P = 456140.351  
TOL = 2.500000000E-05

Selection

PD=20/(0.0058\*(mx-m))

Accept Delete Close Help

Pick a menu item or enter an ANSYS Command (SOLUTION) mat=1 type=1 real=1 csys=0 secn=1



