



Indian Institute of Technology, Patna

A
Presentation
on

Modal, Harmonic and Transient Analysis

Faculty :

Dr. Surajit Kumar Paul

Mechanical Engineering Discipline

Teaching Assistants :

Rathin Maity

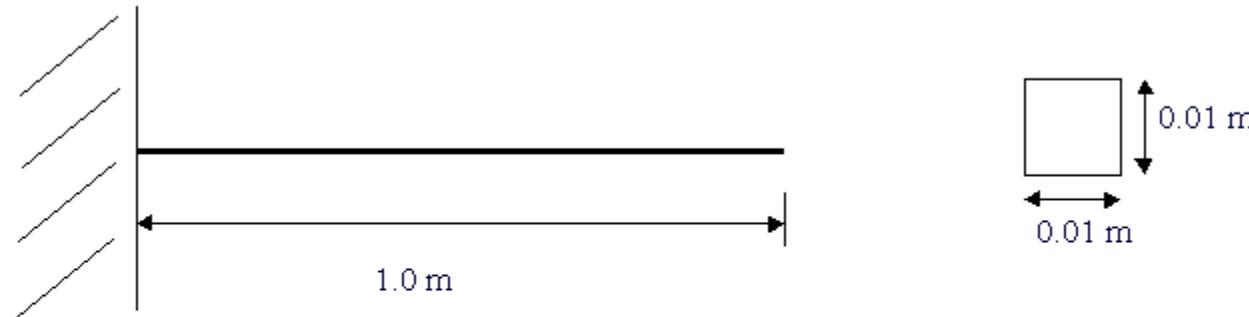
Sudhanshu Kumar

Mohit Sharma

Steps Involved For Modal Analysis

Problem:-

Perform a simple modal analysis of the cantilever beam shown below:



$$\text{Modulus of Elasticity (E)} = 206800(10^6) \text{ N/m}^2$$

$$\text{Density} = 7830 \text{ kg/m}^3$$

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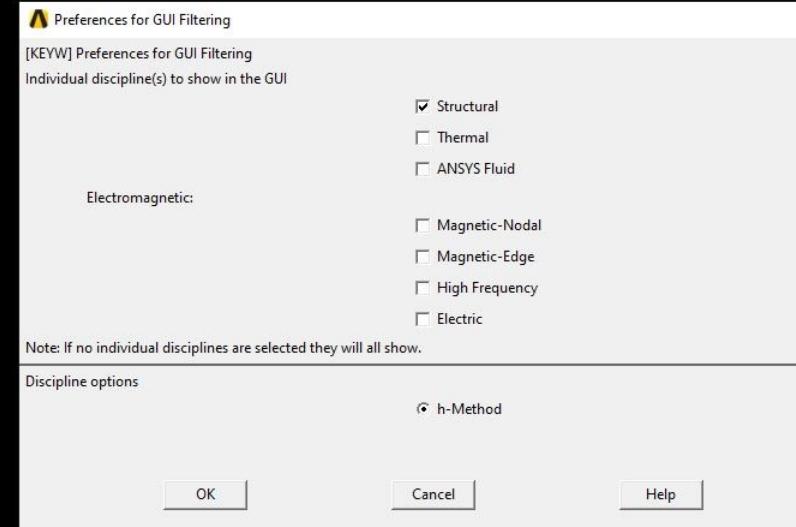
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- Session Editor
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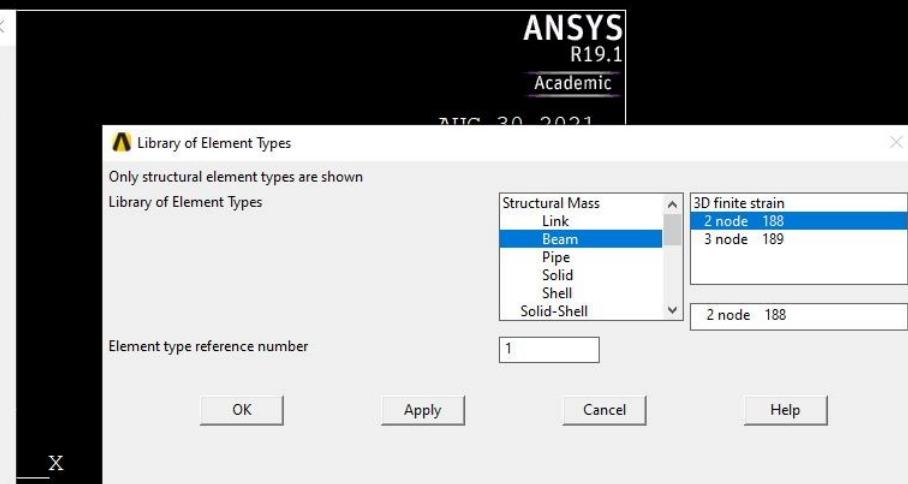
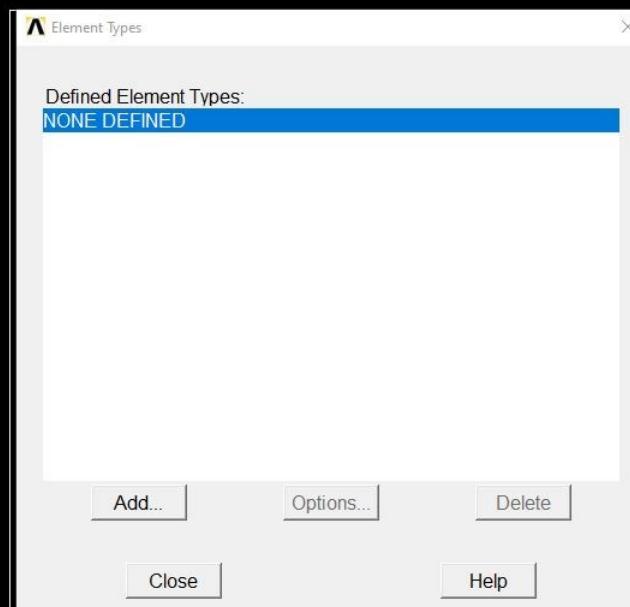


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1 NODES

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Define Material Model Behavior

Material Edit Favorite Help

Material Models Defined

Material Model Number 1

Material Models Available

- Favorites
- Structural
 - Linear
 - Elastic
 - Isotropic
 - Orthotropic
 - Anisotropic
 - Nonlinear
 - Density
 - Thermal Expansion
 - Damping
 - Friction Coefficient

Linear Isotropic Properties for Material Number 1

Linear Isotropic Material Properties for Material Number 1

T1

Temperatures

EX

PRXY

0.3

Add Temperature Delete Temperature Graph

OK

Cancel

Help



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Define Material Model Behavior

Material Edit Favorite Help

Material Models Defined

Material Model Number 1

Linear Isotropic

Material Models Available

- Favorites
- Structural
 - Linear
 - Elastic
 - Isotropic
 - Orthotropic
 - Anisotropic
 - Nonlinear
 - Density
 - Thermal Expansion
 - Damping
 - Friction Coefficient

Density for Material Number 1

Density for Material Number 1

T1

Temperatures

7830

DENS

Add Temperature

Delete Temperature

Graph

OK

Cancel

Help



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Beam Tool

ID	1
Name	
Sub-Type	■
Offset To	Centroid
Offset-Y	0
Offset-Z	0
B	0.01
H	0.01
Nb	0
Nh	0

OK Apply
Close Preview
Help Meshview



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Main Menu

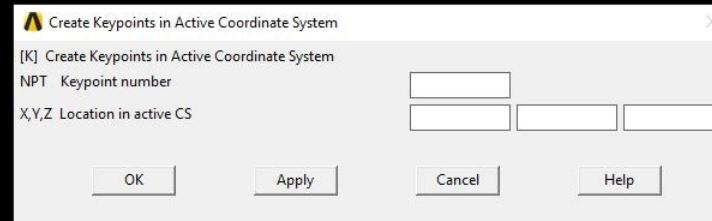
- Preferences
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 - Modeling
 - Create
 - Keypoints
 - On Working Plane
 - In Active CS
 - On Line
 - On Line w/Ratio
 - On Node
 - KP between KPs
 - Fill between KPs
 - KP at center
 - Hard PT on line
 - Hard PT on area
 - Lines
 - Areas
 - Volumes
 - Nodes
 - Elements
 - Contact Pair
 - Circuit
 - Transducers
 - Operate
 - Move / Modify
 - Copy
 - Reflect
 - Check Geom
 - Delete
 - Cyclic Sector
 - CMS
 - Genl plane strn
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 - Coupling / Ceqn

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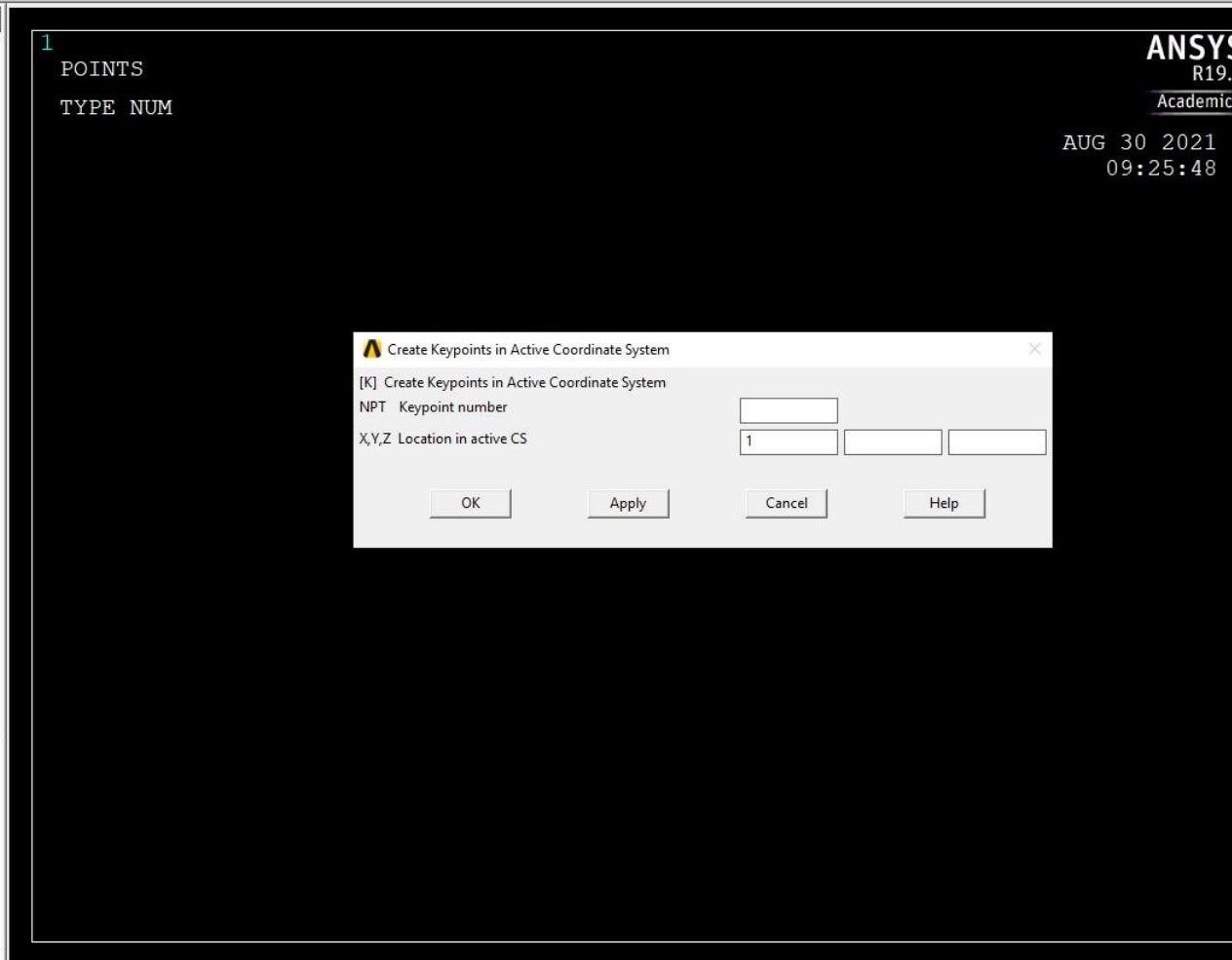


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 - Fill between KPs
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New Analysis



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Main Menu

- Preferences
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 - 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 = 1
Maximum = 2
Minimum = 2
KeyP No. = 1

List of Items
 Min, Max, Inc

Geom plane surv

Update Geom

Meshing

Checking Ctrls

1 POINTS

TYPE NUM

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Y

X

2



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 - Mesh Attributes
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 - Clr Size
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 - Mesher Opts
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1 POINTS

TYPE NUM

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Element Sizes on All Selected Lines

[LESIZE] Element sizes on all selected lines

SIZE Element edge length

NDIV No. of element divisions

(NDIV is used only if SIZE is blank or zero)

KYNDIV SIZE,NDIV can be changed Yes

SPACE Spacing ratio

Show more options No

OK Cancel Help



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Toolbar

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1
POINTS
TYPE NUM

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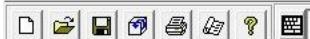
Y

X

M

2





Toolbar

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- Preferences
- Preprocessor
 - Element Type
 - Real Constants
 - Material Props
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 - Modeling
 - Meshing
 - Mesh Attributes
 - MeshTool
 - Size Cntrs
 - Mesher Opt
 - Concatenate
 - Mesh
 - Keypoints
 - Lines
 - Areas
 - Volumes
 - Volume Sweep
 - Tet Mesh From
 - Interface Mesh
 - Modify Mesh
 - Check Mesh
 - Clear
 - Checking Cntrs
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1
POINTS
TYPE NUM

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Mesh Lines

Pick Unpick

Single Box

Polygon Circle

Loop

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

List of Items
 Min, Max, Inc



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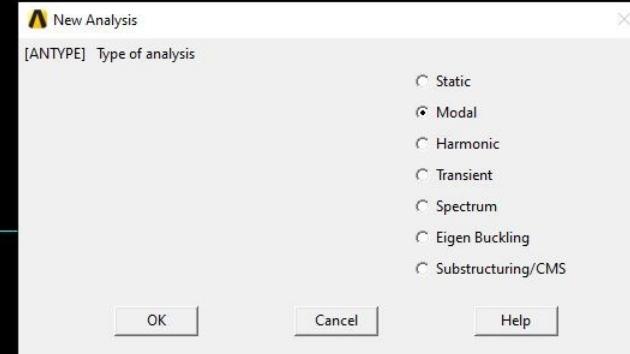
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Modal Analysis
[MODOPT] Mode extraction method

Block Lanczos
 PCG Lanczos
 Supernode
 Subspace
 Unsymmetric
 Damped
 QR Damped

No. of modes to extract

[MXPAND]
Expand mode shapes Yes
NMODE No. of modes to expand
Elcalc Calculate elem results? No

[LUMPM] Use lumped mass approx? No
[PSTRES] Incl prestress effects? No

OK **Cancel** **Help**

1



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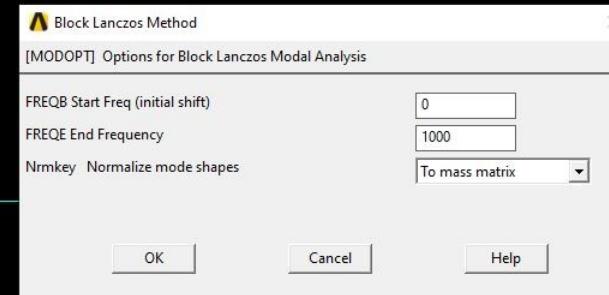
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 - On Nodes
 - On Node Components
 - Symmetry B.C.

Apply U,ROT on Nodes

im B.C.

Pick Unpick

Single Box

Polygon Circle

Loop

Count = 1

Maximum = 11

Minimum = 1

Node No. = 1

List of Items

Min, Max, Inc

CMS)

General Postproc

TimeHist Postpro

ROM Tool

Radiation Opt

1 ELEMENTS

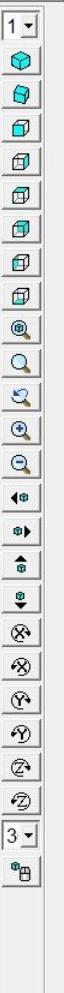
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Y

X



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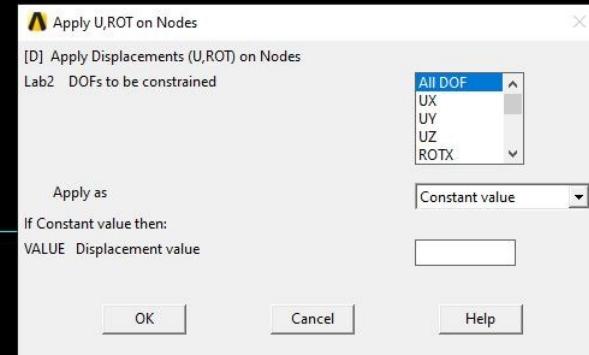
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/STATUS Command

File

S O L U T I O N O P T I O N S

```
PROBLEM DIMENSIONALITY... : : : 3-D  
DEGREES OF FREEDOM... : : : UX UY UZ ROTX ROTY ROTZ  
ANALYSIS TYPE... : : : MODAL  
EXTRACTION METHOD... : : : BLOCK LANCZOS  
EQUATION SOLVER OPTION... : : : SPARSE  
NUMBER OF MODES TO EXTRACT... : : : 10  
MODAL EXTRACTION RANGE... : : : 0.0000 TO 1000.0  
GLOBALLY ASSEMBLED MATRIX... : : : SYMMETRIC  
NUMBER OF MODES TO EXPAND... : : : 10  
ELEMENT RESULTS CALCULATION... : : : OFF
```

L O A D S T E P O P T I O N S

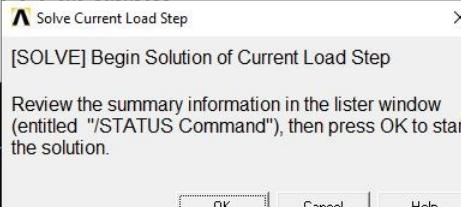
```
LOAD STEP NUMBER... : : : 1  
THERMAL STRAINS INCLUDED IN THE LOAD VECTOR... : : : YES  
PRINT OUTPUT CONTROLS... : : : NO PRINTOUT  
DATABASE OUTPUT CONTROLS... : : :
```

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 - Check Elem Shape
 - Write Results
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 - Safety Factor
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SET,LIST Command

File

***** INDEX OF DATA SETS ON RESULTS FILE *****					
SET	TIME/FREQ	LOAD	STEP	SUBSTEP	CUMULATIVE
1	8.3081		1	1	1
2	8.3081		1	2	2
3	53.149		1	3	3
4	53.149		1	4	4
5	155.14		1	5	5
6	155.14		1	6	6
7	324.75		1	7	7
8	324.75		1	8	8
9	587.75		1	9	9
10	587.75		1	10	10

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To New Analysis

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ELEMENT

Results File: file.rst

Available Data Sets:

Set	Frequency	Load Step	Substep	Cumulative
1	8.3081	1	1	1
2	8.3081	1	2	2
3	53.149	1	3	3
4	53.149	1	4	4
5	155.14	1	5	5
6	155.14	1	6	6
7	324.75	1	7	7
8	324.75	1	8	8
9	587.75	1	9	9
10	587.75	1	10	10

Read

Next

Previous

Close

Help



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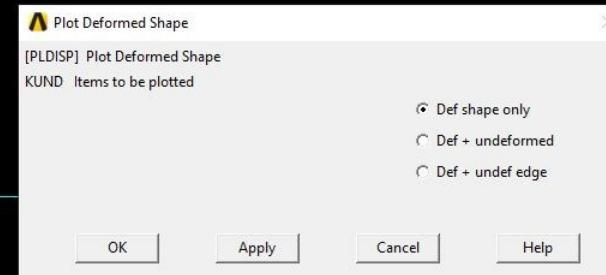
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 - Path Operations
 - Surface Operations
 - Load Case
 - Check Elem Shape
 - Write Results
 - ROM Operations
 - Submodeling
 - Safety Factor
 - Define/Modify
 - Nonlinear Diagnostics
 - Reset
 - Manual Rezoning
- TimeHist Postpro
- ROM Tool
- Radiation Opt
- Session Editor
- Finish

1
DISPLACEMENT
STEP=1
SUB =7
FREQ=324.754
DMX =2.37732

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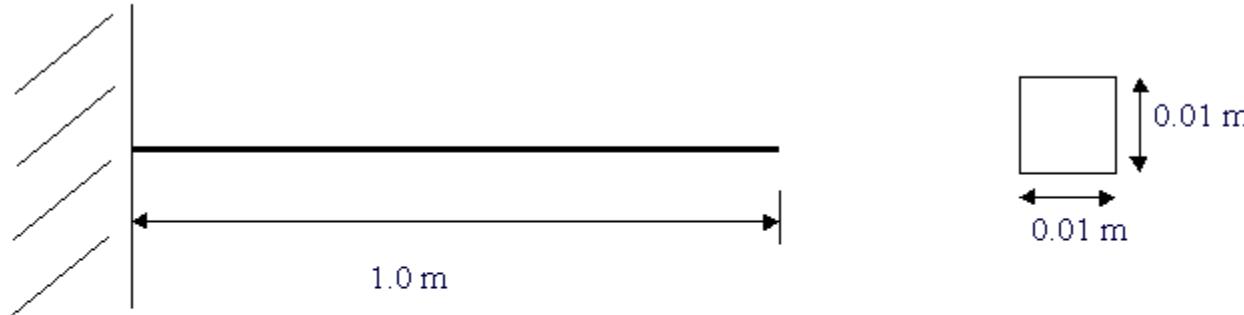
Y
X



Steps Involved
For
Harmonic Analysis

Problem:-

Perform a Harmonic analysis of the cantilever beam shown below:



$$\text{Modulus of Elasticity (E)} = 206800(10^6) \text{ N/m}^2$$

$$\text{Density} = 7830 \text{ kg/m}^3$$

Applying a load of 100 N at the end of the beam. The frequency of the load will be varied from 1 - 100 Hz.

File Select List Plot PlotCtrls WorkPlane Parameters Macro MenuCtrls Help



Toolbar

SAVE_DB RESUM_DB QUIT POWRGRPH

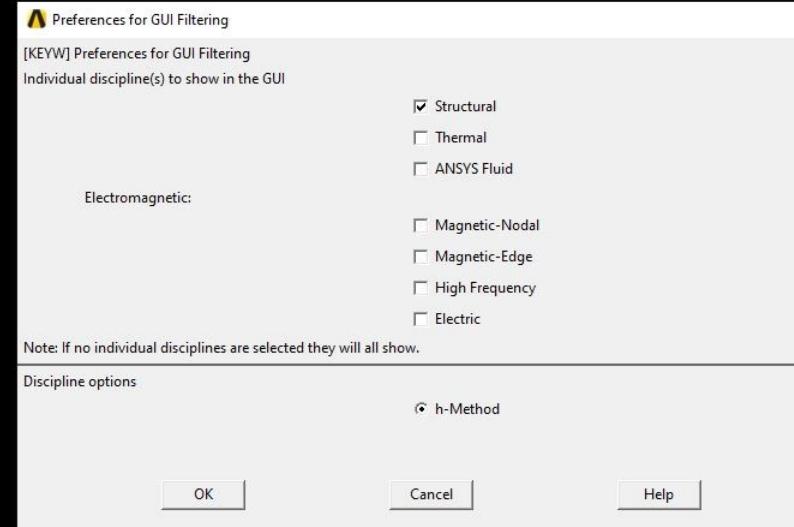
Main Menu

- Preferences
- Preprocessor
- Solution
- General Postproc
- TimeHist Postpro
- ROM Tool
- Radiation Opt
- Session Editor
- Finish

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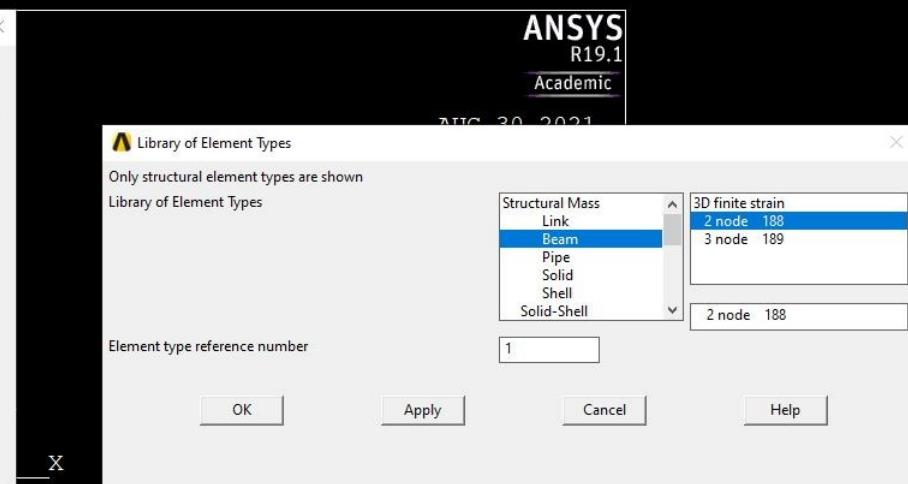
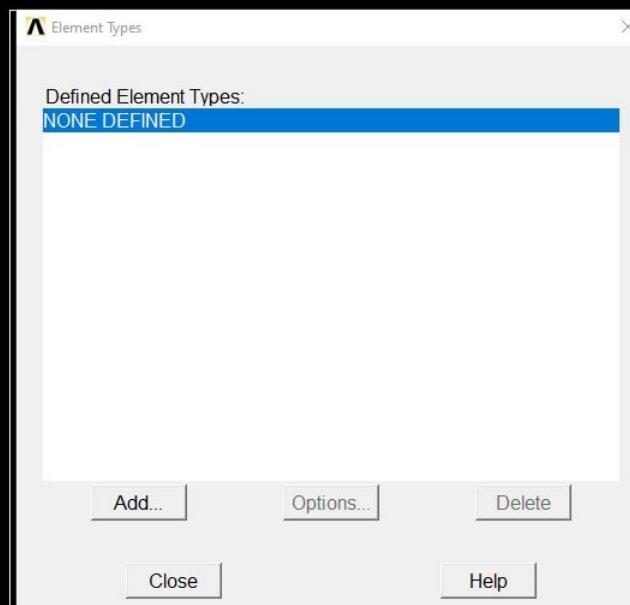


Toolbar

SAVE_DB RESUM_DB QUIT POWRGRPH

Main Menu

- Preferences
- Preprocessor
 - Element Type
 - Add/Edit/Delete
 - Switch Elem Type
 - Add DOF
 - Remove DOFs
 - Elem Tech Control
 - Real Constants
 - Material Props
 - Sections
 - Modeling
 - Meshing
 - Checking Ctrls
 - Numbering Ctrls
 - Archive Model
 - Coupling / Ceqn
 - Multi-field Set Up
 - Loads
 - Physics
 - Path Operations
- Solution
- General Postproc
- TimeHist Postpro
- ROM Tool
- Radiation Opt
- Session Editor
- Finish



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- Preprocessor
 - Element Type
 - Real Constants
 - Material Props
 - Material Library
 - Temperature Units
 - Electromag Units
 - Material Models
 - Convert ALPx
 - Change Mat Num
 - Failure Criteria
 - Write to File
 - Read from File
- Sections
- Modeling
- Meshing
- Checking Ctrls
- Numbering Ctrls
- Archive Model
- Coupling / Ceqn
- Multi-field Set Up
- Loads
- Physics
- Path Operations
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- General Postproc
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- Finish

1 NODES

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Define Material Model Behavior

Material Edit Favorite Help

Material Models Defined

Material Model Number 1

Material Models Available

- Favorites
- Structural
 - Linear
 - Elastic
 - Isotropic
 - Orthotropic
 - Anisotropic
 - Nonlinear
 - Density
 - Thermal Expansion
 - Damping
 - Friction Coefficient

Linear Isotropic Properties for Material Number 1

Linear Isotropic Material Properties for Material Number 1

T1

Temperatures

EX

PRXY

0.3

Add Temperature Delete Temperature Graph

OK

Cancel

Help



File Select List Plot PlotCtrls WorkPlane Parameters Macro MenuCtrls Help



Toolbar

SAVE_DB RESUM_DB QUIT POWRGRPH

Main Menu

- Preferences
- Preprocessor
 - Element Type
 - Real Constants
 - Material Props
 - Material Library
 - Temperature Units
 - Electromag Units
 - Material Models
 - Convert ALPx
 - Change Mat Num
 - Failure Criteria
 - Write to File
 - Read from File
 - Sections
 - Modeling
 - Meshing
 - Checking Ctrls
 - Numbering Ctrls
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 - Multi-field Set Up
 - Loads
 - Physics
 - Path Operations
- Solution
- General Postproc
- TimeHist Postpro
- ROM Tool
- Radiation Opt
- Session Editor
- Finish

1 NODES

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Define Material Model Behavior

Material Edit Favorite Help

Material Models Defined

Material Model Number 1

Linear Isotropic

Material Models Available

Favorites

Structural

Linear

Elastic

Isotropic

Orthotropic

Anisotropic

Nonlinear

Density

Thermal Expansion

Damping

Friction Coefficient

Density for Material Number 1

Density for Material Number 1

T1

Temperatures

7830

DENS

Add Temperature

Delete Temperature

Graph

OK

Cancel

Help



File Select List Plot PlotCtrls WorkPlane Parameters Macro MenuCtrls Help



Toolbar

SAVE_DB RESUM_DB QUIT POWRGRPH

Main Menu

- Preferences
- Preprocessor
 - Element Type
 - Real Constants
 - Material Props
 - Sections
 - Section Library
 - Beam
 - Common Sections
 - Custom Sections
 - Taper Sections
 - Plot Section
 - Sect Control
 - NL Generalized
 - Composite Sections
 - Shell
 - Pretension
 - Joints
 - Reinforcing
 - Pipe
 - Link
 - Axis
 - Contact
 - List Sections
 - Delete Section
 - Modeling
 - Meshing
 - Checking Ctrls
 - Numbering Ctrls
 - Archive Model
 - Coupling / Ceqn
 - Multi-field Set Up
 - Loads
 - Physics
 - Path Operations
- Solution
- General Postproc
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- ROM Tool
- Radiation Opt
- Session Editor
- Finish

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Beam Tool

ID	1
Name	
Sub-Type	■
Offset To	Centroid
Offset-Y	0
Offset-Z	0
B	0.01
H	0.01
Nb	0
Nh	0

OK Apply
Close Preview
Help Meshview



File Select List Plot PlotCtrls WorkPlane Parameters Macro MenuCtrls Help



Toolbar

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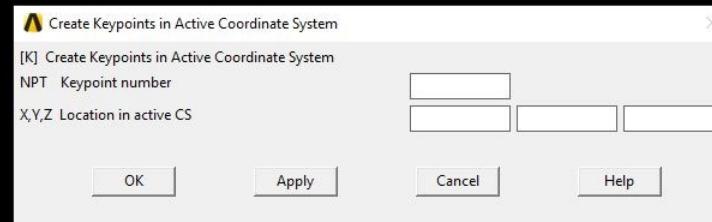
Main Menu

- Preferences
- Preprocessor
 - Element Type
 - Real Constants
 - Material Props
 - Sections
 - Modeling
 - Create
 - Keypoints
 - On Working Plane
 - In Active CS
 - On Line
 - On Line w/Ratio
 - On Node
 - KP between KPs
 - Fill between KPs
 - KP at center
 - Hard PT on line
 - Hard PT on area
 - Lines
 - Areas
 - Volumes
 - Nodes
 - Elements
 - Contact Pair
 - Circuit
 - Transducers
 - Operate
 - Move / Modify
 - Copy
 - Reflect
 - Check Geom
 - Delete
 - Cyclic Sector
 - CMS
 - Genl plane strn
 - Update Geom
 - Meshing
 - Checking Ctrls
 - Numbering Ctrls
 - Archive Model
 - Coupling / Ceqn

1 NODES

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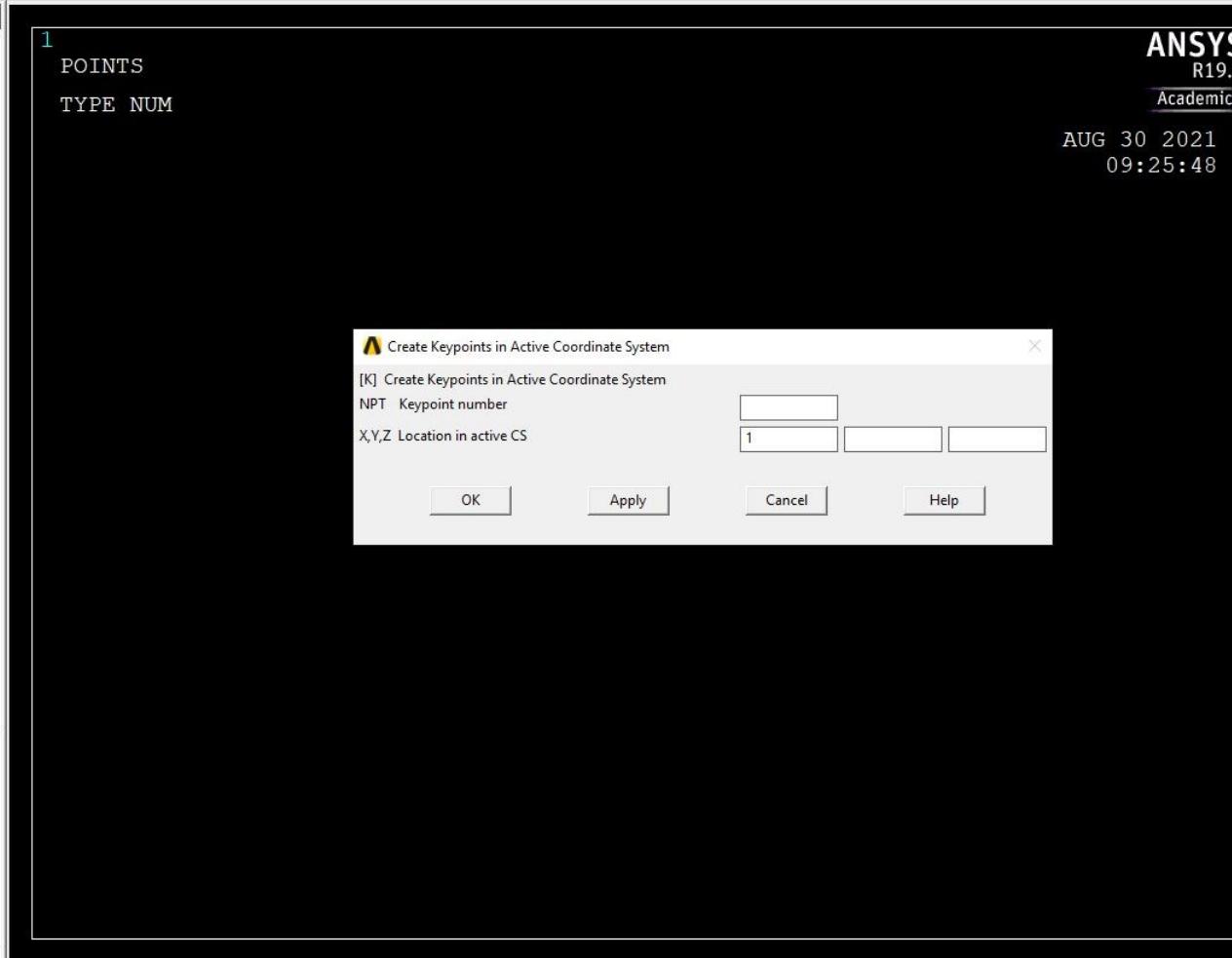


Toolbar

SAVE_DB RESUM_DB QUIT POWRGRPH

Main Menu

- Preferences
- Preprocessor
 - Element Type
 - Real Constants
 - Material Props
 - Sections
 - Modeling
 - Create
 - Keypoints
 - On Working Plane
 - In Active CS
 - On Line
 - On Line w/Ratio
 - On Node
 - KP between KPs
 - Fill between KPs
 - KP at center
 - Hard PT on line
 - Hard PT on area
 - Lines
 - Areas
 - Volumes
 - Nodes
 - Elements
 - Contact Pair
 - Circuit
 - Transducers
 - Operate
 - Move / Modify
 - Copy
 - Reflect
 - Check Geom
 - Delete
 - Cyclic Sector
 - CMS
 - Genl plane strn
 - Update Geom
 - Meshing
 - Checking Ctrls
 - Numbering Ctrls
 - Archive Model
 - Coupling / Cean





New Analysis



SAVE_DB RESUM_DB QUIT POWRGRPH

Main Menu

- 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 = 1
Maximum = 2
Minimum = 2
KeyP No. = 1

List of Items
 Min, Max, Inc

Geom plane surv

Update Geom

Meshing

Checking Ctrls

1 POINTS

TYPE NUM

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Y

X

2



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Toolbar

SAVE_DB RESUM_DB QUIT POWRGRPH

Main Menu

- Preferences
- Preprocessor
 - Element Type
 - Real Constants
 - Material Props
 - Sections
 - Modeling
 - Meshing
 - Mesh Attributes
 - MeshTool
 - Size Cntrs
 - SmartSize
 - ManualSize
 - Global
 - Areas
 - Lines
 - All Lines
 - Picked Lines
 - Copy Divs
 - Flip Bias
 - Clr Size
 - Keypoints
 - Layers
 - Concentrat KPs
 - Mesher Opts
 - Concatenate
 - Mesh
 - Modify Mesh
 - Check Mesh
 - Clear
 - Checking Ctrls
 - Numbering Ctrls
 - Archive Model
 - Coupling / Ceqn
 - Multi-field Set Up
 - Loads
 - Physics
 - Path Operations
- Solution
- General Postproc
- TimeHist Postpro
- ROM Tool

1 POINTS

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Element Sizes on All Selected Lines

[LESIZE] Element sizes on all selected lines

SIZE Element edge length

NDIV No. of element divisions

(NDIV is used only if SIZE is blank or zero)

KYNDIV SIZE,NDIV can be changed Yes

SPACE Spacing ratio

Show more options No

OK Cancel Help



File Select List Plot PlotCtrls WorkPlane Parameters Macro MenuCtrls Help



Toolbar

SAVE_DB RESUM_DB QUIT POWRGRPH

Main Menu

- Preferences
- Preprocessor
 - Element Type
 - Real Constants
 - Material Props
 - Sections
 - Modeling
 - Meshing
 - Mesh Attributes
 - MeshTool
 - Size Cntrs
 - Mesher Opts
 - Concatenate
 - Mesh
 - Modify Mesh
 - Check Mesh
 - Clear
 - Checking Cntrs
 - Numbering Cntrs
 - Archive Model
 - Coupling / Ceqn
 - Multi-field Set Up
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 - Physics
 - Path Operations
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- TimeHist Postpro
- ROM Tool
- Radiation Opt
- Session Editor
- Finish

1 POINTS

TYPE NUM

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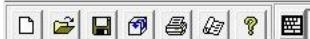
Y

X

M

2





Toolbar

SAVE_DB RESUM_DB QUIT POWRGRPH

Main Menu

- Preferences
- Preprocessor
 - Element Type
 - Real Constants
 - Material Props
 - Sections
 - Modeling
 - Meshing
 - Mesh Attributes
 - MeshTool
 - Size Cntrs
 - Mesher Opt
 - Concatenate
 - Mesh
 - Keypoints
 - Lines
 - Areas
 - Volumes
 - Volume Sweep
 - Tet Mesh From
 - Interface Mesh
 - Modify Mesh
 - Check Mesh
 - Clear
 - Checking Cntrs
 - Numbering Cntrs
 - Archive Model
 - Coupling / Ceqn
 - Multi-field Set Up
 - Loads
 - Physics
 - Path Operations
- Solution
- General Postproc
- TimeHist Postproc
- ROM Tool
- Radiation Opt
- Session Editor
- Finish

1
POINTS
TYPE NUM

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Mesh Lines

Pick Unpick

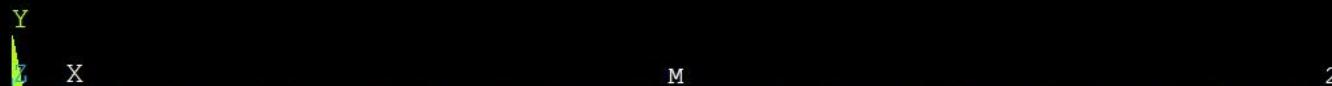
Single Box

Polygon Circle

Loop

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

List of Items
 Min, Max, Inc



- 1
2
3
- 

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 - Analysis Type
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 - ExpansionPass
 - Analysis Options
 - Define Loads
 - Load Step Opt
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 - SE Management (CMS)
 - Results Tracking
 - Solve
 - Manual Rezoning
 - Multi-field Set Up
 - ADAMS Connection
 - Diagnostics
- General Postproc
- TimeHist Postpro
- ROM Tool
- Radiation Opt
- Session Editor
- Finish

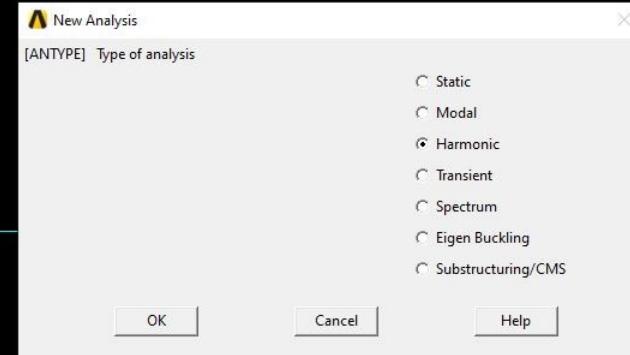
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Toolbar

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 - Manual Rezoning
 - Multi-field Set Up
 - ADAMS Connection
 - Diagnostics
- General Postproc
- Time-Hist Postpro
- ROM Tool
- Radiation Opt
- Session Editor
- Finish

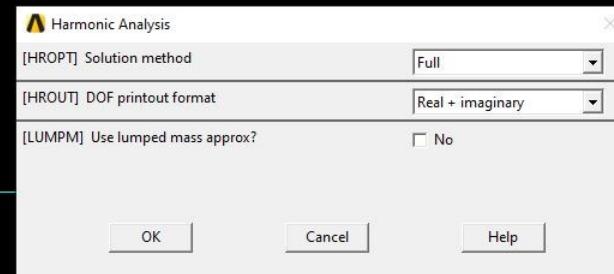
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 - Multi-field Set Up
 - ADAMS Connection
 - Diagnostics
- General Postproc
- TimeHist Postpro
- ROM Tool
- Radiation Opt
- Session Editor
- Finish

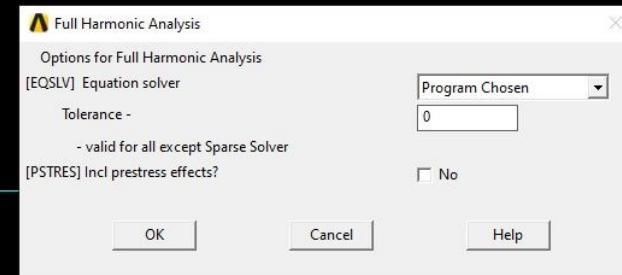
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- Preferences
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- Solution
 - Analysis Type
 - Define Loads
 - Settings
 - Apply
 - Structural
 - Displacement
 - On Lines
 - On Areas
 - On Keypoints
 - On Nodes
 - On Node Components
 - Symmetry B.C.

Apply U,ROT on Nodes

im B.C.

Pick Unpick

Single Box

Polygon Circle

Loop

Count = 1

Maximum = 11

Minimum = 1

Node No. = 1

List of Items

Min, Max, Inc

CMS)

General Postproc

TimeHist Postpro

ROM Tool

Radiation Opt

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Y

X



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 - Settings
 - Apply
 - Structural
 - Displacement
 - ↗ On Lines
 - ↗ On Areas
 - ↗ On Keypoints
 - ↗ **On Nodes**
 - ↗ On Node Components
 - Symmetry B.C.
 - Antisym B.C.
 - Force/Moment
 - Pressure
 - Temperature
 - Inertia
 - Pretnsn Sectn
 - Gen Plane Strain
 - Fluence
 - Field Volume Intr
 - Initial Condit'n
 - Load Vector
 - Functions
 - Delete
 - Operate
 - Load Step Opt's
 - SE Management (CMS)
 - Results Tracking
 - Solve
 - Manual Rezoning
 - Multi-field Set Up
 - ADAMS Connection
 - Diagnostics
 - Unabridged Menu

- General Postproc
- TimeHist Postpro
- ROM Tool
- Radiation Opt

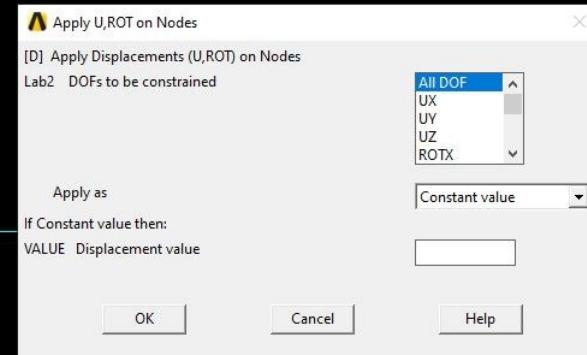
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 - On Nodes
 - On Node Components
 - Symmetry B.C.
 - Antisymm B.C.
 - Force/Moment
 - Pressure
 - Temperature
 - Inertia
 - Pretnsn Sectn
 - Gen Plane Strain
 - Fluence
 - Field Volume Intr
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Main Menu

- Preferences
- Preprocessor
- Solution
 - Analysis Type
 - Define Loads
 - Settings
 - Apply
 - Structural
 - Displacement
 - Force/Moment
 - On Keypoints
 - On Nodes
 - On Node Components
 - From Reactions
 - From Mag Analy

Apply F/M on Nodes

- Pick Unpick
- Single Box
- Polygon Circle
- Loop

 Count = 1
 Maximum = 11
 Minimum = 1
 Node No. = 2

- List of Items
 Min, Max, Inc

- TUTORIAL
 Radiation Opt
 Session Editor
 Finish

1 ELEMENTS

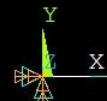
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File Select List Plot PlotCtrls WorkPlane Parameters Macro MenuCtrls Help



Toolbar

SAVE_DB RESUM_DB QUIT POWRGRPH

Main Menu

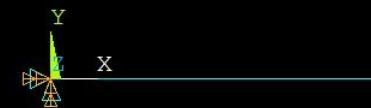
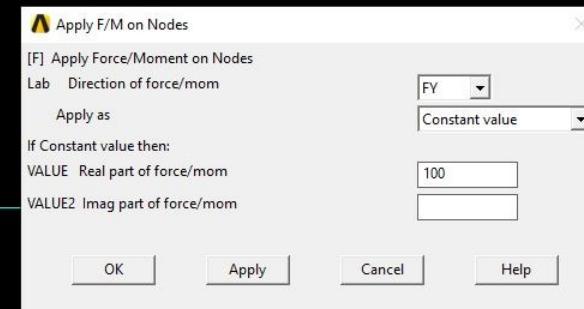
- Preferences
- Preprocessor
- Solution
 - Analysis Type
 - Define Loads
 - Settings
 - Apply
 - Structural
 - Displacement
 - Force/Moment
 - On Keypoints
 - On Nodes
 - On Node Components
 - From Reactions
 - From Mag Analy
 - Pressure
 - Temperature
 - Inertia
 - Pretnsn Sectn
 - Gen Plane Strain
 - Fluence
 - Field Volume Intr
 - Initial Condit'n
 - Load Vector
 - Functions
 - Delete
 - Operate
 - Load Step Opt
 - Physics
 - SE Management (CMS)
 - Results Tracking
 - Solve
 - Manual Rezoning
 - Multi-field Set Up
 - ADAMS Connection
 - Diagnostics
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 - ROM Tool
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1 ELEMENTS

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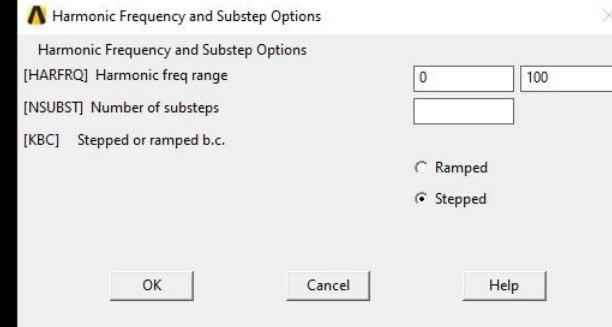
Toolbar

SAVE_DB RESUM_DB QUIT POWRGRPH

Main Menu

- Preferences
- Preprocessor
- Solution
 - Analysis Type
 - Define Loads
 - Load Step Opt
 - Output Ctrls
 - Time/Freqenc
 - Freq and Substeps
 - Damping
 - Nonlinear
 - ExpansionPass
 - Other
 - Reset Options
 - Read LS File
 - Write LS File
- Physics
- SE Management (CMS)
- Results Tracking
- Solve
- Manual Rezoning
- Multi-field Set Up
- ADAMS Connection
- Diagnostics
- General Postproc
- TimeHist Postpro
- ROM Tool
- Radiation Opt
- Session Editor
- Finish

ELEMENTS

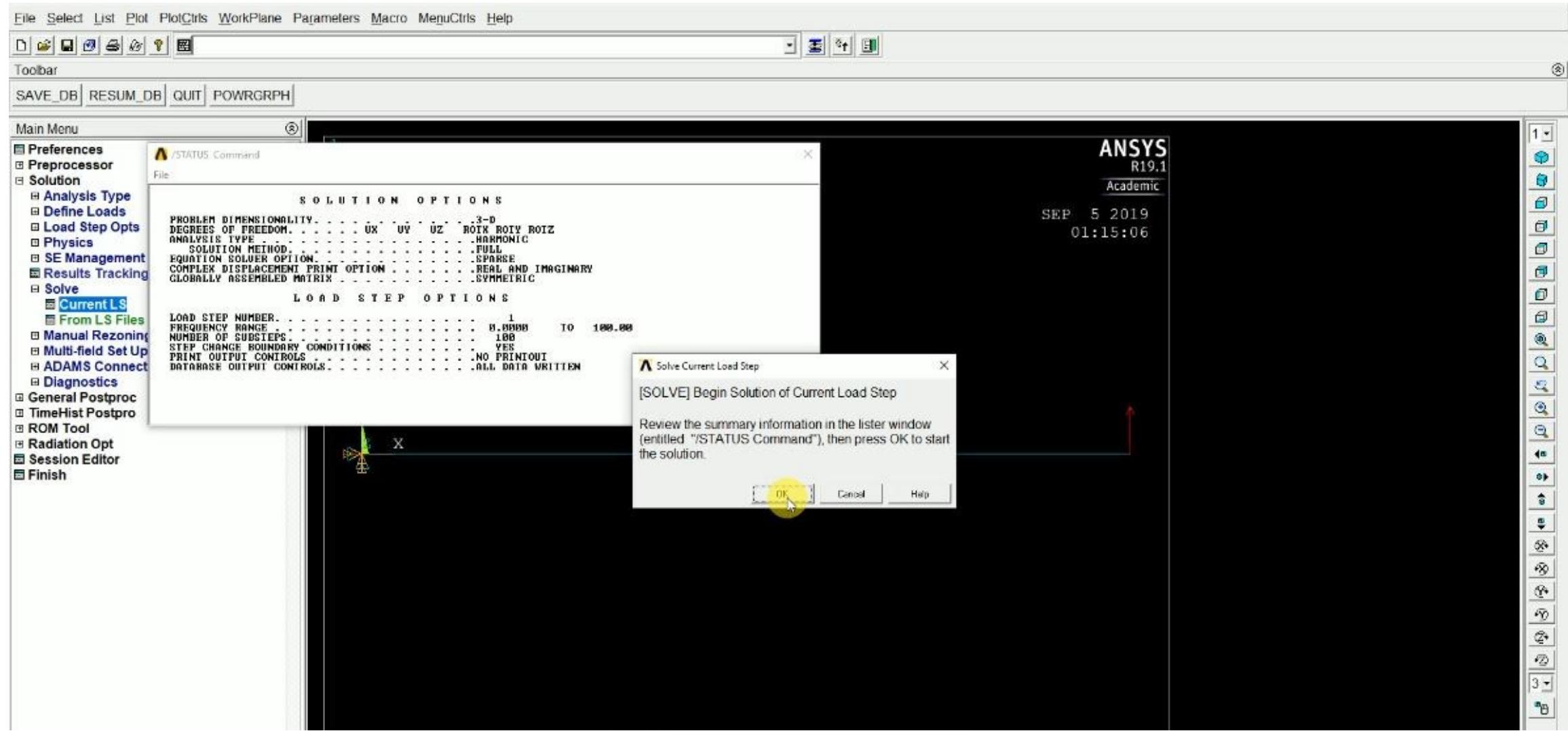


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Toolbar

SAVE_DB RESUM_DB QUIT POWRGRPH

Main Menu

- Preferences
- Preprocessor
- Solution
- General Postproc
- TimeHist Postpro

 - Variable Viewer
 - Settings
 - Store Data
 - Define Variables
 - List Variables
 - List Extremes
 - Graph Variables
 - Math Operations
 - Table Operations
 - Generate Spectrm
 - Reset Postproc

- ROM Tool
- Radiation Opt
- Session Editor
- Finish

ELEMENTS

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Time History Variables - model1.beam1.lst

File Help

+ X A B C D E F None Amplitude

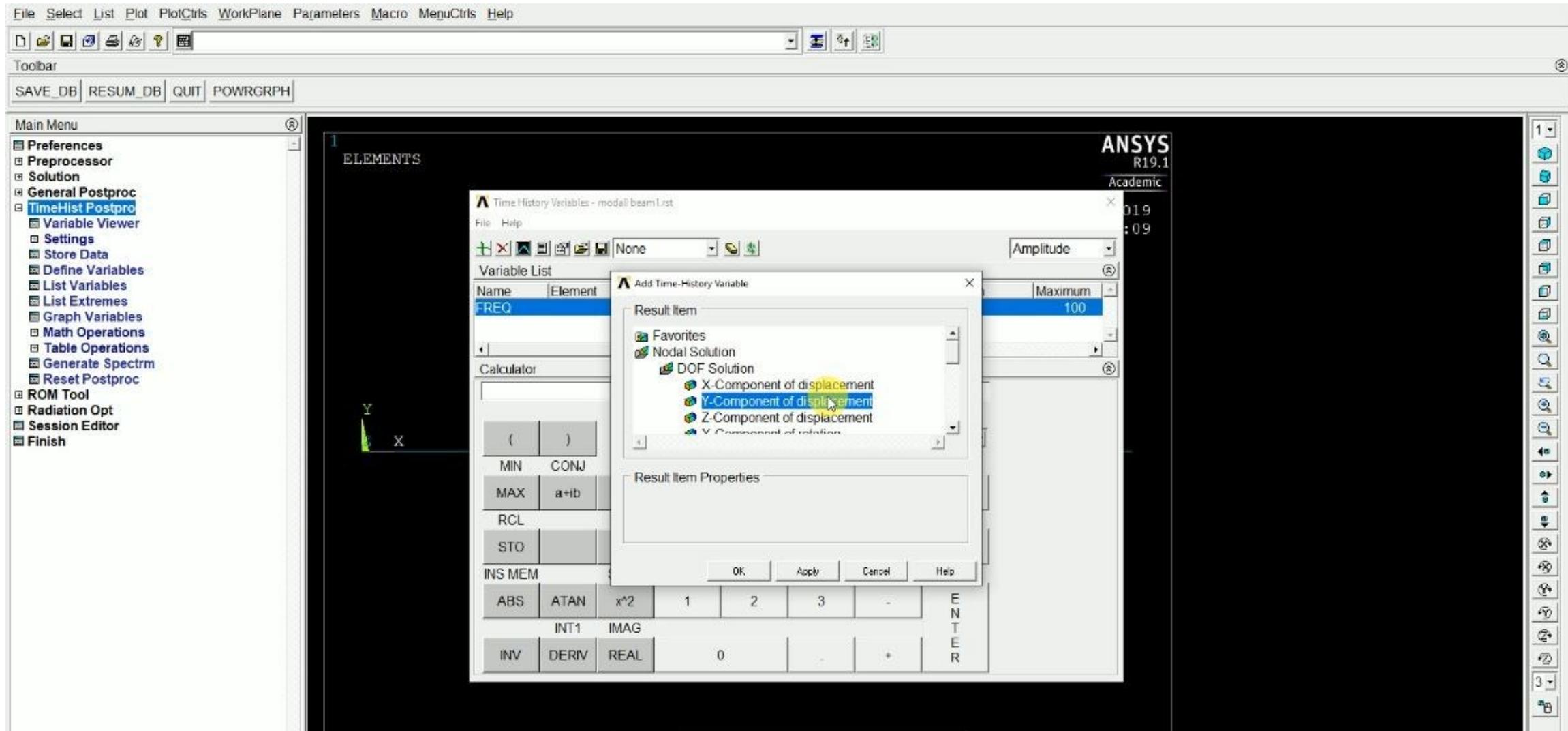
Variable List

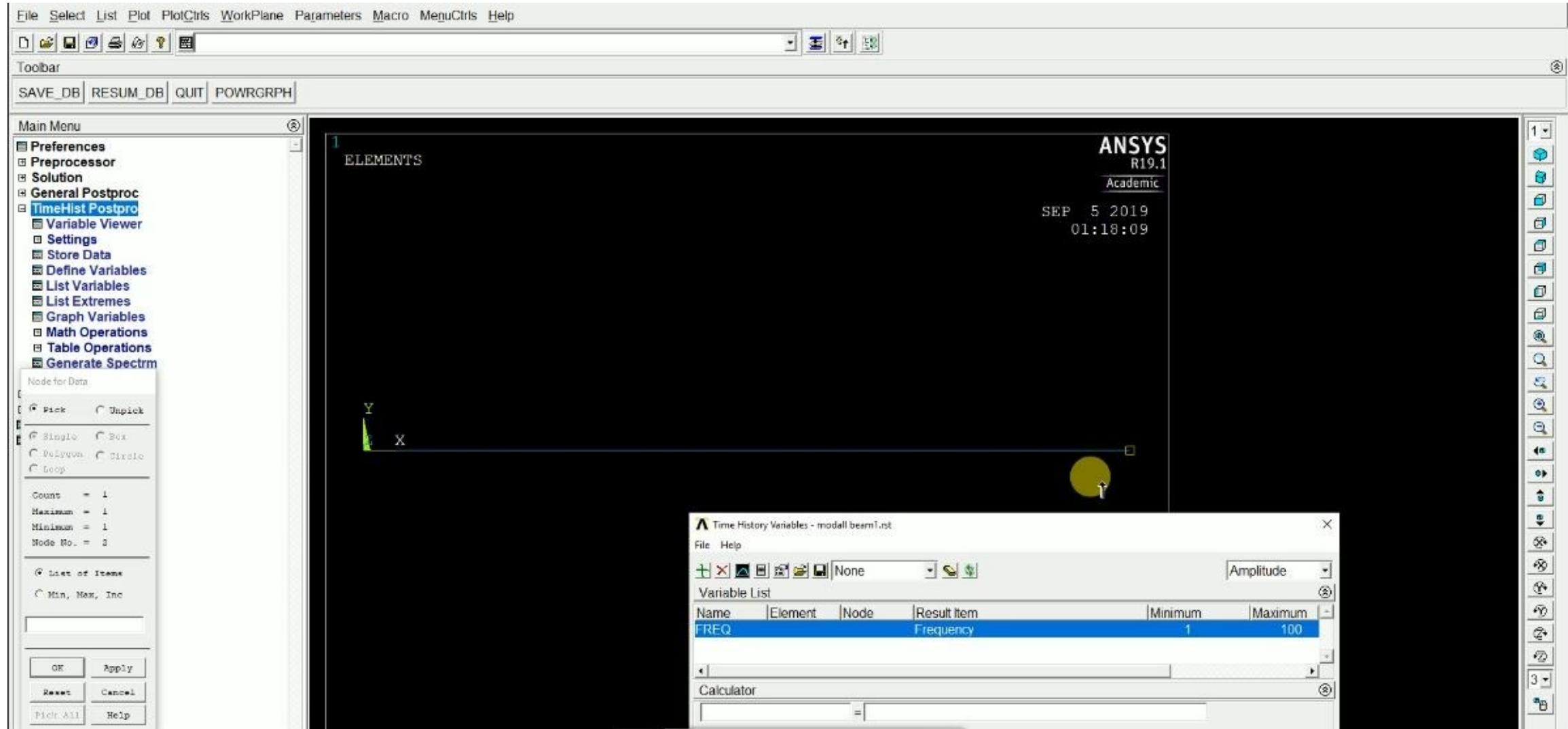
Name	Element	Node	Result Item	Minimum	Maximum
FREQ			Frequency	1	100

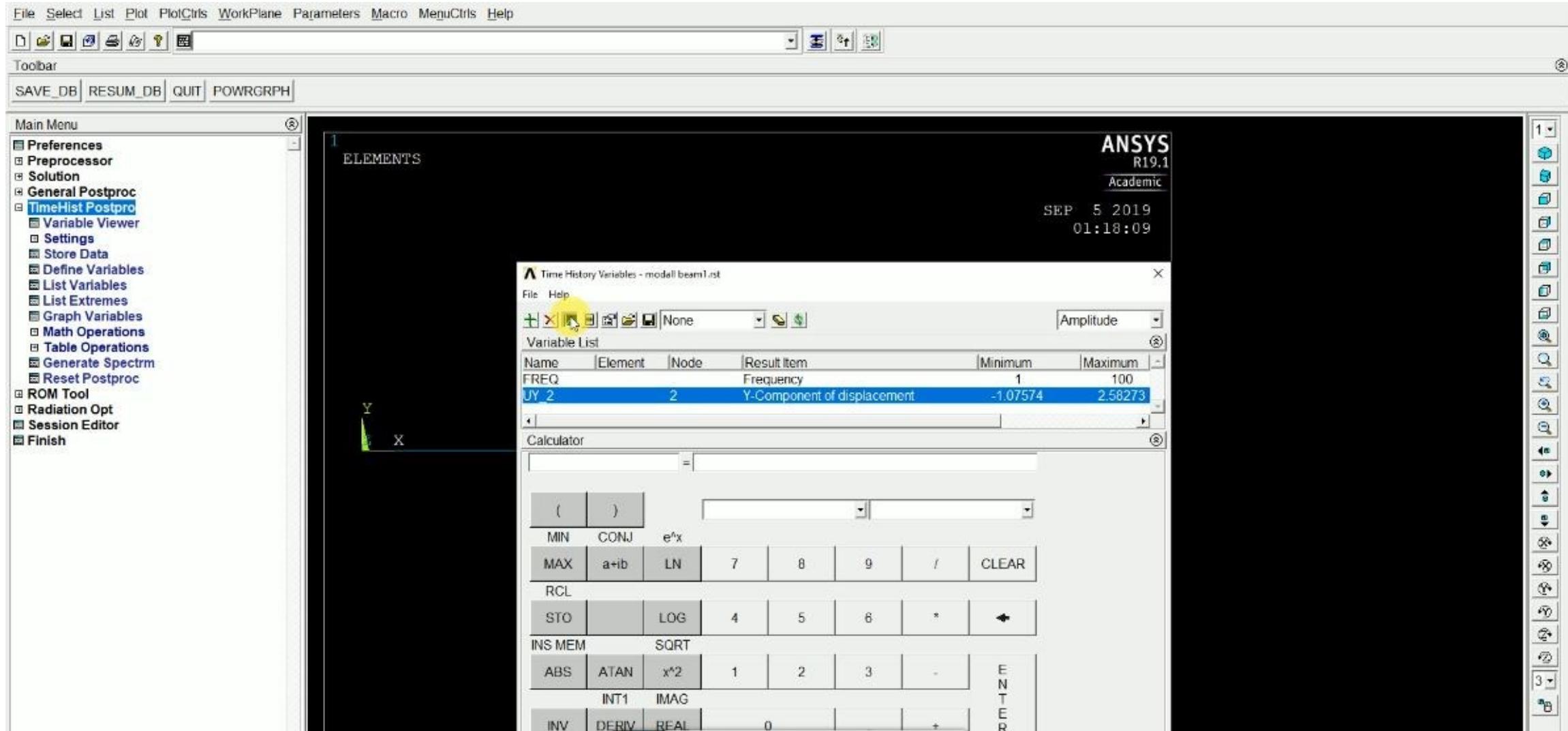
Calculator

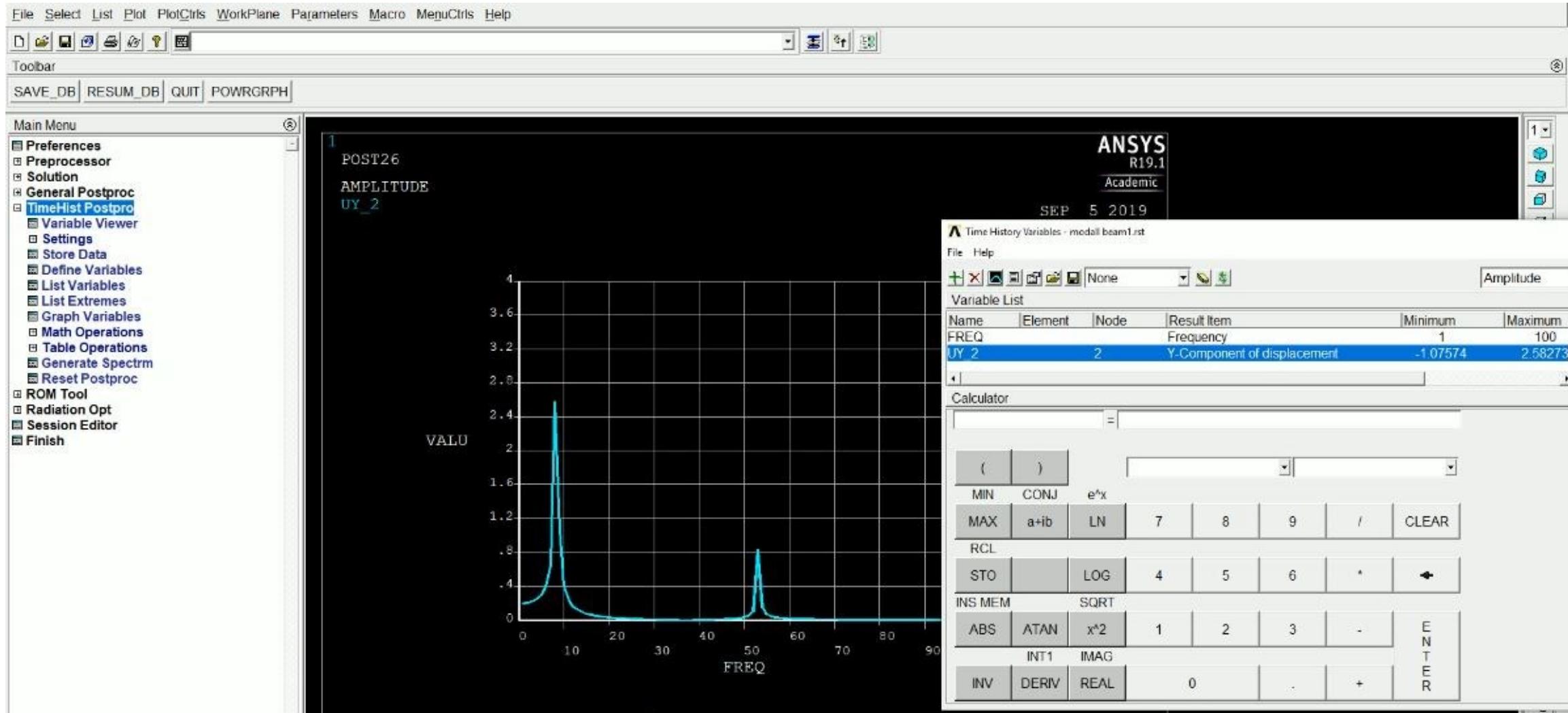
()	e ^x					
MIN	CONJ						
MAX	a+ib	LN	7	8	9	/	CLEAR
RCL							
STO		LOG	4	5	6	*	←
INS MEM		SQRT					
ABS	ATAN	x ²	1	2	3	-	ENTER
INT1	IMAG						
INV	DERIV	REAL	0	.	.	+	







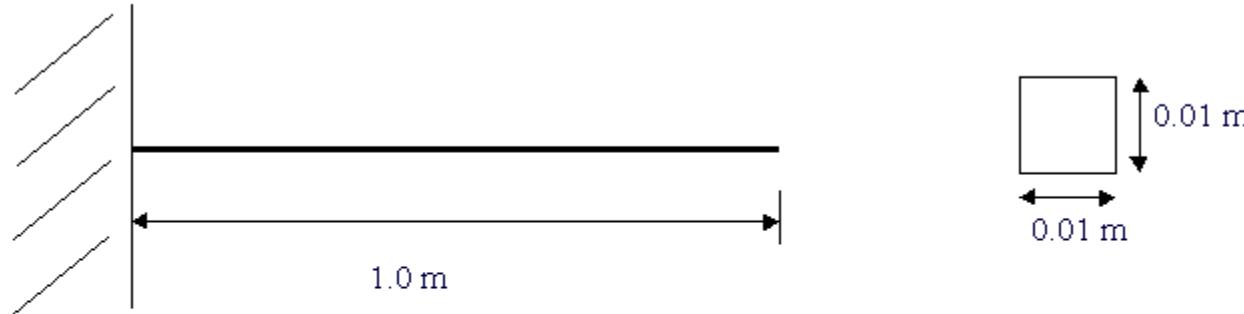




Steps Involved
For
Transient Analysis

Problem:-

Perform a simple Transient analysis of the cantilever beam shown below:



$$\text{Modulus of Elasticity (E)} = 206800(10^6) \text{ N/m}^2$$

$$\text{Density} = 7830 \text{ kg/m}^3$$

In this case, impact the end of the beam with an impulse force and view the response at the location of impact.



File Select List Plot PlotCtrls WorkPlane Parameters Macro MenuCtrls Help



Toolbar

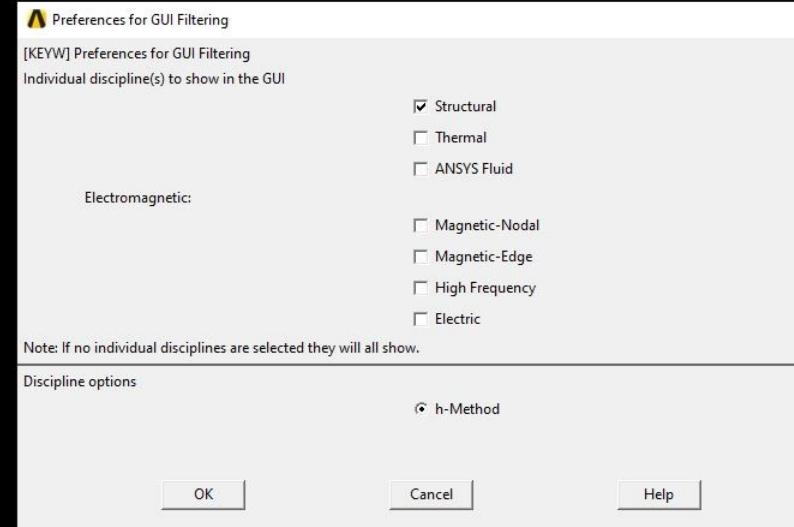
SAVE_DB RESUM_DB QUIT POWRGRPH

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- Preferences
- Preprocessor
- Solution
- General Postproc
- TimeHist Postpro
- ROM Tool
- Radiation Opt
- Session Editor
- Finish

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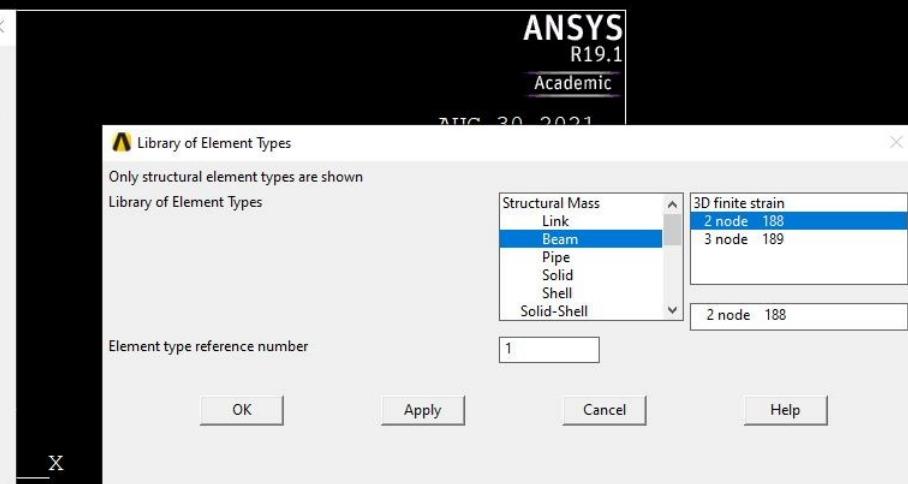
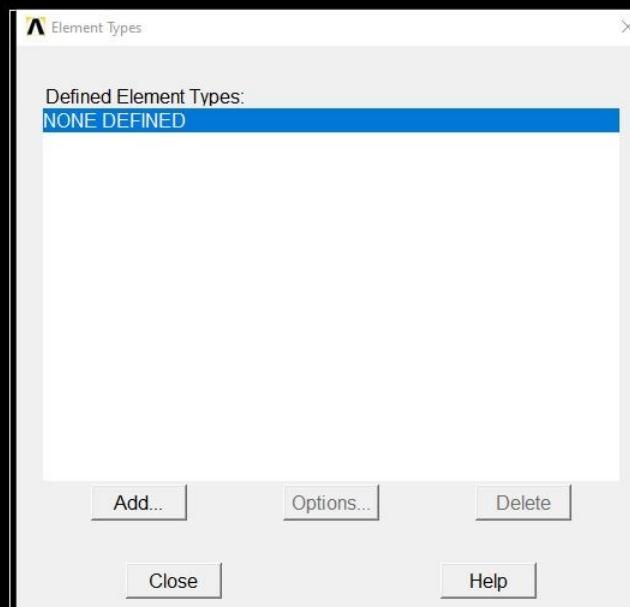


Toolbar

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 - Add DOF
 - Remove DOFs
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1 NODES

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Define Material Model Behavior

Material Edit Favorite Help

Material Models Defined

Material Model Number 1

Material Models Available

- Favorites
- Structural
 - Linear
 - Elastic
 - Isotropic
 - Orthotropic
 - Anisotropic
 - Nonlinear
 - Density
 - Thermal Expansion
 - Damping
 - Friction Coefficient

Linear Isotropic Properties for Material Number 1

Linear Isotropic Material Properties for Material Number 1

T1

Temperatures

EX

PRXY

0.3

Add Temperature Delete Temperature Graph

OK

Cancel

Help



File Select List Plot PlotCtrls WorkPlane Parameters Macro MenuCtrls Help



Toolbar

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Main Menu

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Define Material Model Behavior

Material Edit Favorite Help

Material Models Defined

Material Model Number 1

Linear Isotropic

Material Models Available

- Favorites
- Structural
 - Linear
 - Elastic
 - Isotropic
 - Orthotropic
 - Anisotropic
 - Nonlinear
 - Density
 - Thermal Expansion
 - Damping
 - Friction Coefficient

Density for Material Number 1

Density for Material Number 1

T1

Temperatures

7830

DENS

Add Temperature

Delete Temperature

Graph

OK

Cancel

Help



File Select List Plot PlotCtrls WorkPlane Parameters Macro MenuCtrls Help



Toolbar

SAVE_DB RESUM_DB QUIT POWRGRPH

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 - Common Sections
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 - Plot Section
 - Sect Control
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 - Composite Sections
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Beam Tool

ID	1
Name	
Sub-Type	■
Offset To	Centroid
Offset-Y	0
Offset-Z	0
B	0.01
H	0.01
Nb	0
Nh	0

OK Apply
Close Preview
Help Meshview



File Select List Plot PlotCtrls WorkPlane Parameters Macro MenuCtrls Help



Toolbar

SAVE_DB RESUM_DB QUIT POWRGRPH

Main Menu

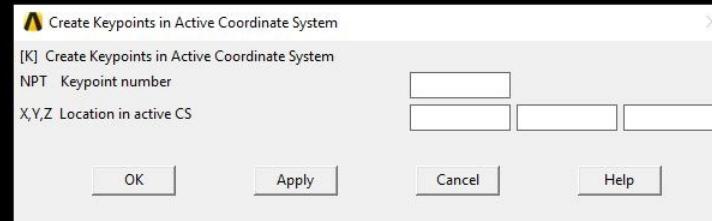
- Preferences
- Preprocessor
 - Element Type
 - Real Constants
 - Material Props
 - Sections
 - Modeling
 - Create
 - Keypoints
 - On Working Plane
 - In Active CS
 - On Line
 - On Line w/Ratio
 - On Node
 - KP between KPs
 - Fill between KPs
 - KP at center
 - Hard PT on line
 - Hard PT on area
 - Lines
 - Areas
 - Volumes
 - Nodes
 - Elements
 - Contact Pair
 - Circuit
 - Transducers
 - Operate
 - Move / Modify
 - Copy
 - Reflect
 - Check Geom
 - Delete
 - Cyclic Sector
 - CMS
 - Genl plane strn
 - Update Geom
 - Meshing
 - Checking Ctrls
 - Numbering Ctrls
 - Archive Model
 - Coupling / Ceqn

1 NODES

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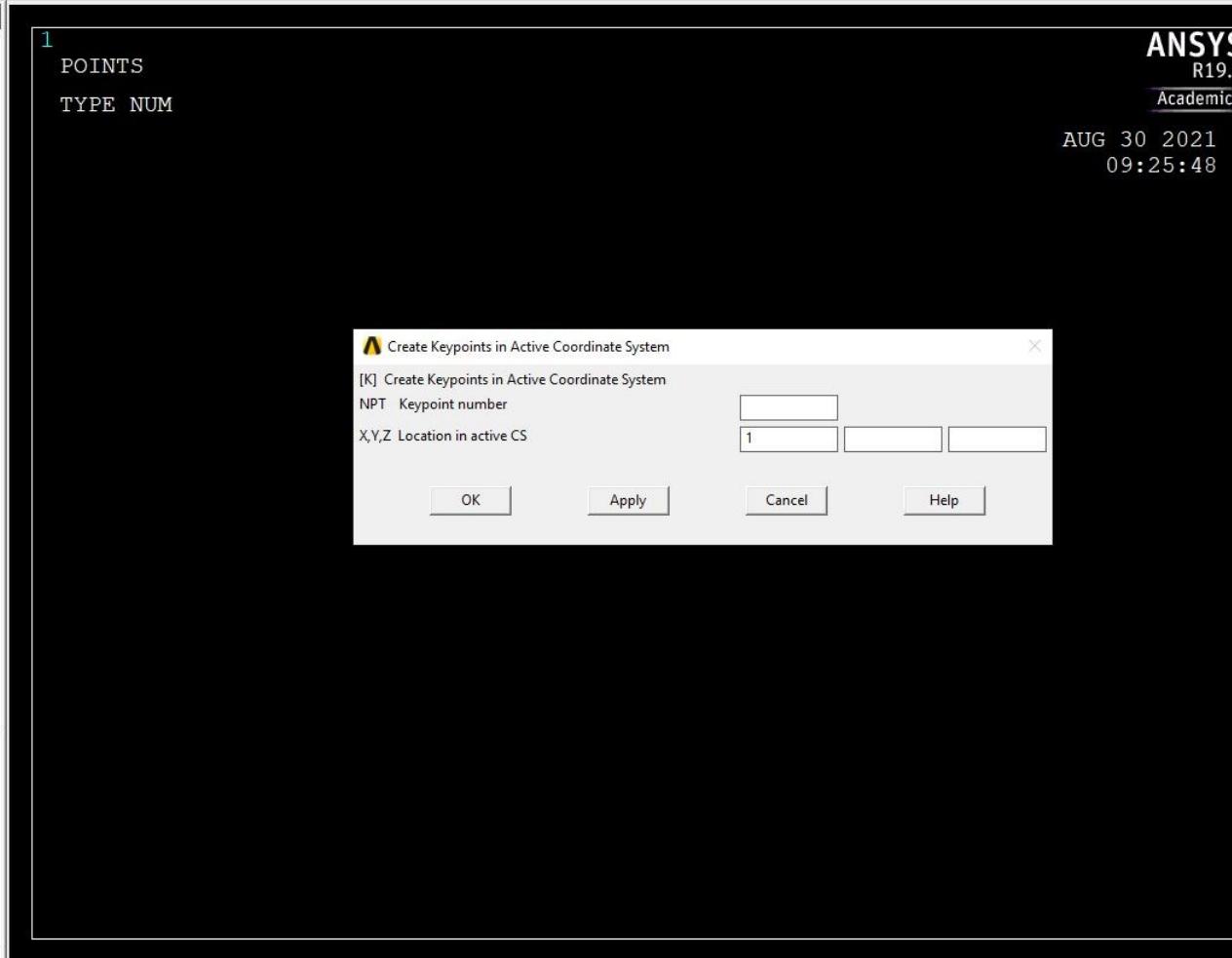


Toolbar

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 - In Active CS
 - On Line
 - On Line w/Ratio
 - On Node
 - KP between KPs
 - Fill between KPs
 - KP at center
 - Hard PT on line
 - Hard PT on area
 - Lines
 - Areas
 - Volumes
 - Nodes
 - Elements
 - Contact Pair
 - Circuit
 - Transducers
 - Operate
 - Move / Modify
 - Copy
 - Reflect
 - Check Geom
 - Delete
 - Cyclic Sector
 - CMS
 - Genl plane strn
 - Update Geom
 - Meshing
 - Checking Ctrls
 - Numbering Ctrls
 - Archive Model
 - Coupling / Cean





New Analysis

SAVE_DB RESUM_DB QUIT POWRGRPH

Main Menu

- 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 = 1
Maximum = 2
Minimum = 2
KeyP No. = 1

List of Items
 Min, Max, Inc

OK Apply
 Reset Cancel
 Pick All Help

Gen plane surv
 Update Geom
 Meshing
 Checking Ctrls

1 POINTS

TYPE NUM

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Y

X

2



File Select List Plot PlotCtrls WorkPlane Parameters Macro MenuCtrls Help



Toolbar

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Main Menu

- Preferences
- Preprocessor
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 - MeshTool
 - Size Cntrs
 - SmartSize
 - ManualSize
 - Global
 - Areas
 - Lines
 - All Lines
 - Picked Lines
 - Copy Divs
 - Flip Bias
 - Clr Size
 - Keypoints
 - Layers
 - Concentrat KPs
 - Mesher Opts
 - Concatenate
 - Mesh
 - Modify Mesh
 - Check Mesh
 - Clear
 - Checking Ctrls
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- ROM Tool

1 POINTS

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Element Sizes on All Selected Lines

[LESIZE] Element sizes on all selected lines

SIZE Element edge length

NDIV No. of element divisions

(NDIV is used only if SIZE is blank or zero)

KYNDIV SIZE,NDIV can be changed Yes

SPACE Spacing ratio

Show more options No

OK Cancel Help



File Select List Plot PlotCtrls WorkPlane Parameters Macro MenuCtrls Help



Toolbar

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 - Mesh
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 - Check Mesh
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- Finish

1
POINTS
TYPE NUM

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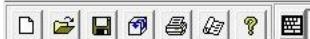
Y

X

M

2





Toolbar

SAVE_DB RESUM_DB QUIT POWRGRPH

Main Menu

- Preferences
- Preprocessor
 - Element Type
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 - Concatenate
 - Mesh
 - Keypoints
 - Lines
 - Areas
 - Volumes
 - Volume Sweep
 - Tet Mesh From
 - Interface Mesh
 - Modify Mesh
 - Check Mesh
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1 POINTS
TYPE NUM

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Mesh Lines

Pick Unpick

Single Box

Polygon Circle

Loop

Count = 0

Maximum = 1

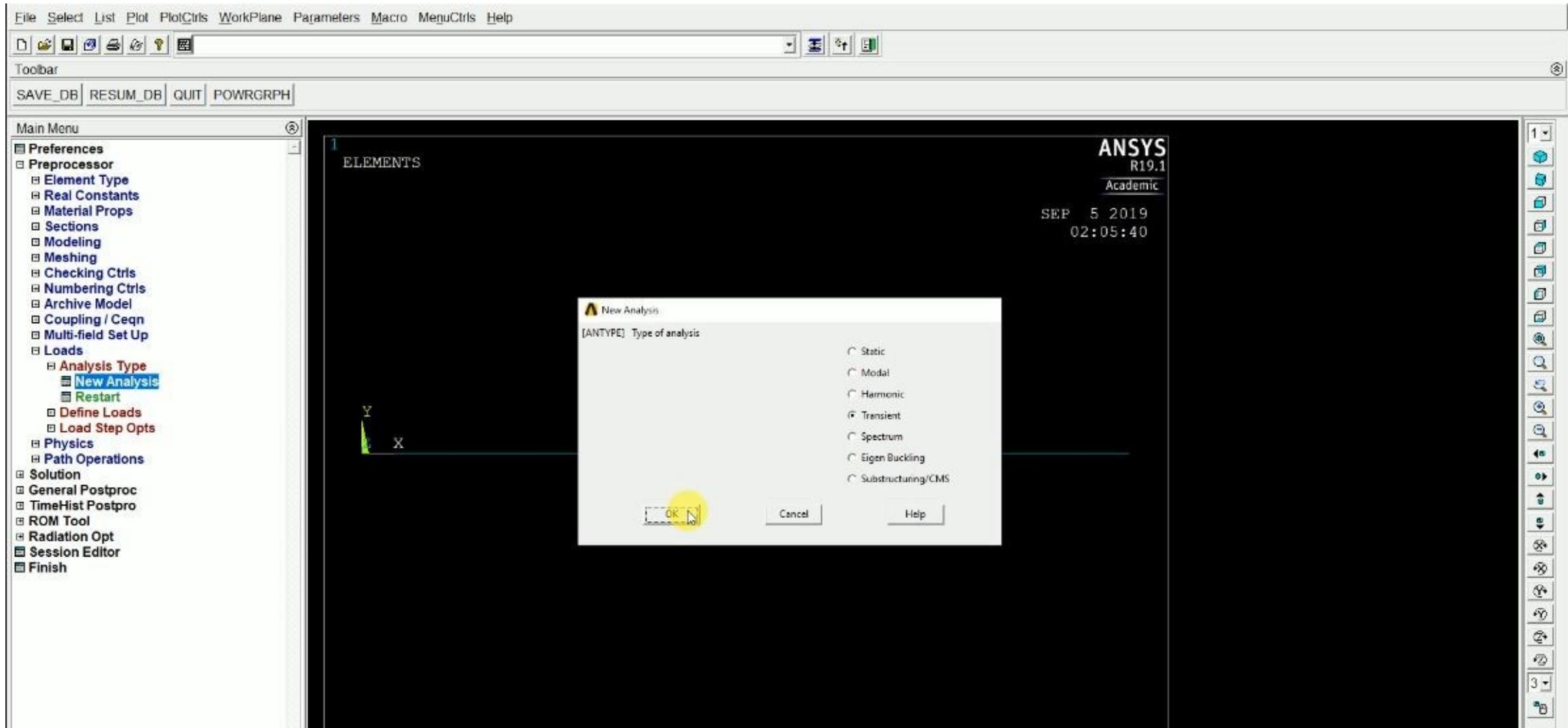
Minimum = 1

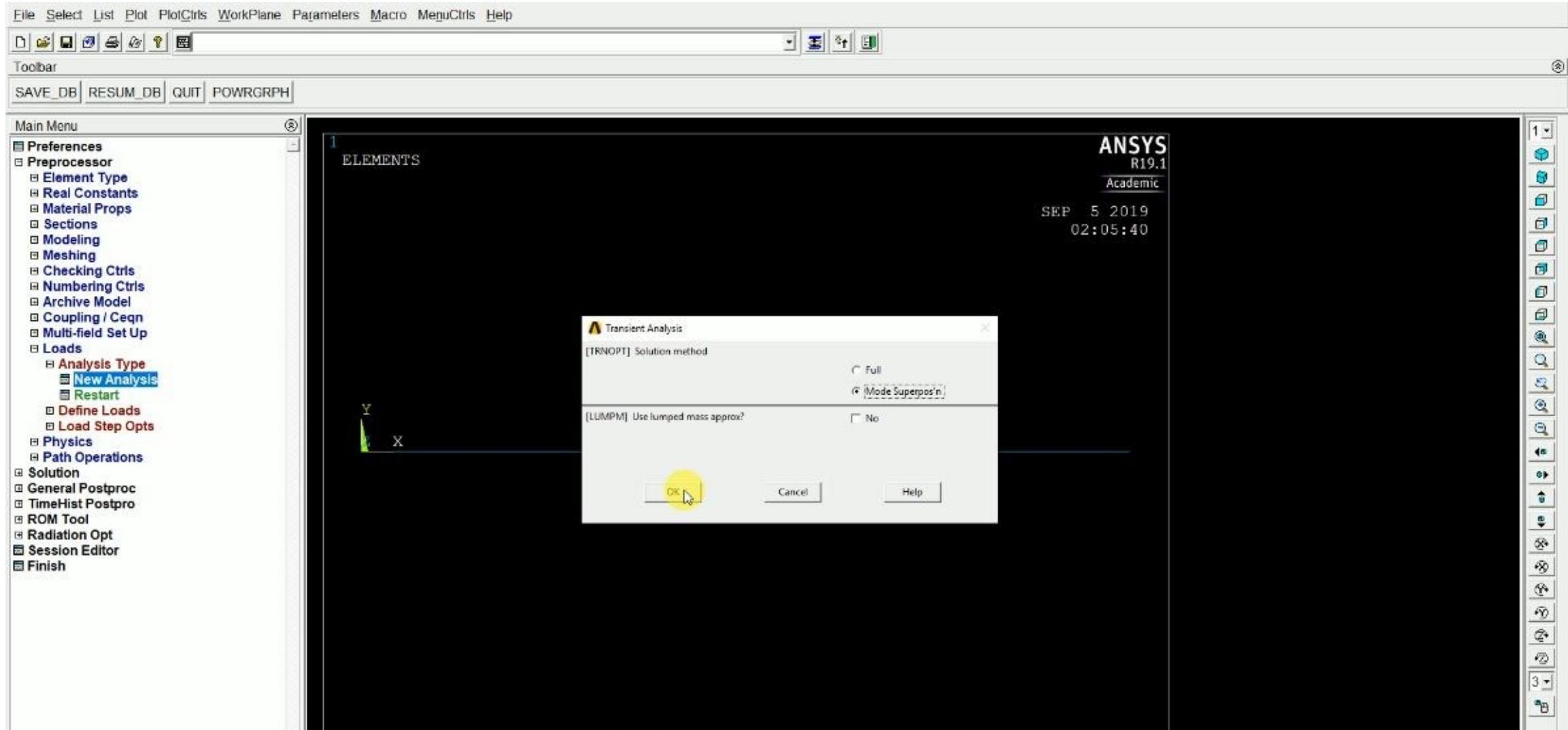
Line No. =

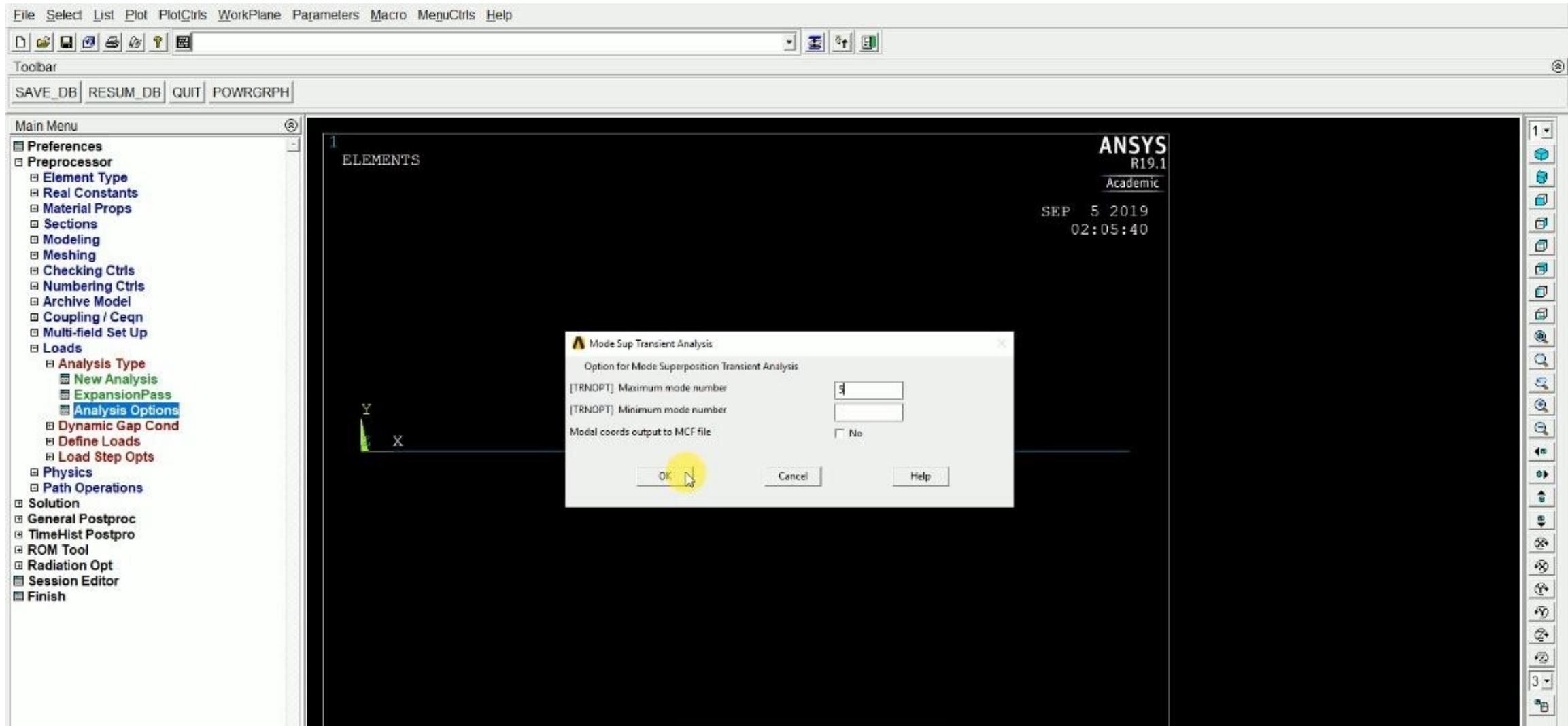
List of Items

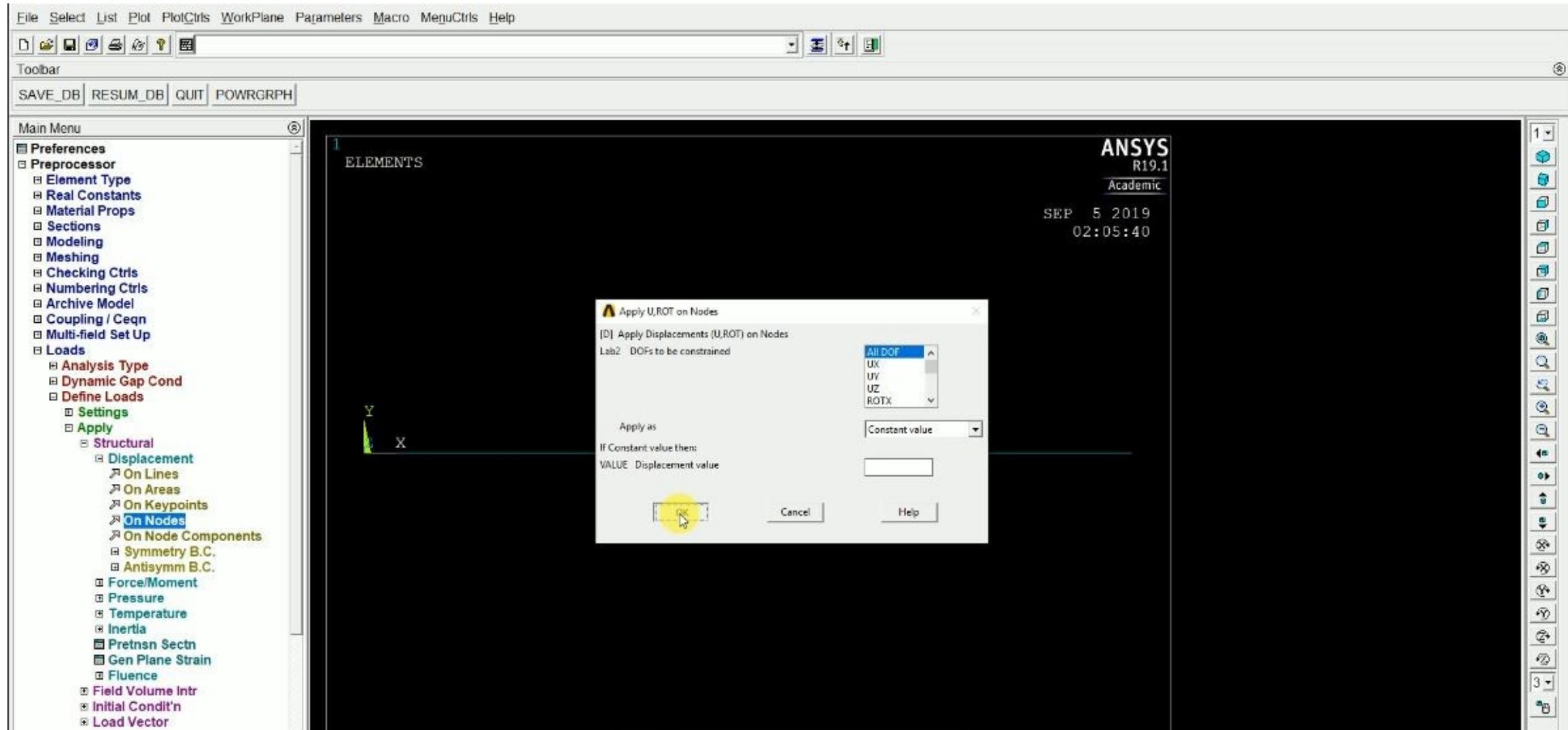
Min, Max, Inc

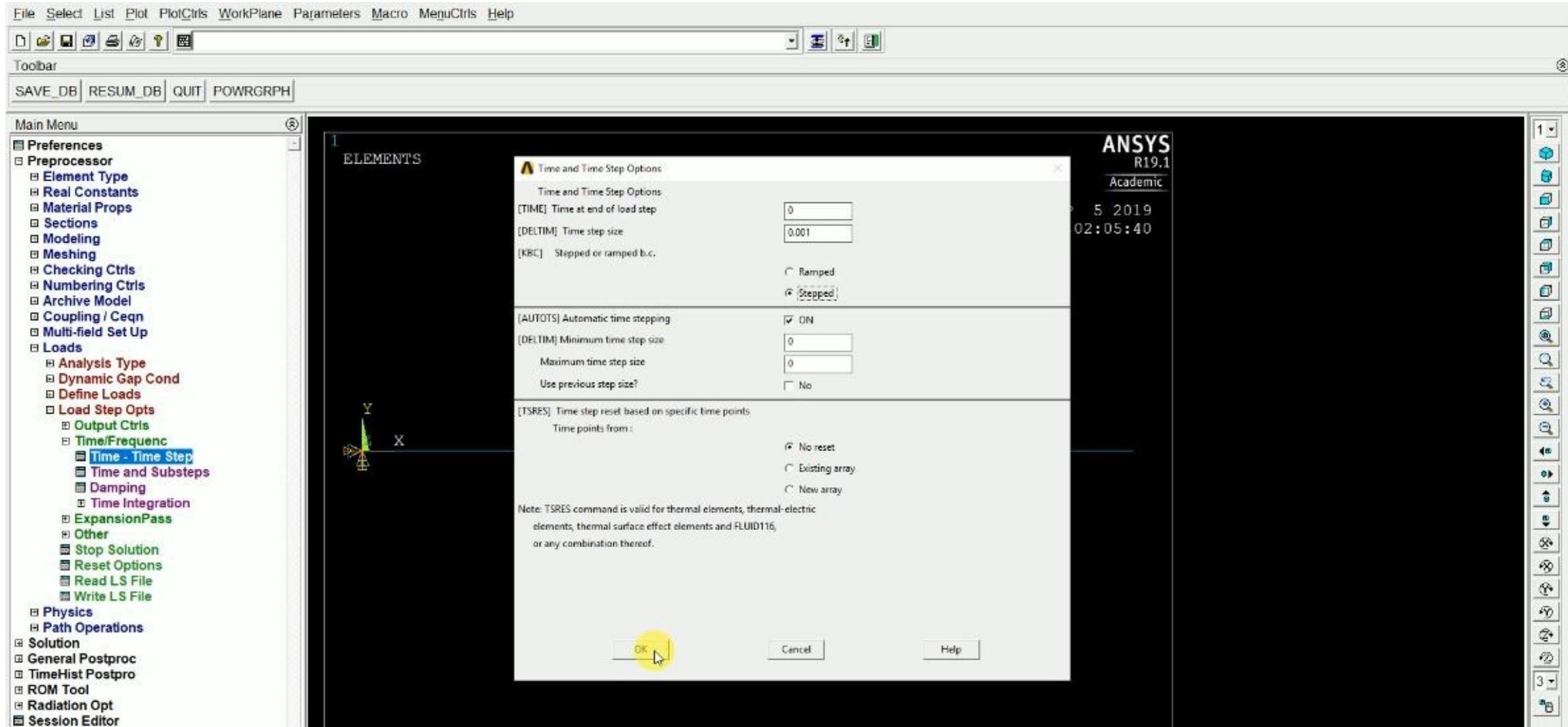


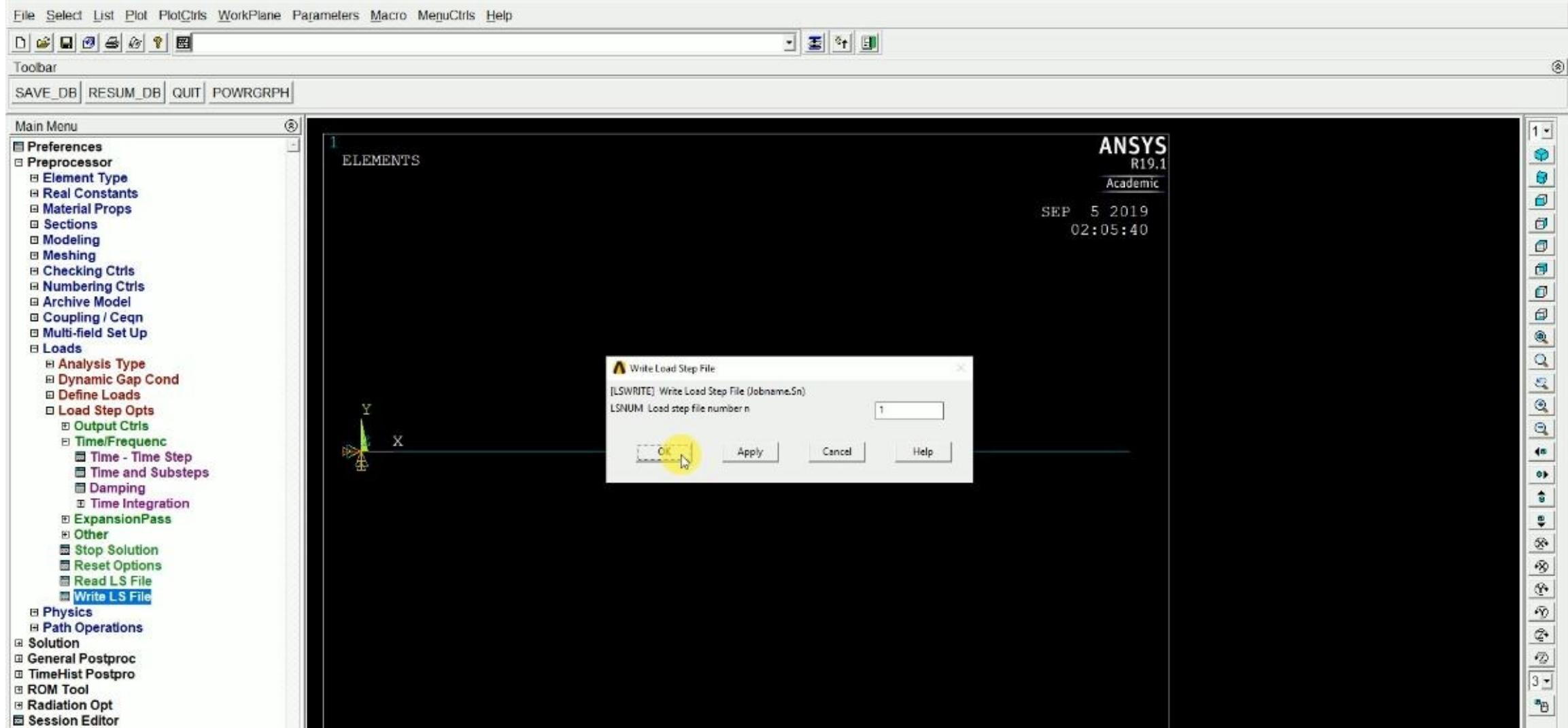


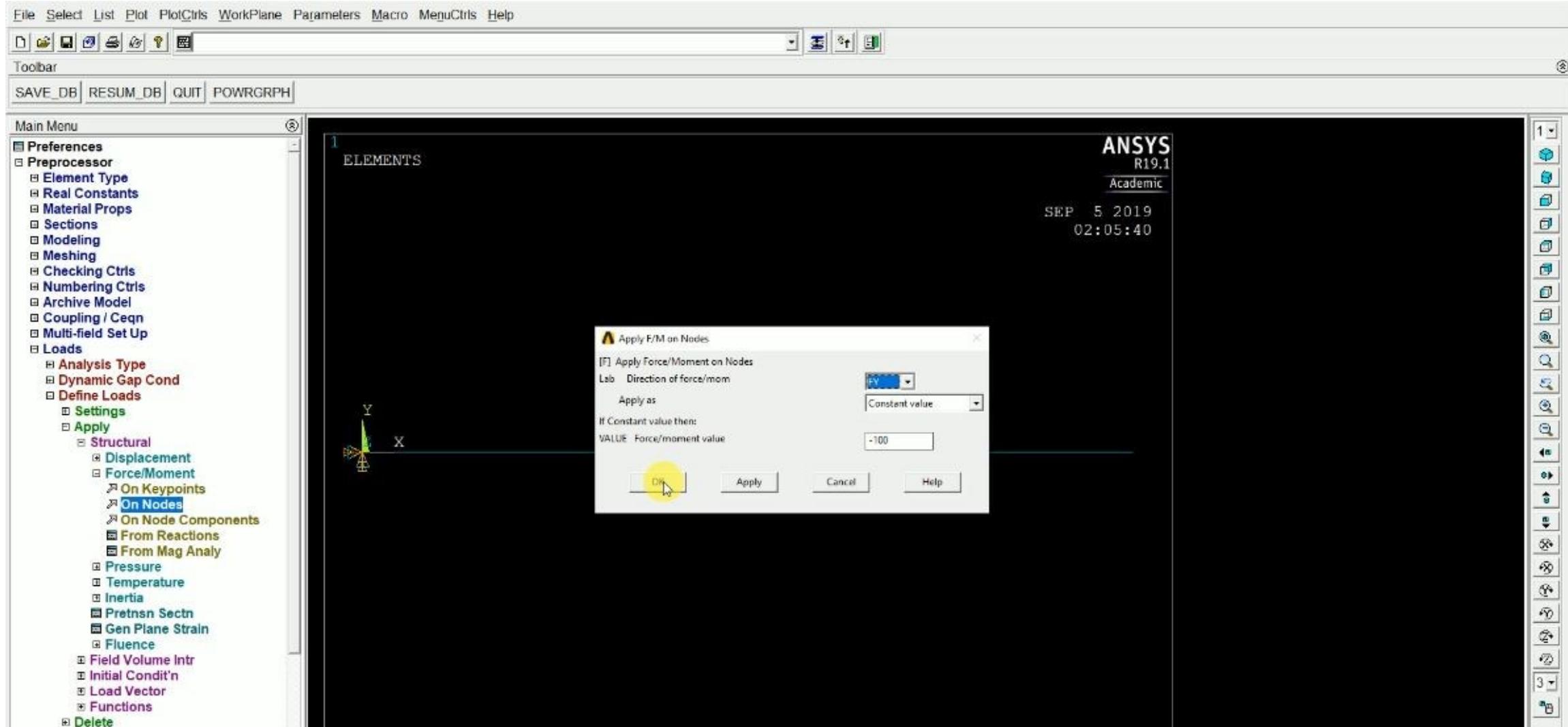


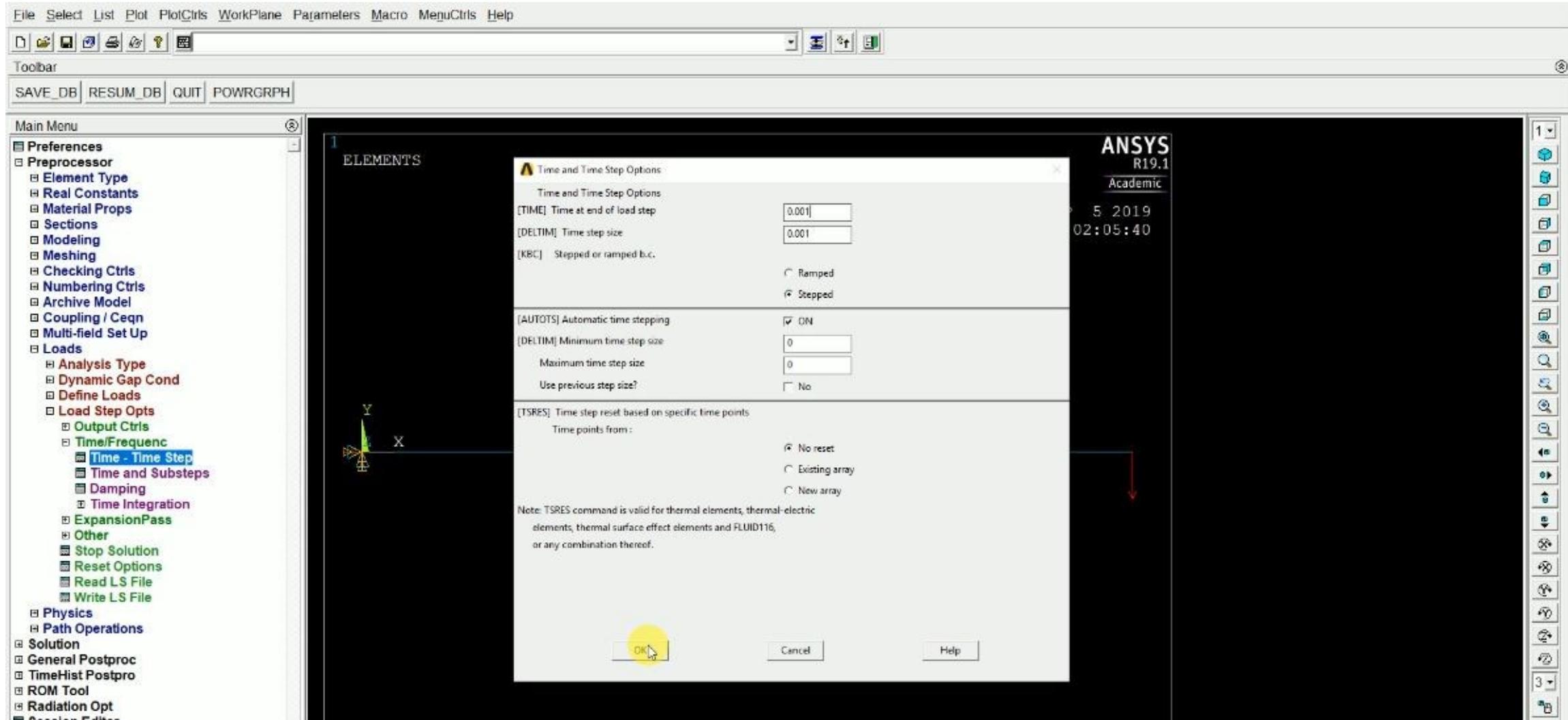


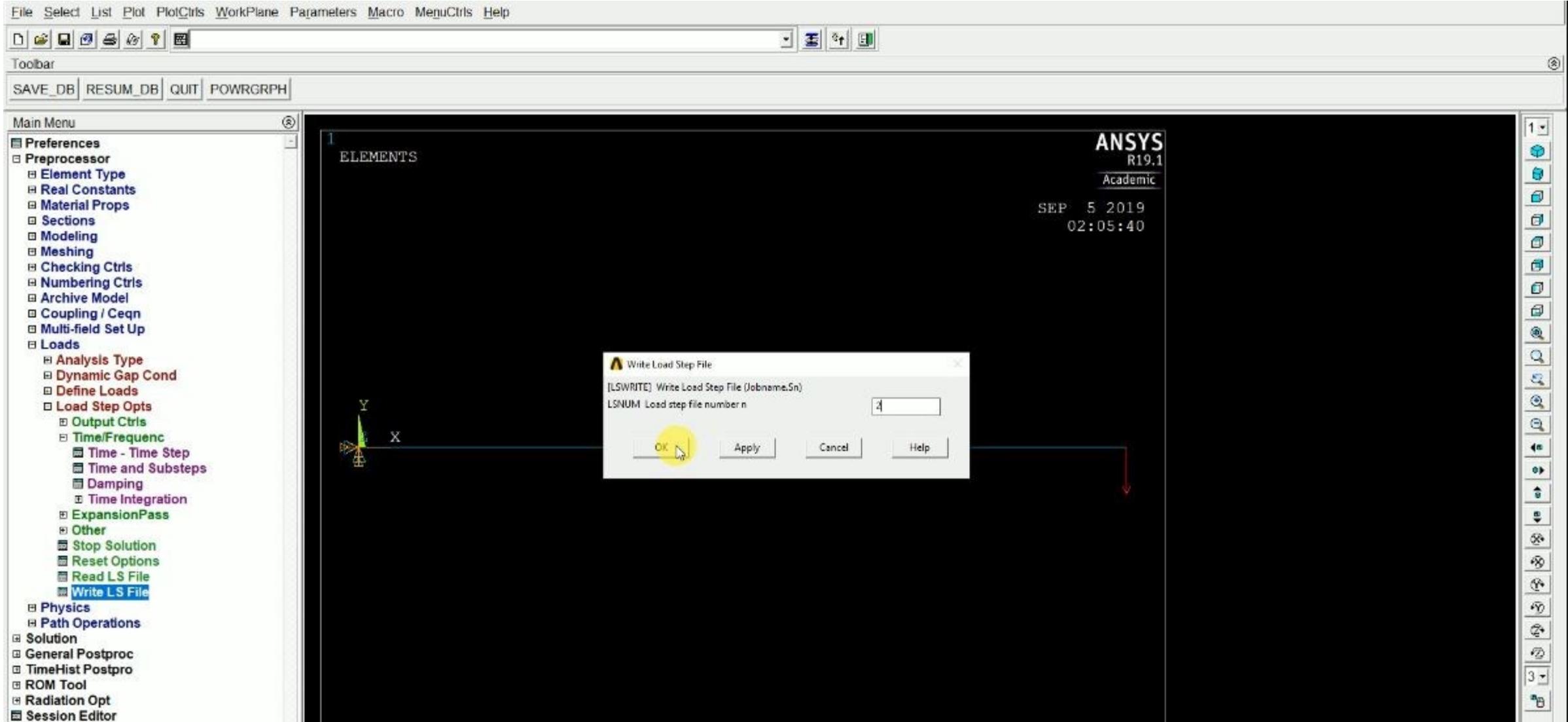


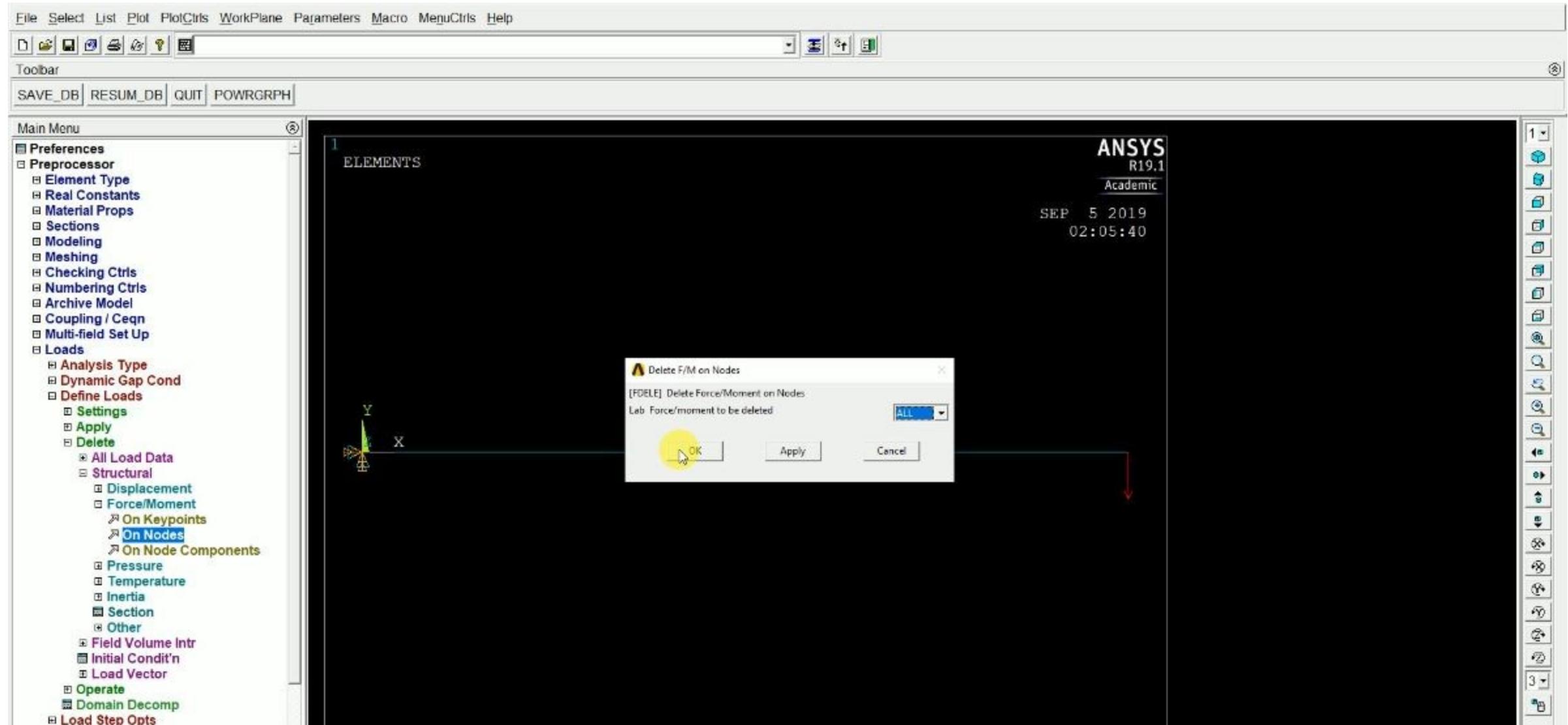














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 - Load Step Opts
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 - Time - Time Step
 - Time and Substeps
 - Damping
 - Time Integration
 - ExpansionPass
 - Other
 - Stop Solution
 - Reset Options
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 - Write LS File
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 - Radiation Opt
 - Session Editor

ELEMENTS

Time and Time Step Options

Time and Time Step Options

[TIME] Time at end of load step

[DELTIM] Time step size

[KBC] Stepped or ramped b.c.

Ramped

Stepped

[AUTOTS] Automatic time stepping ON

[DELTIM] Minimum time step size

Maximum time step size

Use previous step size? No

[TSRES] Time step reset based on specific time points

Time points from :

No reset

Existing array

New array

Note: TSRES command is valid for thermal elements, thermal-electric elements, thermal surface effect elements and FLUID116, or any combination thereof.

OK **Cancel** **Help**

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 - Time - Time Step
 - Time and Substeps
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1 ELEMENTS

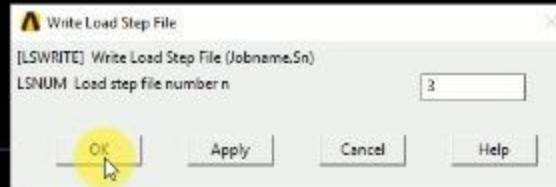
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ELEMENTS

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⚠ Solve Load Step Files

[LSSOLVE] Solve by Reading Data from Load Step (LS) Files

1

3

1

OK



Cancel

Help



File Select List Plot PlotCtrls WorkPlane Parameters Macro MenuCtrls Help



Toolbar

SAVE_DB RESUM_DB QUIT POWRGRPH

Main Menu

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- Preprocessor
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 - Settings
 - Store Data
 - Define Variables
 - List Variables
 - List Extremes
 - Graph Variables
 - Math Operations
 - Table Operations
 - Generate Spectrm
 - Reset Postproc

- ROM Tool
- Radiation Opt
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- Finish

ELEMENTS

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Time History Variables - model1.beam1.rsp

Add Datast

Name	Element	Node	Result Item	Minimum	Maximum
TIME			Time	0	1

Calculator

()

MIN CONJ e^x

MAX a+b LN 7 8 9 / CLEAR

RCL

STO RESP LOG 4 5 6 * ←

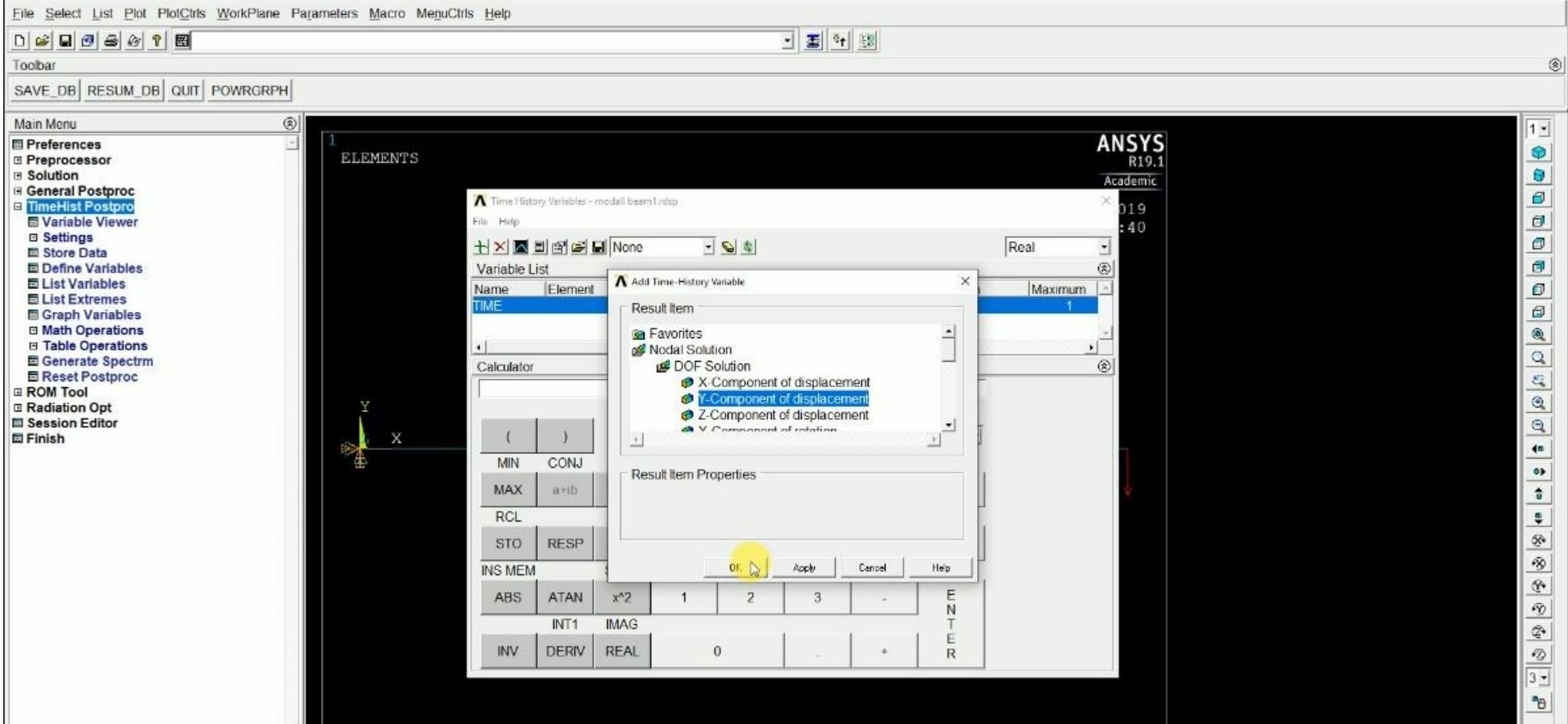
INS MEM SQRT

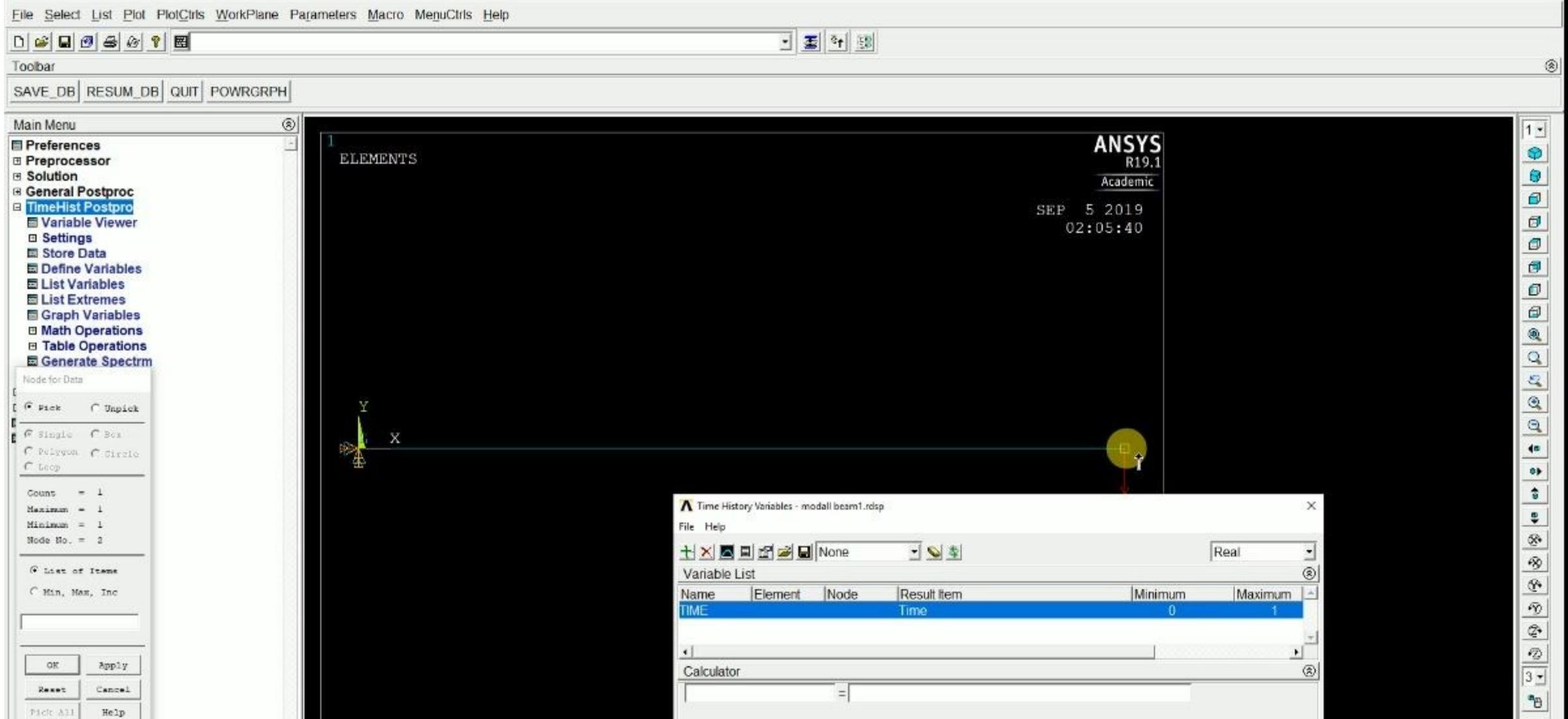
ABS ATAN x² 1 2 3 - ENTER

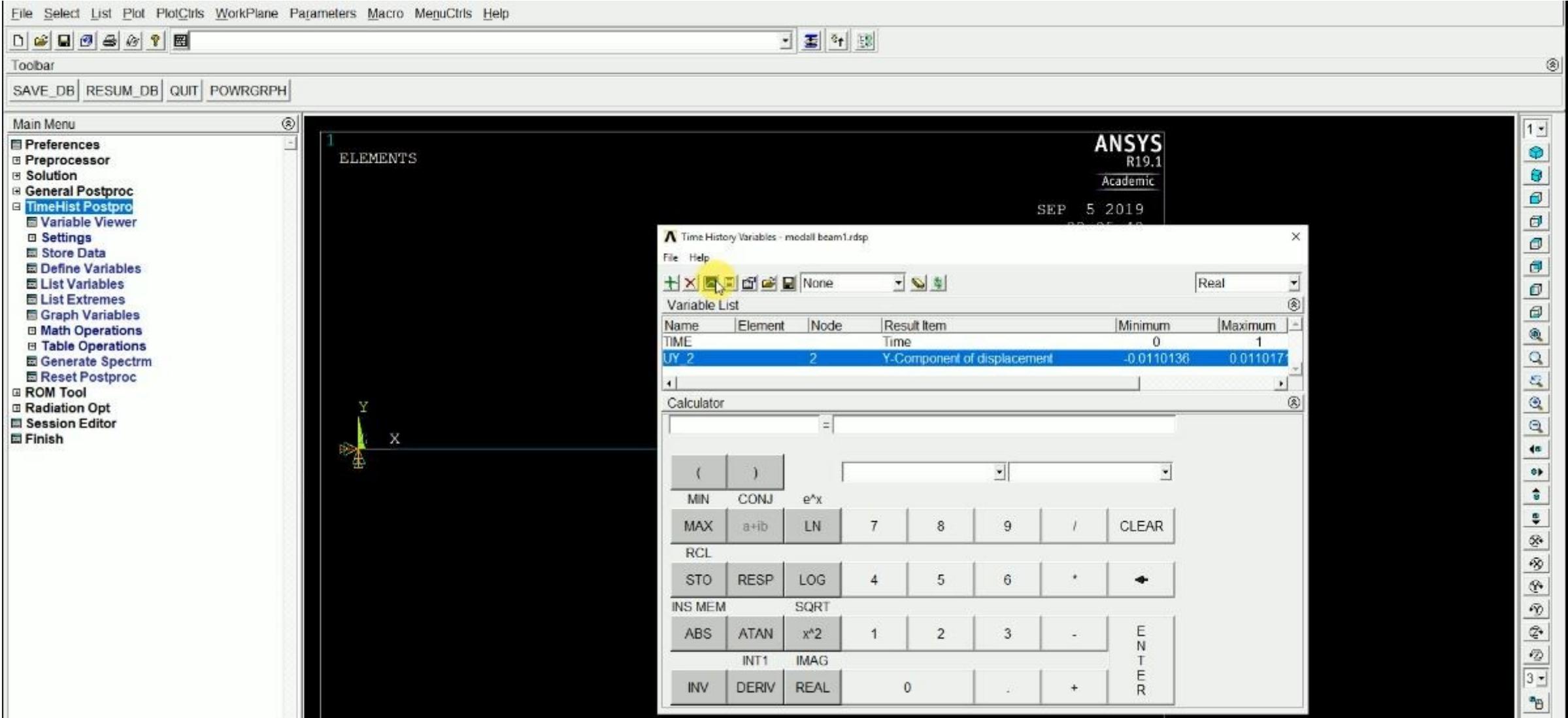
INT1 IMAG

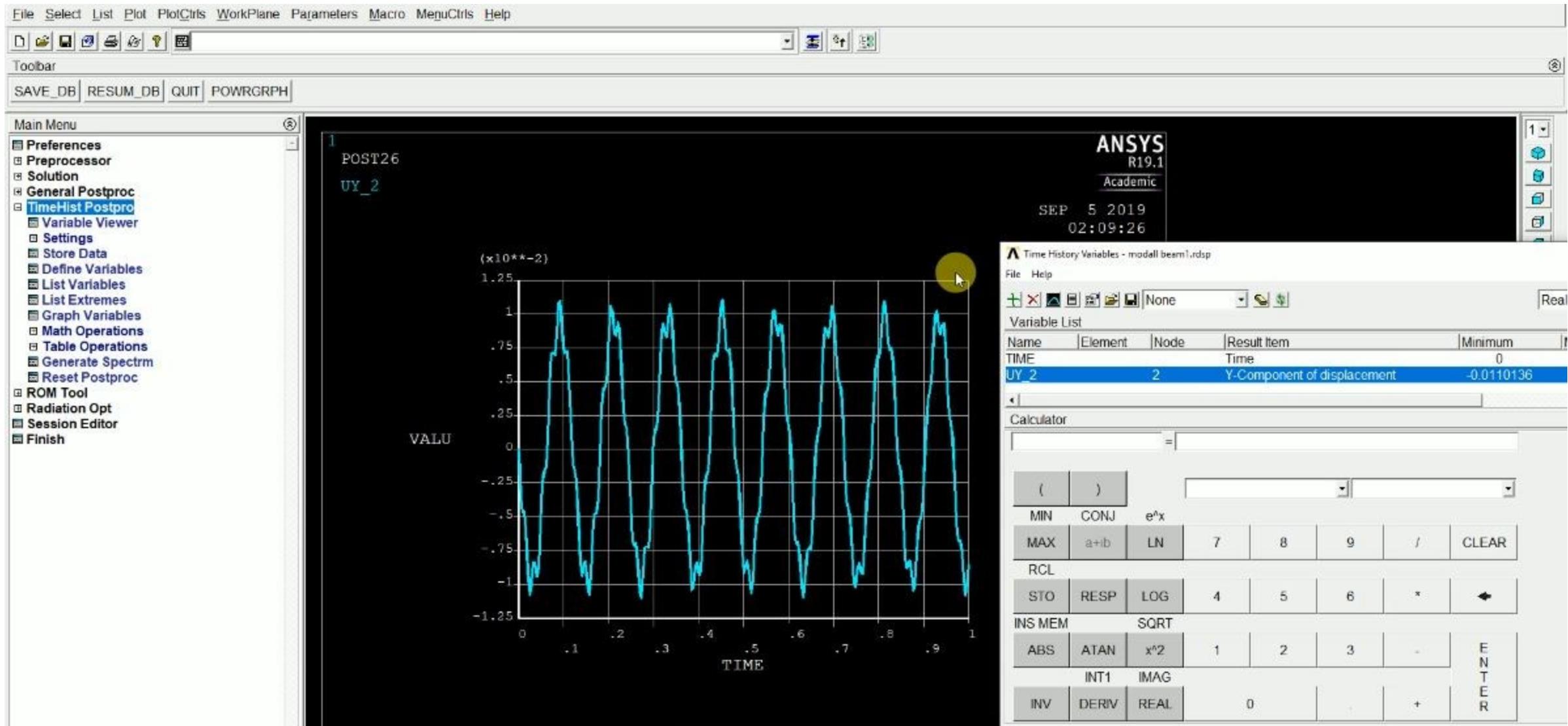
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Thank you!

