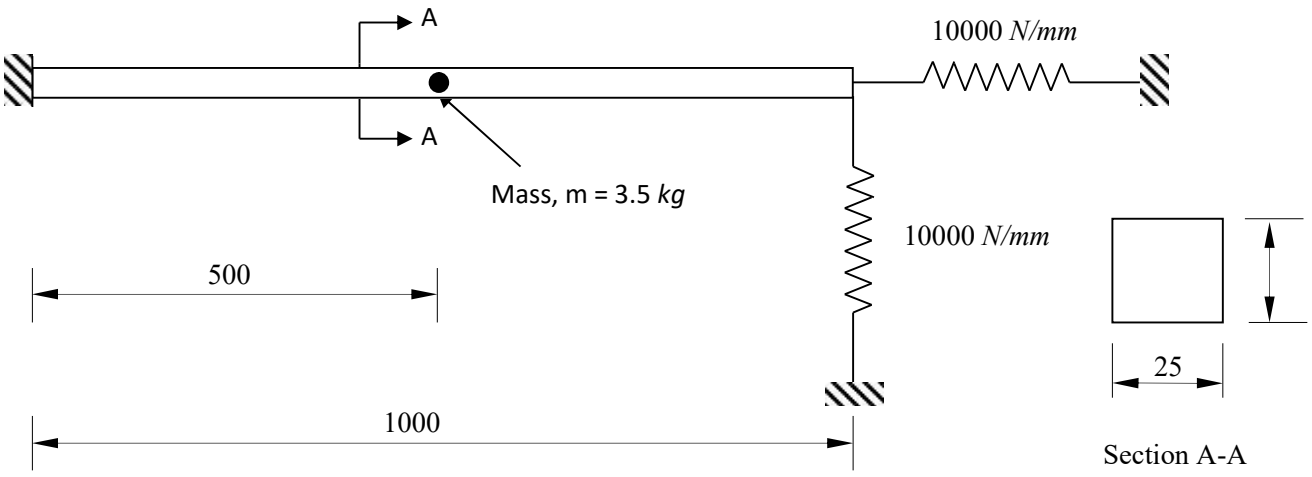
FREE VIBRATION ANALYSIS OF A SYSTEM CONSISTING OF BEAM, SPRING AND MASS ELEMENTS



All dimensions are in *mm*

Figure 1

Material property: E = 72*GPa*, ν =0.3, ρ = 2800 kg/m^3

Perform free vibration analysis of the system shown in Figure 1. The system contains a cantilever beam whose free end is attached to two springs one in axial direction and other in transverse direction. A mass of 3.5 *kg* is attached to the middle of the beam.

PROCEDURE

1. Create Keypoints

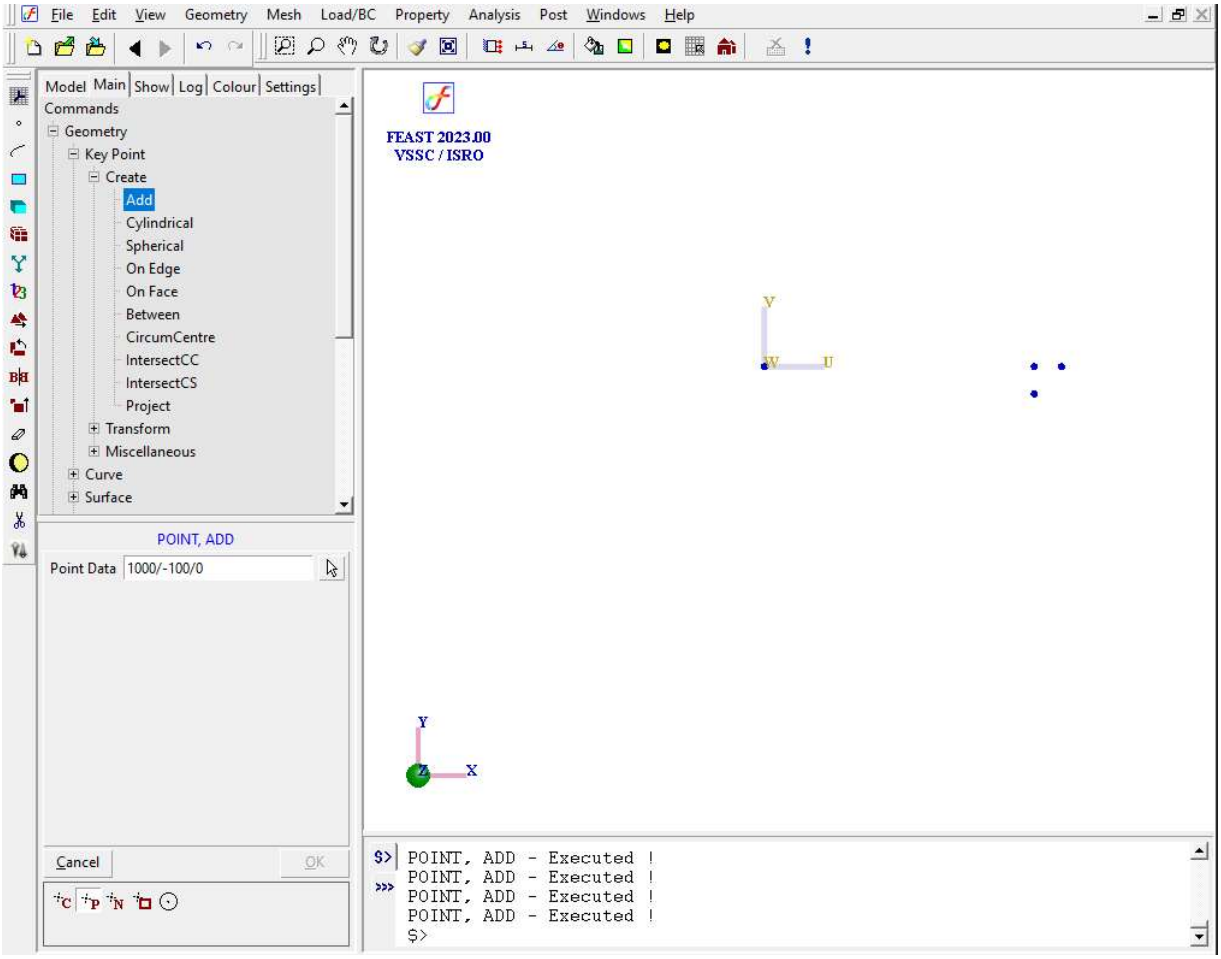
Command: POINT, ADD

Menu: Geometry →Key point→ Create →Add

Parameters:

Point Data	0/0/0

Similarly create key points at (1000/0/0) also. For defining node for the end points of the springs, whose dimensions are irrelevant create key points at(1100/0/0) and (1000/-100/0) At the end of the operation your screen should look like this.



2. Create Curve

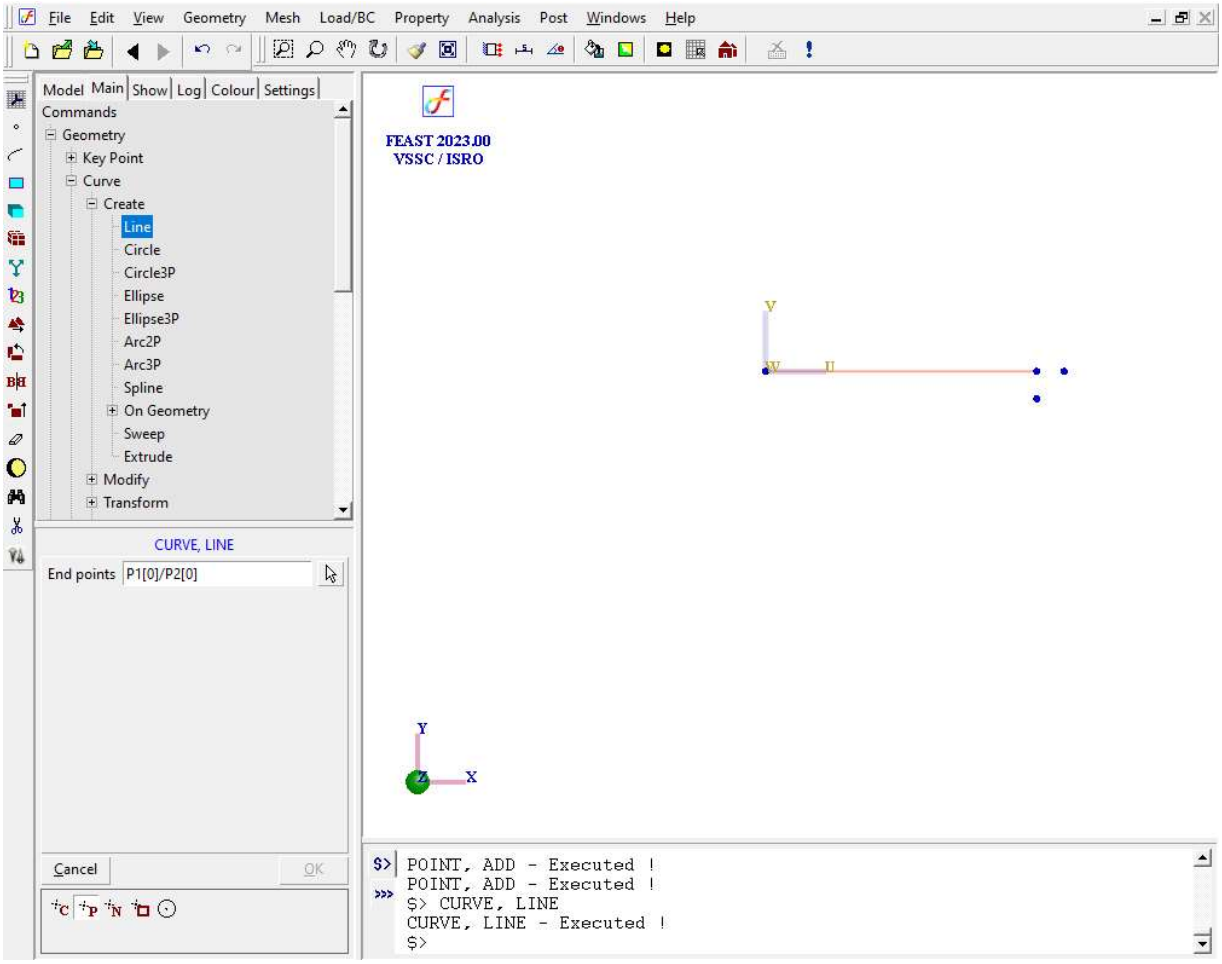
Command: CURVE,LINE

Menu : Geometry → Curve → Create → Line

Parameters:

End Points	Pick the two end points for the beam

At the end of the operation your screen should look like this.



3. Generate mesh

Command :MESH,BAR

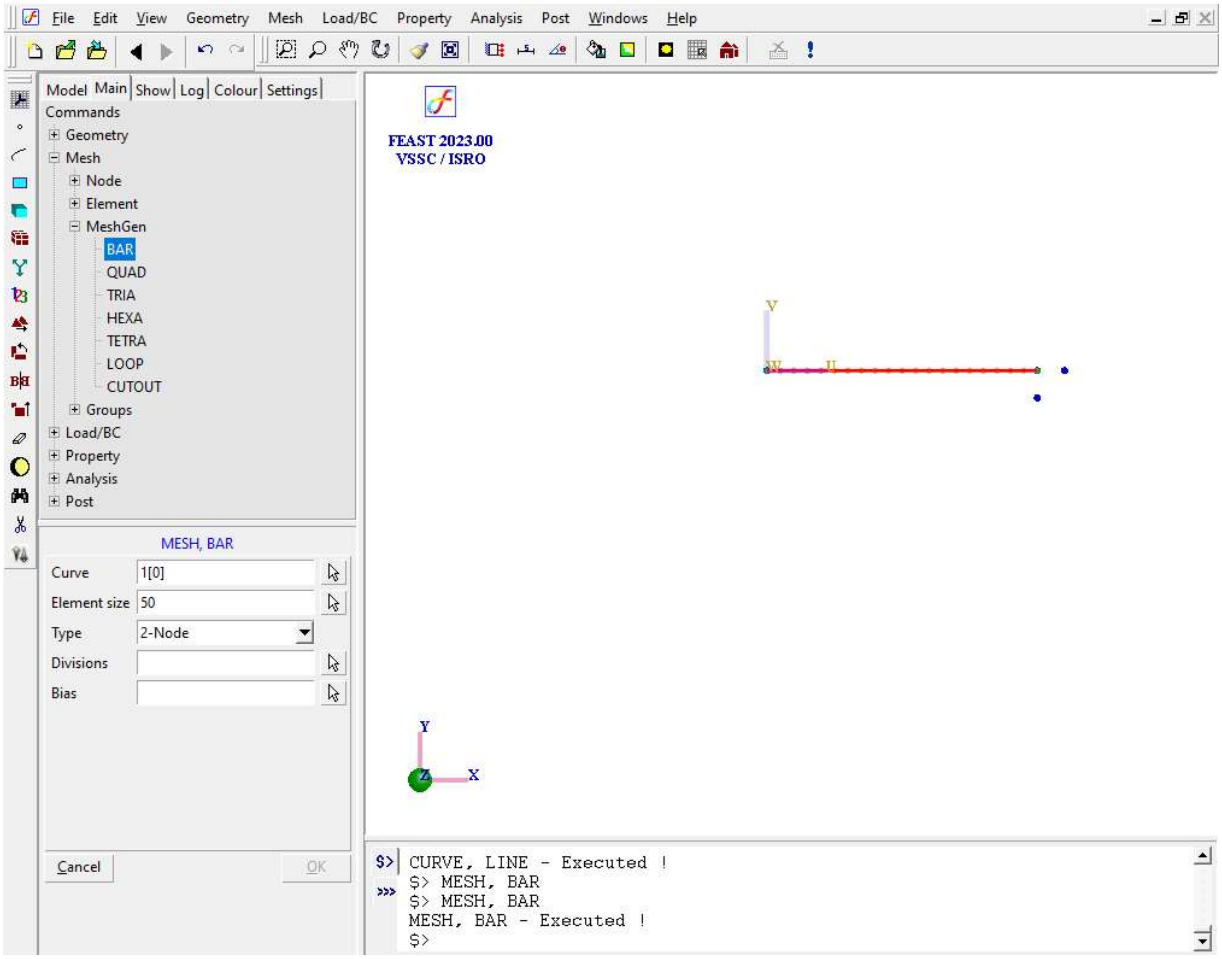
Menu : Mesh→MeshGen→Bar

Parameters :

Curve	(Pick the curve from the window)
Element Size	50 (Click on two points on the curve or type initial size for calculating element divisions)
Type	2 - Node
Divisions	(Click on the curve to adjust the no. of subdivisions)
Bias	

*Note :*Element size can be entered manually or click on two points on the curve to obtain an approximate the element size. Change the subdivisions using right or left mouse button.

At the end of the above operation your screen should like this



4. **Create node for the end points of the spring**

Command : NODE, ADD

Menu : Mesh →Node →Create → Add

Parameters :

Coordinates	1100/0/0
Type	Cartesian

Similarly create node at (1000/-100/0) also

5. **Erase points**

Command :POINT,ERASE

Menu : Geometry→Key Point →Miscellaneous→Erase

Parameters :

List of points	(Select all the key points to erase)

6. **Erase curve**

Command :CURVE,ERASE

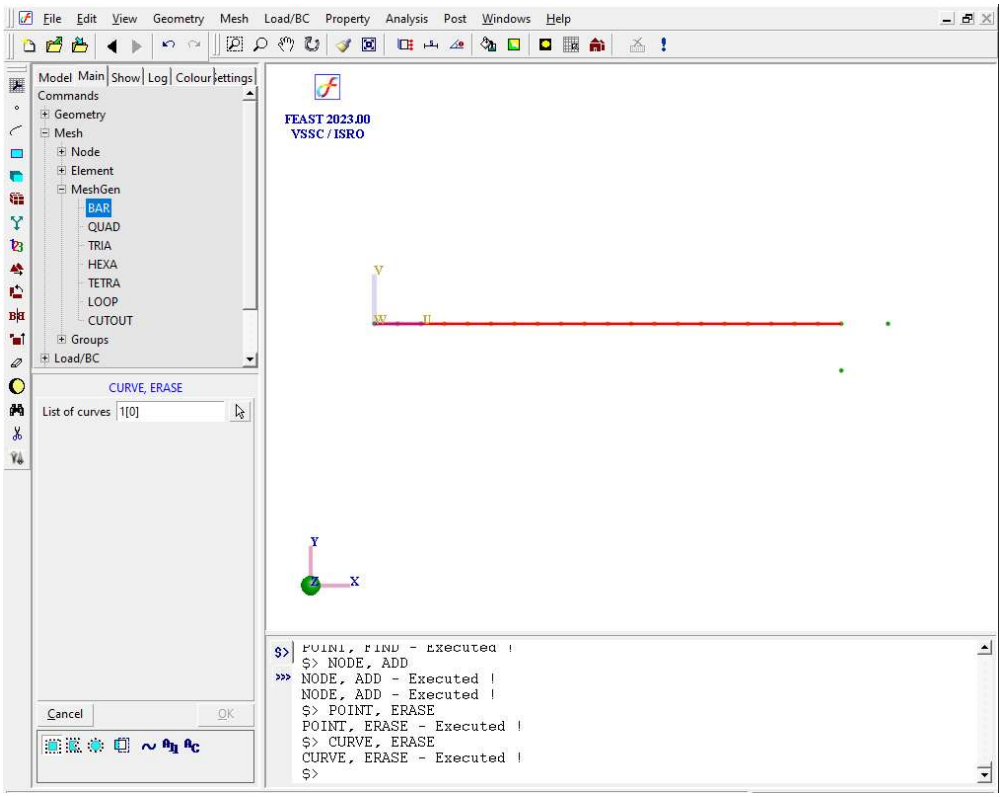
Menu : Geometry→Curve→Miscellaneous→Erase

Parameters:

List of curves	(Select the curve to erase)

Enter the curve ID in the box or pick the curve using mouse pointer.

At the end of the above operation your screen should like this



7. Create an element

Command :ELEMENT,ADD

Menu : Mesh→Element→Create→ Add

Parameters

Nodes	(Select the two node at the right end of the beam)
Dimension	0
Type	Spring

8. Create spring element

Command: SPRING, ADD

Menu : Property→Physical→Spring

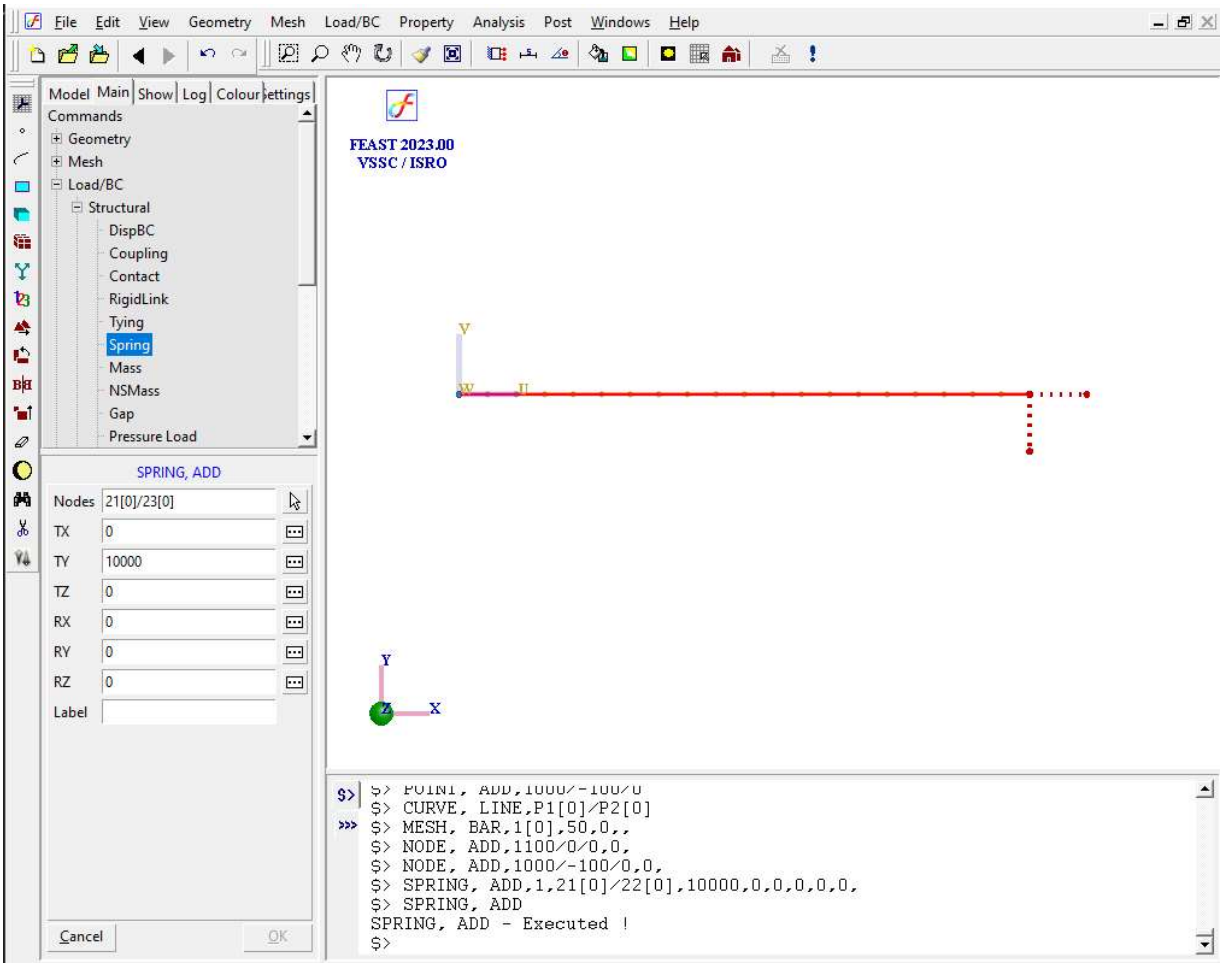
Element	(Select the spring element)
TX	10000

Parameters:

TY	0
TZ	0
RX	0
RY	0
RZ	0
Label	

Similarly create spring element in Y direction also (Give value in TY)

At the end of the above operation your screen should like this



9. Create element

Command : ELEMENT, ADD

Menu : Mesh→Element→Create→ Add

Parameters

Nodes	(Select the node at x=500)
Dimension	0
Type	Mass

10. Create mass element

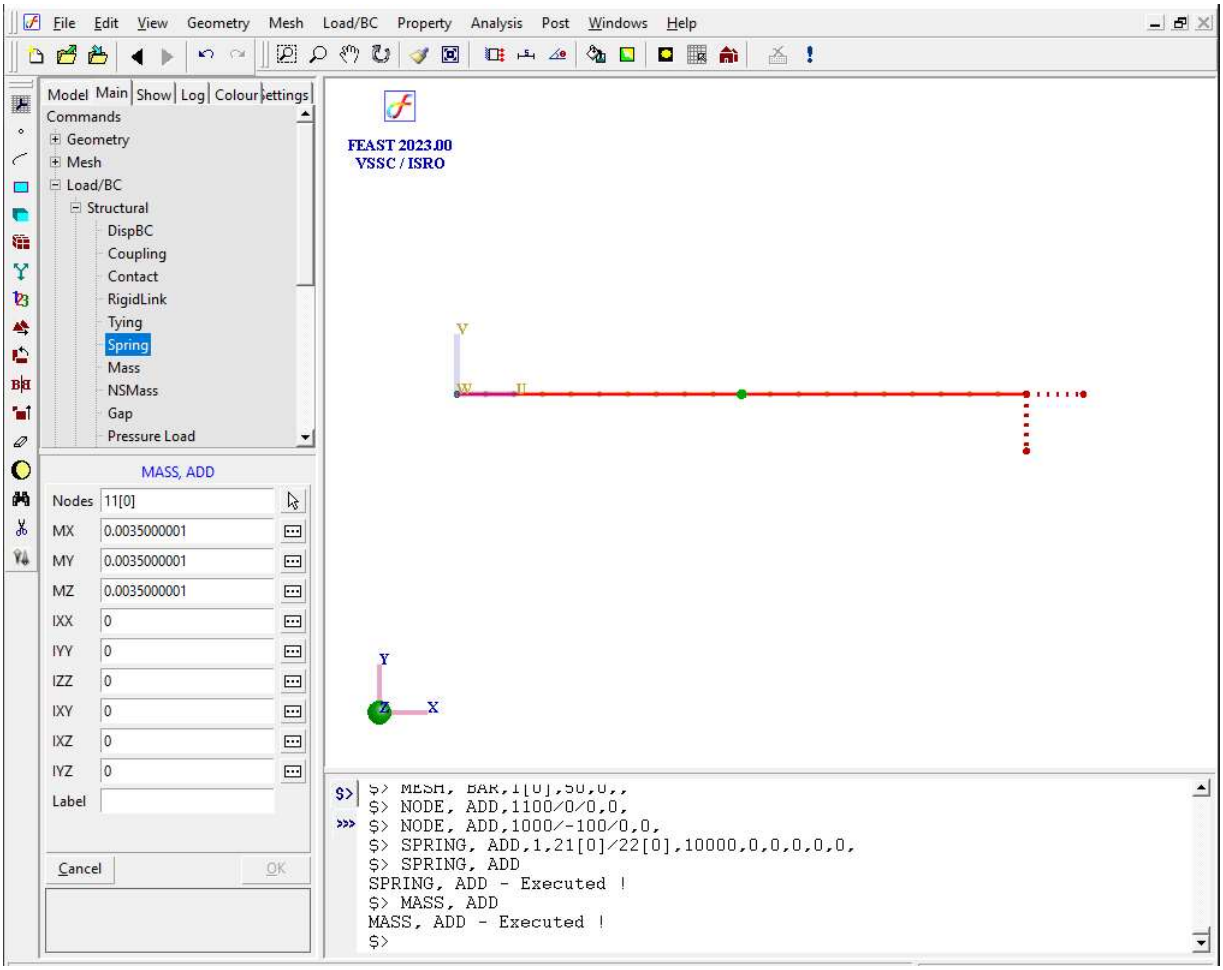
Command : MASS,ADD

Menu : Property→Physical→Mass

Parameters :

Elements	(Select the node at the X = 500)
MX	0.003500000
MY	0.003500000
MZ	0.003500000
IXX	0
IYY	0
IZZ	0
IXZ	0
IYZ	0

At the end of the above operation your screen should like this



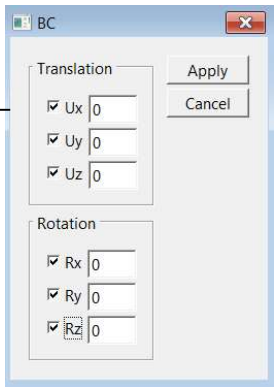
11. Apply Boundary Condition

Command :DISPBC,ADD

Menu : Load/BC →Structural→DispBC

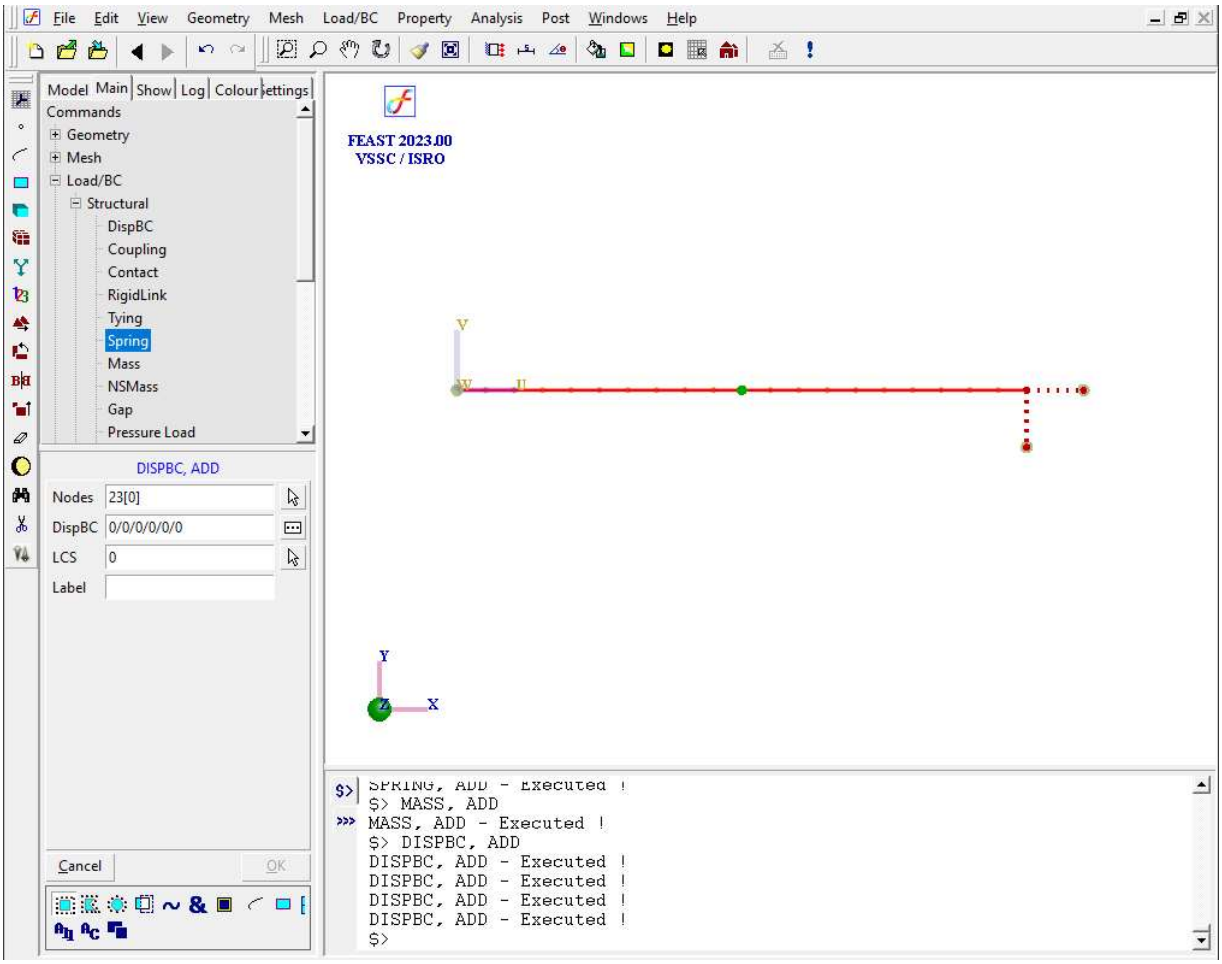
Parameters :

Nodes	(Select the node at X=0)
DispBC	Arrest all DOF
LCS	
Label	



Apply fixed boundary condition at the free ends of the springs also

At the end of the above operation your screen will look like this.



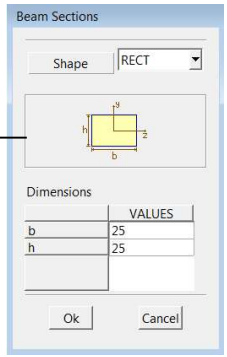
12. Apply Beam Property

Command :BEAMPROP,ADD

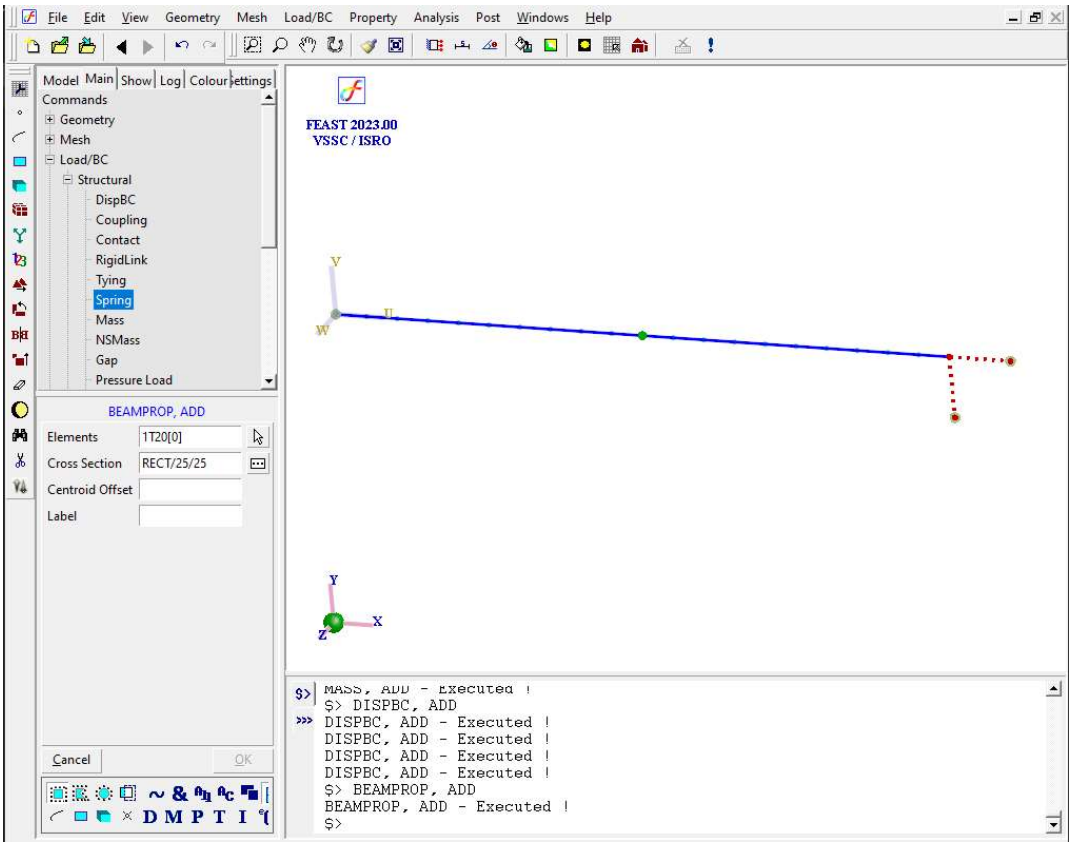
Menu : Property→Physical→ Beam Properties →Cross Section

Parameters:

Elements	(Select all the beam elements)
Cross Section	
Centroid Offset	
Label	



At the end of the above operation your screen will look like this.



13. Apply Material Property

Command :MATERIAL, ISOTROPIC

Menu : Property→Material →Structural→Isotropic

Elements	(Select all the beam elements)

Parameters:

Young's Modulus	72000
Nu	0.3
Density	2.8E-09
Alpha	2.3E-05
Label	

14. Set Analysis Type

Command :ANTYPE,ADD

Menu : Analysis→Analysis Type

Parameters :

Analysis Types	Free Vibration

15. Set free vibration general data

Command :FREEVIBGEN, ADD

Menu : Analysis → Free Vibration → General

Parameters :

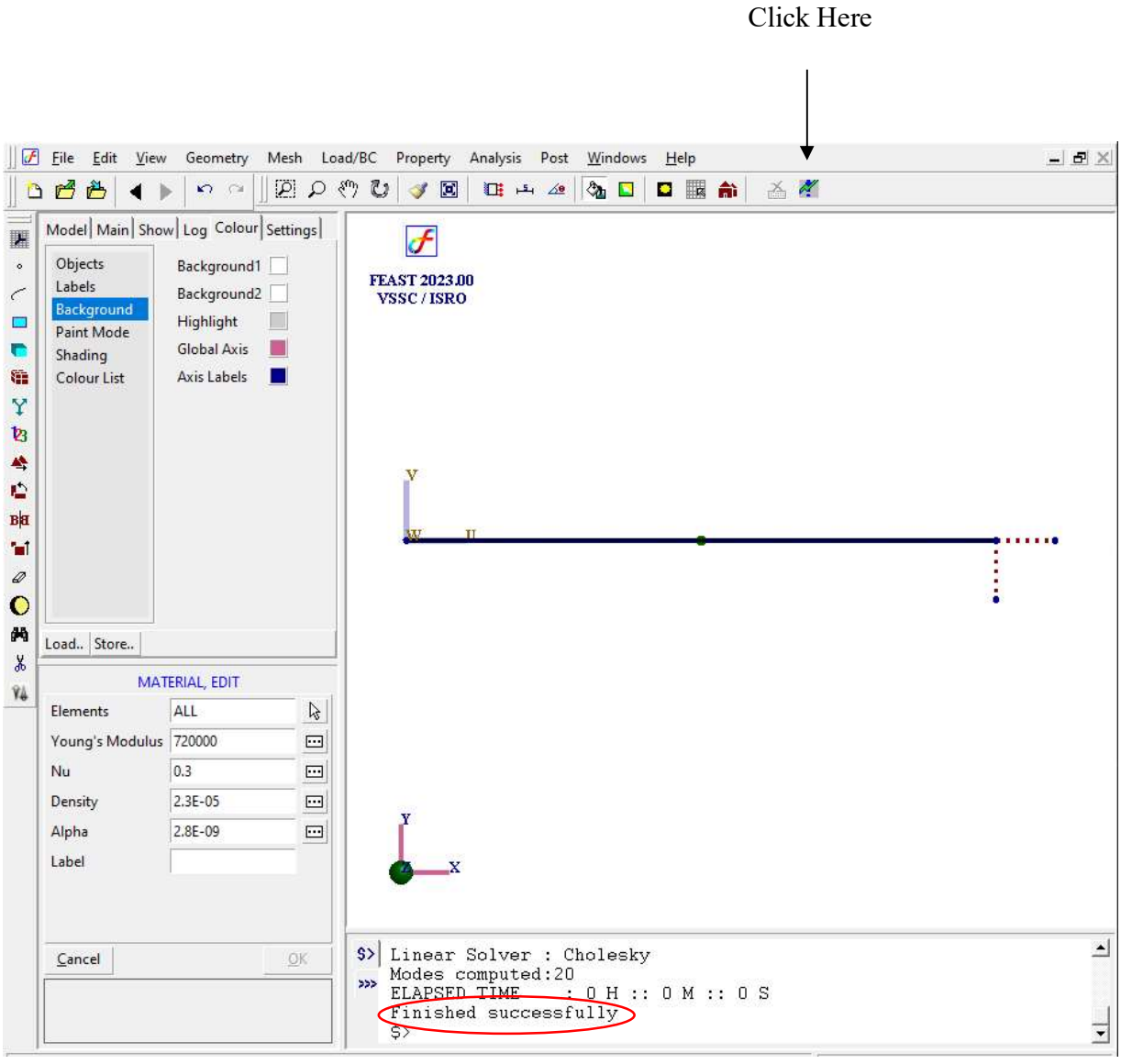
Mode Extraction	No. of modes
No. of modes	20
Mass option	Lumped
Effective mass	No

16. Save the project

Menu : File →Save
Save the file to desired directory

17. Activate solver

Click *Run Solver* button



After solving "Finished successfully" message will be displayed in the message box

18. Post Processing

i. View Results

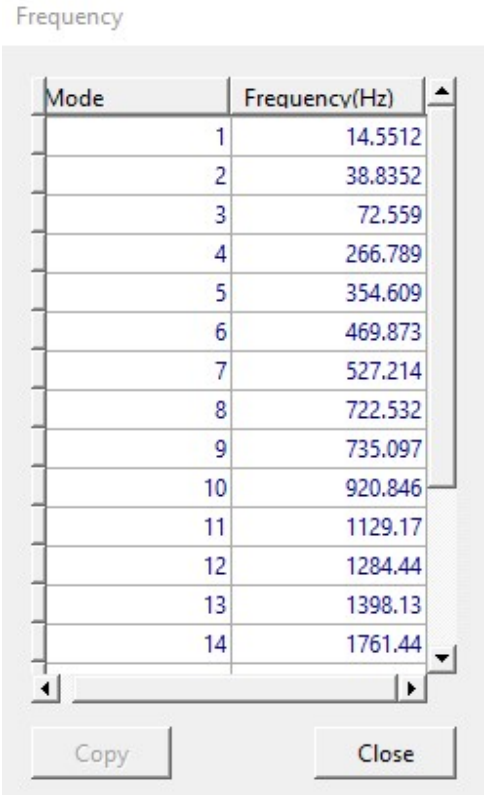
Command: POST, TABLEVIEW

Menu : Post→View Table

Parameters :

Item	Frequency

The following table will be displayed



ii. Deformed Shape

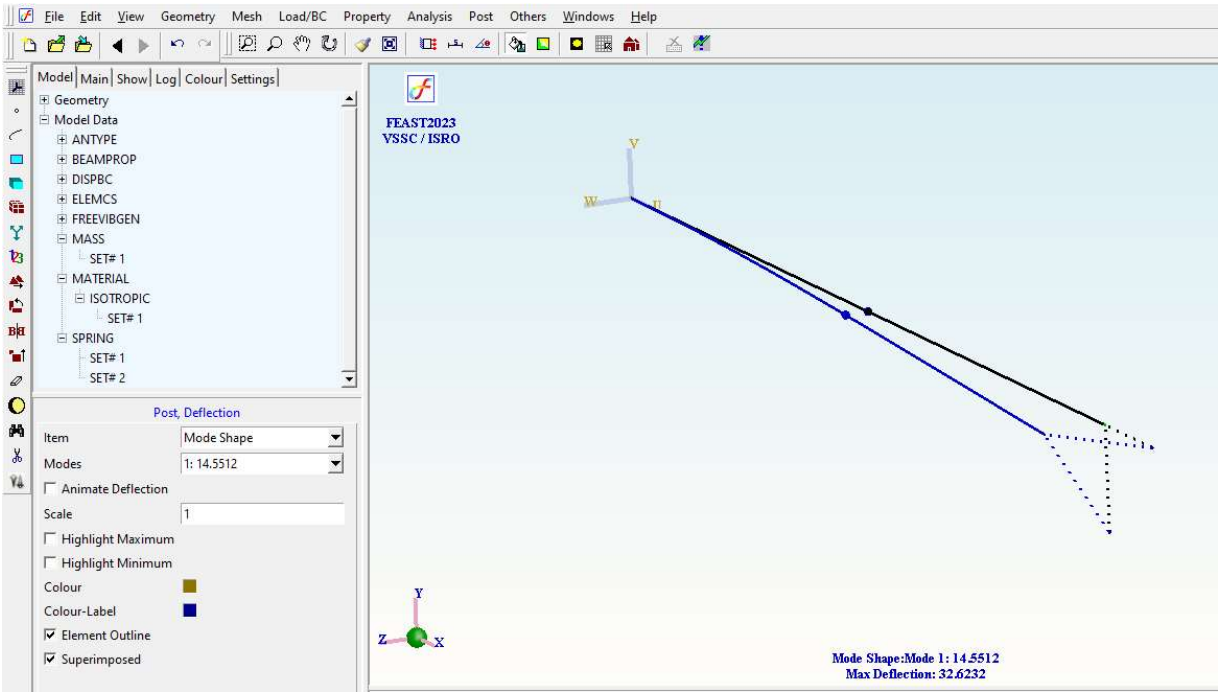
Command :POST,DEFLECTION

Menu : Post→Deflection

Parameters :

Item	Mode Shape
Modes	Select required mode from the list

The mode shape will be displayed as follows


File Edit View Geometry Mesh Load/BC Property Analysis Post Others Windows Help
Model Main Show Log Colour Settings
Geometry
Model Data
ANTYPE
BEAMPROP
DISPBC
ELEMCS
FREEVIBGEN
MASS
SET# 1
MATERIAL
ISOTROPIC
SET# 1
SPRING
SET# 1
SET# 2
Post, Deflection
Item
Mode Shape
Modes
1: 14.5512
Animate Deflection
Scale
1
Highlight Maximum
Highlight Minimum
Colour
Colour-Label
Element Outline
Superimposed
FEAST2023
VSSC / ISRO
Mode Shape:Mode 1: 14.5512
Max Deflection: 32.6232