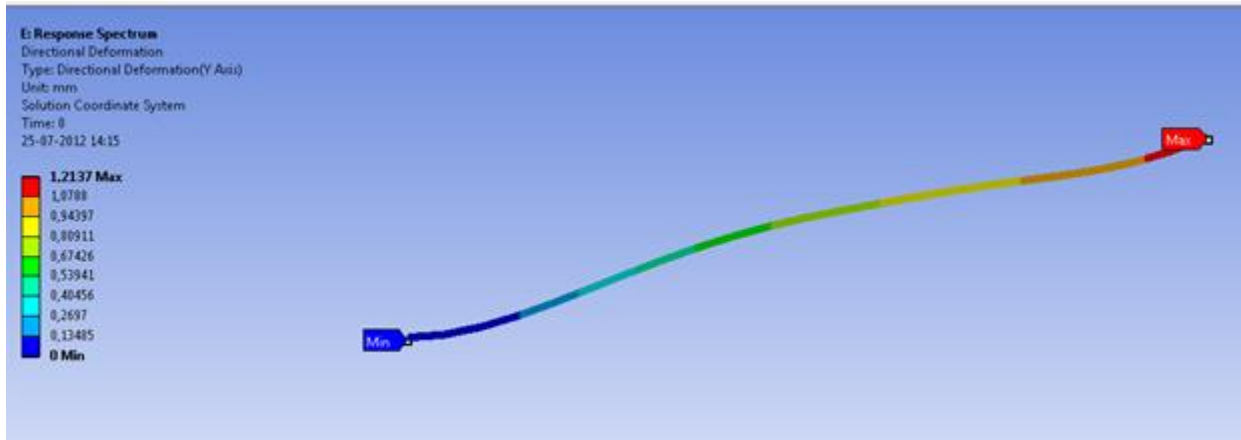
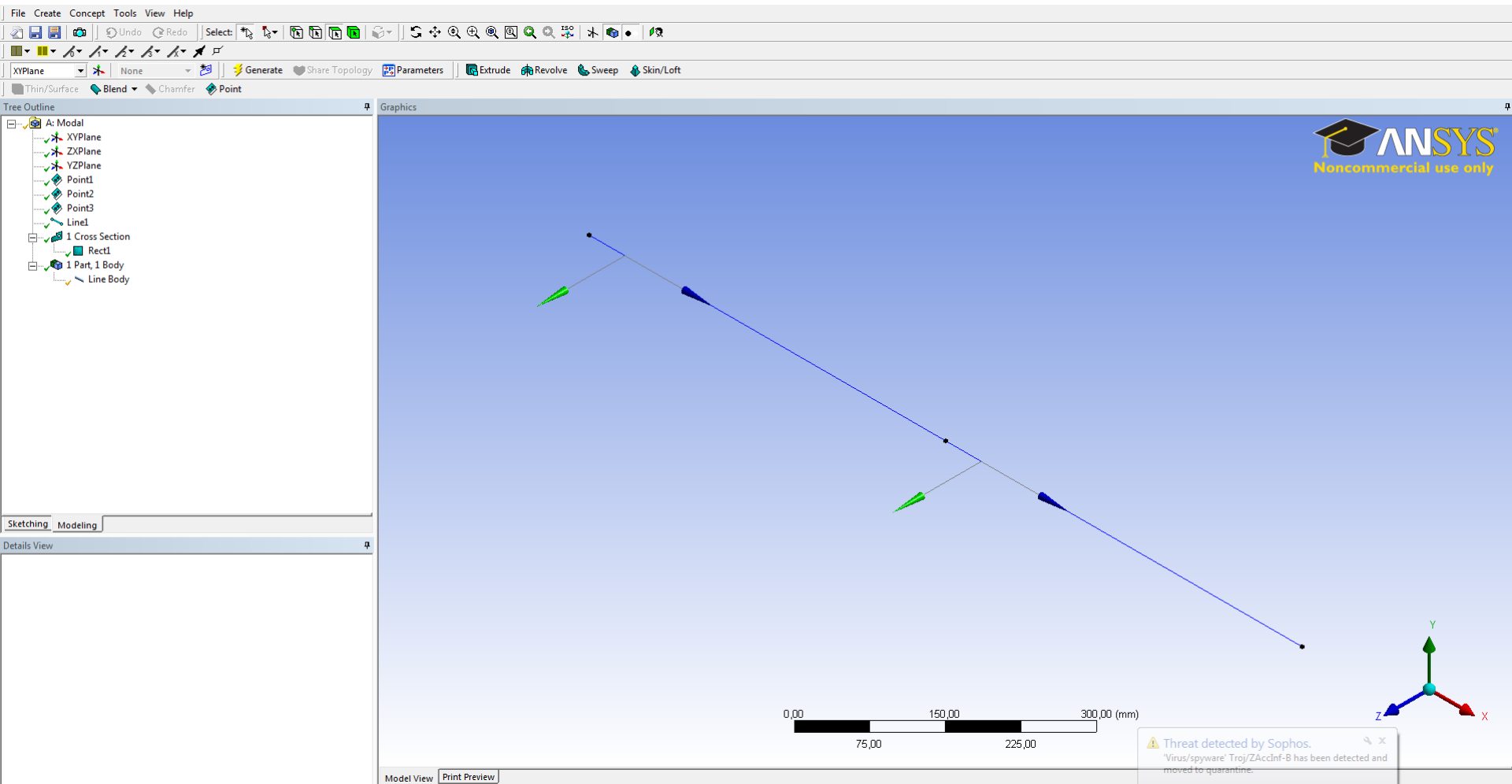


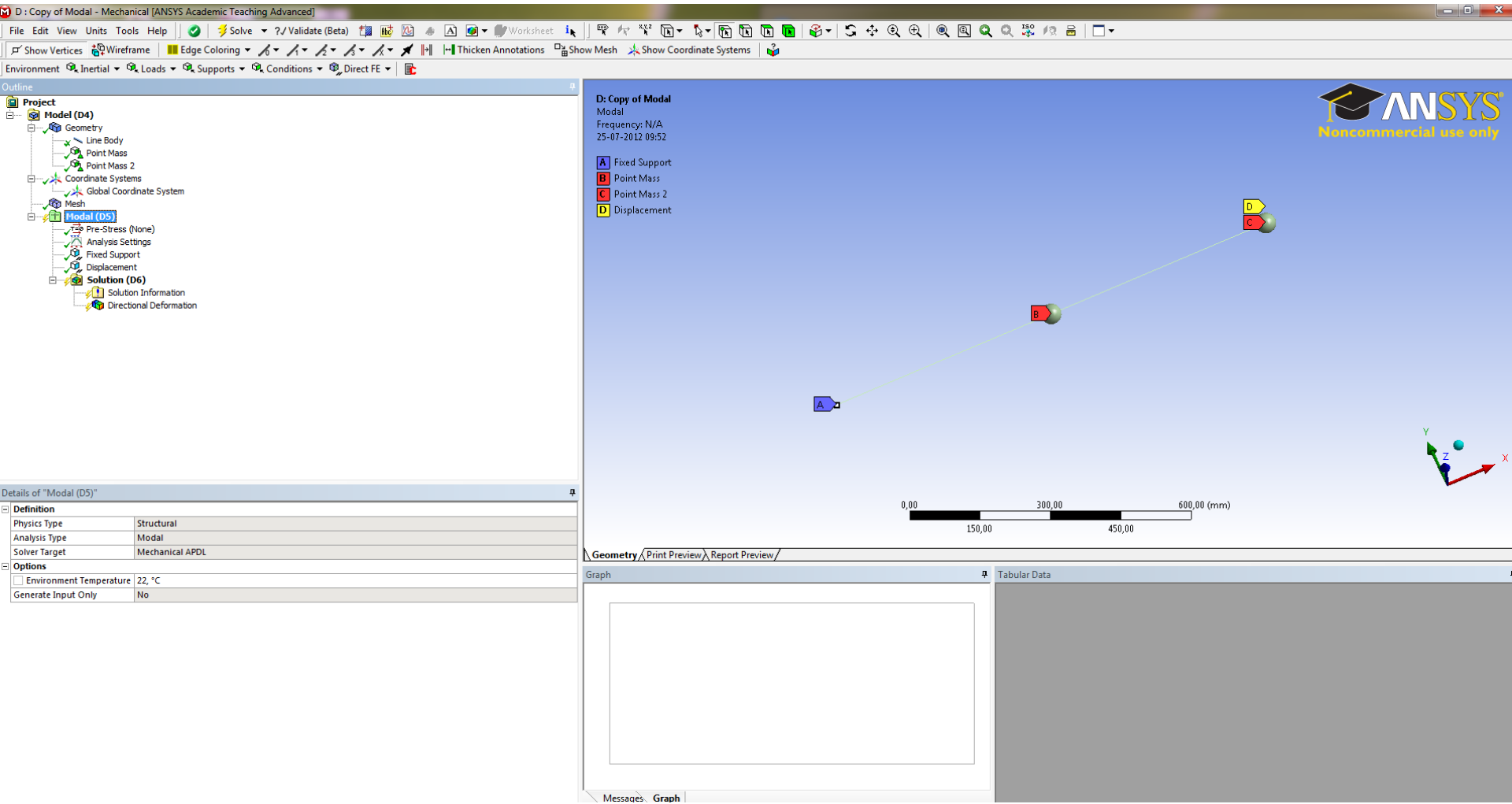
Response Spectrum analysis Workbench 14.0



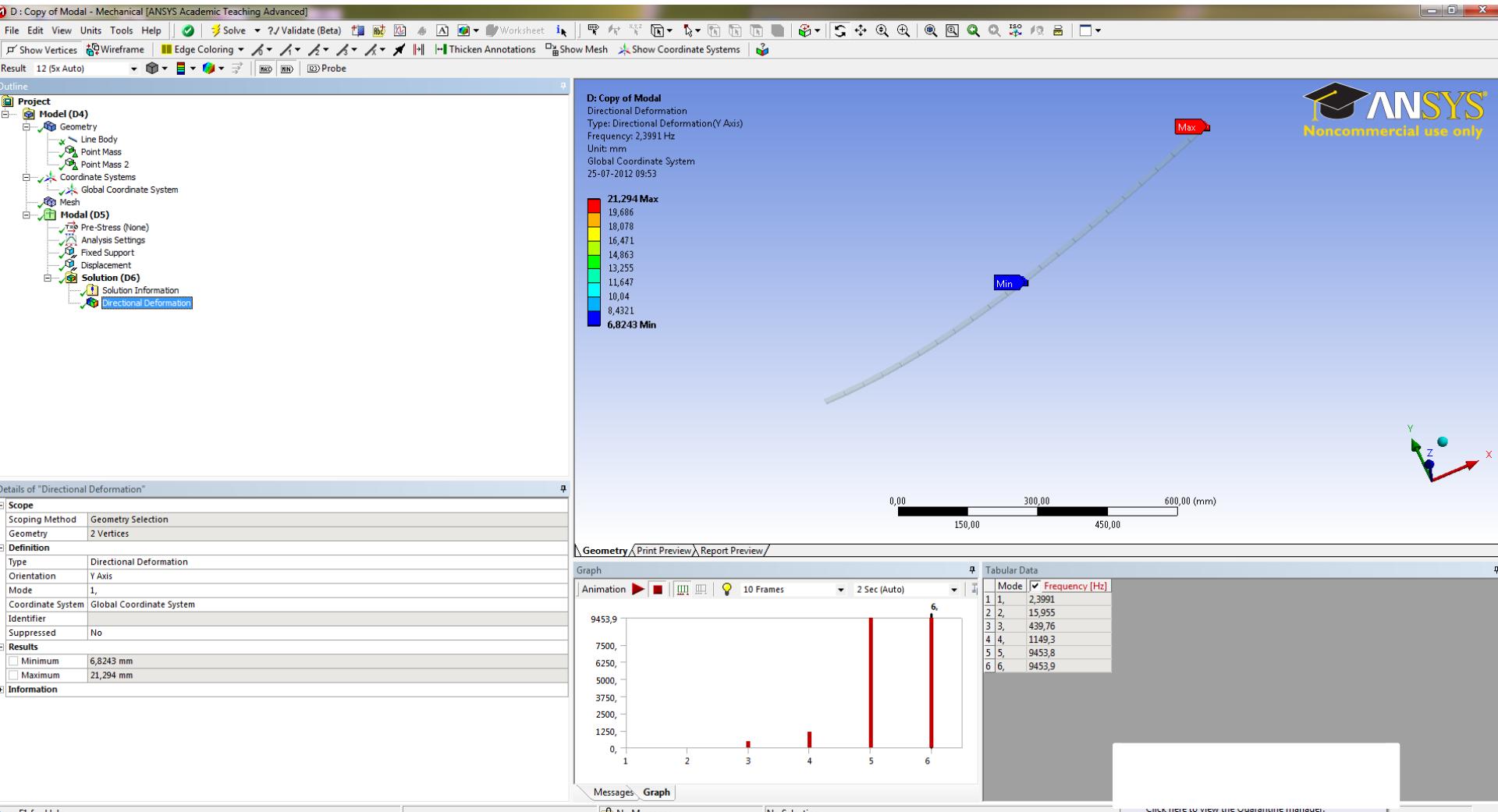
Aalborg Universitet Esbjerg
Søren Heide Lambertsen



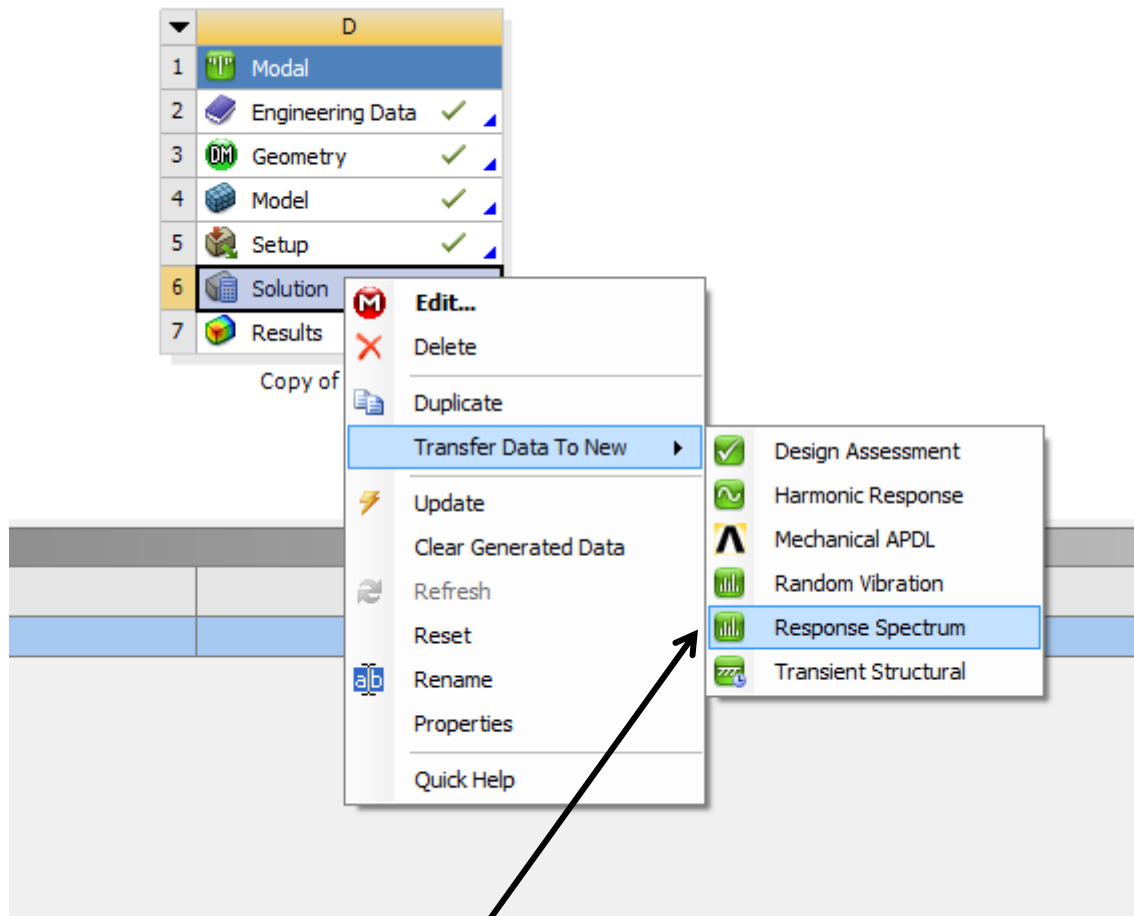
Make a beam model with the cross section dimension at 10X10mm and build the model with three point at a 500 distance. In this example the density of the beam is 1 kg/m^3



Setup the model with two mass point at 2 kg each. Set the displacement in the z direction to zero to make it look like a 2D analysis. Add a Fixed support at the end of the beam and solve the system.



The Modal solution in the y direction



Then add a Response Spectrum from fra modal solution

Multiple Systems - Mechanical [ANSYS Academic Teaching Advanced]

File Edit View Units Tools Help

Show Vertices Wireframe Edge Coloring Thicken Annotations Show Mesh Show Coordinate Systems

Environment RS Base Excitation

Outline

- Project
 - RS Acceleration
 - RS Velocity
 - RS Displacement
- Model
 - Coordinate Systems
 - Mesh
 - Modal (D5)
 - Pre-Stress (None)
 - Analysis Settings
 - Fixed Support
 - Displacement
 - Solution (D6)
 - Solution Information
 - Directional Deformation
 - Response Spectrum (E5)
 - Modal (Modal)
 - Analysis Settings
 - Solution (E6)
 - Solution Information

Details of "Analysis Settings"

Options

Number Of Modes To Use	All
Spectrum Type	Single Point
Modes Combination Type	SRSS

Output Controls

Calculate Velocity	No
Calculate Acceleration	No

Damping Controls

Analysis Data Management

E: Response Spectrum

Analysis Settings
Time: 1, s
25-07-2012 10:41

ANSYS
Noncommercial use only

0,00 150,00 300,00 450,00 600,00 (mm)

Geometry Print Preview Report Preview

Messages

Error	Text	Association	Timestamp
Error	You need at least one structural load to proceed with the solution.	Project> Model> Response Spectrum> Solution	7/25/2012 10:41:25 AM
Error	You need at least one structural load to proceed with the solution.	Project> Model> Response Spectrum	7/25/2012 10:41:25 AM

Threat detected by Sophos.
"Virus/spyware" Trojan/Zacclnf-B has been detected and moved to quarantine.

Then open the Response Spectrum and insert RS Displacement.

Details of "RS Displacement" 🔍

[-] **Scope**

Boundary Condition	None
--------------------	------

[-] **Definition**

Load Data	Tabular Data
Scale Factor	1,
Direction	None
Rigid Response Effect	No
Suppressed	No



Then select ALL BC Support under Boundary condition

Details of "RS Displacement"

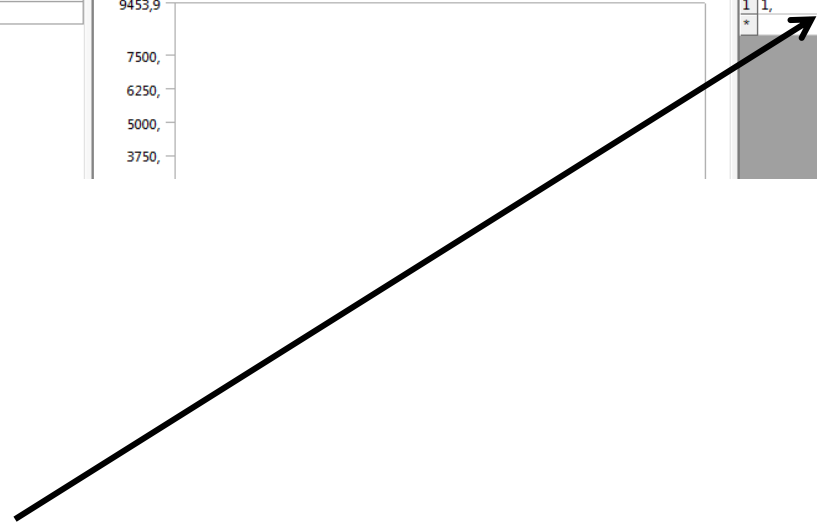
Scope	
Boundary Condition	All BC Supports
Definition	
Load Data	Tabular Data
Scale Factor	1,
Direction	None
Rigid Response Effect	No
Suppressed	No

0,00 150,00 300,00 450,00 600,00 (mm)

Geometry | Print Preview | Report Preview

Graph

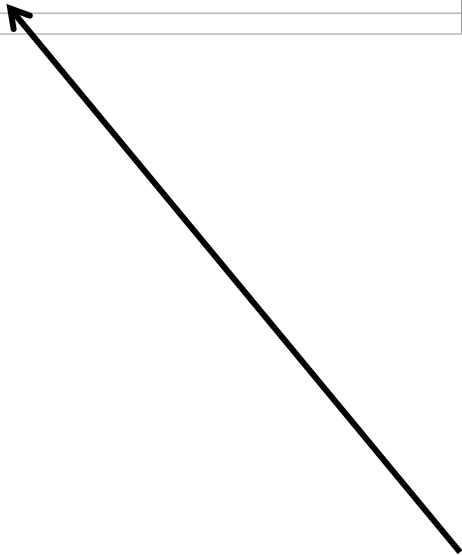
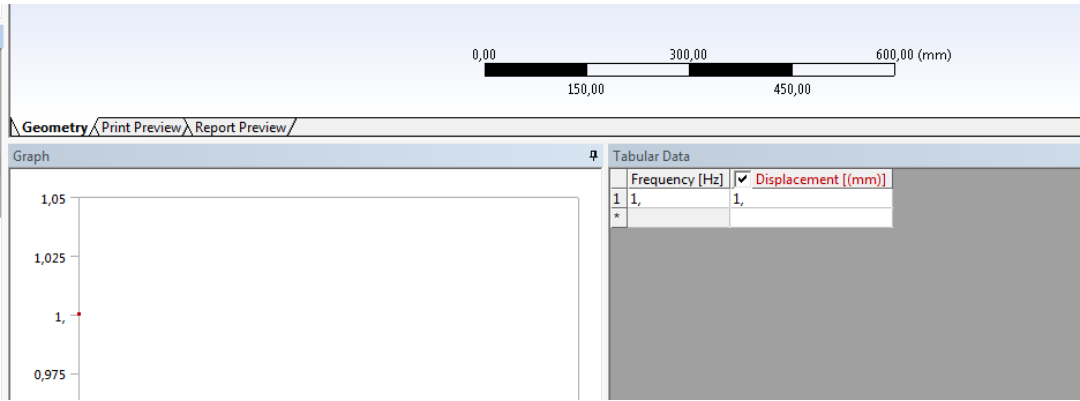
Tabular Data	
Frequency [Hz]	Displacement [(mm)]
1	1,
*	*



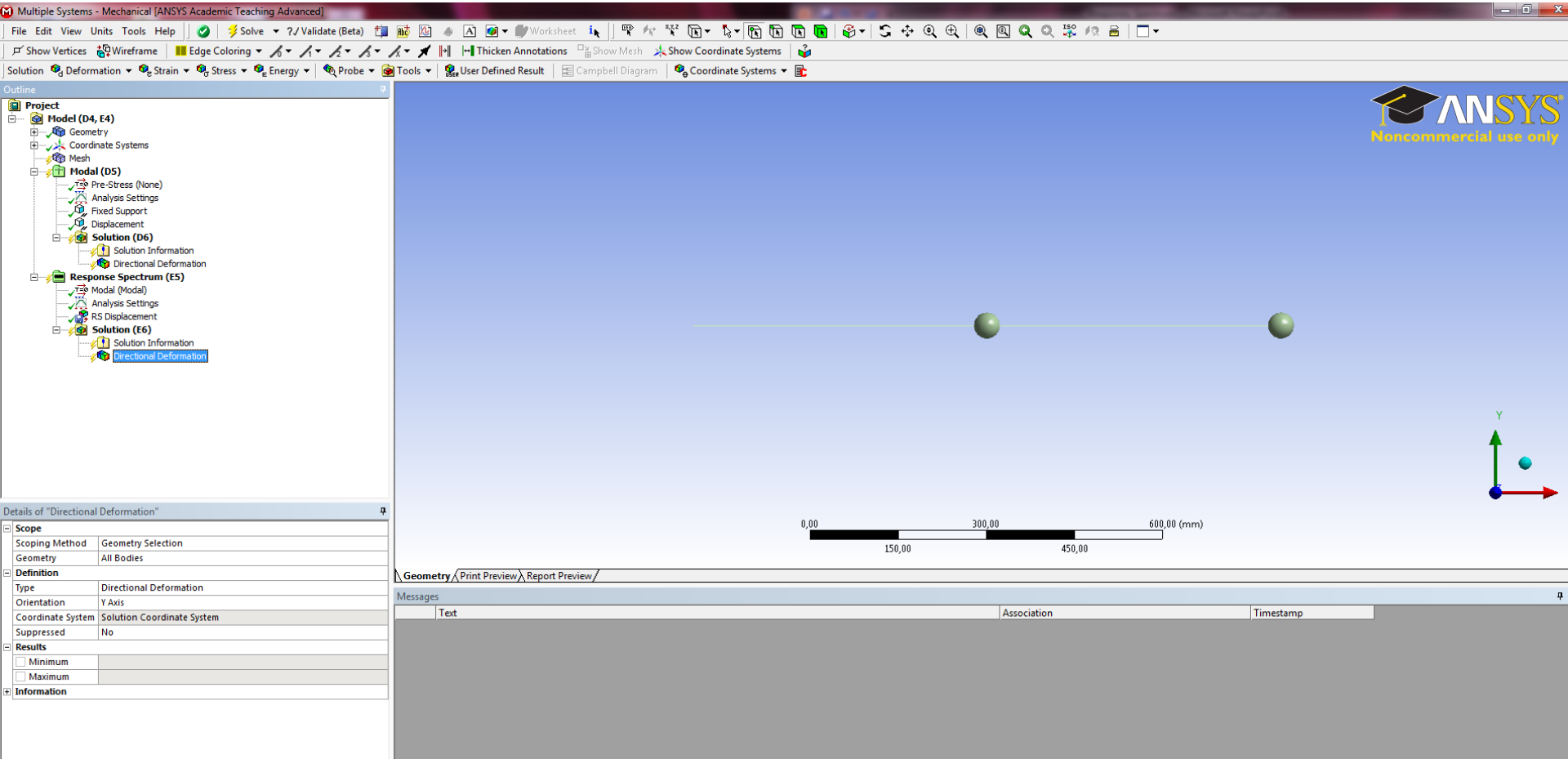
Insert the Response Data

Details of "RS Displacement"

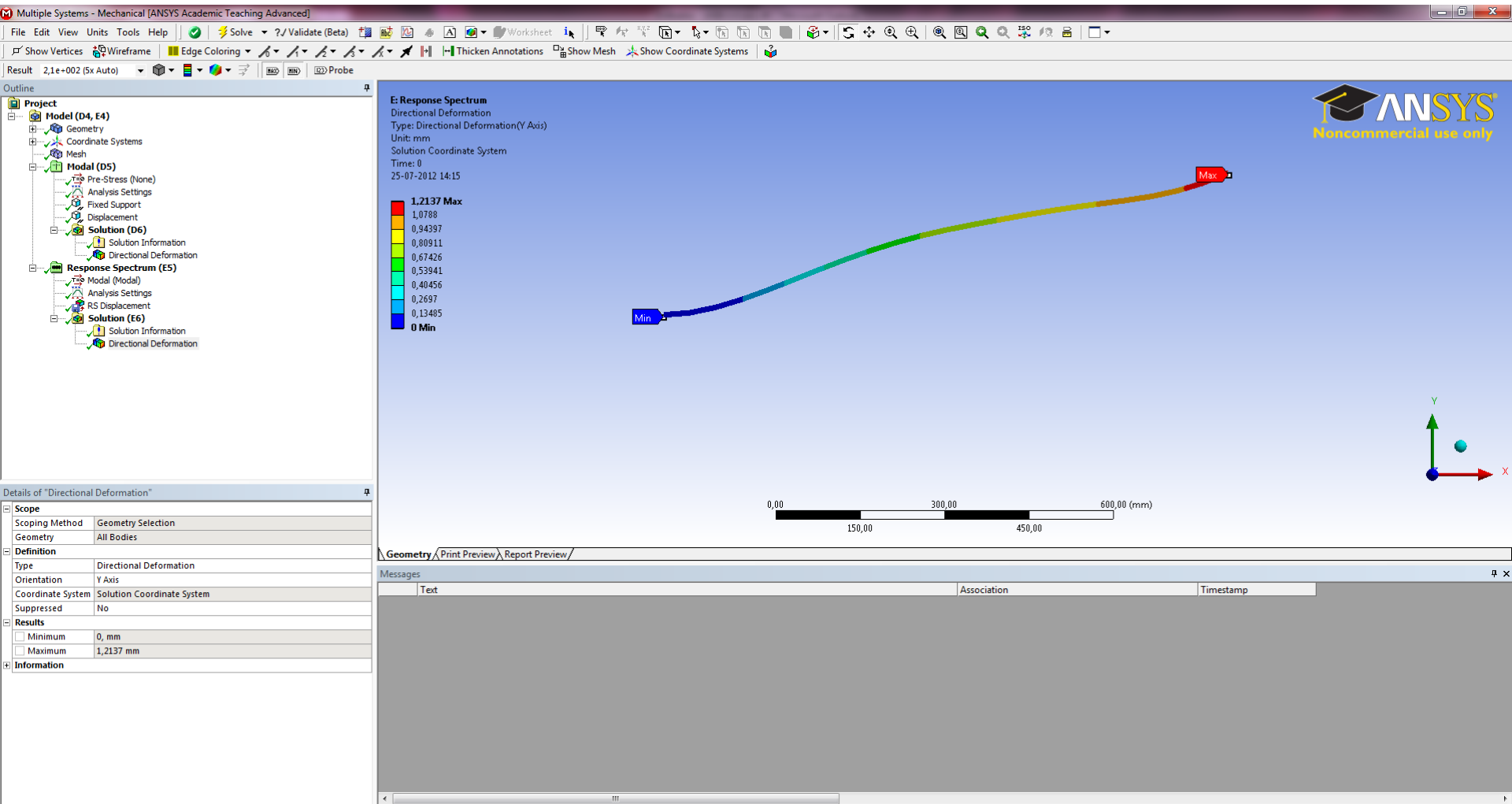
Scope	
Boundary Condition	All BC Supports
Definition	
Load Data	Tabular Data
Scale Factor	1,
Direction	Y Axis
Rigid Response Effect	No
Suppressed	No



And set the Direction Y axis



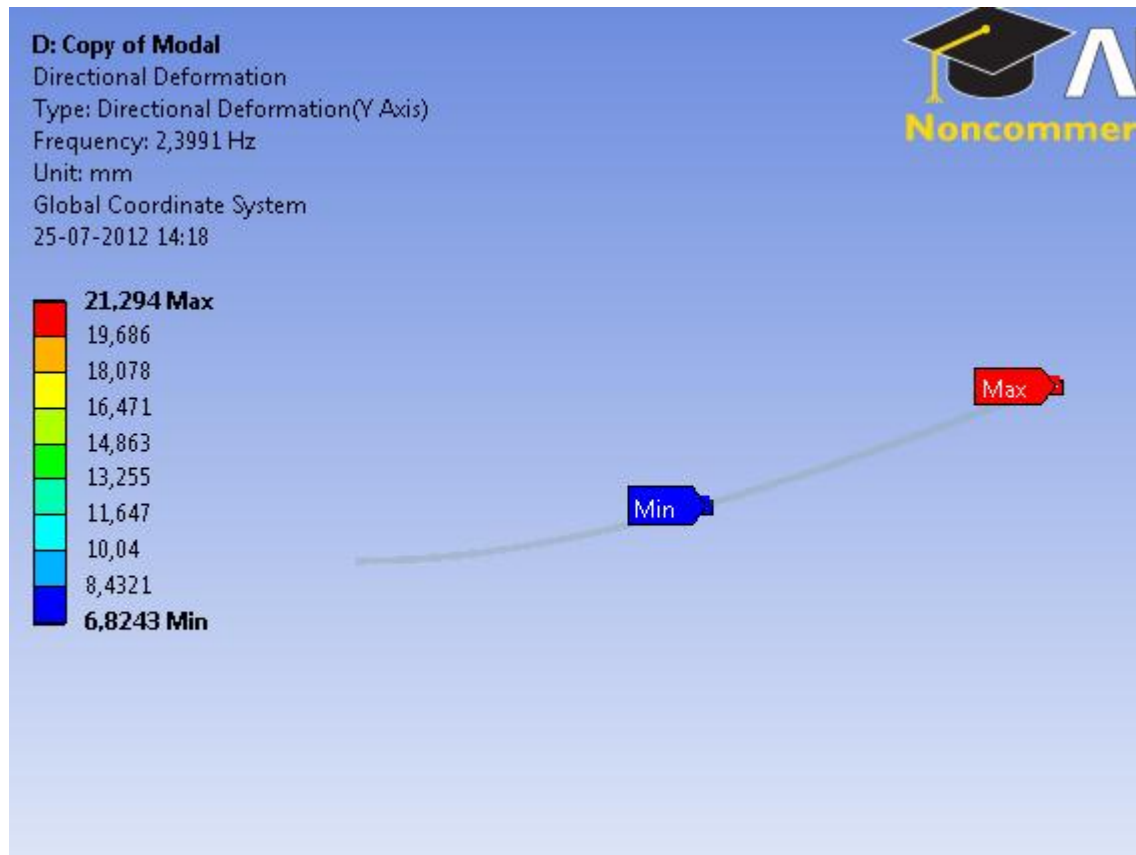
Plot the y deformation and solve



And the result. It is also possible to calculate the result by hand.

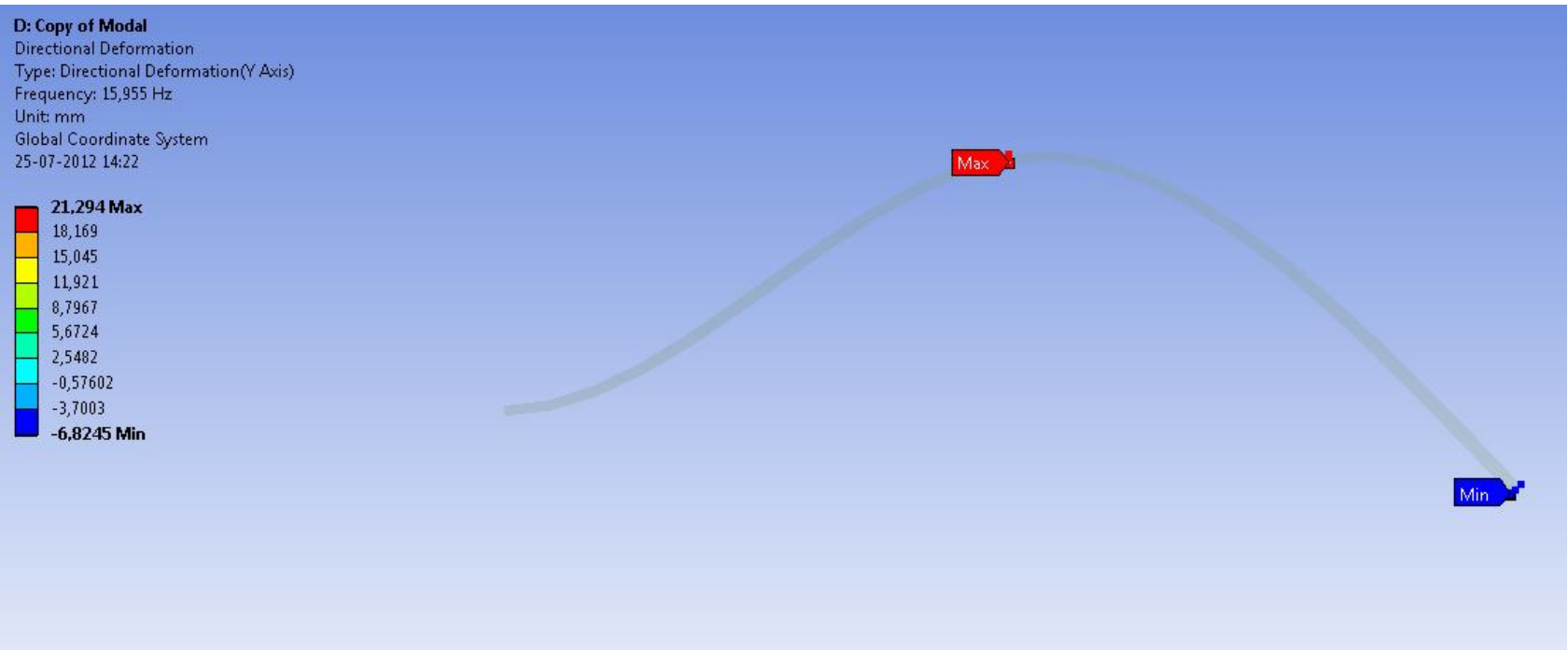
We will use the first two modes from the modal analysis and calculate on two points.

$$\text{Mode 1} = \begin{pmatrix} 0 \\ 6.8243 \\ 21.294 \end{pmatrix}$$



We will use the first two modes from the modal analysis and calculate on two points.

$$\text{Mode 2} = \begin{pmatrix} 0 \\ 21.294 \\ -6.8245 \end{pmatrix}$$



Displacement mode 1 and mode 2 from the modal analysis

$$\theta_1[\text{Mode 1}] = \begin{pmatrix} 0 \\ 6.8243 \\ 21.294 \end{pmatrix} \quad \theta_2[\text{Mode 2}] = \begin{pmatrix} 0 \\ 21.294 \\ -6.8245 \end{pmatrix}$$

The weight vector

$$w = \begin{pmatrix} 0 \\ 2 \\ 2 \end{pmatrix}$$

Check Mass Participation

$$M_k = \frac{(\sum_{i=1}^n W_i \theta_{ik})^2}{\sum_{i=1}^n W_i (\theta_{ik})^2} \quad M_{\text{Participation}} = \sum_{k=1}^m M_k$$

	θ_1 [Mode 1]			θ_2 [Mode 2]		
W_i	θ_1	$W_i\theta_{ik}$	$W_i(\theta_{ik})^2$	θ_2	$W_i\theta_2$	$W_i(\theta_2)^2$
0	0	0	0	0	0	0
2	6,8243	13,6486	93,14214	21,294	42,588	906,8689
2	21,294	42,588	906,8689	-6,8245	-13,649	93,1476
\sum SUM		56,2366	1000,011		28,939	1000,016

Check Mass Participation

Mode	1	2
M_k	3,16252	0,837452

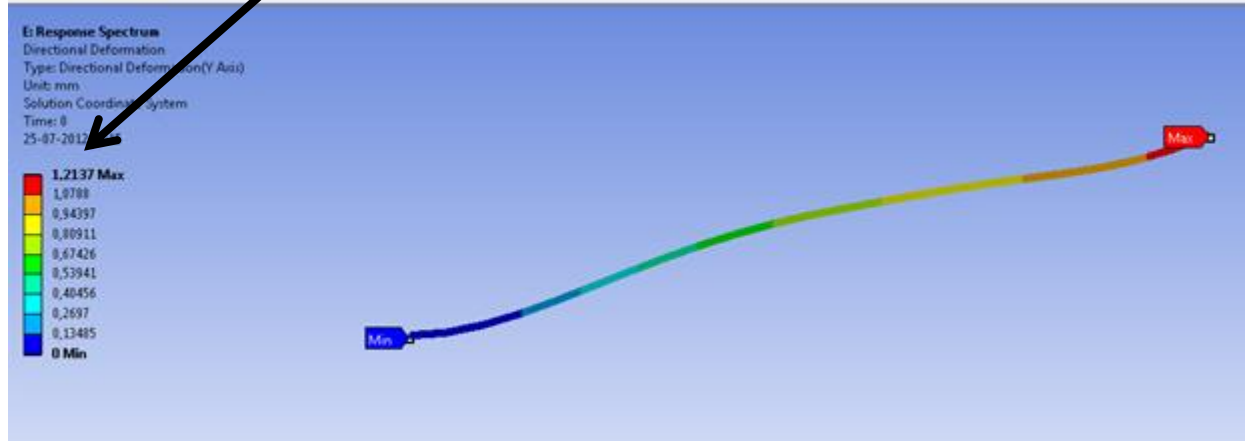
$$M_{Participation} = 3.16252 + 0.837452 = 3.999$$

$$P_k = \frac{\sum_{i=1}^n W_i \theta_{ik}}{\sum_{i=1}^n W_i (\theta_{ik})^2}$$

Calculate mode participation factors			
Mode	1	2	
P_k	0,056236	0,028939	

$$P_k \theta_i =$$

	Mode 1	Mode 2
	0	0
Node	0,383771	0,616217
Node	1,197489	-0,19749
SQSS	1,213665	



References:

- [1] [http://www.edr.se/blogg/blogg/ansys tutorial earthquake analyses in workbench](http://www.edr.se/blogg/blogg/ansys_tutorial_earthquake_analyses_in_workbench)
- [2] Seismic Analysis of Multi-storied RC Building *Presented by* Rahul Leslie
http://www.google.dk/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=4&ved=0CFcQFjAD&url=http%3A%2F%2Fwww.sefindia.org%2Fforum%2Fdownload.php%3Fid%3D4798%26sid%3D87dfeb5a80a2afd5ffc986a87fe604c5&ei=Z-EPUNb0KJDE4gSXv4GAAQ&usg=AFQjCNEkkIJ5zCZAq_5sgDQFGLZiMT7XNw&sig2=L5pr_eCHq4pakW6SIxmCEA