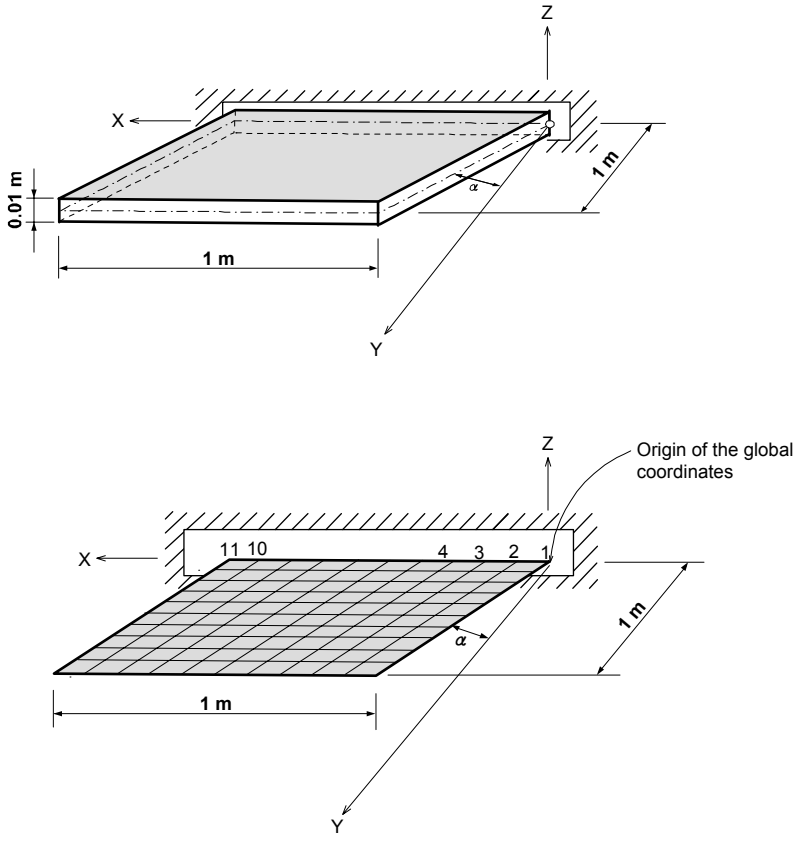
Eigen-10

Title

Eigenvalue analysis of a skewed cantilever plate

Description

A skewed cantilever plate is analyzed to determine the first 2 natural frequencies. Determine the natural frequencies and modes.



Structural geometry and analysis model

MODEL

Analysis Type

3-D eigenvalue analysis

Unit System

m, N

Dimension

Length 1 m Width 1 m

Element

Plate element

Material

Modulus of elasticity $E = 2.1\times10^5$ MPa
Poisson's ratio $\nu = 0.3$
Weight density $\gamma = 7.80$ tf/m^3

Sectional Property

Rectangular cross-section: width 1 m, thickness 0.01 m

Boundary Condition

Node 1~11: Constrain all DOFs

Analysis Case

Eigenvalue analysis

Results

EIGENVALUE ANALYSIS					
	Mode No	Frequency (rad/sec)	Frequency (cycle/sec)	Period (sec)	Tolerance
	1	54,239348	8,632460	0,115842	3,0915e-016
	2	131,878739	20,989153	0,047644	2,0918e-016

the first 2 natural frequencies ($\alpha = 0°$)

EIGENVALUE ANALYSIS					
	Mode No	Frequency (rad/sec)	Frequency (cycle/sec)	Period (sec)	Tolerance
	1	55,960117	8,906329	0,112280	1,1617e-015
	2	134,769863	21,449290	0,046622	1,0015e-015

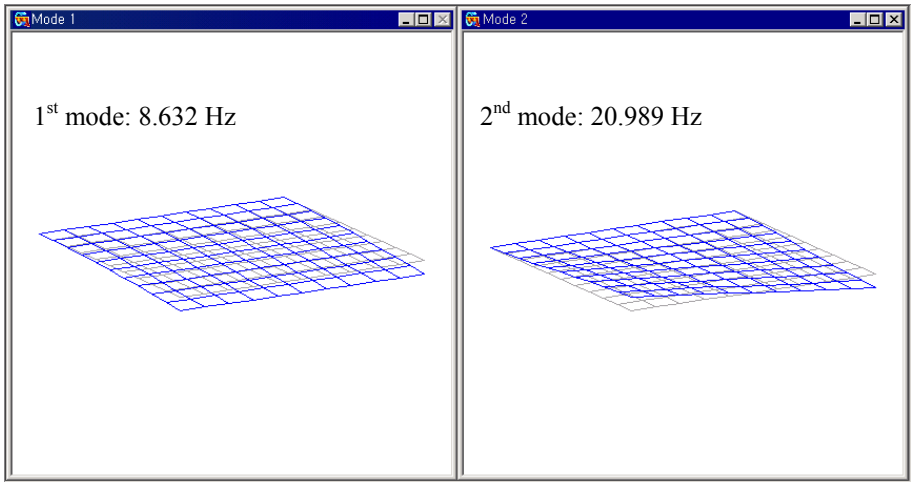
the first 2 natural frequencies ($\alpha = 15°$)

EIGENVALUE ANALYSIS					
	Mode No	Frequency (rad/sec)	Frequency (cycle/sec)	Period (sec)	Tolerance
	1	61,247760	9,747884	0,102586	0,0000e+000
	2	145,570464	23,168259	0,043163	1,0301e-015

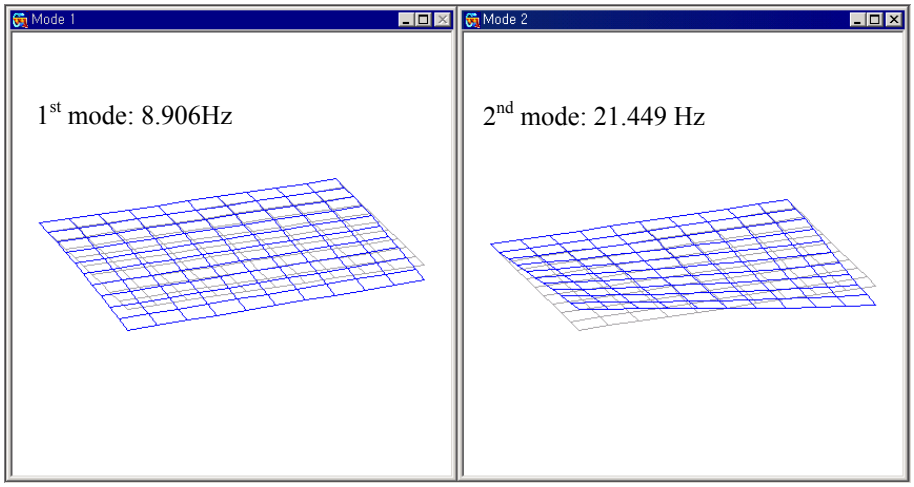
the first 2 natural frequencies ($\alpha = 30°$)

EIGENVALUE ANALYSIS					
	Mode No	Frequency (rad/sec)	Frequency (cycle/sec)	Period (sec)	Tolerance
	1	70,112587	11,158765	0,089616	0,0000e+000
	2	173,283105	27,578863	0,036260	3,6347e-016

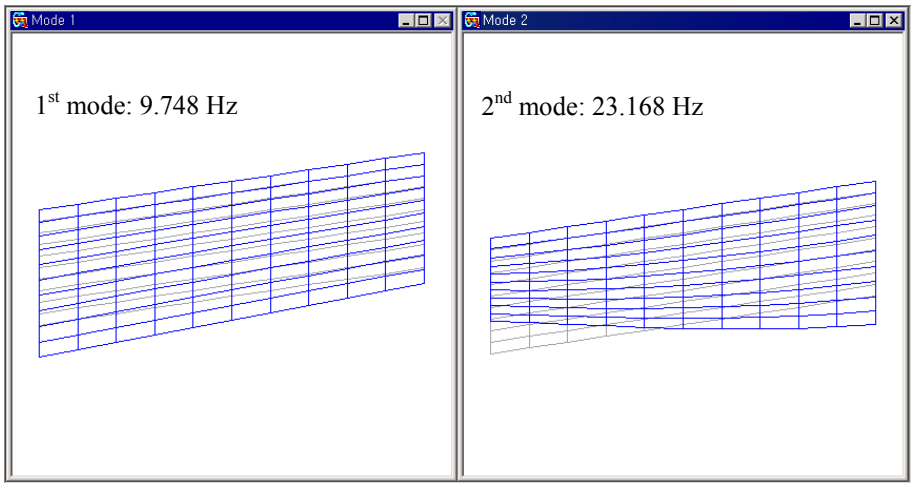
the first 2 natural frequencies ($\alpha = 45°$)



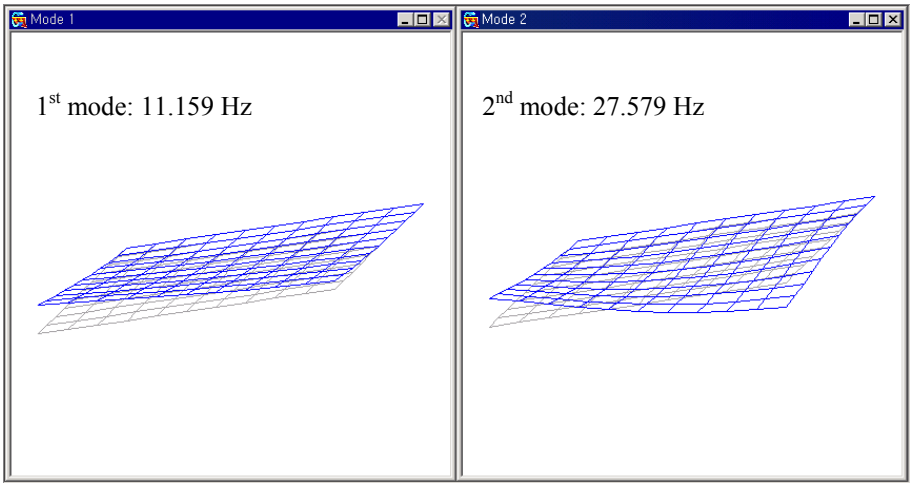
the first 2 mode shapes ($\alpha = 0°$)



the first 2 mode shapes ($\alpha = 15°$)



the first 2 mode shapes ($\alpha = 30°$)



the first 2 mode shapes ($\alpha = 45°$)

Comparison of Results

Unit: Hz

Frequency			
Skew Angle	Mode	Theoretical	MIDAS/Civil
$\alpha = 0°$	1st	8.727	8.632
	2nd	21.304	20.989
$\alpha = 15°$	1st	8.999	8.906
	2nd	22.171	21.449
$\alpha = 30°$	1st	9.899	9.748
	2nd	25.465	23.168
$\alpha = 45°$	1st	11.150	11.159
	2nd	27.000	27.579

References

Afnor (1990). "*Guide de Validation des Progiciels de Calcul de Structures*", SFM, Afnor Technique, France.

Barton, M. V. (1951). "*Vibration of Rectangular and Skew Cantilever Plates*" J. Appl. Mech. **18**, 129-134.