

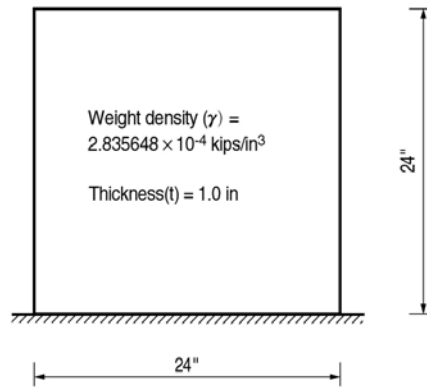
Eigen-6

Title

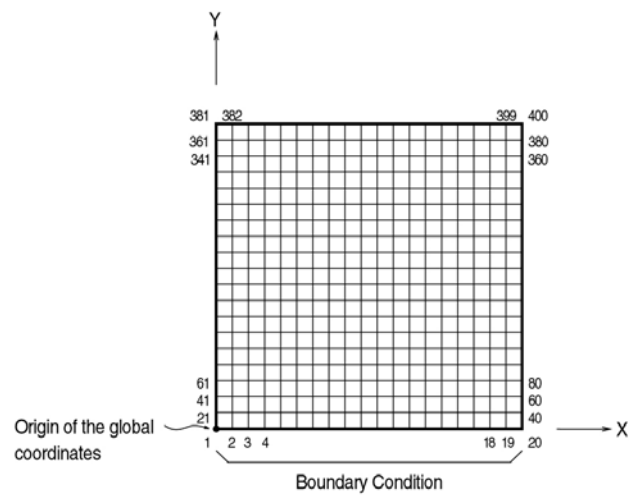
Eigenvalue analysis of a cantilever plate

Description

Calculate the natural frequencies of a square cantilever plate.



(a) Square cantilever plate



(b) Structure modeled with plate elements

Structural geometry and analysis model

Model

Analysis Type

3-D eigenvalue analysis

Unit System

in, kip

Dimension

Length 24.0 in Width 24.0 in Thickness 1.0 in

Gravitational acceleration $g = 386.4 \text{ in/sec}^2$

Element

Plate element (Thick type)

Material

Modulus of elasticity E = $29.5 \times 10^3 \text{ ksi}$

Poisson's ratio ν = 0.3

Weight density γ = $2.835648 \times 10^{-4} \text{ kips/in}^3$

Element Property

Element size $a \times b$ = $24.0/19 \text{ in} \times 24.0/19 \text{ in}$

Thickness t = 1.0 in

Boundary Condition

Nodes 1 ~ 20 ; Constrain all DOFs.

All nodes ; Constrain Dx, Dy and Rz.

Analysis Case

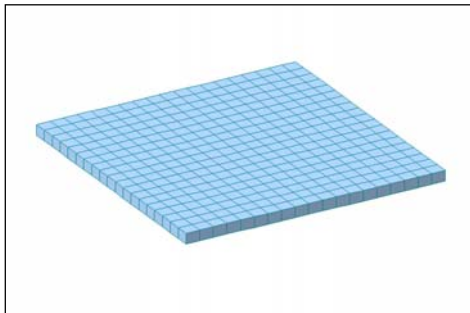
Self weight is converted to nodal masses automatically.

Number of natural frequencies to be computed = 5

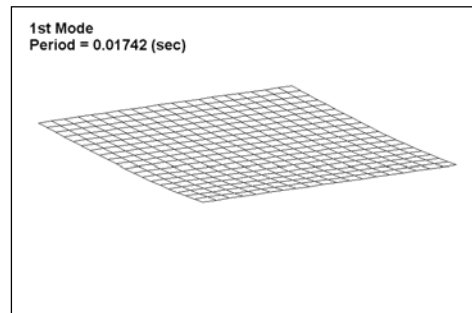
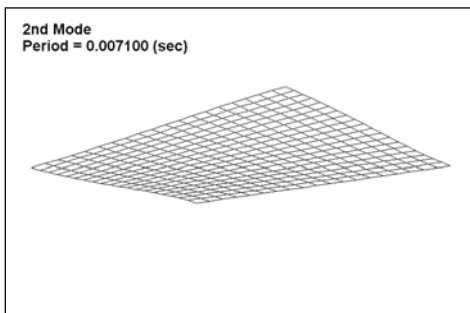
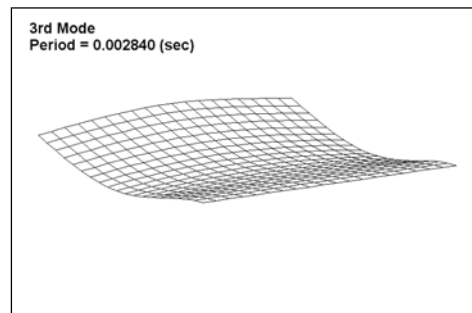
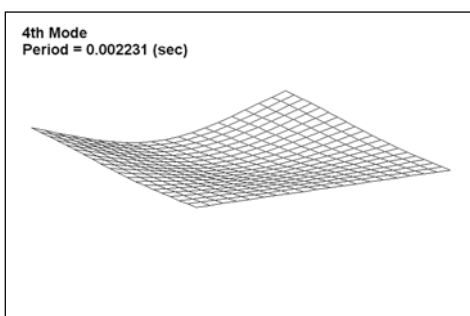
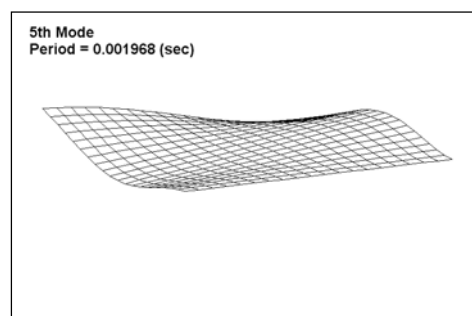
Results

Eigenvalue Analysis Results

EIGENVALUE ANALYSIS													
Mode No	Frequency				Period		Tolerance						
	(rad/sec)		(cycle/sec)		(sec)								
1	364,418220		57,998961		0,017242		6,5746e-016						
2	884,905700		140,837116		0,007100		1,1001e-014						
3	2212,058839		352,060099		0,002840		9,1040e-011						
4	2815,770830		448,143846		0,002231		2,2671e-007						
5	3192,095616		508,037796		0,001968		3,1802e-008						
MODAL PARTICIPATION MASSES(%) PRINTOUT													
Mode No	TRAN-X		TRAN-Y		TRAN-Z		ROTN-X		ROTN-Y		ROTN-Z		
	MASS	SUM	MASS	SUM	MASS	SUM	MASS	SUM	MASS	SUM	MASS	SUM	SUM
1	0,00	0,00	0,00	0,00	62,72	62,72	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2	0,00	0,00	0,00	0,00	0,00	62,72	0,00	0,00	0,00	0,00	0,00	0,00	0,00
3	0,00	0,00	0,00	0,00	18,00	80,72	0,00	0,00	0,00	0,00	0,00	0,00	0,00
4	0,00	0,00	0,00	0,00	1,65	82,37	0,00	0,00	0,00	0,00	0,00	0,00	0,00
5	0,00	0,00	0,00	0,00	0,00	82,37	0,00	0,00	0,00	0,00	0,00	0,00	0,00
EIGENVECTOR													



(a) Finite element model

(b) 1st mode(c) 2nd mode(d) 3rd mode(e) 4th mode(f) 5th mode

Finite element model and the vibration modes

Comparison of Results

Mode	Unit : sec		
	Natural Period		
	Theoretical	SAP2000	MIDAS/Civil
1 st	0.01790	0.01781	0.01724
2 nd	0.00732	0.00648	0.00710
3 rd	0.00292	0.00285	0.00284
4 th	0.00228	0.00223	0.00223
5 th	0.00201	0.00187	0.00197

References

Harris, C. M. and Crede, C. E., “*Shock and Vibration Handbook*”, McGraw-Hill, 1976.

“*SAP90, A Series of Computer Programs for the Finite Element Analysis of Structures, Structural Analysis Verification Manual*”, Computer and Structures, Inc., 1992, Example 15.