

MeshFree Benchmark Series

免網格分析軟體-基準測試

Verification of Linear Dynamics

線性動力學驗證

01

Clamped Supported Thin Square Plate : Harmonic Forced Vibration Response

問題定義

A simply supported thin square plate 10 x 10 x 0.05 m is subject to uniform pressure $P=100$ Pa which changes in time as the following function

$$P=100*\sin(\omega*t),$$

here $\omega=2*\pi*f$, f is excitation frequency.

The excitation frequency changes in range from 0 to just above first resonant frequency of the plate.

16 modes are used to approximate dynamics solution, 2% modal damping is assumed in all modes.

單位: SI

材料屬性

楊氏係數 $2.e+11$ Pa, 泊松比 0.3, 密度 $8.e+3$ kg/m³.

參考

Test 13H from NAFEMS Publication R0016, "Selected Benchmarks for Forced Vibration" J.Maguire, D.J.Dawswell, L.Gould.

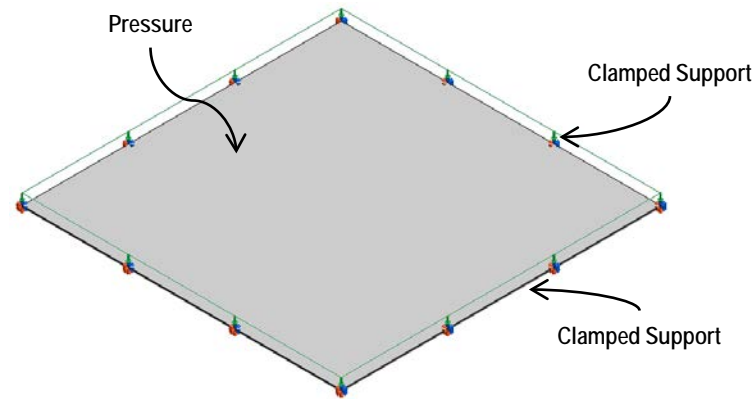
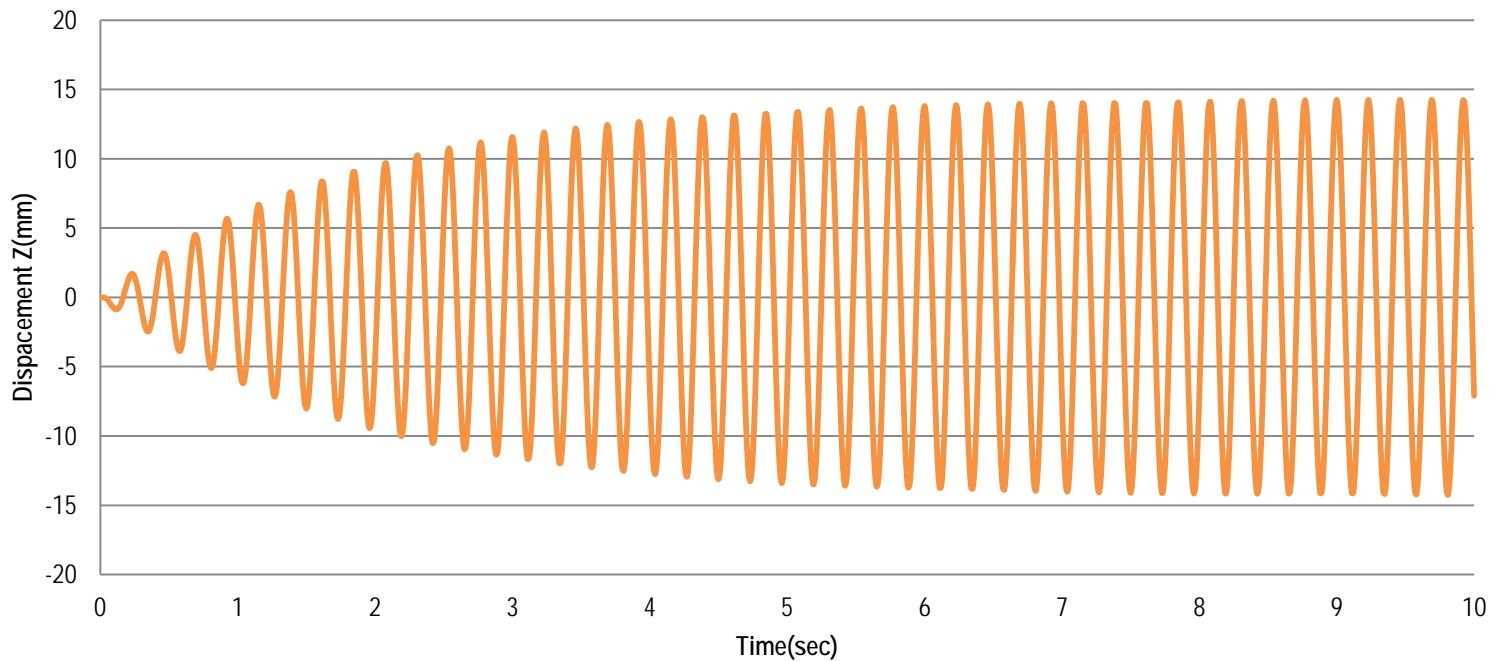


Fig. VD01

Deflection & Surface Stress

	Deflection Y, [mm]	Surface Stress, [MPa]
	14.26	16.42

NFX 3D Displacement - Time

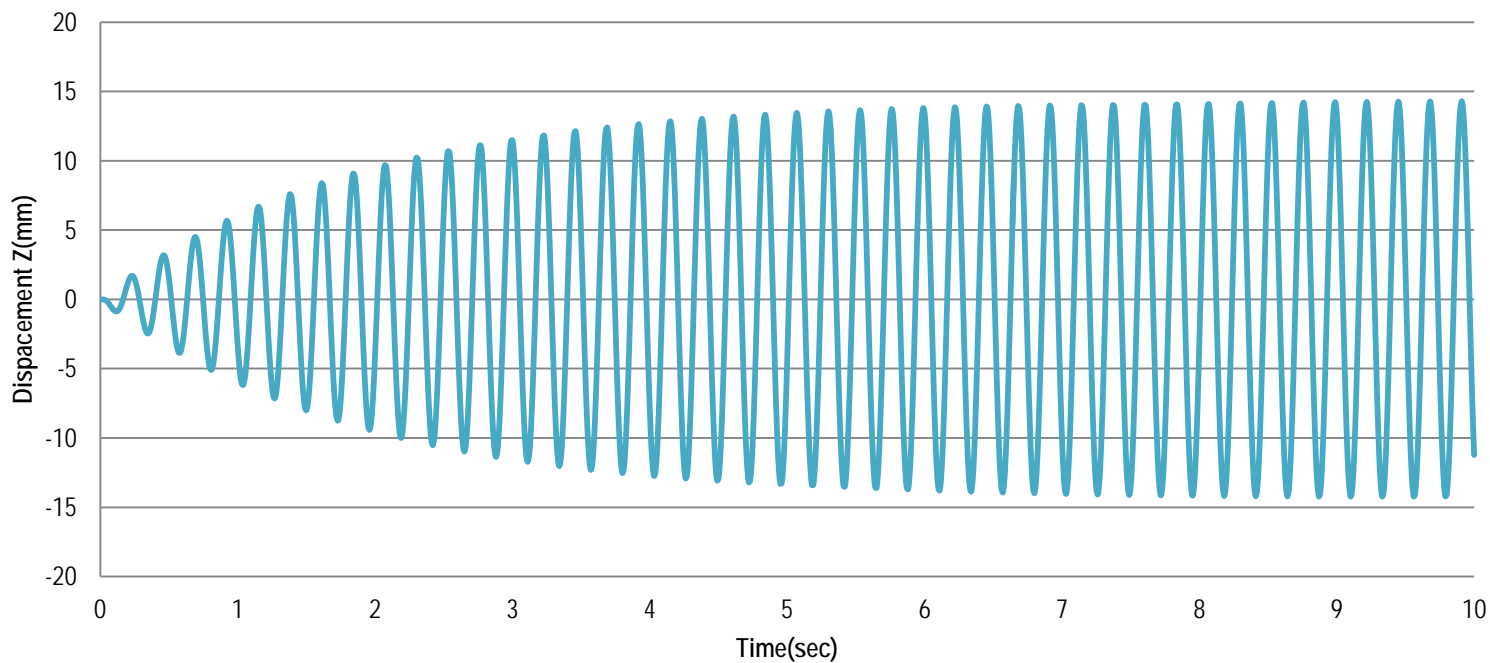


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Deflection & Surface Stress

	Deflection Y, [mm]	Surface Stress, [MPa]
	14.29	16.38

MeshFree 3D Displacement - Time



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02

Clamped Supported Thin Square Plate : Periodic forced Vibration Response

問題定義

A simply supported thin square plate 10 x 10 x 0.05 m is subject to uniform pressure $P=100$ Pa which changes in time as the following function

$$P=100*(\sin(\omega*t) - \sin(3\omega*t))$$

here $\omega=2*\pi*f$, $f=1.2\text{Hz}$ is excitation frequency.

16 modes are used to approximate dynamics solution, 2% modal damping is assumed in all modes.

單位: SI

材料屬性

楊氏係數 $2.e+11$ Pa, 泊松比 0.3, 密度 $8.e+3$ kg/m³.

條件和結果

In order to simulate periodic load changing according to the formula above, two pressure loads were applied to the plate:

$P=100*\sin(\omega*t)$, to the top surface of the plate, and

$P=-100*\sin(3\omega*t)$ to the bottom surface of the plate

參考

Test 13P from NAFEMS Publication R0016, "Selected Benchmarks for Forced Vibration" J.Maguire, D.J.Dawswell, L.Gould.

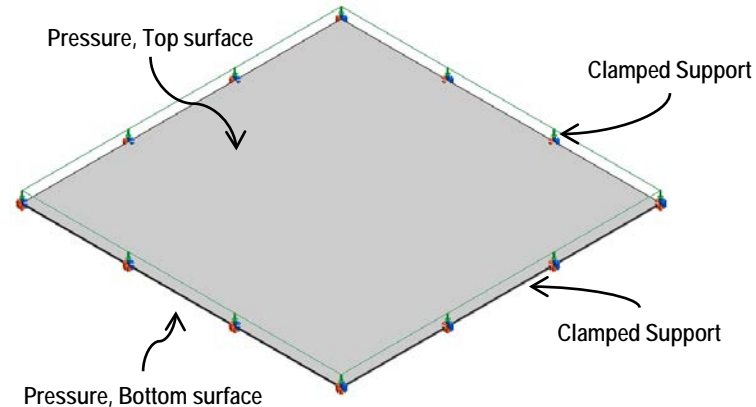
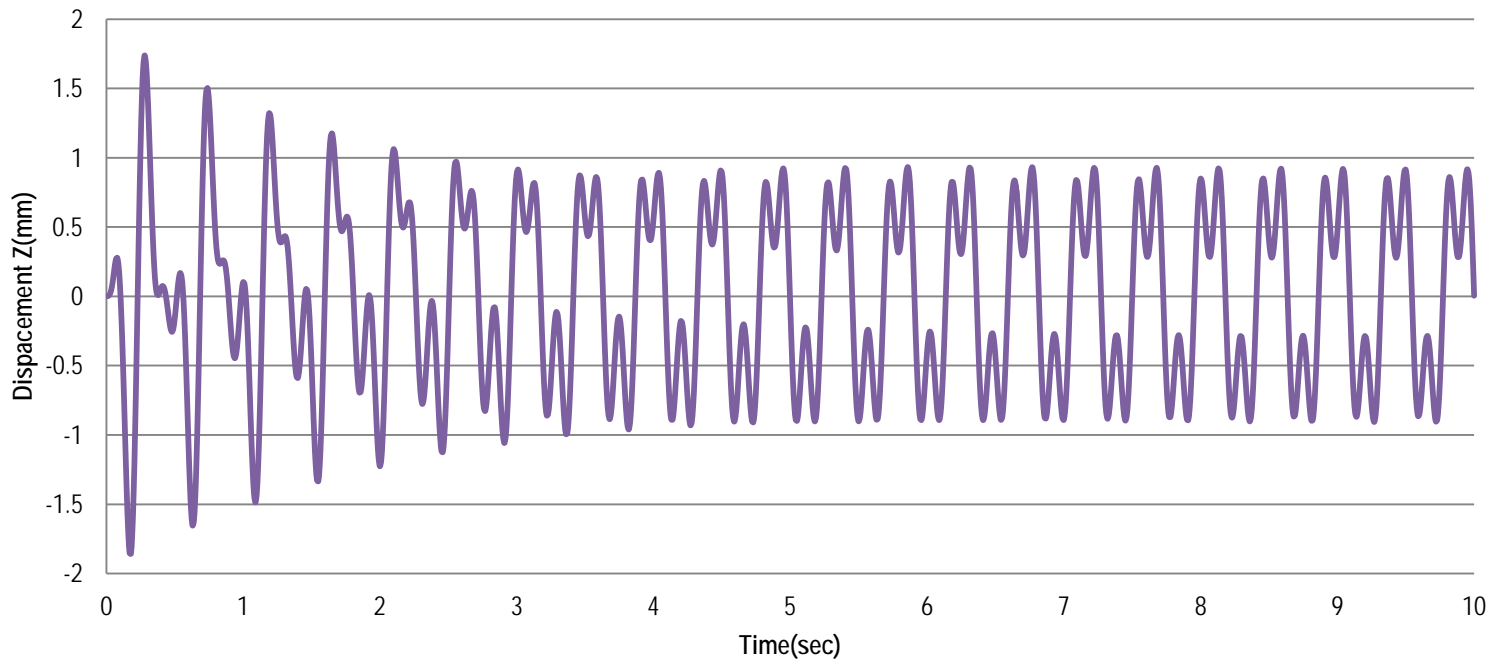


Fig. VD02

Deflection & Surface Stress

	Deflection Y, [mm]	Surface Stress, [MPa]
	1.85	2.19

NFX 3D Displacement - Time

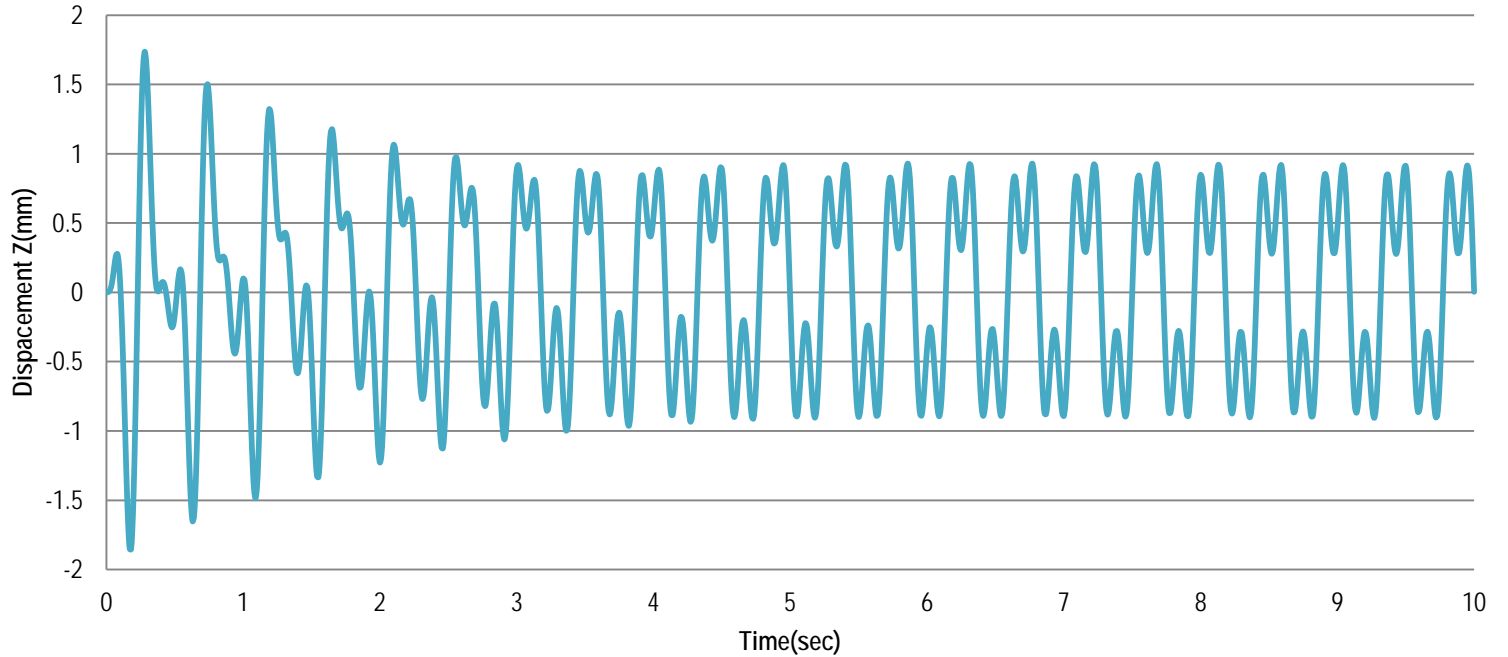


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Deflection & Surface Stress

	Deflection Y, [mm]	Surface Stress, [MPa]
	1.85	1.74

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03

Clamped Supported Thin Square Plate : Transient Forced Vibration Response

問題定義

A simply supported thin square plate $10 \times 10 \times 0.05$ m is subject to suddenly applied uniform pressure $P=100$ Pa which remains constant in time. Find peak dynamics response of the plate.

16 modes are used to approximate dynamics solution, 2% modal damping is assumed in all modes. .

單位: SI

材料屬性

楊氏係數 $2.e+11$ Pa, 泊松比 0.3, 密度 $8.e+3$ kg/m³.

參考

Test 13T from NAFEMS Publication R0016, "Selected Benchmarks for Forced Vibration" J.Maguire, D.J.Dawswell, L.Gould.

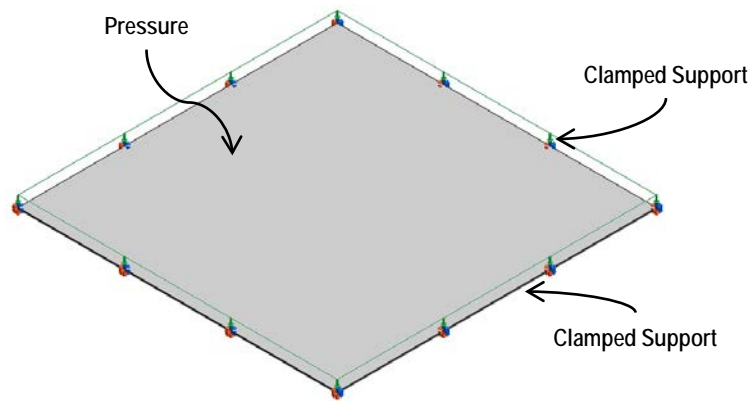
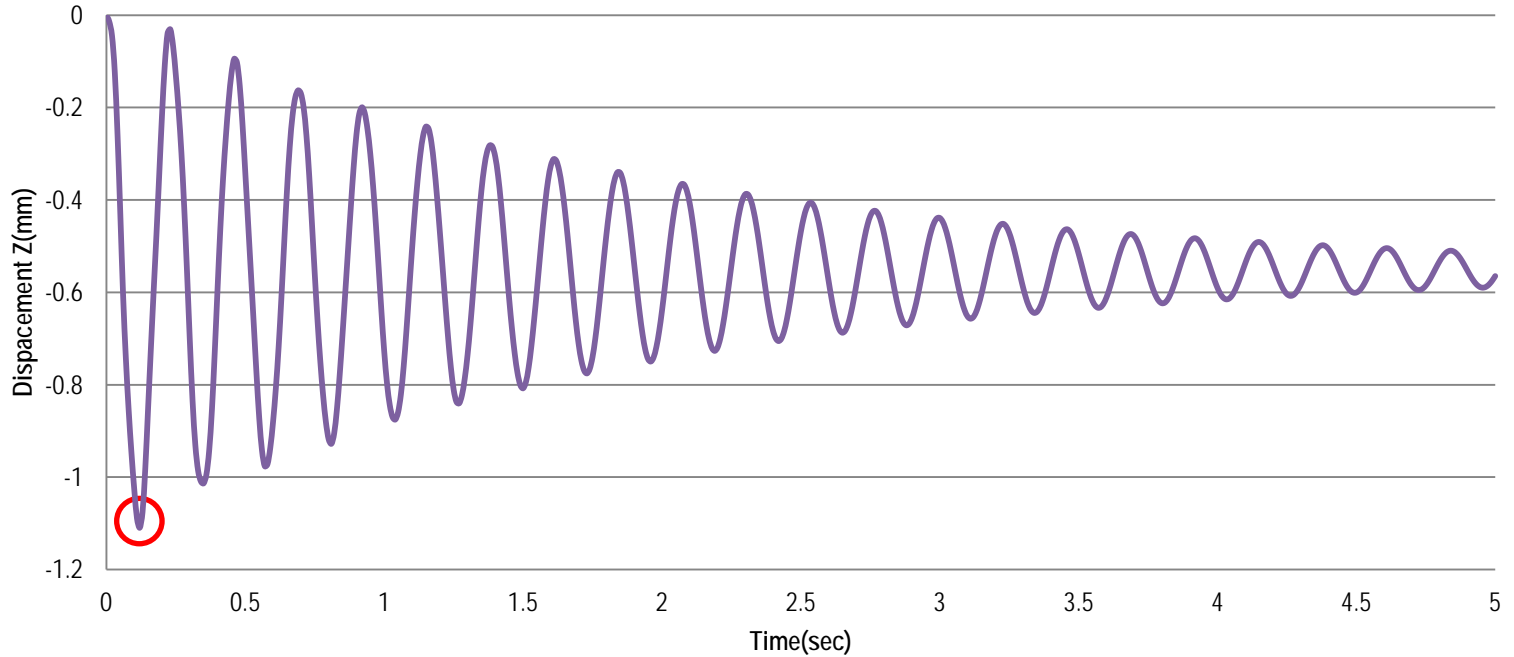


Fig. VD03

Deflection & Surface Stress

	Deflection Y, [mm]	Surface Stress, [MPa]	Peak Time, [sec]
	14.26	16.42	0.12

NFX 3D Displacement - Time

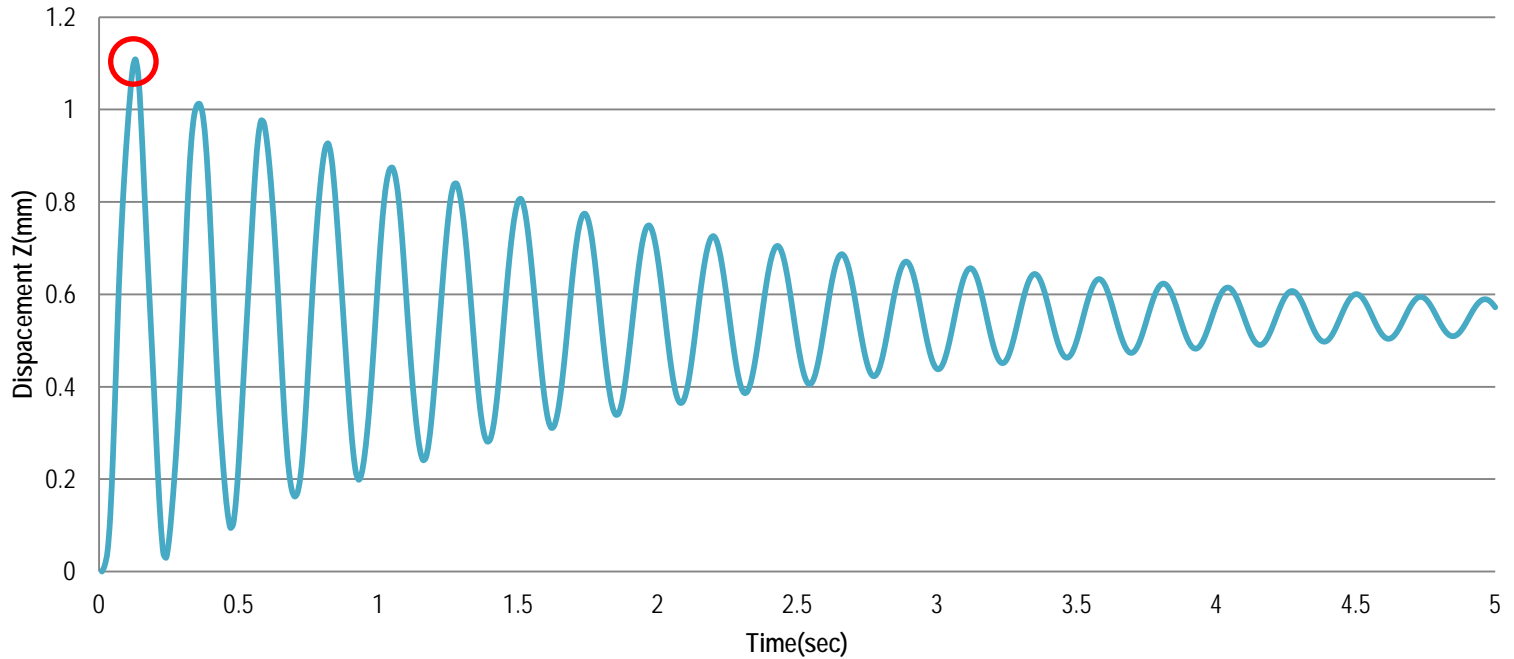


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Deflection & Surface Stress

	Deflection Y, [mm]	Surface Stress, [MPa]	Peak Time, [sec]
	1.108	1.252	0.12

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04

Clamped Supported Thin Square Plate : Frequency Response

問題定義

A simply supported thin square plate 10 x 10 x 0.05 m is subject to uniform pressure $P=100$ Pa which changes in time as the following function

$$P=100*\sin(\omega*t),$$

here $\omega=2*\pi*f$, f is excitation frequency.

16 modes are used to approximate dynamics solution, 2% modal damping is assumed in all modes.

This test is similar to test VD01, but it is solved in frequency domain.

單位: SI

材料屬性

楊氏係數 $2.e+11$ Pa, 泊松比 0.3, 密度 $8.e+3$ kg/m³.

參考

Test 13H from NAFEMS Publication R0016, "Selected Benchmarks for Forced Vibration" J.Maguire, D.J.Dawswell, L.Gould.

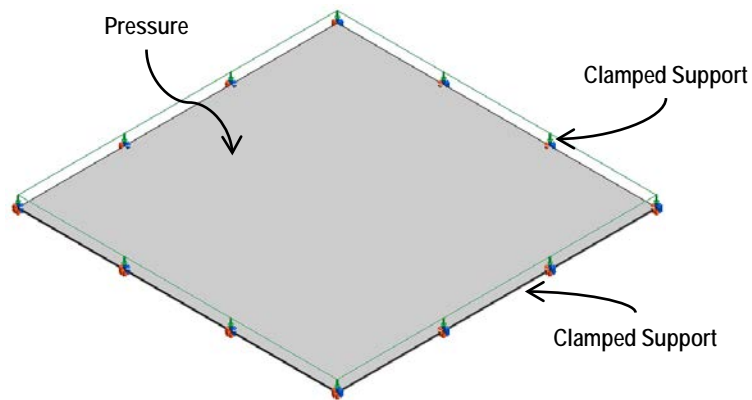
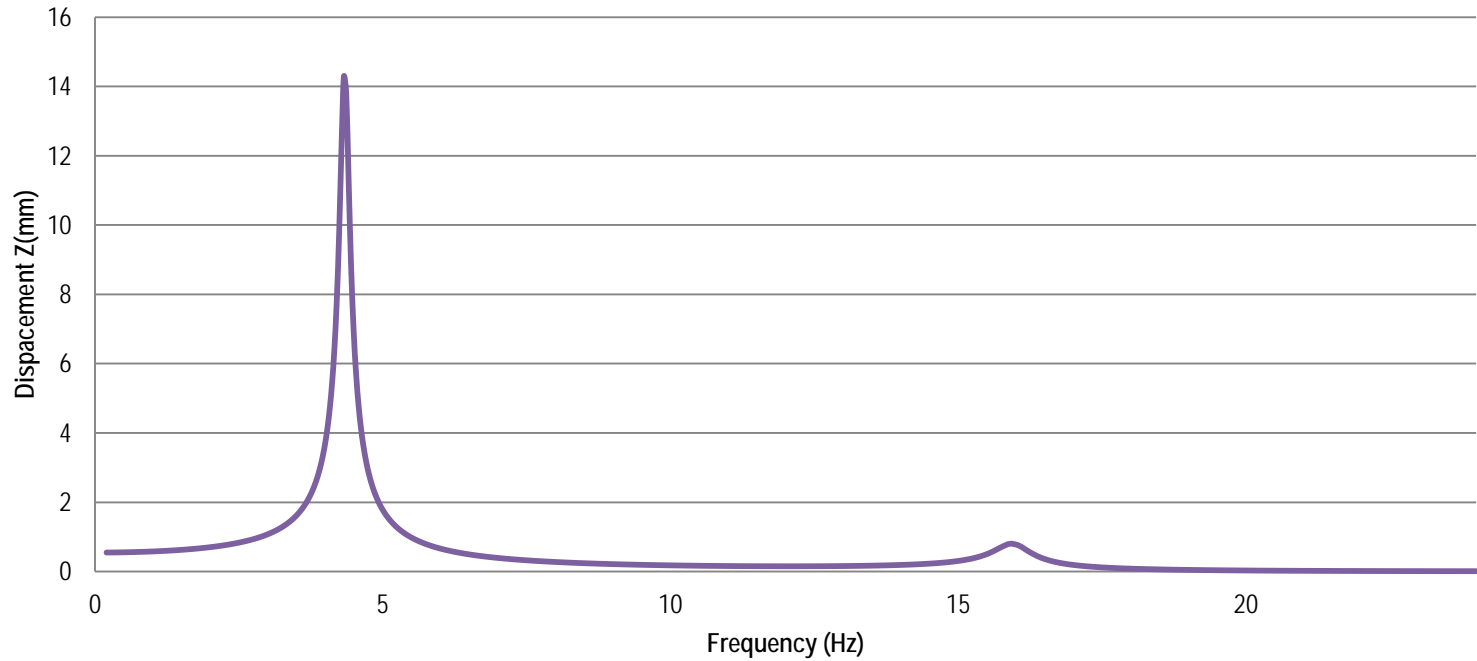


Fig. VD04

Deflection & Surface Stress

	Deflection Y, [mm]	Surface Stress, [MPa]
	14.278	16.336

NFX 3D Displacement - Frequency

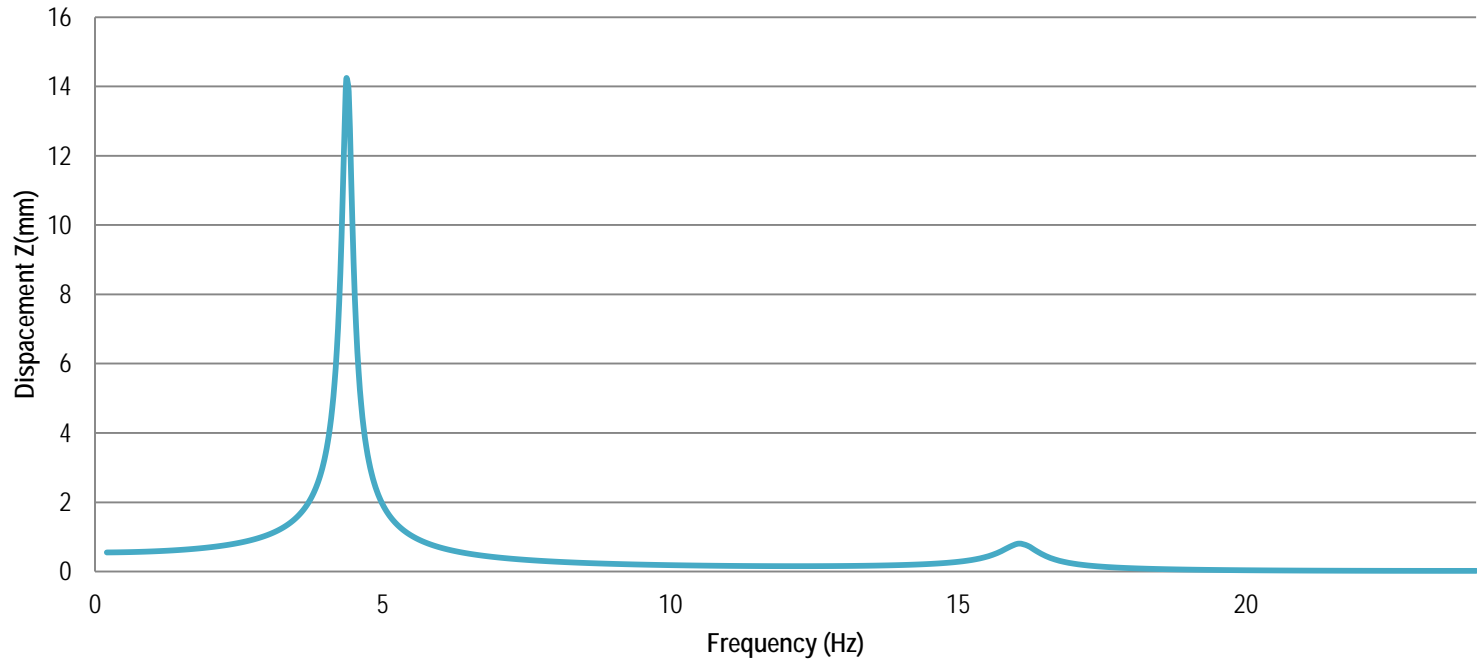


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Deflection & Surface Stress

	Deflection Y, [mm]	Surface Stress, [MPa]
	14.221	13.036

MeshFree 3D Displacement - Frequency



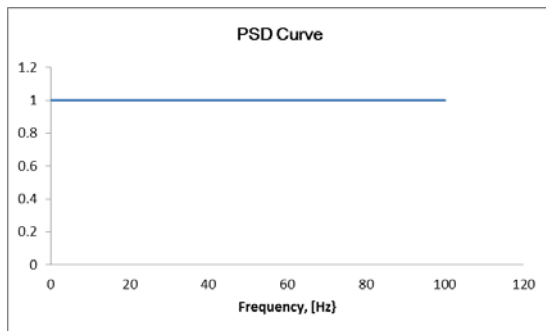
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05

Clamped Supported Thin Square Plate : Random Forced Vibration Response

問題定義

A simply supported thin square plate $10 \times 10 \times 0.05$ m is subject to uniform pressure $P=100$ Pa which forces random vibrations with uniform Power Spectral Density function ("white noise")



16 modes are used to approximate dynamics solution, 2% modal damping is assumed in all modes.

單位: SI

材料屬性

楊氏係數 $2.e+11$ Pa, 泊松比 0.3, 密度 $8.e+3$ kg/m³.

參考

Test 13H from NAFEMS Publication R0016, "Selected Benchmarks for Forced Vibration" J.Maguire, D.J.Dawswell, L.Gould.

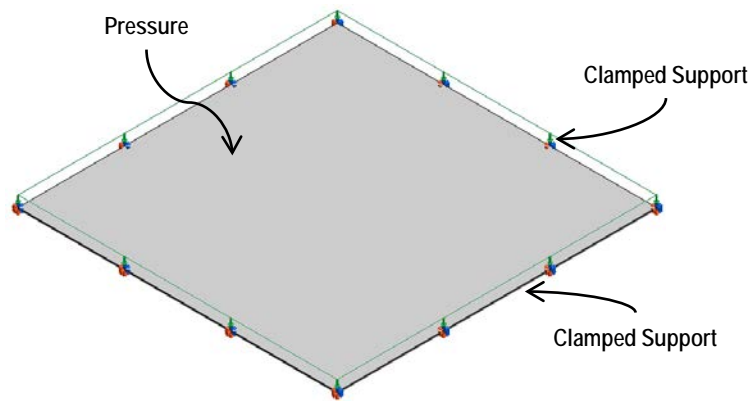
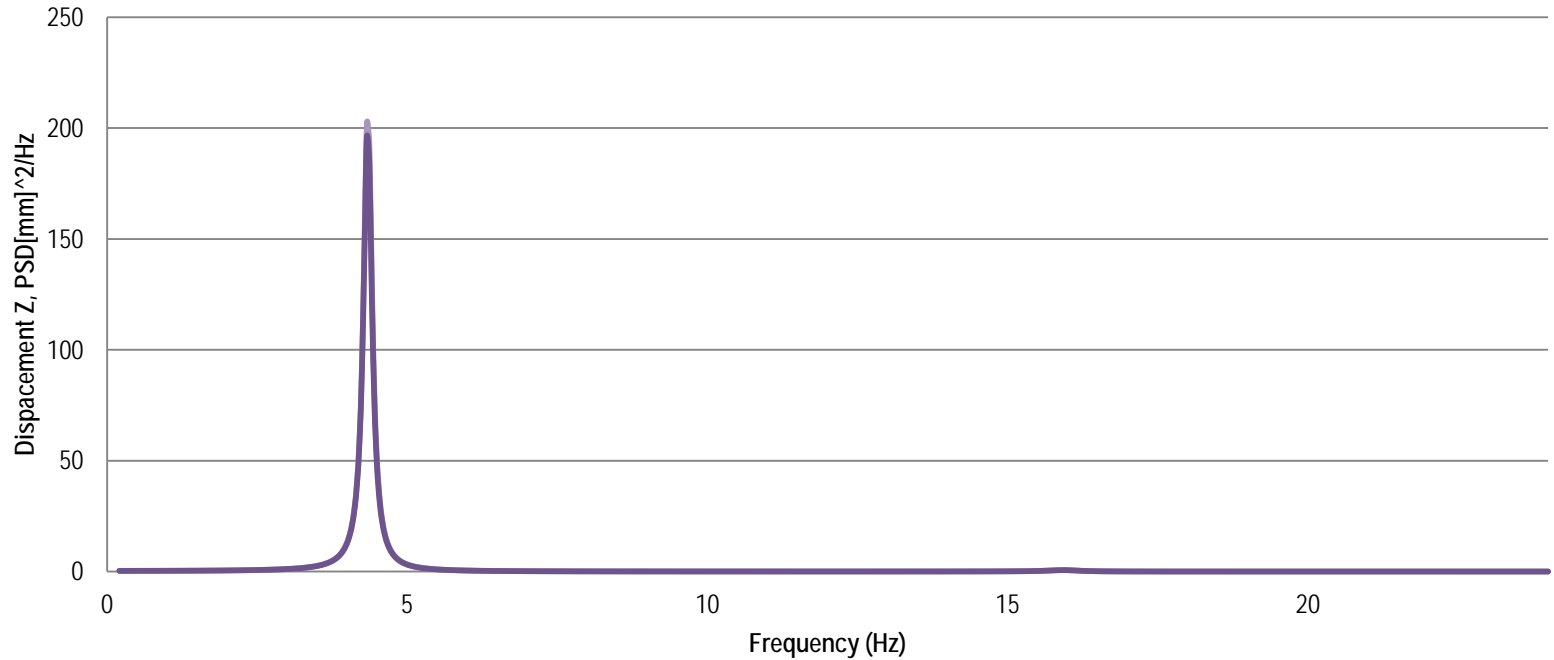


Fig. VD05

Deflection & Surface Stress

	PSD Displacement Y,[mm ² /Hz]	PSD Surface Stress,[MPa ² /Hz]	RMS Maximum Displacement	RMS Maximum Stress
	195.900	256.461	7.412	12.007

NFX 3D Displacement - Frequency

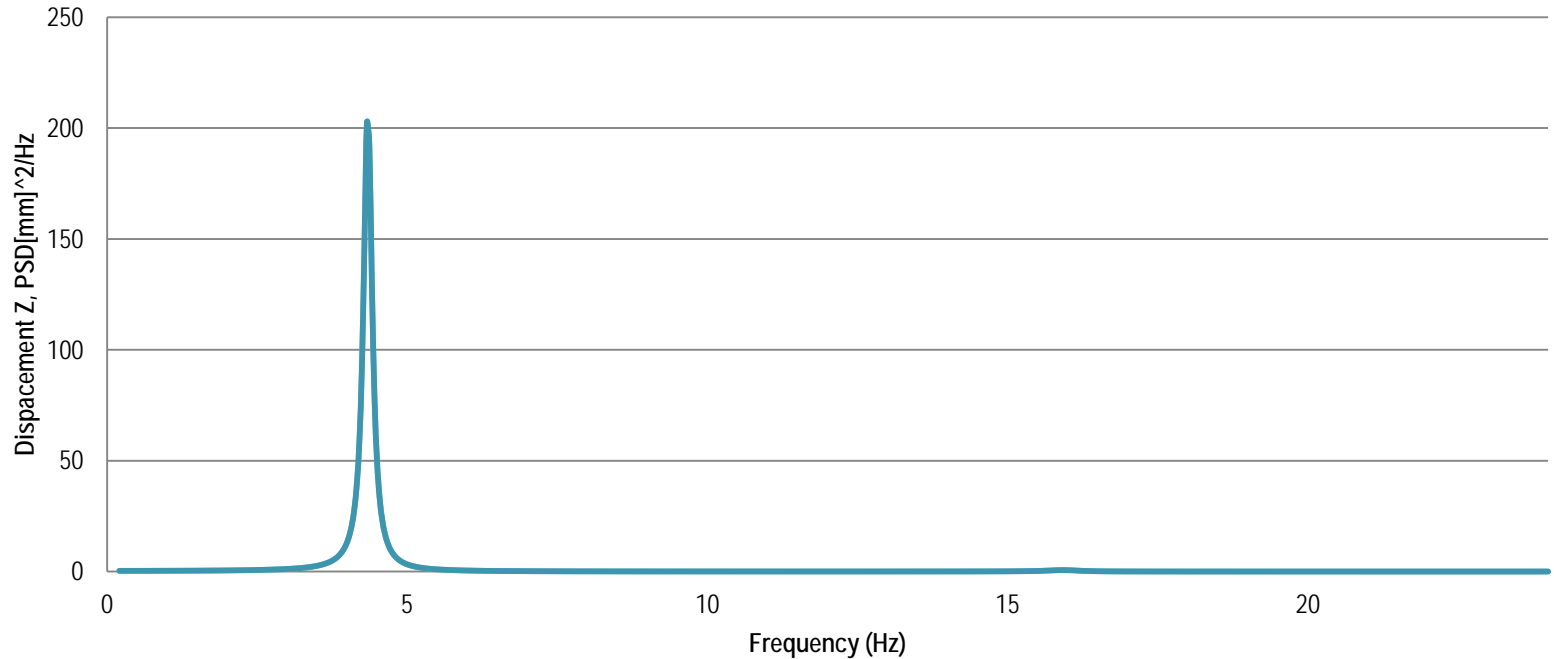


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Deflection & Surface Stress

	PSD Displacement Y,[mm ² /Hz]	PSD Surface Stress,[MPa ² /Hz]	RMS Maximum Displacement	RMS Maximum Stress
	202.234	264.989	7.552	12.448

MeshFree 3D Displacement - Frequency



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