

Stress Test Motions for Soil-Structure Systems

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Outline

Introduction

Stress Test Motions

Summary

Motivation

Improve analysis of infrastructure

Stress test, shake-out ESSI system

Stress test motions variations

- signals
- energies
- strike angles
- duration

Improve ESSI system

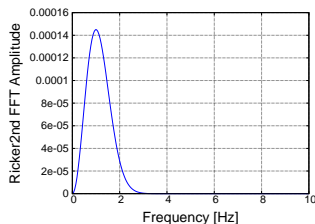
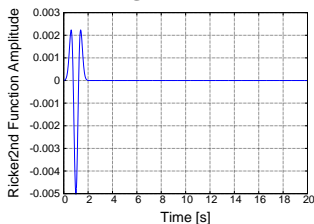
Plane Wave Stress Test Motions

- Excite SSI system with a suite of seismic motions
- Motions: variation in strike and dip, body waves P, S; (near surface waves (Rayleigh, Love, Stoneley, etc.)
- Plane wave stress test motions: 3D-6C (Haskell's solution for plane harmonic waves) and/or 3D-3×1C and/or 3D-1C and or 1D-1C motions
- Knowledge of geology and the soil is important

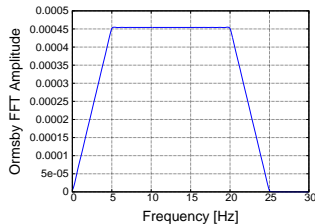
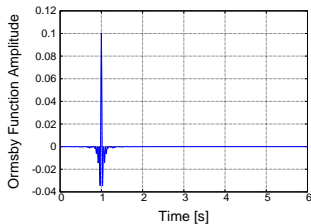


Stress Test Source Signals

- Ricker

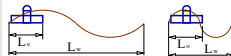
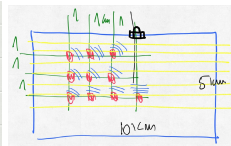
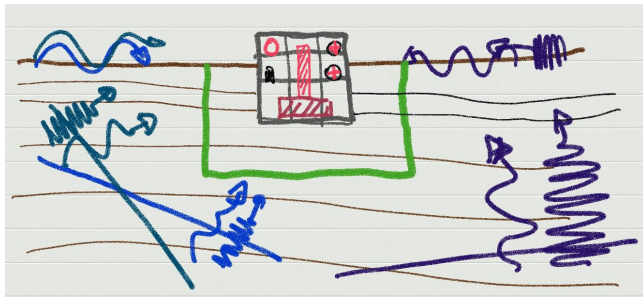


- Ormsby

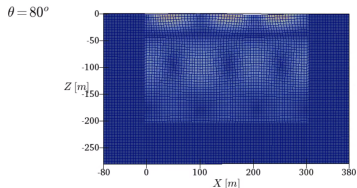
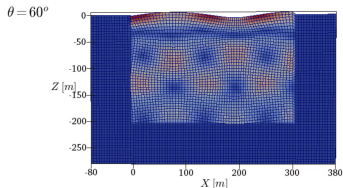
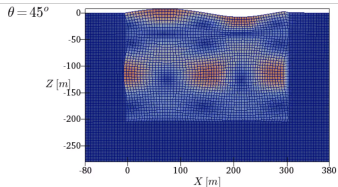
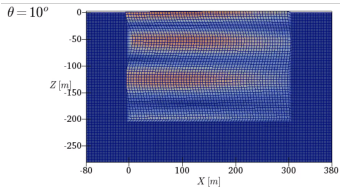


Stress Test Motions

- Variation in inclination, frequency, energy and duration
- Try to "break" the system, shake-out strong and weak links

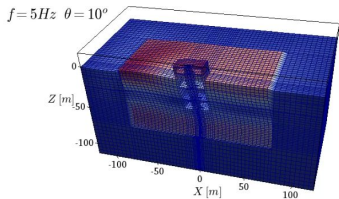


Free Field, Variation in Input Wave Angle, $f = 5\text{Hz}$

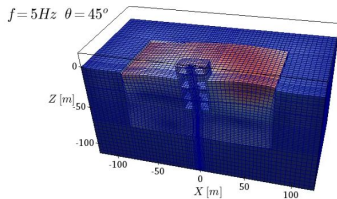


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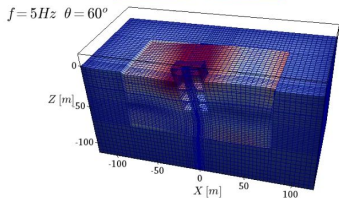
SMR ESSI, Variation in Input Wave Angle, $f = 5\text{Hz}$

Displacement Magnitude $\|u\|$

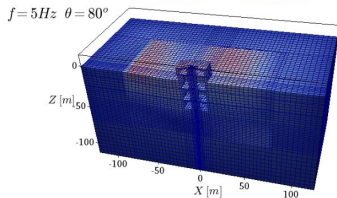
0.0e+00 0.05 0.1 0.15 2.0e-01

Displacement Magnitude $\|u\|$

0.0e+00 0.05 0.1 0.15 2.0e-01

Displacement Magnitude $\|u\|$

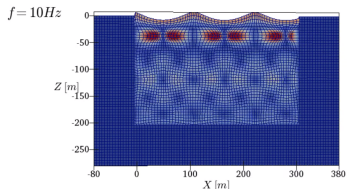
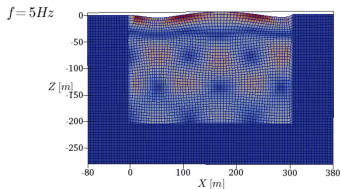
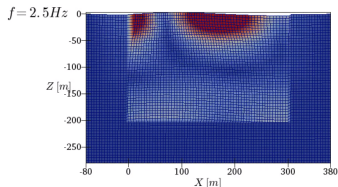
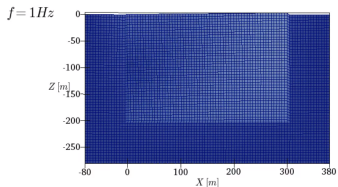
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Displacement Magnitude $\|u\|$

0.0e+00 0.05 0.1 0.15 2.0e-01

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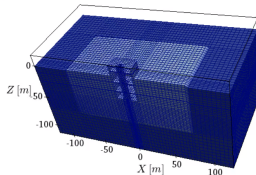
Free Field, Variation in Input Frequency, $\theta = 60^\circ$



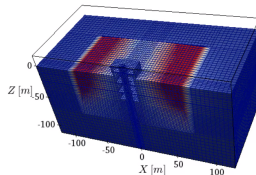
(MP4)

SMR ESSI, Variation in Input Frequency, $\theta = 60^\circ$

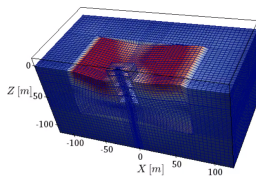
$f = 1\text{Hz}$



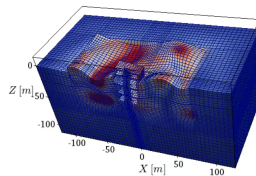
$f = 2.5\text{Hz}$



$f = 5\text{Hz}$



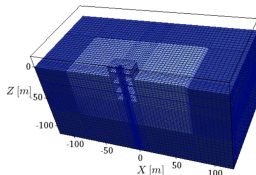
$f = 10\text{Hz}$



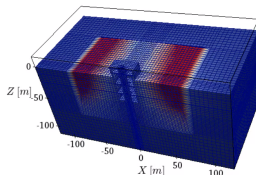
(MP4)

SMR ESSI, Variation in Input Frequency, REAL TIME

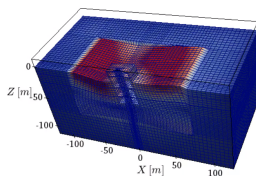
$f = 1\text{Hz}$



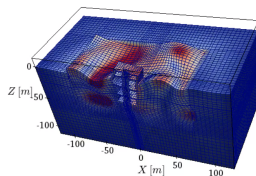
$f = 2.5\text{Hz}$



$f = 5\text{Hz}$

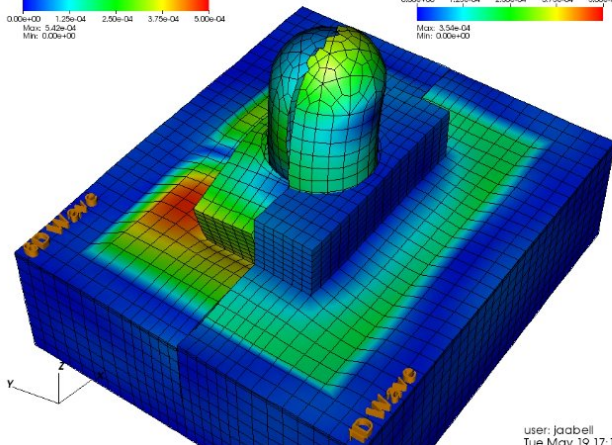
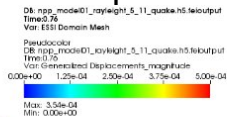
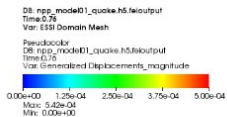


$f = 10\text{Hz}$



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6C vs 1C NPP ESSI Response Comparison



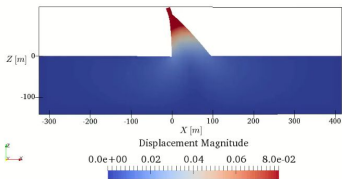
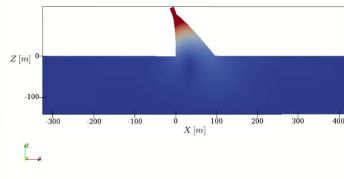
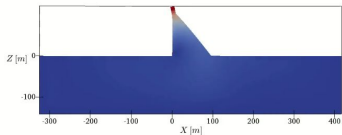
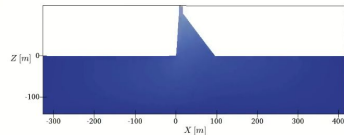
(MP4)

user: jaabell
Tue May 19 17:19:21 2015

Pine Flat Dam, Inclined Plane Waves

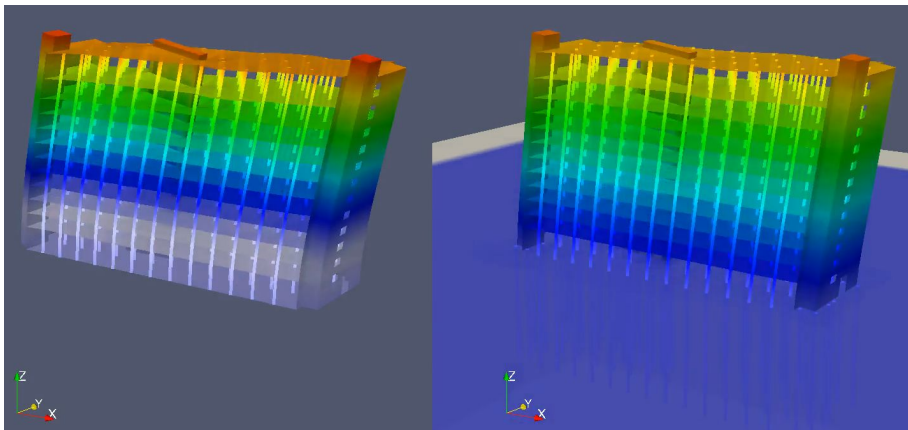
 $\theta = 0^\circ$

Time: 6.56 s


 $\theta = 15^\circ$

 $\theta = 30^\circ$

 $\theta = 60^\circ$


(MP4)

Ventura Hotel, Northridge Earthquake, nonSSI vs SSI



(MP4)

Summary

Stress test, shake-out ESSI system

Stress test motions variations

signals

energies

strike angles

duration

Improve ESSI system: Safety, Economy

<http://real-essi.us>