Educating the Next Generation of Leading Engineers

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Overview

- Engineering Education
- Starting Points
- Is there a shortage of Engineers?
- Technical Competency and Relevancy
- The Right Teams
- Demonstrated Capability

From a 1958 Engineering Education Study…

- Engineers engage in the ***science and art of the possible*** to satisfy man's desires through creative ***design of acceptable systems***, and their components involving matter, energy, information, man and his environment.
- This can be achieved through an integration of knowledge around the ***leading concepts*** of the essential characteristics of engineering activity.

Leading Concepts

- Cause of tension between engineering education and practice.

- Fundamentals have not changed, but the manner in which we demonstrate these concepts has been changed by the advent and introduction of modern technologies.

Starting Points – *Core Values*

- Academe and industry will need a partnership and common core values to produce the next generation of leading engineers.
- ***Common Core Values***
  - ***Design***
  - ***Systems***
  - ***Experiential Learning***
  - ***Professional Practice***

Civil Engineering—ASCE, Vol. 75, No. 7, July 2005 - J. Brown

- *Does the United States face a shortage of civil engineers?*
- Colleges, universities, employers, and corporate recruiters all report ***strong demand for civil engineering graduates***, especially those specializing in water or environmental engineering. Meanwhile, as attested by ASCE's *2005 Report Card for America's Infrastructure*, the ***nation's built environment continues to decline***. In today's global economy, ***technical competency is not enough; communication, project management, and leadership skills are becoming more important then ever***.
- ***While experts disagree on whether there is truly a shortage of civil engineers, they agree to one thing: there is growing demand for a new kind of civil engineer—flexible, more broadly educated, and better prepared to meet the challenges of the future***.

Renewed Infrastructure – 2009

- The incoming administration has pledged to boost the economy by addressing the country's aging and rapidly deteriorating infrastructure.
- This likely means ***utility industries*** like ***electric and water*** will receive huge cash infusions. Roads and bridges will be repaired and rebuilt. Energy efficiency, particularly in government buildings, will be increased.

Focusing the Discourse

- What really matters is not whether there is a shortage of engineers in the US, it is whether there will be sufficient numbers of leading engineers to handle industry's problems.
- For Edison, this has real significance – and for the Dam Safety Community, this is a matter of both technical competency and relevance.

Technical Competency

- "Traditional Competency" is measured in knowing discipline specific information.
- Past generations of engineers relied on fundamental knowledge, hand-calcs, and experience. Required "fields of knowledge" were "manageable."
- The 1990's gave rise to new technologies that have created new "fields of knowledge."
  - Computers, Manufacturing, Energy

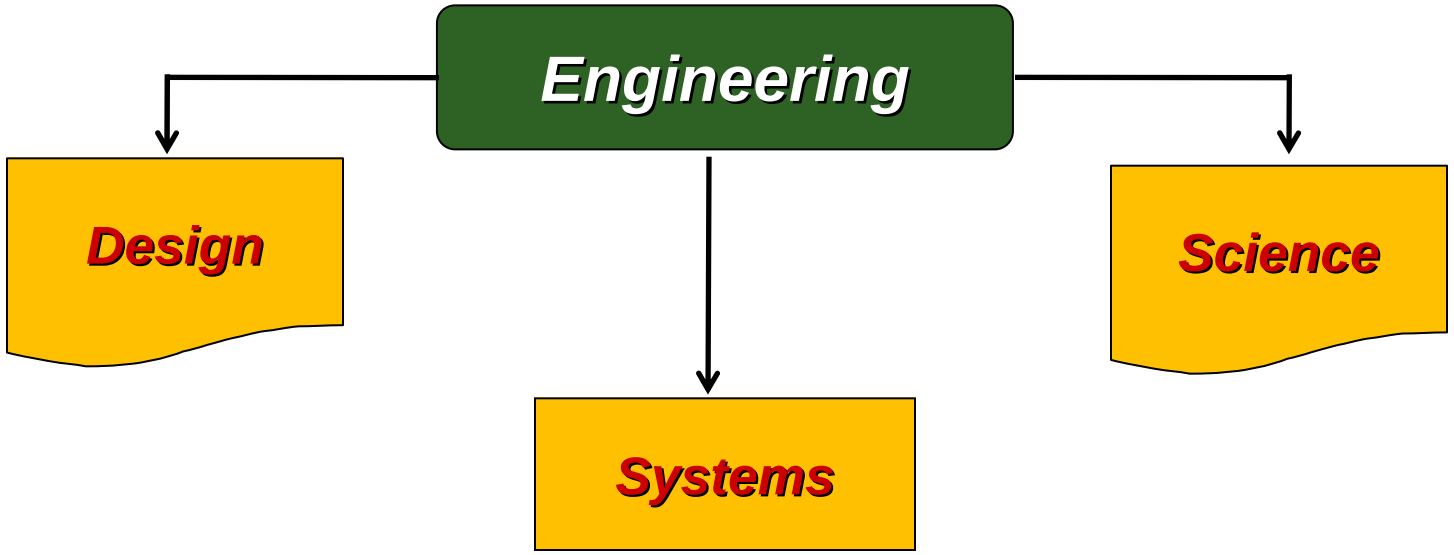
Relevancy

- Edison is an energy company that services a wide customer base with diverse application needs.
- Attention to infrastructure lags growing demand.
- Engineering leaders will need to develop innovative solutions that ensure existing infrastructure can be maintained and enhanced for the future.

Assembling the Right Teams

- Multi-Disciplinary Teams (MDT) are needed
- Leaders who can communicate across disciplines will be needed
- What should we look for?

The Right Mix



Management, Economics, Leadership

Folsom Dam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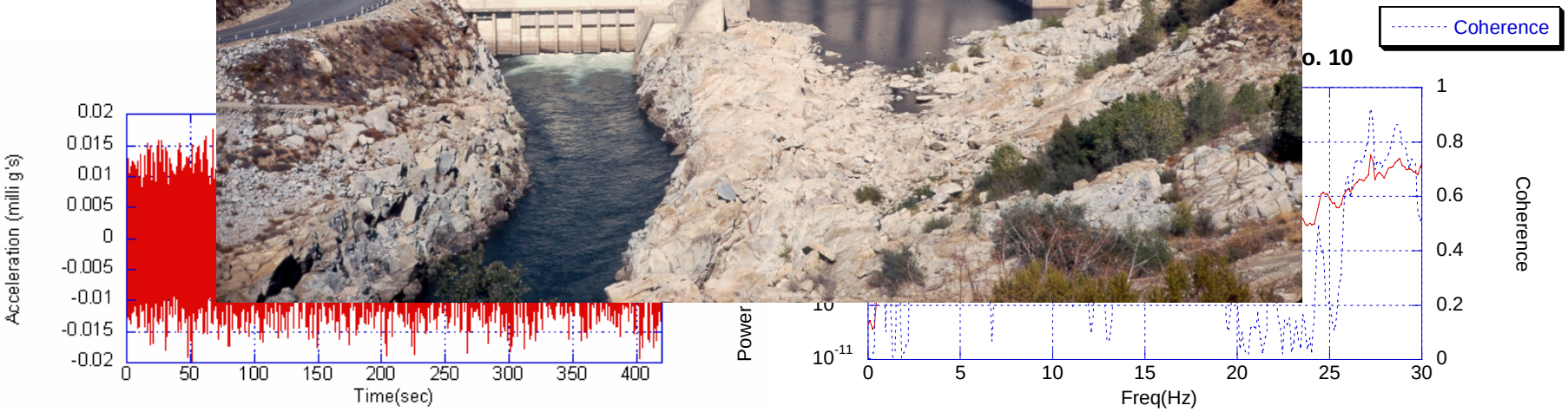
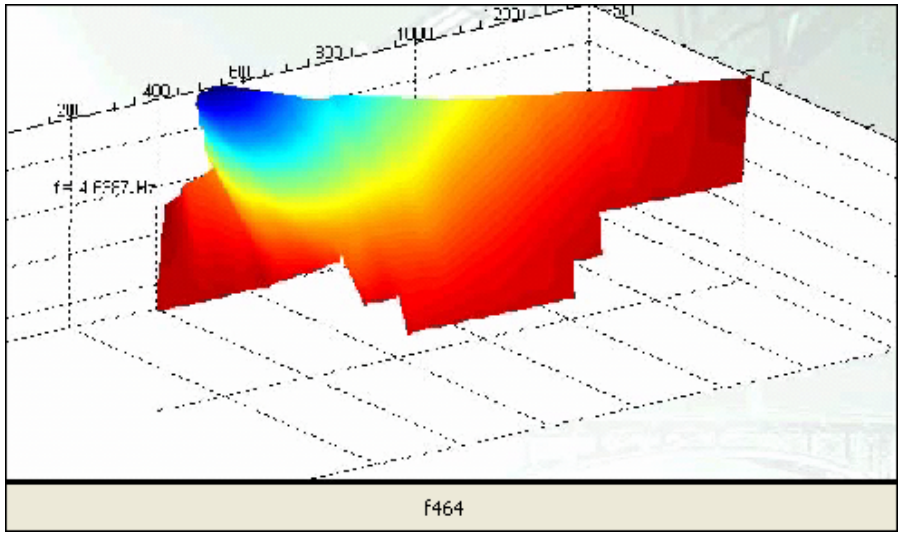
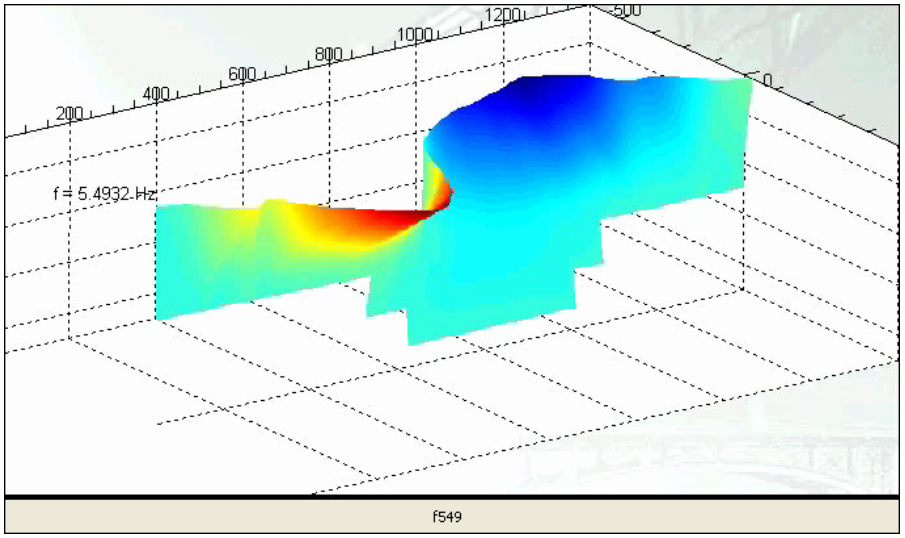
No.


Acceleration (milli g's)
0.02
0.015
0.01
0.005
0
-0.005
-0.01
-0.015
-0.02
0
50
100
150
200
250
300
350
400
Time(sec)
Power
10
10^-11
0
5
10
15
20
25
30
Freq(Hz)
Coherence
1
0.8
0.6
0.4
0.2
0
Coherence
o. 10

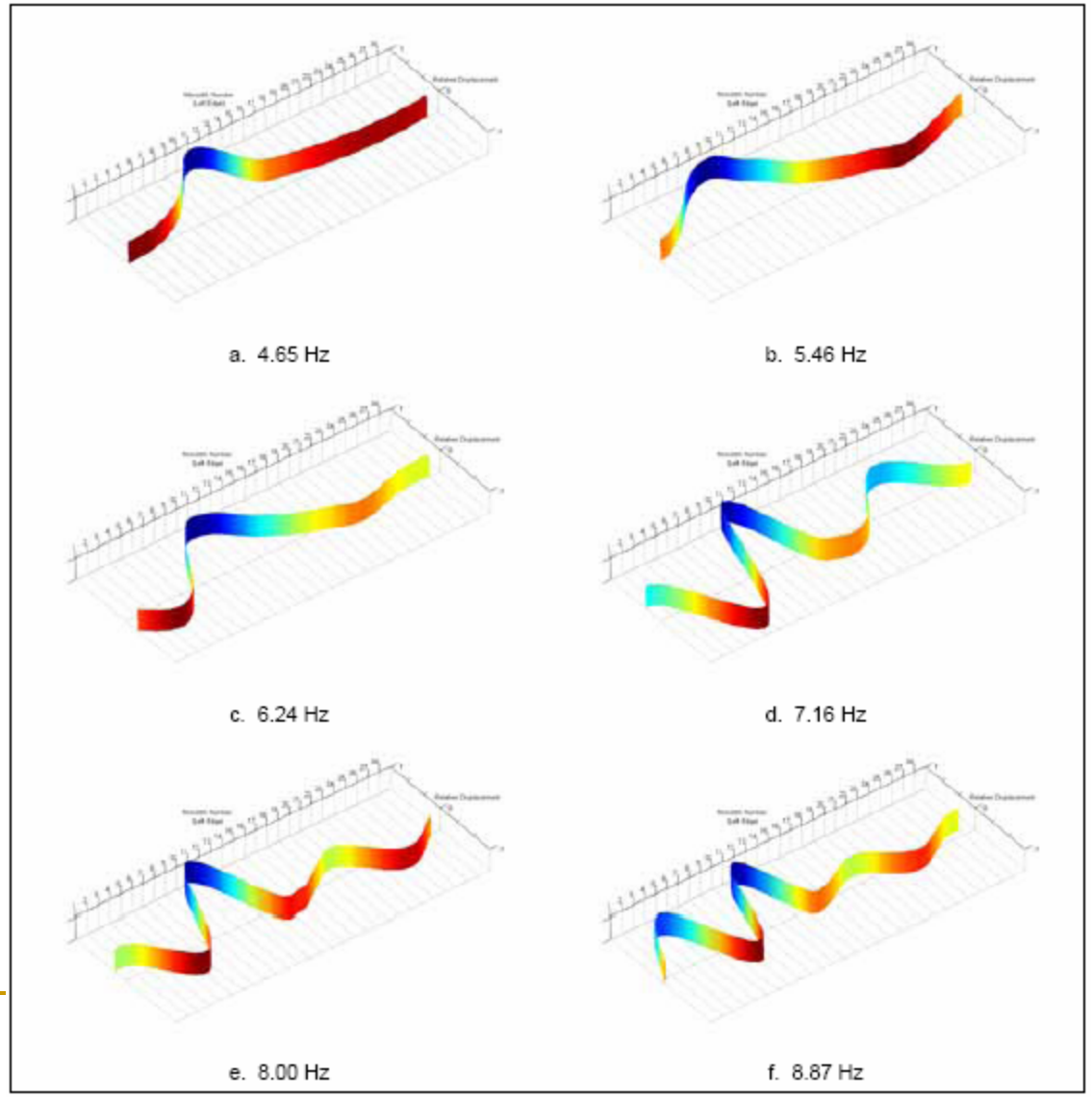
Low-Level Response Behavior





Steady-State Behavior

Ambient Vibration Survey Resonant Frequency (Hz)	Forced Vibration Survey Resonant Frequency (Hz)
4.64	**4.65**
5.49	**5.46**
6.47	**6.24**
7.32	**7.16**
8.18	**8.00**
8.91	**8.87**

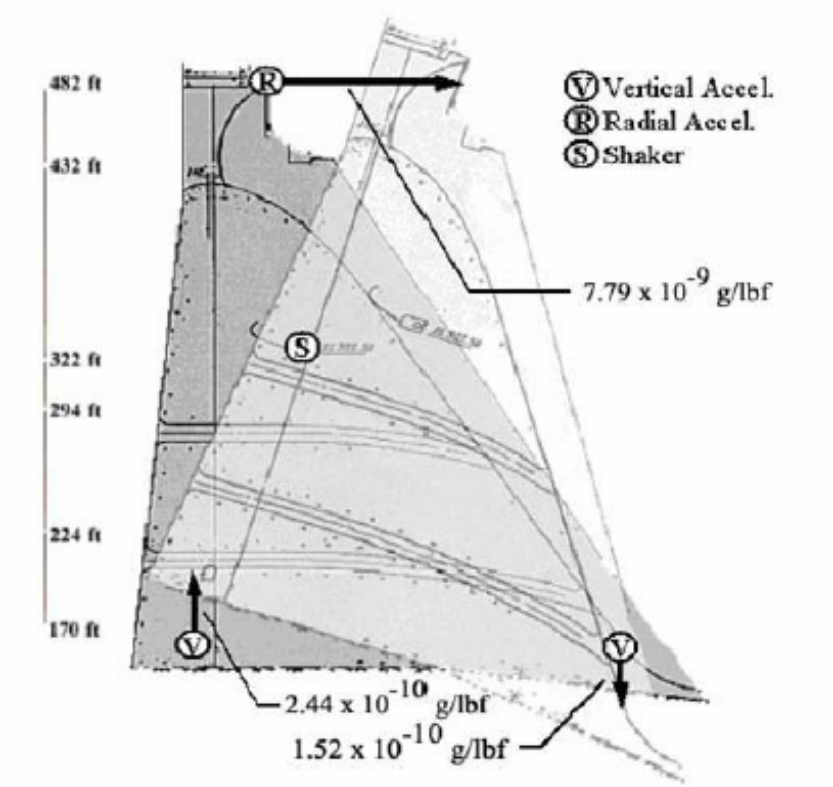


Frequency/Damping Checks

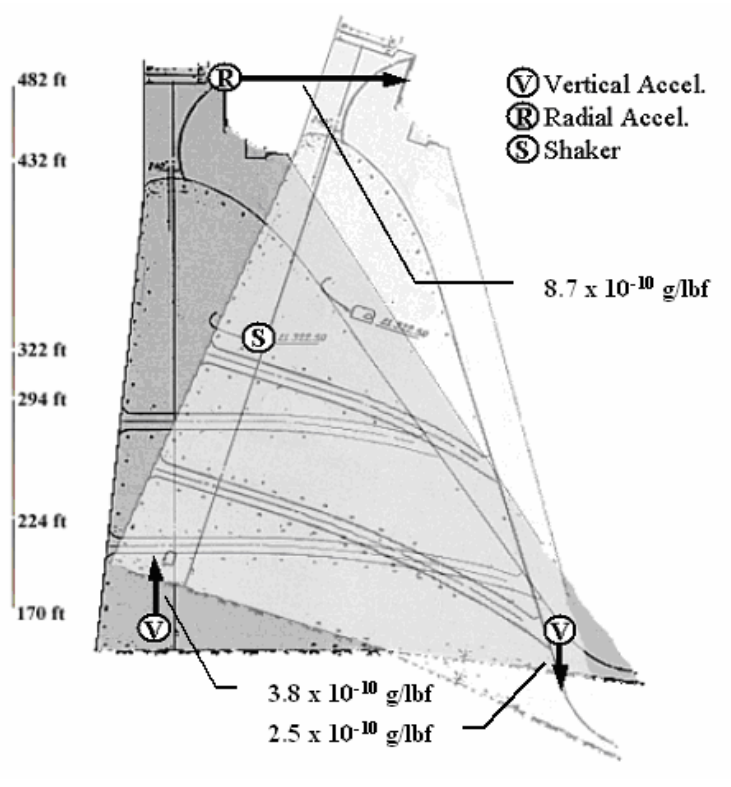
Ambient Vibration Survey Resonant Frequency (Hz)	Forced Vibration Survey Resonant Frequency (Hz)	SAP2000 Computed (eigen) Natural Frequency (Hz)	ABAQUS Computed (eigen) Natural Frequency (Hz)
4.64	4.65	4.67	4.72
5.49	5.46	5.35	5.58
Not Observed	Not Observed	5.91	Not Calculated
6.47	6.24	6.56	6.57, 6.80
7.32	7.16	7.47	7.11, 7.32, 7.55
8.18	8.00	8.40	7.99, 8.28, 8.45
8.91	8.87	8.82	9.02

Resonant Frequency (Hz)	ζ *Half-power method*	ζ *Curve fitting*	ζ *TVA model comparison*	*Description*
4.65	-	**4.0-6.5 %**	-	**1st Sym**
5.46	**5.6-8.4 %**	**4.8-7.0 %**	-	**2nd Sym**
6.24	-	**4.0-8.0%**	-	**3rd Sym**
7.16	**6.3-8.0%**	**4.0-7.8%**	-	**4th Sym**
8.00	-	-	**6-8 %**	**5th Sym**
8.87	-	-	**6-8 %**	**6th Sym**

Foundation Flexibility



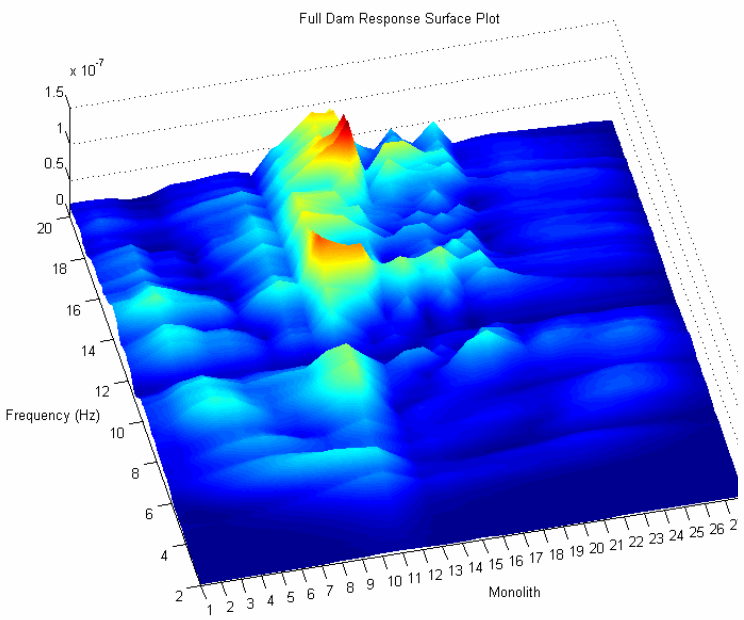
Measured



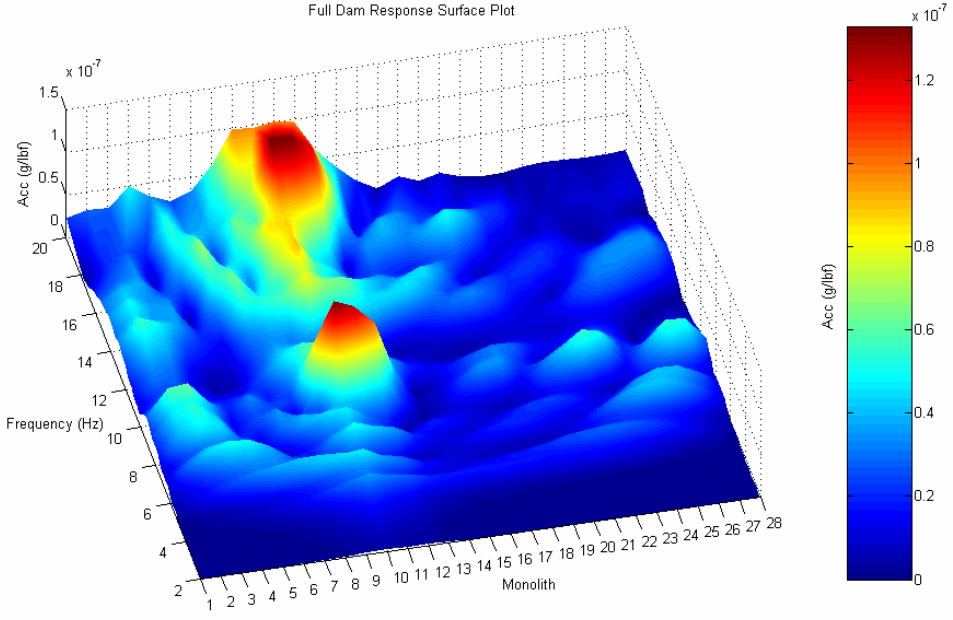
Predicted

Ratio of heel to toe 1.60 (measured) 1.52 (predicted)

Frequency Response Functions

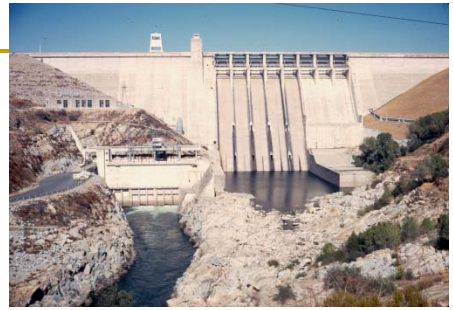


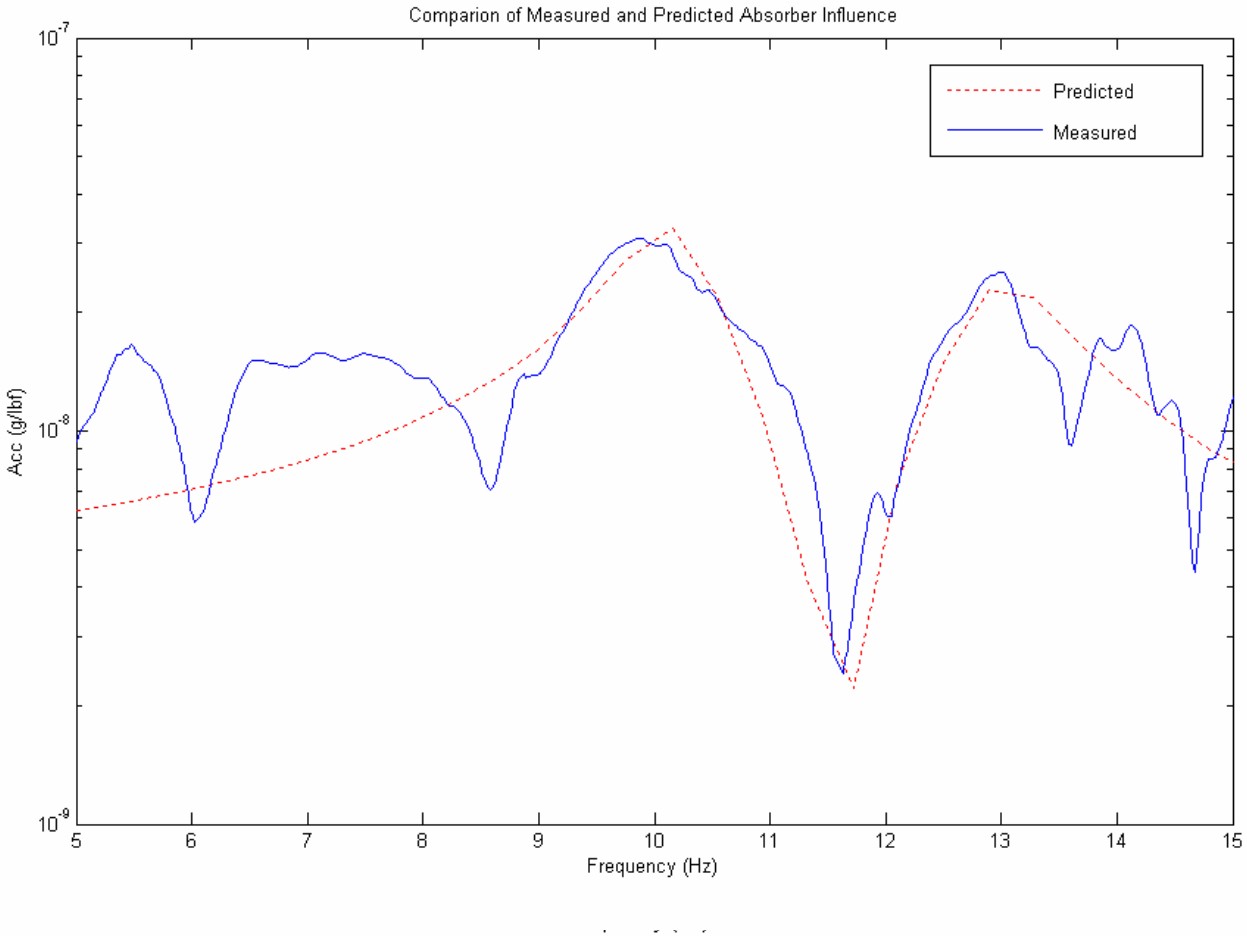
FV measured



Model computed

Tower Influence





Leaders in Engineering will emerge if…

- Academe seeks a closer alliance with industry to identify and promote common core values, and if
- Industry demands a breadth of knowledge and accomplishments consistent with the growing complexities of our profession.