Current Research

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Highlighted Project

- Identification of Potential Roof Control Problems Using LED Lighting & Numerical Modeling of Highwall Stability Using FLAC3D
  - Focus on the latter today
- Funded by NIOSH
  - Capacity building for Rock Mechanics Specialists
  - 5 Year Project
  - Entering Second Year Next Month

Project Team

- PI's
  - Kyle Perry
  - Kot Unrug
- Graduate Students
  - Kevin Harris
  - Michael Raffaldi
  - Adam Gamblin

Project Overview

- Highwall Failures Comprise 15% of surface coal mining Fatalities since 2000
  - Some surface mines still don't utilize presplits for their highwall or don't take geology into account when presplitting
- Can nearby blasting induced ground vibrations lead to highwall failures?
- If so, what are the vibration limits?

General Methodology

- Monitor Highwall Movement Over Time
  - Scan highwall multiple times over months
- Measure ground vibrations with seismographs
  - Tie vibrations to shot design/location
- Model in FLAC3D
  - Replicate Results
  - Push to Failure
  - Provide limitations to blasters

Location

- Near Logan, WV
- Mountaintop and Contour Job
- Shale/Sandstone Highwall
- Blasting
  - 7 7/8” Emulsion ANFO Blend
  - ~20’ Burden and Spacing
  - Electronic Detonators

Status

- Two Seismographs Deployed
  - Plans for a third soon
  - Remote Download
- Initial FLAC3D Models Built
- Initial Scans Performed

Initial Models

- Basic Geometry
- Mohr-Coulomb
  - Average material models for information we gathered
- Static Models
  - Evaluate in-situ stability
  - Refine material properties
  - Begin implementing geology
    - Faults, hillseams, etc.

FLAC3D 4.00
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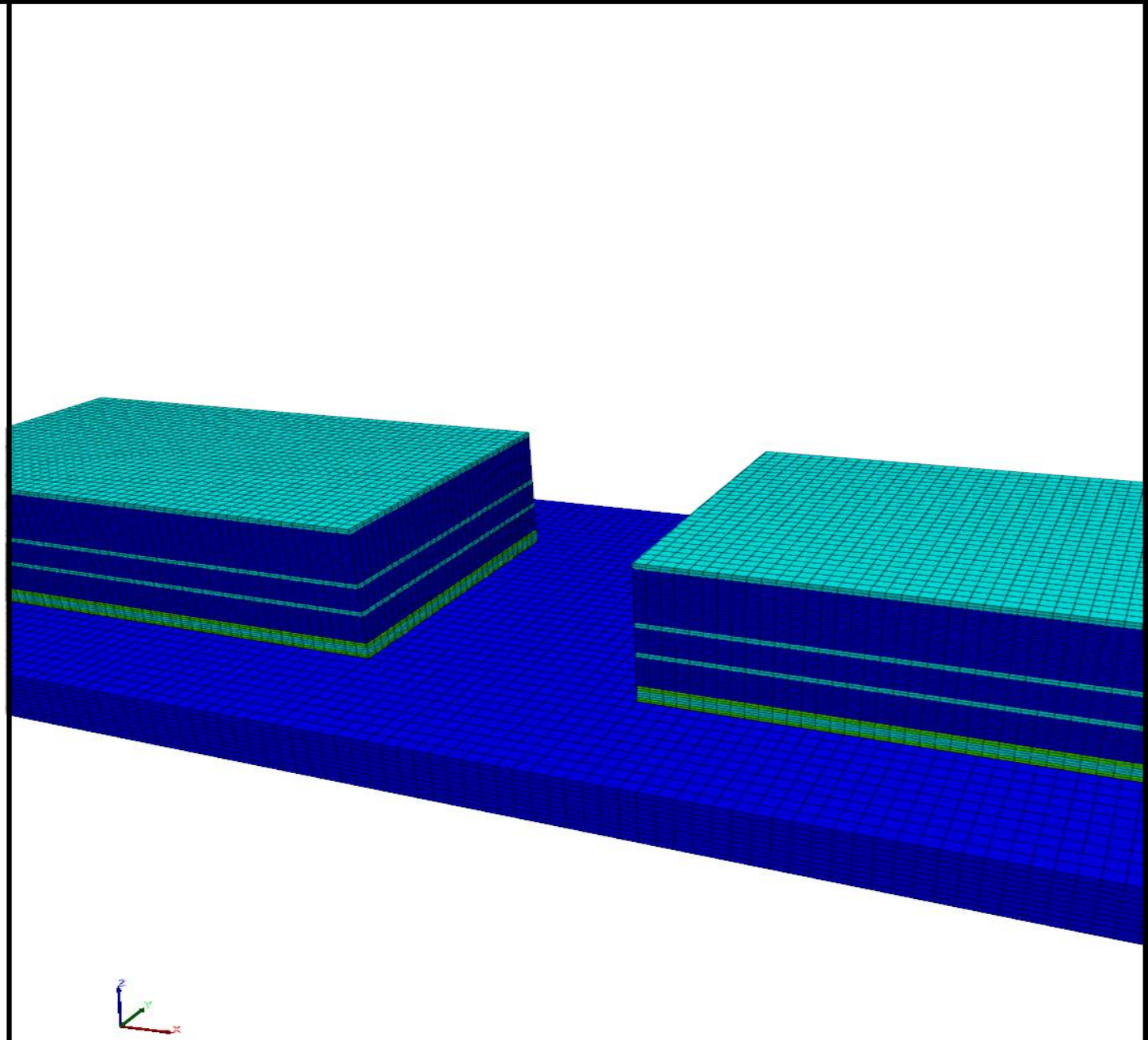
7/24/2012 11:39:03 AM

Axes

SEL Geometry
Colorby: ID

Zone
Colorby: Group 1
- sandstone
- coal
- shale

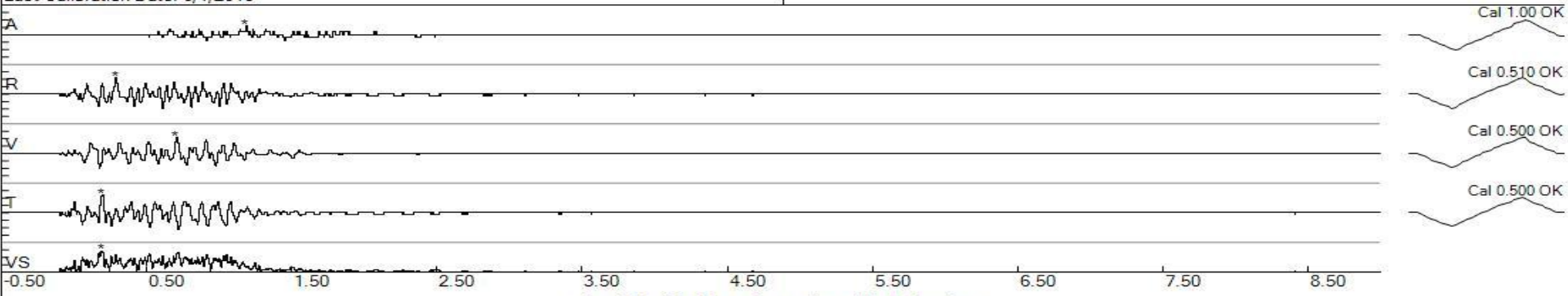


Revised Models

- Begin Dynamic Analysis
- Introduce Ground Vibration Traces
- Re-examine the Model
- Identify Modifications
  - Boundary Conditions
  - Wave Corrections
  - Material Damping Properties
- Relate to Highwall Scans

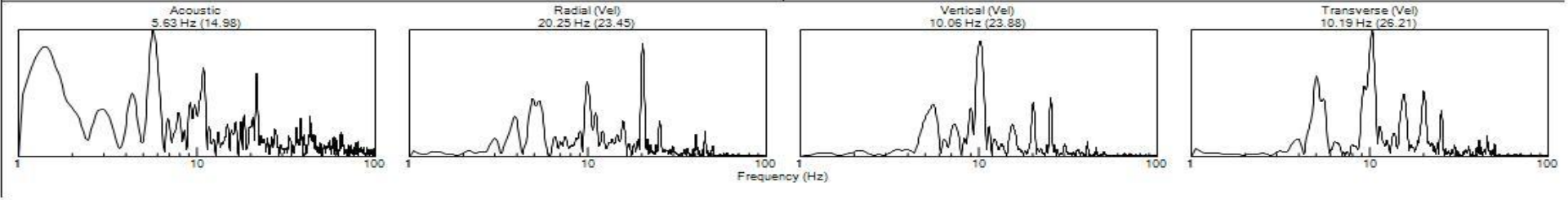
File: 3857201206251706008.dtb
Number: 008
Date: 6/25/2012
Time: 17:06
SN: 3857
Seis. Trigger: 0.050 in/sec
Air Trigger: 148
Sample Rate: 1024
Duration: 9.0 Seconds
Pre-Trigger: 0.50 Seconds
Gain: 2.0x
Voltage: 6.9

Peaks and Frequencies	Graph Information
PPV Maximum: 0.120 in/sec (0.1953 sec)	Duration: -0.500 s To: 9.000 s
Acoustic: 116 dBL @ 25.6 Hz (1.1846 sec)	Acoustic Scale: 126 dBL
Radial: 0.110 in/sec @ 11.6Hz (0.2881 sec)	Seismic Scale: 0.20 in/sec (0.050 in/sec/div)
Vertical: 0.110 in/sec @ 13.4Hz (0.7041 sec)	Time Intervals: 1.00 sec
Transverse: 0.120 in/sec @ 15.5Hz (0.1953 sec)	
Vector Sum: 0.144 in/sec (0.1895 sec)	
Last Calibration Date: 6/1/2010	

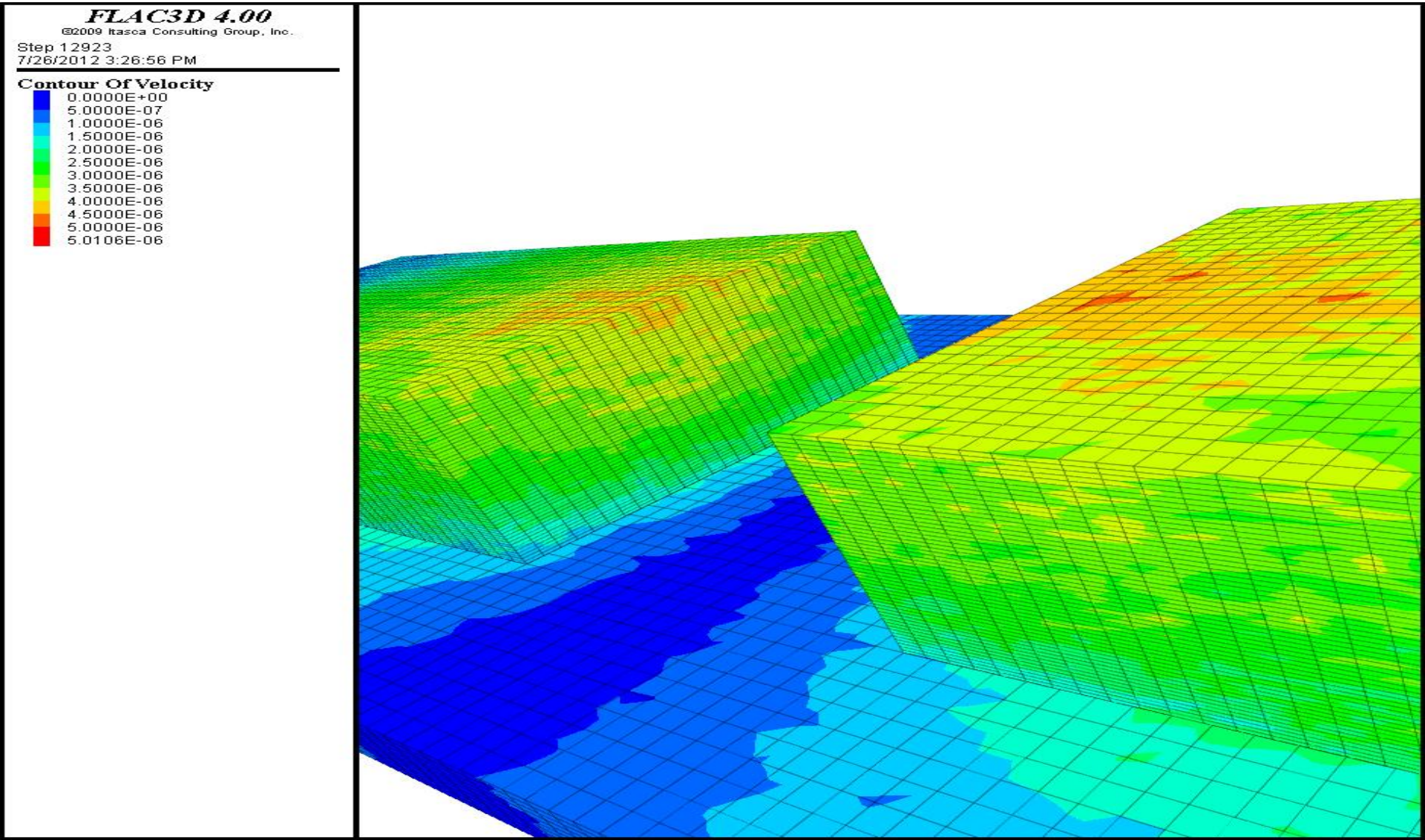


Fast Fourier Transform - Amplitude Spectrum

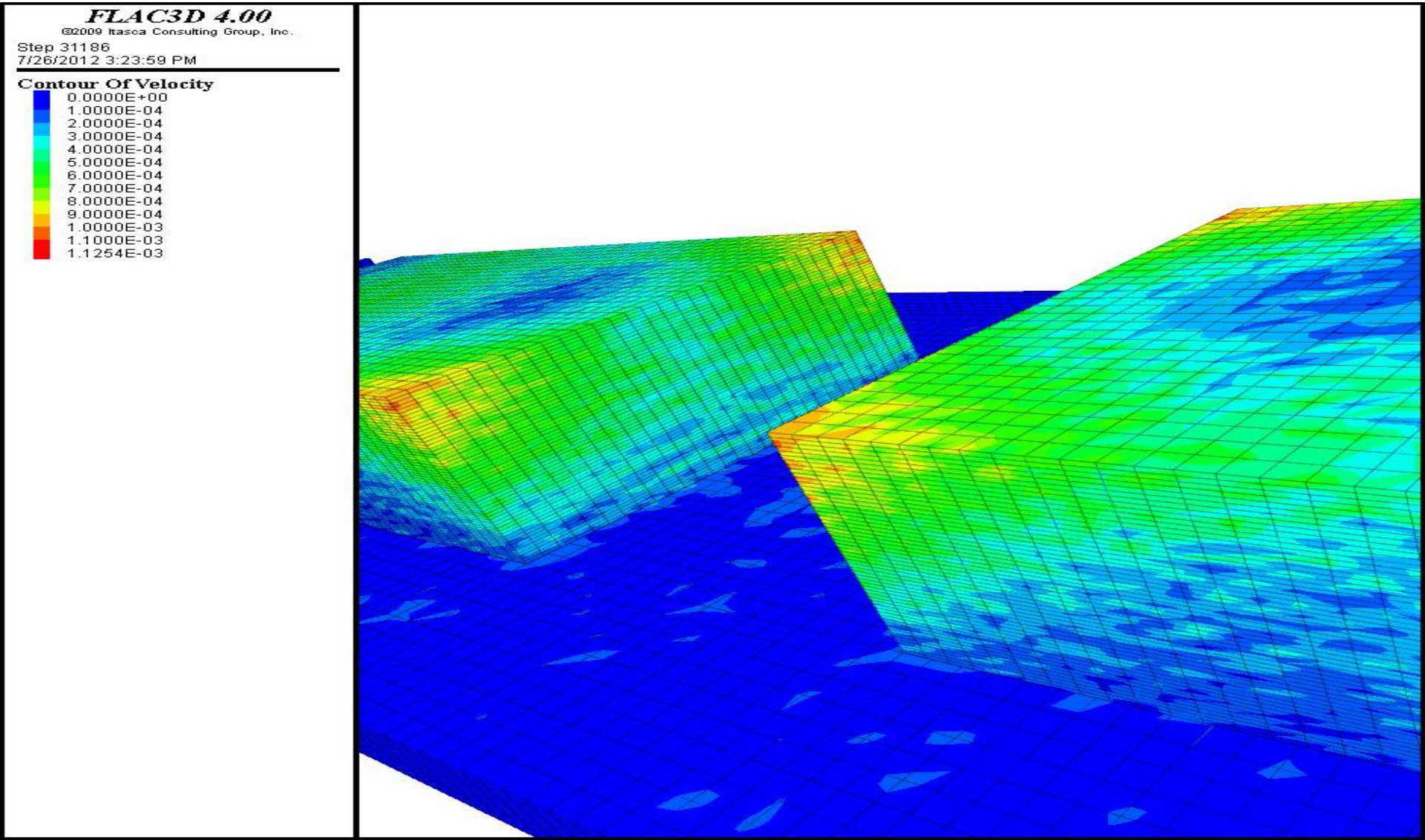
FFT Peak Frequencies	FFT Graph Information
Acoustic: 5.63 Hz (Amp = 14.98)	Range: 1 to 100 Hz
Radial: 20.25 Hz (Amp = 23.45)	Acoustic Scale: 14.98
Vertical: 10.06 Hz (Amp = 23.88)	Seismic Scale: 26.21
Transverse: 10.19 Hz (Amp = 26.21)	



Static Velocity Magnitude (fps)



Dynamic Velocity Magnitude (fps)



Maptek I-Site 8800 Laser Scanner

- Overview
  - Range: 360° Horizontal, 80° Vertical
  - 600m – 1,500m (reflectivity)
  - 8800 p/s
  - 70 megapixel imaging
- Accuracy
  - 20mm @ 1,000 m, 10mm @ 200 m
  - 0.01° Angular
- Advantages
  - Automatic survey registration
  - High resolution
  - Minimal surveying
  - Effortless

Maptek I-Site Studio Software

- Overview
  - Compliments hardware
  - Import/process point cloud
- Features
  - Analyze 3D spatial data
  - Create surfaces, volumes, section & contours
  - Export high resolution visuals
- Advantages
  - Excellent data manipulation
  - Geotechnical Investigation tools

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Scanner Uses

- This project is just using it for highwall monitoring
- Stockpile Volumes
- Subsidence
  - If it can be placed high enough
- Impoundment Stability Monitoring
- Approximate Original Contour
- Almost anything one can think of!

Summary

- Good Start
- Established System
- Great Location, Excellent Cooperation
- Seismographs Installed
- Initial Scanning
- Models In Progress

- Thank you for your time