

Stirred, Not Shaken!
*Beach Renourishment Vibration Control and
Documentation in Staging Areas*

**FSBPA National Conference on Beach Preservation
Technology 2024**

Presented by

ERIC B. REHWOLDT, P.E., P.G.

SEISMIC SURVEYS, LLC



Introduction

- **Seismic Surveys, LLC**

- Specialty consulting company with expertise in monitoring and protecting existing structures from damage from adjacent construction activities.
- Founded as Seismic Surveys, Inc. in 2001
- HQ in Maryland
 - Florida Locations in West Palm Beach and Orlando Metro
 - New Jersey



Introduction (Cont.)

- **Principal Types of Clients and Projects**

- General Contractors
- Owners/Developers
- Mining Companies
- Insurance Companies
- DDC Contractors
- Structural Engineers
- Pile Driving Contractors
- Blasting Contractors
- Demolition Contractors



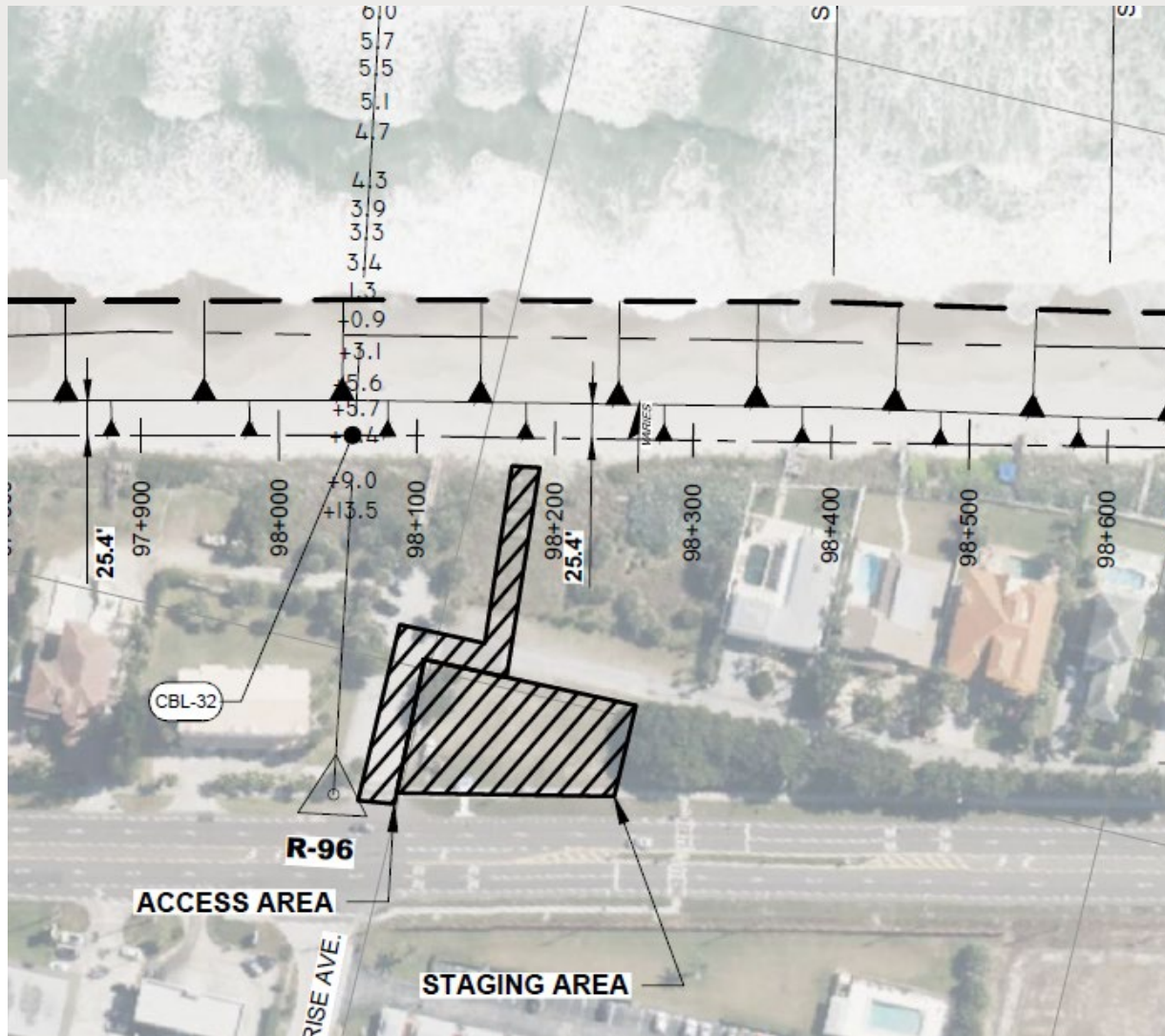
Outline (*Stirred, not Shaken!*)

- Why Monitor Vibrations during Beachfill Construction?
- Human Perception vs. Structural Damage
- Vibration Damage Claims and Mitigation, Including Construction Staging Areas and Access Corridors



*Shaken, NOT Stirred
preferred by James Bond*

The Issue!



PART 3 EXECUTION

3.1 VIBRATION CONTROL PROGRAM

Implement a program that protects existing structures from damages that result from construction equipment operations and vibrations. The purpose of the program is to avoid damages and potential claims that allege damages were caused by construction activities. Document pre-existing conditions, to avoid damaging existing structures that were determined to be susceptible to vibration damage and to avoid damaging existing structures that were not determined to be susceptible to vibration damage; related responsibilities include inspection, damage claims, and work stoppage that results from monitoring.

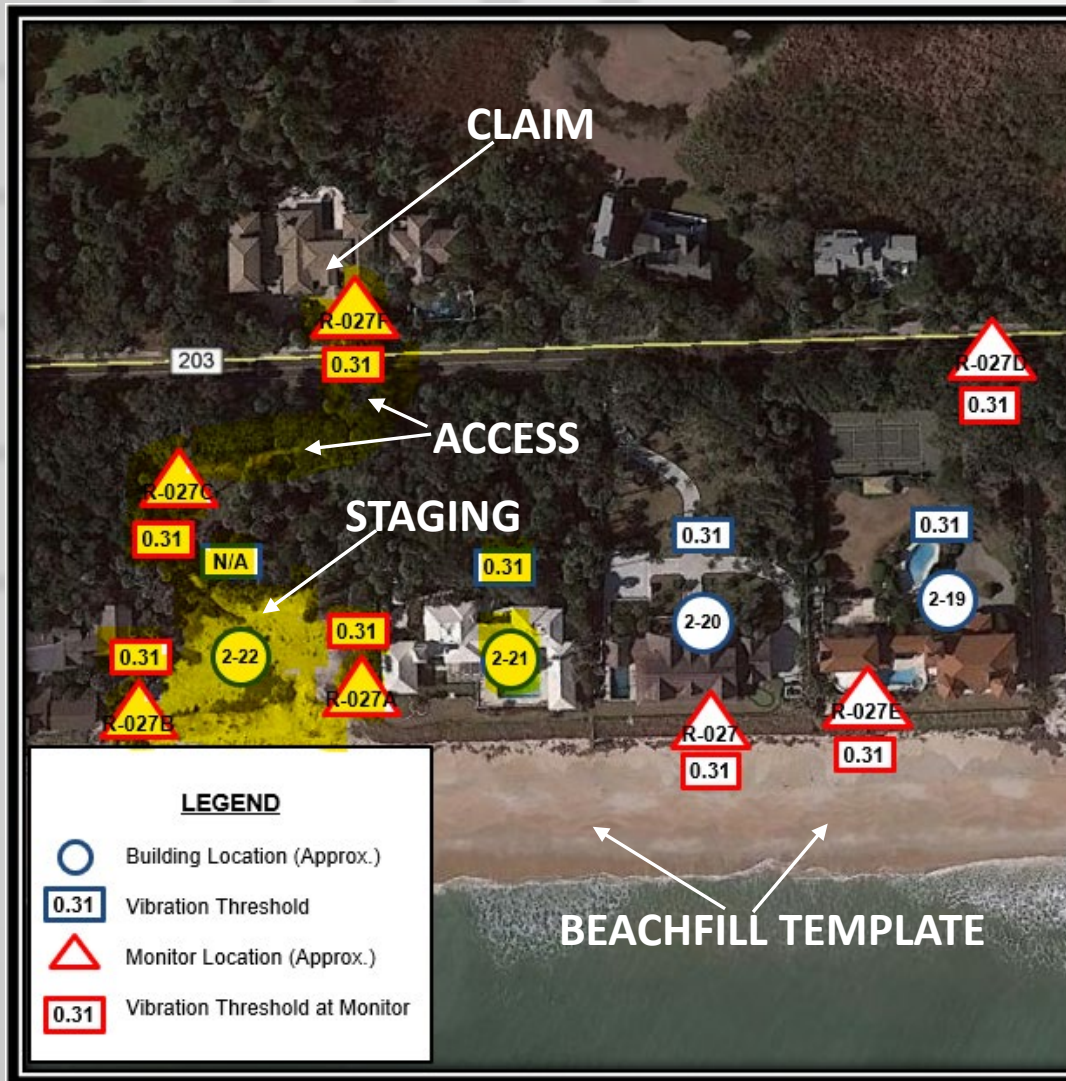
Refer to Clauses PERMITS AND RESPONSIBILITIES and PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS of Section 00700 CONTRACT CLAUSES in Volume 1 of this contract that define the Contractor's responsibilities. Process any claim arising from the construction operation; in particular, all property damage claims will be acknowledged by the Contractor (or his agent) immediately, and the claimed damage inspected within 30 calendar days following initial notification, and processed to a conclusion (honored, denied, or compromised) within 90 calendar days after completion of the contract; but, in no case will the claim(s) remain unresolved for a period exceeding six months.

3.2 PRE-CONSTRUCTION STRUCTURAL SURVEY

Submit three copies of the Pre-Construction Structural Survey within 30 calendar days after Notice to Proceed and prior to mobilization of equipment.

Inspect existing structures within 200 feet from the beach fill limit as to their potential susceptibility to vibration damage from construction equipment induced ground vibration. Visible structural and/or cosmetic damage to buildings, exterior walls, foundations, decks, pools, bulkheads and seawalls will be documented by photographs, sketches, and field notes.

The Issue!



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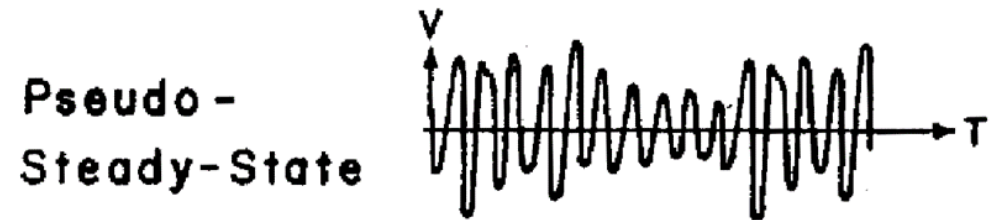
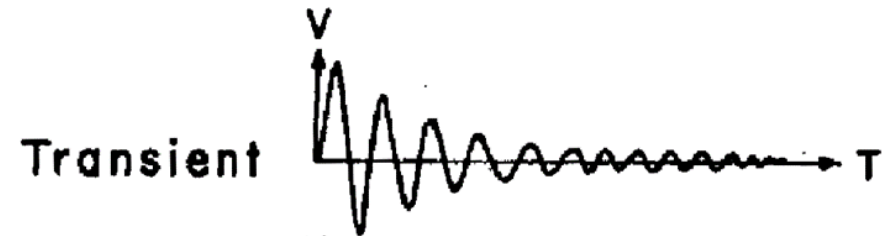
Developing a Vibration Control Plan

- Proximity of work to adjacent structures
- Jurisdictional requirements / Industry standards
- Sensitivity of adjacent structures to potential vibration or movement damage
- Engineering considerations / sources of vibration/ VID
- Risk of unwarranted claims
- Determine the most appropriate monitoring equipment and locations, and determine appropriate monitoring thresholds
- Outline reporting format and alert protocols

Types of Vibrations

- **Transient or Impact Vibrations**
 - (Blasting, Impact Pile Driving, DDC)
- **Steady-State or Continuous**
 - (Vibratory Compactor, Sheet Driving)
- **Pseudo-Steady-State**
 - (Track Equipment, Hoe Ramming)

Types of Construction Vibrations

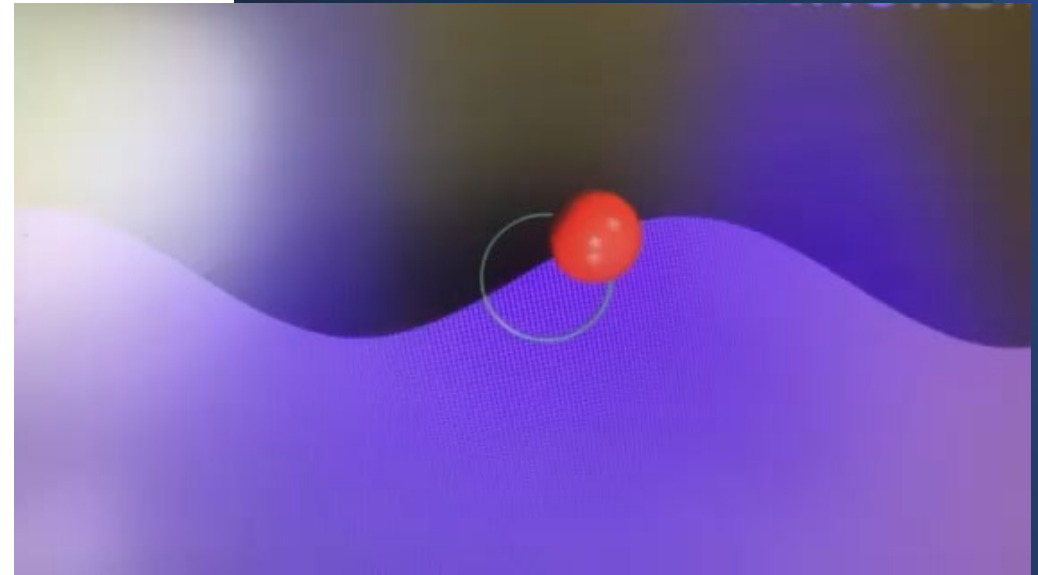


V = Vibration Amplitude

T = Time

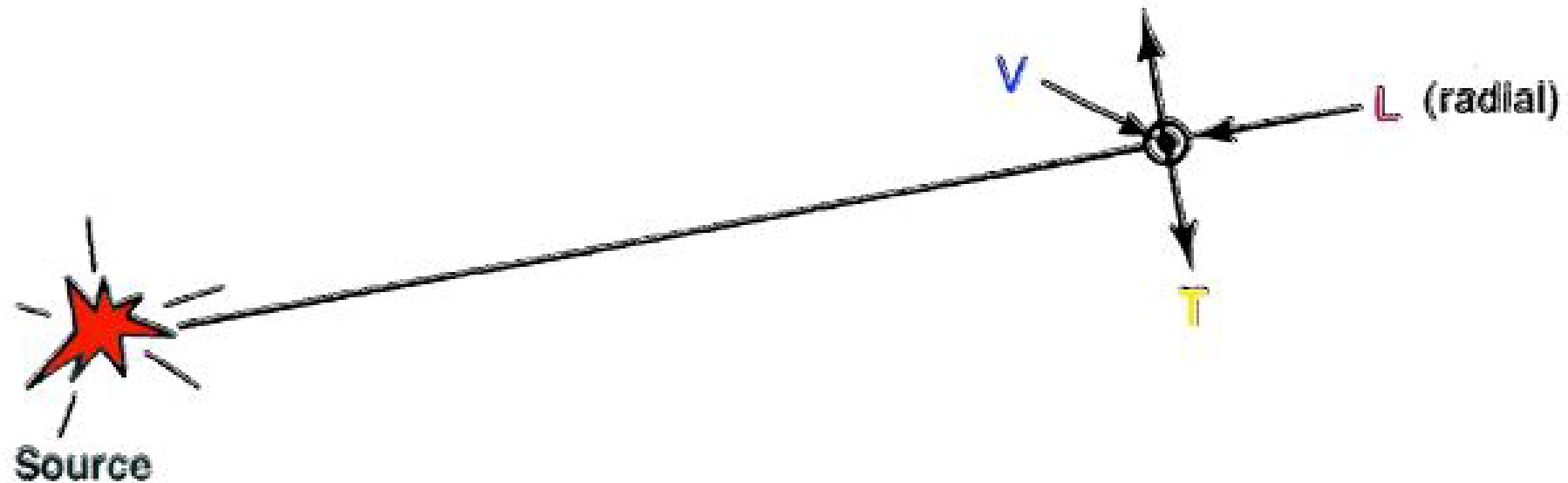
Fundamentals of Ground Vibrations

- **Particle Velocity** - The rate of particle motion in a medium. It is typically expressed in inches or millimeters per second (in/s or mm/s). Remains the best damage potential descriptor.
- **Frequency** - number of cycles over a given amount of time (typically a second). It is expressed as cycles per second or Hertz (Hz).



Vibration Components Measured

We measure in three directions: Transverse, Longitudinal, and Vertical





Vibration Monitoring Equipment

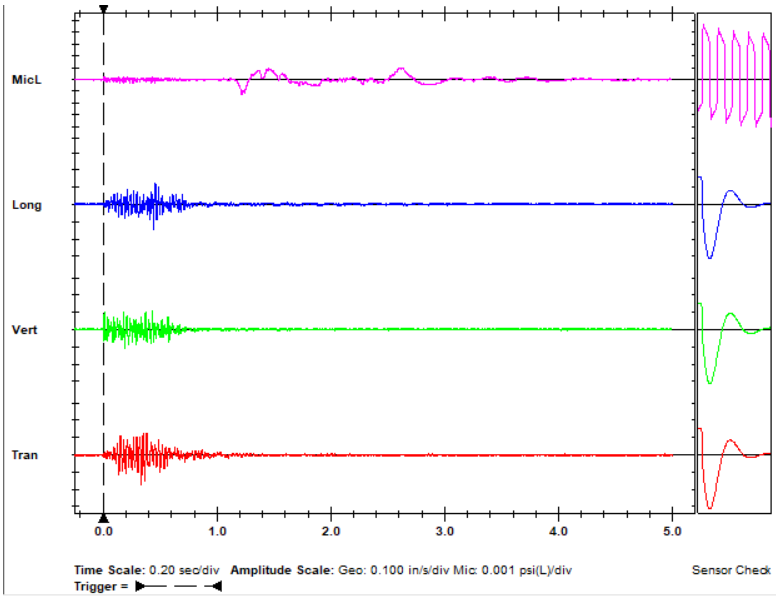
- Typical Engineering Seismographs
 - **Nomis**
 - **Sigicom**
 - **Instantel**

Remote Vibration Monitoring

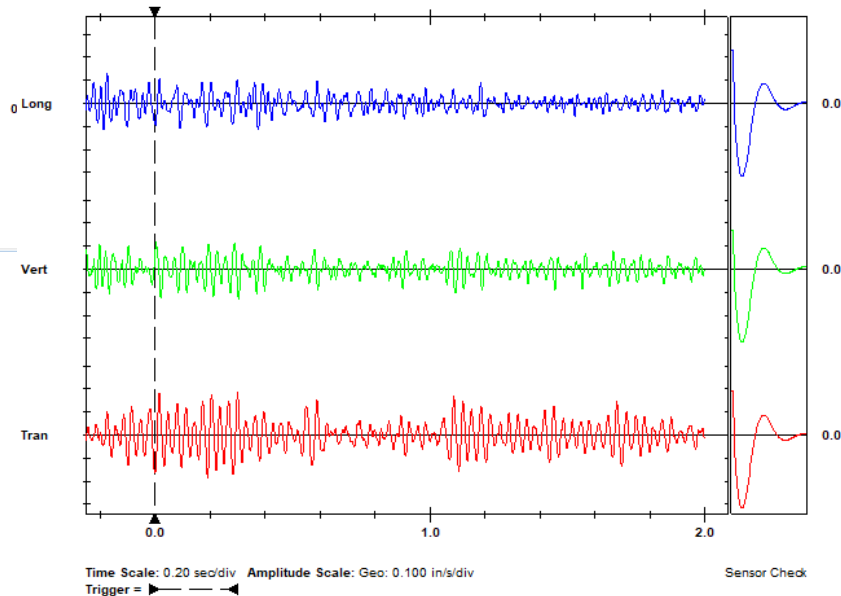


Example Time Histories

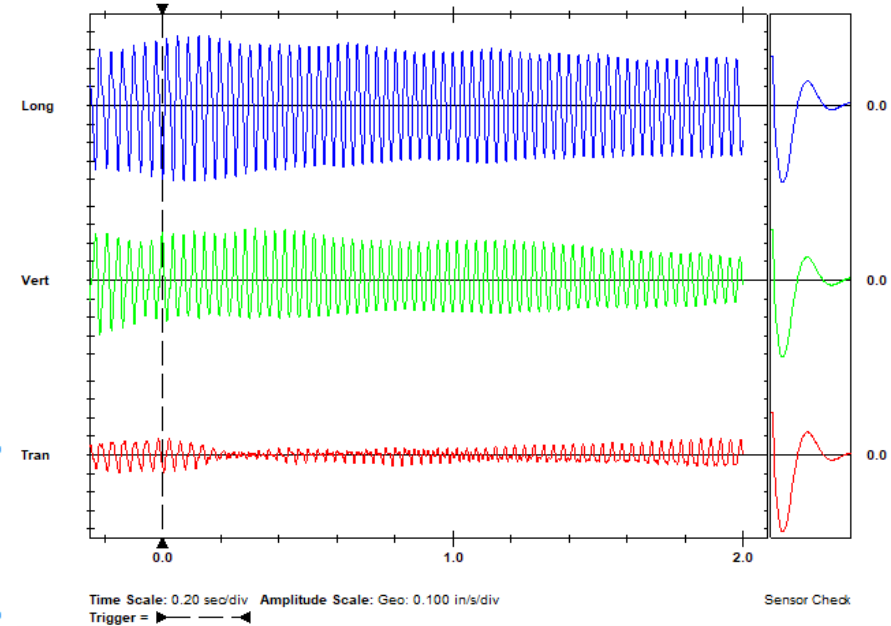
Blast Event



Tracked Excavator/Dozer



Vibratory Hammer



Automated Vibration Threshold Alerts

Tuesday 07:22

(BE20137 Aug 31 /15 07:20:50) >
 Tran: 1.17 in/s
 Vert: 1.89 in/s
 Long: 0.705 in/s

Serial Number Date Yesterday 11:27 Time

(BE20137 Sep 1 /15 07:20:10) >
 Tran: 1.32 in/s
 Vert: 0.435 in/s
 Long: 1.36 in/s

Vibration Readings

(BE20137 Sep 2 /15 07:23:15) >
 Tran: 0.640 in/s
 Vert: 1.29 in/s
 Long: 0.850 in/s



Waveform Trigger Source
 Trigger Level(s)
 Pre-Trigger/Record Time
 Sample Rate
 Operator/Setup File Name

Vert at May 11, 2017 08:55:22
 Geo 0.170 in/s
 0.25 sec/2.0 sec(Fixed)
 1024 sps
 3.mmb

Serial Number
 Model Number
 Battery Level
 Unit Calibration
 Event File Name

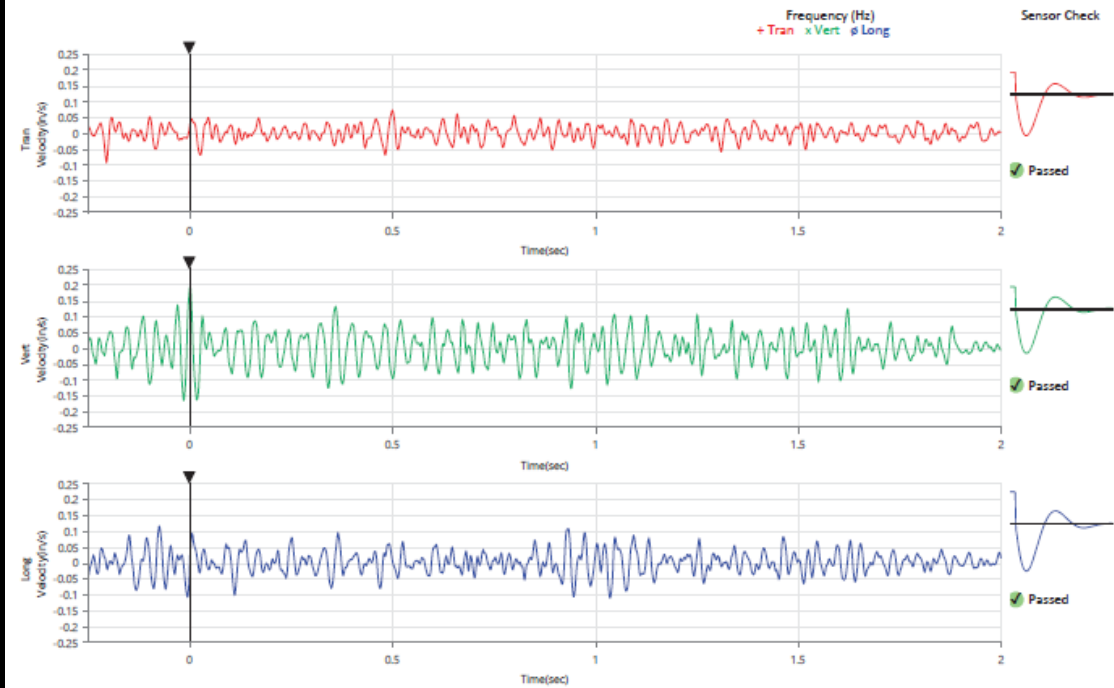
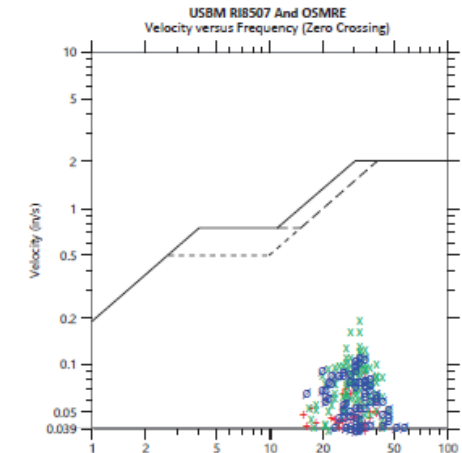
UM10104
 Micromate ISEE 10.85
 3.8 volts
 February 9, 2017 by Instantel
 UM10104_20170511085522.IDFW

Notes
 Location
 Client
 Company
 General Notes

Post Event Notes No text to be displayed.

Geophone	Tran	Vert	Long
Peak Particle Velocity	0.091 in/s	0.194 in/s	0.115 in/s
Zero Crossing Frequency	34.1 Hz	32.0 Hz	32.0 Hz
Time (Relative to Trigger)	-0.204 sec	0.002 sec	-0.074 sec
Peak Acceleration	0.044 g	0.101 g	0.082 g
Peak Displacement	0.000 in	0.001 in	0.001 in
Sensor Check	Passed	Passed	Passed
Frequency	7.3 Hz	7.3 Hz	7.3 Hz
Overswing Ratio	3.8	3.6	3.6

Peak Vector Sum 0.196 in/s at 0.003 sec





What Governs Structure Sensitivity?

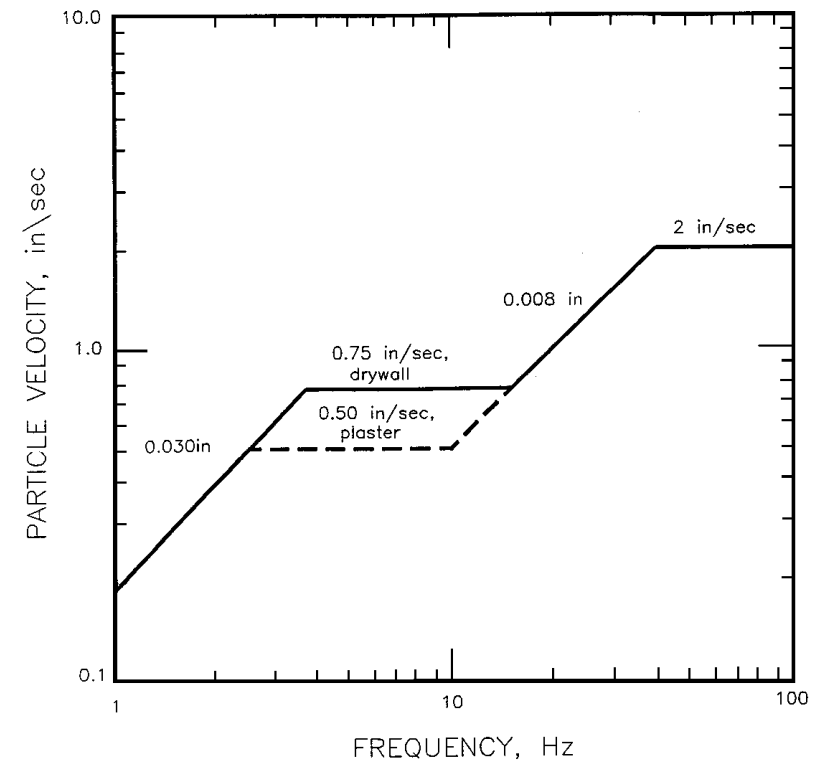
- Framing/Type of Construction
- Age
- Wall finishes
- Use (are there equipment, activities, or collections within the structure that might be sensitive)
- Distance from the source
- Geologic Path between the source and the receiver
- Vibration duration
- Vibration frequency and particle velocity

Vibration Control Standards

• Decades of Research for Blasting Industry

- Blast Vibrations and Impact Hammer Pile Driving both Generate Transient Vibrations (**US Bureau of Mines RI 8507 (1980)**)
- **Standards are Designed to Protect Drywall and Plaster from Cosmetic Cracking**
- **Structural Damage would require 2 to 5 times Higher Vibrations than the Generally Applied Standards**
- **Other standards:** Buried Utilities, Historic Structures, Green Concrete, Engineered Structures, Sensitive Equipment, Human Response and Soil Settlement

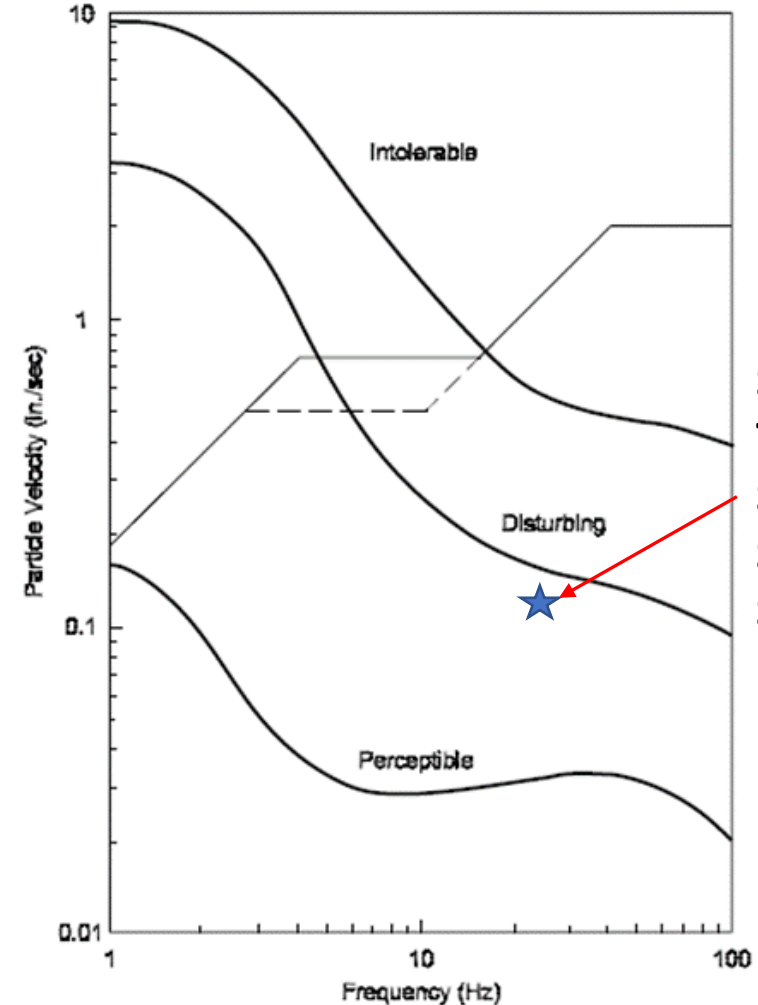
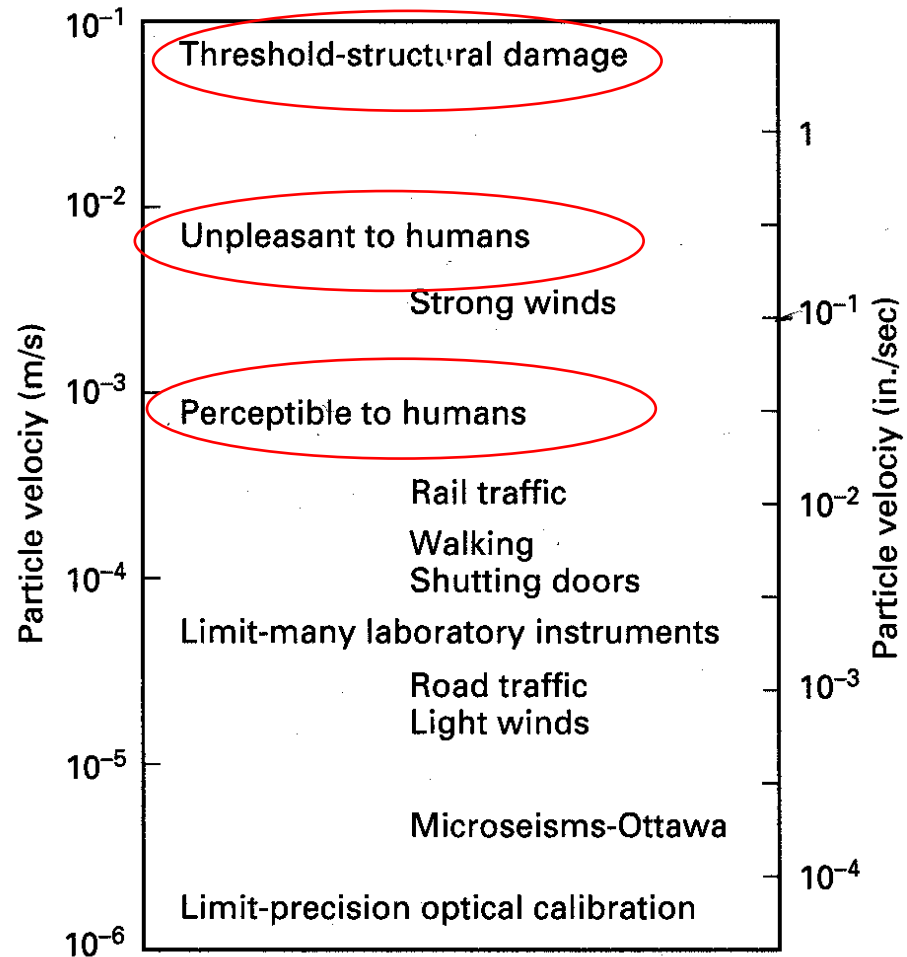
U.S. BUREAU OF MINES CRITERIA
FROM REPORT RI 8507 (November, 1980)



Swiss Vibration Standard

Structural Category	Definition	Source M Vibration (Max)		Source S Vibration (Max)	
		f(Hz)	in/sec	f(Hz)	in/sec
I	Reinforced-Concrete and Steel Structures (without Plaster)	10-30	.47	10-60	1.18
		30-60	.47-.71*	60-90	1.18-1.57**
II	Buildings with concrete floors and basement walls, above grade concrete, masonry walls, retaining walls	10-30	.31	10-60	.71
		30-60	.31-.47*	60-90	.71-.98**
III	Buildings with concrete basement floors and walls, above grade masonry walls, timber floor joists	10-30	.20	10-60	.47
		30-60	.20-.31*	60-90	.47-.71**
IV	Construction sensitive to vibrations	10-30	.12	10-60	.31-.47**
Source M:		Machinery, traffic, construction works – (*)the lower values applies to 30 Hz, the upper to 60 Hz, with interpolation in between.			
Source S:		Blasting operations – (**)the lower values applies to 60 Hz, the upper to 90 Hz, with interpolation in between.			
Ref:		Institution of Swiss Highway Engineers, (VSS), Swiss Standard SN640312: "Vibration Effects on Structures" (in German), VSS Secretariat Zurich, Nov., 1978			

So Why Do People Complain?



**Source M
Threshold for
Sensitive
Structures per
Swiss Standard**



Community Outreach and Education

- **Talk to the neighbors!** Inform on project scope and schedule
- **Discuss potential impacts and listen to concerns (noise, vibration, dust, traffic)**
- **Educate the neighbor** about the measures to address their concerns and minimize the potential for impacts to their property
 - Pre- and Post-Construction surveys
 - Monitoring Plan & Control Standards
 - Communication & Mitigation

-Survey Date: 06-21-22

SSI Job No.: 202

-Survey Date: 08-17-23

SSI ID No.: 11

Address: 6619 84th Avenue North

Description: Cracked stucco face at the corner of Elevation B and C, secor,

DCI-Survey Image # 70P



Pre-Survey Image # 61



Things to Remember and Communicate

- Cracks may be caused by a variety of construction &/or non-construction environmental related factors.
- Structures contain numerous cracks (*of which the property owner is likely unaware*) that increase in size each year.
- Temperature, humidity, wind, and normal use all impart stresses on a structure that are likely to have more of an impact on a building than construction vibrations that are within generally accepted standards.
- **Human beings are far more sensitive to vibration and noise than the structures they occupy (x 100!)**

Damage Concerns/Complaints by Neighbors

- **No rhyme or reason to why certain neighbors complain/claim damages**
 - Not aware of the planned construction activities (truly *Shaken!*)
 - Not aware of actual impacts to their structure and efforts to mitigate (truly *Shaken!*)
 - Truly opportunistic and disingenuous
- **Many damage concerns/complaints adjacent to Contractor Staging/Access areas**
- **Damage concerns/complaints sometimes outside zone of influence**



Post-Survey
and Damage
Claim
Investigation

Pre-Survey Image # 230



Pre-Survey Image # 228



Post-Survey Image # 30



Post-Survey Image # 31





Keys to Damage Claims Mitigation!!

- **Community outreach and ‘Notifications’**
- **Pre-/post-construction surveys and monitoring within 200 feet of beachfill template AND Contractor staging and access corridors**
- **Monitoring data collected during construction compared to standards and thresholds**
 - Triggered/alerts events documented with specific site activities
 - Check on VID for equipment near structures
- **Timeline for location of active construction work areas**
- **Responsive consultant to support project team and execute monitoring plan**
- **DOCUMENTATION and DEFENSIBILITY!**

THANK YOU!!

YOUR PARTNER FOR:

- PRE- AND POST-CONSTRUCTION STRUCTURE INSPECTIONS
- VIBRATION , AIR OVER PRESSURE, AND SOUND MONITORING
- GEOTECHNICAL AND STRUCTURAL MONITORING INSTRUMENTATION
- DAMAGE CLAIM INVESTIGATION AND EXPERT TESTIMONY

