Iowa DOT's Vibration Monitoring Program

Presented by Charles Bernhard, Iowa DOT and Bob Hannen, WJE

https://iowadot.gov/ole/vibration-workshop

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Reactive Beginnings…

- Kingsway Cathedral
- Consulted with WJE to determine the best approach forward
- Conclusion: construction vibration did not cause structural damage… but could have.
- Next steps…

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White Paper

Written as technical guidance for protection of historic structures.

- Division of Responsibility:
  - Office of Location and Environment
  - District Office responsible for non-historic structures

- Tiered Risk Management Includes Assessment of:
  - Magnitude and frequency of “source”
  - Proximity of vibration source to receptor (normally < 300 feet)
  - Medium (e.g., soil, rock)

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Special Provision

- Identifies properties to be protected using vibration monitoring techniques.
- Outlines requirements for monitoring plan
- Establishes preconstruction work requirements
- Qualifies that the peak particle velocity (PPV) will be determined based on the pre-construction survey
- Requires a post-construction for documenting negation of construction effects on receptors.

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Preconstruction Survey

- Purpose

  -Document the structural condition prior to beginning construction activities.

- Parts

  -Risk assessment/management,

  -Identify vulnerabilities, establish vibration threshold

  -Documentation

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Benefits of Being Proactive

- Good working relationship with our stakeholders (e.g. SHPO, FHWA residents of Iowa)
- Less possibility of legal issues saving time and money
- Expedite project
- Avoid liability of repairs

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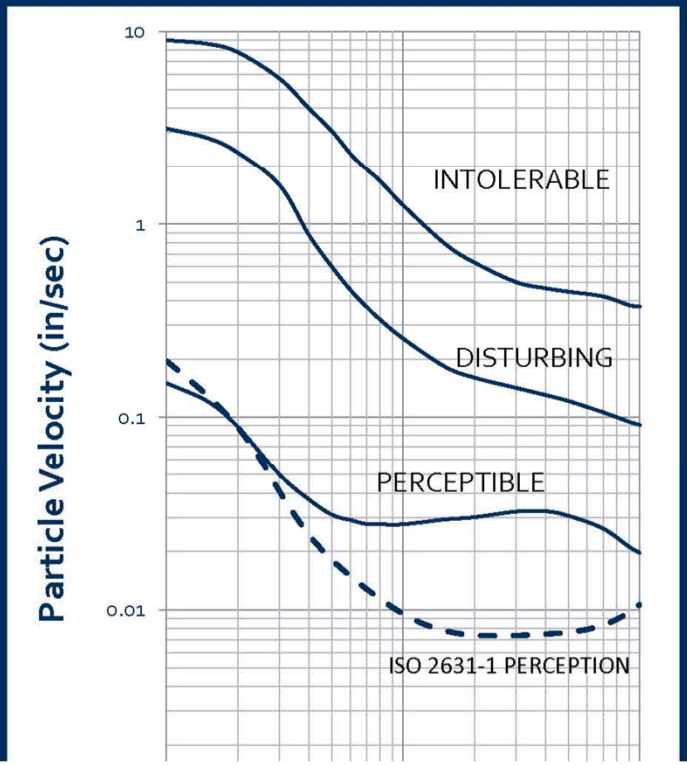
Techniques for Vibration Monitoring/Vibration Limits - WJE

Human Perception



The human body can **perceive very low levels** of vibrations

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Typical Monitoring Equipment

- Engineering Seismographs
  - Digital
  - Continual monitoring
  - Remote access
- Geosonics
- Instantel
- Sigicom

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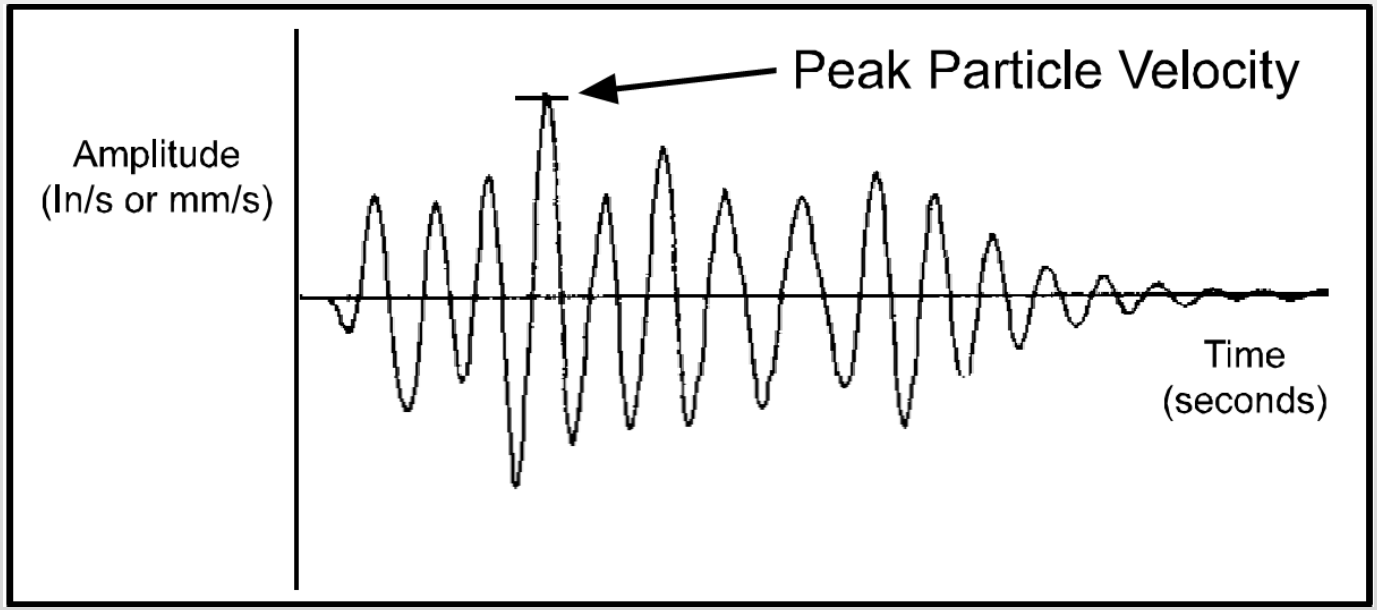
Parameters to Monitor

- Particle Velocity



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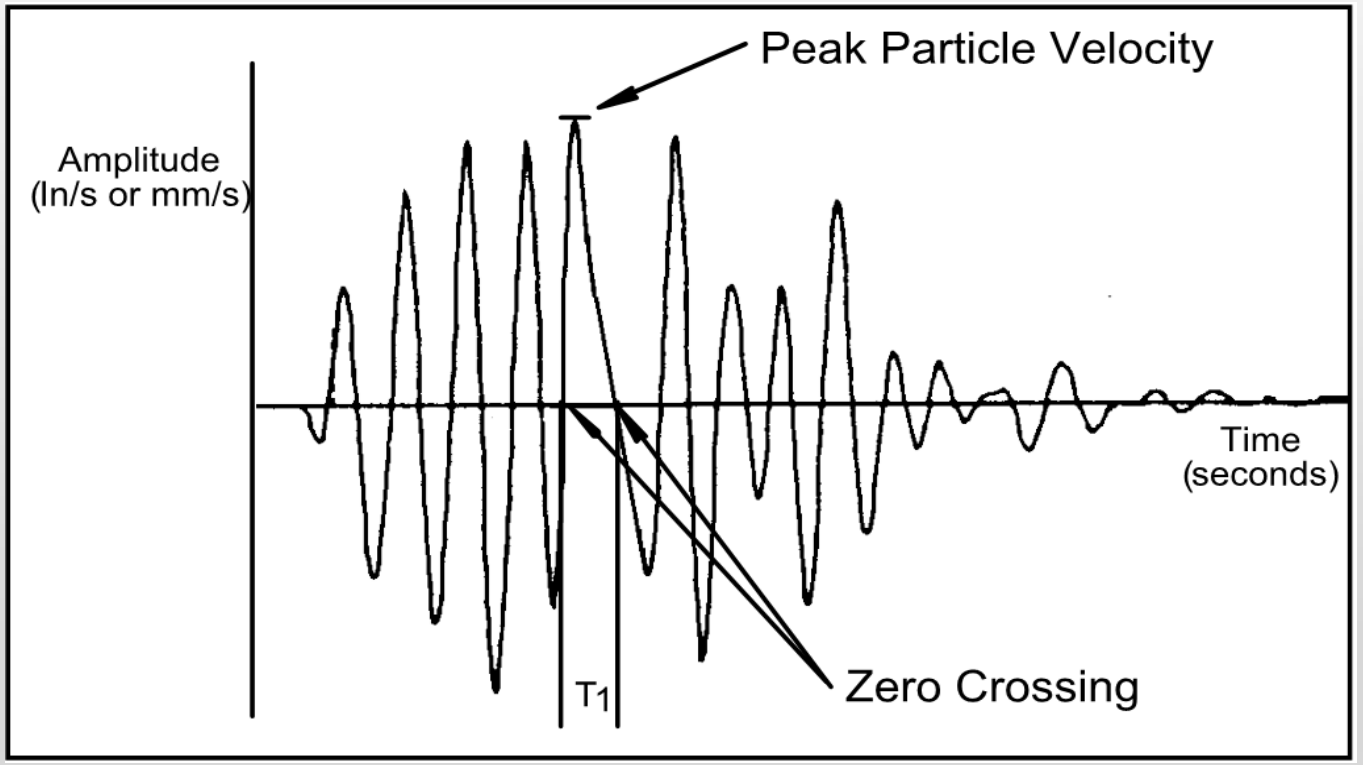
Parameters to Monitor

- Frequency
  - Zero-Crossing
  - Differs from FFT



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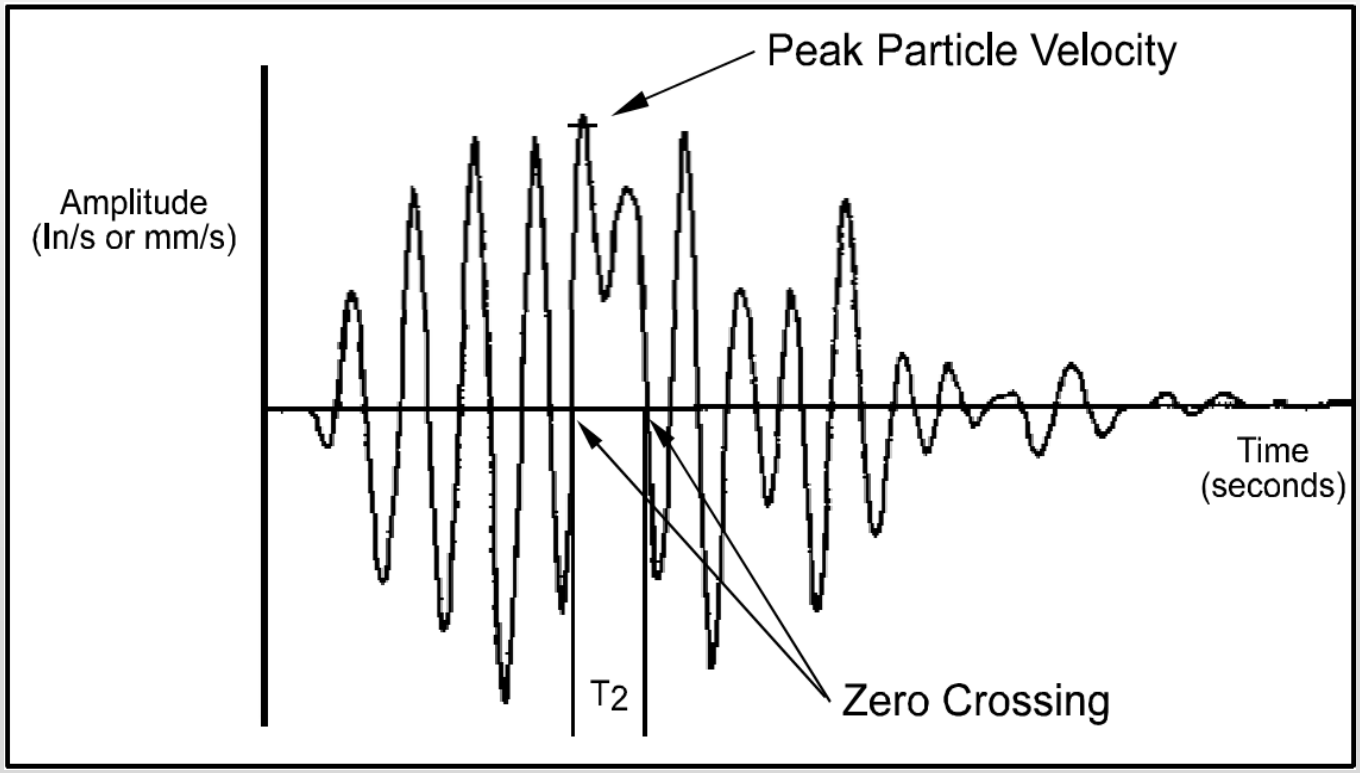
Parameters to Monitor

- Frequency
  - Zero-Crossing
  - Limitations



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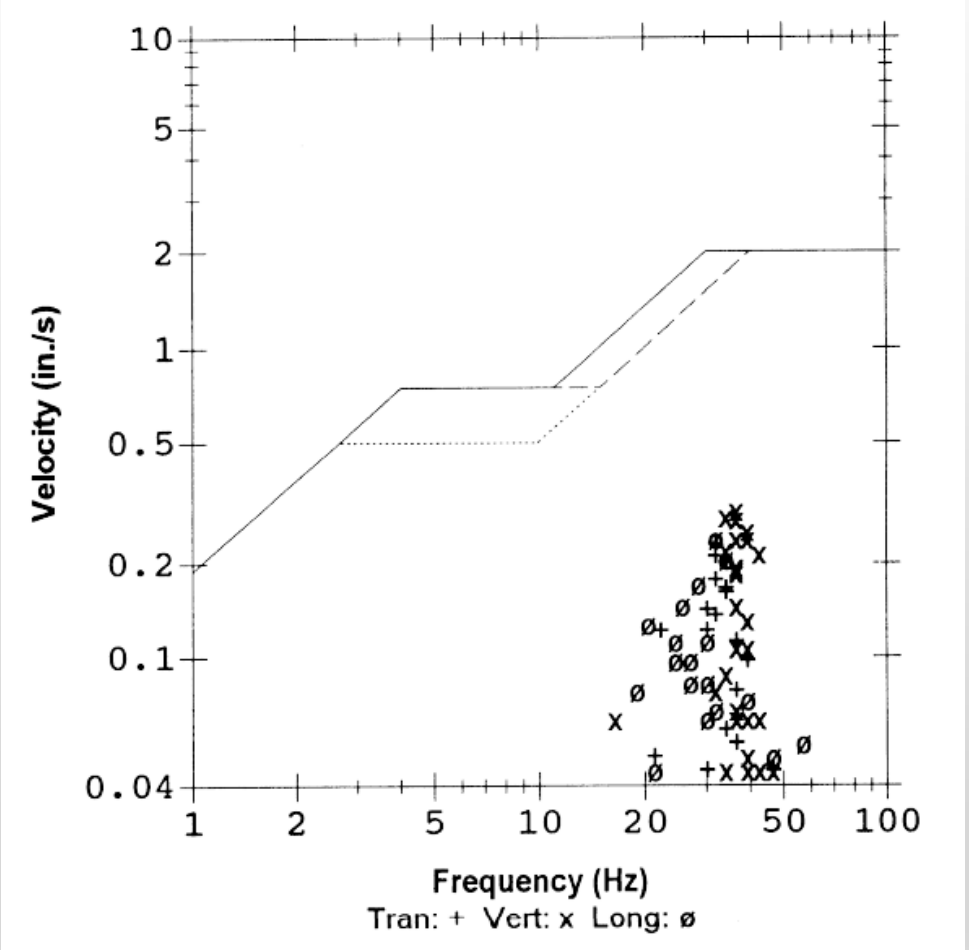
Typical Vibration Limits

- USBM RI-8507 and OSMRE
  - Based on testing of residential buildings
  - Ground vibration measurements
  - Potential for initiating new cracks or enlarge existing cracks
  - Amplitudes below line exhibited No Damage



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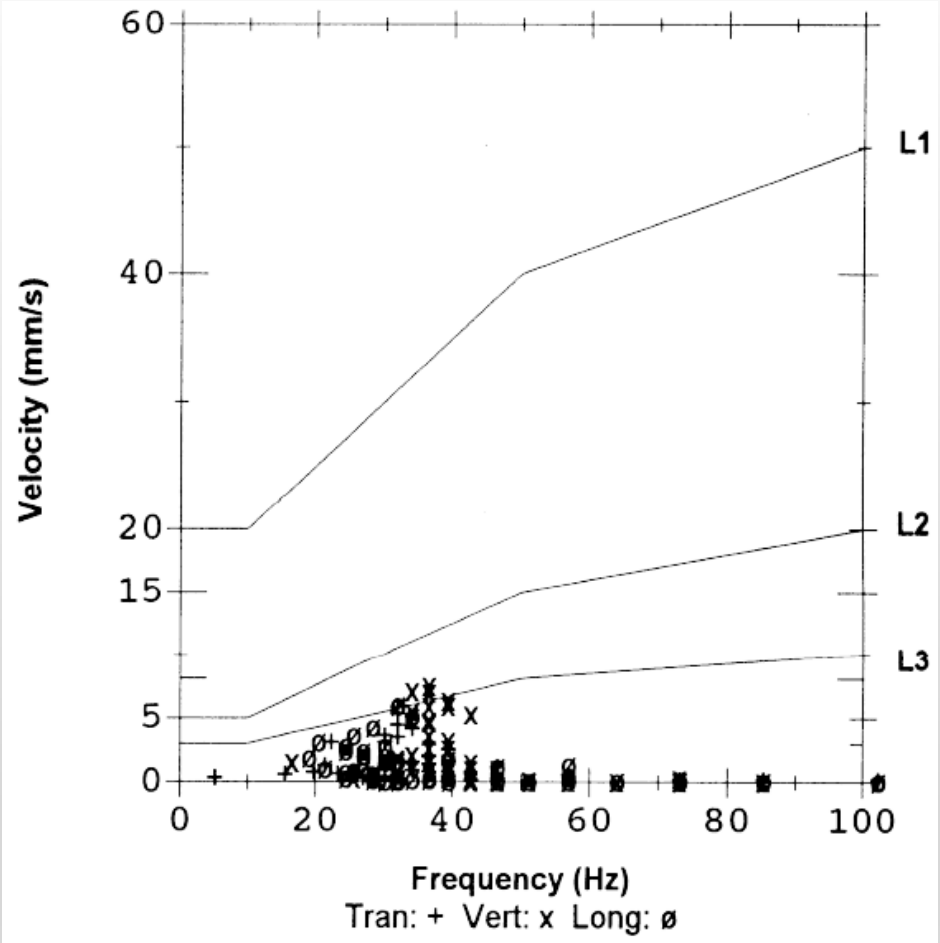
Typical Vibration Limits

- DIN 4150
  - Basis is not clearly identified
  - Ground vibration measurements
  - Line 1 for commercial buildings
  - Line 2 for residential structures
  - Line 3 for historic structures, or ruins



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Seismograph Installation

- Basement slab
- Foundation wall
- Soil outside of building
- Securely attached to surface

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Recommended Reporting

- Daily system checks
- Weekly Reports

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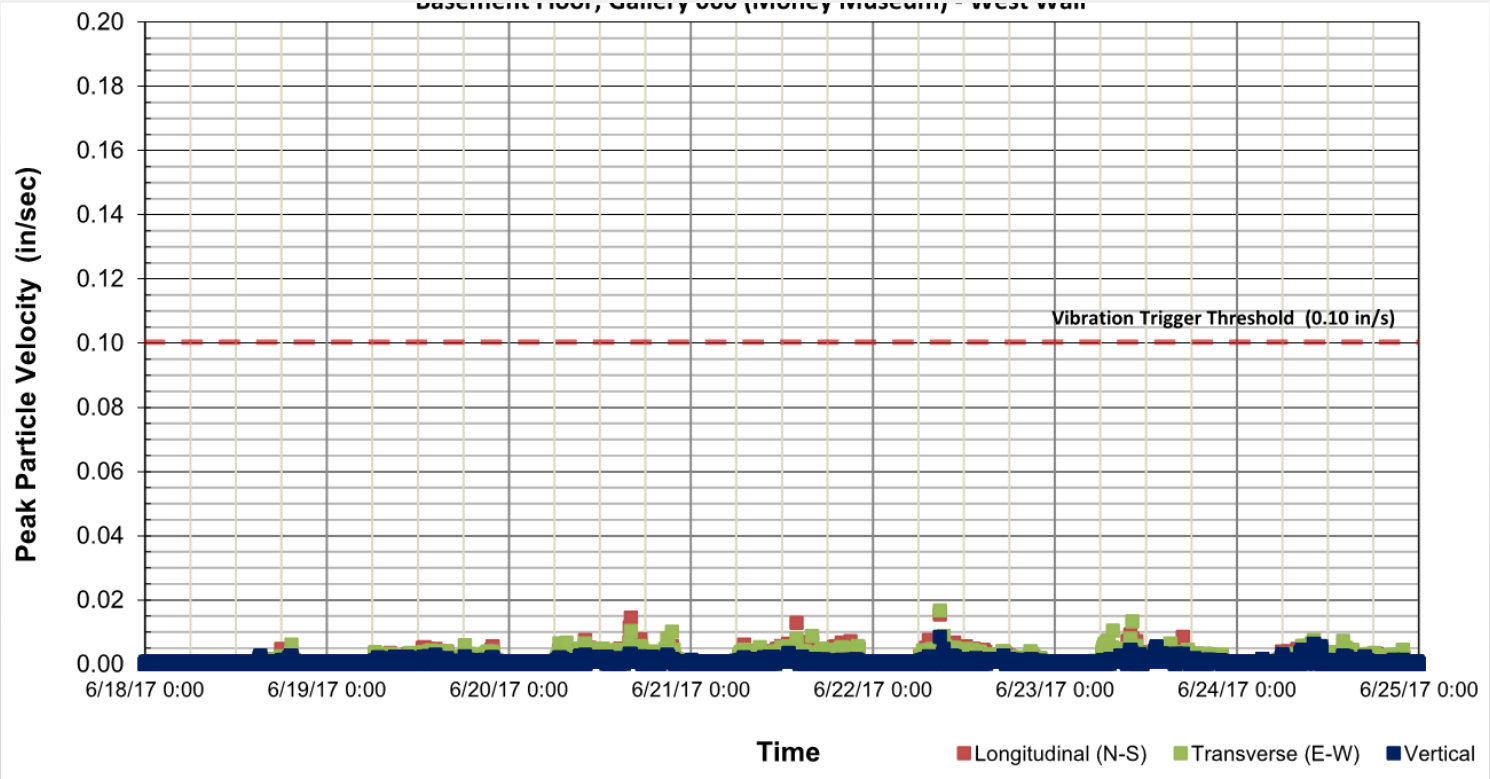
Recommended Reporting

- Show continuity of monitoring



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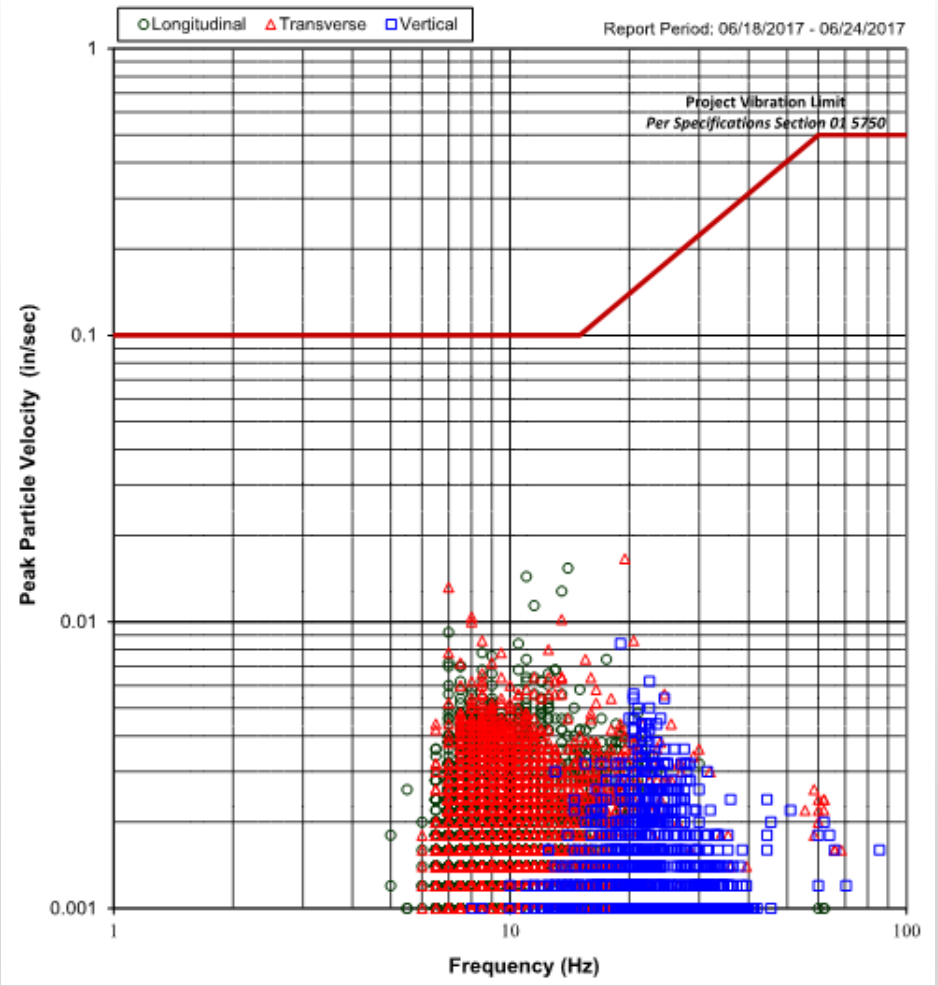
Recommended Reporting

- Amplitudes versus frequencies



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