Management of Vibration Monitoring on Construction Projects

Prepared for: Geo^3 T^2
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Krystle Pelham, Engineering Geologist
NH Dept. of Transportation, Bureau of Materials and Research

Presentation Outline

- Background
- Introduction
- Research Goals
- Approach
- Implementation Plan
- Conclusion and Recommendations

Background

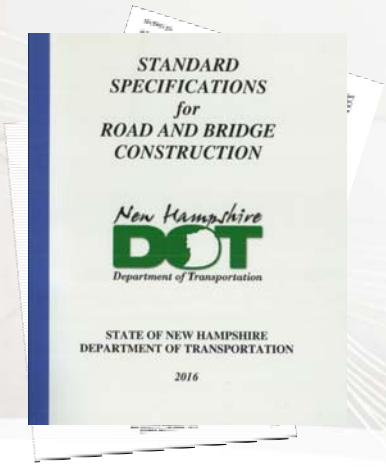
- NHDOT Construction moved toward reconstruction and rehabilitation. Projects are located in highly developed areas where structures can be adversely impacted by ground vibrations
  - Increased level of concern and claims
  - Need was identified to standardize the approach to assess potential for impact and needs on a given project

Introduction

- Non-blasting induced ground vibrations are generated by a number of construction activities:
  - Pile driving
  - Vibratory compaction
  - Pavement breaking
  - Movement of heavy equipment
  - Hoe ramming
  - Dynamic compaction

Introduction Cont.

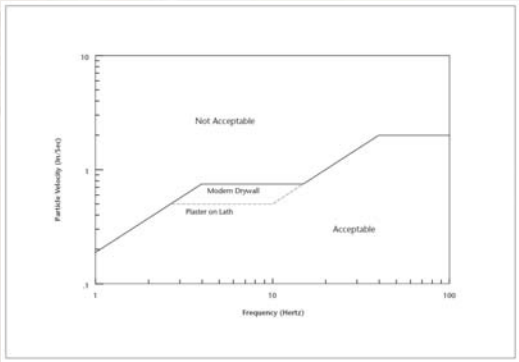
- Significant effort to monitor vibrations from construction activities for a given project
  - NHDOT Item 211.11
  - Tracks the non-blasting vibration monitoring separate



Introduction Cont.

Vibration Criteria

- U.S. Bureau of Mines 1980
- Adopted by most gov. agencies although they are known to be conservative and est. for blasting induced vibrations



Research Goals

1. Develop a method to asses the potential for impacts from construction vibrations
2. Develop a database of historical information that can be used as a decision making tool
3. Develop a guideline to estimate hours and cost of services for proposed projects
4. Identify the types of equipment and activities that cause damaging vibrations

Approach

- Data collected on a variety of projects across the state
  - For NHDOT complaints are most common with *vibratory compaction* and impact *pile driving*
  - Highest vibrations were recorded at start up and shut down of pile driving equipment
    - Variations from site to site and subsurface conditions

Approach

- Most non-blasting vibrations fall in low frequency range 5-30 Hz
- Subsurface conditions can significantly effect levels
- Most homeowners feel vibrations…then it MUST have caused damage
  - People can feel vibrations down to 0.02 in/sec

Approach

Published Levels

Table 12-2 Vibration Source Levels for Construction Equipment (From measured data.[8][9][10][11])

Equipment		PPV at 25 ft (in/sec)	Approximate L_v† at 25 ft
Pile Driver (impact)	upper range	1.518	112
	typical	0.644	104
Pile Driver (sonic)	upper range	0.734	105
	typical	0.170	93
Clam shovel drop (slurry wall)		0.202	94
Hydromill (slurry wall)	in soil	0.008	66
	in rock	0.017	75
Large bulldozer		0.089	87
Caisson drilling		0.089	87
Loaded trucks		0.076	86
Jackhammer		0.035	79
Small bulldozer		0.003	58

† RMS velocity in decibels (VdB) re 1 μinch/second

From FTA

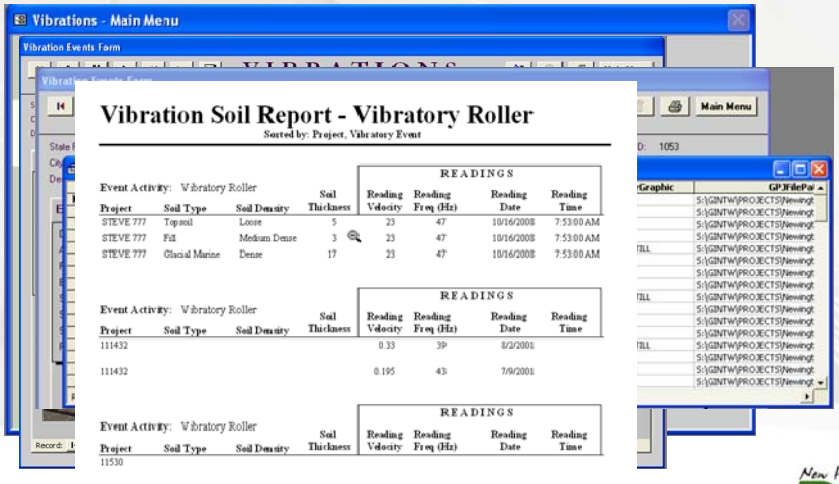
Approach

Database

- Project information
  - Connected to the DOT data warehouse
- Event information
  - Activity (equipment type), structures, type of vibrations (continuous, single event, high-rate repeated impact)
- Seismograph information
- Subsurface conditions
  - Soil information from gINT
- Readings

Approach

Database



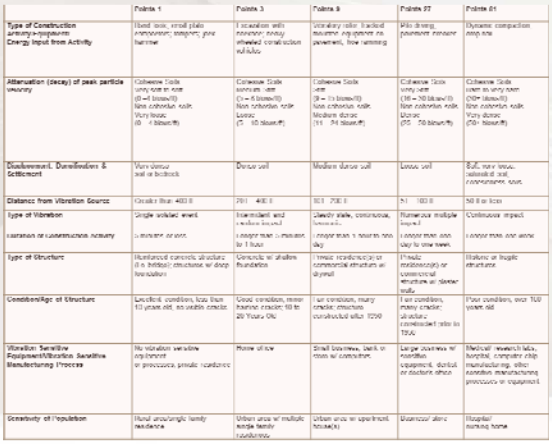
Approach

Development of an Assessment Table

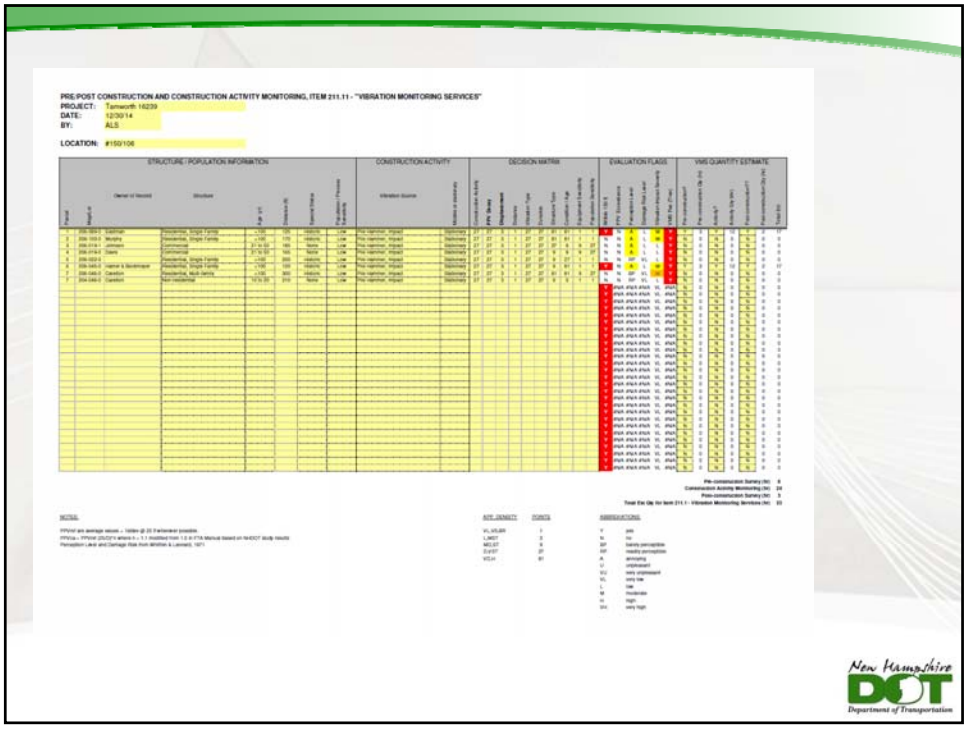
- Routinely used by designers to determine if concerns exist
- Ultimately aids in establishing a preliminary cost estimate and hours for monitoring
- Matrix modified based on the FHWA Rock slope rating system
  - Points score of 10 categories determine the potential level of impact from a given activity

Approach

Development of an assessment table



Construction Vibration Impact	Point Total
Very High Impact	400 or greater
High Impact	300 to <400
Moderate Impact	200 to <300
Low Impact	100 to <200
Very Low Impact	Less than 100


PRE/POST CONSTRUCTION AND CONSTRUCTION ACTIVITY MONITORING, ITEM 211.11 - "VIBRATION MONITORING SERVICES"
PROJECT: Tamworth 16239
DATE: 12/30/14
BY: ALS
LOCATION: #150/106

STRUCTURE / POPULATION INFORMATION | CONSTRUCTION ACTIVITY | DECISION MATRIX | EVALUATION FLAGS | VMS QUANTITY ESTIMATE

Implementation

- Publish a guidance manual outlining the method
- Historical data will become an asset to assess the need and estimate hours
  - Save money!
- Developed a separate form required to be submitted
  - Better database reporting
- Share the institutional knowledge to prepare for the future!

Conclusions

- Value of the database will increase as more data is entered with variable site conditions and activities
- Establishing good public relations, through education, communication, and coordination with landowners and business owners is key
- Projects can require special considerations and may require adjustment to limits or monitoring distances
- Special requirements such as sensitive operations/manufacturing processes historic/fragile structures need to be identified early and called out in the contract documents