



## Florida Department of Transportation Research Evaluation of Vibration Limits and Mitigation Techniques for Urban Construction BDK80 977-22

Construction activities such as pile driving and dynamic compaction of loose soils induce ground and structure vibrations. Their effects may annoy local populations, disturb sensitive equipment, or reduce structures' serviceability and durability. How construction vibration will affect local structures is a complex issue that depends on vibration source, structure and composition of the ground transmitting the vibrations, and condition of structures or sensitivity of equipment subjected to the vibration. Proximity is important, but low frequency vibrations may have an effect at unexpected distances. To mitigate the vibratory effects of construction, it is necessary to understand each of these factors.

In this project, Florida International University researchers undertook to create a comprehensive framework for predicting and estimating construction vibration and its effects. The framework included expected vibration based on planned construction operations, condition of affected buildings, and impact of mitigation strategies. Better understanding and estimation of vibration sources and effects led to recommendations for improved Florida Department of Transportation (FDOT) specifications.

Researchers conducted a survey of FDOT districts, departments of transportation in other states, consulting, design, and construction companies, and vibration consultants. The purpose of the survey was to draw on the field experience of these entities and determine the current state of practice regarding vibration. Surveys addressed such issues as variation of Florida soil conditions, use of condition surveys, vibration limits, mitigations, and codes about vibrations. The survey found widespread experience with vibration damage and with legal claims against agencies or contractors.

Vibration is best characterized by peak particle velocity (PPV). Using field data specific to Florida,



*Vibratory compactors and pile drivers produce intense vibrations that can damage susceptible structures or sensitive equipment.*

a scaled-distance equation was developed to calculate PPV of ground vibrations. The equation was applied to numerous examples of construction operations, including pile driving, sheet pile driving, shaft casing operations, and vibratory roller operations, and at many Florida locations.

Structure condition is critical to understanding the effects of vibration, so the researchers conducted a comprehensive review of structure condition surveys and developed guidelines for such surveys. An analysis of the effects of different factors on vibration limits was accompanied by a summary of mitigation techniques used in industry and those used during bridge and roadway construction operations in Florida.

The effects of vibrations due to construction operations can be difficult to predict, and therefore, it can be difficult to set appropriate guidelines or specifications. Projects like this one yield improved methods of specifying levels of vibration for a given work zone. This helps the FDOT select operations and design work schedules that maximize efficiency and minimize negative impact on local structures and populations.