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AN ABSTRACT OF A THESIS

**VIABILITY OF THE USE OF RANDOM VIBRATION EXCITATION
FOR PILE LENGTH DETERMINATION**

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Unsatisfied with available methods due to their complexity and their cost in time and money, the Tennessee Department of Transportation (TDOT) approached researchers at Tennessee Technological University (TTU) to develop a system to gage the lengths of embedded timber piles to be used by bridge inspection crews. The system needed to be simple to operate, highly accurate, and needed to provide immediate results on site. Based on previous studies at TTU involving random vibration excitation on homogenous materials a field measurement system was developed. The system worked by creating several Frequency Response Functions (FRF's) from signals detected by transducers attached to the sides of a pile. The FRF's were used to determine the natural frequency of the pile, which can be used with the experimentally determined stress wave velocity in the pile to calculate its length. However, due to equipment complexity, signal transmission issues, and the inherent non-homogeneity of wood the system was never fully successful in meeting the requirements outlined by TDOT.

Thus, a study was begun to determine if it was at all possible to obtain data from timber piles that were repeatable and were of the quality needed by the TTU system. A simplified version of the system was used that generated random vibrations at one end of an above-ground pile while taking readings from both ends of the pile to create a single FRF. The tests also explored the relationship between error in the length determination and the method used to determine the natural frequency from the generated FRF's. Tests were conducted on piles of different treatment types and age, and ranging in length from 20 to 40 feet. Based on the result of the study, it was determined that under certain circumstances it was possible to predict pile length within an error band of 9%. As a result of these finding, it was decided to continue to pursue the development of a system that could meet the original TDOT requirements.