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ESTIMATING DRIVEN PILE CAPACITIES DURING CONSTRUCTION

PROBLEM STATEMENT

In the United States, millions of dollars annually are spent to install hundred of thousands of piles. Many are installed with only minimal information recorded. Cost prohibitiveness limits the number of piles that are tested to some 10% of the total installed. Current testing methods record stresses and velocities at the top of the pile only and require that the testing equipment be placed onto the piles once they are vertically positioned for driving.

The purpose of the testing regimen is to estimate total pile capacities, distribution of skin and tip resistance, and the relationship between blow counts and pile capacity. That is, the testing measures the ability of a pile to withstand the driving process and indicates its structural integrity. There are perceived limitations to using test equipment placed only at the top of a pile, in addition to the production delays that result to conduct the tests. The University of Florida under the sponsorship of the Florida Department of Transportation has developed technology that could obtain both pile top and bottom data. The technology will in addition reduce the cost of pile installation by about one half. Using wireless technology, which is implanted in the pile, the transportation industry will be able to assess the integrity of building and bridge infrastructure accurately and accelerate construction.

OBJECTIVES

The primary objective is to develop a testing method that is more time and cost effective, and that will enable a more accurate process by means of utilizing test devices placed at both the top and the bottom of the tested piles.

FINDINGS AND CONCLUSIONS

The technology developed during this project consists of non-recoverable (cast into the pile) wireless transmitter and instrumentation package developed at the University of Florida for pile monitoring. It consists of multiple channel data acquisition system, analog to digital converters, encoder, and a single wireless transmitter. Instrumentation consists of strain gauges, and accelerometers with the viability of adding GPS, tilt, and thermal. The system includes a wake up circuitry for data acquisition years after the pile installation in an extreme event. The transmitter and receiver may be as far as 500 ft apart. The receiver decodes the digital signals and separates it into individual instrument channels. The channels are fed into a laptop computer where the data is analyzed and displayed.

This technology permits in-place and real-time analysis of pile stresses and strains during pile driving. It is also capable of monitoring structural damage from extreme events such as an earthquake or a collision.

BENEFITS

The development and application of this technology will result in a number of benefits, including the following:

- The system may be cast into every pile (i.e. 100% instead of 10%), thereby
    - allowing Factor of Safety to be relatively decreased, and decreasing design pile lengths (cost savings pay for instrumentation)
    - providing real-time assessment of distribution of pile stresses (skin and tip) and pile capacity
    - allowing a contractor to continuously monitor a pile during installation, which enables the ability to change stroke and pile cushion material, which, in turn, saves both time and money.
- Real-time readings permit instantaneous data collection, sorting, and integration, thus assuring quality control and quality assurance for both contractor and owner.
- Wireless operation minimizes accident potential and construction delays (e.g., climbing leads)
- The wireless system sleeps and is capable of waking itself up during an extreme event (e.g., earthquake, collision); it can report the magnitude of the event and the resulting structural damage.

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