U.S. Department of Transportation
Federal Highway Administration

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Priority, Market-Ready Technologies and Innovations

GEOTECHNICAL & HYDRAULICS

Continuous Flight Augered (CFA) Piles

Problem: Bridge deficiencies create safety and mobility concerns

As the Nation's highway infrastructure continues to deteriorate, bridge deficiencies adversely impact mobility, safety, and economic development. Many State departments of transportation (DOT) are struggling to maintain an acceptable schedule of bridge maintenance, repair, and replacement. In 2002, 14 percent of all bridges that were 6.1 meters (20 feet) or longer were considered structurally deficient. Restrictions on vehicle weights that result from these deficiencies may lead to certain vehicles using alternate routes, thus lengthening travel times and reducing efficiency. At the same time, traffic congestion continues to increase.

To mitigate the problems associated with deficient bridges and increased traffic, bridges throughout the country must be replaced or widened, with lane capacity added. Improving the Nation's infrastructure will require a significant investment. To mitigate congestion, construction schedules must be accelerated to reduce the impact on the public, while observing economic stringencies to conserve funds for other projects. To achieve these goals, transportation practioners responsible for foundation design and construction must identify more efficient and cost-effective methods for supporting structures.

Putting It in Perspective

- Twenty-seven percent of the Nation's bridges are structurally deficient or functionally obsolete.
- One in every five highway projects is considered "traffic sensitive."
- From 1991 to 2001, vehicle travel grew at a rate seven times higher than did added roadway capacity.
- The cost of repairing all U.S. bridge deficiencies is estimated at $136 billion.

Solution: Continuous flight augered (CFA) pile foundations offer a low-cost alternative

What are CFA piles?
CFA piles (or auger cast-in-place (ACIP) piles, as they are commonly known in the United States) are a deep-foundation element characterized by drilling a hollow-stem auger into the ground to form the pile's diameter. Sand-cement grout or concrete is pumped into the hole as the auger is removed, eliminating the need for temporary casing or slurry. After the auger is removed, reinforcement is installed. Typically, CFA piles are grouped based on the type of equipment used to install them. CFA piles generally are available in 304.8- to 914.4-millimeter (12- to 36-inch) diameters and typically extend to depths of 18.3 to 21.3 meters (60 to 70 feet). In some cases, CFA piles have been installed to depths of more than 30.5 meters (100 feet). Drilled displacement piles also are commonly used.

Why use CFA piles?
Continuous flight augered piles can be installed quickly and inexpensively and are a viable foundation alternative to driven piles or drilled shafts for certain applications. CFA piles can support lateral earth and critical and noncritical structures and can be used in ground improvement applications. Typical highway project applications for CFA piles include structure support for new bridges, bridge widening, sound wall foundations, column support for embankment construction, and secant walls for lateral earth support. CFA piles are a good deep-foundation solution in areas that are environmentally sensitive or require minimal disturbance to human activity.

Benefits

- Rapid installation accelerates foundation construction, which reduces project schedules.
- Automated monitoring equipment provides real-time quality control.
- Suitable for low headrooms or confined spaces.
- Limited installation noise and vibration for sensitive urban environments.

Successful Applications: States use CFA piles on various projects

Approximately 15 State DOTs and the Federal Highway Administration's (FHWA) Federal Lands Highway Division have approved the use of CFA piles on a project-specific basis.

In the mid-1990s, Texas DOT began using ACIP piles as foundations for sound walls in the Houston, TX, area. The State successfully completed construction of a bridge in Crossley, TX, supporting the abutments on sixty-nine 46-centimeter (18-inch) diameter ACIP piles. Pile lengths were as long as 20.4 meters (67 feet). To handle lateral loads, some of the piles were constructed on a 4-to-1 batter. Texas DOT is planning to construct additional bridges that will be founded on ACIP piles.

To reduce vibrations that might have caused potential damage to an active Metro subway line, the District [of Columbia] Department of Transportation used drilled displacement piles to construct the foundation elements for a portion of a replacement structure. The piles were installed under low headroom conditions and created minimal vibrations, which reduced disturbances to the overhead Metro line.

Deployment Statement

This technology is characterized by drilling into the ground a hollow stem that forms the diameter of the pile. Sand-cement grout or concrete is pumped into the hole as the auger is being removed from the hole, thus eliminating the need for temporary casting. After the auger is removed, reinforcement is installed in the pile. In many situations, these foundation systems can be constructed more quickly and less expensively than other deep foundation alternatives.

Deployment Goal

By September 2008, CFA pile technologies will be routinely evaluated as a deep foundation alternative, and all State DOTs will be using them in locations where they will be cost effective and technically feasible.

Deployment Status

The FHWA Resource Center developed a half-day seminar on CFA pile technology and has presented the seminar in approximately five States. In the future, the FHWA Resource Center, in conjunction with FHWA's headquarters office, will distribute a *Geotechnical Engineering Circular* that will provide design and construction guidance on CFA pile technologies.

Additional Resources

To learn more, visit **http://www.fhwa.dot.gov/resourcecenter**.

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