



Helical piles may be a cost-effective option for bridge foundations on low-volume roads, offering shorter construction times and easier access to challenging areas.

# RESEARCH SOLUTIONS

## Using helical piles in bridge foundations

Iowa DOT and county engineers continually seek improvements to bridge-building practices, including those used to construct bridge foundations. Advances in helical pile foundation technology offer the design community an innovative method for building bridge substructures. New guidance details the use of helical piles as a cost-effective solution for bridge foundations that is quick and easy to install, even in hard-to-reach locations.

### THE NEED

While bridge decks and superstructures are often the focus in bridge design, Iowa DOT and local transportation agencies are always looking for new options to build bridge foundations. Geology, traffic volume, and available resources affect the materials and methods chosen to build bridge foundations. On low-volume roads, county engineers need to use cost-effective and expeditious construction techniques to manage budget constraints and avoid unnecessary disruptions in traffic flow.

Contained in the International Building Code as a deep foundation option, helical piles are rotated into the ground to a depth required to accommodate the design strength of a foundation and anchor it into the ground. While used in a variety of applications, including vertical buildings, marine structures, and drilling platforms, helical piles have not typically been used for bridge foundations.

A desire for relative ease and speed of bridge foundation installation prompted the Iowa Highway

Research Board to explore the viability of helical piles for bridges on low-volume roads. Guidance was needed about installation and design capacities, including the unique loading scenarios of roads and bridges, to provide local engineers with a cost-effective bridge foundation solution.

### PROJECT APPROACH

A review of the historical use of helical piles provided context for understanding the range of present-day uses. Additional resources



**“Helical piles may be an effective method for county engineers to design cost-effective bridge substructures. While helical piles can be installed quickly and easily, their use is dependent on soil type and local geology.”**

**— LEE BJERKE,**  
Iowa County Secondary Roads Research Engineer

detailed helical pile design and installation considerations in several other industries. Other literature explained concerns relevant to bridge foundation and geotechnical issues.

Results from the review illustrated the potential advantages and disadvantages of helical pile bridge foundations. Investigators determined the circumstances and bridge types for which helical piles would be suitable and identified design considerations and material and equipment options needed for installation.

## WHAT IOWA LEARNED

The investigation revealed numerous advantages of using helical piles as deep bridge foundations, including speed and ease of installation due to the smaller equipment needed and the ability to construct in smaller or hard-to-access places. Additionally, while different soil types yield different load capacities, helical piles are effective in many soil strata types. Construction can continue uninterrupted after installation, and the capacity is known immediately. Other advantages include no vibration or excessive noise during installation, and no spoils to remove.

Areas with shallow bedrock or many larger rocks, however, are not conducive to effective helical pile foundations. Bidding this option may be more difficult since precise pile lengths

may be unknown before installation begins. Also, this method is not included in current bridge design codes.

Investigators produced a comprehensive guidance document to support transportation agencies and engineers in considering helical piles as a bridge foundation option. Design guidance and specifications detail materials options, overall site plan and geotechnical report development, and specific steps to calculate load and structural capacities. Construction considerations address safety, equipment and procedures, torque measurement (the amount of force a pile can endure during installation), documentation, and contractor requirements.

The guidance provides a flowchart to help engineers and bridge designers determine whether to use helical piles as a bridge foundation system. An accompanying matrix includes questions about the site and constructability, geotechnical issues, and design considerations. Example specifications for a helical pile deep foundation also illustrate the range and scope of necessary considerations.

## PUTTING IT TO WORK

The *Helical Pile Foundation Guide for Bridge Structures* provides bridge engineers with a cost-effective method for constructing bridge foundations

relatively quickly and easily. Before broad adoption of this practice, a demonstration project is needed to develop specifications and compare implementation and performance to other pile and foundation types.

## ABOUT THIS PROJECT

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