Florida Department of Transportation Research

# Peak Temperature Determination of Drilled Shafts Excluded from Mass Concrete Consideration in Current Specifications

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## Current Situation

The quality of a concrete element degrades if the internal temperatures become too hot. In the case of concrete elements, such as shafts for deep structure foundations, this degradation results in severe surface cracking, delayed expansion of cement products after concrete hardening, and a reduction in concrete strength.

*A drilled shaft exhibits large temperature-induced surface cracks.*

While FDOT and the American Concrete Institute (ACI) have respectively set specifications and suggested criteria to control the temperature for concrete shafts, currently there is no design guide to predict how hot a drilled shaft will get or quality assurance method to confirm temperature limits have not been exceeded in the field.

## Research Objectives

The objective of this research project was to develop and implement methods to predict peak and differential temperatures of drilled shafts to determine if unsafe temperature conditions may arise for a given design.

## Project Activities

First, the University of South Florida research team collected shaft temperature information from hundreds of shafts via cage-based measurements (not the shaft's core temperatures). The team then installed a cross section of sensors—adding to existing permanent sensors—to show the diametric temperature distributions in north-south and east-west directions.

Using the results of the temperature measurements, the team developed models that better quantified the circumstances most likely to lead to overheating in drilled shafts. They used three cementitious material content proportions for the modeling, including Portland cement and fly ash, Portland cement and slag, and pure Portland cement, all of which were found to occur most frequently in the shafts database.

After verifying the model results, the team was able to identify the conditions that cause a drilled shaft to exceed the FDOT and/or ACI temperature limit criteria.

## Project Conclusions and Benefits

As a result of this research, FDOT can more accurately determine if a deep foundation design could create conditions that would cause shafts to overheat and degrade. Using this data, FDOT can be more prepared to set new specifications that more accurately control the temperature for concrete shafts and ultimately save time and money on deep foundation projects that involve concrete elements.

*For more information, please see fdot.gov/research.*