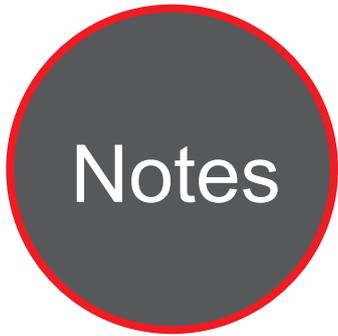




CALTRANS DIVISION OF RESEARCH,  
INNOVATION AND SYSTEM INFORMATION

# Research



# Notes



Pavement

DECEMBER 2023

Project Title:  
Concrete Coefficient of Thermal  
Expansion Moisture-Dependency  
and Tensile Creep

Task Number: 3768

Start Date: July 1, 2021

Completion Date: September 30,  
2023

Task Manager:  
Weili Zhao  
Transportation Engineer  
weili.zhao@dot.ca.gov

## Concrete Coefficient of Thermal Expansion Moisture-Dependency and Tensile Creep

Develop a test to measure concrete Coefficient of Thermal  
Expansion moisture-dependency

### WHAT IS THE NEED?

This study is a continuation of task 3199 “Implement Concrete ME (Mechanistic Empirical) Design Tools” and is necessary to fully calibrate Caltrans’ concrete pavement design code and Pavement ME. The coefficient of thermal expansion (CTE) is one of the most important variables controlling the performance of jointed plain concrete pavement (JPCP) and continuously reinforced concrete pavement (CRCP). Therefore, it is one of the properties for which Caltrans specifications either prescribe a limit (CRCP) or require a submittal (JPCP).

The current standard test for measuring CTE evaluates the concrete in saturated conditions. However, significant increases in CTE have been observed when concrete dries. Recent research conducted at the University of California Pavement Research Center (UCPRC) showed that thermal stresses in JPCP pavements increased up to 70% because of the CTE increases associated with concrete drying in California’s prevalent dry-warm summers. It also showed that concrete CTE moisture-dependency might considerably vary from one mixture to another. To address these issues and prevent any unintended reduction in pavement life and resiliency, it is necessary to update current practice and specifications for concrete CTE testing.



DRISI provides solutions and  
knowledge that improves  
California’s transportation system



## WHAT ARE WE DOING?

Phase 1 will include the development and validation of a test to measure concrete CTE moisture-dependency in the laboratory. Phase 2 will consist of testing CTE moisture-dependency for a set of concrete mixes that represent concrete highway infrastructure construction practice. The impact of CTE-moisture dependency on concrete pavements performance will be evaluated in this Phase. Phase 3 will be focused on specification language with proposed test method and suggested updates of specification language.

## WHAT IS OUR GOAL?

The goal is to develop a test to measure concrete CTE moisture-dependency and a framework for modeling CTE evolution in the field and the structural response of concrete pavements under thermal and drying shrinkage actions including concrete tensile creep/relaxation capacity.

## WHAT IS THE BENEFIT?

By preventing the use of concrete with high CTE moisture susceptibility in CRCP and by adequately accounting for thermal stresses and deformations in JPCP and CRCP, the life, reliability and resiliency of concrete pavement performance will improve.

## WHAT IS THE PROGRESS TO DATE?

As of December 2023, the research team has made the following progress:

- Completed literature review on tensile creep testing
- Completed testing of CET-moisture dependency
- Completed tensile creep testing
- Completed development of testing and modeling framework and started preparation of final report