# Modeling of Bonding for Epoxy Resins between Steel Rebar and Concrete at Elevated Temperatures

**Thanyawat Pothisiri**

**Contact:** thanyawat.p@chula.ac.th

## Abstract

Epoxy resins have increasingly been used to bond steel rebars into existing cast-in-place or precast concrete structures due to the advantage of higher bond strength compared with mechanical steel-to-concrete anchors at normal temperature. At elevated temperatures, however, significant bond deterioration can be expected as the resin's modulus decreases with an increase of temperature. The decrease in the load bearing capacity of the bond can lead to collapse of the structural systems after exposure to high temperatures.

A mechanical model is proposed in this study to investigate the characteristics of the adhesive bonding stress between steel rebar and concrete interface at elevated temperatures. The model is calibrated with the results obtained from a series of pull-out tests using deformed bars with varying diameters of 12 mm, 16 mm, 20 mm and 25 mm. It is found that the model provides good prediction of the bond stress.

**Keywords:** epoxy resins; bonding; steel rebar; concrete; elevated temperatures.

## 1 Introduction

Epoxy resins have increasingly been used as bonding materials for structural elements in modern construction [1]. Among many applications, epoxy resins are used to bond steel rebars into existing cast-in-place or precast concrete structures. Previous studies have shown the advantage of concrete/steel bonds using epoxy resins in terms of higher bond strength compared with mechanical steel-to-concrete anchors at normal temperature [2]. At elevated temperatures, however, a significant decrease of the bond capacity has been reported due to a decrease of the resin's modulus with an increase of temperature during the glass transition period [3]. The decrease in the load bearing capacity of the bond can lead to collapse of the structural systems after exposure to high temperatures.

To date, limited mechanical models and experimental data are available on the degradation of bond strength of epoxy resins between concrete and steel rebar at elevated temperatures. Most studies have investigated residual bond strength after exposing the specimen to high temperatures and cooling it back to laboratory temperature before performing a pull-out test [4]. Tests with both thermal loading and pull-out being performed simultaneously have been conducted only for specimens with a 12 mm diameter rebar [3]. Due to variation of actual rebar's diameter used in construction, the effect of rebar size on bond failure of epoxy resins at high temperatures must be studied.

A mechanical model is proposed in this study to investigate the characteristics of the adhesive bonding stress between steel rebar and concrete interface at elevated temperatures. The model is calibrated with the results obtained from a series of pull-out tests using deformed bars with varying diameters of 12 mm, 16 mm, 20 mm and 25 mm.

https://doi.org/10.2749/222137817822208519
Distributed by structurae