The Summer Undergraduate Research Fellowship (SURF) Symposium
6 August 2015
Purdue University, West Lafayette, Indiana, USA

Straining Definitions

William G. Pollalis and Santiago Pujol
School of Civil Engineering, Department of Structural Engineering, Purdue University

ABSTRACT

The concept of strain is ubiquitous in engineering textbooks. It is defined early in engineering education as change in length divided by initial length, and is used to quantify deformations due to things like stresses and temperature changes. The concept itself is quite straightforward and represents homogenous materials well, but homogenous materials are rarely present in engineering design. Composite materials such reinforced concrete cannot be simply defined, as their properties are heavily influenced by their non-uniformity. For example, there are large deformations around tensile cracks in reinforced concrete, where the reinforcement withstands all the tensile stress, and little deformation in uncracked regions. How should tensile strain in reinforced concrete be measured? Industry mandates that steel reinforcement samples be tested using a gage length of 8 inches on a region that includes fracture, but do these measurements portray the in situ tensile behavior of reinforced concrete? This project addresses the deceivingly simple question of what gage length to use with reinforced concrete to reconcile results from testing samples of the individual elements of reinforced concrete. The project subjects rebars encased in rectangular concrete prisms to uniaxial tension, and then uses 3d optical point tracking (e.g. Optotrak) and Digital Image Correlation (DIC) to monitor deformations. The deformations at failure are then analyzed using different gage lengths to calculate the strain occurring between two points. It was found that gage lengths greater than 6 times the average crack spacing showed converging tensile strains.

KEYWORDS

Reinforced concrete, Strain, cracking, DIC, Optical tracking, Gage length