

# Accepted Manuscript

Direct Digital Image Analysis of Local Displacements and Strains  
in a Pull-out Test

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PII: S2352-0124(18)30039-0  
DOI: doi:[10.1016/j.istruc.2018.03.014](https://doi.org/10.1016/j.istruc.2018.03.014)  
Reference: ISTRUC 270  
To appear in: *Structures*  
Received date: 28 August 2017  
Revised date: 22 March 2018  
Accepted date: 23 March 2018

Please cite this article as: Orit Leibovich, David Z. Yankelevsky, Avraham N. Dancygier , Direct Digital Image Analysis of Local Displacements and Strains in a Pull-out Test. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Istruc(2017), doi:[10.1016/j.istruc.2018.03.014](https://doi.org/10.1016/j.istruc.2018.03.014)

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**Direct Digital Image Analysis of Local displacements and Strains in a Pull-out Test.**Orit Leibovich<sup>2</sup>, David Z. Yankelevsky<sup>1+</sup>, and Avraham N. Dancygier<sup>3</sup>Faculty of Civil & Environmental Engineering, National Building Research Institute,  
Technion-Israel Institute of Technology, Haifa, ISRAEL 32000**ABSTRACT**

Reinforced concrete (RC) is the most popular building material, where RC structural members are made of concrete and reinforcing steel bars (rebars). The structural behavior of a RC element is based on the combined action of concrete and steel rebars that is responsible to transfer loads between the steel rebars and the concrete. This mechanism is known as 'bond'. In deformed rebars, bond is achieved mainly due to a mechanical interaction between the ribbed surface of the rebar and the surrounding concrete.

This paper describes findings of a new experimental procedure, which enables continuous direct observation and measurements of the concrete displacements near the rib of a pulled-out rebar. The setup is based on a standard pull-out test and includes a cylindrical concrete specimen with a centrally embedded rebar. During casting, a 90-degree small size "window" sector is left open and enables acquisition of high-resolution digital photographs during the test. By digital image correlation analysis, the concrete displacements are measured and strain fields are derived. This new experimental technique provides important new information that is described in this paper; such information was not available until now. The new data sheds light on the complex interaction between the embedded rebar and the surrounding concrete and leads to their better understanding.

**Keywords:** Bond; Rebar-concrete interaction; Experimental technique; Image correlation.

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