Shrinkage Effect on Beams Strengthened with Additional Concrete Layers

Dr Andreas LAMPROPOULOS
Senior Lecturer in Civil Engineering, University of Brighton, UK
a.lampropoulos@brighton.ac.uk

Andreas Lampropoulos is a Senior Lecturer in Civil Engineer at the University of Brighton in UK. He received his diploma, masters, and PhD from the University of Patras in Greece, in 2003, 2005, and 2010, respectively. His research interests include the development of new concrete materials and the earthquake strengthening of existing structures.

Dr Ourania TSIOULOU
Civil Engineer
tsioulou@hotmail.com

Ourania Tsioulou is a Civil Engineer. She received her diploma, masters, and PhD from the University of Patras in 2003, 2005, and 2010, respectively. Her research interests include the strengthening of existing concrete members with concrete layers and jackets, and the experimental and analytical investigation of concrete interface behaviour.

Prof. Stephanos DRITSOS
Professor in Civil Engineering, University of Patras, Greece
dritsos@upatras.gr

Stephanos Dritsos is a Professor in the Department of Civil Engineering at the University of Patras. He received his PhD in civil engineering from the University of Patras in 1986. His research interests include the seismic assessment and redesign of existing buildings and the repair and/or strengthening of concrete structures.

Summary

A common technique used to increase the flexural capacity of reinforced concrete beams is the addition of concrete layers in the compressive or in the tensile side. Until now, there are limited studies for the effect of the concrete shrinkage on the performance of the strengthened beams. In most of the published studies, concrete shrinkage is ignored and perfect connection is assumed between the old and the new concrete which is not conservative. In this study full scale beams strengthened with additional concrete layers in the tensile side have been investigated. The results of an experimental investigation together with numerical and analytical results are presented. The crucial effect of the concrete shrinkage on the slip of the interface is highlighted and the interaction between the slip induced by concrete shrinkage and the slip due to bending loading is presented.

Keywords: concrete, strengthening, beams, shrinkage, interfaces

1. Introduction

The technique of strengthening using additional concrete layers or jackets is extensively used in earthquake prone areas to improve the performance of existing structures. In case of strengthening with additional concrete layers, the shrinkage of the additional concrete layer induces additional stresses and slip at the interface. There are studies where the effect of restrained concrete shrinkage has been investigated [1-9] and the importance of this phenomenon has been highlighted. However, there are not any published studies about the interaction of the slip due to the shrinkage of the new layer and the slip induced during the bending of the strengthened specimens. In this paper experimental results of full scale tests are used for the validation of the numerical and analytical models. A parametric study has been conducted to quantify the contribution of concrete shrinkage to the interface slip for different shrinkage strain values.

2. Experimental work

The results presented in this section are part of an extensive experimental investigation [10]. Strengthened beams with additional layers have been tested and the effectiveness of this technique has been investigated for different interface types [10]. In the present study the results of the strengthened specimens in the tensile side have been used to validate the numerical and the

https://doi.org/10.2749/222137814814067996