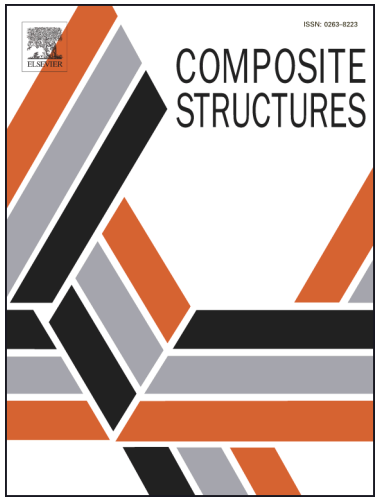

Behavior of Rc Beams Flexurally Strengthened with Nsm Cfrp Laminates

S.J.E. Dias, J.A.O. Barros, Worajak Janwaen

PII: S0263-8223(17)30678-5
DOI: https://doi.org/10.1016/j.compstruct.2018.05.126
Reference: COST 9765

To appear in: *Composite Structures*

Received Date: 1 March 2017
Revised Date: 23 March 2018
Accepted Date: 28 May 2018

Please cite this article as: Dias, S.J.E., Barros, J.A.O., Janwaen, W., Behavior of Rc Beams Flexurally Strengthened with Nsm Cfrp Laminates, *Composite Structures* (2018), doi: https://doi.org/10.1016/j.compstruct.2018.05.126

BEHAVIOR OF RC BEAMS FLEXURALLY STRENGTHENED WITH NSM CFRP LAMINATES

S. J. E. Dias[1], J. A. O. Barros[2] and Worajak Janwaen [3]

[1] Assistant Prof., ISISE, Dep. of Civil Eng., Univ. of Minho, Azurém, 4810-058 Guimarães, Portugal, sdias@civil.uminho.pt

[2] Full Prof., ISISE, Dep. of Civil Eng., Univ. of Minho, Azurém, 4810-058 Guimarães, Portugal, barros@civil.uminho.pt

[3] PhD Student, ISISE, Dep. of Civil Eng., Univ. of Minho, Azurém, 4810-058 Guimarães, Portugal, tontrakarn.w@gmail.com

ABSTRACT

An experimental program was carried out to investigate the behavior of RC beams flexurally strengthened using the NSM technique with CFRP laminates. Four beams were tested, a reference beam without CFRP, and three beams flexurally strengthened using different percentage of laminates. The experimental results show that NSM CFRP laminates is an effective solution to increase cracking, yielding and maximum loads of beams failing in bending. Furthermore, the high tensile strength of the CFRP was effectively mobilized. By increasing the CFRP percentage, the load carrying capacity of the NSM beams increased, while the ductility level decreased. Taking into account the experimental results, the predictive performance of the analytical formulation proposed by the ACI was assessed considering two methodologies to determine the maximum strain that can be applied to the CFRP: i) the ACI proposal; ii) the equation proposed by Barros et al. (2007). ACI formulation provides safe results by using both methodologies, but the Barros et al. equation ensures better predictions. A numerical strategy was used to evaluate the load-deflection relationship of the tested beams and to highlight the influence of the longitudinal bars percentage, the CFRP percentage and the concrete strength on the NSM flexural strengthening effectiveness of RC beams.

KEYWORDS: NSM CFRP laminates, Flexural strengthening, RC beams, Experimental results, Analytical study, Numerical simulation

1. INTRODUCTION

Using advanced composites materials like carbon fiber reinforced polymers (CFRP), competitive structural strengthening solutions can be developed due to the high strength-to-weight ratio, high durability (non-corrodible), electromagnetic neutrality, ease of handling, rapid execution with low labor, and practically unlimited availability in size, geometry and dimension of these materials [1-3].

For the flexural strengthening, CFRP can be applied according to the followings two main techniques: Externally Bonded Reinforcement (EBR) where the CFRP (wet lay-up sheets or laminates) is bonded to the tension face of the