

Acoustic emission monitoring of damage progression in CFRP retrofitted RC beams

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Abstract. The increased use of carbon fiber reinforced polymer (CFRP) in retrofitting reinforced concrete (RC) members has led to the need to develop non-destructive techniques that can monitor and characterize the unique damage mechanisms exhibited by such structural systems. This paper presented the damage characterization results of six CFRP retrofitted RC beam specimens tested in the laboratory and monitored using acoustic emission (AE). The focus of this study was to continuously monitor the change in AE parameters and analyze them both qualitatively and quantitatively, when brittle failure modes such as debonding occur in these beams. Although deterioration of structural integrity was traceable and can be quantified by monitoring the AE data, individual failure mode characteristics could not be identified due to the complexity of the system failure modes. In all, AE was an effective non-destructive monitoring tool that can trace the failure progression in RC beams retrofitted with CFRP. It would be advantageous to isolate signals originating from the CFRP and concrete, leading to a more clear understanding of the progression of the brittle damage mechanism involved in such a structural system. For practical applications, future studies should focus on spectral analysis of AE data from broadband sensors and automated pattern recognition tools to classify and better correlate AE parameters to failure modes observed.

Keywords: acoustic emission; reinforced concrete; CFRP; intensity analysis

1. Introduction

Retrofitting reinforced concrete (RC) structures using materials such as fiber reinforced polymers (FRP) has gained popularity in the past decades. This has been mainly due to the maintenance and repair requirements of existing civil infrastructure and the versatile features of FRP composites, such as light weight, ease in onsite application, good corrosion resistance, etc. However, for RC beams externally retrofitted with FRP the debonding failure mechanism has been deemed the most critical failure mode (Teng *et al.* 2001). There have been numerous efforts to counter this form of failures, yet the complex nature of this failure mechanism has not led to convincing mitigation solutions. Thus, there is a genuine need for a real time non-destructive

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