Rehabilitation of Deteriorated Steel Truss Members Using CFRP

By

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Abstract

The main problem facing steel structures is corrosion which can lead to the failure in the design. Generally, retrofitting steel structures costs far less than replacement and it takes less time. With regards to this issue, there is a growing focus on the repair or rehabilitation of corroded steel structures. Repairing by welding, as a traditional method, is costly, time-consuming and has other problems related to quality control and safety instructions. As a consequence, many designers are seeking more economical solutions. This study aims to investigate the rehabilitation of corroded steel trusses using Carbon Fibre Reinforced Polymer (CFRP) as a new method. Angular steel samples were selected and tensile and compressive characteristics of the corroded rehabilitated steel were investigated.

The environmental temperature (-20^{o} C – 60^{o} C) and the effects of moisture (immersing the sample under tap water for 500 hrs – 2000 hrs) on corroded rehabilitated steel simulated by different sizes of notches (3 mm - 12mm) were considered in this investigation. To simulate the temperature difference during day and night or between seasons, the influences of the recycling temperature on the rehabilitation of the corroded steel were examined by subjecting the sample to fluctuated temperature.

The results revealed that CFRP is able to rehabilitate the corroded steel at different conditions, i.e. there is high gain in the tensile strength of the corroded steel which nearly reaches the original value of the raw steel in some conditions. However, the influence of the environmental temperature is very pronounced, i.e. recycling of low and high values of temperature compromise the rehabilitation

process; where the improvement on the tensile and compressive properties are not remarkable compared to the room temperature condition.

Moisture effect caused gradual reduction in ultimate tensile capacity when the immersion time increased. The reduction recorded a maximum value of about 6.9% less than the original sample at 2000 hours. For the compression test, moisture had a faster effect on ultimate compression capacity, especially in the first 1000 hours which recorded a reduction of about 9.4% compared with the original sample.

For field applications, it is recommended that the percentage of CFRP area to steel area at the corroded section, should be about 35% to 45%, to achieve the most economic use of the CFRP and maintain the corroded steel member within the allowable elastic strain. The finite element model, developed using the Strand 7 program, showed good agreement with the experimental work regarding the strain value of CFRP strips.

CERTIFICATION OF DISSERTATION

I certify that the ideas, experimental work, results, analyses, software and conclusions in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any award, except where otherwise acknowledged.

..... Date / /

Signature of Candidate

ENDORSEMENT

..... Date / /

Signature of Principal Supervisor

..... Date / /

Signature of Associate Supervisor

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