

Mechanics-based approach for predicting the short-term deflection of CFRP plated RC beams

ABSTRACT

Most design codes available today for predicting the deflection of adhesively plated RC beams use a full-interaction moment-curvature approach that requires the flexural rigidity to be quantified empirically. Due to their empirical nature, these design rules can only be applied within the bounds of the tests from which they were derived. Furthermore, as these design rules follow a full-interaction analysis, the slip between the reinforcement and adjacent concrete was not considered and the method does not cope with the discrete rotation of the cracks; that is, the deflection associated with crack widening was not directly considered. As an alternative, partial-interaction mechanics-based methods can be used. In this study, a mechanics-based approach for quantifying the deflection of adhesively plated RC beams was presented. The approach took into account the slip between the reinforcement and adjacent concrete, the formation and widening of flexural cracks, and the intermediate crack debonding mechanism of the externally bonded plate. The deflection from the mechanics-based approach was determined by considering the discrete rotation of individual cracks and the curvature of uncracked regions of the beam. The deflection results derived from the mechanics-based approach were compared with the experimental results of seven adhesively plated CFRP RC beams bonded to their tension face and a significant correlation between the results was observed. The mechanics-based approach does not require any components on the member level to be quantified empirically; thus, it could be useful in predicting the deflection of adhesively plated RC beams with new types of reinforcement material.

Keyword: Adhesively plated beam; Partial-interaction; Moment-rotation; Discrete rotation deflection; Intermediate crack debonding