Kinematics-based model for complete behavior of RC dapped-end connections failing along a re-entrant corner crack

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Abstract

Reinforced concrete dapped-end connections, which are common in existing Gerber-beam bridges, typically feature an inclined corner crack at service loads due to the high stress concentrations in the re-entrant corner. These cracks introduce corrosion issues and increase the stresses in the dapped-end reinforcement, which in the event of further deterioration and increased loading may lead to yielding and failure of the connection. This paper proposes a kinematics-based model for the complete behaviour of such connections which predicts the opening of the cracks based on first principles: compatibility, equilibrium and constitutive relationships. The model stems from an earlier kinematics-based approach for the capacity prediction of dapped-end connections failing along re-entrant corner cracks, and extends it to describe the complete pre-peak, peak and post-peak behaviour.

Keywords: reinforced concrete dapped-end connections; kinematics-based model; re-entrant corner crack; complete behaviour

1 Introduction

Reinforced concrete dapped-end connections are common in existing Gerber-beam bridges, as they were preferred in the past due to their statical determinacy and suitability for precast construction. Within the existing road network in Wallonia (Belgium) alone there are over 30 reinforced concrete bridges with dapped-end connections [1].

However, these connections feature a sudden reduction in depth at a sharp re-entrant corner, typically resulting in the formation of inclined corner cracks at service loads. These cracks introduce corrosion issues and increase the stresses in the dapped-end reinforcement, which in the event of further deterioration and increased loading may lead to yielding and failure of the connection. Furthermore, due to the sudden change of geometry in the vicinity of the connection, these zones are characterized by a complex flow of forces, and as a result their