Abstract

An optimization method based on homogenization is proposed for finding optimal strut-and-tie (ST) models for reinforced concrete (RC) elements. The method uses a layout that minimizes displacement for a given loading state in a linearly elastic regime by mixing two materials. Although this optimal layout might contain fine mixtures, one can still obtain a strongly resembling ST model without mixtures that performs closely to the optimal configuration through a penalization procedure. Two examples from the ST literature are used to illustrate the application of the method: the dapped beam and the beam on beam. The reinforcement layouts obtained make the element more efficient in terms of ultimate load divided by the weight of the steel used and having smaller deflections and crack widths. It is remarkable that the used optimization method, which considers the structure in the linearly elastic regime, gives a very good performance for the nonlinear regime.