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Reformulation of Theory of Critical Distances to Predict the Strength of Notched Plain Concrete Beams under Quasi Static Loading

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Abstract : The theory of critical distances (TCD), due to its appealing characteristics, has been successfully used in the past to predict the strength of brittle as well as ductile materials, weakened by the presence of stress risers under both static and fatigue loading. By utilising most of the TCD's unique features, this paper summarises an attempt for a reformulation of the point method of the TCD to predict the strength of notched plain concrete beams under mode I quasi-static loading. A zone of micro cracks, which is responsible for the non-linearity of concrete, is taken into account considering the concept of an effective elastic crack. An attempt is also made to correlate the value of the material characteristic length required for the application of TCD with the maximum aggregate size in the concrete mix, eliminating the need for any extensive experimentation prior to the application of TCD. The devised reformulation and the proposed power law based relationship is found to yield satisfactory predictions for static strength of notched plain concrete beams, with geometric dimensions of the beam, tensile strength, and maximum aggregate size of the concrete mix being the only needed input parameters.

Keywords : characteristic length, effective elastic crack, inherent material strength, modeI loading, theory of critical distances
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