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Structural Dependence of Plastic Rotation Capacity in RC Beams

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ABSTRACT

The structural dependence of plastic rotation capacity in RC beams is evaluated using the Finite Element Method. Parts of the overall project have been published by the authors recently (Gamino; Bittencourt [1] and Gamino; Borges; Bittencourt [2]). The objective is to achieve a better understanding of the non-linear behaviour of reinforced concrete members and perform extensive parameter studies, using a rational model developed by Bigaj [3] to analyze the phenomenon of plastic rotation capacity in reinforced concrete members. It is assumed that only bending failure is relevant due to sufficient member resistance against shear and torsion.

The paper begins with the physical and theoretical background of the phenomenon of plastic hinge development in RC structures. Special emphasis is laid on the issue of structural dependence of deformation capacity of plastic hinges in RC members. Member size dependence and influence of properties of construction materials were emphasized as well. The essential components of the Bigaj´s model for calculating the plastic rotation capacity are discussed. The behaviour of the plastic hinge is analysed taking into account the strain localisation in the damage zones of the hinge region. The Fictitious Crack Model (FCM) and the Compressive Damage Zone Model (CDZ) are adopted in a Fracture Mechanics approach to model the behaviour of concrete in tension and compression, respectively.

The approach is implemented in FEMOOP, a FEM solver under development, and applied to evaluate ductility in 2D beams. Application examples are presented to validate the implemented capabilities. Figure 1 and Figure 2 show the predicted compressive zone of plastic hinge for beams, respectively, with and without stirrups, tested by Bresler; Scordelis [4]. The models were generated with GID and analised with the capabilities implemented in FEMOOP.

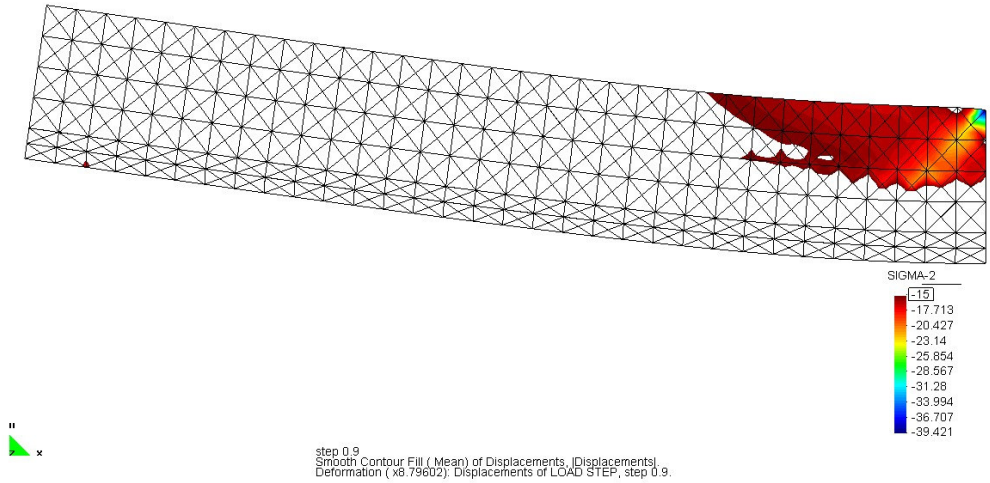

Figure 1. Compressive principal stresses in plastic hinge for a beam without stirrups.

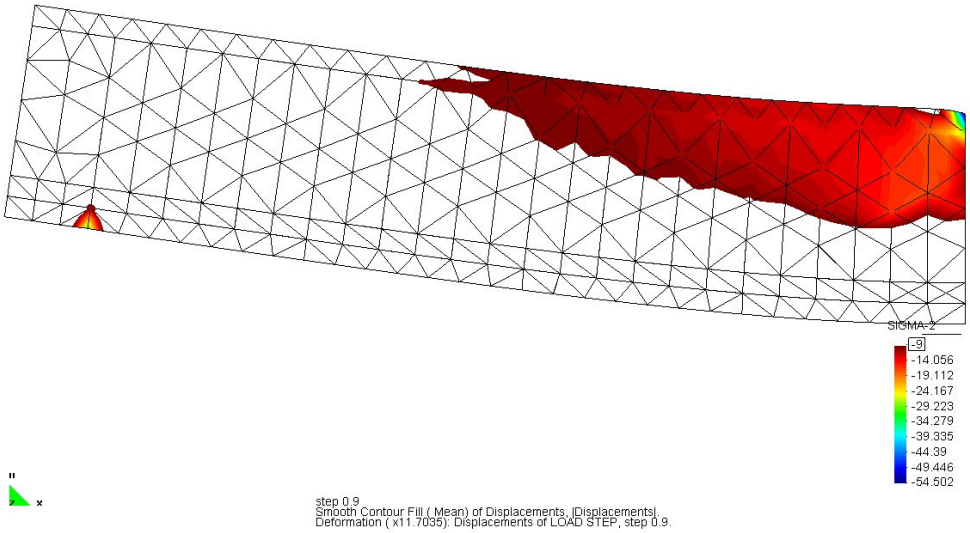

Figure 2. Compressive principal stresses of plastic hinge for a beam with stirrups.

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