
Abstract

Concrete structures usually present regions characterized by changes in the geometry which may be concentrated (such as corners of framed structures) or distributed over a given length (such as arch-shaped members). In these regions, the inner tension and compression chords need to be deviated, originating a state of strains and stresses whose performance (strength and behaviour) depends much on the detailing of the reinforcement. For incorrect detailing, premature brittle failures are observed. This is for instance the case of shear failures or failures due to cover spalling of arch-shaped members and of failures due to deviation forces in corner frames. Suitable detailing leads however to satisfactory behaviour with sufficient strength and deformation capacity.

The present work investigates on the behaviour of these regions and on their suitable detailing. The physical parameters governing their behaviour are identified and consistent rules for their design and assessment are provided. The investigation presents first an overview on the shear transfer mechanisms for straight, prismatic members (members without changes in the geometry). This allows understanding the role of the various physical parameters on the shear strength and in particular of the slenderness and normal forces. This study is completed with a specific testing programme where refined measurements were performed in order to quantify the amount of shear carried by each shear transfer action.

A second test series is later described investigating the behaviour of arch-shaped members failing in shear. The influence of curvature is shown to be beneficial or detrimental depending on the arrangement of the curvature (convex or concave) with respect to the acting shear force. These results have been investigated on the basis of the Critical Shear Crack Theory, which is shown to be suitable for the design of such members if the deviation forces are accounted.

The investigation is completed by a third testing campaign and a series of finite-element analyses on corner frame regions. The aim of this study is to investigate on the suitability of various reinforcement details and to enhance their performance by providing innovative reinforcement arrangements. Considerations for their design based on equilibrium models (strut-and-tie models, stress fields) are finally provided.

Keywords : structural concrete, arch-shaped member, corner frame, shear force, normal force, deviation force, shear transfer mechanism, transverse reinforcement, Critical Shear Crack Theory, stress fields, strut-and-tie models.