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ANCHORAGE CAPACITY AND PERFORMANCE IN PLAIN AND STEEL-FIBRE-REINFORCED CONCRETE

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SUMMARY

Nowadays, prefabricated concrete components made from Steel-Fiber-Reinforced Concrete (SFRC) are widely used in the construction industry. These components are often connected to existing or new structural elements through various fastening systems. Previous studies have shown that the addition of steel fibers to concrete mixture substantially improves the fracture properties of concrete. To date, however, rather limited research is available on the behavior of fastening systems in SFRC. To improve the current knowledge of fastening systems to SFRC structures, a pilot experimental study is carried out on cast-in-place anchor bolts embedded in Plain Concrete (PC) and SFRC members. In this study, the influence of the presence of steel fibers and concrete compressive strength on the anchorage capacity and performance is evaluated. Furthermore, the applicability of current design methods is evaluated for anchorage systems in SFRC.

Keywords: *Anchor bolt, Headed anchor, Plain concrete, Fiber-reinforced concrete, Pull-out test, Design recommendations*

1. INTRODUCTION

Anchors of different kinds, including cast-in-place and post-installed anchors, are often used to anchor loads in concrete structures and infrastructures. An overview of various anchorage systems is given in Eligehausen et al. [1]. The cast-in-place anchors have been used ever since reinforced concrete was introduced around 1900. The post-installed anchors started to be used in the 1960s with the advances in drilling technology of concrete structures. Every year millions of fasteners are used in the construction industry around the world. Some examples of their applications in practice are shown in Figure 1. They are mainly used to attach different structural components such as concrete/steel beams and columns to concrete walls and foundations or for installing various mechanical components to concrete foundations. They can be used for attaching piping systems to concrete walls/ceilings and even for hanging concrete panels/ventilation systems to the roof of tunnels. They are also used for fastening steel rails to concrete sleepers or installing guardrails in road infrastructures. Anchors and fasteners are also widely used in power plants, hydropower structures, and even in transport infrastructures such as bridges, sleepers, transmission lines, etc. Over the past few decades, the structural performance of various anchorage systems has been studied in ordinary plain concrete by various research institutes around the world in cooperation with various anchor producers [2-9]. These studies formed a basis for the development of theoretical and empirical models for fastening systems that were incorporated in several design guidelines in the Europe and US such as CEB [10], CEN/TS [11], *fib* Bulletin 58 [12], and ACI 349 [13].

Several studies on fastening systems recently revealed that the current models can further be refined in various cases. Nilforoush et al. [14-17] recently carried out experimental and numerical studies on cast-in-place headed anchors and studied the influence of global and local stress fields in the anchoring zone of headed anchors. The experimental and numerical results showed that the size of the anchor bearing head, the height of concrete components, the presence of concrete cracks and the amount of orthogonal surface reinforcements in the anchoring zone can affect the anchorage capacity while their influences are not fully considered by current design models. Sharma et al. [18-19] also showed both experimentally and numerically that the tensile and

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