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Aggregate effect in fastening applications

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Abstract

In the last decade, the construction industry saw a shift towards rehabilitation and modular construction in order to address the growing demand for faster construction on one side, and change in usage and sustainability on the other side. Consequently, post installed fastening systems have become an important part of civil engineering structures and see increasingly wider application. In the present paper, the experimental investigation of a potential aggregate effect on the concrete cone capacity is presented. Three concrete batches were cast aiming at the same mix design while varying the petrography of the aggregates. Pull-out tests for mechanical anchors were performed at two different ages. Each concrete was fully characterized in terms of compressive, tensile strength, and fracture properties. Based on the obtained data the current design codes for concrete cone capacity in tension are evaluated regarding their ability to predict the anchor capacity from concrete compressive strength only in spite of the differences in used coarse aggregate.

Keywords: mix design; concrete composition; fasteners; concrete cone failure; concrete capacity;

1 Introduction

Nowadays, due to expanding demands concerning the efficiency of construction projects, emphasis is given to faster construction without sacrificing high safety levels and sustainability. In order to fulfil these requirements increased insights into the (time-dependent) properties of all involved components and materials as well as their interaction are required. Fastening systems have become an important part of modern structures due to their ability to meet the above trends. Concrete is the most widely used construction material playing a major role in the construction business. Fasteners are most frequently used with concrete as a base material. The efficient design and long-time performance of fastening systems thus requires a thoroughly understanding of the time-dependent behaviour of concrete. Concrete is an aging material and potential damage can be introduced by time dependent processes such as creep and shrinkage. The latter are highly effected by environmental conditions and mix design. On the other side, the ongoing hydration leads to steadily improving material properties. However, these are not spatially constant and dependent on the specimen size as well as the history of environmental conditions.

In this contribution, the dependence of one of the major failure modes of anchors in concrete under tensile loading – the concrete cone capacity – on the concrete composition and, specifically, the used coarse aggregate type, is investigated. As it is common in reinforced concrete design, the concrete cone capacity is typically predicted in terms of concrete compressive strength. Yet, the mix design of concretes around the world varies

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