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Anisotropic Concrete Compressive Strength in Existing Structures

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1 Abstract

Assessment of the load-carrying capacity of existing concrete structures is often based on the concrete compressive strength obtained from drilled cores. These cores are typically drilled perpendicular to the concrete surface, under the assumption that the mechanical properties of the concrete are isotropic. Recent studies however showed that concrete may in fact be subject to anisotropic behaviour. These studies are limited to newly-cast concrete only, and little is known about the anisotropic behaviour of existing structures in-service. This paper presents the first results of a large experimental programme where the anisotropy of the compressive strength in existing concrete structures is investigated. For this, 195 cores, drilled from a large concrete bridge located in Denmark, are tested. Three drilling directions are considered. The results are analysed using statistical techniques. The results showed that there is a statistically significant difference between the compressive strength in longitudinal and transverse/vertical direction, with an average value of 4.5 MPa in the disadvantage of the longitudinal direction.

Keywords: Compressive strength; Assessment; Existing structures; Concrete structures; Bridges; Statistical analyses.

2 Introduction

2.1 Problem statement

Assessment of the load-carrying capacity of existing concrete structures is often based on the concrete compressive strength obtained from drilled cores. For practical convenience, these cores are typically drilled perpendicular to the concrete surface, under the assumption that the mechanical properties of the concrete are isotropic. Several experimental studies however showed that this assumption is not always valid [1 – 6], and strength differences up to 50% for different drilling directions have been reported [1]. These studies disagree on the magnitude and causes of the anisotropic behaviour of the compressive strength. Due to their experimental set-up however, it is difficult to draw general conclusions on the topic; either the sample sizes were small (<5), no statistical analyses were conducted, or the test specimens were not representative for actual drilled cores.

To gain a better statistical insight, the main-author of this paper recently published a thorough experimental and statistical study (> 290 cores) on the anisotropic behaviour of the concrete compressive strength, and how it is affected by the reinforcement ratio, *w/c* ratio, curing time, structural geometry and loading history [7, 8]. An important conclusion of the study was that the strength anisotropy was strongly affected by the loading history of the structure. For structures

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