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P. Carrara, L. De Lorenzis

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Consistent identification of the interfacial transition zone in simulated cement microstructures

P. Carrara[a,*], L. De Lorenzis[a]

[a] *Technische Universität Braunschweig, Institute of Applied Mechanics, Bienroder Weg 87, 38106 Braunschweig, Germany*

Abstract

A method to consistently identify the thickness of the interfacial transition zone (ITZ) between aggregates and bulk hardened cement paste (HCP) is proposed. Three different criteria to identify the boundaries of the ITZ are established, all based on the analysis of the trend of the effective water-to-cement ratio (w/c) close to an aggregate surface. The method is conceived so as to keep at minimum the operator intervention, thus permitting an objective evaluation of the ITZ thickness. The proposed procedure is applied to a series of ordinary Portland cement samples with different w/c ratios obtained using the code CEMHYD3D. The obtained results and the effects of the presence of the ITZ on the unhydrated and hydrated microstructures are analyzed and discussed.

Keywords: cement paste microstructure, interfacial transition zone, ITZ thickness, numerical analyses, simulated microstructures

1. Introduction

It is widely accepted that concrete at the mesoscopic scale should be treated as a three-phase composite material constituted by bulk hardened cement paste (HCP), aggregates and an interfacial transition zone (ITZ) between these two [1–6]. The bulk HCP is the cement matrix at a sufficient distance from the aggregates, while the aggregates can be coarse (gravel) or fine (sand). The physical and mechanical characteristics of the ITZ are different than those of the bulk HCP and this largely influences the overall behavior of the concrete [4, 7–11]. However, because of the processes that lead to its formation, the ITZ does not have clearly defined boundaries [4].

*Corresponding author

Email addresses: p.carrara@tu-braunschweig.de (P. Carrara), l.delorenzis@tu-braunschweig.de (L. De Lorenzis)