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# Numerical analysis of the failure of recycled aggregate concrete by considering the random composition of old attached mortar

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**Abstract**

Considering the randomness in properties of old adhered mortar (OM) around recycled aggregate (RA), a statistical analysis on its composition has been performed. The random effect of OM on the fracture behaviour of recycled aggregate concrete (RAC) at the mesoscopic scale has then been studied. This numerical approach explicitly takes into account an effective interphase (EI) between RA and cement mortar, which is composed of unknown OM and new forming mortar. Based on the identified component fraction, the elastic and fracture properties of EI have been calculated. Corresponding numerical results agree with the experimental ones. Numerical damage localization fields show that local crack patterns of RAC are different from those of normal concrete due not only to the fragility of the OM in EI but also to the brittleness of aggregate issued from demolition. The direct effect of OM properties on the macroscopic mechanical characteristics of RAC is explicitly demonstrated. The established numerical model provides the possibility to predict fracture behaviour of RAC by performing a certain number of experimental tests.

*Keywords:* Recycled aggregate concrete, Old mortar, Mesoscopic modelling, Interfacial transition zone, Fracture

## 1. Introduction

The reuse of construction waste materials has become increasingly important nowadays due to the environment pressure, the scarcity of natural resources and the shortage of waste disposal land. Concrete made with recycled aggregate (RA) has been proven to be economically and technically

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