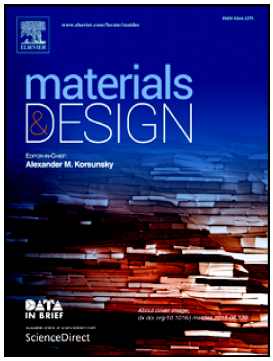
Accepted Manuscript



Experimental and numerical investigation of influence of air-voids on the compressive behaviour of foamed concrete

Thang T. Nguyen, Ha H. Bui, Tuan D. Ngo, Giang D. Nguyen

PII: S0264-1275(17)30535-X
DOI: doi: 10.1016/j.matdes.2017.05.054
Reference: JMADE 3078

To appear in: *Materials & Design*

Received date: 24 February 2017
Revised date: 10 May 2017
Accepted date: 19 May 2017

Please cite this article as: Thang T. Nguyen, Ha H. Bui, Tuan D. Ngo, Giang D. Nguyen , Experimental and numerical investigation of influence of air-voids on the compressive behaviour of foamed concrete, *Materials & Design* (2016), doi: 10.1016/j.matdes.2017.05.054

Experimental and numerical investigation of influence of air-voids on the compressive behaviour of foamed concrete

Thang T. Nguyen [a], Ha H. Bui [a,*], Tuan D. Ngo [b] and Giang D. Nguyen [c]

[a] MCG Lab, Department of Civil Engineering, Monash University, Australia
[b] Department of Infrastructure, School of Engineering, The University of Melbourne, Australia
[c] School of Civil, Environmental & Mining Engineering, The University of Adelaide, Australia

ABSTRACT

A combined experimental and numerical approach is proposed in this study for the characterisation of the mechanical behaviour of foamed geopolymer concretes. Advanced experimental techniques employing X-Ray CT give both microstructures and mechanical responses of a range of geopolymer concretes with varying densities. In parallel with this, a numerical modelling technique based on the discrete element method (DEM) is developed for explicit descriptions of air-void distribution, while the mortar binder is described at the micro/meso scale with cohesive behaviour. The calibrated and validated DEM model is then used to systematically study the effects of air-void content, air-void distribution and microstructural parameters, including particle size and porosity on the compressive strength of foamed concretes. A non-linear relationship between the compressive strength and porosity of foamed concretes is found from DEM simulations, which are consistent with our experimental findings and existing strength-porosity models. Furthermore, it is found that the air-void distribution has a significant influence on the compressive strength of foamed concretes, while the micro-void structure has less effect on the loading bearing capacity of the material. The proposed combined approach demonstrates the tight correlations between experimental and numerical techniques in characterising the mechanical behaviour of foamed concretes for practical design purposes.

Keywords: Foamed concrete, air-void, discrete element method (DEM), strength prediction.

1 INTRODUCTION

In recent years, the trend of lightweight concrete in construction has significantly increased. Lightweight concrete is well recognised as a material with advanced physical properties such as low cement and aggregate content, as well as excellent sound and thermal insulation [1, 2]. Consequently, it has been commonly used in many aspects of the construction industry, such as a thermal and sound insulation component, lightweight block and an infill material for lightweight composite panels [3,

* Corresponding author. Tel.: + 61 03 9905 2599; fax: + 61 03 9905 4944.
Email: ha.bui@monash.edu (Ha H. Bui)