MECHANICAL AND MICROSTRUCTURAL CHARACTERIZATION OF CERAMIC-LATERIZED CONCRETE COMPOSITE

By

AWOYERA, PAUL OLUWASEUN

Matric Number: 13PCI00544

May 2018

`

MECHANICAL AND MICROSTRUCTURAL CHARACTERIZATION OF CERAMIC-LATERIZED CONCRETE COMPOSITE

By

AWOYERA, PAUL OLUWASEUN
B.Eng, M.Eng Civil Engineering (Akure)
Matric Number: 13PCI00544

A THESIS SUBMITTED TO THE DEPARTMENT OF CIVIL ENGINEERING, COLLEGE OF ENGINEERING, COVENANT UNIVERSITY, OTA, OGUN STATE, NIGERIA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF DOCTOR OF PHILOSOPHY (Ph.D) DEGREE IN CIVIL ENGINEERING

May 2018

`

ACCEPTANCE

This is to attest that this thesis is accepted in partial fulfilment of the requirements for the award of the Degree of Doctor of Philosophy in Civil Engineering in the Department of Civil Engineering, College of Engineering, Covenant University, Ota.

Philip John Ainwokhai ……………………………
(Secretary, School of Postgraduate Studies) Signature and Date

Prof. Samuel T. Wara ……………………………
(Dean, School of Postgraduate Studies) Signature and Date

`

DECLARATION

I, **AWOYERA, PAUL OLUWASEUN** (13PCI00544), declare that this research was carried out by me under the supervision of Prof. Joseph O. Akinmusuru of the Department of Civil Engineering, Covenant University, Ota and Prof. Julius M. Ndambuki of the Department of Civil Engineering, Tshwane University of Technology, Pretoria South Africa. I attest that the thesis has not been presented either wholly or partly for the award of any degree elsewhere. All sources of data and scholarly information used in this thesis are duly acknowledged.

AWOYERA, PAUL OLUWASEUN ....

Signature & Date

`

CERTIFICATION

We certify that this thesis titled "Mechanical and Microstructural Characterization of Ceramic-Laterized Concrete Composite" is an original work carried out by AWOYERA, PAUL OLUWASEUN (13PCI00544), in the Department of Civil Engineering, College of Engineering, Covenant University, Ota, Ogun State, Nigeria, under the supervision of Prof. Joseph Akinmusuru and Prof. Julius M. Ndambuki. We have examined and found the work acceptable as part of the requirements for the award of Doctor of Philosophy (Ph.D) degree in Civil Engineering (Materials and Structures Option).

Prof. Joseph O. Akinmusuru ....
(Supervisor) Signature & Date

Prof. Julius M. Ndambuki ....
(Co-Supervisor) Signature & Date

Dr. Anthony N. Ede ....
(Head of Department) Signature & Date

Prof. James A. Osunade ....
(External Examiner) Signature & Date

Prof. Samuel T. Wara ....
(Dean, School of Postgraduate Studies) Signature & Date

`

DEDICATION

To the I am that I am, the King of kings, the Ancient of days, the Father of Spirits, the Creator of Heaven and Earth, the One who offered me the privilege of existence, the God Almighty.

`

ACKNOWLEDGEMENTS

It was a mighty long way to have come and to realize that it is done, for this reason, it is just right for me to give all glory, adoration and honour to the Lord God Almighty, who has made it all possible for me to attain this esteem height in life and career. I am indeed grateful to Him.

Our dear Chancellor and Chairman of the Board of Regents, Covenant University, Dr. David O. Oyedepo, I am sincerely grateful for the enabling platform you have instituted from which I am a beneficiary. May God continue to renew your strength and fulfil all your heart desires! I also appreciate the Vice-Chancellor, Prof. A. A. A. Atayero and the management team for the strategies put in place that enabled the accomplishment of this research. The Dean School of Postgraduate Studies (SPS), Prof. S. T. Wara and the Sub-Dean, Prof. A. H. Adebayo, and the staff of the postgraduate school are well appreciated for their support at different stages of the research.

My special and unreserved thanks goes to my Supervisor, Prof. J.O. Akinmusuru for his support, both in moral and financial terms. Your constant drive, advice to achieve success in my work, and continuous support in challenging times are highly appreciated. Also, my sincere thanks goes to my co-supervisor, Prof. J.M. Ndambuki for his contribution to my written work, advice, and support.

I would like to thank the Head of Civil Engineering Department, Dr. A. N. Ede, and former Heads of Department, Prof. D. O. Olukanni and Dr. A. S. Ogbiye for their support and contribution to this research. I also thank the members of the postgraduate committee in the department for their constructive criticism of my work, and all other Faculty and Staff of the Civil Engineering Department for their inestimable support. My special thanks to the postgraduate coordinator, Dr. B.U. Ngene, and the Director, Vice-Chancellor’s Office, Prof. D.O. Omole for contribution made towards the success of my Ph.D programme, and to Engr. J. K. Jolayemi, and Mr. J.A. Adediran for providing support during the laboratory tests.

My profound gratitude goes to the Commonwealth Scholarship Commission in the United Kingdom (UK) for awarding me a Split-Site PhD Scholarship that was tenable at the University of Nottingham (UoN), United Kingdom. I am extremely grateful to my host Supervisors at UoN, Prof. Andrew Dawson and Dr. Nick Thom for their support, guidance and persistent help during my study. Many thanks to Jon Watson and Niger Rooks for helping with material testing, also to Dr Niger Neate, Dr. Elisabeth Steer, Dr. Christopher Fox, and Dr. Jason Greaves for their support during micro scale analysis of composites.

I sincerely appreciate my College examiners and SPS representative for their valuable contribution to this work through constant review. Special thanks to my internal and external assessors for their constructive critiquing of this work. The external examiner for this dissertation is also well appreciated for the tremendous contributions made to this work.

In the same vein, I would like to thank Prof. Kolapo O. Olusola and Dr. Festus Olutoge for their technical advice at the preliminary stages of my Ph.D programme. I also thank my students, Wisdom Anele, Martins Ojuh, Cornelia Mebitaghan, Aderoba Adediran and Christopher Ekedum for their support.

I would like to express my heartfelt gratitude to my parents, Chief Thomas Awoyera and Mrs. Olapeju Awoyera for their prayers and great contribution towards my education, most especially at the basic and undergraduate level. Also, to my siblings (Mr. Nicholas Awoyera, Mr. Anthony Awoyera and Mrs. Bukola Akeju), and my in-laws (Mrs. Comfort Sanusi, Mr. Oluwaseun Sanusi and Mr. Opeyemi Sanusi) for being supportive to my family while I was away for my Scholarship programme in the UK.

“Behind every successful man there is a virtuous woman”, I owe my deepest gratitude to my loving and caring wife, Esther Awoyera (nee Sanusi). While some women belong to the kitchen, you are always by my side, I am ever grateful for your patience, encouragement and untiring prayers. Many thanks to my son, Samuel. Please forgive me for not being physically supportive at some points, most especially during my period of study in the United Kingdom.

Finally, my regards and blessings to everyone who have contributed to this work, but whose names might have been unintentionally omitted, I pray that God will grant you all your heart desires.

`

TABLE OF CONTENTS

`

`

`

`

LIST OF TABLES

`

LIST OF PLATES

`

`

LIST OF FIGURES

`

`

LIST OF ABBREVIATIONS

ACI: American Concrete Institute

Afm, Aft: Ettringite (Aft: mono-sulfate or (Al_2O_3 -Fe_2O_3- mono, Afm: sulfoaluminate hydrates Al_2O_3 -Fe_2O_3- tri)

APD: Average Pore Diameter

ASTM: American Society of Testing Materials

BSE: Back-Scattered Electron

C: Calcite ($CaCO_3$)

C_2S: Di calcium silicate

C_3A: Tri calcium aluminate

C_3S: Tri calcium silicate

C_4AF: Tetra calcium alumino-ferrite

CDW: Construction and Demolition Waste

CEMI: Portland cement (CEM I 52.5R)

CH: Calcium hydroxide

CM: Cement Matrix

CPD: Critical Pore Diameter

C-S-H: Calcium Silicate Hydrate

DEF: Delayed Ettringite formation

DTG: derivative of weight loss

EDS or EDX: Energy-Dispersive X-ray

erf: error function

FA: Fly ash

GGBS: Ground Granulated Blast Furnace Slag

ITZ: Interfacial Transition Zone

l: length

L: Liter

LOI: Loss on ignition

Ma-P%: Macro pores percentages

Mi-P %: Micro pores percentages

`

MIP: Mercury Intrusion Porosimetry

NVC: Normal Vibrated Concrete

OPC: Ordinary Portland Cement

P: Intrusion pressure

P: Porosity

Pc: Capillary pressure

r: Pore radius

RCA: Recycled Concrete Aggregate

RHA: Rice Husk Ash

SCMs: Supplementary Cementitious Materials

SE: Secondary Electron

SEM: Scanning Electron Microscopy

SG: Specific Gravity

TGA: Thermo Gravimetric Analysis

v: Apparent velocity of flow of water per unit time per unit area

V: Volume

Vf: aggregate volume fraction

w/c ratio: water to cement ratio

w/b ratio: water to binder ratio

x: depth

XRD: X-ray Diffraction

γ: Mercury surface tension

η: Dynamic viscosity of the liquid

θ: Contact angle (140^{o})

`

ABSTRACT

Ceramics is one of the solid wastes generated from construction and demolition sites, or industries that can constitute nuisance to the environment. Hence, reusing this kind of waste could be of immense benefit not only to the construction industry but also to the environment. This research focused on the mechanical and microstructural characterization of ceramic-laterized composite. The mechanical properties of mortar and concrete elements produced using cementitious composite, comprising of blended ceramic-cement as binders, ceramic aggregate, laterite and conventional aggregates, were determined after the samples have been cured by immersion in water. Non-destructive tests were performed on the hardened mortars, using X-ray CT scan and Ultrasonic Pulse Velocity (UPV) techniques. Also, dry bulk density, water absorption due to capillarity, compressive and flexural strength of mortars were determined. Mechanical properties of concrete such as compressive, split-tensile and flexural strength of concrete cubes, cylinders and prisms were determined. Next, predictive models for determining the compressive and split-tensile strength of ceramic-laterized concrete were developed using the Artificial Neural Network (ANN) technique. The results of compressive and split-tensile strengths obtained from this study and those of related studies were utilized for the model development. Finally, micro scale analysis was performed on mortar fragments from selected mixes, which revealed the hydration mechanism and pore structure of the concrete, as they relate to the strength properties. The concrete specimens were characterized using more advanced analysis techniques, comprising of Scanning Electron Microscopy, in secondary and backscattered electron modes, X-ray Diffractometer, mercury intrusion porosimetry (MIP), and thermogravimetric analysis (TGA). From the results, a mortar sample which was composed of 10% powdered ceramics as cement replacement, and 100% fine ceramics as sand replacement developed better strength characteristics than the reference mortar. The micro scale analysis showed that the best mortar mix developed larger peaks of Ettringite, Portlandite and Calcite minerals than the reference mortar. This could be the cause of its high strength. While for concrete, the reference mix yielded higher mechanical properties than the concrete containing secondary aggregates. However, a laterized concrete mix comprising both 90% of ceramic fine and 10% of laterite as the fine aggregate provided the optimal strength out of all the modified mixes, and this was the case whether the coarse aggregate was 100% granite or 100% coarse ceramics. Although, the strength reduction was about 9% when compared with the reference case, this reduction in strength is acceptable, and does not compromise the use of these alternative aggregates in structural concrete. Thus, this has shown that ceramic aggregate could be adequately used to supplement or totally replace natural aggregate in concrete while laterite could be sparingly used as replacement for river sand.

Keywords: Ceramic wastes; Green concrete; Hydration mechanism; Laterized concrete; Microstructure; Porosity

`

REFERENCES

Abadou, Y., Mitiche-Kettab, R. and Ghrieb, A. (2016). Ceramic waste influence on dune sand mortar performance. *Construction and Building Materials,* **125:** 703–713.

Abd elaty, M. and Allah, A. B. (2014). Compressive strength prediction of Portland cement concrete with age using a new model. *HBRC Journal,* **10(2):** 145–155.

Abdulkareem, O. A., Mustafa Al Bakri, A. M., Kamarudin, H., Khairul Nizar, I. and Saif, A. A. (2014). Effects of elevated temperatures on the thermal behavior and mechanical performance of fly ash geopolymer paste, mortar and lightweight concrete. *Construction and Building Materials,* **50:** 377–387.

Abur, B., Oguche, E. and Duvuna, G. (2014). Characterization of municipal solid waste in the federal capital abuja, Nigeria. *Global Journal of Science Frontier Research: H Environment and Earth Science,* **14(2):** 1–6.

Adepegba, D. (1975). A comparative study of normal concrete with concrete which contained laterite instead of sand. *Building Science,* **10(2):** 135–141.

Agbesola, Y. (2013). Sustainability of municipal solid waste management in nigeria: a case study of lagos. Unpublished Masters Thesis, Department of Civil Engineering, Linköping University, Sweden.

Ahmed, M., Mallick, J. and Abul Hasan, M. (2016). A study of factors affecting the flexural tensile strength of concrete. *Journal of King Saud University - Engineering Sciences,* **28(2):** 147–156.

Ahmed Memon, F., Nuruddin, M. F., Demie, S. and Shafiq, N. (2011). Effect of curing conditions on strength of fly ash-based self-compacting geopolymer concrete. *International Journal of Civil and Environmental Engineering,* **3:** 183–186.

Airey, G. D. and Collop, A. C. (2016). Mechanical and structural assessment of laboratory- and field-compacted asphalt mixtures. *International Journal of Pavement Engineering,* **17(1):** 50–63.

Ajdukiewicz, A. and Kliszczewicz, A. (2002). Influence of recycled aggregates on mechanical properties of HS/HPC. *Cement and Concrete Composites,* **24(2):** 269–279.

Akbarnezhad, A., Ong, K. C. G., Zhang, M. H., Tam, C. T. and Foo, T. W. J. (2011). Microwave-assisted beneficiation of recycled concrete aggregates. *Construction and Building Materials,* **25(8):** 3469–3479.

Akçaoğlu, T., Tokyay, M. and Çelik, T. (2005). Assessing the ITZ microcracking via scanning electron microscope and its effect on the failure behavior of concrete. *Cement and Concrete Research,* **35(2):** 358–363.

Al Bakri, A., Norazian, M., Kamarudin, H., Mohd Salleh, M. and Alida, A. (2013). Strength of concrete based cement using recycle ceramic waste as aggregate. *Advanced Materials Research,* **740:** 734–738.

Alarcon-Ruiz, L., Platret, G., Massieu, E. and Ehrlacher, A. (2005). The use of thermal analysis in assessing the effect of temperature on a cement paste. *Cement and Concrete Research,* **35(3):** 609–613.

Ali-Benyahia, K., Sbartaï, Z.-M., Breysse, D., Kenai, S. and Ghrici, M. (2017). Analysis of the single and combined non-destructive test approaches for on-site concrete strength assessment: General statements based on a real case-study. *Case Studies in Construction Materials,* **6:** 109–119.

`

Alshihri, M. M., Azmy, A. M. and El-bisy, M. S. (2009). Neural networks for predicting compressive strength of structural light weight concrete. *Construction and Building Materials,* **23(6):** 2214–2219.

Alwaeli, M. and Nadziakiewicz, J. (2012). Recycling of scale and steel chips waste as a partial replacement of sand in concrete. *Construction and Building Materials,* **28(1):** 157–163.

Amini, K., Jalalpour, M. and Delatte, N. (2016). Advancing concrete strength prediction using non-destructive testing: Development and verification of a generalizable model. *Construction and Building Materials*, **102:** 762–768.

Applegarth, L. J., Tuffen, H., James, M. R., Pinkerton, H. and Cashman, K. V. (2013). Direct observations of degassing-induced crystallization in basalts. *Geology,* **41(2):** 243–246.

Arezoumandi, M., Volz, J. and Myers, J. J. (2013). Shear behavior of high-volume fly ash concrete versus conventional concrete. *Journal of Materials in Civil Engineering,* **25:** 1506–1513.

Arioz, O. (2007). Effects of elevated temperatures on properties of concrete. *Fire Safety Journal,* **42(8):** 516–522.

American Society for Testing and Materials, C496/C496M-11. (2004). *Standard test method for splitting tensile strength of cylindrical concrete specimens*. ASTM International, West Conshohocken, PA.

American Society for Testing and Materials, C618. (2008). *Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete*. American Society for Testing and Materials.

Ata, O. (2007). Effects of varying curing age and water/cement ratio on the elastic properties of laterised concrete. *Civil Engineering Dimension,* **9(2):** 85–89.

Atan, M. and Awang, H. (2011). The compressive and flexural strengths of self-compacting concrete using raw rice husk ash. *Journal of Engineering Science and Technology,* **6:** 720–732.

Awoyera, P. (2014). Forensic investigation of fire-affected concrete buildings. LAP LAMBERT Academic Publishing, Germany.

Awoyera, P. (2016). Nonlinear finite element analysis of steel fibre-reinforced concrete beam under static loading. *Journal of Engineering Science and Technology,* **11(12):** 1–9.

Awoyera, P. (In Press). Predictive models for determination of compressive and split-tensile strengths of steel slag aggregate concrete. *Materials Research Innovations*, 1–7.

Awoyera, P., Ijalana, G. and Babalola, O. (2015). Influence of steel and bamboo fibres on mechanical properties of high strength concrete. *Journal of Materials and Environmental Sciences,* **6(12):** 3634–3642.

Awoyera, P. O., Akinmusuru, J. O. and Ndambuki, J. M. (2016). Green concrete production with ceramic wastes and laterite. *Construction and Building Materials,* **117:** 29–36.

Awoyera, P. O., Akinmusuru, J. O., Dawson, A. R., Ndambuki, J. M. and Thom, N. H. (2018). Microstructural characteristics, porosity and strength development in ceramic-laterized concrete. *Cement and Concrete Composite,* **86:** 224-237.

`

Awoyera, P. O. and Akinwumi, I. I. (2014). Compressive strength development for cement, lime and termite-hill stabilised lateritic bricks. *The International Journal of Engineering and Science,* **3:** 37–43.

Awoyera, P. O., Dawson, A. R., Thom, N. H. and Akinmusuru, J. O. (2017). Suitability of mortars produced using laterite and ceramic wastes: Mechanical and microscale analysis. *Construction and Building Materials,* **148:** 195-203.

Ay, N. and Ünal, M. (2000). *The use of waste ceramic tile in cement production*. *Cement and Concrete Research*, **30(3):** 497-499.

Bailey, R. A., Clark, H. M., Ferris, J. P., Krause, S. and Strong, R. L. (2002). Nuclear Chemistry of the Environment. In: *Chemistry of the Environment*, 449 - 556, Academic Press, New York.

Bakri, M., Hussin, K., Mohd, C., Baharin, S., Ramly, R. and Khairiatun, N. (2006). concrete Ceramic waste slab. *Journal of Engineering Research and Education,* **3:** 139–145.

Bal, L. and Buyle-bodin, F. (2013). Artificial neural network for predicting drying shrinkage of concrete. *Construction and Building Materials,* **38:** 248–254.

Balogun, L. (1986). Effect of temperature on the residual compressive strength of laterised concrete. *Building and Environment,* **21(3–4):** 221–226.

Balogun, L. A. and Adepegba, D. (1982). Effect of varying sand conctent in laterized concrete. *The International Journal of Cement Composites and Lightweight Concrete,* **4(4):** 235–240.

Bary, B., De Morais, M. V. G., Poyet, S. and Durand, S. (2012). Simulations of the thermo-hydro-mechanical behaviour of an annular reinforced concrete structure heated up to 200??C. *Engineering Structures,* **36:** 302–315.

Basheer, P. A. M., Chidiac, S. E. and Long, A. E. (1996). Predictive models for deterioration of concrete structures. *Construction and Building Materials,* **10:** 27–37.

Benezet, J. C. and Benhassaine, A. (1999). The influence of particle size on the pozzolanic reactivity of quartz powder. *Powder Technology,* **103(1):** 26–29.

Bentur, A., Alexander, M., Bentz, D., Buyukozturk, O., Elsen, J., Hooton, D. and Van Mier, J. (2000). Review of the work of the RILEM TC 159-ETC: Engineering of the interfacial transition zone in cementitious composites. *Materials and Structures/Materiaux et Constructions,* **33(226):** 82–87.

Bentz, D. P. and Stutzman, P. E. (2006). Curing, hydration, and microstructure of cement paste. *ACI Materials Journal,* **103(5):** 348–356.

Bentz, D., Peltz, M. and Winpigler, J. (2009). Early-age properties of cement-based materials. ii: influence of water-to-cement ratio. *Journal of Materials in Civil Engineering,* **21(9):** 512–517.

Bernard, F. and Kamali-Bernard, S. (2015). Numerical study of ITZ contribution on mechanical behavior and diffusivity of mortars. *Computational Materials Science*, **102:** 250–257.

Bhatti, M. A. (2006). Predicting the compressive strength and slump of high strength concrete using neural network, **20:** 769–775.

Bichi, M. and Amatobi, D. (2013). Characterization of household solid wastes generated in Sabon-gari area of Kano in Northern Nigeria. *American Journal of Research Communication,* **1(4):** 165 – 171.

`

Bilim, C., Atis, C. D., Tanyildizi, H. and Karahan, O. (2009). Predicting the compressive strength of ground granulated blast furnace slag concrete using artificial neural network. *Advances in Engineering Software*, **40:** 334–340.

Binici, H. (2007). Effect of crushed ceramic and basaltic pumice as fine aggregates on concrete mortars properties. *Construction and Building Materials,* **21(6):** 1191–1197.

Bonicelli, A., Giustozzi, F. and Crispino, M. (2015). Experimental study on the effects of fine sand addition on differentially compacted pervious concrete. *Construction and Building Materials,* **91:** 102–110.

Borges, P. H. R., Costa, J. O., Milestone, N. B., Lynsdale, C. J. and Streatfield, R. E. (2010). Carbonation of CH and C–S–H in composite cement pastes containing high amounts of BFS. *Cement and Concrete Research,* **40(2):** 284–292.

Boukour, S. and Benmalek, M. L. (2016). Performance evaluation of a resinous cement mortar modified with crushed clay brick and tire rubber aggregate. *Construction and Building Materials,* **120:** 473–481.

British Standards Institution BSI 1881-108. (1983). *Testing concrete. Method for making test cubes from fresh concrete*. British Standard, London, UK.

British Standards Institution BSI 1881-118. (1983). *Methods for determination of flexural strength*. British Standard, London, UK.

British Standards Institution BSI 3148. (1980). M*ethod for test for water for making concrete*. British Standard, London, UK.

British Standards Institution BSI 5328. (1981). *Testing concrete - Methods of specifying concrete including ready-mixed concrete*. British Standard, London, UK.

British Standards Institution BSI 812-103. (1985). *Testing aggregates. Method for determination of particle size distribution - Sieve tests*. British Standard, London, UK.

British Standards Institution BSI 812-105.1. (1989). *Testing aggregates. Methods for determination of particle shape - Flakiness index*. British Standard, London, UK.

British Standards Institution BSI 812-110. (1990). *Methods for determination of aggregate crushing value*. British Standard, London, UK.

British Standards Institution BSI 812-112. (1990). *Testing aggregates. Method for determination of aggregate impact value*. British Standard, London, UK.

British Standards Institution BSI 812-2. (1996). *Methods of Sampling and Testing of Mineral Aggregates*. British Standard, London, UK.

British Standards Institution BSI 882. (1992). *Aggregates from natural sources.* British Standard, London, UK.

British Standards Institution BSI EN, 12390-6. (2006). *Testing hardened concrete – part 6: Tensile splitting strength of test specimens*. British Standard, London, UK.

British Standards Institution BSI EN 1015-10. (1999). *Methods of test for mortar for masonry —Part 10: Determination of dry bulk density of hardened mortar*. British Standard, London, UK.

British Standards Institution BSI EN 1015-11. (1999). *Methods of test for mortar for masonry — Part 11: Determination of flexural and compressive strength of hardened mortar*. British Standard, London, UK.

British Standards Institution BSI 1015-18. (1999). *Methods of test for mortar for masonry —Part 18: Determination of water absorption coefficient due to capillary action of*

`

hardened mortar. British Standard, London, UK.

British Standards Institution BSI EN 1097-2. (1998). *Tests for mechanical and physical properties of aggregates. Methods for the determination of resistance to fragmentation*. British Standard, London, UK.

British Standards Institution BSI EN 1097-6. (1995). *Tests for mechanical and physical properties of aggregates*. British Standard, London, UK.

British Standards Institution BSI EN 12350-2. (2009). *Testing fresh concrete - Slump-test.* British Standard, London, UK.

British Standards Institution BSI EN 12390-1. (2012). *Testing hardened concrete. Shape, dimensions and other requirements for specimens and moulds*. British Standard, London, UK.

Brooks, R. (2010). Residual compressive strength of laterised concrete subjected to elevated temperatures. *Research Journal of Applied Sciences, Engineering and Technology,* **2(3):** 262–268.

BU, J., and TIAN, Z. (2016). Relationship between pore structure and compressive strength of concrete: Experiments and statistical modeling. *Sadhana,* **41(3):** 337–344.

Bunaciu, A., Udriştioiu, E. and Aboul-Enein, H. (2015). X-Ray Diffraction: Instrumentation and Applications. *Critical Reviews in Analytical Chemistry,* **45(4):** 289–299.

Burch, S. (2002). Measurement of density variations in compacted parts using X-ray computerised tomography. *Metal Powder Report,* **57(2):** 24–28.

Buttress, A. J., Jones, D. A., Dodds, C., Dimitrakis, G., Campbell, C. J., Dawson, A. and Kingman, S. W. (2015). Understanding the scabbling of concrete using microwave energy. *Cement and Concrete Research,* **75:** 75–90.

Calcamuggio, J. (2011). Tile Flooring 101: Types of Tile Flooring. Retrieved January 1, 2015, from http://buildipedia.com/at-home/floors/tile-flooring-101-types-of-tile-flooring.

Canut, M. (2011). Pore structure in blended cement pastes. PhD Thesis, Department of Civil Engineering, Technical University of Denmark, Denmark.

Carmichael, R. P. (2009). Relationships between young’s modulus, compressive strength, poisson’s ratio, and time for early age concrete. MSc Thesis, Department of Civil Engineering, Swarthmore College, Philadelphia.

Chen, H., Zhu, Z., Liu, L., Sun, W. and Miao, C. (2016). Aggregate shape effect on the overestimation of ITZ thickness: Quantitative analysis of Platonic particles. *Powder Technology,* **289:** 1–17.

Chen, L. (2010). Grey and neural network prediction of concrete compressive strength using physical properties of electric arc furnace oxidizing slag. *Journal of Environmental and Engineering Management,* **20(3):** 189–194.

Chen, W. and Brouwers, H. J. H. (2010). Alkali binding in hydrated Portland cement paste. *Cement and Concrete Research*, **40(5):** 716–722.

Cheng, Y., Huang, F., Li, G. L., Xu, L. and Hou, J. (2014). Test research on effects of ceramic polishing powder on carbonation and sulphate-corrosion resistance of concrete. *Construction and Building Materials,* **55:** 440–446.

Cheng, Y., Huang, F., Liu, R., Hou, J. and Li, G. (2016). Test research on effects of waste

`

ceramic polishing powder on the permeability resistance of concrete. *Materials and Structures,* **49(3):** 729–738.

Chindaprasirt, P., Hatanaka, S., Chareerat, T., Mishima, N. and Yuasa, Y. (2008). Cement paste characteristics and porous concrete properties. *Construction and Building Materials*, **22(5):** 894–901.

Chindaprasirt, P. and Rukzon, S. (2014). Strength and chloride resistance of the blended Portland cement mortar containing rice husk ash and ground river sand. *Materials and Structures,* **48 (11):** 3771 - 3777.

Coelho, A. and De Brito, J. (2011). Distribution of materials in construction and demolition waste in Portugal. *Waste Management Research,* **29(8):** 843–853.

Cong, X. and Kirkpatrick, R. J. (1995). Effects of the temperature and relative humidity on the structure of CSH gel. *Cement and Concrete Research,* **25(6):** 1237–1245.

Costa, U. and Ursella, P. (2003). Construction and demolition waste recycling in Italy, WASCON 2003-Progress on the road to sustainability. San Sebastian, Spain.

Cui, L. and Cahyadi, J. H. (2001). Permeability and pore structure of OPC paste. *Cement and Concrete Research,* **31(1):** 277–282.

Dawood, E. and Ramli, M. (2011). Effect of Steel Fibres on the Engineering Performance of Concrete. *Asian Journal of Applied Sciences,* **4(1):** 97–100.

De Belie, N., Kratky, J. and Van Vlierberghe, S. (2010). Influence of pozzolans and slag on the microstructure of partially carbonated cement paste by means of water vapour and nitrogen sorption experiments and BET calculations. *Cement and Concrete Research,* **40(12):** 1723–1733.

de Brito, J., Pereira, A. S. and Correia, J. R. (2005). Mechanical behaviour of non-structural concrete made with recycled ceramic aggregates. *Cement and Concrete Composites,* **27(4):** 429–433.

De Brito, J. and Saikia, N. (2013). Recycled Aggregate in Concrete. London: Springer.

De Rojas, M., Marin, F., Rivera, J. and Frias, M. (2006). Morphology and properties in blended cements with ceramic wastes as a pozzolanic material. *Journal of the American Ceramic Society,* **89:** 3701–3705.

Denk, W. and Horstmann, H. (2004, November). Serial block-face scanning electron microscopy to reconstruct three-dimensional tissue nanostructure. *PLoS Biology,* **2(11):** e329.

Dharmawardhana, C. C., Misra, A., Aryal, S., Rulis, P. and Ching, W. Y. (2013). Role of interatomic bonding in the mechanical anisotropy and interlayer cohesion of CSH crystals. *Cement and Concrete Research,* **52:** 123–130.

Dhavamani, D. and Gobinatha, D. (2013). chemical resistance of concrete with ceramic waste aggregate. *International Journal of Current Engineering and Technology,* **3(3):** 1024 – 1028.

Diamond, S. and Huang, J. (2001). The ITZ in concrete - A different view based on image analysis and SEM observations. *Cement and Concrete Composites,* **23(3):** 179–188.

Donatello, S., Kuenzel, C., Palomo, A. and Fernández-Jiménez, A. (2014). High temperature resistance of a very high volume fly ash cement paste. *Cement and Concrete Composites,* **45:** 234–242.

Duan, Z., Kou, S. and Poon, C. (2013). Prediction of compressive strength of recycled

`

aggregate concrete using artificial neural networks. *Construction and Building Materials,* **40:** 1200–1206.

Durdziński, P. T., Dunant, C. F., Haha, M. and Scrivener, K. L. (2015). A new quantification method based on SEM-EDS to assess fly ash composition and study the reaction of its individual components in hydrating cement paste. *Cement and Concrete Research,* **73:** 111–122.

Dwaikat, M. B. and Kodur, V. K. R. (2009). Hydrothermal model for predicting fire-induced spalling in concrete structural systems. *Fire Safety Journal,* **44(3):** 425–434.

Ekman, A., Campos, M., Lindahl, S., Co, M., Börjesson, P., Karlsson, E. N. and Turner, C. (2013). Bioresource utilisation by sustainable technologies in new value-added biorefinery concepts – two case studies from food and forest industry. *Journal of Cleaner Production,* **57:** 46–58.

El-Hassan, H., Yixin Shao, Y. and Ghouleh, Z. (2013). Reaction products in carbonation-cured lightweight concrete. *Journal of Materials in Civil Engineering,***25(6):** 799–809.

Elaty, M. A. M., Ghazy, M. F. M. and Abd Elaty, M. (2014). Performance of Portland cement mixes containing silica fume and mixed with lime-water. *HBRC Journal,* **10(3):** 247–257.

Elkhadiri, I. and Puertas, F. (2008). The effect of curing temperature on sulphate-resistant cement hydration and strength. *Construction and Building Materials,* **22(7):** 1331–1341.

Ercikdi, B., Yılmaz, T. and Külekci, G. (2014). Strength and ultrasonic properties of cemented paste backfill. *Ultrasonics,* **54(1):** 195–204.

Erdem, S. (2012). Impact load-induced microstructural damage of concrete made with unconventional aggregates. PhD Thesis, Department of Civil Engineering, University of Nottingham, United Kingdom.

Ergün, A. (2011). Effects of the usage of diatomite and waste marble powder as partial replacement of cement on the mechanical properties of concrete. *Construction and Building Materials,* **25(2):** 806–812.

Ergün, A., Kürklü, G., M. Serhat, B. and Mansour, M. Y. (2013). The effect of cement dosage on mechanical properties of concrete exposed to high temperatures. *Fire Safety Journal,* **55:** 160–167.

Espinos, A., Romero, M. L. and Lam, D. (2016). Fire performance of innovative steel-concrete composite columns using high strength steels. *Thin-Walled Structures,* **106:** 113–128.

Etxeberria, M., Vázquez, E., Marí, A. and Barra, M. (2007). Influence of amount of recycled coarse aggregates and production process on properties of recycled aggregate concrete. *Cement and Concrete Research,* **37(5):** 735–742.

European Commission. (2000). The ETN recycling in construction. Use of recycled materials as aggregates in the construction industry. Brussels.

European Commission. (2007). Ceramic Manufacturing Industry. Seville, Spain.

European Environment Agency. (2009). EU as a recycling society: Present recycling levels of Municipal Waste and Construction and Demolition Waste in the EU. Denmark.

Famy, C. and Taylor, H. F. W. (2001). Ettringite in hydration of Portland cement concrete and its occurrence in mature concretes. *ACI Materials Journal,* **98(4):** 350–356.

`

Fan, C.-C., Huang, R., Hwang, H. and Chao, S.-J. (2016). Properties of concrete incorporating fine recycled aggregates from crushed concrete wastes. *Construction and Building Materials,* **112:** 708–715.

Fermor, L. (1981). What is laterite? *Geology Magazine,* **5(8):** 453 – 462.

Fernandes, M., Sousa, A. and Dias, A. (2004). Environmental impact and emissions trade, ceramic industry. A case study. Portuguese Association of Ceramic Industry APICER (2004), Coimbra, Portugal.

Franklin associate. (1998). Characterization of building-related construction and demolition debris in the United States, Report No. EPA530-R-98-010. USA.

Frías, M., Rodríguez, O., Vegas, I. and Vigil, R. (2008). Properties of calcined clay waste and its influence on blended cement behavior. *Journal of the American Ceramic Society*, **91(4):** 1226–1230.

Gallucci, E., Mathur, P. and Scrivener, K. (2010). Microstructural development of early age hydration shells around cement grains. *Cement and Concrete Research,* **40(1):** 4–13.

Galvão, J. C. A., Portella, K. F., Joukoski, A., Mendes, R. and Ferreira, E. S. (2011). Use of waste polymers in concrete for repair of dam hydraulic surfaces. *Construction and Building Materials,* **25(2):** 1049–1055.

Gao, J. M., Qian, C. X., Liu, H. F., Wang, B. and Li, L. (2005). ITZ microstructure of concrete containing GGBS. *Cement and Concrete Research, 35*(**7**)**:** 1299–1304.

Gao, Y., De Schutter, G., Ye, G., Huang, H., Tan, Z. and Wu, K. (2013a). Characterization of ITZ in ternary blended cementitious composites: Experiment and simulation. *Construction and Building Materials,* **41:** 742–750.

Gao, Y., De Schutter, G., Ye, G., Huang, H., Tan, Z. and Wu, K. (2013b). Porosity characterization of ITZ in cementitious composites: Concentric expansion and overflow criterion. *Construction and Building Materials,* **38:** 1051–1057.

Gao, Y., De Schutter, G., Ye, G., Tan, Z. and Wu, K. (2014). The ITZ microstructure, thickness and porosity in blended cementitious composite: Effects of curing age, water to binder ratio and aggregate content. *Composites Part B: Engineering,* **60:** 1–13.

García-González, J., Rodríguez-Robles, D., Juan-Valdés, A., Pozo, J. M. M. and Guerra-Romero, M. I. (2015a). Ceramic ware waste as coarse aggregate for structural concrete production. *Environmental Technology,* **36(23):** 3050–3059.

García-González, J., Rodríguez-Robles, D., Juan-Valdés, A., Pozo, J. M. M. and Guerra-Romero, M. I. (2015b). Porosity and pore size distribution in recycled concrete. *Magazine of Concrete Research,* **67(22):** 1214–1221.

Garzón-roca, J., Marco, C. O. and Adam, J. M. (2013). Compressive strength of masonry made of clay bricks and cement mortar : Estimation based on Neural Networks and Fuzzy Logic. *Engineering Structures*, **48:** 21–27.

Georgali, B. and Tsakiridis, P. E. (2005). Microstructure of fire-damaged concrete. A case study. *Cement and Concrete Composites,* **27(2):** 255–259.

Giaccio, G. and Zerbina, R. (1998). Failure mechanism of concrete- combined effects of coarse aggregates and strength level. *Advanced Cement Based Materials,* **7(2):** 41–48.

Glaeser, R., Facciotti, M., Walian, P., Rouhani, S., Holton, J., MacDowell, A. and Padmore, H. (2000). Characterization of conditions required for x-ray diffraction experiments with protein microcrystals. *Biophysical Journal,* **78(6):** 3178–3185.

`

Goldman, L. W. (2007). Principles of CT and CT technology. *Journal of Nuclear Medicine Technology,* **35(3):** 115-28-30.

GonÃ\Salves, J. P. (2007). UtilizaÃ§Ã\poundso do resÃ\-duo da indÃ\textordmasculinestria cerÃ\textcentmica para produÃ§Ã\poundso de concretos. *Rem: Revista Escola de Minas,* **60:** 639–644.

Grieve, G. (2006). Design of concrete to meet durabilty requirements; developemtn towards a performance specification in South Africa. In: Integrative oncology, principles and practice, Taylor and Francis group, London, pp. 12–13.

Guan, W., Ji, F., Fang, D., Cheng, Y., Fang, Z., Chen, Q. and Yan, P. (2014). Porosity formation and enhanced solubility of calcium silicate hydrate in hydrothermal synthesis. *Ceramics International,* **40(1):** 1667–1674.

Guerra, I., Vivar, I., Llamas, B., Juan, A. and Moran, J. (2009). Eco-efficient concretes: The effects of using recycled ceramic material from sanitary installations on the mechanical properties of concrete. *Waste Management,* **29(2):** 643–646.

Guo, Y. C., Zhang, J. H., Chen, G. M. and Xie, Z. H. (2014). Compressive behaviour of concrete structures incorporating recycled concrete aggregates, rubber crumb and reinforced with steel fibre, subjected to elevated temperatures. *Journal of Cleaner Production*, **72:** 193–203.

Hafner, B. (2007). Scanning Electron Microscopy Primer. Characterization Facility. University of Minnesota-Twin Cities, Minnesota.

Hanna, R. D. and Ketcham, R. A. (2017). X-ray computed tomography of planetary materials: A primer and review of recent studies. *Chemie Der Erde - Geochemistry,* **77(4):** 547-572.

Haque, M. N., Al-Khaiat, H. and John, B. (2008). Durability design in the African concrete code. *Kuwait Journal of Science and Engineering,* **35(2):** 39–54.

Hashin, Z. and Monteiro, P. J. M. (2002). An inverse method to determine the elastic properties of the interphase between the aggregate and the cement paste. *Cement and Concrete Research,* **32(8):** 1291–1300.

Heap, M. J., Lavallée, Y., Laumann, A., Hess, K. U., Meredith, P. G., Dingwell, D. B. and Weise, F. (2013). The influence of thermal-stressing (up to 1000°C) on the physical, mechanical, and chemical properties of siliceous-aggregate, high-strength concrete. *Construction and Building Materials,* **42***:* 248–265.

Helmi, M., Hall, M. R., Stevens, L. A. and Rigby, S. P. (2016). Effects of high-pressure/temperature curing on reactive powder concrete microstructure formation. *Construction and Building Materials*, **105:** 554–562.

Hilal, A. A., Thom, N. H. and Dawson, A. R. (2015). On void structure and strength of foamed concrete made without/with additives. *Construction and Building Materials,* **85:** 157–164.

Hodhod, O. A. and Ahmed, H. I. (2014). Modeling the corrosion initiation time of slag concrete using the artificial neural network. *HBRC Journal,* **10(3):** 231-234.

Hong-guang, N. and Ji-zong, W. (2000). Prediction of compressive strength of concrete by neural networks, **30:** 1245–1250.

Hou, P., Qian, J., Cheng, X. and Shah, S. P. (2015). Effects of the pozzolanic reactivity of nanoSiO2 on cement-based materials. *Cement and Concrete Composites,* **55:** 250–258.

`

Hou, X., Struble, L. J. and Kirkpatrick, R. J. (2004). Formation of ASR gel and the roles of C-S-H and portlandite. *Cement and Concrete Research,* **34(9):** 1683–1696.

Hussin, A. and Poole, C. (2011). Petrography evidence of the interfacial transition zone (ITZ) in the normal strength concrete containing granitic and limestone aggregates. *Construction and Building Materials,* **25(5):** 2298–2303.

Ikponmwosa, E. and Salau, M. (2010). Effect of heat on laterised concrete. *Maejo International Journal of Science and Technology,* **4(1):** 33–42.

Itskos, G., Itskos, S. and Koukouzas, N. (2010). Size fraction characterization of highly-calcareous fly ash. *Fuel Processing Technology,* **91:** 1558–1563.

Jamil, M., Khan, M. N. N., Karim, M. R., Kaish, A. B. and Zain, M. F. M. (2016). Physical and chemical contributions of Rice Husk Ash on the properties of mortar. *Construction and Building Materials,* **128:** 185–198.

Janotka, I. and Nürnbergerová, T. (2005). Effect of temperature on structural quality of the cement paste and high-strength concrete with silica fume. *Nuclear Engineering and Design,* **235(19):** 2019–2032.

Jin, R. and Chen, Q. (2013). An investigation of current status of "green" concrete in the construction industry. In: 49th ASC Annual International Conference Proceedings, San Luis Obispo, CA.,USA.

Juan, A., Medina, C., Guerra, M., Morán, J., Aguado, P., Sánchez de Rojas, M. and Rodríguez, O. (2010). Re-Use of Ceramic Wastes in Construction. In W. Wunderlich (Ed.), *Ceramic Materials*. InTech.

Kamseu, E., Ponzoni, C., Tippayasam, C., Taurino, R., Chaysuwan, D., Bignozzi, M. C. and Leonelli, C. (2015). Influence of fine aggregates on the microstructure, porosity and chemico-mechanical stability of inorganic polymer concretes. *Construction and Building Materials,* **96:** 473–483.

Kennedy, B. M., Jellinek, A. M., Russell, J. K., Nichols, A. R. L. and Vigouroux, N. (2010). Time-and temperature-dependent conduit wall porosity: A key control on degassing and explosivity at Tarawera volcano, New Zealand. *Earth and Planetary Science Letters*, **299(2):** 126–137.

Kevern, J. T., Schaefer, V. R. and Wang, K. (2009). Evaluation of Pervious Concrete Workability Using Gyratory Compaction. *Journal of Materials in Civil Engineering,* **21(12):** 764–770.

Khan, R. (2010). Quantification of microstructural damage in asphalt. PhD Thesis, University of Nottingham, United Kindom.

Khatib, J. M., Wright, L. and Mangat, P. S. (2016). Effect of desulphurised waste on long-term porosity and pore structure of blended cement pastes. *Sustainable Environment Research,* **26(5):** 230–234.

Khoury, G. A. (2000). Effect of fire on concrete and concrete structures. *Progress in Structural Engineering and Materials,* **2(4):** 429–447.

Ko, J., Ryu, D. and Noguchi, T. (2011). The spalling mechanism of high-strength concrete under fire. *Magazine of Concrete Research,* **63(5):** 357–370.

Kodur, V. (2014). Properties of concrete at elevated temperatures. *ISRN Civil Engineering,* **2014:** 1-15.

Kodur, V. K. R., Yu, B. and Dwaikat, M. M. S. (2013). A simplified approach for predicting

`

temperature in reinforced concrete members exposed to standard fire. *Fire Safety Journal,* **56:** 39–51.

Kore Sudarshan, D. and Vyas, A. K. (In Press). Impact of fire on mechanical properties of concrete containing marble waste. *Journal of King Saud University - Engineering Sciences*.

Koyuncu, H., Guney, Y., Yilmaz, G., Koyuncu, S. and Bakis, R. (2004). Utilization of ceramic wastes in the construction sector. *Key Engineering Materials,* **268:** 2509–2512.

Kulovaná, T. and Pavlík, Z. (2016). Characterization of composite materials based on cement-ceramic powder blended binder. In: AIP Conference Proceedings 1738, Rodos Palace Hotel, Rhodes, Greece.

Kurdowski, W. (2014). Cement and Concrete Chemistry. New York London: Springer Dordrecht Heidelberg.

Kurtis, K. (2007). Structure of the hydrated cement paste. *CEE 8813B Materials Science of Concrete, Lecture Notes*, Georgia Institute of Technology (Georgia Tech, GT), Atlanta, Georgia.

Labana, L., Ndambuki, J., Masu, L. and Salim, R. (2009). Investigation of the performance of fibre reinforced polymers (FRP) in structural foundations. In: Education towards a technologically innovative society conference proceeding, Vanderbijlpark, South Africa.

Laneyrie, C., Beaucour, A. L., Green, M. F., Hebert, R. L., Ledesert, B. and Noumowe, A. (2016). Influence of recycled coarse aggregates on normal and high performance concrete subjected to elevated temperatures. *Construction and Building Materials*, **111:** 368–378.

Lasisi, F. and Osunade, A. M. (1984). Effect of grain size on the strength characteristics of cement-stabilized lateritic soils. *Building and Environment,* **19(1):** 49–54.

Lavat, A. E., Trezza, M. A. and Poggi, M. (2009). Characterization of ceramic roof tile wastes as pozzolanic admixture. *Waste Management,* **29(5):** 1666–1674.

Lavina, B. (2014). Modern X-ray Diffraction Methods in Mineralogy and Geosciences. *Reviews in Mineralogy and Geochemistry,* **78:** 1–31.

Lee, S. (2003). Prediction of concrete strength using artificial neural networks, **25:** 849–857.

Leemann, A., Loser, R. and Münch, B. (2010). Influence of cement type on ITZ porosity and chloride resistance of self-compacting concrete. *Cement and Concrete Composites,* **32(2):** 116–120.

Leemann, A., Münch, B., Gasser, P. and Holzer, L. (2006). Influence of compaction on the interfacial transition zone and the permeability of concrete. *Cement and Concrete Research,* **36(8):** 1425–1433.

Li, B., Mao, J., Lv, J. and Zhou, L. (2015). Effects of micropore structure on hydration degree and mechanical properties of concrete in later curing age. *European Journal of Environmental and Civil Engineering,* **20(5):** 1–16.

Li, L. Y. and Purkiss, J. (2005). Stress-strain constitutive equations of concrete material at elevated temperatures. *Fire Safety Journal,* **40(7):** 669–686.

Li, Q., Li, Z. and Yuan, G. (2012). Effects of elevated temperatures on properties of concrete containing ground granulated blast furnace slag as cementitious material. *Construction and Building Materials,* **35:** 687–692.

Lian, C., Zhuge, Y. and Beecham, S. (2011). The relationship between porosity and strength for porous concrete. *Construction and Building Materials,* **25(11):** 4294–4298.

Limbachiya, M. C., Leelawat, T. and Dhir, R. K. (2000). Use of recycled concrete aggregate in high-strength concrete. *Materials and Structures,* **33(9):** 574.

Lin, K. L. and Lin, C. Y. (2005). Hydration characteristics of waste sludge ash utilized as raw cement material. *Cement and Concrete Research,* **35(10):** 1999–2007.

Liu, F., Liu, J., Ma, B., Huang, J. and Li, H. (2015). Basic properties of concrete incorporating recycled ceramic aggregate and ultra-fine sand. *Journal Wuhan University of Technology, Materials Science Edition,* **30(2):** 352–360.

Lo, Y., Gao, X. F. and Jeary, P. (1999). Microstructure of pre-wetted aggregate on lightweight concrete. *Building and Environment,* **34(6):** 759–764.

López-Mesa, B., Pitarch, Á., Tomás, A. and Gallego, T. (2009). Comparison of environmental impacts of building structures with in situ cast floors and with precast concrete floors. *Building and Environment,* **44(4):** 699–712.

López, V., Llamas, B., Juan, A., Morán, J. M. and Guerra, I. (2007). Eco-efficient concretes: impact of the use of white ceramic powder on the mechanical properties of concrete. *Biosystems Engineering,* **96(4):** 559–564.

Lucero, C. L., Bentz, D. P., Hussey, D. S., Jacobson, D. L. and Weiss, W. J. (2015). Using neutron radiography to quantify water transport and the degree of saturation in entrained air cement based mortar. *Physics Procedia,* **69:** 542–550.

Ma, H. (2014). Mercury intrusion porosimetry in concrete technology: tips in measurement, pore structure parameter acquisition and application. *Journal of Porous Materials*, **21(2):** 207–215.

Mandal, T., Tinjum, J. M. and Edil, T. B. (2016). Non-destructive testing of cementitiously stabilized materials using ultrasonic pulse velocity test. *Transportation Geotechnics*, **6:** 97–107.

Margarido, F. (2015). Environmental Impact and Life Cycle Evaluation of Materials. In: Materials for Construction and Civil Engineering, M.C. Goncalves, F. Margarido (Eds.), Springer International Publishing Switzerland, Cham (2015), pp. 799-835.

Marinescu, M. and Brouwers, J. (2012). Chloride binding related to hydration products part I: Ordinary Portland cement. *RILEM Bookseries,* **3:** 125–131.

Marinkovic, S., Radonjanin, V., Malešev, M. and Ignjatovic, I. (2010). Comparative environmental assessment of natural and recycled aggregate concrete. *Waste Management,* **30:** 2255–2264.

Martinez, C., Romero, M., Moran del Pozo, J. and Valdes, A. (2009). Use of ceramic wastes in structural concretes. In: 1st Spanish National Conference on Advances in Materials Recycling and Eco – Energy, Madrid, Spain.

Masad, E. (2004). X-ray computed tomography of aggregates and asphalt mixes. *Materials Evaluation Journal,* **62(7):** 775–783.

Mathew, G. and Paul, M. M. (2014). Influence of fly ash and ggbfs in laterized concrete exposed to elevated temperatures. *Journal of Materials in Civil Engineering,* **26:** 411–419.

`

Matos, A. M. and Sousa-Coutinho, J. (2012). Durability of mortar using waste glass powder as cement replacement. *Construction and Building Materials,* **36:** 205–215.

McCann, D. and Forde, M. (2001). Review of NDT methods in the assessment of concrete and masonry structures. *NDT and E International,* **34(2):** 71–84.

Medina, C., Sanchez de Rojas, M., Frias, M. and Juan, A. (2011). Using ceramic materials in ecoefficient concrete and precast concrete products. In: Advances in Ceramics – Electric and Magnetic Ceramics, Bioceramics, Ceramics and Environment, C. Sikalidis (Ed.), InTech, Croatia, pp 533 - 550.

Medina, C., Sánchez de Rojas, M. I., Thomas, C., Polanco, J. A. and Frías, M. (2016). Durability of recycled concrete made with recycled ceramic sanitary ware aggregate. Inter-indicator relationships. *Construction and Building Materials,* **105:** 480–486.

Mehta, P. K., Monteiro, P. J. M. and Ebrary, I. (2006). Concrete: microstructure, properties, and materials. Concrete. McGraw-Hill.

Mendes, A., Sanjayan, J. G., Gates, W. P. and Collins, F. (2012). The influence of water absorption and porosity on the deterioration of cement paste and concrete exposed to elevated temperatures, as in a fire event. *Cement and Concrete Composites,* **34(9):** 1067–1074.

Midwest Research Institute. (1996). Ceramic Product Manufacturing. USA.

Mindeguia, J.-C., Pimienta, P., Carré, H. and Borderie, C. La. (2013). Experimental analysis of concrete spalling due to fire exposure. *European Journal of Environmental and Civil Engineering,* **17:** 453–466.

Mohammed, M. (2015). Multi-scale response of sustainable self-compacting concrete (SCC) to carbonation and chloride penetration. PhD Thesis, Department of Civil Engineering, University of Nottingham, United Kingdom.

Mohammed, M. K., Dawson, A. R. and Thom, N. H. (2013). Production, microstructure and hydration of sustainable self-compacting concrete with different types of filler. *Construction and Building Materials,* **49:** 84–92.

Mondal, P. (2008). Nanomechanical properties of cementitious materials. PhD Thesis, Department of Civil Engineering, Northwestern University, United Kingdom.

Moosberg-Bustnes, H., Lagerblad, B. and Forssberg, E. (2004). The function of fillers in concrete. *Materials and Structures*c, **37(2):** 74.

Morin, V., Moevus, M., Dubois-Brugger, I. and Gartner, E. (2011). Effect of polymer modification of the paste-aggregate interface on the mechanical properties of concretes. *Cement and Concrete Research,* **41(5):** 459–466.

Mortar Industrial Association. (2015). A guide to BS EN 998 -1 and BS EN 998 - 2. Mineral Products Association Ltd, Data sheet.

Murray, J. W., Kinnell, P. K., Cannon, A. H., Bailey, B. and Clare, A. T. (2013). Surface finishing of intricate metal mould structures by large-area electron beam irradiation. *Precision Engineering,* **37(2):** 443–450.

Namyong, J., Sangchun, Y. and Cho, H. (2004). Prediction of Compressive Strength of In-Situ Concrete Based on Mixture Proportion. *Journal of Asian Architecture and Building Engineering,* **3(1):** 9–16.

Narmluk, M. and Nawa, T. (2011). Effect of fly ash on the kinetics of Portland cement hydration at different curing temperatures. *Cement and Concrete Research,* **41(6):**

`

579–589.

Nazari, A. and Riahi, S. (2012). The effect of aluminium oxide nanoparticles on the compressive strength and structure of self-compacting concrete. *Magazine of Concrete Research,* **64(1):** 71–82.

Neville, A. (1996a). Properties of Concrete (4th ed.). New York, USA: Wiley.

Neville, A. (1996b). Properties of Concrete. Essex, England: ADDISON Wesley Longman.

Neville, A. (2011). Properties of Concrete. London: Pearson Education Limited.

Ni, H.-G. and Wang, J.-Z. (2000). Prediction of compressive strength of concrete by neural networks. *Cement and Concrete Research,* **30(8):** 1245–1250.

NIS 444, part 1. (2003). Composition, specifications and conformity criteria for common cements. Nigeria Industrial Standards Center, Nigeria.

Ogbuene, E., Igwebuike, E. and Agusiegbe, U. (2013). The Impact of Open Solid Waste Dumpsite on Soil quality: A Case Study of Ugwuaji in Enugu. *British Journal of Advanced Academic Research*, **2(1):** 43–53.

Ogunbode, E., Ibrahim, S., Kure, M. and Saka, R. (2013). Flexural Performance of Laterized Concrete made with Blended Flyash Cement (Fa-Latcon). *Greener Journal of Science, Engineering and Technological Research,* **3(4):** 102 – 109.

Olawuyi, B. J. and Olusola, K. O. (2010). Compressive Strength of Volcanic Ash/Ordinary Portland Cement Laterized Concrete. *Civil Engineering Dimension,* **12(1):** 23–28.

Olusola, K. (2005). Some factors affecting compressive strength and elastic properties of laterite concrete. Unpublished Ph.D Thesis, Department of Building Technology, Obafemi Awolowo University, Nigeria.

Ortiz, O., Castells, F. and Sonnemann, G. (2009). Sustainability in the construction industry: A review of recent developments based on LCA. *Construction and Building Materials,* **23(1):** 28–39.

Ortiz, O., Pasqualino, J. C. and Castells, F. (2010). Environmental performance of construction waste: Comparing three scenarios from a case study in Catalonia, Spain. *Waste Management,* **30(4):** 646–654.

Osunade, J. (2002). Effect of replacement of lateritic soils with granite fines on the compressive and tensile strengths of laterized concrete. *Building and Environment*, **37(5):** 491–496.

Osunade, J. and Babalola, J. . (1991). Effect of mix proportion and reinforcement size on the anchorage bond stress of laterized concrete. *Building and Environment,* **26(4):** 447–452.

Oyekan, G. (2008). The Effect of Partial Replacement of Cement with Crushed Waste Glass in Laterized Concrete Production. *Research Journal of Applied Sciences,* **3:** 311–316.

Oyelami, C. A. and Van Rooy, J. L. (2016). A review of the use of lateritic soils in the construction/development of sustainable housing in Africa: A geological perspective. *Journal of African Earth Sciences,* **119:** 226–237.

Pacewska, B., Wilińska, I., Bukowska, M. and Nocuń-Wczelik, W. (2002). Effect of waste aluminosilicate material on cement hydration and properties of cement mortars. *Cement and Concrete Research,* **32(11):** 1823–1830.

Pacheco-Torgal, F. and Jalali, S. (2010). Reusing ceramic wastes in concrete. *Construction and Building Materials,* **24(5):** 832–838.

`

Pacheco-Torgal, F. and Jalali, S. (2011). Compressive strength and durability properties of ceramic wastes based concrete. *Materials and Structures,* **44(1):** 155–167.

Pala, M., Özbay, E., Öztas, A. and Yüce, M. (2007). Appraisal of long-term effects of fly ash and silica fume on compressive strength of concrete by neural networks. *Construction and Building Materials,* **21(2):** 384–394.

Pan, Z., Sanjayan, J. G. and Collins, F. (2014). Effect of transient creep on compressive strength of geopolymer concrete for elevated temperature exposure. *Cement and Concrete Research,* **56:** 182–189.

Panesar, D. K. (2013). Cellular concrete properties and the effect of synthetic and protein foaming agents. *Construction and Building Materials,* **44:** 575–584.

Parichatprecha, R. and Nimityongskul, P. (2009). Analysis of durability of high performance concrete using artificial neural networks. *Construction and Building Materials,* **23(2):** 910–917.

Paul, D. (2011). Characterisation of lightly stabilised granular materials by various laboratory testing methods. PhD Thesis, Department of Civil Engineering, University of New South Wales, Australian.

Paul, M. M. (2012). Behaviour of laterised normal and self compacting concrete subjected to elevated temperatures. PhD Thesis, Department of Civil Engineering, Cochin University of Science and Technology, India.

Pavlík, Z., Pavlíková, M., Fořt, J., Kulovaná, T. and Černý, R. (2014). Reuse of waste ceramic powder with a high content of amorphous phases as partial replacement of portland cement. *Advanced Materials Research,* **905:** 212–215.

Pereira, L. (2002). Construction and demolition waste recycling: the case of the Portuguese northern region. Master's Thesis, Construction Sciences Department, Minho University, Portugal.

Peschard, A., Govin, A., Grosseau, P., Guilhot, B. and Guyonnet, R. (2004). Effect of polysaccharides on the hydration of cement paste at early ages. *Cement and Concrete Research,* **34(11):** 2153–2158.

Philippidis, T. and Aggelis, D. (2003). An acousto-ultrasonic approach for the determination of water-to-cement ratio in concrete. *Cement and Concrete Research,* **33(4):** 525–538.

Poon, C. ., Shui, Z. . and Lam, L. (2004a). Effect of microstructure of ITZ on compressive strength of concrete prepared with recycled aggregates. *Construction and Building Materials,* **18(6):** 461–468.

Poon, C. S., Shui, Z. H. and Lam, L. (2004b). Compressive behavior of fiber reinforced high-performance concrete subjected to elevated temperatures. *Cement and Concrete Research,* **34(12):** 2215–2222.

Poon, C. S., Shui, Z. H., Lam, L., Fok, H. and Kou, S. C. (2004). Influence of moisture states of natural and recycled aggregates on the slump and compressive strength of concrete. *Cement and Concrete Research,* **34(1):** 31–36.

Pop, A. and Ardelean, I. (2015). Monitoring the size evolution of capillary pores in cement paste during the early hydration via diffusion in internal gradients. *Cement and Concrete Research,* **77:** 76–81.

Popovics, S. (1990). Analysis of concrete strength versus water-cement ratio relationship. *Material Journal,* **87(5):** 517–529.

`

Prajapati, L., Patel, I. and Agrawa, V. (2014). Analysis of the strength and durability of the concrete with partially replaced by the ceramic slurry waste powder. *International Journal of Emerging Technology and Advanced Engineering,* **4(3):** 725 – 729.

Promentilla, M. A. B. and Sugiyama, T. (2010). X-ray microtomography of mortars exposed to freezing-thawing action. *Journal of Advanced Concrete Technology,* **8(2):** 97–111.

Provis, J., and Van Deventer, J. (2014). *Alkali activated materials : State-of-the-art report, RILEM TC 224-AAM*. New York London.

Qing, Y., Zenan, Z., Deyu, K. and Rongshen, C. (2007). Influence of nano-SiO2 addition on properties of hardened cement paste as compared with silica fume. *Construction and Building Materials,* **21(3):** 539–545.

Rakhimova, N. R. and Rakhimov, R. Z. (2014). A review on alkali-activated slag cements incorporated with supplementary materials. *Journal of Sustainable Cement-Based Materials,* **3(1):** 61–74.

Reixach, F., Cuscó, A. and Barroso, J. (2000). *Situatión actual y perspectives de futuro de los resíduos de la construcción.* Catalunya, Spain.

Roberts, D. J., Nica, D., Zuo, G. and Davis, J. L. (2002). Quantifying microbially induced deterioration of concrete: Initial studies. In *International Biodeterioration and Biodegradation,* **49:** 227–234.

Roesler, J., Harders, H. and Baeker, M. (2007). Mechanical behaviour of engineering materials: Metals, ceramics, polymers, and composites. Berlin Heidelberg, Germany: Springer.

Rossen, J. E. and Scrivener, K. L. (2017). Optimization of SEM-EDS to determine the C–A–S–H composition in matured cement paste samples. *Materials Characterization*, **123:** 294–306.

Rossignolo, J. A. (2007). Effect of silica fume and SBR latex on the pasteaggregate interfacial transition zone. *Materials Research,* **10:** 83–86.

Roszczynialski, W. (2002). Determination of pozzolanic activity of materials by thermal analysis. *Journal of Thermal Analysis and Calorimetry,* **70(2):** 387–392.

Rupasinghe, M., San Nicolas, R., Mendis, P., Sofi, M. and Ngo, T. (2017). Investigation of strength and hydration characteristics in nano-silica incorporated cement paste. *Cement and Concrete Composites,* **80:** 17–30.

Sadrmomtazia, A., Sobhanib, J. and Mirgozar, M. (2013). Modeling compressive strength of EPS lightweight concrete using regression, neural network and ANFIS. *Construction and Building Materials,* **42:** 205–216.

Salau, M. A. (2003). Long-term deformations of laterized concrete short columns. *Building and Environment,* **38(3):** 469–477.

Samadi, M., Hussin, M. W., Seung Lee, H., Mohd Sam, A. R., A. Ismail, M., Abdul Shukor Lim, N. H. and Nur, N. H. (2015). Properties of mortar containing ceramic powder waste as cement replacement. *Jurnal Teknologi,* **77(12):** 93–97.

Sánchez De Rojas, M. I., Marín, F., Rivera, J. and Frías, M. (2006). Morphology and properties in blended cements with ceramic wastes as a pozzolanic material. *Journal of the American Ceramic Society,* **89(12):** 3701–3705.

Sarker, P. K., Kelly, S. and Yao, Z. (2014). Effect of fire exposure on cracking, spalling and residual strength of fly ash geopolymer concrete. *Materials and Design*, **63:** 584–592.

Sarsfield, B., Davidovich, M., Desikan, S., Fakes, M., Futernik, S., Hilden, J. and Volk, K. (2006). Powder X-ray diffraction detection of crystalline phase in amorphous pharmaceuticals. International Centre for Diffraction Data, 322–327.

Schlorholtz, S. (2003). *Development of In-Situ Detection Methods for Materials-Related Distress (MRD) in Conceret Pavements. CTRE Project 00-96*. Ames, Iowa.

Schuldyakov, K. V., Kramar, L. Y. and Trofimov, B. Y. (2016). The Properties of Slag Cement and its Influence on the Structure of the Hardened Cement Paste. *Procedia Engineering,* **150:** 1433–1439.

Scrivener, K. L., Crumbie, A. K. and Laugesen, P. (2004). The interfacial transition zone (ITZ) between cement paste and aggregate in concrete. *Interface Science, **12***(**4**)**:** 411–421.

Scrivener, K. L. and Nonat, A. (2011). Hydration of cementitious materials, present and future. *Cement and Concrete Research,* **41(7):** 651–665.

Segre, N. and Joekes, I. (2000). Use of tire rubber particles as addition to cement paste. *Cement and Concrete Research,* **30(9):** 1421–1425.

Senthamarai, R. and Devadas Manoharan, P. (2005). Concrete with ceramic waste aggregate. *Cement and Concrete Composites,* **27(9):** 910–913.

Setina, J., Gabrene, A. and Juhnevica, I. (2013). Effect of pozzolanic additives on structure and chemical durability of concrete. *Procedia Engineering,* **57:** 1005–1012.

Shafabakhsh, G., Jafari Ani, O. and Talebsafa, M. (2015). Artificial neural network modeling (ANN) for predicting rutting performance of nano- modified hot-mix asphalt mixtures containing steel slag aggregates. *Construction and Building Materials Journal,* **85:** 136–143.

Shaikh, F. U. A. and Supit, S. W. M. (2014). Mechanical and durability properties of high volume fly ash (HVFA) concrete containing calcium carbonate (CaCO3) nanoparticles. *Construction and Building Materials*,**70:** 309–321.

Shatat, M. R. (2016). Hydration behavior and mechanical properties of blended cement containing various amounts of rice husk ash in presence of metakaolin. *Arabian Journal of Chemistry,* **9:** 1869–1874.

Shi, X., Xie, N., Fortune, K. and Gong, J. (2012). Durability of steel reinforced concrete in chloride environments: An overview. *Construction and Building Materials,* **30:** 125–138.

Shivhare, M. and McCreath, G. (2010). Practical Considerations for DoE Implementation in Quality By Design. Retrieved January 24, 2017, from http://www.bioprocessintl.com/manufacturing/information-technology/practical-considerations-for-doe-implementation-in-quality-by-design-297328/

Shuaibu, R., Mutuku, R. and Nyomboi, T. (2014). Strength Properties of Sugarcane Bagasse Ash Laterised Concrete. *International Journal of Civil and Environmental Research,* **1(3):** 110 – 121.

Siddique, R. and Kaur, D. (2012). Properties of concrete containing ground granulated blast furnace slag (GGBFS) at elevated temperatures. *Journal of Advanced Research,* **3(1):** 45–51.

`

Sidorova, A., Vazquez-Ramonich, E., Barra-Bizinotto, M., Roa-Rovira, J. J. and Jimenez-Pique, E. (2014). Study of the recycled aggregates nature's influence on the aggregate-cement paste interface and ITZ. *Construction and Building Materials,* **68:** 677–684.

Silvestre, R., Medel, E., García, A. and Navas, J. (2013). Using ceramic wastes from tile industry as a partial substitute of natural aggregates in hot mix asphalt binder courses. *Construction and Building Materials,* **45:** 115–122.

Sinka, I. C., Burch, S. F., Tweed, J. H. and Cunningham, J. C. (2004). Measurement of density variations in tablets using X-ray computed tomography. *International Journal of Pharmaceutics, 271*(**2**)**:** 215–224.

Skalny, J., Marchand, J. and Odler, I. (2002). Sulfate attack on concrete. *Modern Concrete Technology Series,* **32:** 217.

Soares, D., de Brito, J., Ferreira, J. and Pacheco, J. (2014). In situ materials characterization of full-scale recycled aggregates concrete structures. *Construction and Building Materials,* **71:** 237–245.

Sobhani, J., Najimi, M., Pourkhorshidi, A. R. and Parhizkar, T. (2010). Prediction of the compressive strength of no-slump concrete : A comparative study of regression , neural network and ANFIS models. *Construction and Building Materials,* **24(5):** 709–718.

Solís-Carcaño, R. and Moreno, E. I. (2008). Evaluation of concrete made with crushed limestone aggregate based on ultrasonic pulse velocity. *Construction and Building Materials,* **22(6):** 1225–1231.

Sonebi, M., Grünewald, S., and Cevik, A. (2016). Modelling fresh properties of self-compacting concrete using neural network technique. *Computers and Concrete*, **4:** 903–921.

Soroka, I. and Stern, N. (1976). Calcareous fillers and the compressive strength of portland cement. *Cement and Concrete Research,* **6(3):** 367–376.

Sui, C., Li, Y. and Ding, Q. (2015). Hydration process of cement-based materials by AC impedance method. *Journal of Wuhan University of Technology-Mater. Sci. Ed.,* **30(1):** 142–146.

Sun, G., Zhang, Y., Sun, W., Liu, Z. and Wang, C. (2011). Multi-scale prediction of the effective chloride diffusion coefficient of concrete. *Construction and Building Materials,* **25:** 3820–3831.

Sun, X., Zhang, B., Dai, Q. and Yu, X. (2015). Investigation of internal curing effects on microstructure and permeability of interface transition zones in cement mortar with SEM imaging, transport simulation and hydration modeling techniques. *Construction and Building Materials,* **76:** 366–379.

Suzuki, M., Seddik Meddah, M. and Sato, R. (2009). Use of porous ceramic waste aggregates for internal curing of high-performance concrete. *Cement and Concrete Research,* **39(5):** 373–381.

Tabak, Y., Kara, M., Günay, E., Yildirim, S. and Yilmaz, S. (2012). Ceramic Tile Waste as a Waste Management Solution for Concrete. In: Third International Conference on Industrial and Hazard Waste Management, Turkey.

Tabsh, S. W. and Abdelfatah, A. S. (2009). Influence of recycled concrete aggregates on strength properties of concrete. *Construction and Building Materials,* **23(2):** 1163–1167.

`

Tam, V. W. Y., Gao, X. F. and Tam, C. M. (2005a). Carbonation around near aggregate regions of old hardened concrete cement paste. *Cement and Concrete Research,* **35(6):** 1180–1186.

Tam, V. W. Y., Gao, X. F. and Tam, C. M. (2005b). Microstructural analysis of recycled aggregate concrete produced from two-stage mixing approach. *Cement and Concrete Research,* **35(6):** 1195–1203.

Tang, S. W., Yao, Y., Andrade, C. and Li, Z. J. (2015). Recent durability studies on concrete structure. *Cement and Concrete Research,* **78:** 143–154.

Tanyildizi, H., Özcan, F., Atis, C. D., Karahan, O. and Uncuog, E. (2009). Comparison of artificial neural network and fuzzy logic models for prediction of long-term compressive strength of silica fume concrete. *Advances in Engineering Software,* **40:** 856–863.

Tarun, R. and Rakesh, K. (2013). Recycled materials for use in the concrete industry. Ist Edn., Create Space Independent Publishing Platform. ISBN No 1500416533

Tasong, W. A., Lynsdale, C. J. and Cripps, J. C. (1999). Aggregate-cement paste interface: Part I. Influence of aggregate geochemistry. *Cement and Concrete Research,* **29(7):** 1019–1025.

Taylor, H. F. W., Famy, C. and Scrivener, K. L. (2001). Delayed ettringite formation. *Cement and Concrete Research,* **31(5):** 683-693.

Terry, R. and Kyuho, C. (2006). Environmental and social issues associated with aggregate extraction; The Lafayette - West Lafayette, Indiana, and other examples, USA. The Geological Society of London, IAEG2006 Paper number 692.

Thomas, J. and Jennings, H. (2014). The science of concrete. Retrieved November 7, 2016, from http://iti.northwestern.edu/cement/index.html

Tikul, N. and Srichandr, P. (2010). Assessing the environmental impact of ceramic tile production in Thailand. *Journal of the Ceramic Society of Japan,* **118(1382):** 887 – 894.

Toledo Filho, R. D., Gonçalves, J. P., Americano, B. B. and Fairbairn, E. M. R. (2007). Potential for use of crushed waste calcined-clay brick as a supplementary cementitious material in Brazil. *Cement and Concrete Research,* **37(9):** 1357–1365.

Topc, B. (2008). Prediction of compressive strength of concrete containing fly ash using artificial neural networks and fuzzy logic. *Computational Materials Science*, **41:** 305–311.

Topçu, ilker B. and Günçan, N. F. (1995). Using waste concrete as aggregate. *Cement and Concrete Research,* **25(7):** 1385–1390.

Torelli, G., Mandal, P., Gillie, M. and Tran, V.-X. (2016). Concrete strains under transient thermal conditions: A state-of-the-art review. *Engineering Structures,* **127:** 172–188.

Torkittikul, P. and Chaipanich, A. (2010). Utilization of ceramic waste as fine aggregate within Portland cement and fly ash concretes. *Cement and Concrete Composites,* **32(6):** 440–449.

Torres, I. and Matias, G. (2016). Sustainable mortars for rehabilitation of old plasters. *Engineering Structures,* **129:** 11 - 17.

Uchaker, E., Zheng, Y. Z., Li, S., Candelaria, S. L., Hu, S. and Cao, G. Z. (2014). Better than crystalline: amorphous vanadium oxide for sodium-ion batteries. *Journal of*

`

Materials Chemistry A, **2(43):** 18208–18214.

Udoeyo, F., Brooks, R., Udo-Inyang, P. and Iwuji, C. (2010). Residual compressive strength of laterized concrete subjected to elevated temperatures. *Research Journal of Applied Sciences, Engineering and Technology,* **2(3):** 262–267.

Udoeyo, F., Brooks, R., Utam, C., Udo-Inyang, P. and Ukpong, E. (2010). Effect of non-standard curing methods on the compressive strength of laterized concrete. *ARPN Journal of Engineering and Applied Sciences*, **5:** 2–20.

Udoeyo, F. F., Iron, U. H. and Odim, O. O. (2006). Strength performance of laterized concrete. *Construction and Building Materials,* **20(10):** 1057–1062.

United Nations Environment Programme. (2007). *Solid Waste Management Vol 1.*

Valcke, S. L. A., De Rooij, M. R., Visser, J. H. M. and Nijland, T. G. (2010). Distinguishing between hydrated, partially hydrated or unhydrated clinker in hardened concrete using microscopy. In: 32nd International Conference on Cement Microscopy*,* New Orleans, Louisiana, USA.

Vasanelli, E., Calia, A., Colangiuli, D., Micelli, F. and Aiello, M. A. (2016). Assessing the reliability of non-destructive and moderately invasive techniques for the evaluation of uniaxial compressive strength of stone masonry units. *Construction and Building Materials,* **124:** 575–581.

Vasanelli, E., Colangiuli, D., Calia, A., Sileo, M. and Aiello, M. A. (2015). Ultrasonic pulse velocity for the evaluation of physical and mechanical properties of a highly porous building limestone. *Ultrasonics,* **60:** 33–40.

Vejmelkova, E., Kulovana, T., Keppert, M., Konvalinka, P., Ondracek, M., Sedlmajer, M. and Cerny, R. (2012). Application of waste ceramics as active pozzolana in concrete production. In: *IACSIT* Coimbatore Conference, Singapore.

Vieira, J. P. B., Correia, J. R. and De Brito, J. (2011). Post-fire residual mechanical properties of concrete made with recycled concrete coarse aggregates. *Cement and Concrete Research,* **41(5):** 533–541.

Vijai, K., Kumutha, R. and Vishnuram, B. G. (2010). Effect of types of curing on strength of geopolymer concrete. *International Journal of the Physical Sciences,* **5(9):** 1419–1423.

Vu, M.-H., Sulem, J. and Laudet, J.-B. (2012). Effect of the curing temperature on the creep of a hardened cement paste. *Cement and Concrete Research,* **42(9):** 1233–1241.

Vu, X. H., Daudeville, L. and Malecot, Y. (2011). Effect of coarse aggregate size and cement paste volume on concrete behavior under high triaxial compression loading. *Construction and Building Materials,* **25(10):** 3941–3949.

Wald, F., Simões da Silva, L., Moore, D. B., Lennon, T., Chladná, M., Santiago, A. and Borges, L. (2006). Experimental behaviour of a steel structure under natural fire. *Fire Safety Journal,* **41(7):** 509–522.

Wang, C.-C. and Wang, H.-Y. (2017). Assessment of the compressive strength of recycled waste LCD glass concrete using the ultrasonic pulse velocity. *Construction and Building Materials,* **137:** 345–353.

Wang, G., Zhang, C., Zhang, B., Li, Q. and Shui, Z. (2015). Study on the high-temperature behavior and rehydration characteristics of hardened cement paste. *Fire and Materials,* **39:** 741–750.

`

Wattanasiriwech, D., Saiton, A. and Wattanasiriwech, S. (2009). Paving blocks from ceramic tile production waste. *Journal of Cleaner Production,* **17(18):** 1663–1668.

William, H., Lawrence, J. and Janet, S. (2004). Aggregate and the Environment. Environmental Awareness Series. American Geosciences Institute, Alexandria, VA.

Winslow, D., and Liu, D. (1990). The pore structure of paste in concrete. *Cement and Concrete Research,* **20(2):** 227–235.

Wong, H. S., Pappas, A. M., Zimmerman, R. W. and Buenfeld, N. R. (2011). Effect of entrained air voids on the microstructure and mass transport properties of concrete. *Cement and Concrete Research,* **41(10):** 1067–1077.

Wriggers, P. and Moftah, S. O. (2006). Mesoscale models for concrete: Homogenisation and damage behaviour. *Finite Elements in Analysis and Design,* **42(7):** 623–636.

Wu, B. and Ye, G. (2015). Development of porosity of cement paste blended with supplementary cementitious materials after carbonation. The 14th International Congress of the Chemistry of Cement, di(October), 1–18.

Wu, X., Zhang, Z. and Chen, Y. (2005). Study of the environmental impacts based on the "green tax"—applied to several types of building materials. *Building and Environment,* **40(2):** 227–237.

Wu, Y., Li, X., Wang, Y. and Zhang, B. (2014). An Improved Algorithm in Porosity Characteristics Analysis for Rock and Soil Aggregate. *Discrete Dynamics in Nature and Society,* **2014:** 10–17.

Xiao, J., Li, J. and Zhang, C. (2005). Mechanical properties of recycled aggregate concrete under uniaxial loading. *Cement and Concrete Research,* **35(6):** 1187–1194.

Xiao, J., Li, W., Sun, Z., Lange, D. A. and Shah, S. P. (2013). Properties of interfacial transition zones in recycled aggregate concrete tested by nanoindentation. *Cement and Concrete Composites,* **37:** 276–292.

Xing, Z., Beaucour, A. L., Hebert, R., Noumowe, A. and Ledesert, B. (2011). Influence of the nature of aggregates on the behaviour of concrete subjected to elevated temperature. *Cement and Concrete Research,* **41(4):** 392–402.

Xu, W., Lo, Y. T., Ouyang, D., Memon, S. A., Xing, F., Wang, W. and Yuan, X. (2015). Effect of rice husk ash fineness on porosity and hydration reaction of blended cement paste. *Construction and Building Materials,* **89:** 90–101.

Xue, Q., Li, J. S. and Liu, L. (2014). Effect of compaction degree on solidification characteristics of Pb-contaminated soil treated by cement. *Clean - Soil, Air, Water,* **42(8):** 1126–1132.

Yang, H., Lin, Y., Hsiao, C. and Liu, J. (2009). Evaluating residual compressive strength of concrete at elevated temperatures using ultrasonic pulse velocity. *Fire Safety Journal,* **44(1):** 121–130.

Ye, G. (2005). Percolation of capillary pores in hardening cement pastes. *Cement and Concrete Research,* **35(1):** 167–176.

Yim, H. J., Kim, J. H., Kwak, H. G. and Kim, J. K. (2013). Evaluation of internal bleeding in concrete using a self-weight bleeding test. *Cement and Concrete Research,* **53:** 18–24.

Ying, W. (2013). Performance assessment of cement-based materials blended with micronized sand: microstructure, durability and sustainability. PhD Thesis, Delft

`

University of Technology, Netherlands.

Yousef, M. A. and Sefain, M. Z. (1989). Comparative Studies on the Thermal Behavior of Natural and Synthetic Fibers. *Polymer-Plastics Technology and Engineering,* **28(9):** 1015–1023.

Youssef, M. A. and Moftah, M. (2007). General stress-strain relationship for concrete at elevated temperatures. *Engineering Structures,* **29(10):** 2618–2634.

Yuan, S. C. and Harrison, J. P. (2005). Development of a hydro-mechanical local degradation approach and its application to modelling fluid flow during progressive fracturing of heterogeneous rocks. *International Journal of Rock Mechanics and Mining Sciences,* **42(7):** 961–984.

Yue, L. and Shuguang, H. (2001). The microstructure of the interfacial transition zone between steel and cement paste. *Cement and Concrete Research,* **31(3):** 385–388.

Yun, T. S., Kim, K. Y., Choo, J. and Kang, D. H. (2012). Quantifying the distribution of paste-void spacing of hardened cement paste using X-ray computed tomography. *Materials Characterization,* **73:** 137–143.

Zhang, G., Patuwo, B. E. and Hu, M. Y. (1998). Forecasting with artificial neural networks : The state of the art. *International Journal of Forecasting*, **14:** 35–62.

Zhang, M. and Gjørv, O. (1995). Microstructure of the interfacial zone between lightweight aggregate and cement paste. *Cement and Concrete Research,* **20(4):** 610–618.

Zhang, W., Min, H., Gu, X., Xi, Y. and Xing, Y. (2015). Mesoscale model for thermal conductivity of concrete. *Construction and Building Materials,* **98:** 8–16.

Zhang, Z., Shi, G., Wang, S., Fang, X. and Liu, X. (2013). Thermal energy storage cement mortar containing n-octadecane/expanded graphite composite phase change material. *Renewable Energy,* **50:** 670–675.

Zheng, J. jun, Wong, H. S. and Buenfeld, N. R. (2009). Assessing the influence of ITZ on the steady-state chloride diffusivity of concrete using a numerical model. *Cement and Concrete Research,* **39(9):** 805–813.

Zheng, J., Zhou, X. and Jin, X. (2012). An n-layered spherical inclusion model for predicting the elastic moduli of concrete with inhomogeneous ITZ. *Cement and Concrete Composites,* **34(5):** 716–723.

Zhou, X. Q. and Hao, H. (2008). Mesoscale modelling of concrete tensile failure mechanism at high strain rates. *Computers and Structures,* **86(22):** 2013–2026.

Zhu, L., Dai, J., Bai, G. and Zhang, F. (2015). Study on thermal properties of recycled aggregate concrete and recycled concrete blocks. *Construction and Building Materials,* **94:** 620–628.

Zimbili, O., Salim, W. and Ndambuki, M. (2014). A Review on the usage of ceramic wastes in concrete production. *International Journal of Civil, Architectural, Structural and Construction Engineering,* **8(1):** 91–95.

Zingg, A., Winnefeld, F., Holzer, L., Pakusch, J., Becker, S. and Gauckler, L. (2008). Adsorption of polyelectrolytes and its influence on the rheology, zeta potential, and microstructure of various cement and hydrate phases. *Journal of Colloid and Interface Science,* **323(2):** 301–312.

Zurada, J. (1992). Introduction to artificial neural systems. *Info Access Distribution Ltd*.