



College of Science  
Physics Department

***Thermo-Physical Studies on Synthesized Lightweight  
Nano Cementitious Materials***

**Thesis**

*Submitted for the Degree of Doctor of Philosophy  
(Ph.D.) in Science-Physics (Solid State Physics)*

**By**

**Hamada Shoukry Mohamed**

M.SC. Cairo University, 2011

**Housing & Building National Research Center (HBRC)**

***To***

***Physics Department, Faculty of Science,  
Ain Shams University***

***2017***



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***Supervisors***

- Prof. Dr. Sc. Mohamed Fathy Kotkata  
***Professor of physics, Ain shams university***
- Prof. Dr. Sc. Salah Abo El-Enein  
***Professor of physical chemistry, Ain shams university***
- Prof. Dr. Mohamed Saad Morsy  
***Professor of building physics, HBRC***
- Prof. Dr. Sayed Shebl Mohamed  
***Professor of building physics, HBRC***

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## ***Approval Sheet***

### ***Title:***

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***Candidate:*** *Hamada Shoukry Mohamed Mohamed*

***Degree:*** *Doctor of Philosophy (Ph.D.) in Science-Physics  
(Solid State Physics)*

### ***Supervision Committee***

***Approved by***

***Signature***

1. Prof. Dr. Sc. Mohamed Fathy Kotkata  
***Professor of physics, Ain shams university***
2. Prof. Dr. Sc. Salah Abo El-Enein  
***Professor of physical chemistry, Ain shams university***
3. Prof. Dr. Mohamed Saad Morsy  
***Professor of building physics, HBRC***
4. Prof. Dr. Sayed Shebl Mohamed  
***Professor of building physics, HBRC***

## **Dedication**

***To the spirit of my father,***

*As well as my mother*

***To my wife, brothers, sisters and  
my SONS***

***I dedicate this Research***

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## LIST OF SYMBOLS AND ABBREVIATIONS

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ASTM	American Society of Testing and Materials
C <sub>3</sub> A	Tricalcium Aluminate, 3CaO. Al <sub>2</sub> O <sub>3</sub>
C <sub>4</sub> AF	Tetracalcium AluminoFerrite, 4CaO. Al <sub>2</sub> O <sub>3</sub> . Fe <sub>2</sub> O <sub>3</sub>
C <sub>2</sub> S	Dicalcium Silicate, 2CaO. SiO <sub>2</sub>
C <sub>3</sub> S	Tricalcium Silicate, 3CaO. SiO <sub>2</sub>
CH	Calcium Hydroxide, Ca(OH) <sub>2</sub>
CSH	Calcium Silicate Hydrate
DSC	Differential Scanning Calorimetry
DTG	Derivative Thermogravimetry
EDAX	Energy Dispersive Analytical X-ray spectroscopy
EVM	Expanded Vermiculite
FRCC	Fiber-Reinforced Cement Composites
hcp	Hydrated Cement Paste
ITZ	Interfacial Transition Zone
LWA	Lightweight Aggregates
LWFRCC	Lightweight Fiber-Reinforced Cement Composites
L.O.I	Loss on Ignition
NLWFRCC	Nanostructured Lightweight Fiber-Reinforced Cement Composites
NC	Nano Clay
NMK	Nano Metakaolin
NCB	Nano Clay Cement Binder
R-value	Thermal Resistance
R <sub>si</sub>	Inside Surface Resistance
R <sub>so</sub>	Outside Surface Resistance

SEM	Scanning Electron Microscope
SSA	Specific Surface Area
TEM	Transmission Electron Microscope
TGA	Thermogravimetric Analysis
TC	Thermal Conductivity
U-value	Overall Thermal Transmittance
WPC	White Portland Cement
XRD	X-Ray Diffraction
XRF	X-Ray Fluorescence