

# **3rd International Conference on Efficient Building Design 2018**

Materials and HVAC Equipment

Beirut, Lebanon  
4 - 5 October 2018

ISBN: 978-1-7138-0598-4

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2018) by American Society of Heating, Refrigerating  
and Air-Conditioning Engineers (ASHRAE)  
All rights reserved.

Printed with permission by Curran Associates, Inc. (2020)

ISBN: 978-1-7138-0598-4

For permission requests, please contact American Society of Heating, Refrigerating  
and Air-Conditioning Engineers (ASHRAE) at the address below.

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)  
1791 Tullie Circle  
N.E. Atlanta, GA 30329  
USA

Phone: (404) 636-8400

Fax: (404) 321-5478

[ashrae@ashrae.org](mailto:ashrae@ashrae.org)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2633  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

<b>CONTROLLING SUNLIGHT ENTERING THE INDOOR SPACE THROUGH WINDOWS USING DUAL SOLAR SCREENS</b> .....	1
<i>E.M. Alawadhi</i>	
<b>ENERGY COMPARISON OF AIR CONDITIONING SPLIT SYSTEM VS. SOLAR ABSORPTION SYSTEMS WITH OPTIMIZATION FOR A EDUCATIONAL BUILDING</b> .....	8
<i>H. Safwat, F. Anees</i>	
<b>CONTRIBUTING ALGORITHMS OF ENERGY EFFICIENCY AND RENEWABLE ENERGY IN THE RESIDENTIAL, COMMERCIAL AND INDUSTRIAL SECTORS</b> .....	19
<i>G. El-Jamal, A. Mourtada, C. Maatouk, F. Kaddah, M. Ghandour</i>	
<b>ESTABLISHMENT OF A SUSTAINABLE ENERGY ACTION PLAN: CASE STUDY OF UNION OF MUNICIPALITIES</b> .....	27
<i>S. Saad, M. El Brouche, A. Mourtada, M. Ghandour</i>	
<b>DESIGN OPTIMIZATION FOR MAINTAINING OCCUPANTS' OUTDOOR THERMAL COMFORT</b> .....	36
<i>H.I. Hamdan, B.A. Nehme</i>	
<b>TRANSITION ENGINEERING THE WATER-ELECTRICITY NEXUS OPERATING IN BUILDING SERVICES AND URBAN HEAT ISLANDS – CONCEPT DESIGN – IS AIRCONDITIONING REALLY NECESSARY?</b> .....	43
<i>E.L. Peterson</i>	
<b>HOLISTIC APPROACH TO ENERGY PERFORMANCE OF GREEN BUILT ENVIRONMENT</b> .....	52
<i>E.E. Khalil</i>	
<b>BENEFITS FROM COMBINATION OF CENTRALIZED VENTILATION SYSTEM AND DECENTRALIZED CONDITIONING UNITS</b> .....	60
<i>M. Danielak</i>	
<b>PREDICTION AND CONTROL OF NOISE AND VIBRATION WITHIN A SPORT FACILITY</b> .....	68
<i>G. Annan, B. Nehme</i>	
<b>A FOUR STEP APPROACH FOR ENERGY CONSERVATION AND RETROFITTING INTERVENTIONS FOR RESIDENTIAL BUILDINGS</b> .....	76
<i>M.H. Hassan, M. Abbas, B. Mneymeh, I. Srour</i>	
<b>INVESTIGATION OF THERMAL COMFORT IN A SPACE CONDITIONED BY LIQUID DESICCANT MEMBRANE CHILLED CEILING/DISPLACEMENT VENTILATION SYSTEM</b> .....	85
<i>R. Seblany, N. Ismail, J. Virgone, N. Ghaddar, M. Simonetti, A. Zoughaib, K. Ghali, F. Giovanni</i>	
<b>INTERRELATIONSHIP BETWEEN ARCHITECTURAL AND MECHANICAL ASPECTS OF THE BUILDING ENVELOPE DESIGN</b> .....	95
<i>H. Maamoun</i>	
<b>HYGROTHERMAL ENGINEERING ANALYSIS OF WALLS AND ROOFS IN HOT AND HUMID CLIMATES</b> .....	103
<i>G. Annan, B. Nehme</i>	
<b>GLOBAL TRENDS IN COLLABORATIVE INFRASTRUCTURE DEVELOPMENT TO FOSTER ECONOMICALLY, ENVIRONMENTALLY &amp; SOCIALLY SUSTAINABLE BUILT ENVIRONMENT IN REGIONAL ECONOMIES</b> .....	111
<i>O. Taneja</i>	
<b>MATHEMATICAL MODELLING OF HYBRID COOLING VEST INTEGRATED WITH BIOHEAT MODEL FOR ASSESSING COOLING EFFECT ON HUMANS IN HOT CONDITIONS</b> .....	119
<i>R. Raad, M. Itani, N. Ghaddar, K. Ghalil</i>	
<b>EFFECT OF INTER-SEGMENTAL VENTILATION ON THE SEGMENTAL HEAT LOSSES BY MEANS OF ELECTRIC CIRCUIT ANALOGY</b> .....	128
<i>N. Ismail, N. Ghaddar, K. Ghali</i>	
<b>NUMERICAL STUDY ON PCM-DESICCANT COOLING VEST TO IMPROVE COOLING AND PERFORMANCE OF WORKERS IN HOT HUMID CONDITIONS</b> .....	142
<i>M. Itani, K. Ghali, R. Bachnak, N. Ghaddar</i>	
<b>QUANTIFYING LOSSES DUE TO THERMAL DISCOMFORT: AN AGENT BASED MODELING APPROACH</b> .....	151
<i>M. Awada, I. Srour</i>	
<b>A COMPARATIVE ASSESSMENT OF THE PERFORMANCE OF COOLING SYSTEMS FOR LARGE-SCALE HIGH-DENSITY DATA CENTERS USING CFD SIMULATIONS</b> .....	160
<i>K.A. Hweij, A. Adhdar</i>	

<b>A FULL THREE-DIMENSIONAL SIMULATION OF AN INDUSTRIAL BAKING OVEN .....</b>	<b>168</b>
<i>M. Al Nasser, I. Fayssal, F. Moukalled</i>	
<b>CFD-OPTIMIZED RADIANT COOLING WITH DEDICATED OUTDOOR AIR SYSTEM (DOAS) FOR HIGH CEILINGED SPACES IN HOT AND DRY CLIMATES .....</b>	<b>178</b>
<i>Y. Ghossoub, A. Akhdar</i>	
<b>LEVERAGING DIGITAL TRANSFORMATION IN REGIONAL ECONOMIES WITH CONCOMITANT SKILLS DEVELOPMENT OF PEOPLE FOR MORE EFFICIENT OPERATIONS &amp; RESILIENCE OF BUILDINGS OVER THEIR LIFE-CYCLE .....</b>	<b>188</b>
<i>O. Taneja</i>	
<b>HIGH SOLAR COMBI-PLUS SYSTEM USING PCM STORAGE: KSA CASE STUDY .....</b>	<b>197</b>
<i>M. Hmadi, A. Mourtada</i>	
<b>SUSTAINABLE DESIGN IN METRO STATIONS.....</b>	<b>206</b>
<i>S.K.H. Lai, A.H.E. Beh, W.Y.M. Xie, H. Wijaya, K.W. Ang</i>	
<b>ENERGY PERFORMANCE AND OCCUPANT COMFORT IN AN OFFICE BUILDING: CO- SIMULATION OF AN AGENT-BASED BEHAVIOR MODEL WITH ENERGYPLUS.....</b>	<b>215</b>
<i>M. Awada, I. Srour, M. Hajj-Hassan, H. Houry, D. Kiomjian</i>	
<b>PRINCIPLES OF SPLIT MASS FLOW AND HEAT SHIFTING PSYCHROMETRICS TOWARD EFFICIENT COMFORT MANAGEMENT .....</b>	<b>224</b>
<i>P. Phillips</i>	
<b>WORLD CLASS ENERGY EFFICIENT HVAC SYSTEM FOR NEW "TWISTY TOWER" IN SOUTH AFRICA .....</b>	<b>232</b>
<i>P.J. de Bod</i>	
<b>ENERGY CONSERVATION FOR AN OFFICE BUILDING IN A HOT CLIMATE .....</b>	<b>240</b>
<i>H.S. Dalal</i>	
<b>A SIMPLIFIED PERSONALIZED AND DISPLACEMENT VENTILATION MODEL FOR PREDICTING PASSIVE CONTAMINANT SPREAD IN OFFICE SPACES .....</b>	<b>246</b>
<i>D. Al Assaad, N. Ghaddar, C. Habchi, K. Ghali</i>	
<b>FEASIBILITY ASSESSMENT FOR RETROFITTING AN ENERGY-EFFICIENT HOSPITAL BUILDING THROUGH ENERGY MODELLING AND FIELD INVESTIGATION.....</b>	<b>256</b>
<i>F.J. Wang, P.Y. Yu, C.S. Kuo, C.P. Wang, H.W. Lin</i>	
<b>Author Index</b>	