

https://dspace.org/

Book of Abstracts WABER SuDBE Conference 2024, 30 – 31 July 2024 University of the Witwatersrand Johannesburg, South Africa

Laryea, Samuel

Laryea, Samuel; Li, Baizhan; Essah, Emmanuel Adu; Sarfo, Mensah; Hong, Liu ...

2024-07

WABER SuDBE Conference 2024

https://hdl.handle.net/10539/40292

Laryea, Samuel. (2024). Proceedings of the WABER SuDBE 2024 Conference 30th – 31st July 2024 University of the Witwatersrand, Johannesburg, South Africa. [Conference Proceedings, University of the Witwatersrand, Johannesburg, South Africa]. WIReDSpace. https://hdl.handle.net/10539/40292

Downloaded from a DSpace repository. https://dspace.org/

BOOK OF ABSTRACTS

WABER SuDBE CONFERENCE 2024

30 – 31 July 2024
University of the Witwatersrand
Johannesburg, South Africa

EDITORS

Prof. Samuel Laryea, University of the Witwatersrand, South Africa
Prof. Baizhan Li, Chongqing University, China
A/Prof. Emmanuel Adu Essah, University of Reading, United Kingdom
A/Prof. Sarfo Mensah, Kumasi Technical University, Ghana
Prof. Hong Liu, Chongqing University, China
Prof. Runming Yao, University of Reading, UK/Chongqing University, China

ISBN: 978-0-7961-6310-3



In collaboration with:

University of the Witwatersrand, Johannesburg
University of Reading
Tsinghua University
China Academy of Building Research
Growthpoint Properties
School of Construction Economics & Management
cidb Construction Industry Development Board
A&O Shearman

Proceedings of the WABER SuDBE 2024 Conference

30th – 31st July 2024

University of the Witwatersrand, Johannesburg, South Africa

© Copyright
The copyright for papers in this publication belongs to the authors of the papers.

ISBN: 978-0-7961-6310-3 (e-book)

The ISBN for this publication was provided by the National Library of South Africa. Legal deposits of the publication have been supplied to the National Library of South Africa, Library of Parliament, and other places of Legal Deposit.

First published in July 2024

Published by:
WABER SuDBE Conference 2024
C/o Professor Samuel Laryea, Conference chair
School of Construction Economics and Management
University of the Witwatersrand, Johannesburg, South Africa
Email: info@wabersudbe.com / samuel.laryea@wits.ac.za

Website: www.wabersudbe.com

Editors

Prof Samuel Laryea, University of the Witwatersrand, South Africa
Prof Baizhan Li, Chongqing University, China
A/Prof Emmanuel Adu Essah, University of Reading, United Kingdom
A/Prof Sarfo Mensah, Kumasi Technical University, Ghana
Prof Hong Liu, Chongqing University, China
Prof Runming Yao, University of Reading, UK / Chongqing University, China

Declaration

All papers in this publication have been through a review process involving a review of abstracts, peer review of full papers by at least two referees, reporting of comments to authors, revision of papers by authors and re-evaluation of the revised papers to ensure quality of content.

TABLE OF CONTENTS

Table of Contents	ii
Foreword	iii
Conference organising and scientific committee	v
Confirmation of 60/40 rule	ix
Programme and profile of speakers	xi
Conference themes	xv
Conference papers	xvii
Index of authors	169
Index of keywords	173

FOREWORD

It is my pleasure to welcome you to this special WABER SuDBE Conference 2024 which is a joint international conference co-organised by the West Africa Built Environment Research (WABER) Conference and the International Conference on Sustainable Development in Building and Environment (SuDBE) in collaboration with various partners.

The International Conference on Sustainable Development in Building and Environment (SuDBE) was initiated in 2003 by the National Centre for International Research of Low-carbon Green Buildings at Chongqing University, China. The West Africa Built Environment Research (WABER) Conference was initiated in 2008 as an initiative of the School of Construction Management and Engineering, University of Reading, UK, and provides a platform for sharing the latest ideas in built environment research on the African continent.

I am pleased to welcome everyone to Wits University, Johannesburg. I hope you enjoy this Conference in the beautiful environment of our university. There are two days of technical presentations and an industry panel discussion, with a welcome cocktail party on the first night, and a conference dinner on the second night. This is followed by two days of technical tours, which provide an opportunity to see some landmark buildings in Pretoria, and two green rated developments by Growthpoint Properties in Rosebank and Sandton, Johannesburg.

The technical presentations consist of seven keynote speeches and 130 paper presentations. The keynote speeches focus on an array of interesting topics that relate to the general conference theme of sustainable built environments. We have four keynote speeches relating to the theme of adaptability of the built environment to climate change and the sustainable development goals. The three other keynote speeches address matters of resilient and sustainable futures, the use of digital technologies to improve the sustainability of buildings, and artificial intelligence and carbon neutrality. The academic and industry leaders speaking on these topics are very experienced and their keynote presentations are expected to stimulate new ideas and discussion in the conference.

The accepted papers to be presented in the parallel sessions relate to eight themes namely:

- Climate Responsive Built Environments
- Air Quality and Healthy Building
- Thermal Comfort and Intelligent Operation
- Low Carbon Technology and Energy System
- Sustainable Urban Renewal
- Building Technology and Performance
- Construction and Project Management
- Real Estate and Property Management

Thank you and congratulations to all the authors of papers in this publication. I also want to sincerely recognise and appreciate the efforts of the 154 reviewers from 21 different countries who assisted enormously with the scientific work of reviewing the abstracts and full papers submitted for this Conference. We initially received 191 abstracts that were thoroughly reviewed to provide comments and decisions to authors. 161 full papers were subsequently received, and we would like to express our deepest appreciation to the reviewers below who did the hardwork of reviewing the 161 full papers and providing review reports which assisted the editors to make decisions on the papers and control the quality of the papers accepted for publication in the proceedings. Ultimately, 123 papers were accepted and published in this

conference proceedings. I extend special thanks to A/Prof Emmanuel Essah and A/Prof Sarfo Mensah for leading the review processes and performing extensive editorial duties.

There are also two workshops taking place during the conference. The first one is a Workshop on "Low-carbon urban and city development towards carbon neutrality" which is led by Prof Yong Ding from Chongqing University. The second one is a Workshop on Sustainable construction industry growth which is facilitated by the cidb Centre of Excellence at Wits University.

Lastly, we also have an industry panel discussion on the risks associated with South African renewable energy projects. This will be facilitated by A&O Shearman whom we are proud to have as our partners for this conference.

The conference programme presents a valuable package that will facilitate intellectual and practical discussions on sustainable built environments and the construction sector's role in addressing the global challenge of climate change and the sustainable development goals (SDGs).

Special thanks to all our conference partners particularly A&O Shearman, the Construction Industry Development Board (cidb), Gauteng Tourism, and Growthpoint Properties for your valuable support.

I would conclude by wishing all participants a stimulating, rewarding and enjoyable conference. I look forward to enjoying your presentations, debates and company over the conference period of 29th July to 2nd August. Thank you.

Professor Samuel Laryea
WABER SuDBE 2024 Conference Co-Chair
Wits University, Johannesburg, South Africa
29th July 2024

CONFERENCE ORGANISING COMMITTEE

- Professor Samuel Laryea, Wits University, South Africa, Conference Co-Chair
- Professor Baizhan Li, Chongqing University, China, Conference Co-Chair
- Professor Runming Yao, University of Reading, UK / Chongqing University, China, Conference Secretary
- Professor Hong Liu, Chongqing University, China, Conference Secretary
- A/Professor Emmanuel Essah, University of Reading, UK, Conference Secretary

CONFERENCE SCIENTIFIC COMMITTEE AND REVIEW PANEL

1. Prof. Samuel Laryea, Wits University, Johannesburg, South Africa
2. A/Prof Emmanuel Essah, University of Reading, United Kingdom
3. A/Prof Sarfo Mensah, Kumasi Technical University, Kumasi, Ghana
4. Prof Runming Yao, University of Reading, UK / Chongqing University, China
5. Prof Zhiwen Luo, Cardiff University, United Kingdom
6. Prof Bankole Awuzie, University of Johannesburg, South Africa
7. A/Prof Collins Ameyaw, Kumasi Technical University, Ghana
8. A/Prof Ebenezer Adaku, Ghana Institute of Management and Public Administration, Ghana
9. A/Prof Ehsan Saghatforoush, Wits University, Johannesburg, South Africa
10. A/Prof Elvis Attakora-Amaniampong, SDD-UBIDS, Ghana
11. A/Prof Haruna Musa Moda, University of Doha for Science and Technology, Doha, Qatar
12. A/Prof Ian Ewart, University of Reading, Reading, United Kingdom
13. A/Prof Justus Agumba, Tshwane University of Technology, South Africa
14. A/Prof Kathy Michell, University of Cape Town, South Africa
15. A/Prof Kola Akinsomi, Wits University, South Africa
16. A/Prof Lekan Amusan, Covenant University, Nigeria
17. A/Prof Mehdi Shahrestani, University of Reading, Reading, United Kingdom
18. A/Prof Moshood Fadeyi, Singapore Institute of Technology, Singapore
19. A/Prof Norhayati Mahyuddin, University of Malaya, Kuala Lumpur, Malaysia
20. Dr. Ogbeifun Edoghogho, University of Jos, Nigeria / Univ. of Johannesburg, South Africa
21. A/Prof Shen Wei, University College London, United Kingdom
22. Prof Divine Ahadzie, Kwame Nkrumah University of Science and Technology, Ghana
23. A/Prof Yakubu Aminu Dodo, Najran University, Saudi Arabia
24. A/Prof Yewande Adewunmi, Wits University, South Africa
25. A/Prof. Alex Opoku, University of Sharjah, United Arab Emirates
26. A/Prof. Callistus Tengan, Bolgatanga Technical University, Ghana
27. A/Prof. Ebenezer Boakye, Takoradi Technical University, Takoradi, Ghana
28. A/Prof. Emmanuel Manu, Nottingham Trent University, United Kingdom
29. A/Prof. Evans Zoya Kpamma, Sunyani Technical University, Ghana
30. A/Prof. Francis Kwesi Bondinuba, Kumasi Technical University, Ghana
31. A/Prof. Mavis Osei, Kwame Nkrumah University of Science and Technology, Ghana
32. A/Prof. Richard Ohene Asiedu, Koforidua Technical University, Ghana

33. Dr Adedeji Afolabi, Covenant University, Nigeria
34. Dr Adwoa Ofori, Trinity College Dublin, Ireland
35. Dr Afolabi Dania, University of Westminster, London, United Kingdom
36. Dr Akosua B.K. Amaka-Otchere, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
37. Dr Amna Shibeika, University of Reading, Reading, United Kingdom
38. Dr Baba Adama Kolo, Ahmadu Bello University, Nigeria
39. Dr Bashar Mohammed Al-Falah, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia
40. Dr Bismark Duodu, Kwame Nkrumah University of Science and Technology, Ghana
41. Dr Bruno Lot Tanko, University of Reading-Malaysia, Johor, Malaysia
42. Dr Christopher Amoah, University of the Free State, South Africa
43. Dr Christos Halios, University of Reading, United Kingdom
44. Dr Cynthia Adeokun, O.N.A Architects Ltd., United Kingdom
45. Dr Emmanuel Selorm Adukpo, University College London, United Kingdom
46. Dr Eng L Ofetotse, Greenwich University, London, United Kingdom
47. Dr Faizah Mohammed Bashir, University of Hail, Hail, Saudi Arabia
48. Dr Folake Ekundayo, Design Studio, United Kingdom
49. Dr Frank Ametefe, University of Cape Town, South Africa
50. Dr Gabriel Nani, Kwame Nkrumah University of Science and Technology, Ghana
51. Dr Geoff Cook, University of Reading, United Kingdom
52. Dr Hafizah Mohd Latif, Universiti Teknologi MARA, Malaysia
53. Dr Hua Zhong, Nottingham Trent University, United Kingdom
54. Dr Immanuel Darkwa, Trinity College Dublin, Ireland
55. Dr Jeremy Gibberd Wits University, Johannesburg, South Africa
56. Dr Jesse Nor, Abuja Metropolitan Management Council, Abuja, Nigeria
57. Dr Koech Cheruiyot, Wits University, Johannesburg, South Africa
58. Dr Kwadwo Oti-Sarpong, University of Cambridge, United Kingdom
59. Dr Lewis Abedi Asante, Kumasi Technical University, Ghana
60. Dr Lovelin Obi, Northumbria University , United Kingdom
61. Dr Lungie Maseko, Wits University, Johannesburg, South Africa
62. Dr Luqman Oyewobi, FUT, Minna, Nigeria
63. Dr Mate Janos Lorincz , University of Reading, United Kingdom
64. Dr Maxwell Antwi-Afari Fordjour, Aston University, United Kingdom
65. Dr Michael Peters, University of Reading, United Kingdom
66. Dr Mojtaba Amiri, Wits University, Johannesburg, South Africa
67. Dr Neil Govender, Wits University, Johannesburg, South Africa
68. Dr Oluseyi Odeyale, University of Ibadan, Nigeria
69. Dr Oluwaseun Dosumu, University of Rwanda, Rwanda
70. Dr Prisca Simbanegavi, Wits University, South Africa
71. Dr Qingqin Wang, China Academy of Building Research, China
72. Dr Ravi Rangarajan, University of Doha for Science and Technology, Qatar
73. Dr Razaq Sherif , Abuja Metropolitan Management Council, Abuja, Nigeria
74. Dr Rolien Terblanche, University of Cape Town, South Africa
75. Dr Ronan Champion, University of Reading, Reading, United Kingdom
76. Dr Sena Agbodjah, Academic City University College, Ghana

77. Dr Shiyu Han, Chongqing University, China
78. Dr Stanley Okangba, Wits University, Johannesburg, South Africa
79. Dr Thabelo Ramantswana, Wits University, South Africa
80. Dr Tunji-Olayeni Patience Fikiemo, Covenant University, Nigeria
81. Dr. Elijah Boadu Frimpong, Kumasi Technical University, Ghana
82. Dr. Elizabeth Ojo-Fafore, Wits University, South Africa
83. Dr. Emefa Amponsah, Takoradi Technical University, Ghana
84. Dr. Godwin Kumi Acquah, Kwame Nkrumah University of Science and Technology, Ghana
85. Dr. Isaac Mensah, Department of Feeder Roads, Accra, Ghana
86. Dr. Kofi Agyekum, Kwame Nkrumah University of Science and Technology, Ghana
87. Dr. Kofi Owusu Adjei, Kumasi Technical University, Ghana
88. Dr. Kwabena Fosuhene M-Ansong, Kumasi Technical University, Ghana
89. Dr. Kwadwo Twumasi-Ampofo, Center for Scientific and Industrial Research, Ghana
90. Dr. Michael Adabre, Hong Kong Polytechnic University, Hong Kong
91. Dr. Michael Nii Addy, Kwame Nkrumah University of Science and Technology, Ghana
92. Dr. Olumuyiwa Bayode Adegun, Federal University of Technology, Akure, Nigeria
93. Dr. Stephen Agyefi-Mensah, Cape Coast Technical University, Ghana
94. Dr. Kwabena Abrokwa Gyimah, Kwame Nkrumah Univ. of Science & Technology, Ghana
95. Dr. Timothy Crentsil, Kumasi Technical University, Ghana
96. Dr Bernard Acheampong, University of Reading, United Kingdom
97. Mr Faranani Gethe, Wits University, Johannesburg, South Africa
98. Mr Hillary Chanda, University of Reading, United Kingdom
99. Mr. Kingford Mkandawire, University of Reading, United Kingdom
100. Ms Emma Ayesu-Koranteng, Nelson Mandela University, South Africa
101. Ms Lerato Mompati, Wits University, Johannesburg, South Africa
102. Ms Zamageda Zungu, Wits University, Johannesburg, South Africa
103. Oscar Kwasafo, Wits University, Johannesburg, South Africa
104. Prof Cheng Sun, Harbin Institute of Technology, China
105. Prof Da Yan, Tsinghua University, China
106. Prof Dengjia Wang, Xi'an University of Architecture and Technology, China
107. Prof Xinhua Xu, Huazhong University of Science and Technology, China
108. Prof Yong Ding, Chongqing University, China
109. Prof Zhijian Liu, North China Electric Power University, China
110. Prof Abimbola Windapo, University of Cape Town, South Africa
111. Prof Ahmed Doko Ibrahim, Ahmadu Bello University, Nigeria
112. Prof Armando Oliveira, Porto University , Portugal
113. Prof Borong Lin, Tsinghua University, China
114. Prof Carmel Lindkvist, Norwegian University of Science and Technology, Norway
115. Prof Chi Feng, Chongqing University,
116. Prof Chimay Anumba, University of Florida, USA
117. Prof Christopher Pain , Imperial College London, United Kingdom
118. Prof Deji Ogunsemi, Federal University of Technology, Akure, Nigeria
119. Prof Eziyi Ibem, University of Nigeria, Nigeria
120. Prof Fidelis Emuze, Central University of Technology, Bloemfontein, South Africa
121. Prof George Ofori, London South Bank University, United Kingdom
122. Prof Guangyu Cao, Norwegian University of Science and Technology, Norway

123. Prof GWK Intsiful, University of Liberia, Liberia
124. Prof Immaculate Nwokoro, University of Lagos, Nigeria
125. Prof Jianlei Niu, Hong Kong Polytechnic University , China
126. Prof Joy Maina, Ahmadu Bello University, Nigeria
127. Prof Kemiki Olurotimi, Federal University of Technology, Minna, Nigeria
128. Prof Kulomri Adogbo, Ahmadu Bello University, Nigeria
129. Prof Larry Bellamy, University of Canterbury, New Zealand
130. Prof Linhua Zhang, Shandong Jianzhu University, China
131. Prof Nathaniel Aniekwu, University of Benin, Nigeria
132. Prof Neng Zhu, Tianjin University, China
133. Prof Nishani Harinarain, University of Kwazulu Natal, South Africa
134. Prof Prashant Kumar, University of Surrey, United Kingdom
135. Prof Ron Watermeyer, Infrastructure Options / Wits University, South Africa
136. Prof Runping Niu, Beijing University of Civil Engineering and Architecture, China
137. Prof Salman Azhar, Auburn University, USA
138. Prof Santiago Gassó-Domingo, Polytechnic University of Catalonia, Spain
139. Prof Sarah Hayes, Bath Spa University, United Kingdom
140. Prof Sasan Sadrizadeh, KTH Royal Institute of Technology, Sweden
141. Prof Shijie Cao, Southeast University, China
142. Prof Shilei Lyu, Tianjin University, China
143. Prof Stephen Oluigbo, Ahmadu Bello University, Nigeria
144. Prof Winston Shakantu, Nelson Mandela University, South Africa
145. Prof Xianting Li, Tsinghua University, China
146. Prof Xudong Yang, Tsinghua University , China
147. Prof. Humphrey Danso, University of Education, Winneba, Ghana
148. Dr Matthew Ikuabe, Wits University, South Africa
149. Dr Timothy Ayodele, Obafemi Awolowo University, Nigeria
150. Dr Chidinma Emma-Ochu, Federal Polytechnic Nekede Owerri, Nigeria
151. Dr Miriam Chukwuma-Uchegbu, Federal University of Technology Owerri, Nigeria
152. Dr Partson Paradza, BA ISAGO University, Botswana
153. Dr Lynda Mbadugha, Wits University, South Africa
154. Patricia Kio, Fitchburg State University, USA

THANK YOU VERY MUCH TO ALL 154 REVIEWERS BASED IN 21 DIFFERENT COUNTRIES!!!

CONFIRMATION OF DHET 60-40% CONFERENCE RULE

29th July 2024

TO WHOM IT MAY CONCERN

I confirm that the papers accepted for publication in the WABER SuDBE 2024 Conference proceedings in July 2024 were peer-reviewed by at least two referees. The peer review process entailed initial screening of abstracts, review of full papers by at least two referees, reporting of the review reports to authors, revision of papers by authors, and re-evaluation of re-submitted papers to ensure quality of content. A paper is only accepted for publication in the conference proceedings based on the reviewers' recommendation. I also confirm that the accepted papers were from multiple institutions as detailed below.

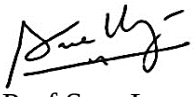
Institution	**No of papers**	**%**
Ahmadu Bello University, Nigeria	3	2.4%
Arusha Technical College, Tanzania	1	0.8%
Ashesi University, Ghana	1	0.8%
Beijing Institute of Technology, China	1	0.8%
Central University of Technology, South Africa	3	2.4%
Chongqing Jiaotong University, China	1	0.8%
Chongqing University, China	51	41.5%
Dalian University of Technology, China	2	1.6%
Durban University of Technology, South Africa	3	2.4%
Federal University of Technology, Akure, Nigeria	1	0.8%
Federal University of Technology, Minna, Nigeria	1	0.8%
Fitchburg State University, United States of America	1	0.8%
Guangdong Midea Air-Conditioning Equipment Co. Ltd, China	3	2.4%
Hebei University of Technology, China	2	1.6%
Henan Polytechnic University, China	2	1.6%
Huazhong University of Science and Technology, China	5	4.1%
Kano State Polytechnic, Nigeria	1	0.8%
Kumasi Technical University, Ghana	2	1.6%
Kwame Nkrumah University of Science & Technology, Ghana	1	0.8%
Norwegian University of Science & Technology, Norway	1	0.8%
Obafemi Awolowo University, Nigeria	1	0.8%
The University of Sheffield, United Kingdom	1	0.8%
Tsinghua University, China	2	1.6%
Universiti Teknologi MARA, Malaysia	1	0.8%
University of Johannesburg, South Africa	1	0.8%
University of KwaZulu-Natal, South Africa	4	3.3%
University of Reading, United Kingdom	4	3.3%
University of the Free State, South Africa	2	1.6%

University of the Witwatersrand, South Africa	12	9.8%
Walter Sisulu University, South Africa	1	0.8%
Wuhan University of Science and Technology, China	1	0.8%
Wuhan University of Technology, China	2	1.6%
Xi'an University of Architecture and Technology, China	1	0.8%
Zhongkai University of Agriculture and Engineering, China	4	3.3%

As shown in the Table above, only 9.8% of the papers emanated from the University of the Witwatersrand, which was the host institution, with the remaining 90.2% coming from diverse institutions. Based on the above, the WABER SuDBE 2024 Conference, met the 60-40 percentage policy.

Papers accepted for publication were published via the conference proceedings. The conference proceedings' ISBN is: 978-0-7961-6032-4 (e-book)

Yours Sincerely,



Prof Sam Laryea
University of the Witwatersrand
Co-Chair of WABER SuDBE 2024 Conference

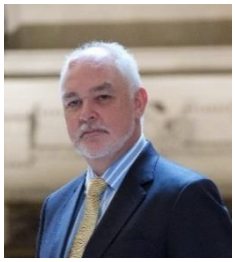
PROFILES OF KEYNOTE SPEAKERS



Keynote Title:
Resilient and Sustainable Futures – Opportunities to Leverage Emerging Technologies

Professor Chimay Anumba
FREng, Ph.D., D.Sc., Dr.h.c., CEng/PE, FICE, FIStructE, FASCE, NAC
University of Florida, USA

Chimay Anumba is a Professor and Dean of the College of Design, Construction and Planning at the University of Florida. A Fellow of the Royal Academy of Engineering, FREng, he holds a Ph.D. in Civil Engineering from the University of Leeds, UK; a higher doctorate – D.Sc. (Doctor of Science) - from Loughborough University, UK; and an Honorary Doctorate (Dr.h.c.) from Delft University of Technology in The Netherlands. He has over 500 scientific publications and his work has received support worth over $150m from a variety of sources. He has also supervised 57 doctoral candidates to completion and mentored over 25 postdoctoral researchers. He is the recipient of the 2018 ASCE Computing in Civil Engineering Award and is a member of the US National Academy of Construction (NAC).



Keynote Title:
The use of digital techniques to improve the sustainability of buildings

Professor Tim Broyd
University College of London, UK

Tim Broyd is Director of the Institute for Digital Innovation in the Built Environment and Professor of Built Environment Foresight at the University College London, The Bartlett School of Sustainable Construction. He moved to UCL following a career in industry, and has substantial experience as corporate director of technology, innovation and sustainability for globally operating engineering design consultancies, including both Atkins and Halcrow. In addition, he was CEO of construction industry research body CIRIA from 2002 to 2007. Within his new role he works with leading individuals in industry and government to understand and prepare for the challenges and opportunities that lie ahead. This recently included the responsibility for a 'foresight' input to the UK Government's developing strategy for construction as well as leading the strategic planning of the UK's development and implementation of BIM. Tim is a Fellow of the Royal Academy of Engineering, the Institution of Civil Engineers and the Royal Society for Arts, manufactures and Commerce. He is also a Visiting Professor in Construction Management at the University of Reading and in Civil Engineering at the University of Dundee. He has maintained an active engagement in the development and deployment of BIM techniques for over a decade, is Vice Chairman of BuildingSmart (UK) Ltd and sits on the UK Government's BIM Task Force. He is also a Director of CEEQUAL Limited, which is responsible for developing and marketing CEEQUAL, the world's leading

technique for assessing the sustainability of infrastructure projects. He became Vice President of the Institution of Civil Engineers in 2011, with particular responsibility for Public Voice and Policy. He was subsequently elected the 152nd President of the Institution of Civil Engineers, taking office in November 2016.



Keynote Title:
Artificial intelligence and carbon neutrality: several case studies

Professor Borong Lin
Tsinghua University, China

Borong LIN is the Professor and Deputy Dean in the Faculty of Building Science and technology at Tsinghua University. He also serves as the Dean of Key Laboratory of Eco Planning & Green Building commissioned by the Ministry of Education, and the Fellow of IBPSA (International Building Performance Simulation Association). Prof. Lin was the winner of The National Science Fund for Distinguished Young Scholars in 2018, awarded the National Changjiang Scholar at 2019 and 2020 Xplorer Prize. He was selected as World's Top 2% Scientists by Stanford University and Elsevier China Highly Cited Scholars. Prof. Lin's research focuses on the whole life cycle technology innovation for enhancing built environment quality, energy efficiency and carbon neutrality from the architectural design phase to new product development and real operation. As PI, Prof. Lin won the second prize of national S&T award and 5 first prize of provincial or ministerial S&T awards. He has published over 150 SCI journal papers and is an editorial member of five international peer reviewed journals.



Keynote Title:
Sustainability through smart infrastructures

Professor Jeremy Gibberd
University of the Witwatersrand, South Africa

Jeremy Gibberd is a Co-coordinator of the Construction Industry Board (CIB) Working Group (W116) on Smart and Sustainable Built Environments (SASBE) and a member of the Multi-stakeholder Advisory Committee (MAC) of UNEP's Sustainable Building and Construction programme. He has developed specialist expertise in sustainable built environments, education and community architecture, building performance analysis and facilities management. Jeremy completed his PhD at the University of Pretoria in 2003 on methodologies for integrating sustainability into built environments in developing country contexts. Jeremy has lectured on environmental design, advanced technology and design at SCAD in the USA and has developed and taught courses on urban design, architectural design, materials, sustainability, energy and facilities management with various organisations. He regularly works as a research scientist and consultant to government, business and community organisations. Jeremy has published widely and

presented as invited or keynote speaker at numerous international meetings and conferences.



Keynote Title:
Sustainability through construction materials

Professor Humphrey Danso
AAMUSTED University, Ghana

Humphrey Danso is a Professor and Dean of the School of Graduate Studies at Akenten Appiah Minkah University of Skills Training and Development in Ghana. Previously, he was also Dean of the Faculty of Technical Education. He holds a PhD in Civil Engineering from the University of Portsmouth, United Kingdom; MPhil in Civil Engineering from Voronezh State University of Architecture and Civil Engineering, Russia; MSc in Strategic Management and Leadership, Kwame Nkrumah University of Science and Technology, Ghana, 2019-2021; and MTech in Competency-Based Training from the University of Education Winneba in Ghana. Humphrey has published over Ninety (90) publications in international outlets in the areas of construction materials, construction management, and sustainable construction.



Keynote Title:
Sustainable urban development and management

Professor Kathy Michell
University of Cape Town, South Africa

Kathy is on the full-time academic staff at the University of Cape Town and was Head of the Department of Construction Economics and Management from 2017 to 2020 and the Deputy Dean for Undergraduate Studies (Teaching & Learning) in the Faculty of Engineering and the Built Environment from 2021 – 2023. Kathy holds a Doctorate in property and facilities management from the University of Salford (United Kingdom), an MPhil in cost and systems engineering and BSc (Hons) in Quantity Surveying from the University of Cape Town. She is the Director of the Sustainability oriented and Cyber Research Unit for the Built Environment at UCT. She is a registered Professional Quantity Surveyor with the South African Council for the Quantity Surveying Profession and a member of the Royal Institution of Chartered Surveyors, the Association of South African Quantity Surveyors, and the South African Facilities Management Association. Kathy is a Past-President of the South African Council for the Quantity Surveying Profession and served a four-year term as a Council Member on the Council for the Built Environment in South Africa. She was the Africa Market Seat on the Governing Council of the Royal Institution of Chartered Surveyors (2020 – 2023), is a current member of the Board of the

CIB International Council for Building and Construction Research, a member of the International Facilities Management Association Research Advisory Committee and is a founding Director of the Africa Facilities Management Association.



Keynote Title:
Role of the client in achieving sustainable built environments

Professor Ron Watermeyer
DEng, CEng, PrEng, PrCM, PrCPM, Hon.FSAICE,
FIStructE, FICE, FSAAE
University of the Witwatersrand, South Africa

.

Ron Watermeyer served as the South African Institution of Civil Engineering's 101st President in 2004. In 2009 he obtained a senior doctorate (Doctor of Engineering) from the University of the Witwatersrand for his engineering development work which has significantly contributed to the delivery of infrastructure for the advancement of a changing South African society. He has published more than 100 papers, articles and book chapters on various aspects on the delivery of infrastructure. He is currently a Trustee of Engineers Against Poverty (London based international charity), a visiting adjunct professor, School of Construction Economics and Management, University of the Witwatersrand, the Chair of ISO TC 59 / SC18 (Construction procurement), a Member of the Certification Board of FIDIC Credentialing Limited and a Director of Infrastructure Options (Pty)Ltd. Ron has been at the forefront of many development initiatives in South Africa since the early 1990s. He has reinterpreted building regulations, developed systems for the classification of sites in terms of geotechnical characteristics and building practice and established technical requirements for a structural warranty scheme for houses. He has also changed construction methods, technologies and practices to facilitate socio-economic development imperatives and pioneered the development of construction procurement procedures, practices, tactics and strategy and client delivery management practices aimed at improving infrastructure project outcomes.

CONFERENCE THEMES

- T1 Climate Responsive Built Environments
- T2 Air Quality and Healthy Building
- T3 Thermal Comfort and Intelligent Operation
- T4 Low Carbon Technology and Energy System
- T5 Sustainable Urban Renewal
- T6 Building Technology and Performance
- T7 Construction and Project Management
- T8 Real Estate and Property Management

CONFERENCE PAPERS

T1 CLIMATE-RESPONSIVE BUILT ENVIRONMENTS 1

A unified data mining framework for air source heat pump performance prediction and key influencing factor analysis – Yang, Y., Lin, B., Geng, Y., Pei, X. and Ji, W 3

Addressing compliance checking matters of buildings to green standards using natural language processing: a review – Yamusa, M. A., Abdullahi, M., Ibrahim, Y. M., Ahmadu, H. A., and Abubakar, M. 4

Analyzing urban spatial agglomeration based on POI data: a case study of Shihezi city, Xinjiang – Han, Y., Liu, Q., Wu, X. and Su, Y. 5

Climate adaptation mechanism of traditional Yi dwellings from an e[m]ergy perspective – Ahou, Y., Yang, Z. and Xia, Q. 6

Exploration of the sustainable design strategies for the social houses of rural area – Wang, M. and Duan, D. 7

Female students' perceptions of environmental sustainability: a case study of a university building in the UAE – Shibeika, A. 8

Hydrophobicity optimization and exploration of a novel building envelope material – Zhao, H., Wu, S., Wu, Y., Sun, H. and Lin, B. 9

Infrastructure in Johannesburg from a sustainable development perspective – Jia, S. and Yang, Y 11

Numerical simulation study on the effect of water diffuser on the performance of heat storage tank – Ren, Y., Ren, Z., Xiao, Y., Zhang, Z., Yang, Z., Pang, Y.. and E, Reaihan. 12

Research and application of ecological environment functional materials in China – Liang, J., Lei, Y., Han, X., Dong, B. Zhang, H., Zhang, N. and Wang, L. 13

Study of the moisture buffering characteristics of building envelopes with double-layer hygroscopic materials – Liu, S., Yan, T., Xu, X., Wan, H. and Huang, G. 14

Towards a decision support for green public procurement implementation: a review of the primary decision-making factors – Yamusa, M. A., Abubakar, M., Nasir, R. M. and Abdulzaziz, M. 15

T2 AIR QUALITY AND HEALTHY BUILDING 16

A study of the effect of air purifiers on the concentration of particulate matter in primary school classrooms – Luo, H., Chen, Y., Yuan, F. and Yao, R. 17

A study of the effect of indoor glare on personnel's emotions based on the PAD (Pleasure-Arousal-Dominance) emotion model – Li, H. Zhu, Y., Song, B. and Li, B. 19

An experimental study of human activity patterns on particle resuspension in a test chamber – Yuan, F., Luo, H. and Yao, R. 20

Analysis on occupant behavior and energy consumption characteristics of air conditioning usage in residential buildings – Ao, J., Chen, Z., and Du, C. 21

Characteristics and prediction of air conditioners use in residential rooms based on fractal theory – Fu, C., Liu, M. and Li, Z. 22

Distribution and characteristic analysis of indoor thermal environment monitoring points during air conditioning heating – Ding, Y., Yu, Z. and Liu, Y. 23

Evaluation of the aerosol transport behaviour and infection risk in an isolation ward by a CFD modelling – Wang, F., Wang, Y., Zhang, Y. and Xu, X. 25

Experimental study of the disinfection efficacy of microwave radiation on A. Variegatus attached to the filter – Zhang, Y., Xu, X., Wang, F. and Yan, T. 26

Implications of indoor heating terminals on allergic and respiratory diseases in childhood: repeated cross-sectional surveys in China – Wang, C., Yu, W., Wei, S., Zhou, H. and Zhang, Y. 27

Indoor particles exposure and air filtration intervention association with children health-review – Zhong, T. and Du, C. 28

Investigating the impact of the indoor environmental quality of vehicles with different fuel transmission: emphasis on particulate matter –Mohamed, A. and Essah, E., A. 29

Relationship between indoor environment factors of residential settings and rheumatic diseases in older adults – Gao, N. and Yu, W. 30

Research on the correction method of carbon dioxide monitoring sensor in human respiratory zone – Wang H. and Yu W. 31

Study on efficient removal technology of toluene from indoor ambient air – Wang, J., Chen, J., Chen, D. and Yang, C. 33

The effect of air purifiers on the concentration of particulate matter 2.5 -a review – Cheng, L. and Li, M. 35

The impact of different indoor mould concentrations on lung tissue inflammation in mice – Wu, M., Du, C., Ma, P. and Yang, X. 37

The impact of short-term exposure to different air-conditioning environments on human thermal adaptation – Pan, Y., Shi F., Sun Z., Guo S. and Yan H. 38

The optimal parameters of airflow comfort and validation in air conditioners – Liu, Y., Wang, B., Wang, Y., Fan, J., Zhang, L. and Zhu, Y. 39

T3 THERMAL COMFORT AND INTELLIGENT OPERATION 40

A study of corrected skin wettedness levels in a downward outdoor-indoor temperature transient environment – Guo, J., Liu, H. and Chen, G. 41

A study of human perception and response under a high temperature local radiation – Wang, W., He, B. and Liu, H. 43

A study of the effect of long-term thermal history on thermal comfort of indoor occupants in summer climate chamber – Fu, Y. and Liu, H. 45

A study of thermal comfort experienced by postpartum women during sleeping hours – Wang, Y., Yu, W. and Shi, W. 47

Analysis of thermal comfort in indoor air conditioning environment for summer rest in hot summer and warm winter zone – Ma, X., Yu, W., Guo, L. and Zhang, Y. 49

Assessment of the effect of differences in human constitutional characteristics on thermal comfort – Ming, R., Miao, T., Wang, B., Wu, X. and Li, J. 50

Dynamic thermal sensation prediction model of the elderly using a machine learning method – Zhou, S. and Li, B. 51

Effects of different vegetation types on outdoor thermal comfort – Lei, H and Yuan, M. 53

Evaluation of the indoor environment and perceived IEQ: a case study in Norwegian primary schools – Chaulagain, A., Mathisen, H., M., Alam, B., G., Bartonova, A., Fredriksen, M., Høiskar, B., A., K., Gustavsen, K., Canet, A., M., Fredriksen, T. and Cao, G. 55

Experimental study on the thermal environment demand of underground stations in Chongqing – Ding, Y., Liu, Y. and Jiang, X. 57

Heat transfer analysis of separated gravity heat pipe used in a self-activated PCM wall – Xu, D., Yan, T., Xu, X., Wu, W., Long, W, Ming, T. and Wu, Y. 59

Human thermal comfort based dynamic regulation of air conditioning during cooling in residential buildings – Jing, M., Du, C., Zhang N. and Yu W. 60

Investigating the impact of infant BMI values on heat comfort perception in hot summer and cold winter regions – Shi, W., Yu W., Zhou, H. and Wang Y. 61

Predictive control model for regional cooling system combined with ice storage technology – Tang, C. Bao, L. and Li, N. 63

Research on human thermal response in naturally slightly hotter indoor environment – Ding, Y. Zhou, Z. and Zhang, X. 65

Research on thermal comfort influence and improvement strategy of air conditioning dynamic environment – Guo, L., Yu, W., Zhang, Y. and Guo, R. 66

Study on the effect of light environment on human comfort in a warmer office environment – Bai, S., and Li, Z. 67

Study on thermal comfort of postpartum mothers in air-conditioned environment in summer – Huang, X., Yu, W., Du, C. and Zhou, H 68

Study on thermal sensation prediction and temperature satisfaction of air conditioning dynamic environment in winter – Zhang, Y., Yu, W. and Guo, L. 69

The spatiotemporal variation pattern of indoor thermal environment under different set temperatures in summer intermittent convective cooling environment – Guo, S., Sun, Z., Shi, F., Pan, Y. and Yan, H. 71

Thermal comfort in hot summer and cold winter area with retrofitted traditional electric heating devices (Huo Xiang) – Huang, D. and Liu, H. 73

Thermal comfort in urban parks: a review – Zheng, P. and Yao, R 74
Thermal comfort prediction model based on optimized random forest algorithm – Jiang, Y. 75

T4 LOW CARBON TECHNOLOGY AND ENERGY SYSTEM 76

A general energy saving potential evaluation method of a pipe-embedded wall integrated with natural energy based on revised degree hour – Fan, S., Yan, T., Tang, X., Yu, Z., Li, X., Lyu, W. and Xu, X. 77
A low-carbon distributed energy system suitable for residents in mountainous areas of southwestern China: a case study of Weining County in Guizhou Province – Zhang, Z. and Xiao, Y. 78
Achieving sustainability in student housing: nexus of student housing design and energy use behaviour in northern Ghana – Appau, W. M., Anugwo, I. C., Attakora-Amaniampong, E. and Simpeh, F. 79
Comprehensive life cycle assessment of carbon emissions in the construction industry: a review of methods, tools, and applications – Zhu, T., Hua, J., Huang, L. and Zhang, X. 80
Developing an integrated real-time urban construction carbon emission monitoring framework: towards sustainable urban development – He, Y., Ding, Y., Jiang, X. and Zhao, W. 81
Efficient matching method of cold and heat sources under dynamic load demand characteristics – Ding, Y., Yu, X., Jiang, X. and Zhao, W. 83
Energy-saving optimal control strategy of an ASHP integrated central air-conditioning system – Gao, J., Yang, Y., Yan, J., Xu, X. and Liu, Y. 85
Global energy-saving potential estimation of Radiative Sky Cooling (RSC) used in the pipe-embedded wall cooling system – Yan, T., Fan, S., Xu, X., Lyu, W., Ming, T. and Wu, Y. 87
Low carbon concrete formulation and construction technology in construction phase – Zhao, W., Ding Y., Lai, W., Jiang, X. and He Y. 88
Main accounting indexes of building carbon emissions – Ding, Y. and Chen, W. 89

T5 SUSTAINABLE URBAN RENEWAL 90

Application of Chinese traditional mural materials in modern architectural wall decoration – Liu, C. and Syed, A. S. A. B. 91
Correlation between summer outdoor thermal environment and comfort in urban block of Northern Xinjiang – Su, Y., Huang, Z. and Wu, X. 92
Effective integration of traditional mural elements to enhance the attractiveness and artistry of installation artworks through Ryan's narrative theory – Li T., Feng Y., Ye Q. and Liu C. 93
Enlightenment of American buildings to China of sustainable integrated design –Zhu, X. 94
Environmental safety assessment of street road lighting combining visual characteristics and physical quantities – Liang, B., Huang, Z., Qin, Y., Li, Z.. and Luo, H. 95
Exploration of interactive dream analysis installation in art design in community public facilities – Ye, Q., Zeng, C., Li, T. and Liu, C. 96
Population, texture, green volume - the suitable density of historic districts based on intrinsic ecology – Hu, C. and Gong, C. 97
Public art and cultural education function of digital exhibition in museums – Li, L. 98
Research on design of interactive installation based on cultural sustainable intangible cultural heritage – Zeng, C., Ye, Q. , Li L. and Liu, C. 99
Temporal and spatial distribution characteristics of thermal environment of subway stations - an experimental study – Ding, Y., Jiang, X., He, Y., Zhao, W., Liu, Y. and Hou, Y. 101
The impact of road expansion on nearby infrastructure – the case of N11 in Mokopane, South Africa – Mogale, W., Musonda, E. and Harinarain, N. 102
Utilising African epistemologies to augment Collaborative Online International Learning (COIL) initiatives in the built environment field – Qumbisa, N. and Makhwabe, S. 103

T6 BUILDING TECHNOLOGY AND PERFORMANCE 104

A review of the impact of office lighting environment on employees' emotional state – Li, M. and Cheng, L. 105
A review on indoor lighting evaluation regarding its' effects and indicators – Lin, S. and Du, C. 107

A study on the impact of enhancing window airtightness on residential building energy consumption in hot summer and cold winter region – Yu, Z., Zhang, C., Xu, X., Tang, X. and Yu, Z. 108

An advanced design method of intelligent buildings in sustainable development – Xia, Q., Yang, Z. and Ahou, Y. 109

Assessing the performance of PCM embedded non-linear thermal wall – Li, S., Ji, W., Liu, S., Kwanda, L, T. and Kusakana, K. 111

Development and prospection of occupant behavior in residential building – Liao, X, and Li, B. 112

Effect of elevated temperature on the mechanical properties of high volume recycled coarse aggregate concrete containing volcanic ash – Gambo, S., Yahaya, M. W. and Ibrahim, A. G. 113

Effects of masonry materials characteristics on painted external wall surfaces – Afful, M. O., Mensah, S., Orgen, N. K. and Ameyaw, C. 114

Experimental investigation on post-fire mechanical properties of Q960 ultra-high-strength steel after cold-forming process – Wang, J. and Shi, Y. 115

Housing characteristics and heat perception: comparison across formal and informal neighbourhoods in Lagos, Nigeria – Adegun, O. B., Morakinyo, T. E., Akinbobola, A., Obe, B. and Olusoga, O. O. 116

Impact of PCMC roof on indoor thermal-humidity environment and air conditioning energy consumption – Jiang, L., Gao, Y., Liu, S. Rashidov, J., Zhang, X. and Fan, Z. 117

Numerical study on lateral behavior of cold-formed steel composite shear wall – Xiaowei, R., and Yu, S. 119

Research on the structural regulation of sepiolite fibre and application as self-humidity-control functional building materials – Han, X., Tang, R., Hao, L., Dong, B., Wang, L. and Liang, J. 120

Sociotechnical system failure in construction projects: a distributed situation awareness of sky central roof damage – Mkandawire, K., Kabiri, S. and Connaughton, J. 121

The effect of Melanopic equivalent daylighting illuminance (m-EDI) on satisfaction and productivity in the workplace – Li, Z., Yao, R., Bai, S. and Zhu, Y. 122

Thermal properties of surrounding rock in deep-buried metro station fresh air shafts enhanced by phase change materials: a case study from Chongqing, China – Ren, Z., Ren, Y., Yang, Z., and Xiao, Y. 123

T7 CONSTRUCTION & PROJECT MANAGEMENT 124

A digital skills gap analysis of building inspectors: the case of the City of Johannesburg Metropolitan Authority – Gethe, F., Awuzie, B., Simbanegavi, P. and Chiloane, M. B. 125

Academia-industry linkages: a missing link in TVET institutions in Tanzania - Mhando, Y., Mamboya, F. and Chacha, M. 126

An evaluation of the quantitative risk assessment simulation undertaken during the planning stage of mega-projects – Zwane, S., Schutte, D., Maila, S. and Jones, R. 127

Ascertaining the knowledge of Ghanaian construction professionals on the use of clay bricks as a sustainable construction material – Darko, P., D., Nani, G., Mensah, N., A., A., O., Yusif, M. and Badii, P. 129

Barriers to digitalization of procurement – a review – Ojo-Fafore, E. and Laryea, S. 130

Bibliometric analysis of virtual reality in construction education – Kio, P., Ohochuku, C., Aduloju, T., and Agidani, J. 131

Bibliometric review of social value in construction literature – Laryea, S., Kwasafo, O., K. and Mensah, S. 133

Buried alive: the challenges facing the emerging contractors in the Limpopo province, South Africa – Moeti, M., Amoah, C. and Le Roux, L. 134

Challenges associated with differential measurements in stairs construction in low rise residential buildings – Boadi, E. O., Mensah, S., Ameyaw, C., Orgen, N. K. and Bondinuba, F. K. 135

Construction materials management techniques used in building projects in Kano Metropolis, Nigeria – Wudil, B. I., Bashir, K., K., Sani U., and Aikawa, I. U. 136

Detecting and preventing unbalanced bidding in South African public sector construction – Tilese, N., Makhaga, T., Mphahlele, M. and Zungu, Z. 137

Establishing success and failure factors of circular economy transitions in property development firms: a servitized business model approach – Nemakhavhani, R., Awuzie, B. and Aigbavboa, C. 138

Evaluating the new universities project outcomes using the PMBOK project performance domains – Mosalaesi, T. and Laryea, S. 139

Exploring the challenges in the performance of small-medium contractors in South Africa: a consultants' perspective – Simpeh, F., Baba, V. and Anugwo, I., C. 141

Fostering construction firm resilience through persuasive narratives of strategy: a conceptual framework – Zungu, Z., Laryea, S. and Nkado, R. 142

Investigate the potential impact of individual tracking technology in the Construction Industry – Lai, H., Y. and Essah, E., A. 143

Investigating management practices in the construction and delivery of electricity projects in Nigeria – Oladiran, O., J. and Oguntona, O., A. 144

Key barriers to green building implementation in South Africa – Mompati, L., Mandlate, M., Kabini, K. and Nomvalo, U. 145

Modelling leadership development determinants in Ghana's construction industry: the moderating role of professional capability – Sam, A.. Aigbavboa, C. O. and Thwala, W. D. 147

Perceptions of tender document quality and its impact on construction estimates – Nezambe, B. Laryea, S. and Govender, N. 149

Risk factors that contribute to the collapse of major construction companies: the case of fallen South African construction giants – Scholtz, R., Deacon, H., A., Le Roux, L. and Amoah, C. 150

Team communication in the built environment: the South African land surveyor's perspective – Harinarain, N. and Mbanjwa, S. 151

The job satisfaction of black female quantity surveyors – Punungwe, F. and Terblanche, R. 153

Understanding mason training in South Africa – Khuzwayo, B., Walker, M. and Graham, B. 154

Using dynamic BIM to improve construction safety culture – Amiri, M., Saghatforoush, E. and Laryea, S. 155

Wearable technology to reduce fatigue risks for construction workers: a scoping review – Mtetwa, S. I., Mollo, L., G. and Emuze, F., A. 157

T8 REAL ESTATE AND PROPERTY MANAGEMENT 158

Assessment of void periods in residential buildings in Minna, Nigeria – Ogunbajo, R. A. and Kuma, S. S. 159

Prop-tech trend in Nigerian real estate practice: adoption and challenges – Araloyin, F. M., Fateye, T. B. and Adebowale, O. O. 160

Remote sensing to map and estimate the extent of flood damage – a South African case study – Malusi, B., Musonda, E. and Harinarain, N. 161

Residential choice and preferences in Ashesi University: comparative study of stated and revealed preferences – Doamekpor, N., A., A., Nyarko, G., K. and Adeku, V. 163

The impact of inflation on house prices in South Africa: effects of COVID-19 – Mpofu, B., Simbanegavi, P., Moobela, C. and Weaich, M. 165

Utilisation of digital elevation modelling to determine areas affected by floods in KwaZulu-Natal – Zwane, S., Musonda, E. and Harinarain, N. 167

INDEX OF AUTHORS 169

INDEX OF KEYWORDS 173

T1 CLIMATE-RESPONSIVE BUILT ENVIRONMENTS

A unified data mining framework for air source heat pump performance prediction and key influencing factor analysis – Yang, Y., Lin, B., Geng, Y., Pei, X. and Ji, W 3

Addressing compliance checking matters of buildings to green standards using natural language processing: a review – Yamusa, M. A., Abdullahi, M., Ibrahim, Y. M., Ahmadu, H. A., and Abubakar, M. 4

Analyzing urban spatial agglomeration based on POI data: a case study of Shihezi city, Xinjiang – Han, Y., Liu, Q., Wu, X. and Su, Y. 5

Climate adaptation mechanism of traditional Yi dwellings from an e[m]ergy perspective – Ahou, Y., Yang, Z. and Xia, Q. 6

Exploration of the sustainable design strategies for the social houses of rural area – Wang, M. and Duan, D. 7

Female students' perceptions of environmental sustainability: a case study of a university building in the UAE – Shibeika, A. 8

Hydrophobicity optimization and exploration of a novel building envelope material – Zhao, H., Wu, S., Wu, Y., Sun, H. and Lin, B. 9

Infrastructure in Johannesburg from a sustainable development perspective – Jia, S. and Yang, Y 11

Numerical simulation study on the effect of water diffuser on the performance of heat storage tank – Ren, Y., Ren, Z., Xiao, Y., Zhang, Z., Yang, Z., Pang, Y.. and E, Reaihan. 12

Research and application of ecological environment functional materials in China – Liang, J., Lei, Y., Han, X., Dong, B. Zhang, H., Zhang, N. and Wang, L. 13

Study of the moisture buffering characteristics of building envelopes with double-layer hygroscopic materials – Liu, S., Yan, T., Xu, X., Wan, H. and Huang, G. 14

Towards a decision support for green public procurement implementation: a review of the primary decision-making factors – Yamusa, M. A., Abubakar, M., Nasir, R. M. and Abdulzaziz, M. 15

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

A UNIFIED DATA MINING FRAMEWORK FOR AIR SOURCE HEAT PUMP PERFORMANCE PREDICTION AND KEY INFLUENCING FACTOR ANALYSIS

Yuren Yang[1], Borong Lin[2], Yang Geng[3], Xingyu Pei[4] and Wenjie Ji[5]
[1, 2, 3]*Key Laboratory of Eco Planning & Green Building, Tsinghua University, China; School of Architecture, Tsinghua University, China*
[4, 5]*School of Mechanical Engineering, Beijing Institute of Technology, China*

Air source heat pumps (ASHPs) have significant emission reduction potential, low operating costs, low maintenance requirements, and suitability for various geographic conditions. Accurate prediction and analysis for the operational performance of ASHPs is crucial for developing optimal control strategies and ensuring the efficient and stable operation of heat pump systems. This study proposes a framework utilizing machine learning algorithms for performance prediction and interpretability analysis of ASHP systems. The proposed framework comprises three modules: data preprocessing, model construction, and interpretability analysis. It focuses on predicting the performance of ASHP systems based on real-time operational parameters, meteorological parameters, time indices, and other features, as well as extracting key influencing features and analysing the effects of each feature on system performance across different intervals. The proposed framework was applied to an ASHP system in a secondary school in Beijing, China, achieving an accuracy of 78.24% in predicting its heating capacity for the next hour. The interpretability analysis was performed using the SHAP method, which is based on cooperative game theory. The analysis revealed that instantaneous flow rate had the greatest impact on the heating capacity, but its influence varied significantly across different flow rate intervals.

Keywords: air source heat pump (ASHP), heating capacity, interpretability analysis, machine learning

[1] yangyuren@mail.tsinghua.edu.cn
[2] linbr@tsinghua.edu.cn
[3] gengy@tsinghua.edu.cn
[4] pxy0937@gmail.com
[5] jiwenjie@bit.edu.cn

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

ADDRESSING COMPLIANCE CHECKING MATTERS OF BUILDINGS TO GREEN STANDARDS USING NATURAL LANGUAGE PROCESSING: A REVIEW

Muhammad Aliyu Yamusa[1], Muhammad Abdullahi[2], Yahaya Makarfi Ibrahim[3], Hassan Adaviriku Ahmadu[4] and Mu'awiya Abubakar[5]

[1,2]*Department of Quantity Surveying & Public Procurement Research Centre, Ahmadu Bello University, Zaria, Nigeria*

[3,4]*Department of Quantity Surveying, Ahmadu Bello University, Zaria, Nigeria*

[5]*Department of Building & Public Procurement Research Centre, Ahmadu Bello University, Zaria, Nigeria*

The incorporation of sustainability objectives in green building (GB) projects adds complexity to their design, construction, and management. Current developments in the area of artificial intelligence, precisely natural language processing (NLP) techniques have provided great potential in analysing voluminous regulatory documents to draw insightful information relating to the standards, requirements, and codes to enhance the efficiency and accuracy of compliance checking. However, there is a dearth of attempts to tap the potential of NLP to facilitate automated compliance checking, especially within the context of green buildings. This paper, therefore, aims to assess the benefits and limitations of the current advancements in NLP-based methodologies for automated compliance checking of regulatory documents in green buildings. This paper conducts a systematic review of literature to achieve its aim. The challenges and benefits, as well as the areas of the application of NLP in automated compliance checking of regulatory documents in green buildings, are highlighted. The research offers a guide for future investigations aimed at broadening the utilisation of NLP in automating the compliance verification process for regulatory documents in green buildings and the construction sector as a whole.

Keywords: compliance checking, green building, NLP, regulatory documents, standards

[1] yamusajf@yahoo.com
[2] bnabdallah02@gmail.com
[3] makarfi@gmail.com
[4] ahmaduhassan@rocketmail.com
[5] muawiyaabubakar1@gmail.com

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

ANALYZING URBAN SPATIAL AGGLOMERATION BASED ON POI DATA: A CASE STUDY OF SHIHEZI CITY, XINJIANG

Yu Han[1], Qiaochu Liu[2], Xuezheng Wu[3] and Yuan Su[4]
[1, 2, 3, 4] *School of Architecture & Fine Art, Dalian University of Technology, Dalian 116024, China*

Numerous cities within developing nations possess vast potential across dimensions such as population density, geographical positioning, and natural resource endowments. However, their urban transportation frameworks and spatial planning strategies often fail to align effectively with the pivotal gathering spaces for residents. This study aims to extensively leverage urban Point of Interest (POI) data to decipher urban structures, pinpoint core urban blocks, and conduct centrality research employing spatial algorithms. Utilizing Shihezi in Xinjiang as a case study, this research initiates data collection of the city's POI through POI-kit software, organizing information points in a zonal framework. Subsequently, POI is categorized into distinct types, assigning differential weightage based on their types. Furthermore, precise aggregation features of POI points are delineated through kernel density analysis. Building upon this, the centre is quantified using ArcGIS's Getis-Ord Gi* index method to derive refined POI data. By amalgamating the aggregation characteristics of blocks derived from kernel density analysis and analyzing the data for hot spots and cold spots using the Getis-Ord Gi* index, visualization of the distribution of diverse types of POI points and population aggregation within Shihezi city is facilitated. Theoretical contributions encompass a streamlined method for urban POI data, aligning it with the distribution of core urban blocks while ensuring typological diversity. On a practical front, this study furnishes rapid analyses of varied urban centralities in response to shifts in spatial arrangements. Consequently, it aids designers in optimizing urban milieu, furnishing effective renewal strategies.

Keywords: aggregation analysis, kernel density analysis, POI, urban centrality, Shihezi.

[1] 13506713000@163.com
[2] lqc_arch@163.com
[3] 505183538@qq.com
[4] suyuan@dlut.edu.cn

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

CLIMATE ADAPTATION MECHANISM OF TRADITIONAL YI DWELLINGS FROM AN E[M]ERGY PERSPECTIVE

Yimu Ahou[1], Zhenjing Yang[2] and Qing Xia[3]
[1,2,3]School of Architecture and Urban Planning Chongqing University

The traditional dwellings of the Yi ethnic group in Southwest China embody the wisdom of local residents in adapting to the climate. Scientific refinement of this wisdom can guide modern energy-saving building design. Previous studies on these dwellings often focus on specific architectural elements, rarely discuss their synergistic effects, and seldom delve into energy levels, making holistic conclusions difficult. This research aims to explore how various elements within the dwelling work synergistically through the lens of energy flow. By introducing H.T. Odum's e[M]ergy (In order to distinguish it from energy, *[M]* is used here. For details on the concept of e[M]ergy, see 1.1) theory, the study interprets how buildings achieve climate adaptation from a holistic perspective. This research uses detailed indoor temperature and energy data from field measurements and software simulations. E[M]ergy theory is then used to discuss the relationship between building energy flow and climate adaptation. Traditional Yi dwellings cope with the local winter season through heat storage in the envelope and heat supply from the fire pit. The two modes of heating work synergistically, as the airflow brought by the use of the fire pit facilitates the release of heat stored in the envelope. Yi traditional houses use minimal non-renewable energy (firewood) to drive renewable energy (sunlight) for heating, aligning with e[M]ergy theory's self-organization and achieving high renewable e[M]ergy efficiency.

Keywords: climate adaptation, e[m]ergy, traditional dwelling of Yi

[1] 10642572392qq.com
[2] ahym15181501002@gmail.com
[3] fimberchen@126.com

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

EXPLORATION OF THE SUSTAINABLE DESIGN STRATEGIES FOR THE SOCIAL HOUSES OF RURAL AREA

Mingzhu Wang[1] and Degang Duan[2]
[1,2]School of Architecture, Xi'an University of Architecture and Technology, China

Climate change is one of the hugely significant challenges of the world in the twenty-first century. Most resident buildings, especially for housing, are ageing and deteriorating, and they cannot adapt to future climate conditions and occupant requirements. Also, social housing typically encompasses neighbourhoods with low socioeconomic status. Thus, social housing design strategies should jointly respond to climate change adaptation and life cycle assessments. According to the results of China's seventh population census, China has a population of 1.4 billion, of which the rural population accounts for 36.11 per cent. The existing urban habitable living area is limited, and it is impossible to turn the entire rural population into the urban population, so some scholars proposed the concept of "local urbanisation". Based on this, the construction of resettlement farmhouses is an important step to realise "local urbanisation" or "urbanisation in the vicinity", and it is an important hand to narrow the gap between urban and rural areas. This study investigates the strategy of sustainable design based on the adaptation of future climate and the life cycle cost. Those strategies could be beneficial to reducing energy consumption and the cost of social housing design. Space design is used to balance the pursuit of commonality and individuality. They are also, exploring the sustainable design goals of the resettlement of rural houses from three aspects: natural climate, social economy and building technology. Passive design strategies, such as a sunroom, can improve indoor space comfort and light, natural ventilation, air circulation and thermal insulation. This study provides new rural resettlement housing of "basic type + derivative type" to balance the government and rural occupancy economy investment. At present, a complete system of social security housing has been developed, and different scholars have done a certain number of researches on the construction of resettlement space and quality enhancement for the disadvantaged and low-income groups in urban shantytowns and urban villages, but there is still less attention and research on rural areas. Resettlement of agricultural housing as a kind of social security housing, the resettlement object is the villager who will be demolished in a specific village, generally using the method of resettlement in the nearest location. The resettlement target has the following characteristics: the same geographical environment as the original residence, the same dialect, and the same traditional customs and habits are determined. In this type of collective demolition in a village, there is a certain degree of blood relationship between the demolished households, the circle of interpersonal communication is fixed, and the social relationship is relatively stable. The study considers the wind and light environments of the overall village environment at the village layout level and the comfort of the indoor thermal environment for individual buildings. The design of the farmhouse enhances the comfort of the indoor environment and reduces the energy consumption during the operation phase of the building through several passive design strategies such as shading, cavity space and sunroom design. The study has been able to reduce the construction cost of the space building at the early stage of the building construction by proposing flexible policies and an optional construction menu for the resettled people to choose from.

Keywords: flexible policies, passive design strategies, social housing of rural areas, sustainable

[1] 950709may@gmail.com

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

FEMALE STUDENTS' PERCEPTIONS OF ENVIRONMENTAL SUSTAINABILITY: A CASE STUDY OF A UNIVERSITY BUILDING IN THE UAE

Amna Shibeika[1]
[1]*School of Construction Management and Engineering, University of Reading, UK*

University campuses are considered high consumers of natural resources and play an important role as leaders in diffusing sustainability concepts and behaviours. The relevant literature highlights the need to investigate the intersection between the micro (individual beliefs and actions) of building users and the macro (organizational programs and management practices) of environmental sustainability in university campuses. Hence, this study aimed to investigate students' knowledge and perceptions of the environmental sustainability of their university campuses. This study engaged United Arab Emirates University (UAEU) students as researchers and respondents through an in-depth case study of a building on the UAEU campus in Al Ain, Abu Dhabi. The mixed methods analysis sheds light on students' knowledge of environmental sustainability in general and their perception of sustainability practices for energy conservation, water conservation, waste recycling, sustainable landscaping, and sustainable transportation programs in the case study building. Students' perceptions were influenced by their ability to realize relevant environmental design elements and university initiatives. Building automation and awareness campaigns are highlighted as potential areas of improvement. As higher education in developing countries accelerates, this study's findings contribute to the emerging literature on the contribution and commitment of higher education institutions to sustainable development.

Keywords: case study, environmental sustainability, student perceptions, university buildings

[1] a.shibeika@reading.ac.uk

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

HYDROPHOBICITY OPTIMIZATION AND EXPLORATION OF A NOVEL BUILDING ENVELOPE MATERIAL

Hengxin Zhao[1], Shuangdui Wu[2], Yifan Wu[3], Hongli Sun[4] and Borong Lin[5]

[1,2,3,5]*Department of Building Science, Tsinghua University, Beijing 100084, China*
[1,2,3,4,5]*Key Laboratory of Eco Planning & Green Building, Ministry of Education, Tsinghua University*
[4] *College of Architecture and Environment, Sichuan University, Chengdu, 610065, China*

Due to the impact of global climate change and energy crisis, energy conservation in the building sector is crucial. As an important part of the building, the optimization of the building envelope is beneficial to reduce building energy consumption. However, the existing building envelope generally suffers from weak regulation and complex control. Therefore, this study proposes a thermal diode combining superhydrophobic and superhydrophilic materials, which can be combined with the building. The building envelope contributes to the dual carbon target in the building sector through passive insulation and heat removal. Furthermore, this study verifies the function of the hydrophobic surface on the property of the thermal diode by means of material fabrication and experimentation, while using simulations to demonstrate the potential of the structure for application in buildings. Due to the use of phase change heat transfer, the thermal diode has the unidirectional heat transfer capacity of 10 times, and it has a 12-21% cooling energy saving effect when applied in buildings. This research provides a technical reference for the development of new thermal diode and building envelopes.

Keywords: building energy saving, novel thermal diode, smart building envelope, superhydrophobic material

[1] zhx20@mails.tsinghua.edu.cn
[2] wusd21@mails.tsinghua.edu.cn
[3] wu-yf19@mails.tsinghua.edu.cn
[4] shl@scu.edu.cn
[5] linbr@tsinghua.edu.cn

Zhao, *et al.* (2024) Hydrophobicity optimization and exploration of a novel building envelope material In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 57-63

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

INFRASTRUCTURE IN JOHANNESBURG FROM A SUSTAINABLE DEVELOPMENT PERSPECTIVE

Sihao Jia[1] and Yixuan Yang[2]
[1]*Department of Urban Studies and Planning, University of Sheffield, United Kingdom*
[2]*The Bartlett School of Architecture, University College London, United Kingdom*

Transport and housing are critical components of urban development and play a significant role in sustainable development. South Africa's rapid urbanization presents several sustainability challenges, such as congestion, limited public transport options, low adoption rates of environmentally friendly transport modes, and affordability issues stemming from inadequate or unevenly distributed housing. This study focuses on the transport and housing problems in South African cities, examining these issues through a comprehensive lens of sustainable urban development. The primary aim of this study is to elucidate the interactions between transport and housing in Johannesburg and to explore how improvements in these areas can enhance the city's sustainability. The research employs an analytical approach that integrates policy analysis with empirical data and case studies, comparing Johannesburg with other cities in the Global South. The findings will offer solutions for integrated urban planning, public transport investments, sustainable mobility schemes, and affordable housing development strategies. This study provides a deeper understanding of the sustainable development challenges facing South African cities, using Johannesburg as a case study. It offers valuable insights and practical recommendations for policymakers and urban planners, helping them to address these challenges effectively.

Keywords: housing, Johannesburg, sustainable development, transportation, urban planning

[1] sjia13@sheffield.ac.uk
[2] yixuan.yang.22@ucl.ac.uk

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

NUMERICAL SIMULATION STUDY ON THE EFFECT OF WATER DIFFUSER ON THE PERFORMANCE OF HEAT STORAGE TANK

Yucheng Ren[1], Zhili Ren[2], Yimin Xiao[3], Zhengfei Zhang[4], Zehui Yang[5], Yantao Pang[6] and Reaihan E[7]

[1, 2, 3, 4, 5, 6] *School of Civil Engineering, Chongqing University, Chongqing, China*

[1, 7] *College of Water Conservancy & Architectural Engineering, Shihezi University, Xinjiang, China*

Energy storage technology has received increasing attention in the context of "double carbon" goal. As an important component in natural layered thermal storage tanks, water diffusers play a significant role. However, water diffusers still exist uneven radial and vertical flow distribution problems, such as mixing of cold and hot water which result in poor stratification effect. A novel diffuser was designed based on an equal-diameter flared diffuser and has added three layers of concentric ring type uniform flow plates which are perforated with several 20 mm diameter holes. Three-dimensional numerical models were established using computational fluid dynamics (CFD) software to simulate the original water tank and the improved water tank equipped with a novel type of diffuser, respectively. Three key performance evaluation indicators, namely the thermocline thickness, energy storage efficiency, and velocity uniformity index, were selected for calculation and comparative analysis to evaluate the stratification effect of the water tank. The research results showed that the improved water tank saved heat storage time and increased heat storage efficiency by 11.24%. The thermocline thickness has significantly decreased, and the stratification effect was better. The minimum thermocline thickness has been reduced by 55.905%, and the maximum thickness by 40.748%. When the heat storage time reached 900 s, the energy storage efficiency increased from 87.955% to 92.540%. This study can provide theoretical basis and technical support for the design of water diffusers. It is of great significance for improving the energy storage efficiency of water tanks and achieving energy saving in heating systems.

Keywords: energy saving, numerical simulation, thermal storage tank (TST), thermocline thickness, water diffuser

[1] yucheng9011@163.com
[2] renzhilicqu@qq.com
[3] xiaoyimin@cqu.edu.cn
[4] 1915444857@qq.com
[5] 958732868@qq.com
[6] 1751749087@qq.com
[7] 826811421@qq.com

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

RESEARCH AND APPLICATION OF ECOLOGICAL ENVIRONMENT FUNCTIONAL MATERIALS IN CHINA

Jinsheng Liang[1], Yinyuan Lei[2], Xiaoyu Han[3], Bin Dong[4], Hong Zhang[5], Na Zhang[6] and Lijuan Wang[7]

[1,2,3,4,5,6,7]*Key Laboratory of Special Functional Materials for Ecological Environment and Information, Ministry of Education, Hebei University of Technology, China*

[1,2,3,4,5,6,7]*Institute of Power Source and Ecomaterials Science, Hebei University of Technology, China*

As the global environment deteriorated, the industrial development model emphasizing speed and quantity no longer meets demands for high-quality development. Instead, the coexistence of human being and ecological environments emerge as significant features. Ecological environment functional materials refer to environmental pollution control materials and micro-environment regulation materials developed mainly from natural mineral resources. They are primarily used in pollution control, environmental restoration, micro-environment regulation, and other fields. Silicate minerals with diverse nanostructures in nature not only exhibit unique properties but also harmonize well with the environment, making them excellent natural raw materials. This paper aims to introduce ecological environment functional materials through a comprehensive review of extensive literature. In this work, the connotation, basic concepts, and new developments of ecological environment functional materials were introduced. Subsequently, it summarized the main characteristics and research progress of typical ecological environment functional materials constructed with sepiolite, montmorillonite, tourmaline, diatomite, biochar and iron tailings. On this basis, in conjunction with industry development trends, the paper provides an outlook on future developments and discusses typical issues encountered in product development. It is highly expected that this critical review will present an insight into the prospective development of ecological environment functional materials.

Keywords: ecological environment functional materials, functional materials, harmonious integration, minerals.

[1] liangjinsheng@hebut.edu.cn
[2]yinyuan_lei@126.com
[3] hanxiaoyu9234@126.com
[4] dongbin@hebut.edu.cn
[5] zhanghong@hebut.edu.cn
[6] ZhangNaa_08@163.com
[7] wanglj77@163.com

Liang, *et al.* (2024) Research and application of ecological environment functional materials in China In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 88-98

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

STUDY OF THE MOISTURE BUFFERING CHARACTERISTICS OF BUILDING ENVELOPES WITH DOUBLE-LAYER HYGROSCOPIC MATERIALS

Sheng Liu[1], Tian Yan[2], Xinhua Xu[3], Hang Wan[4] and Gongsheng Huang[5]

[1,3]*Department of Building Environment & Energy Engineering, Huazhong University of Science & Technology, Wuhan, China*

[2]*Department of Building Environment & Energy Engineering, Wuhan University of Technology, Wuhan, China*

[4,5]*Department of Architecture and Civil Engineering, City University of Hong Kong, Kowloon, Hong Kong, China*

Indoor dehumidification is commonly accomplished by using mechanical cooling which leads to substantial consumption of high-grade energy resources. Hygroscopic materials can passively stabilize indoor humidity variations without adding extra energy costs. Moisture adsorption/desorption modelling, which simulates the moisture transfer between hygroscopic materials and the surrounding air, is an efficient method to assess the moisture buffering performance of the materials. This study aims to develop a moisture calculation method for double-layer hygroscopic materials (DLHM) and investigate their dynamic moisture buffering capabilities, providing references for engineering applications. This study presents a moisture transfer calculation method for multiple-layer hygroscopic materials and the evaluation indexes of the dynamic moisture buffing capacity including t_{ar}, M_{ad}, and M_{ss}. The dynamic moisture buffering characteristics of single-layer and double-layer hygroscopic materials are compared. The findings indicate that placing a thin layer of material with high moisture capacity (like LSB) behind a material with high vapor permeability (like CI) can greatly improve both stable daily absorbed moisture (M_{ad}, from 40.0 g/m^2 to 58.4 g/m^2) and stable stored moisture (M_{ss}, from 20.1 g/m^2 to 29.3 g/m^2). The proposed method can be applied in designing building envelopes with DLHM, thereby facilitating the practical implementation in engineering applications.

Keywords: double-layer hygroscopic materials, dynamic moisture buffering capacities, moisture transfer function, optimal thickness distribution

[1] liusheng2023@hust.edu.cn
[2] yantian@whut.edu.cn
[3] bexhxu@hust.edu.cn
[4] wanhang111@hotmail.com
[5] gongsheng.huang@cityu.edu.hk

Liu, *et al.* (2024) Study of the moisture buffering characteristics of building envelopes with double-layer hygroscopic materials In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 99-109

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

TOWARDS A DECISION SUPPORT FOR GREEN PUBLIC PROCUREMENT IMPLEMENTATION: A REVIEW OF THE PRIMARY DECISION-MAKING FACTORS

Muhammad Aliyu Yamusa[1], Mu'awiya Abubakar[2], Rashida Maiturare Nasir[3] and Michael Abdulzaziz[4]
[1,3]Department of Quantity Surveying, Ahmadu Bello University, Zaria, Nigeria
[2]Department of Building, Ahmadu Bello University, Zaria, Nigeria
[4]Strategic Supply Chain Ltd, Abuja, Nigeria

Green Public Procurement (GPP) if implemented effectively, can help in attaining environmental goals on a national level, lasting financial savings, encouraging innovation, igniting the marketplace for green products, services, and work as well as job creation towards sustainable consumption and production. Nevertheless, the utilisation of GPP should only be considered after a thorough examination, as numerous crucial elements and circumstances must align to ensure its effectiveness and feasibility. A systematic evaluation of the determining factors to ensure effective GPP implementation is not well documented. The aim of this study is to conduct a comprehensive evaluation of the determining factors involved in the decision to implement GPP. The paper conducts a systematic literature review to achieve its aim. The decision-making factors (DMFs) for GPP implementation were identified using SCOPUS and Google Search. In light of these findings, a conceptual framework was proposed to provide a comprehensive understanding of the identified DMFs for the GPP implementation. This research paper contributes to enhancing both the theoretical and practical comprehension of the principal DMFs for GPP implementation, ultimately aiding in the maximization of benefits and the mitigation of risks.

Keywords: conceptual framework, DMFs, GPP, implementation, sustainable consumption and production

[1] yamusajf@yahoo.com
[2] muawiyaabubakar@abu.edu.ng
[3] rmnasir@abu.edu.ng
[4] sschainltd@gmail.com

Yamusa, *et al.* (2024) Towards a decision support for green public procurement implementation: a review of the primary decision-making factors In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 110-117

T2 AIR QUALITY AND HEALTHY BUILDING

A study of the effect of air purifiers on the concentration of particulate matter in primary school classrooms – Luo, H., Chen, Y., Yuan, F. and Yao, R. 17

A study of the effect of indoor glare on personnel's emotions based on the PAD (Pleasure-Arousal-Dominance) emotion model – Li, H. Zhu, Y., Song, B. and Li, B. 19

An experimental study of human activity patterns on particle resuspension in a test chamber – Yuan, F., Luo, H. and Yao, R. 20

Analysis on occupant behavior and energy consumption characteristics of air conditioning usage in residential buildings – Ao, J., Chen, Z., and Du, C. 21

Characteristics and prediction of air conditioners use in residential rooms based on fractal theory – Fu, C., Liu, M. and Li, Z. 22

Distribution and characteristic analysis of indoor thermal environment monitoring points during air conditioning heating – Ding, Y., Yu, Z. and Liu, Y. 23

Evaluation of the aerosol transport behaviour and infection risk in an isolation ward by a CFD modelling – Wang, F., Wang, Y., Zhang, Y. and Xu, X. 25

Experimental study of the disinfection efficacy of microwave radiation on A. Variegatus attached to the filter – Zhang, Y., Xu, X., Wang, F. and Yan, T. 26

Implications of indoor heating terminals on allergic and respiratory diseases in childhood: repeated cross-sectional surveys in China – Wang, C., Yu, W., Wei, S., Zhou, H. and Zhang, Y. 27

Indoor particles exposure and air filtration intervention association with children health-review – Zhong, T. and Du, C. 28

Investigating the impact of the indoor environmental quality of vehicles with different fuel transmission: emphasis on particulate matter –Mohamed, A. and Essah, E., A. 29

Relationship between indoor environment factors of residential settings and rheumatic diseases in older adults – Gao, N. and Yu, W. 30

Research on the correction method of carbon dioxide monitoring sensor in human respiratory zone – Wang H. and Yu W. 31

Study on efficient removal technology of toluene from indoor ambient air – Wang, J., Chen, J., Chen, D. and Yang, C. 33

The effect of air purifiers on the concentration of particulate matter 2.5 -a review – Cheng, L. and Li, M. 35

The impact of different indoor mould concentrations on lung tissue inflammation in mice – Wu, M., Du, C., Ma, P. and Yang, X. 37

The impact of short-term exposure to different air-conditioning environments on human thermal adaptation – Pan, Y., Shi F., Sun Z., Guo S. and Yan H. 38

The optimal parameters of airflow comfort and validation in air conditioners – Liu, Y., Wang, B., Wang, Y., Fan, J., Zhang, L. and Zhu, Y. 39

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

A STUDY OF THE EFFECT OF AIR PURIFIERS ON THE CONCENTRATION OF PARTICULATE MATTER IN PRIMARY SCHOOL CLASSROOMS

Hao Luo[1], Yu Chen[2], Feng Yuan[3] and Runming Yao[4]
[1,2,3,4]*Joint International Research Laboratory of Green Buildings and Built Environments (Ministry of Education), Chongqing University, Chongqing 400045, China*

Children spend most of their daytime hours in classrooms attending classes and studying, and particulate matter in classrooms can affect children's health. In this paper, a portable High Efficiency Particulate Air (HEPA) purifier is placed in a primary school classroom, and a controlled experiment is set up to investigate the effects of different outdoor pollution conditions on the indoor particulate matter concentration by monitoring the indoor and outdoor concentrations, and to explore the factors affecting the purification effect of the air purifier. During the experiment, students in the classroom maintained normal learning and living conditions. The results show that the overall particle removal rate increases with the increase of outdoor particle concentration; under similar outdoor PM2.5 concentration, the PM2.5 removal rate of a single air purifier with 3rd gear speed increased by about 10% compared with that of 2nd gear speed, but a single air purifier placed in the corner of a classroom had a poor removal effect, with a removal rate of less than 40%. By comparing the PM2.5 removal efficiencies of air purifiers placed in different locations at 2nd gear and 3rd gear speed, it was found that air purifiers placed at the back of the classroom in a central location were the most effective.

Keywords: air purifier, classroom, high efficiency particulate air (HEPA), particulate matter

[1] Luohaoscmy@163.com
[2] 2115498595@qq.com
[3] ylddonggua@126.com
[4] r.yao@cqu.edu.cn

Luo, *et al.* (2024) A study of the effect of air purifiers on the concentration of particulate matter in primary school classrooms In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 119-126

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

A STUDY OF THE EFFECT OF INDOOR GLARE ON PERSONNEL'S EMOTIONS BASED ON THE PAD (PLEASURE-AROUSAL-DOMINANCE) EMOTION MODEL

Haohang Li, Yanfeng Zhu, Bai Song and Baizhan Li
[1,2,3]*School of Civil Engineering, Chongqing University, Chongqing, 400045, China*

Dynamic natural lighting in offices can influence occupants' emotions and work efficiency. This research aimed to analyse how different office glare environments affect occupants' emotional tendencies using the PAD (Pleasure-Arousal-Dominance) affective model and spatial algorithms, aiming to enhance the emotional experience and work efficiency. Various louvre angles were adjusted to create different indoor lighting environments, with 12 subjects evaluating their emotional responses and glare perceptions using the PAD effective scale. The study found that the use of the PAD model was effective in expressing employees' emotional experiences. Adjusting lighting conditions may reduce anxiety, increase job satisfaction, and enhance job creativity. This research guides enhancing indoor lighting design to improve office personnel's emotional experiences, leading to a more conducive work environment, increased job satisfaction, and enhanced productivity.

Keywords: indoor light environment, natural lighting, PAD emotional model, uncomfortable glare

[1] 202216131427@stu.cqu.edu.cn
[2] 807933806@qq.com
[3] song.bai@stu.cqu.edu.cn
[4] baizhanli@cqu.edu.cn

Li, *et al.* (2024) A study of the effect of indoor glare on personnel's emotions based on the PAD (Pleasure-Arousal-Dominance) emotion model In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 127-137

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

AN EXPERIMENTAL STUDY OF HUMAN ACTIVITY PATTERNS ON PARTICLE RESUSPENSION IN A TEST CHAMBER

Feng Yuan[1], Hao Luo[2], and Runming Yao[3]
[1,2]*Joint International Research Laboratory of Green Buildings and Built Environments (Ministry of Education), Chongqing University, Chongqing, 400045, China*
[3]*School of the Built Environment, University of Reading, UK*

The intensity of human activity is strongly correlated with the particulate matter resuspension concentration. In schools, the intensity of student activity is higher, and their activity patterns are more complex. Characteristics of student activities, such as movement speed, trajectory, the number of participants, and aisle widths, were included in the experimental scenarios. The experimental data showed that the higher the speed, the higher the resuspension concentration. The results between different trajectories showed that the L-shaped trajectory condition had the highest particulate matter resuspension concentration compared to straight and folded trajectories for larger particles. It can be found that people walking in opposite directions need to turn sideways to pass and, therefore change their walking styles and therefore increasing the particle resuspension concentration in crowded conditions. In summary, this study explores the effect of activity patterns on the resuspension of particulate matter and contributes to the effective control of particulate matter pollution levels.

Keywords: activity patterns, indoor air quality, particulate matter, particle resuspension

[1] ylddonggua@126.com
[2] luohaoscmy@163.com
[3] r.yao@cqu.edu.cn

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

ANALYSIS ON OCCUPANT BEHAVIOUR AND ENERGY CONSUMPTION CHARACTERISTICS OF AIR CONDITIONING USAGE IN RESIDENTIAL BUILDINGS

Jingyun Ao[1], Zhaoyang Chen[2] and Chenqiu Du[3]

[1, 2, 3] *Joint International Research Laboratory of Green Buildings and Built Environments (Ministry of Education), Chongqing University, Chongqing 400045, China*

[1, 2, 3] *School of Civil Engineering, Chongqing University, Chongqing 400045, China*

Air conditioning (AC) usage characteristic is one of the main factors affecting the energy consumption of residential buildings. In order to clarify the influence of the behavioural characteristics of AC usage on AC energy consumption, this study conducted large-scale field measurement of 14 houses in Chongqing, a typical city in Hot Summer and Cold Winter (HSCW) zone. Based on the AC energy consumption, indoor temperature and humidity data collected from measurement, AC usage behaviour was analysed using different statistical methods. The results revealed that AC setpoints varied widely among different residences, especially during the heating season. In contrast, the free-running indoor temperature showed a stronger linear correlation with outdoor temperature. The daily average AC operation duration was 6.76h in the cooling season, which was significantly higher than 3.8h in the heating season. The typical AC usage patterns of the cooling and heating season were identified using K-means++ cluster analysis. The research results provide the important information for the study of residential AC usage characteristics. Besides, the study of AC usage behaviour can provide boundary conditions and reliable occupant behaviour settings to improve the accuracy of future AC energy consumption simulation. The results of this study will contribute to the proposal of AC energy-saving measures and the formulation of standards.

Keywords: air conditioner energy consumption, cluster analysis, occupant behaviour, residential building

[1] aojingyun@163.com
[2] 1325507377@qq.com
[3] duchenqiu90@163.com

Ao, Chen and Du (2024) Analysis on occupant behaviour and energy consumption characteristics of air conditioning usage in residential buildings In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 149-157

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

CHARACTERISTICS AND PREDICTION OF AIR CONDITIONERS USE IN RESIDENTIAL ROOMS BASED ON FRACTAL THEORY

Chenghao Fu[1], Meng Liu[2] and Ziqiao Li[3]
[1,2,3]*Joint International Research Laboratory of Green Buildings and Built Environments (Ministry of Education), Chongqing University, Chongqing, China*
[1,2,3]*National Centre for International Research of Low-carbon and Green Buildings (Ministry of Science and Technology), Chongqing University, Chongqing, China*

This study investigates the characteristics of residential room air-conditioning user groups and the fractal characteristics at different time scales based on fractal theory. By analyzing the electricity consumption data of air conditioning systems in 13 residential buildings, various statistical methodologies were employed, including distribution-based descriptive statistics, normality tests, spectral analysis, unifractal analysis, multifractal detrended fluctuation analysis (MFDFA), and Ward's minimum variance hierarchical clustering method. The findings reveal dynamic and multiscale relationships in the usage patterns of air conditioners, characterized predominantly by non-normal and non-linear features, manifesting anti-persistent fractal complexity. Traditional descriptive statistics, which assume Gaussian probability density function (PDF) distributions, proved inadequate in fitting or characterizing the data and its interdependencies effectively. Notably, when comparing clusters of similar usage groups, there were significant categorical and statistical differences between groups characterized by normality-based descriptors such as mean, variance, skewness, and kurtosis, and those characterized by fractal-based descriptors like the Hurst exponent and multifractal spectral width. The statistical outputs from MFDFA offer a novel indicator for assessing the dynamics of residential air conditioner usage. This approach provides a more accurate depiction of complex, nonlinear interactions between asset utilization and occupant behavior without requiring assumptions about the distribution's shape. In addition, the changes in energy use characteristics at different time scales were analyzed using the Hurst index and multifractal spectral width as fractal features. The final results show that there is a significant difference between the traditional statistical method and the analysis method based on the fractal theory in the energy use characteristics of residential air conditioning, and the larger the fractal dimension, the higher the complexity of the time series data, and the higher the accuracy used for the prediction of energy consumption.

Keywords: building energy**,** cluster analysis, fractal theory, HVAC, multifractal detrended fluctuation analysis

[1] chenghaofu1999@163.com
[2] liumeng@cqu.edu.cn

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

DISTRIBUTION AND CHARACTERISTIC ANALYSIS OF INDOOR THERMAL ENVIRONMENT MONITORING POINTS DURING AIR CONDITIONING HEATING

Yong Ding[1], Zonglu Yu[2] and Yinfan Liu[3]

[1,2,3]*Joint International Research Laboratory of Green Building and Built Environment, Ministry of Education, Chongqing University, Chongqing, 400044, China*

[1,2,3]*National Centre for International Research of Low-carbon and Green Buildings, Ministry of Science and Technology, Chongqing University, Chongqing, 400044, China*

To regulate the indoor thermal environment, accurate environmental parameters must be obtained to meet comfort and energy conservation requirements. Indoor environmental parameters are usually acquired through detection and monitoring methods, but the data are influenced by the location and quantity of measurement points. Systematically and reasonably determining the location of monitoring points is the key to ensuring that the results truly reflect the indoor state and to achieve accurate monitoring. This article focuses on the uneven distribution of indoor environmental parameters and explores the state monitoring characteristics in nonuniform environmental spaces. By using actual measurement methods, the temperature and humidity were monitored at various points in the indoor thermal environment involving an up supply with an up return air-conditioning system under winter heating conditions. By analyzing the overall distribution of the monitoring results, the fluctuation characteristics of the measurement points, and the differences in the monitoring points, the characteristic distribution of the indoor thermal environment state could be obtained. Based on feature analysis, a systematic approach and method for indoor environmental state monitoring were developed. For the system in this article, the measurement point on the 1.1-m wall surface can reflect the indoor conditions well and can be employed as the optimal monitoring point. The research results could provide a sound basis for ensuring the accuracy of indoor environmental regulation.

Keywords: indoor thermal environment, State characteristics, monitoring points, correction principles

[1] dingyongqq@163.com
[2] 1041782770@qq.com
[3] 535896937@qq.com

Ding, Yu and Liu (2024) Distribution and characteristic analysis of indoor thermal environment monitoring points during air conditioning heating In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 168-178

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

EVALUATION OF THE AEROSOL TRANSPORT BEHAVIOUR AND INFECTION RISK IN AN ISOLATION WARD BY A CFD MODELLING

Feifei Wang[1], Yikang Wang[2], Yuan Zhang[3] and Xinhua Xu[4]
[1,2,3,4]*School of Environment Science and Engineering, Huazhong University of Science and Technology, Wuhan 430074, China*

This paper develops a dose-response model based on an infection risk evaluation model by a CFD modelling. The effects of ventilation strategies on the aerosol dispersion processes and infection risk in an isolation ward are discussed. The numerical models are first validated by the previous experimental data. It is found that the position of the exhaust outlet has a great influence on the flow field in the ward. In the upper exhaust such as up-supplying and down-exhaust (UD) and under floor air distribution (UFAD) condition, the airflow exhaled from the human's mouth is not fully mixed with the mainstream of the air inlet, and almost directly flows out of the exhaust; while in the lower exhaust such as up-supplying and up-exhaust (UU) and perforated ceiling air supplying (PCAS) condition, the airflow is more chaotic and almost all over the room until being discharged. At the steady state, the upper supplying and exhaust (UU) ventilation strategy results in the least suspended droplets in the ward and thus removes droplets more efficiently than the other three strategies. Therefore, the risk of infection in the ward with the UU ventilation strategy is the lowest, e.g, only 7.98% in the breathing zone plane. Moreover, the risk of infection varies in magnitude for different viruses under the same ventilation strategy, which indicates that the risk of infection is closely related to virus-related parameters, i.e., k-values and viral load. Nevertheless, for all viruses, the infection risk is highest in the UD condition and lowest in the UU condition.

Keywords: CFD simulation, infection risk evaluation, isolation ward, ventilation strategy

[1]ffwang@hust.edu.cn

Wang, *et al.* (2024) Evaluation of the aerosol transport behaviour and infection risk in an isolation ward by a CFD modelling In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 179-190

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

EXPERIMENTAL STUDY OF THE DISINFECTION EFFICACY OF MICROWAVE RADIATION ON A. VARIEGATUS ATTACHED TO THE FILTER

Yuan Zhang[1], Xinhua Xu[2], Feifei Wang[3] and Tian Yan[4]

[1,2,3]*School of Environmental Science and Engineering, Huazhong University of Science and Technology, Wuhan, China*

[4]*School of Civil Engineering and Architecture, Wuhan University of Technology, Wuhan, China*

In the air-conditioning system, traditional filter can only intercept microorganisms but not inactivate them. The microorganisms intercepted will further grow and multiply on the filter, and then enter the room with supply air, causing secondary pollution to the indoor air. To prevent microbial pollution in the air-conditioning system entering indoors, it is very important to disinfect the filter. In this work, the microwave radiation is used to disinfect the filter and a SiC composite filter is proposed and fabricated to enhance the microwave radiation absorption capacity of the general filter. A laboratory-scale microwave disinfection experimental platform for air-conditioning duct is designed and built. The disinfection efficacy of microwave radiation on *A. variegatus* attached to the SiC composite filter and its influencing factors are experimentally studied. The results indicate that the *A. variegatus* attached to the SiC composite filter can be efficiently and rapidly disinfected by the microwave radiation under appropriate conditions. Specially, the disinfection rate of each measuring point on the SiC composite filter can reach more than 90% when the operating power is 700 W and disinfection time is 5 min and about 100% when the disinfection time is extended to 15 min. The disinfection rate can be increased with the increase of operating power and the extension of disinfection time in a certain rang, and the effect of operating power is greater. The research work in this study can provide some reference and data support for the application of microwave disinfection technology in the field of air-conditioning system.

Keywords: air-conditioning system, filter, indoor air quality, microbial contamination ,

[1] hustzhangyuan@hust.edu.cn
[2] bexhxu@hust.edu.cn
[3] ffwang@hust.edu.cn
[4] yantian@whut.edu.cn

Zhang, *et al.* (2024) Experimental study of the disinfection efficacy of microwave radiation on A. Variegatus attached to the filter In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 191-200

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

IMPLICATIONS OF INDOOR HEATING TERMINALS ON ALLERGIC AND RESPIRATORY DISEASES IN CHILDHOOD: REPEATED CROSS-SECTIONAL SURVEYS IN CHINA

Chenyang Wang[1], Wei Yu[2], Shen Wei[3], Haixia Zhou[4] and Yan Zhang[5]

[1,2,4,5]*Joint International Research Laboratory of Green Buildings and Built Environments (Ministry of Education), Chongqing University, Chongqing, China*

[1,24,5]*National Centre for International Research of Low-Carbon and Green Buildings (Ministry of Science and Technology), Chongqing University, Chongqing, China*

[3]*The Bartlett School of Sustainable Construction, University College London (UCL), London, UK*

With the rapid and continuous urbanization process, more Chinese families tend to adopt indoor heating to maintain a suitable environment in the winter. However, few existing have investigated the relationship between type of indoor heating and asthma and allergic rhinitis in childhood in terms of time scales and large-scale urban surveys. To characterize the relationship and variation between the type of heating terminals and asthma and allergic rhinitis in childhood in China from 2010 to 2019. In this study, a repeated cross-sectional study in 4 cities is carried out continuously in China. We used the Pearson test to elucidate the distribution of the method of indoor heating and health outcomes, and the two-level logistic regression model to study the relationship between them. Due to climatic variations and heating policies, the difference in type of indoor heating terminals ($P<0.001$) in China is prominent. Our study reveals a significant difference in the type of heating terminals between the northern and southern cities. During the winter season, a larger proportion of southern might opt for air conditioning for heating (AH) or electric heaters (EH), while floor heating (FH) remains the preferred choice for the majority (>50%) of the northern families. In the north, FH could potentially serve as a protective factor against respiratory and allergic diseases in preschoolers. Similarly, both AH and EH have emerged as protective factors against respiratory and allergic diseases in southern preschoolers. However, FH could potentially pose a risk factor for eczema and rhinitis.

Keywords: method of indoor heating, preschooler, repeated cross-sectional surveys, respiratory diseases, risk assessment

[1] 20231601019@stu.cqu.edu.cn
[2] yuweicqu@cqu.edu.cn
[3] shen.wei@ucl.ac.uk
[4] 220211601063@stu.cqu.edu.cn
[5] 220221601009@cqu.edu.cn

Wang, *et al.* (2024) Implications of indoor heating terminals on allergic and respiratory diseases in childhood: repeated cross-sectional surveys in China In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 201-211

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

INDOOR PARTICLES EXPOSURE AND AIR FILTRATION INTERVENTION ASSOCIATION WITH CHILDREN HEALTH-REVIEW

Tao Zhong[1] and Chenqiu Du[2]
[1]*School of Civil Engineering, Chongqing University, Chongqing 400045, China*
[2]*Joint International Research Laboratory of Green Buildings and Built Environments (Ministry of Education), Chongqing University, Chongqing 400045, China*

Airborne particulate matter can get in the respiratory system to cause an inflammatory reaction, and some might contain allergens such as pollen, mould spores, etc., which can cause allergic reactions that affect the one of the most vulnerable group – children. Studies are reviewed respectively from perspective of from perspective of epidemiology or air quality improvement. Air purifier is one of the most important protective measures. However, the health effects of air filtration interventions on children respiratory system continue to be unclear. Therefore, this review systematically summarizes the international research published in the past 20 years through a main search on WOS, using the search string (pm OR pm exposure) AND (air purifier OR air filtration) and other keywords, selecting the most relevant and influential papers to investigate health effects of air filtration interventions on children. The health effects of air filtration interventions on children respiratory system are counted and discussed to determine whether and to what extent air filtration interventions improved children respiratory system, which can provide a reference for exploring the health assessment of children's exposure to indoor particulate matter, and determining the criteria and public health interventions for reducing indoor particulate matter to improve air quality.

Keywords: air filtration intervention, children, particulate matter, public health, respiratory system

[1] 3479380490@qq.com
[2] duchenqiu90@163.com

Zhong and Du (2024) Indoor particles exposure and air filtration intervention association with children health-review In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 212-228

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

INVESTIGATING THE IMPACT OF THE INDOOR ENVIRONMENTAL QUALITY OF VEHICLES WITH DIFFERENT FUEL TRANSMISSION: EMPHASIS ON PARTICULATE MATTER

Ayub Mohamed[1] and Emmanuel A. Essah[2]
[1,2]School of the Built Environment, University of Reading, Reading, UK

In today's world, human activities have changed, with significant rise in individuals spending more time indoors including other enclosed spaces such as vehicles. Buildings have been extensively researched regarding their indoor environments (IEs). This, however, is not the case with vehicles, even though a substantial amount of time is spent in vehicles due to changes of workers commute patterns. With increased commuters since the Covid pandemic, understanding the IE of automobiles is vital as individuals are spending considerable time in vehicles.The aim of this research is to investigate the IE of vehicles with different fuel transmissions (i.e. petrol, diesel, and electric) and its impact on users. The methodology uses a questionnaire (non-heating and heating season) with an integrated Likert scale to determine the perception of vehicle users during different traffic conditions. 150 participants responded to the questionnaire. In addition, measurements (non-heating season) of $PM_{2.5}$ and PM_{10} were collated for six vehicles of different fuel transmissions. The results from the questionnaire illustrate, in normal conditions, approximately 20% of participants experienced stress and tiredness most of the time, and 10% of individuals rarely experience these sensations. Experimentally, significant variation in pollutant concentrations in the vehicles for the different non-heating season and fuel transmission were observed. 75% of vehicles assessed exceeded acceptable guidelines for some of the monitored pollutants and reached elevated levels for CO_2. Similarly, the air change rate (ACH) was significantly low in some vehicles, and combined with pollutants at elevated levels, this can be a reason as to why drivers' felt stressed and/or tired.The findings presented in this research demonstrates the impact commuting has on the users of vehicles, regardless of vehicle transmission type. It also provides significant synergies noticed in buildings where the accumulation of carbon dioxide is proxy for poor indoor air quality.

Keywords: indoor environments, stress, tiredness levels, vehicle transmission

[1] ayub.mohamed@student.reading.ac.uk
[2] e.a.essah@reading.ac.uk

Mohamed and Essah (2024) Investigating the impact of the indoor environmental quality of vehicles with different fuel transmission: emphasis on particulate matter In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 229-239

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

RELATIONSHIP BETWEEN INDOOR ENVIRONMENT FACTORS OF RESIDENTIAL SETTINGS AND RHEUMATIC DISEASES IN OLDER ADULTS

Ning Gao[1] and Wei Yu[2]
[1,2]School of Civil Engineering, Chongqing University

The aim of this study is to analyze the relationship between indoor environment factors of residential settings and rheumatic diseases in the elderly, and to provide a basis for protecting the health of the elderly. A cross-sectional survey was conducted to investigate whether the elderly aged 60-74 in the main urban area of Chongqing have rheumatic diseases and their symptoms (joint pain, joint swelling, joint stiffness), as well as their indoor environment and health conditions (such as wet characterization.). The results shows that factors such as smoking of family members, new furniture, new decoration, damp clothing and bedding, water damage and window condensation are related to the occurrence of rheumatic diseases and their symptoms. Studies have shown that indoor humidity and air pollution may lead to rheumatic diseases and symptoms in the elderly, and improving the indoor environment can alleviate these symptoms. Specific recommendations include reducing indoor humidity and air pollution, such as avoiding smoking, controlling indoor humidity and dealing with damp and moldy items in a timely manner.

Key words: elderly, indoor environment, regression analysis, rheumatism symptoms,

[1] 2934160659@qq.com
[2] yuweixscq@126.com

Gao and Yu (2024) Relationship between indoor environment factors of residential settings and rheumatic diseases in older adults In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 240-248

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

RESEARCH ON THE CORRECTION METHOD OF CARBON DIOXIDE MONITORING SENSOR IN HUMAN RESPIRATORY ZONE

Heqi Wang[1] and Wei Yu[2]
[1,2]*School of Civil Engineering, Chongqing University, China*

The traditional CO_2 monitoring sensors are often arranged on the wall, but they cannot reflect the CO_2 concentration in the human respiratory zone exactly. This paper aims to explore the correction relationship between the CO_2 concentration in the human respiratory zone and the CO_2 concentration at the monitoring point of the sensor located on the wall, so as to improve the accuracy of the sensor's monitoring of the CO_2 concentration in the human respiratory zone. The CO_2 concentration in the human respiratory zone is measured by a handheld experimental instrument, and the monitoring value is reflected by the CO_2 sensor on the wall. Aiming at a shopping mall in Chongqing, this paper detects the indoor CO_2 concentration under two conditions with the most and least number of people, compared with the monitoring value of the wall CO_2 concentration sensor, to find the correction relationship between the measured value and the monitoring value. Based on the correction coefficient proposed in this paper, the accuracy of CO_2 concentration monitoring sensors monitored CO_2 concentration in human respiratory zone are improved by 12%±2%. To improve the air quality of shopping malls, improve the comfort and satisfaction of customers, and promote economic development to make certain contributions.

Keywords: carbon dioxide sensor, correction factor, human respiratory zone

[1] 437432819@qq.com

Wang and Yu (2024) Research on the correction method of carbon dioxide monitoring sensor in human respiratory zone In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 249-256

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

STUDY ON EFFICIENT REMOVAL TECHNOLOGY OF TOLUENE FROM INDOOR AMBIENT AIR

Jinyang Wang[1], Jinfa Chen[2], Dapeng Chen[3] and Cuixia Yang[4]
[1, 2, 3, 4]*Innovation Research Institute, Guangdong Midea Air-Conditioning Equipment Co., China*

Volatile organic compounds (VOCs) are widely present in various indoor emission sources. Using TiO2 based photocatalysts is currently considered a promising approach for removing toluene, one of the main VOCs. However, the residence time of toluene in the catalyst is too long to meet practical usage conditions using TiO2 and its modified forms until recently. In this study, TiO2 was successfully decorated by SnO2 and Pt to form heterojunction structure using a two-step calcination method. The characterization results indicate that the existence of heterojunction significantly enhances the separation efficiency of photogenerated carriers and holes. The test results demonstrate that the catalyst exhibits excellent toluene removal performance in an extremely short residence time, and it can maintain excellent catalytic activity even after 5 tests. This indicates that the catalyst has broad application prospects in the direction of indoor environmental health.

Keywords: indoor air, photocatalysis, TiO2, toluene, VOCs

[1] wangjy225@midea.com
[2] chenjf148@midea.com
[3] chendp5@midea.com
[4] cuixia.yang@midea.com

Wang, *et al.* (2024) Study on efficient removal technology of toluene from indoor ambient air In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 257-265

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

THE EFFECT OF AIR PURIFIERS ON THE CONCENTRATION OF PARTICULATE MATTER 2.5 -A REVIEW

LiXuan Cheng[1] and Meng Li[2]
[1,2]School of Civil Engineering, Chongqing University, Chongqing, 400045, China

With the increasing emphasis on indoor health environments, it is crucial to thoroughly consider the impact of various indoor factors on human health. One such factor, indoor particulate matter concentration, is often overlooked but has been confirmed to be linked to the development or exacerbation of certain respiratory diseases. This review conducted a comprehensive literature search using Web of Science and Scopus databases to identify relevant research articles and literature within the defined search scope. The aim was to gather and analyze existing data on the impact of air purifiers on indoor particulate matter concentrations. The findings indicate that different air purifiers, as well as other varying factors, have different effects on the concentration of indoor particulate matter. Based on this analysis, the review provides recommendations for the optimal use of air purifiers to reduce particulate matter concentrations and improve indoor air quality. These suggestions aim to guide users in effectively selecting and using air purifiers to create healthier indoor environments.

Keywords: air purifier, indoor air quality, particulate matter

[1] Chenglixuan2019@163.com
[2]13774275319@163.com

Cheng and Li (2024) The effect of air purifiers on the concentration of particulate matter 2.5 -a review In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 267-276

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

THE IMPACT OF DIFFERENT INDOOR MOULD CONCENTRATIONS ON LUNG TISSUE INFLAMMATION IN MICE

Meixing Wu[1], Chenqiu Du[2], Ping Ma[3] and Xu Yang[4]

[1,2]*National Centre for International Research of Low-carbon and Green Buildings (Ministry of Science and Technology), Chongqing University, Chongqing, 400045, China*

[1,2]*Joint International Research Laboratory of Green Buildings and Built Environments (Ministry of Education), Chongqing University, 400045, China*

[3,4]*Key Laboratory of Environmental Related Diseases and One Health, Xianning Medical College, Hubei University of Science and Technology, Xianning 437100, China*

[3,4]*Hubei Industrial Technology Research Institute of Intelligent Health, Xianning 437100, China*

Indoor mould contamination is closely related to the incidence and mortality of lung diseases such as asthma and chronic obstructive pulmonary disease (COPD). Studies suggest that this association may be due to mould-induced inflammation in the lungs. However, existing research has lacked a quantitative evaluation of how mould affects lung inflammation. Therefore, in this study, mice were exposed to mould aerosols with 1500 CFU/m³, 15000 CFU/m³ and 150000 CFU/m³ concentrations. Then the pathological examination of the lungs of mice and the detection of pulmonary inflammatory markers were used to evaluate the severity of inflammatory reaction in each group. The final results showed that mould exposure caused inflammation in the lungs of mice, but the effect was minimal at 1500cfu/m mould concentrations that met the building standards.

Keywords: indoor environmental health, mould exposure, pulmonary inflammation

[1] 1509840809@qq.com
[2] duchenqiu90@163.com
[3] mping68@126.com
[4] yangxu@mail.ccnu.edu.cn

Wu, *et al.* (2024) The impact of different indoor mould concentrations on lung tissue inflammation in mice In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 277-285

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

THE IMPACT OF SHORT-TERM EXPOSURE TO DIFFERENT AIR-CONDITIONING ENVIRONMENTS ON HUMAN THERMAL ADAPTATION

Yu Pan[1], Fangning Shi[2], Zhen Sun[3], Shijing Guo[4] and Haiyan Yan[5]
[1,4,5]College of Architectural and Artistic Design, Henan Polytechnic University, Jiaozuo, Henan, 454000, China
[2]College of Civil Engineering, Hunan University, Changsha, Hunan, 410081, China
[3]College of Architecture, Xi'an University of Architecture and Technology, Xi'an, Shaanxi, 710055, China

This study investigates the short-term effects of air conditioning temperatures on human thermal comfort, which is crucial for optimizing energy savings in building air conditioning systems during summer. Using an experimental research method, the impact of air conditioning environments set at 26℃ and 20℃ on human thermal adaptation was examined in a room at a university in Jiaozuo, Henan Province, China. The experiment included monitoring indoor thermal environment parameters, physiological parameters, and collecting subjective responses through questionnaires.The findings indicate that a lower set temperature, although not accelerating the cooling process, can achieve a lower indoor temperature over time. Compared to the 26℃ condition, subjects under the 20℃ condition experienced lower thermal sensation, thermal sensitivity, and preferred a lower comfortable temperature. Additionally, subjects demonstrated psychological and physiological adaptations to the cooler environment at 20℃. These adaptations manifested as lower skin temperatures, a smaller increase in blood pressure, and a preference for lower comfort temperatures.

Keywords: different air conditioning environments, human adaptability, thermal adaptation, thermal reaction

[1] 1186338476@qq.com
[2] sfn@hnu.edu.cn
[3] sunzhen@xauat.edu.cn
[4] 2871457924@qq.com
[5] yhy@hpu.edu.cn

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

THE OPTIMAL PARAMETERS OF AIRFLOW COMFORT AND VALIDATION IN AIR CONDITIONERS

Yi Liu[1], Bo Wang[2], Yican Wang[3], Junhui Fan[4], Le Zhang[5], Yingxin Zhu[6]
[1, 2, 3, 5] *Guangdong Midea Air-Conditioning Equipment Co. Ltd, 528311 Guangdong, China*
[2] *Chongqing University, 400044 Chongqing, China*
[4, 6] *Tsinghua University, 100084 Beijing, China*

While meeting the basic demand for indoor air conditioning temperatures, the need for airflow comfort is becoming increasingly prominent. This study comprehensively investigates airflow comfort from three dimensions: airflow intensity, perception of airflow velocity variation, and overall enveloping sensation. Here, airflow intensity is defined as the subjective perception of the strength of airflow velocity; the perception of airflow velocity variation refers to the subjective perception of the degree of change in airflow velocity; the overall enveloping sensation refers to the subjective feeling of being surrounded by the airflow environment. Human subject experiments were conducted in an artificial climate chamber. We obtained subjective questionnaires from 76 subjects, 39 males and 37 females, who experienced 10 different combinations of airflow source and air velocity under various environmental conditions. By analysing the preferences of two groups of people - those who like airflow and those who do not - we have determined optimal parameters for airflow comfort. Using these optimal parameters, we designed a new type of air conditioner that has achieved an airflow satisfaction rate of 73.3%. This demonstrates the effectiveness of our device in providing a comfortable environment for users with various needs. These research results provide an important reference for airflow comfort and have profound implications for the design of air conditioners.

Keywords: airflow comfort, air conditioner, dynamic airflow, optimal parameter

[1] 11824036@zju.edu.cn
[2] bo2.wang@midea.com
[3] wangyc44@midea.com
[4] 2942401964@qq.com
[5] zhangle50@midea.com
[6] zhuyx@mail.tinghua.edu.cn

Liu *et al.* (2024) The optimal parameters of airflow comfort and validation in air conditioners In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 296-305

T3 THERMAL COMFORT AND INTELLIGENT OPERATION

A study of corrected skin wettedness levels in a downward outdoor-indoor temperature transient environment – Guo, J., Liu, H. and Chen, G. 41

A study of human perception and response under a high temperature local radiation – Wang, W., He, B. and Liu, H. 43

A study of the effect of long-term thermal history on thermal comfort of indoor occupants in summer climate chamber – Fu, Y. and Liu, H. 45

A study of thermal comfort experienced by postpartum women during sleeping hours – Wang, Y., Yu, W. and Shi, W. 47

Analysis of thermal comfort in indoor air conditioning environment for summer rest in hot summer and warm winter zone – Ma, X., Yu, W., Guo, L. and Zhang, Y. 49

Assessment of the effect of differences in human constitutional characteristics on thermal comfort – Ming, R., Miao, T., Wang, B., Wu, X. and Li, J. 50

Dynamic thermal sensation prediction model of the elderly using a machine learning method – Zhou, S. and Li, B. 51

Effects of different vegetation types on outdoor thermal comfort – Lei, H and Yuan, M. 53

Evaluation of the indoor environment and perceived IEQ: a case study in Norwegian primary schools – Chaulagain, A., Mathisen, H., M., Alam, B., G., Bartonova, A., Fredriksen, M., Høiskar, B., A., K., Gustavsen, K., Canet, A., M., Fredriksen, T. and Cao, G. 55

Experimental study on the thermal environment demand of underground stations in Chongqing – Ding, Y., Liu, Y. and Jiang, X. 57

Heat transfer analysis of separated gravity heat pipe used in a self-activated PCM wall – Xu, D., Yan, T., Xu, X., Wu, W., Long, W, Ming, T. and Wu, Y. 59

Human thermal comfort based dynamic regulation of air conditioning during cooling in residential buildings – Jing, M., Du, C., Zhang N. and Yu W. 60

Investigating the impact of infant BMI values on heat comfort perception in hot summer and cold winter regions – Shi, W., Yu W., Zhou, H. and Wang Y. 61

Predictive control model for regional cooling system combined with ice storage technology – Tang, C. Bao, L. and Li, N. 63

Research on human thermal response in naturally slightly hotter indoor environment – Ding, Y. Zhou, Z. and Zhang, X. 65

Research on thermal comfort influence and improvement strategy of air conditioning dynamic environment – Guo, L., Yu, W., Zhang, Y. and Guo, R. 66

Study on the effect of light environment on human comfort in a warmer office environment – Bai, S., and Li, Z. 67

Study on thermal comfort of postpartum mothers in air-conditioned environment in summer – Huang, X., Yu, W., Du, C. and Zhou, H 68

Study on thermal sensation prediction and temperature satisfaction of air conditioning dynamic environment in winter – Zhang, Y., Yu, W. and Guo, L. 69

The spatiotemporal variation pattern of indoor thermal environment under different set temperatures in summer intermittent convective cooling environment – Guo, S., Sun, Z., Shi, F., Pan, Y. and Yan, H. 71

Thermal comfort in hot summer and cold winter area with retrofitted traditional electric heating devices (Huo Xiang) – Huang, D. and Liu, H. 73

Thermal comfort in urban parks: a review – Zheng, P. and Yao, R 74

Thermal comfort prediction model based on optimized random forest algorithm – Jiang, Y. 75

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

A STUDY OF CORRECTED SKIN WETTEDNESS LEVELS IN A DOWNWARD OUTDOOR-INDOOR TEMPERATURE TRANSIENT ENVIRONMENT

Ji Guo[1], Hong Liu[2] and Guangyi Chen[3]

[1,2,3]*Joint International Research Laboratory of Green Buildings and Built Environments (Ministry of Education), Chongqing University, Chongqing, China*

[1,2,3]*National Centre for International Research of Low-carbon and Green Buildings (Ministry of Science and Technology), Chongqing University, Chongqing, China*

Quantifying physiological states is critical to ensuring human safety in hot environments. This study explored the subjective and sweating characteristics of humans to a sudden drop in temperature following heat stress, an area that is often overlooked. This study examined the differences between the two-node model and the skin surface microenvironment in calculating skin wettedness due to environmental humidity. 24 University students participated in experiments conducted from August to September 2023 in the Artificial Climate Laboratory at Chongqing University. However, the calculated results of the actual sensor measurements are strongly influenced by the ambient temperature and humidity. Therefore, in this study, the Bayesian statistical method was used to correct the final skin wetness value by defining the weights of the two parts of the result as 0.59 and 0.41. The results showed that the corrected skin wettedness values more accurately reflected human heat stress levels than the original values. Males had higher mean skin wettedness ($p<0.01$) and were more susceptible to temperature gradients, compared to females. The new standardized effective temperature (ET^*) correlated strongly with the thermal sensory vote (TSV), with R^2 values of 0.82 and 0.85 for the Ex and Post-Ex phases, respectively. However, temperature dips suppressed the ET^* correlation to TSV, although there was little effect on the correlation of the sweat sensory with the corrected skin wettedness, with temperature dips correlating well with the overall sweat sensory mean value ($WSSMV$) at 24℃, 26℃, and 28℃. correlated well (R^2=0.89, 0.89 and 0.93, respectively). These findings help to extend the dynamic thermal comfort theory.

Keywords: new standard effective temperature, overall sweat sensory mean value, skin wettedness, temperature transient, thermal sensory vote

[1] guojiyyds@163.com
[2] liuhong1865@163.com
[3] 202116131430@cqu.edu.cn

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

A STUDY OF HUMAN PERCEPTION AND RESPONSE UNDER A HIGH TEMPERATURE LOCAL RADIATION

Wen Wang[1], Bo He[2] and Hong Liu[3]
[1,2,3]*School of Civil Engineering Chongqing University, Chongqing,400044, China*

In this paper, the thermal stress of labourers under high temperature local radiation conditions was studied. Fourteen young and healthy subjects were exposed to three different air temperatures (33 ℃, 36 ℃, 39 ℃) in an artificial climate room, and the relative humidity was 60%. In the experiment, two radiation intensity conditions (1.0kW/m^2 and 2.0kW/m^2) were created with an electric heating tube. The subjects moved at a speed of 4.0km/h on a treadmill to simulate moderate labour intensity exercise. During the experiment, the physiological parameters and the subjective thermal sensation and self-induced fatigue questionnaires were filled out. The results show that: the increase in ambient temperature and radiation intensity resulted in a large increase in human skin temperature during the first 20 minutes of the experiment, which then stabilised. The skin temperature at all points was above 34℃, with the highest temperature in the calf and the lowest in the chest. Heart rate, core temperature and other physiological parameters continued to rise during the experiment, and temperature had a greater effect on core temperature than thermal radiation. In addition, radiation intensity had an effect on thermal sensation and fatigue level. The human body will feel more fatigued, and the average fatigue score is rising, which may affect the labour efficiency of workers and may also increase the safety risk of workers. Thus, this paper suggests a combination of subjective questionnaires and objective physiological parameters to improve workers' safety and risk prediction. This study may provide suggestions for worker safety and labour risk under high temperature localised radiation conditions, and may be useful for clothing design and the development of localised cooling devices.

Keywords: high temperature, thermal radiation, subjective perception, thermal response, heat strain risk

[1] wenwangyyds@163.com

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

A STUDY OF THE EFFECT OF LONG-TERM THERMAL HISTORY ON THERMAL COMFORT OF INDOOR OCCUPANTS IN SUMMER CLIMATE CHAMBER

Yingmei Fu[1] and Hong Liu[2]

[1]*Joint International Research Laboratory of Green Buildings and Built Environments (Ministry of Education), Chongqing University, Chongqing, China*
[1, 2]*National Centre for International Research of Low-carbon and Green Buildings (Ministry of Science and Technology), Chongqing University, Chongqing, China*

This study explores the effects of prolonged thermal history on thermal responses and thermal comfort of summer commuters during indoor sedentary recovery. The study is conducted at the Artificial Climate Laboratory of Chongqing University. Subjects are from the south and the north and have different thermal histories. The study design includes concurrent environmental measurements, questionnaires, and physiological measurements of 24 students who perform sedentary activities indoors. In order to remove environmental adaptation effect, the freshmen of Chongqing University are selected as the survey sample. Differences in mean skin temperature (MTSK), mean thermal sensation vote (MTSV), mean thermal comfort vote (MTCV), mean hygrometric sensation vote (MHSV), and water loss are analyzed between populations. It also provides an in-depth analysis of the relevance between thermal sensation and thermal comfort in different populations. The results show there is significant variability in mean skin temperatures of northern and southern subjects, and that mean skin temperatures of southern men (S-M) are significantly higher than that of northern men (N-M). The women show greater variability in thermal sensation with room temperature and are less satisfied with room temperature than men. Men reach their most comfortable state at a thermal sensation of -0.35, while northern (N-W) and southern women (S-W) reach their most comfortable state at a thermal sensation of -0.30 and -0.17, respectively. This study will inform further exploration of summer indoor air conditioning operating temperature ranges suitable for people with different heat history.

Keywords**:** long-term thermal history, skin temperature, thermal response, thermal comfort, thermal sensation

[1]fym13135549751@163.com
[2]liuhong1865@163.com

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

A STUDY OF THERMAL COMFORT EXPERIENCED BY POSTPARTUM WOMEN DURING SLEEPING HOURS

Yuqing Wang[1], Wei Yu[2] and Weiwei Shi[3]
[1, 2 3]*School of Civil Engineering, Chongqing University, Chongqing, 400044, China*

Postpartum women, due to their weakened bodies and susceptibility to sweating, exhibit distinct thermal regulation and comfort preferences compared to typical adults. They tend to favor indoor environments. This study aims to explore the summer air-conditioning habits and thermal comfort of postpartum women during sleeping hours. A survey was conducted in Chongqing in October 2023, revealing that postpartum women prefer higher air-conditioning temperatures while sleeping and prioritize access to fresh air. Additionally, lower Body Fat Percentage (BFP) was associated with higher thermal resistance in clothing and a preference for increased air-conditioning temperatures. Approximately half of the female participants expressed discomfort with the indoor air-conditioning system while sleeping. They expressed a desire for improved indoor air quality, aiming to achieve a sense of stillness without compromising the comfortable temperature. This research holds practical importance in conducting thermal comfort assessments for postpartum women and offers valuable insights for optimizing the thermal and humid environment for this demographic.

Keywords: indoor thermal environment, postpartum, PMV, sleeping hours, thermal comfort

[1] 18602366025@163.com
[2] yuweixscq@126.com
[3] 1765597054@qq.com

Wang, Yu and Shi (2024) A study of thermal comfort experienced by postpartum women during sleeping hours In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 339-348

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

ANALYSIS OF THERMAL COMFORT IN INDOOR AIR CONDITIONING ENVIRONMENT FOR SUMMER REST IN HOT SUMMER AND WARM WINTER ZONE

Xianghui Ma[1], Wei Yu[2], Lei Guo[3] and Yan Zhang[4]
[1,2,3,4]School of Civil Engineering Chongqing University, Chongqing, 400044, China

In regions with hot summers and cold winters, indoor air conditioning has become an indispensable tool due to the impact of high temperatures. In order to investigate the behavioural adaptation characteristics and thermal comfort of young people aged 20-30 who spend long periods indoors during the summer, a questionnaire survey on the thermal comfort of family air conditioning environments for young people was conducted in Guangdong in August 2023. The survey was conducted through interviews and online questionnaires sent via smartphones, with a total of 1000 questionnaires sent and 661 valid responses received. The survey results were analysed using multiple linear regression analysis in Origin and Spearman rank correlation coefficient analysis in the SPSS25 platform. The results showed that young people prefer to set the air conditioning temperature between 25-26°C and prefer air conditioning with medium to low fan speeds. Moreover, most people spend more than 3 hours indoors resting, and as the rest time increases, feelings of stuffiness become stronger. They alleviate this feeling by turning on the air conditioning's fresh air function. This study can provide reference for the summer heat adaptation and indoor environment design of teenagers in regions with hot summers and cold winters.

Keywords: air conditioning environment, hot summer and warm winter zones, thermal comfort, young people

[1] 1119451699@qq.com
[2] yuweixscq@126.com
[3] 2427789612@qq.com
[4] 2306997309@qq.com

Ma, *et al.* (2024) Analysis of thermal comfort in indoor air conditioning environment for summer rest in hot summer and warm winter zone In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 349-357

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

ASSESSMENT OF THE EFFECT OF DIFFERENCES IN HUMAN CONSTITUTIONAL CHARACTERISTICS ON THERMAL COMFORT

Ru Ming[1], Te Miao[2], Bo Wang[3], Xin Wu[4] and Jinbo Li[5]
[1,2,3,4,5]Guangdong Midea Air-Conditioning Equipment Co. Ltd, 528311 Guangdong, China
[1,3]Chongqing University, 400045 Chongqing, China

Individual differences significantly affect thermal comfort. However, it has not been widely studied how to determine human thermal preference based on human constitution characteristics. In this study, a climate chamber experiment was conducted, and fourteen human physiological parameters were tested. According to these 14 physiological parameters, the subjects were divided into three types of people with constitutional characteristics: warmer constitution group (WCG), neutral constitution group (NCG) and colder constitution group (CCG). The influence of physical characteristics on thermal comfort was systematically evaluated, and a predictive model for human thermal preference was established. The results showed that the model could effectively predict human thermal preference based on human physiological parameters, with a prediction accuracy of 0.85. Visceral fat grade, Gender, Age, Body mass index, and Body surface area had a significant effect on human thermal preference, and the weight is 0.305, 0.150, 0.163, 0.140, and 0.210 respectively. This study contributed to the design of optimal indoor environments and air conditioning control for occupants with different constitutions.

Keywords: air conditioner control, constitutional characteristic, decision tree model, thermal comfort, thermal preference

[1] mingru@midea.com
[2] miaote@midea.com
[3] bo2.wang@midea.com
[4] wuxin8@midea.com
[5] lijb@midea.com

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

DYNAMIC THERMAL SENSATION PREDICTION MODEL OF THE ELDERLY USING A MACHINE LEARNING METHOD

Shan Zhou[1] and Baizhan Li[2]
[1,2]*Joint International Research Laboratory of Green Buildings and Built Environments (Ministry of Education), Chongqing University, Chongqing, 400045, China*

Accurately predicting elderly people's thermal sensations under dynamic thermal environments can help to improve their living quality and prevent discomfort. This study aims to investigate thermal responses of the elderly under dynamic thermal environments and predict elderly people's thermal sensation votes using the random forest algorithm. The algorithm includes input parameters of thermal environments and physiological parameters, as well as the output parameter of thermal sensation. A series of climate chamber experiments were conducted to collect fundamental data for local skin temperature and thermal sensation. The experiments were designed with temperature step changes to simulate dynamic thermal environments. Thermal sensation vote and local skin temperatures were collected. Results show under the same air temperature, TSV becomes lower after cold exposure. The feature importance results show that the most influential three parameters are time, air temperature, and hand temperature. The random forest algorithm showed high prediction performance, and the algorithm can be applied to a broad range of dynamic thermal environments for the elderly. This study can contribute to indoor thermal design for the elderly and comprehensively evaluate dynamic thermal environments.

Keywords: dynamic environment, elderly, machine learning, skin temperature, thermal sensation

[1] shanzhou@cqu.edu.cn
[2] baizhanli@cqu.edu.cn

Zhou and Li (2024) Dynamic thermal sensation prediction model of the elderly using a machine learning method In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 367-376

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

EFFECTS OF DIFFERENT VEGETATION TYPES ON OUTDOOR THERMAL COMFORT

Huiting Lei[1] and Mengwei Yuan[2]
[1,2]*International Research Laboratory of Green Buildings and Built Environments (Ministry of Education), Chongqing University, Chongqing, China*

Climate change is leading to higher surface and air temperatures in cities, which will affect the perceived outdoor thermal environment. Previous studies have shown that vegetation is effective in improving outdoor thermal comfort and that different vegetation types have different effects on outdoor thermal comfort. Due to the differences in the responsiveness of different urban form types to the thermal environment, there is still uncertainty about the effect of urban form on the ability of different vegetation type configurations to improve outdoor thermal comfort. This paper investigates this issue by comparing the human energy balance of different vegetation type configurations in three different Local Climate Zones (LCZs). The study selected three different types of zones in Shapingba District, Chongqing Municipality, namely LCZ high-density high-level + LCZB sparse forest, LCZ5 low-density mid-level + LCZB sparse forest, and LCZ5 low-density mid-level + LCZA dense forest, and three test sites were selected for each zone, which were man-made ground, a single lawn, and an arbor-shrub vegetation combination. The results of the study show that the tree-shrub composite vegetation form has the effect of significantly reducing the heat gain of the human body under the tree (up to 179 W/m^2), which is mainly because the tree affects the radiation absorbed by the human body under the tree (up to 148 W/m^2), but it is difficult to fully achieve the thermal comfort state by only relying on the passive design of tree-shrub composite. In addition, we suggest that for low-density and low-storey residential areas, the optimal greening configuration is tree-irrigation composite + small lawn, while for high-density and high-storey residential areas, the vegetation type configuration should minimise the use of a single lawn, and use as many tree-irrigation plants as possible for greening.

Keywords: COMFA model, human thermal comfort, local climate zones, outdoor thermal environment

[1] p0o9_q1w2e3@163.com
[2] 378103713@qq.com

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

EVALUATION OF THE INDOOR ENVIRONMENT AND PERCEIVED IEQ: A CASE STUDY IN NORWEGIAN PRIMARY SCHOOLS

Aayam Chaulagain[1], Hans Martin Mathisen[2], Azimil Gani Alam[3], Alena Bartonova[4], Mirjam F Fredriksen[5], Britt Ann Kåstad Høiskar[6], Kai Gustavsen[7], Alfred Mansanet Canet[8], Tore Fredriksen[9] and Guangyu Cao[10]

[1,2,3,10]*Department of Energy & Process Eng., Norwegian University of Science & Technology, Trondheim - Norway*
[4,5,6]*Norwegian Institute of Air Research (NILU), Lillestrøm - Norway*
[7]*Norwegian Asthma and Allergy Association (NAAF), Oslo - Norway*
[8,9]*Oslobygg KF - Oslo municipality, Oslo - Norway*

Indoor environment quality (IEQ) plays important role for occupants' wellness, particularly students and their study's performance in education facilities. The objective of this study is to evaluate IEQ-based on thermal environment (TE) and atmospheric environment (AE), in two Norwegian primary schools' classrooms. Field IEQ measurements and user feedback were two methods to collect data. Data collected from field measurements described measured IEQ and web-based questionnaire named as IS survey provided students' perception on IEQ. Data evaluation was carried out for 16 and 13 days at Bratteberg and Øyra respectively. With necessary scaling data to one day form, theoretical calculations were performed to evaluate IEQ and to know the relationship between measured and perceived IEQ. Measured TE and AE as per standard most of the time of category A. Significant difference was seen on perceived air quality dissatisfied (PAPD) and Percentage Dissatisfied (PD) as a function of CO_2. The difference was up to 52±1% with highest PDs. Volatile Organic Compound (VOC) concentration of classroom related PAPD with R^2 of 0.81 and 0.94 in each of the two schools, pointing it out as a prominent reason for high PAPD. This study showed that PD as a function of only one variable such as CO_2 will underrepresent the PD with air quality.

Keywords: atmospheric environment, indoor environment quality, perceived air quality, percentage dissatisfied, thermal environment

[1] shishirchaulagain9898@gmail.com
[2] hans.m.mathisen@ntnu.no
[3] azimil.g.alam@ntnu.no
[4] aba@nilu.no
[5] mff@nilu.no
[6] bah@nilu.no
[7] kai.gustavsen@naaf.no
[8] alfred.mansanet@osloskolen.no
[9] tore.fredriksen@obf.oslo.kommune.no
[10] guangyu.cao@ntnu.no

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

EXPERIMENTAL STUDY ON THE THERMAL ENVIRONMENT DEMAND OF UNDERGROUND STATIONS IN CHONGQING

Yong Ding[1], Yan Liu[2] and Xiangting Jiang[3]

[1, 2, 3] *Joint International Research Laboratory of Green Building and Built Environment, Ministry of Education, Chongqing University, Chongqing 400044, China*

[1, 2, 3] *National Centre for International Research of Low-carbon and Green Buildings, Ministry of Science and Technology, Chongqing University, Chongqing 400044, China*

The demand for thermal comfort in underground stations significantly differs due to the influence of access and activity characteristics of passengers. The actual thermal environment distribution and thermal comfort state feedback of passengers are not completely consistent with the current characteristics required in standards according to actual measurements as well. Therefore, this study conducted a 4-year on-site thermal environment test and questionnaire survey on the thermal environmental demand of representative underground stations in Chongqing, China. The results showed that the main influencing factors and control points of different station parts differ in winter and summer, and a certain temperature difference that the platform temperature be approximately 1°C higher than that of the concourse mezzanine was necessary in summer but no additional measures are needed to maintain the temperature difference in winter, based on which parameter settings for each part were proposed. This research could provide a basis for the reasonable determination of thermal environment parameters and the design of environmental control systems at underground stations.

Keywords: temperature gradient, thermal comfort, thermal environmental demand, underground station

[1] dingyongqq@163.com
[2] 202216131240t@stu.cqu.edu.cn
[3] 644659637@qq.com

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

HEAT TRANSFER ANALYSIS OF SEPARATED GRAVITY HEAT PIPE USED IN A SELF-ACTIVATED PCM WALL

Dawei Xu[1], Tian Yan[2], Xinhua Xu[3], Wei Wu[4], Wen Long[5], Tingzhen Ming[6] and Yongjia Wu[7]

[1,3,5]*Department of Building Environment & Energy Engineering, Huazhong University of Science & Technology, China*
[2,6,7]*School of Civil Engineering and Architecture, Wuhan University of Technology, China*
[4]*School of Energy and Environment, City University of Hong Kong, Hong Kong, China*

Self-activated phase change material (PCM) wall integrated with separated gravity heat pipe (SGHP) and the radiant cooler is a novel wall system using the space cold energy to meet carbon peaking and neutrality goals. The SGHP is the key component for heat transport from the wall to the radiant cooler without using mechanical energy. Its heat transfer effects directly affect the thermal performance of the wall system. In this study, a visual heat transfer experimental platform was built using devices such as a transparent quartz glass SGHP. The thermal characteristics of the SGHP at different evaporation end temperatures were obtained by experiments. Results show that, when the boundary temperature of the evaporation end is 40 ℃ and the boundary temperature at the condensation end (air) is 20.6 ℃, the average heat flux q_{con} at the condensation end of the SGHP is about 91.9 W/m^2. Further experimental results indicate that for the evaporation end temperature of 32-40 ℃, the heat transfer intensity at the condensation end of the SGHP can reach 51.6~91.9 W/m^2. The research findings can provide a theoretical reference and data support for the design application and operational optimization of SAPCM-RSC walls.

Keyword: experiment, evaporation and condensation, low-energy building, separated gravity heat pipe, thermal characteristics

[1] daweixu2000@qq.com
[2] yantian@whut.edu.cn
[3] bexhxu@hust.edu.cn
[4] weiwu53@cityu.edu.hk
[5] M202274076@hust.edu.cn
[6] tzming@whut.edu.cn
[7] yjwu2019@whut.edu.cn

Xu, *et al.* (2024) Heat transfer analysis of separated gravity heat pipe used in a self-activated PCM wall In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 411-421

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

HUMAN THERMAL COMFORT BASED DYNAMIC REGULATION OF AIR CONDITIONING DURING COOLING IN RESIDENTIAL BUILDINGS

Mingyi Jing[1], Chenqiu Du[2], Na Zhang[3] and Wei Yu[4]
[1,2,3,4]*National Centre for International Research of Low-carbon and Green Buildings (Ministry of Science and Technology), Chongqing University, Chongqing, 400045, China*
[1,2,3,4]*Joint International Research Laboratory of Green Buildings and Built Environments (Ministry of Education), Chongqing University, 400045, China*

In order to explore the method of dynamic adjustment of air conditioner temperature to satisfy personnel's thermal comfort needs, this study carried out a thermal comfort experiment of dynamic adjustment of temperature in simulated cooling mode (24-28°C) by taking household split air conditioner as an example, and set up four temperature change intervals of 26-24°C, 28-24°C, 28-26°C, 26-28°C, four rates of temperature change of ±2°C/0.5h, ±2°C/1h, +4°C/ 0.5h & -4°C/0.67h, ±4°C/1h, and three cold stimulus application times, namely, initial and final time period - short time, initial and final time period, and intermediate time period, were tested under 10 working conditions, and the physiological parameters and subjective evaluations of 24 subjects were tested. The results showed that under the experimental working conditions, the personnel's thermal sensation vote TSV ∈ ±0.4 and the thermal comfort vote were distributed in the range of (0.2, 1.6) (0 - neutral, 1 - slightly satisfied, and 2 - very satisfied), indicating that the 10 working conditions could satisfy thermal comfort well. The comfort of each working condition was comprehensively evaluated by the factor analysis method, and it was found that the personnel thermal comfort was best in the 26-28℃-±2℃/0.5h-beginning and end cold stimulus regulation mode, and second best in the 28-24℃-+4℃/0.5h & -4℃/0.67h, and then the optimised air conditioning cooling temperature dynamic regulation strategy was proposed: 26℃ (30min)-24℃ (30min)-28℃ (30min) cycle regulation. The results provide theoretical support for the dynamic regulation of air-conditioning temperature to meet the thermal comfort needs of human.

Keywords: dynamic regulation strategy, factor analysis method, human thermal comfort, split air conditioners, temperature regulation

[1] jingmy127@163.com
[2] duchenqiu90@163.com
[3] 1292541208@qq.com
[4] yuweixscq@126.com

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

INVESTIGATING THE IMPACT OF INFANT BMI VALUES ON HEAT COMFORT PERCEPTION IN HOT SUMMER AND COLD WINTER REGIONS

Weiwei Shi[1], Wei Yu[2], Haixia Zhou[3] and Yuqing Wang[4]
[1,2,3,4]*School of Civil Engineering Chongqing University, Chongqing, 400044, China*

The difference in BMI of infants leads to different responses to heat, but their communication or self-regulation abilities are limited, thus requiring in-depth research on thermal comfort. This study aims to explore the impact of different BMI values on thermal comfort among infants in Chongqing, China, and provide theoretical basis for the control of indoor thermal and humid environment for infants. This study conducted a questionnaire survey on the habits and behavioural characteristics of air conditioning settings in infants and young children aged 0-3 under different activity scenarios in Chongqing, China. The study investigated the correlation between the BMI value of infants and their thermal comfort and discomfort symptoms. The questionnaire was filled out by mothers who observed their objective physiological characteristics. The results indicate that due to the high metabolic rate of infants and their poor adaptability to cold and hot environments, there are differences in thermal comfort compared to ordinary adults. Spearman correlation analysis showed a significant positive correlation (correlation coefficient -. 245 * *) between BMI values and calculated PMV values in infants. In addition, 68.7% of infants will experience one thermal discomfort symptom during sleep, and over 30% of infants will experience multiple thermal discomfort symptoms. Among them, infants with higher BMI values are more likely to experience heat discomfort symptoms. This study can provide a scientific basis for designing and creating a safe and comfortable living environment for infants, promoting their healthy growth.

Keywords: BMI value, infants and young children, symptoms of thermal discomfort, thermal comfort

[1] 1765597054@qq.com
[2] yuweixscq@126.com
[3] zhouhaixia@cqu.edu.cn
[4] 18602366025@163.com

Shi, *et al.* (2024) Investigating the impact of infant BMI values on heat comfort perception in hot summer and cold winter regions In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 439-448

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

PREDICTIVE CONTROL MODEL FOR REGIONAL COOLING SYSTEM COMBINED WITH ICE STORAGE TECHNOLOGY

Chuanyu Tang[1], Linqing Bao[2] and Nan Li[3]
[1,2,3]*School of Civil Engineering, Chongqing University, Chongqing, 400045, China*
[3]*National Centre for International Research of Low-carbon and Green Buildings, Ministry of Science & Technology, Chongqing University, Chongqing, 400044, China*

Due to the hot climate, energy consumption for refrigeration is significantly higher in the subtropical monsoon climate region. Combined with renewable energy and ice storage technology, a model predictive control model of regional cooling system is proposed, which is conducive to improving the flexibility of regional cooling system and the ability of peak shifting and valley filling. In this model, BP neural network optimized by artificial bee colony (ABC) is used to predict the cooling load of the regional cooling system, and the model parameter identification method is adopted, combined with river water source heat pump and ice storage technology, to make full use of renewable energy and maximize the capacity of peak shifting and valley filling, and to establish an optimization strategy model of the regional cooling system. The results show that the load prediction algorithm of ABC-BP neural network has a high accuracy, and the variance coefficient of load prediction root-mean-square error is 16.67%, which is lower than BP, SVR and LSTM. In addition, compared with the three control strategies of chiller priority, ice storage priority and fixed proportion, the operation strategy optimized by comprehensive model can reduce the average daily cost by 19.20%, 4.45% and 5.10%, respectively, and the maximum daily energy consumption by 30.02%, 18.08% and 8.90%, respectively. The results show that the integrated predictive control model has significant economic and social benefits.

Keywords: district cooling system, HVAC, ice storage technology, load forecasting, optimization strategy

[1] 1246431511@qq.com
[2] 18883209080@163.com
[3] nanlicqu@126.com

Tang, Bao and Li (2024) Predictive control model for regional cooling system combined with ice storage technology In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 449-457

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

RESEARCH ON HUMAN THERMAL RESPONSE IN NATURALLY SLIGHTLY HOTTER INDOOR ENVIRONMENT

Yong Ding[1], Zhiru Zhou[2] and Xuejuan Zhang[3]

[1,2,3]*Joint International Research Laboratory of Green Building and Built Environment, Ministry of Education, Chongqing University, Chongqing 400044, China*

[1,2,3]*National Centre for International Research of Low-carbon and Green Buildings, Ministry of Science and Technology, Chongqing University, Chongqing 400044, China*

There is a clear difference between people's hot and cold sensations and the range of acceptable temperatures in naturally slightly hotter environment and an air-conditioned environment. In order to explore the difference of human thermal response, the acceptable thermal environment state of personnel, and the relationship between thermal sensation and body parts in the natural thermal environment, this paper takes the hot summer area as the research object to explore the law of human thermal response in the indoor thermal environment of buildings. Human thermal comfort experiments were conducted using a combination of on-site thermal environment measurements, physiological parameter measurements and subjective questionnaires. The results of the study clarified the boundaries of the acceptable temperature range of the human body, proposed representative representational sites of thermal sensation in summer, discovered the thermal adaptation characteristics of personnel in a hotter environment, and provided comments for the development of standards related to thermal comfort. The results of the study can provide a basic basis for further rational determination of natural room temperature environment evaluation and environment efficient creation and provide a simpler state perception object and a more direct regulation object for the subsequent thermal environment comfort regulation.

Keywords: human thermal response patterns, naturally slightly hotter environment, thermal sensation representation sites, thermal adaptation characteristics

[1] dingyongqq@163.com
[2] 2970260295@qq.com
[3] 1020115124@qq.com

Ding, Zhou and Zhang (2024) Research on human thermal response in naturally slightly hotter indoor environment In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 459-470

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

RESEARCH ON THERMAL COMFORT INFLUENCE AND IMPROVEMENT STRATEGY OF AIR CONDITIONING DYNAMIC ENVIRONMENT

Lei Guo[1], Wei Yu[2], Yan Zhang[3] and Rui Guo[4]
[1,2,3,4] *School of Civil Engineering Chongqing University, Chongqing, 400044, China*

The current air-conditioning environment is usually a steady-state thermal environment, which makes the human body in a thermal neutral state for a long time, resulting in weakened adaptability and prone to morbid building syndrome. Most of the existing dynamic control methods of air conditioning are based on PMV theory, but their accuracy is limited in dynamic environment. At present, the suitable range of dynamic air conditioning environment in relevant research results is not clear and there are few experimental verifications related to dynamic adjustment strategies. In order to create a more comfortable thermal environment, this paper creates a dynamic temperature air-conditioning environment in the artificial climate chamber in Chongqing based on experimental research. During the experiment, the environmental, human physiological and subjective parameters were collected, the predictive thermal sensation (PTS) model was established based on the standard effective temperature (SET), the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method is used to rank the dynamic conditions. According to the analysis results, it can be concluded that the neutral thermal sensation temperature in summer, the optimal SET temperature with the lowest dissatisfaction rate, and the comfort range of grade I are 26℃, 24.9℃, [23.6℃, 27.3℃], respectively. According to the TOPSIS analysis results, 26-24℃ (Increase/decrease 2℃ every 0.5 hour) is the best, followed by 28-24℃ (Increase/decrease 4℃ every 0.5 hour). Finally, the comprehensive analysis results give the optimization control strategy of air conditioning dynamic environment.

Keywords: dynamic conditions, indoor environment, PTS model, TOPSIS, thermal comfort

[1] gleikyyj@163.com
[2] yuweixscq@126.com
[3] 2306997309@qq.com
[4] 2045149419@qq.com

Guo, *et al.* (2024) Research on thermal comfort influence and improvement strategy of air conditioning dynamic environment In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 471-481

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

STUDY ON THE EFFECT OF LIGHT ENVIRONMENT ON HUMAN COMFORT IN A WARMER OFFICE ENVIRONMENT

Shouyuan Bai[1] and Zhongzhe Li[2]
[1, 2]*International Research Laboratory of Green Buildings and Built Environments (Ministry of Education) Chongqing University, Chongqing, China*

Indoor thermal and light environments are the key factors of indoor environmental quality (IEQ), which affect the human comprehensive comfort. In the actual environment, there is an interactive effects between indoor thermal environment factors and light environment factors, which comprehensively affect the human comfort. Therefore, this paper focus on the influence of light environment (illuminance, CCT) on human comfort in a warm office environment. The experiment adopts a full factorial design, combining subjective questionnaires and objective measurements, to study the effects of different combinations of illuminance (150lx, 500lx and 1000lx) and correlated colour temperatures (CCT) (2700K, 4000K and 6200K) on the comfort of office workers in a warm office environment at 29°C. For the creation of the experimental environment, we chose to use ducted ceiling air supply with a DC fresh air fan and Philips Lighting CW dual-colour light strips to create the thermal environment and light environment for the experiment respectively. The sequence of experimental conditions was also designed using the Latin square balance method to balance the possible fatigue effects of the 16 subjects participating in the test. The results of the study showed that illuminance and CCT both had a significant effect on light perception, but illuminance had a greater effect. In warmer environments, high CCT can improve thermal perception as well as work performance through a variety of mechanisms, and can improve comprehensive satisfaction through a reasonable pairing with illuminance. Based on the results of this study, a more comprehensive and holistic understanding of the components of comfort can be achieved, which provides a certain scientific basis and theoretical foundation for future research on the integrated comfort of more factors, and enhances people's quality of life and work efficiency in these environments.

Keywords: comprehensive comfort, interactive effects, thermal and light composite environments

[1] baishouyuan1759@163.com
[2] zhongzheli@cqu.edu.cn

Bai and Li (2024) Study on the effect of light environment on human comfort in a warmer office environment In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 482-493

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

STUDY ON THERMAL COMFORT OF POSTPARTUM MOTHERS IN AIR-CONDITIONED ENVIRONMENT IN SUMMER

Xin Huang[1], Wei Yu[2], Chenqiu Du[3] and Haixia Zhou[4]
[1,2,3,4]School of Civil Engineering Chongqing University, Chongqing, 400044, China

The high temperature environment in summer is easy to affect the health of postpartum mothers. It is of great significance to study the thermal comfort behaviour characteristics of postpartum mothers in air conditioning environment in summer to improve their quality of life. In this study, 189 postpartum mothers in Chongqing, China were selected as subjects, and the subjective evaluation data of postpartum mothers on thermal environment were collected through questionnaires, and the thermal adaptive behaviour of postpartum mothers was statistically analyzed with mathematical methods. Research shows that 85% of postpartum mothers feel comfortable with indoor air conditioning environment, and 84% of postpartum mothers are satisfied with indoor air quality; Postpartum mothers are more sensitive to temperature, humidity and wind speed, and prefer warmer temperatures. They prefer 25-26 ℃ and 26-27 ℃when sleeping, and 25-26 ℃ when active. Air conditioning wind speed is more willing to choose low-speed wind. Clothing has high thermal resistance and is easy to produce discomfort, which can improve the comfort of postpartum mothers from the perspective of reducing discomfort symptoms. In addition, postpartum mothers have higher requirements for fresh air. This study helps to develop thermal comfort products and services that are more suitable for postpartum mothers in summer and improve their happiness and life satisfaction.

Keywords: air-conditioning, hot summer regions, cold winter regions, postpartum mothers, thermal comfort

[1] 841388132@qq.com
[2] yuweixscq@126.com
[3] duchenqiu90@163.com
[4] 641499266@qq.com

Huang *et al.* (2024) Study on thermal comfort of postpartum mothers in air-conditioned environment in summer In: Laryea, S. *et al. (*Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 494-504

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

STUDY ON THERMAL SENSATION PREDICTION AND TEMPERATURE SATISFACTION OF AIR CONDITIONING DYNAMIC ENVIRONMENT IN WINTER

Yan Zhang, Wei Yu and Lei Guo
[1]*School of Civil Engineering Chongqing University, Chongqing, 400044, China*

A suitable dynamic environment is beneficial to human health and energy conservation. However, the research on thermal comfort under indoor dynamic temperature changing environment is scarce. This study analyzed the preference temperature and influencing factors of thermal sensation under variable temperature environment by split air conditioner. A variety of variable temperature heating conditions were set up to simulate the thermal comfort experiment of personnel resting for a long time. The thermal sensation and thermal comfort at different operating temperatures were studied by subjective questionnaires and environmental parameters. According to our findings, in the variable temperature environment in winter, the thermal sensation of personnel is affected by operating temperature ($p<0.01$) and operating temperature change rate ($p<0.01$). The increase of operating temperature increases the thermal sensation. When people rest in the room for a long time, the decrease of heart rate cause the decrease of thermal sensation. In the variable temperature environment of air conditioning, the thermal neutral temperature is 19 °C (operating temperature). When the actual operating temperature of the personnel area is 19 ~ 24 °C, the temperature satisfaction rate is roughly proportional to the thermal sensation. It is concluded that the heating time can be extended appropriately to increase the thermal sensation and improve the satisfaction. When people stay in the room, the decrease in thermal sensation caused by decreased metabolism can be offset by increasing the temperature in winter. This paper provides support for feasible dynamic temperature control strategies.

Keywords: air conditioning, dynamic environment, operating temperature, satisfaction rate, thermal sensation

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

THE SPATIOTEMPORAL VARIATION PATTERN OF INDOOR THERMAL ENVIRONMENT UNDER DIFFERENT SET TEMPERATURES IN SUMMER INTERMITTENT CONVECTIVE COOLING ENVIRONMENT

Shijing Guo[1], Zhen Sun[2], Fangning Shi[3], Yu Pan[4] and Haiyan Yan[5]
[1]*Henan Polytechnic University,China*
[2]*Xi'an University of Architecture and Technology, China*
[3]*Hunan University, China*

Due to the summer split air conditioner convection cooling characteristics of the thermal environment in time and space will have different patterns of change, in order to understand the split air conditioner cooling in different cold exposure intensity of the indoor thermal environment of the spatial and temporal changes in the indoor thermal environment, through the experiments to collect the set temperature of 28℃, 26℃, 20℃ under three conditions of the thermal environment parameters, according to the organization of the indoor airflow will be divided into the indoor thermal environment of the jet zone and reflux zone. The indoor thermal environment is divided into jet zone and return zone according to the indoor airflow organisation. It is found that the indoor thermal environment is characterised by dynamic changes due to the phased changes in the air supply parameters at the air conditioning outlet. The spatial distribution of temperature and air velocity in the jet zone is less uniform than that in the return zone during the falling phase of air conditioning operation. It is found that the jet zone in the horizontal direction and at 0.1 m is more obviously affected by convection cooling, with lower air temperature and higher air velocity, and this study can provide a theoretical basis for the design of the indoor thermal environment of intermittent convection-cooled buildings as well as air-conditioning operation.

Keywords: convection cooling, split air conditioning, thermal environment, spatial and temporal characteristics,

[1] 2871457924@qq.com
[2] sunzhen@xauat.edu.cn
[3] sfn@hnu.edu.cn
[4] 1186338476@qq.com
[5] yhy@hpu.edu.cn

Guo, *et al.* (2024) The spatiotemporal variation pattern of indoor thermal environment under different set temperatures in summer intermittent convective cooling environment In: Laryea, S. *et al. (*Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 515-525

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

THERMAL COMFORT IN HOT SUMMER AND COLD WINTER AREA WITH RETROFITTED TRADITIONAL ELECTRIC HEATING DEVICES (HUO XIANG)

Dilong Huang[1] and Hong Liu[2]
[1, 2]*School of Civil Engineering, Chongqing University, Chongqing 400044, China*

This study aims to investigate the thermal comfort provided by retrofitted Huo Xiang devices in regions characterized by hot summer and cold winter, and to explore the differences in performance among the two retrofit types and the traditional type. The traditional Huo Xiang was retrofitted in two ways, (1) Air fan form retrofitted Huo Xiang, (2) Fin form retrofitted Huo Xiang. Sixteen subjects evaluated both the traditional and retrofitted Huo Xiang devices within an artificial climate chamber at Chongqing University at set temperatures of 12, 14, and 16 °C. Measurements of skin temperatures and subjective thermal perceptions were taken and analyzed under these conditions. Results indicated that subjects experienced enhanced overall sensation and comfort within 15 minutes of activating the devices, highlighting the potential of these retrofitted units in improving winter indoor thermal comfort in hot summer and cold winter regions. Furthermore, a comparative analysis of heating devices based on similar principles showed that outcomes varied significantly across different parts of the human body, with the air fan form of retrofitted Huo Xiang receiving the highest preference among the tested devices.

Keywords: Huo Xiang, personal comfort system, personal heating system, thermal comfort

[1] 30025552@365cqu.onmicrosoft.com
[2] liuhong1865@163.com

Huang and Liu (2024) Thermal comfort in hot summer and cold winter area with retrofitted traditional electric heating devices (Huo Xiang) In: Laryea, S. *et al. (*Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 527-535

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

THERMAL COMFORT IN URBAN PARKS: A REVIEW

Peiping Zheng and Runming Yao
[1,2]*Joint International Research Laboratory of Green Buildings and Built Environments (Ministry of Education), Chongqing University, Chongqing, 400045, China*
[2]*School of the Built Environment, University of Reading, UK*

A satisfactory thermal environment in urban parks has an important impact on people's health and energy consumption. However, the influence of design factors on thermal comfort in urban parks has not been thoroughly reviewed. The purpose of this study is to review the design factors affecting the thermal comfort in urban parks. The results show that compared with summer, people are generally less sensitive to temperature changes in winter. And the widths with neutral temperature ranges such as PET (Physiological Equivalent Temperature) and UTCI (Universal Thermal Climate Index) in winter is wider. The combination of trees, water, grass and other landscape factors may have a surprising effect on the thermal comfort in urban parks. Moreover, user characteristics (such as gender, age, psychology and behaviour) that affect the thermal comfort in urban parks.

Keywords: design factors; outdoor environment, thermal comfort; urban parks

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

THERMAL COMFORT PREDICTION MODEL BASED ON OPTIMIZED RANDOM FOREST ALGORITHM

Yonghao Jiang[1]
[1]*School of Civil Engineering, Chongqing University, China*

The current thermal comfort prediction models based on the random forest classification algorithm mostly employ the average majority voting rule, which cannot distinguish between strong and weak classifiers, and lack interpretability in feature selection. Therefore, on the one hand, according to the class imbalance characteristics of the thermal comfort data set, the Kappa coefficient is introduced to evaluate the voting ability of the decision tree in the forest when classifying, and perform weighted voting. On the other hand, the SHAP values are introduced to quantify the contribution of each feature to the model prediction, adding interpretability to feature selection. In this study, relevant data on thermal comfort of young people in office buildings in Chongqing during the summer under 12 typical working conditions of temperature and wind speed were obtained through on-site measurements and questionnaire surveys. An optimized random forest algorithm was used to train the model, increasing the accuracy of temperature expectation by 4.4% and wind speed expectation by 4.6%. The optimal input parameters for temperature (wind speed) expectation prediction model were found to be workstation temperature, forehead skin temperature, and forearm skin temperature. This study provides new theoretical and methodological references for machine learning-based thermal comfort prediction models and feature selection.

Keywords: Kappa coefficient, random forest, SHAP values, thermal comfort

[1] 2302510704@qq.com

Jiang (2024) Thermal comfort prediction model based on optimized random forest algorithm In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 545-554

T4 LOW CARBON TECHNOLOGY AND ENERGY SYSTEM

A general energy saving potential evaluation method of a pipe-embedded wall integrated with natural energy based on revised degree hour – Fan, S., Yan, T., Tang, X., Yu, Z., Li, X., Lyu, W. and Xu, X. 77

A low-carbon distributed energy system suitable for residents in mountainous areas of southwestern China: a case study of Weining County in Guizhou Province – Zhang, Z. and Xiao, Y. 78

Achieving sustainability in student housing: nexus of student housing design and energy use behaviour in northern Ghana – Appau, W. M., Anugwo, I. C., Attakora-Amaniampong, E. and Simpeh, F. 79

Comprehensive life cycle assessment of carbon emissions in the construction industry: a review of methods, tools, and applications – Zhu, T., Hua, J., Huang, L. and Zhang, X. 80

Developing an integrated real-time urban construction carbon emission monitoring framework: towards sustainable urban development – He, Y., Ding, Y., Jiang, X. and Zhao, W. 81

Efficient matching method of cold and heat sources under dynamic load demand characteristics – Ding, Y., Yu, X., Jiang, X. and Zhao, W. 83

Energy-saving optimal control strategy of an ASHP integrated central air-conditioning system – Gao, J., Yang, Y., Yan, J., Xu, X. and Liu, Y. 85

Global energy-saving potential estimation of Radiative Sky Cooling (RSC) used in the pipe-embedded wall cooling system – Yan, T., Fan, S., Xu, X., Lyu, W., Ming, T. and Wu, Y. 87

Low carbon concrete formulation and construction technology in construction phase – Zhao, W., Ding Y., Lai, W., Jiang, X. and He Y. 88

Main accounting indexes of building carbon emissions – Ding, Y. and Chen, W. 89

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

A GENERAL ENERGY SAVING POTENTIAL EVALUATION METHOD OF A PIPE-EMBEDDED WALL INTEGRATED WITH NATURAL ENERGY BASED ON REVISED DEGREE HOUR

Shiguang Fan[1], Tian Yan[2], Xiaoliang Tang[3], Zhongyi Yu[4], Xianting Li[5], Weihua Lyu[6] and Xinhua Xu[7]

[1]*Department of Building Environment & Energy Engineering, Huazhong University of Science & Technology, China*
[2]*Department of Building Environment & Energy Engineering, Wuhan University of Technology, Wuhan, China*
[3]*CITIC General Institute of Architectural Design and Research Co., Ltd., Wuhan, China*
[4]*Department of Building Science, School of Architecture, Tsinghua University, China*
[5]*China Academy of Building Research, Beijing, China*

Pipe Embedded Wall (PEWall) can be integrated with different natural energy sources, such as the geothermal energy, air energy and solar energy, to significantly decrease the building load and energy consumption. However, there is no general evaluation method for the energy saving potential evaluation of the PEWall utilizing different natural energy sources. This study aims to present a general energy saving potential evaluation method of the PEWall integrated with natural energy. Revised Degree Hour (RDH) method is proposed for PEWall to evaluate its application potential with different natural energy utilization forms by combining the revised factor and conventional degree hour. To evaluate the energy saving potential of the PEWall with natural energy, two steady equivalent models of the PEWall are developed, then the energy-saving expression based on the RDH for the PEWall are given. The RDH parameter determination of the PEWall is also presented. With a practical PEWall system, the proposed energy saving evaluation method is validated by the coincident numerical simulation results. The results show the method can be applied to calculate the energy saving potential of the PEWall with good accuracy. The proposed method is simple, useful and accurate in the energy saving potential evaluation for the PEWall integrated with natural energy and it has a good application prospect in the engineering field.

Keywords: energy saving potential, equivalent model, natural energy source, pipe-embedded wall, revised degree hour

[1] fanshiguang@hust.edu.cn
[2] yantian@whut.edu.cn
[3] 170467793@qq.com
[4] yuzhongyi9551@sohu.com
[5] xtingli@tsinghua.edu.cn
[6] lvweihua@emcso.com
[7] bexhxu@hust.edu.cn

Fan, *et al.* (2024) A general energy saving potential evaluation method of a pipe-embedded wall integrated with natural energy based on revised degree hour In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 556-566

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

A LOW-CARBON DISTRIBUTED ENERGY SYSTEM SUITABLE FOR RESIDENTS IN MOUNTAINOUS AREAS OF SOUTHWESTERN CHINA: A CASE STUDY OF WEINING COUNTY IN GUIZHOU PROVINCE

Zhengfei Zhang[1] and Yimin Xiao[2]
[1,2]School of Civil Engineering, Chongqing University, Chongqing, China

Under the dual-carbon Chinese goals, the building energy system needs to be gradually transformed into a low-carbon energy system, and the buildings need to be transformed from a mere energy consumer to a complex system integrating energy production and consumption. Mountainous rural areas in Southwest China are dominated by scattered households and single yards, with unique energy-use patterns. And some regions (e.g., Yunnan-Guizhou Plateau) have abundant solar energy resources. However, there is a scarcity of studies on southwest mountainous rural energy consumption and renewable energy systems applications, specifically based on photovoltaic power generation. Therefore, this paper took Weining County in Guizhou as an example, based on the research data on rural buildings' energy consumption and resource endowment, we propose a low-carbon energy system consisting of photovoltaic and solar thermal systems. The aim is to provide sustainable energy for rural households in the southwestern mountainous region of China to meet buildings' terminal energy demand. This study included survey and simulation methods to derive the energy consumption of rural buildings, design of the energy system, simulation of the energy system's full-year electricity and heat production, and analysis of the dynamic balance of energy supply and demand. When the energy is imbalanced, we choose locally available energy to supplement. Through comprehensive and comparative analysis, we concluded that based on photovoltaic power generation, supplemented by grid power is the optimal energy system form, suitable for application in mountainous areas in southwest China. Compared with the local traditional energy system, this system can reduce 5031.39 kg of CO2 emissions annually, the static payback period is 13 years, which can provide a reference for the rural buildings' energy system construction in southwestern mountainous areas.

Keywords: southwestern mountainous areas of China, rural building energy consumption, low-carbon energy system, energy dynamic balance

[1] 202016021208t@cqu.edu.cn
[2] xiaoyimin1974@126.com

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

ACHIEVING SUSTAINABILITY IN STUDENT HOUSING: NEXUS OF STUDENT HOUSING DESIGN AND ENERGY USE BEHAVIOUR IN NORTHERN GHANA

Williams Miller Appau[1], Iruka Chijindu Anugwo[2], Elvis Attakora-Amaniampong[3] and Frederick Simpeh[4]

[1,2]*Durban University of Technology, Department of Construction Management and Quantity Surveying, South Africa*

[3]*Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development, Department of Construction and Wood Technology Education*

[1,4]*SD Dombo University for Business and Integrated Development Studies, Department of Real Estate, Ghana, Wa, Ghana*

The sustainability of university campuses continues to be a challenge in the developing world. An increase in student enrolment has generally led to a substantial proportion of energy consumption in university housing. Emerging Student housing has often been presumed to ensure energy sustainability. However, testing its efficacy, most especially in the context of energy use behaviour is limited. The study assesses the relationship between student housing design and energy use behaviour in student housing in SD Dombo University of Business and Integrated Development Studies, Wa, Upper West Region, Ghana. The study used a case study, and 3 expertise of the Works and Municipal Services Unit of the university and 2 halls of resident managers were purposively selected to provide data on energy demand and use in the residential hall. Using the Building information model and Building energy audit approaches, one residential hall among 4 similar halls were selected. Schooling hours and weekends were selected as peaks for determining energy use behaviours. The findings revealed that peak cooling total load did not differ from the maximum cooling load capacity, and estimated peak heating load was less than the actual heating load resulting to a high actual cooling load density. This has effects on the cooling airflow capacity of the building. Energy use-behaviour was driven by high energy use during school hours and weekends in the residential halls. University campuses are required to increase their energy load capacity and facilitate the regulations of lights, gadgets, and use of ceiling fans to ensure student housing performance.

Keywords: energy sustainability, building information modelling, energy use behaviour, student housing, university campuses

[1] wappau@ubids.edu.gh
[2] ianugwo@gmail.com
[3] aattakora@ubids.edu.gh
[4] Simfredy24@yahoo.com

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

COMPREHENSIVE LIFE CYCLE ASSESSMENT OF CARBON EMISSIONS IN THE CONSTRUCTION INDUSTRY: A REVIEW OF METHODS, TOOLS, AND APPLICATIONS

Tian Zhu[1], Jianmin Hua[2], Lepeng Huang[3] and Xiang Zhang[4]
[1,2,3]School of Civil Engineering, Chongqing University, Chongqing, 400045, China
[4]School of Undergraduate, Chongqing University, Chongqing, 400045, China

With the relentless rise in global greenhouse gas emissions, the specter of climate change and deteriorating environmental health looms larger than ever. The construction sector is a pivotal contributor to these emissions, underscoring the urgency of advancing carbon lifecycle assessments and effective reduction strategies. This research provides a comprehensive overview of lifecycle assessment methods and tools, analyzing case studies that apply these methods in practice. It focuses on diverse strategies for reducing building carbon emissions, including optimized material selection, enhanced energy efficiency, and improved operational practices. A key innovation of this study is its systematic analytical framework, which integrates recent findings on building carbon assessment and mitigation strategies. The objective is to equip practitioners and researchers with a thorough understanding of carbon emission evaluation and reduction tactics, fostering sustainable development in the construction sector. The research also identifies major challenges, such as defining system boundaries, clarifying assessment criteria, harmonizing methodologies, and balancing emission reduction measures. To address these challenges, the research proposes future priorities, including establishing standardized criteria, exploring new technologies' impacts on assessment methodologies, promoting compatibility among methodologies, fostering interdisciplinary collaboration, and analyzing policy-influencing factors. These directions are crucial for advancing sustainable building practices and confronting the challenges posed by global climate change.

Keywords: building carbon emissions, building sustainable development, emission reduction strategies, life cycle assessment.

[1] Tian.Zhu@stu.cqu.edu.cn
[2] hjm191@163.com
[3] huang lepeng@cqu.edu.cn
[4] 676347964@qq.com

Zhu, *et al.* (2024) Comprehensive life cycle assessment of carbon emissions in the construction industry: a review of methods, tools, and applications In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 591-601

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

DEVELOPING AN INTEGRATED REAL-TIME URBAN CONSTRUCTION CARBON EMISSION MONITORING FRAMEWORK: TOWARDS SUSTAINABLE URBAN DEVELOPMENT

Yufeng He[1], Yong Ding[2], Xiangting Jiang[3] and Wenchao Zhao[4]

[1,2 3 4]*Joint International Research Laboratory of Green Building and Built Environment, Ministry of Education, Chongqing University, Chongqing, 400044, China*
[1,2 3 4]*National Centre for International Research of Low-carbon and Green Buildings, Ministry of Science and Technology, Chongqing University, Chongqing, 400044, China*
[4]*Shanghai Construction No.1 (Group) Co., Ltd., Shanghai, 200120, China*

Traditional carbon emission monitoring relies on either historical data and statistical models or on the analysis of satellite remote sensing data to measure urban-scale carbon fluxes. This approach presents issues such as time delays, uncertainties, and untraceable data, making it difficult to meet the needs for real-time, precise monitoring and management. Consequently, this article aims to develop an integrated real-time urban carbon emissions monitoring framework that addresses multiple emission sources across various urban construction fields, including buildings, energy, transportation, industry, municipal activities, and carbon sinks. It integrates IoT, big data, satellite remote sensing, and AI technologies to facilitate real-time data collection, accurate analysis, and intelligent decision support. The framework consists of four core modules: domain categorization and decision support, real-time carbon emission monitoring, data processing and intelligent analysis, and information visualization. These modules are designed to enhance the precision and timeliness of carbon emission data, assist urban planners, policymakers, and business managers in developing effective emission reduction strategies, and promote the shift towards a low-carbon development model for cities.

Keyword: carbon emission monitoring framework, real-time, urban construction

[1] 857761885@qq.com
[2] dingyongqq@163.com
[3] 644659637@qq.com
[4] zhaowenchao@stu.cqu.edu.cn

He, *et al.* (2024) Developing an integrated real-time urban construction carbon emission monitoring framework: towards sustainable urban development In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 602-613

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

EFFICIENT MATCHING METHOD OF COLD AND HEAT SOURCES UNDER DYNAMIC LOAD DEMAND CHARACTERISTICS

Yong Ding[1], Xueqin Yu[2], Xiangting Jiang[3] and Wenchao Zhao[4]
[1, 2, 3, 4]*Joint International Research Laboratory of Green Building and Built Environment, Ministry of Education, Chongqing University, Chongqing, 400044, China*
[1, 2, 3, 4]*National Centre for International Research of Low-carbon and Green Buildings, Ministry of Science and Technology, Chongqing University, Chongqing, 400044, China*
[4]*Shanghai Construction No.1 (Group) Co., Ltd., Shanghai, 200120, China*

At present, one of the primary causes of the high energy consumption in central air conditioning systems is the chiller's operating efficiency, which is typically lower than the chiller's rated performance. This study examined the design and operation of the chiller in the central air conditioning system, as well as the chiller's actual operation, to investigate the reasons behind the low-efficiency operation of high-performance chillers and find solutions. Based on the combinations of the dynamic performance characteristics of chillers and the dynamic load distribution characteristics of buildings with different functions, the key elements of achieving efficient operation of chillers are analyzed, and efficient system design ideas and methods matching the dynamic load distribution characteristics with the dynamic regulation performance of chillers are proposed. By means of a case study, this method can be used to rationally select the type and capacity configuration of the chiller, which can ensure that most of the operating cycle of the chiller is in the high-efficiency zone, to achieve the purpose of efficient operation of the system.

Keywords: central air conditioning, cold source configuration, dynamic load characteristic, design optimization, energy saving

,

[1] dingyongqq@163.com

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

ENERGY-SAVING OPTIMAL CONTROL STRATEGY OF AN ASHP INTEGRATED CENTRAL AIR-CONDITIONING SYSTEM

Jiajia Gao[1], Guokongming Yang[2], Junjun Yan[3], Xinhua Xu[4] and Yaqin Liu[5]
[1,2,3,5]*School of Urban Construction, Wuhan University of Science and Technology, Wuhan, China*
[4]*School of Environmental Science and Engineering, Huazhong University of Science and Technology, Wuhan, China*

The air source heat pumps (ASHP) are widely used in domestic hot water and air conditioning systems because they can utilize low-grade air as a source of cooling and heating. However, the supply-water temperature of ASHPs is usually fixed, which makes the system less finely regulated and consumes more energy. This study presents an online optimization control strategy for supply-water temperature in an ASHP (air-source heat pump) integrated small-scale central air-conditioning system. The strategy aims to coordinate indoor and outdoor air temperatures to improve the control performance of the indoor environment and reduce chiller energy consumption. The optimization strategy uses real-time outdoor air temperature as the primary parameter for feed-forward optimization of chilled supply-water temperature, enabling quick response to load changes. Additionally, real-time indoor air temperature is used as the auxiliary parameter for feedback optimization to correct the chilled supply-water temperature. A simulation model of the ASHP central air-conditioning system is established by using TRNSYS software. Simulation confirms that the accuracy and robustness of indoor air temperature control performance can be improved by this optimization strategy. It is found that the total cooling energy consumption of this optimization strategy was 19.64% and 33.64% at high load conditions (June to August) and light load conditions (March to May) respectively. Additionally, the control performance of this optimization strategy is confirmed by experiments, the result shows about 31.14% of the total cooling energy consumption can be saved in July. The coordinated control algorithm for indoor and outdoor air temperatures is easy to implement in standard temperature control devices and has great potential for wide application in the field of energy saving in air-conditioning.

Keywords: ASHP integrated central air-conditioning, energy-saving of air-conditioning, indoor and outdoor temperature coordination, indoor temperature control, optimization of supply-water temperature

[1] gaojiajia@wust.edu.cn
[2] 1661556584@qq.com
[3] 846379872@qq.com
[4] bexhxu@mail.hust.edu.cn
[5] 1667011877@qq.com

Gao, *et al.* (2024) Energy-saving optimal control strategy of an ASHP integrated central air-conditioning system In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 627-637

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

GLOBAL ENERGY-SAVING POTENTIAL ESTIMATION OF RADIATIVE SKY COOLING (RSC) USED IN THE PIPE-EMBEDDED WALL COOLING SYSTEM

Tian Yan[1], Shiguang Fan[2], Xinhua Xu[3], Weihua Lyu[4], Tingzhen Ming[5] and Yongjia Wu[6]

[1,5,6]*School of Civil Engineering and Architecture, Wuhan University of Technology, China*
[2,3]*Department of Building Environment & Energy Engineering, Huazhong University of Science & Technology, China*
[4]*China Academy of Building Research, 100013, Beijing, China*

By integrating with the pipe-embedded wall, the radiative sky cooling (RSC) technology may be feasible for energy-saving on a global scale. However, the potential of RSC in the pipe-embedded wall (PEWall) is not clear under different climate conditions around the world. It is recommended to estimate the energy saving potential of RSC used in PEwall as the cold source for different climate zone cities. This study aims to obtain the global energy-saving data of RSC used in pipe-embedded wall, which can provide basis for the RSC application in buildings. In this study, the climate zones worldwide are classified and the cooling demand are proposed based on the weather data. Then, the heat-transfer model of RSC and the RDH (revised degree hour) based energy potential evaluation model are established. Finally, the global potential of energy-saving for RSC with wall system are calculated and analyzed. Results show that the RSC technology with pipe embedded wall has good energy-saving effect in regions with cooling demand worldwide. In the tropical savanna or desert climate zone, it has the best energy-saving potential. The energy-saving and carbon reduction in the cooling season are respectively ~50 kWh/m^2 and ~30 kgCO2/m^2. For the other region such as subtropical monsoon climate zone, the energy-saving is relatively small (about 10 kWh/m^2). The global energy-saving potential estimation proposed by this study provide the data support and is valuable for engineers to select the feasible technology for low-energy buildings.

Keywords: energy-saving potential, low-energy building, pipe-embedded wall, radiative sky cooling (RSC), revised degree hour (RDH)

[1] yantian@whut.edu.cn
[2] fanshiguang@hust.edu.cn
[3] bexhxu@hust.edu.cn
[4] lvweihua@emcso.com
[5] tzming@whut.edu.cn
[6] yjwu2019@whut.edu.cn

Yan, *et al.* (2024) Global energy-saving potential estimation of Radiative Sky Cooling (RSC) used in the pipe-embedded wall cooling system In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 639-649

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

LOW CARBON CONCRETE FORMULATION AND CONSTRUCTION TECHNOLOGY IN CONSTRUCTION PHASE

Wenchao Zhao[1], Yong Ding[2], Wen Lai[3], Xingting Jiang[4] and Yufeng He[5]

[1,2,4,5]*Joint International Research Laboratory of Green Building and Built Environment, Ministry of Education, Chongqing University, Chongqing, 400044, China*

[1,2,4,5]*National Centre for International Research of Low-carbon and Green Buildings, Ministry of Science and Technology, Chongqing University, Chongqing, 400044, China*

[1,3]*shanghai Construction No.1 (Group) Co., Ltd., Shanghai, 200120, China*

To achieve a clean and low-carbon transition throughout the building phase, the relationship between raw materials and construction processes must be carefully considered while maintaining project quality. Based on a commercial project's mass concrete pouring process, this study analysed the carbon emissions of concrete materials with different water-binder ratios, percentage of mineral admixture, and sand ratios by Chinese standards and construction techniques; in the meantime, it compares the carbon emissions of the construction process with various construction techniques such as truck-mounted concrete pump, stationary concrete pump, and concrete chutes. The results of the study show that an increase in the water-binder ratio and percentage of mineral admixture will lead to a significant reduction in carbon emissions, and the appropriate concrete construction process can effectively reduce the carbon emissions in the construction phase, while there is an interplay between the mixing ratio and the construction process.

Keywords: concrete mixture proportioning, construction phase, construction techniques, low-carbon concrete

[1] zhaowenchao@stu.cqu.edu.cn
[2] dingyongqq@163.com
[3] 67466733@qq.com
[4] xiangtingjiang@163.com
[5] 622200972003@mails.cqjtu.edu.cn

Zhao, *et al.* (2024) Low carbon concrete formulation and construction technology in construction phase In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 650-660

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

MAIN ACCOUNTING INDEXES OF BUILDING CARBON EMISSIONS

Yong Ding[1] and Wendi Chen[2]
[1, 2] *Joint International Research Laboratory of Green Building and Built Environment, Ministry of Education, Chongqing University, Chongqing 400044, China*
[1, 2] *National Centre for International Research of Low-carbon and Green Buildings, Ministry of Science and Technology, Chongqing University, Chongqing 400044, China*

The current research on carbon emissions accounting in buildings focuses on the sources of data, level of granularity, and process decomposition in the accounting process. To delineate the sources and attributions of carbon emissions in buildings, this study decomposes both the formation and usage processes of buildings. This paper proposes a classification method for carbon emissions accounting in buildings based on three perspectives: stages, industries, and users, with three dimensions: process, source, and use. Using cluster analysis and factor analysis approaches to analyze different components and factors that contribute to carbon emissions in buildings and quantify them, we establish a comprehensive set of indicators for measuring carbon emissions in buildings. The effectiveness and applicability of the assessment indicator system are determined, providing direct guidance for building-related industries and policymakers.

Keywords: accounting methods, building carbon emissions, elements, index system

[1] dingyongqq@163.com
[2] strawberry_0807@163.com

T5 SUSTAINABLE URBAN RENEWAL

Application of Chinese traditional mural materials in modern architectural wall decoration – Liu, C. and Syed, A. S. A. B. 91

Correlation between summer outdoor thermal environment and comfort in urban block of Northern Xinjiang – Su, Y., Huang, Z. and Wu, X. 92

Effective integration of traditional mural elements to enhance the attractiveness and artistry of installation artworks through Ryan's narrative theory – Li T., Feng Y., Ye Q. and Liu C. 93

Enlightenment of American buildings to China of sustainable integrated design –Zhu, X. 94

Environmental safety assessment of street road lighting combining visual characteristics and physical quantities – Liang, B., Huang, Z., Qin, Y., Li, Z.. and Luo, H. 95

Exploration of interactive dream analysis installation in art design in community public facilities – Ye, Q., Zeng, C., Li, T. and Liu, C. 96

Population, texture, green volume - the suitable density of historic districts based on intrinsic ecology – Hu, C. and Gong, C. 97

Public art and cultural education function of digital exhibition in museums – Li, L. 98

Research on design of interactive installation based on cultural sustainable intangible cultural heritage – Zeng, C., Ye, Q. , Li L. and Liu, C. 99

Temporal and spatial distribution characteristics of thermal environment of subway stations - an experimental study – Ding, Y., Jiang, X., He, Y., Zhao, W., Liu, Y. and Hou, Y. 101

The impact of road expansion on nearby infrastructure – the case of N11 in Mokopane, South Africa – Mogale, W., Musonda, E. and Harinarain, N. 102

Utilising African epistemologies to augment Collaborative Online International Learning (COIL) initiatives in the built environment field – Qumbisa, N. and Makhwabe, S. 103

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

APPLICATION OF CHINESE TRADITIONAL MURAL MATERIALS IN MODERN ARCHITECTURAL WALL DECORATION

Chunxia Liu[1] and Abu Bakar Syed Alwi Syed[2]
[1]College of Creative Arts, Universiti Teknologi MARA, Malaysia

Traditional murals are an important decorative element of Chinese architecture, playing a key role in enhancing its artistic value. However, as technology advances and architectural design innovates, people's demands for interior decoration have increased. The fixed procedures and material constraints of traditional frescoes pose challenges to their inheritance and development. In order to solve this problem, this study takes the application of traditional Chinese frescoes in modern architecture as the research object, uses the practical verification method to explore the materials and techniques of traditional frescoes, and combines with the literature combing method to conduct a case study on modern architectural wall decoration, aiming at exploring the new application of traditional materials in modern decoration, and promoting the diversified development of traditional frescoes in the field of architectural wall decoration. This study provides an in-depth discussion and summary of the production process of traditional frescoes, material selection, wall decoration process, fresco pigments and painting techniques. Although traditional mural painting techniques are limited by material properties and are mostly used for building interior decoration, the study points out that: 1. On the basis of traditional materials, the introduction of energy-saving and environmentally friendly new materials can be a feasible way to do so. 2. Expanding the application of traditional mural paintings to the exterior of the building for the overall decoration of the building gives traditional mural paintings a new visual and tactile artistic effect. Traditional frescoes should be experimented by combining traditional materials with new scientific and technological invention materials, and combining new waterproof, sunscreen and moisture-proof materials with traditional materials. This research makes a useful exploration for the contemporary inheritance and innovative application of traditional mural art.

Keywords: Chinese traditional murals, materials, modern architecture, wall decoration

[1] xia1608@126.com
[2] syeda214@uitm.edu.my

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

CORRELATION BETWEEN SUMMER OUTDOOR THERMAL ENVIRONMENT AND COMFORT IN URBAN BLOCK OF NORTHERN XINJIANG

Yuan Su[1], Ziyang Huang[2] and Xuezheng Wu[3]
[1,2]School of Architecture & Fine Art, Dalian University of Technology, Dalian 116024, China
[3]Jiangsu SOHO Holdings Group Co., Ltd, Nanjing 210005, China

With the improvement of urban residents' living standards and the shift in lifestyle preferences, the demand for thermal comfort in outdoor environments continues to increase. This demand is particularly prominent in arid and hot regions of northern Xinjiang, where outdoor thermal conditions during the summer become a focal point of concern. By analyzing the POI and the Getis-Ord Gi* index in Shihezi city in Xinjiang, this study utilized subjective questionnaire surveys and climate parameter measurements to calculate the neutral temperature and establish the thermal comfort range of the district. Thermal grades were delineated and adaptively adjusted. The study found that, considering both winter and summer seasons, the UTCI values for this district ranged from [19.4°C to 28.1°C]. Satisfaction rates in the measured district exhibited a noticeable decline once the UTCI value reached 35, and after reaching 45°C, satisfaction rates gradually approached 0% within bin intervals of 1°C, based on a sample size of five interviewees. This demonstrates a consistent perception of outdoor thermal environments among residents within the same urban area, aligning with previous scholarly research. Notably, there is a significant negative correlation between thermal bias and UTCI, with each district having a distinct critical point for thermal bias. Leveraging the UTCI values adjusted by the neutral temperature of the core streets of Shihezi and the acceptable temperature range, further insights into thermal environmental characteristics were revealed. Based on these findings, outdoor thermal comfort ranges and thermal categories were classified, providing valuable reference for enhancing outdoor environmental quality and thermal comfort in arid and hot regions.

Keywords: block thermal environment; correlation analysis; outdoor thermal comfort; universal thermal climate index

[1] suyuan@dlut.edu.cn
[2] 596261276@qq.com
[3] 505183538@qq.com

Su, Huang and Wu (2024) Correlation between summer outdoor thermal environment and comfort in urban block of Northern Xinjiang In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 674-684

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

EFFECTIVE INTEGRATION OF TRADITIONAL MURAL ELEMENTS TO ENHANCE THE ATTRACTIVENESS AND ARTISTRY OF INSTALLATION ARTWORKS THROUGH RYAN'S NARRATIVE THEORY

Tong Li[1], Yingqi Feng[2], Qishan Ye[3] and Chunxia Liu[4]
[1,2,3,4]HeXiangNing College of Art and Design, Zhongkai University of Agriculture and Engineering, China

With the rapid development of digital technology, in todays close integration of science and art, mural art presents a new development trend of diversification, dynamization and virtualization. The installation art of mural elements has become the main innovative presentation of traditional murals nowadays, but the lack of narrative in these installations greatly reduces the viewer's immersiveness, interactivity and so on. This study focuses on the installation art design of mural elements under the perspective of Ryan's narrative theory and explores its relationship with sustainable development, providing insights into the promotion and implementation of mural art design under the framework of sustainable development. Starting from the perspective of Ryan's narrative theory, this study designs the installation art of fresco elements in terms of both semantic and discursive modes, aiming to enhance the narrative, fictional, immersive, and interactive qualities of the installation art of fresco elements, as well as to analyze the potential impacts of the installation art of fresco elements in terms of cultural inheritance and community participation. The design of installation art of mural painting elements through Ryan's narrative theory increases the possibility of sustainable development of mural paintings. Finally, using Kaiping Mural as a case study, through theoretical analysis and empirical research, we delve into the contextual environment of Kaiping City's site selection, reveal how mural art interacts with cultural sustainability, and explore its positive impact on community and cultural heritage.

Keywords: art design, installation art, narrative theory, traditional mural painting

[1] 251970931@qq.com
[2] vicky583214134@163.com
[3] 907629855@qq.com
[4] xia1608@126.com

Li, *et al.* (2024) Effective integration of traditional mural elements to enhance the attractiveness and artistry of installation artworks through Ryan's narrative theory In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 685-695

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

ENLIGHTENMENT OF AMERICAN BUILDINGS TO CHINA OF SUSTAINABLE INTEGRATED DESIGN

Xirui Zhu[1]
[1]*Joint International Research Laboratory of Green Buildings and Built Environments (Ministry of Education), Chongqing University, Chongqing, 400045, China)*

With the in-depth implementation of the "double carbon" goal, sustainable buildings have been pushed to the forefront of public opinion. To combat climate change, countries have varying degrees of sustainable control methods in the design, construction, and operation of the building sector. There are certain gaps in policies and regulations in promoting and implementing sustainable buildings in different countries. The Chinese government relies more on relevant green certification ratings to promote sustainable buildings. “Sustainable architecture” has been one-sidedly interpreted as green-certified buildings achieved through passive building design methods, and its comprehensive design value has been ignored. The United States is more proactive. Various departments have formulated a series of integrated design control policies to guide sustainable buildings beyond the building itself and enable it to assume more comprehensive and coordinated macro functions of energy, buildings, community engagement, education, and management. From the perspective of integrated design of sustainable buildings, this article analyzes and sorts out the sustainable building design methods used in contemporary American carbon neutrality practices, and summarizes a systematic sustainable building design strategy toolkit, which will be instructive for the sustainable design of buildings and will also inspire the cultivation of sustainable design for architects in the context of carbon neutrality.

Keywords: green-certified building, integrated design, policy control, sustainable building

[1] 202316131447@stu.cqu.edu.cn

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

ENVIRONMENTAL SAFETY ASSESSMENT OF STREET ROAD LIGHTING COMBINING VISUAL CHARACTERISTICS AND PHYSICAL QUANTITIES

Bo Liang[1], Zi-xin Huang[2], Yang Qin[3], Zhi-ting Li[4] and Hong Luo[5]
[1 2 4,5]School of Civil Engineering, Chongqing Jiaotong University, Chongqing 400074, China
[1]State Key Laboratory of Bridge and Tunnel Engineering in Mountainous Areas, Chongqing 400074, China
[3]Kaiyang County Highway Quality Supervision and Administration Office, Guiyang City, Guizhou 550399, China

The lighting scenarios were categorized into unlit, residential, and commercial areas based on the lighting components and influencing factors of urban roads. Accurate vehicle tests were conducted to collect road illumination, color temperature, and visual recognition data from 10 drivers at different periods within each block. A safety evaluation model was constructed by analyzing the relationship between changes in these parameters using an entropy-weighted Topsis comprehensive evaluation method. Furthermore, K-means cluster analysis was employed to classify the safety level into five grades. The results indicate that drivers are safer during the day, relatively safer in unlit neighborhoods at night, and less safe to drive in residential and commercial areas.The findings of this study provide a theoretical basis for the design of urban road lighting.

Keywords: physical quantities of the optical environment, safety assessment, traffic safety, traffic risk level, visual biomass

[1] liang_laoshi@126.com
[2] 949699792@qq.com
[3] 1132587832@qq.com
[4] 187169468@qq.com
[5] luohongriben@126.com

Liang, *et al.* (2024) Environmental safety assessment of street road lighting combining visual characteristics and physical quantities In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 707-716

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

EXPLORATION OF INTERACTIVE DREAM ANALYSIS INSTALLATION IN ART DESIGN IN COMMUNITY PUBLIC FACILITIES

Qishan Ye[1], Cuilin Zeng[2], Tong Li[3] and Chunxia Liu[4]
[1,2,3,4]He Xiangning College of Art and Design, Zhongkai University of Agriculture and Engineering, China

This study explores the use and interpretation of dreams in the field of creative and stylistic constructions, focusing on interactive dream analysis installations in community public facilities.Dreams mirror the subconscious mind, and modern technology, by means of artistic innovation, allows us to interact with dreams, interpret the depths of the mind, and inspire unlimited creativity.The aim of this study was to analyze the application of interactive dream analysis devices. The findings suggest that the field's contribution lies in how technology-enhanced dream analysis can be applied to artistic design to promote personal insight and emotional relief. The installation functions as a cutting-edge communal commons where users can engage with their own dreams by drawing, touching, and hearing feedback, and explore various dream kinds through an interactive interface, promoting emotional release and comprehension of one's own dreams. It is a means of artistic expression and a platform to promote deep personal reflection and community interaction, to promote mental health and quality of life, as well as to stimulate creativity and imagination in the community.

Keywords: art design, community public facilities, dream analysis human emotion interactive installation

[1] 907629855@qq.com
[2] 1605175404@qq.com
[3] 251970931@qq.com
[4] xia1608@126.com

Ye, *et al.* (2024) Exploration of interactive dream analysis installation in art design in community public facilities In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 717-726

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

POPULATION, TEXTURE, GREEN VOLUME - THE SUITABLE DENSITY OF HISTORIC DISTRICTS BASED ON INTRINSIC ECOLOGY

Changjuan Hu[1] and Cong Gong[2]
[1,2]School of Architecture and Urban Planning, Chongqing University, China

As of the end of 2023, China has designated over 1200 historic districts. Urban ecological policy and people's yearning for a livable environment promote the pace of ecological revitalization of historic districts. However, in the process of rapid urbanization, the historic districts that follow the natural evolution have gradually become the obsolete and unlivable part of the city. Re-examine the practical issues faced by the revitalization of historic districts from an ecological perspective. Constructing the 'Quartet Framework' based on four basic problems of Chinese ecological philosophy's spatial view: 'spatiotemporal theory', 'ontology', 'technique theory', and 'realm theory'. Exploring the integration of ancient ecological smart and modern ecological wisdom in four aspects. In response to the density-loss issues, exploring the Intrinsic ecological characteristics from three aspects: 1) Population density: Comparing population density with ancient and modern time, exploring the reasonable population density and residential retention rate; 2) Building density: Through comparative analysis, the "Space-mate" tool is used to explore the intrinsic ecology of building density; 3) Green density: with the ecological district as control sample, obtain the GSR and GCR through the formula, and calculate the ecological efficiency and ecological efficiency ratio of the plots in historic district. The reasonable population density is approximately 150-300 people/ha. To maintain the social ecology, the resident retention rate should be around 60%. Chinese districts are mainly composed of low rise buildings with a plot ratio of 0.8, but with an average density of about 50%, their open space ratio of 0.62 is much greater than the target districts' 0.32, providing a more effective and controllable open space.The Chinese districts distributing in the 'C' and 'D' area or higher density areas, and the form is more inclined towards high-density, low-rise courtyards and slab-type mixed building forms. The ecological efficiency of ecological district refers to leaf area index of 20.656 per unit green space area; Similarly, it can be concluded that the ecological efficiency of the historic district is 115.915, the numerical result of the ecological efficiency ratio is 5.612>1, indicating that the ecological efficiency of historic district is higher. Reasonable population density predictions of Chinese districts are often made based on the current state of socio-economic development, referring to surveys of residents' willingness. Chinese districts have a more distinct intrinsic ecology for the target cases, with a more compact and dense texture and more reasonable and effective open space. They have a more overall, orderly, and compact district form, providing a foundation for energy conservation and resource recycling in the future. Historic district can create more ecological benefits per unit green space area than ecological district, and have more advantages in green quantity: 1) Large trees have more diverse characteristics in community configuration; 2) The proportion of total leaf area of trees is larger; 3) Historic districts provide more temporal and spatial benefits to trees; 4) Historic districts have richer 3 D greening. This study explores the spatiotemporal integration of ancient ecological smart and modern ecological wisdom in revitalization of historic district, and studied the reasonable ecological density from three aspects: population density, building density, and green density. The combination of ancient and modern ecological wisdom will guide our thinking on modern urban construction and the revitalization of historic districts.

Keywords**:** ancient ecological smart, eco-historic district, ecological revitalization, intrinsic ecology, modern ecological wisdom

[1] changjuanhu@cqu.edu.cn
[2] gongcong89@cqu.edu.cn

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

PUBLIC ART AND CULTURAL EDUCATION FUNCTION OF DIGITAL EXHIBITION IN MUSEUMS

Li Li[1]
[1]*Zhongkai University of Agriculture and Engineering, China*

The cultural and educational functions of digital exhibitions in museum public art have not been thoroughly studied yet. This research aims to explore new ways of combining public art with museums and promote museums to become important windows of public art education. This article uses concept analysis, historical tracing, and case induction and comparison methods to deeply explore the concepts of public art function and museum publicness, and combines existing research to define relevant concepts in order to establish the accuracy of the research object. In the context of new media, combined with digital exhibitions, the application methods of digital exhibitions as a means of exerting the function of public art and cultural education have been summarized and applied in the practice of real museums. To enable digital exhibitions to play their role in museums, realize the function of public art and cultural education, and make museums truly become educational venues for the public

Keywords: public art and design, cultural education, digital exhibitions, museums

[1] 2399352445@qq.com

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

RESEARCH ON DESIGN OF INTERACTIVE INSTALLATION BASED ON CULTURAL SUSTAINABLE INTANGIBLE CULTURAL HERITAGE

CuiLin Zeng[1], Qishan Ye[2], Li Li[3] and Chunxia Liu[4]
[1,2,3,4]HeXiangNing College of Art and Design, Zhongkai University of Agriculture and Engineering, 510225, China

This study explores interactive art installations integrating intangible cultural heritage elements, as defined by UNESCO, to preserve diverse traditions and identities. Focusing on their contemporary relevance, the research examines how these installations use technology and design to enhance accessibility and engagement with cultural practices, fostering community ownership and intercultural dialogue. A mixed-methods approach, including literature reviews, surveys, interviews, and site observations, evaluates audience experiences. Findings highlight the installations' transformative potential in heritage conservation, creating immersive educational experiences that deepen appreciation. Implications for future design, policies, and community initiatives are discussed, acknowledging measurement limitations and suggesting paths for refining methodologies in cultural sustainability efforts.

Keywords: cultural sustainability, intangible cultural heritage, interactive installations, preservation, promotion, social interaction

[1] 1605175404@qq.com
[2] 907629855@qq.com
[3] 2399352445@qq.com
[4] xia1608@126.com

Zeng, *et al.* (2024) Research on design of interactive installation based on cultural sustainable intangible cultural heritage In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 729-738

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

TEMPORAL AND SPATIAL DISTRIBUTION CHARACTERISTICS OF THERMAL ENVIRONMENT OF SUBWAY STATIONS - AN EXPERIMENTAL STUDY

Yong Ding[1], Xiangting Jiang[2], Yufeng He[3], Wenchao Zhao[4], Yan Liu[5] and Yilin Hou[6]
[1,2,3,4,5,6]*Joint International Research Laboratory of Green Building and Built Environment, Ministry of Education, Chongqing University, Chongqing 400044, China*
[1,2,3,4,5]*National Centre for International Research of Low-carbon and Green Buildings, Ministry of Science and Technology, Chongqing University, Chongqing 400044, China*

With the acceleration of China's urbanization, numerous subway lines have been built one after another. Especially in Chongqing, where the terrain and climate conditions are complex, the construction of thermal and humidity environments for underground rail transit buildings faces severe challenges. However, there is still a lack of targeted research on the spatial and temporal distribution characteristics of the thermal environment during the entire ride from entrance to exit in stations with different depths of burial, there is a need to further explore the spatial and temporal distribution of heat and humidity throughout the construction of the station. Therefore, in this study, four representative underground stations with different burial depths were selected and their thermal and humidity environments were tested for one year. The results show that the spatial and temporal distribution characteristics of different stations have significant differences on the thermal and humidity environments. Temperature transition is better in winter stations. The temperature transition between the station concourse and platform is poorer in summer, and the temperature inside the station is more affected by the operational settings of the air-conditioning system. In the transition seasons, the temperature distribution inside the station is relatively concentrated and is related to the outdoor temperature and the depth of the station. The humidity environment inside the station is at a good level in both winter and transition seasons. In contrast, the relative humidity distribution inside the station is worse in summer. The test and analysis results of this study clarify the key direction of the environmental control system of underground stations in different seasons, and provide basic data support for the rational design and operation control of thermal environment air-conditioning systems in underground stations in hot-summerand cold-winter zone.

Keywords: underground station, thermal environment, influencing factors, environmental control system

[1] dingyongqq@163.com
[2] 644659637@qq.com
[3] 857761885@qq.com
[4] zhaowenchao@stu.cqu.edu.cn
[5] 202216131240t@stu.cqu.edu.cn
[6] 1315407317@qq.com

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

THE IMPACT OF ROAD EXPANSION ON NEARBY INFRASTRUCTURE – THE CASE OF N11 IN MOKOPANE, SOUTH AFRICA

Walter Mogale[1], Evaristo Musonda[2] and Nishani Harinarain[3]
[1, 2, 3]*Land Surveying Discipline, School of Engineering, University of KwaZulu-Natal, South Africa*

Traffic congestion affects both the speed of travel and the reliability of travel conditions, posing a significant obstacle to effective transportation and urban growth. While most studies cover the effects of traffic congestions, the need to ease the traffic congestions, and the aspects of creating safer traffic flows, this study contributes to addressing the impacts of road expansion on the adjacent infrastructure. The study aimed to assess the impact of the road expansion on the infrastructure in the Mokopane area along the N11 road in South Africa. Data was collected from the QGIS software base map. The polygons outlining the existing buildings and fences along the N11 road were digitised from the satellite imagery on QGIS software and converted into shapefiles. Electric pole shapefiles were obtained from the Mogalakwena Local Municipality. The scenario for the road expansion was prepared using buffer analysis tools in the ArcGIS Pro software. The infrastructure affected by the expansion of the N11 road was identified, assessed and mapped using the ArcGIS Pro software. The results indicated that the road expansion will affect five commercial buildings and thirty electric poles. This study highlights the relationship between the development of roads and its broader impact on the surrounding infrastructure. The results of the study contribute to identifying and quantifying the existing infrastructure along the road earmarked for expansion. This will assist the authorities to come up with efficient ways to manage the existing infrastructure and also contribute to effective geospatial methodologies of studying the impacts of road expansion during the plan and implementations stages.

Keywords: Arcgis pro software, buffer analysis, infrastructure, road expansion, shapefiles.

[1] 220032354@stu.ukzn.ac.za
[2] musondae@ukzn.ac.za
[3] harinarain@ukzn.ac.za

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

UTILISING AFRICAN EPISTEMOLOGIES TO AUGMENT COLLABORATIVE ONLINE INTERNATIONAL LEARNING (COIL) INITIATIVES IN THE BUILT ENVIRONMENT FIELD

Nolwazi Qumbisa[1] and Siyamthanda Makhwabe[2]
[1,2]*Built Environment Department, Central University of Technology, Free State, South Africa.*

Recently, there has been an increasing acknowledgment of the necessity to incorporate indigenous and non-Western ways of learning into educational methodologies to promote cultural appropriateness and inclusivity. Higher education institutions can create culturally responsive and fair learning environments by including African epistemologies into COIL projects, showing respect for all participants' knowledge and experiences. The research aims to explore the potential advantages and viable approaches for incorporating African epistemologies into COIL initiatives within higher education institutions. The goal is to improve cultural inclusivity, reciprocity, and efficacy of international collaborative learning experiences. The authors employed a mixed methods research technique to perform a pilot study with second year Built Environment students. The study utilised a questionnaire. This study investigates the viewpoints and encounters of 14 undergraduate students from the Central University of Technology who took part in a Collaborative Online International Learning (COIL) project in 2023. The findings from this study suggest that using African epistemologies in COIL projects do not only improve the response rate of South African students but also to enhance the overall notion of Africanizing the curriculum. Moreover, findings suggest that the inclusion of African epistemologies not only enriches the educational experience but also fosters a more inclusive and equitable learning environment. By incorporating African epistemologies and pedagogies, higher education institutions have the potential to cultivate more inclusive and culturally sensitive learning environments that benefit all individuals involved.

Keywords: African epistemologies, built environment, collaborative learning, higher education

[1] nqumbisa@cut.ac.za
[2] smakhwabe@cut.ac.za

T6 BUILDING TECHNOLOGY AND PERFORMANCE

A review of the impact of office lighting environment on employees' emotional state – Li, M. and Cheng, L. 105

A review on indoor lighting evaluation regarding its' effects and indicators – Lin, S. and Du, C. 107

A study on the impact of enhancing window airtightness on residential building energy consumption in hot summer and cold winter region – Yu, Z., Zhang, C., Xu, X., Tang, X. and Yu, Z. 108

An advanced design method of intelligent buildings in sustainable development – Xia, Q., Yang, Z. and Ahou, Y. 109

Assessing the performance of PCM embedded non-linear thermal wall – Li, S., Ji, W., Liu, S., Kwanda, L, T. and Kusakana, K. 111

Development and prospection of occupant behavior in residential building – Liao, X, and Li, B. 112

Effect of elevated temperature on the mechanical properties of high volume recycled coarse aggregate concrete containing volcanic ash – Gambo, S., Yahaya, M. W. and Ibrahim, A. G. 113

Effects of masonry materials characteristics on painted external wall surfaces – Afful, M. O., Mensah, S., Orgen, N. K. and Ameyaw, C. 114

Experimental investigation on post-fire mechanical properties of Q960 ultra-high-strength steel after cold-forming process – Wang, J. and Shi, Y. 115

Housing characteristics and heat perception: comparison across formal and informal neighbourhoods in Lagos, Nigeria – Adegun, O. B., Morakinyo, T. E., Akinbobola, A., Obe, B. and Olusoga, O. O. 116

Impact of PCMC roof on indoor thermal-humidity environment and air conditioning energy consumption – Jiang, L., Gao, Y., Liu, S. Rashidov, J., Zhang, X. and Fan, Z. 117

Numerical study on lateral behavior of cold-formed steel composite shear wall – Xiaowei, R., and Yu, S. 119

Research on the structural regulation of sepiolite fibre and application as self-humidity-control functional building materials – Han, X., Tang, R., Hao, L., Dong, B., Wang, L. and Liang, J. 120

Sociotechnical system failure in construction projects: a distributed situation awareness of sky central roof damage – Mkandawire, K., Kabiri, S. and Connaughton, J. 121

The effect of Melanopic equivalent daylighting illuminance (m-EDI) on satisfaction and productivity in the workplace – Li, Z., Yao, R., Bai, S. and Zhu, Y. 122

Thermal properties of surrounding rock in deep-buried metro station fresh air shafts enhanced by phase change materials: a case study from Chongqing, China – Ren, Z., Ren, Y., Yang, Z., and Xiao, Y. 123

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

A REVIEW OF THE IMPACT OF OFFICE LIGHTING ENVIRONMENT ON EMPLOYEES' EMOTIONAL STATE

Meng Li[1] and Lixuan Cheng[2]
[1, 2] *School of Civil Engineering, Chongqing University, Chongqing, 400045, China*

For most employees, the office is the primary workplace, and its lighting environment can affect their mood and alertness. Translation: This review employed a research methodology that involved paper selection, study classification and analysis, and discussion of limitations and future research directions. It explored the specific impacts of lighting environment parameters on the emotional states and alertness of office workers based on past studies. The review considered highly scrutinized research variables and analyzed current research limitations. The conclusions drawn are as follows: When considering correlated colour temperature (CCT) alone, cool white light is more conducive to enhancing alertness, while warm white light tends to decrease it. Alertness levels are higher at CCTs of 5000K-6000K (cool light). For subjective mood, the selected studies do not reach a consensus. When considering illuminance alone, the conclusion that higher illuminance can improve employees' subjective alertness and vitality is not consistent. For mood, within the illuminance range of 100lux-1500lux, higher illuminance can improve employees' mood and increase positive emotions, while lower illuminance can lead to a decline in positive emotions. When considering the interaction between CCT and illuminance, for mood, low illuminance combined with either high or low CCT negatively affects mood. The conclusion regarding whether the combination of high CCT and high illuminance significantly increases alertness is still inconsistent. This review provides a reference for future research on optimizing office lighting environments, aiming to promote pleasant mood states among office workers.

Keywords: alertness, correlated colour temperature (CCT), lighting environment, mood, office

[1]13774275319@163.com
[2] chenglixuan2019@163.com

Li and Cheng (2024) A review of the impact of office lighting environment on employees' emotional state In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 776-783

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

A REVIEW ON INDOOR LIGHTING EVALUATION REGARDING ITS' EFFECTS AND INDICATORS

Siyu Lin[1] and Chenqiu Du[2]
[1,2]Chongqing Univ, Joint Int Res Lab Green Bldg & Built Environm, Minist Educ, Chongqing 400045, Peoples R China; Chongqing Univ, Natl Ctr Int Res Low Carbon & Green Bldg, Minist Sci & Technol, Chongqing 400045, Peoples R China

Human health and well-being is currently a hot topic in light environment research. Working and living in low-light environments for long periods of time can negatively affect human physiology and psychology. In order to bring extraordinary benefits to the future design of healthy indoor light environments in buildings, it is necessary to conduct assessment studies on the light environment under indoor lighting. This paper reviews the literature on the effects of light on human health in recent years, analyzes the mechanisms by which light affects the human body, compiles indoor light environment evaluation indicators, and proposes that current research lacks an in-depth exploration of the evaluation of light environments as well as a model that can scientifically and comprehensively evaluate light environments. This review aims to provide new research inspiration for light environment research in the field of ergonomics.

Keywords: evaluation, health and comfort, indoor light environment, indicators, multi-indicator evaluation

[1] siyu_lin2021@163.com
[2] duchenqiu90@163.com

Lin and Du (2024) A review on indoor lighting evaluation regarding its' effects and indicators In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 785-795

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

A STUDY ON THE IMPACT OF ENHANCING WINDOW AIRTIGHTNESS ON RESIDENTIAL BUILDING ENERGY CONSUMPTION IN HOT SUMMER AND COLD WINTER REGION

Zhanzhi Yu[1], Chong Zhang[2], Xinhua Xu[3], Xiaoliang Tang[4] and Zhongyi Yu[5]

[1,2]*School of Architecture and Urban Planning, Huazhong University of Science and Technology, Wuhan 430074, China*

[2]*Hubei Engineering and Technology Research Center of Urbanization, Wuhan 430074, China*

[1,3]*Department of Building Environment and Energy Engineering, Huazhong University of Science and Technology, Wuhan 430074, China*

[4,5]*CITIC General Institute of Architectural Design and Research Co., Ltd., Wuhan 430074, China*

Airtightness of residential buildings and its design standard in hot summer and cold winter climate attract more and more attention from researchers. However, the specific requirements for airtightness of residential buildings in such regions of China that can achieve a compromise between energy performance and economy are still unclear. Further investigation on this topic is needed. The main purpose of this study is to investigate the impact of airtightness level of window system on the energy performance of the residential building in hot summer and cold winter climate. In this study, the eQUEST software was used to perform building energy performance simulation and calculate the heating, cooling, and annual total energy consumption of residential building under different airtightness levels of window. The findings indicate that improving airtightness leads to reduction of 10.4 % to 12.8 % in annual total energy consumption for residential building in hot summer and cold winter climate.

Keywords: air infiltration, airtightness, building energy saving, fenestration, residential building

[1] zhanzhiyu@hust.edu.cn
[2] zhangchong@hust.edu.cn
[3] bexhxu@hust.edu.cn
[4] 170467793@qq.com
[5] yuzy@citic.com

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

AN ADVANCED DESIGN METHOD OF INTELLIGENT BUILDINGS IN SUSTAINABLE DEVELOPMENT

Qing Xia[1], Zhenjing Yang[2] and Yimu Ahou[3]
[1,2,3]*School of Architecture and Urban Planning, Chongqing University, China*

With the intensification of the global climate crisis, the construction industry, which is a major energy consumer, urgently needs innovative technological solutions to enhance low-carbon intelligent building technology and achieve sustainable development goals. This study aims to explore the application and innovation of BIM technology in the whole life cycle of buildings, so as to improve energy efficiency, reduce carbon emissions and promote environmental sustainability. This study first analyzed the concept of smart buildings and the key role of BIM in sustainable buildings. Subsequently, the integration of BIM with advanced smart technologies, such as Internet of Things (IoT), artificial intelligence, and big data analytics in the design, construction, and operation of buildings throughout their lifecycle was deeply studied. Through the strategic application of these technologies, buildings can skillfully adapt to the surrounding environment and achieve intelligent control mechanisms, thereby significantly reducing energy consumption. The results show that the proposed BIM has good effectiveness and superiority in the application of the whole life cycle of the building. It can provide information for the future development of low-carbon intelligent buildings and provide support for the construction industry to take a more substantial step in sustainable development.

Keywords: BIM technology, building life cycle, low-carbon intelligent buildings

[1] fimberchen@126.com
[2] young30331@163.com
[3] 1064257239@qq.com

Xia, Yang and Ahou (2024) An advanced design method of intelligent buildings in sustainable development In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 804-814

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

ASSESSING THE PERFORMANCE OF PCM EMBEDDED NON-LINEAR THERMAL WALL

Suo Li[1], Wenjie Ji[2], Shuli Liu[3], Lagouge Tartibu Kwanda[4] and Kanzumba Kusakana[5]
[1, 2, 3] *School of Mechanical Engineering, Beijing Institute of Technology, Beijing, China*
[4] *School of Mechanical Engineering, University of Johannesburg, Johannesburg, South Africa*
[5]*Electrical, Electronic and Computer Engineering Department, Central University of Technology, Free State, Bloemfontein, South Africa*

The energy consumption of the HVAC system represents a significant proportion of the total energy required to maintain the thermal environment of a building. Trombe wall, which has passive solar structures, can harness solar energy for indoor ventilation or heating, thus reducing the reliance on the HVAC system and improving the indoor thermal comfort. This study proposed a novel non-linear structure Trombe wall (NSTW) and explored whether this structure could enhance the performance, whose surface structure was not flat as in traditional designs but was a continuously varying curved surface. Also, the phase change material (PCM) was combined with this NSTW to further improve the ability of energy storage. The thermal resistance-capacitance (RC) method was employed to establish its heat transfer model, and the accuracy of the RC model was verified through experiments. The results showed that a great agreement between the RC model and the experiment, with a mean relative error of 3.7%. Additionally, throughout the entire process, the temperature of the airflow inside the air tunnel remained above the ambient temperature, with the maximum temperature difference reaching 16.4°C. The heated air flow could either supply to indoors for heating directly in winter or facilitate the air circulation and ventilation within the interior space in summer and transition seasons. It had proved that the NSTW possessed excellent ventilation and heating capabilities, which could enhance indoor thermal comfort and be beneficial to the HVAC system energy saving by reducing the thermal load of indoor environment.

Keywords: building energy conservation, PCM, RC model, solar energy utilization, thermal environment, Trombe wall

[1] lisuo0817@163.com
[2] jiwenjie@bit.edu.cn
[3] shuli79@126.com
[4] ltartibu@uj.ac.za
[5] kkusakana@cut.ac.za

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

DEVELOPMENT AND PROSPECTION OF OCCUPANT BEHAVIOUR IN RESIDENTIAL BUILDING

Xilong Liao[1] and Baizhan Li[2]

[1, 2]*Joint International Research Laboratory of Green Buildings and Built Environments (Ministry of Education), Chongqing University, Chongqing, 400045, China.*

[1, 2]*National Centre for International Research of Low-carbon and Green Buildings (Ministry of Science and Technology), Chongqing University, Chongqing, 400045, China.*

The air-conditioning energy consumption of residential buildings has great potential for energy saving. Thus, it is crucial to understand the relationship between occupant behaviour and air-conditioning energy consumption. This paper aims to provide a comprehensive overview of the current research of occupant behaviour research and suggest future focus. This paper recognizes VOSviewer as a powerful tool for data visualization, based on the relative literature in recent years, through literature clustering, keyword analysis and summary of key literature, our analysis reveals that establishing the occupant behaviour model, adjust building energy policies and machine learning are the most common methods, and researchers always focus on energy saving, low-carbon target and occupant thermal comfort. In the future, the research subjects will be further detailed, and occupant behaviour model of the individual level will attract more researchers' attention. On the other hand, researching different regions' building energy policies on the basic of big data will be a hot topic.

Keywords**:** energy saving, low-carbon, occupant behaviour, residential buildings, VOSviewer.

1 liao_xi_long@163.com
2 baizhanli@cqu.edu.cn

Liao and Li, (2024) Development and prospection of occupant behaviour in residential building In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 826-836

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

EFFECT OF ELEVATED TEMPERATURE ON THE MECHANICAL PROPERTIES OF HIGH VOLUME RECYCLED COARSE AGGREGATE CONCRETE CONTAINING VOLCANIC ASH

Sanusi Gambo[1], Mohammed Wali Yahaya[2] and Abdullahi Getso Ibrahim[3]
[1,2,3]*Department of Building, Ahmadu Bello University, Zaria, Nigeria*

The extensive utilization of natural coarse aggregate (NCA) in the manufacturing of concrete has resulted in its depletion, causing significant economic and environmental repercussions. Employing coarse aggregate sourced from construction and demolition waste offers a promising solution to minimize the demand for natural aggregate. Concrete structures might encounter high temperatures during fire incidents, potentially impacting their mechanical characteristics. Hence, this study examined the influence of elevated temperatures on the attributes of concrete incorporating recycled coarse aggregate and volcanic ash. High-volume recycled coarse aggregate concrete (RCAC) was produced by substituting 15% of ordinary Portland cement with volcanic ash (VA) and entirely replacing NCA with RCA. Concrete mix proportioning for Grade 20 was carried out according to the Department of Environment (DoE) guidelines. The mix proportions used were 1:1.8:2.5 with a water-binder ratio of 0.45, producing 100x100x100 mm cubes and 200x100 mm cylinders. The specimens were immersed in water at room temperature for 90 days and then oven-dried at 105°C for 24 hours to remove any excess moisture. Subsequently, the samples were exposed to elevated temperatures of 200°C, 400°C, 600°C, and 800°C at a heating rate of 10°C/minute for 2 hours. Following heating, the specimens were allowed to cool naturally to room temperature before undergoing compressive and tensile strength testing. Results indicated a reduction in compressive strength for RCAC samples exposed to 400°C, 600°C, and 800°C by 30.6%, 59.13%, and 73.5%, respectively. In comparison, the compressive strength of the control concrete decreased by 31.46%, 55.86 and 68.7% at 400^0C, 600^0C, and 800^0C respectively. This suggests that RCA could serve as a feasible alternative for the substantial replacement of NCA in concrete production.

Concrete, construction and demolition waste, elevated temperature, recycled coarse aggregate, volcanic ash

[1] gambomsc12845@gmail.com
[2] yahayamohammed.wali@gmail.com
[3] getsomsc12012@gmail.com

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

EFFECTS OF MASONRY MATERIALS CHARACTERISTICS ON PAINTED EXTERNAL WALL SURFACES

Mark Osae Afful[1], Sarfo Mensah[2], Nanyi Kobina Orgen[3] and Collins Ameyaw[4]
[1,2,3,4]*Department of Building Technology, Kumasi Technical University, Ghana*

Building paint defects have environmental and health implications and cause damage to properties. However, the role of masonry background materials in painting defects has not been explored. The objective of this study was to reveal the effects of background materials used in the construction of external masonry walls on the paints applied to the walls and to further determine the appropriate constructional remedies. Using a simple random sampling technique to select three sub-metropolitan districts in the Kumasi metropolitan area of Ghana, 173 buildings were sampled for observation. Using an experimental research design, painting defects in 173 buildings in the Kumasi Metropolis in Ghana were observed. Laboratory examination of background material specimens collected from the building sites revealed that the sand used for moulding of sandcrete blocks had certain properties such as uncontrolled sizes, unwanted particles such as silt, salts, and alkali substances, and other contaminants, which affect the block strength, cement/sand mortar for plastering and rendering block walls, and eventually, the paints applied to the walls. We determined that moulding 20 units of 125 mm thick sandcrete blocks using 50 kg OPC cement, in addition to sieving and washing sand before use for block moulding and wall rendering, would provide excellent background performance for painting.

Keywords: background materials, building finishes, paints defects, painted wall surfaces, sandcrete blocks

[1] affulmiky@gmail.com
[2] sarfo.mensah@kstu.edu.gh
[3] nanyiorgen8@gmail.com
[4] collins.ameyaw@kstu.edu.gh

Afful *et al.*, (2024) Effects of masonry materials characteristics on painted external wall surfaces In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 845-854

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

EXPERIMENTAL INVESTIGATION ON POST-FIRE MECHANICAL PROPERTIES OF Q960 ULTRA-HIGH-STRENGTH STEEL AFTER COLD-FORMING PROCESS

Jie Wang[1] and Yu Shi[2]
[1,2]*School of Civil Engineering, Chongqing University, Chongqing 400045, China*

The utilisation of Q960 ultra-high-strength steel in engineering structures is an increasingly appealing proposition due to its demonstrated ability to provide superior mechanical properties. Its use in the manufacture of cold-formed steel has garnered significant attention. This study is an experimental investigation of stress-strain characteristics of Q960 ultra-high-strength steel, including effects of cold forming, high temperature and cooling conditions. A total of 90 coupon specimens were subjected to the experimental conditions, including seven different heating conditions and two different cooling conditions. Tensile coupon tests indicated a slight enhancement of strength properties and a decrease in ductility properties in the corner Q960 ultra-high-strength steel coupon specimens. In addition, the effects of exposure temperature and cooling conditions on the stress-strain curves of flat and corner Q960 ultra-high-strength steel coupon specimens were investigated and the trends of key mechanical parameters were subsequently discussed. The results of this research will form the basis for subsequent numerical and theoretical studies on the residual fire resistance of structures made from Q960 ultra-high-strength steel.

Keywords: cold-forming process, constitutive model, exposure temperature, mechanical property, ultra-high-strength steel

[1] jiewang4648@126.com
[2] shiyu7811@163.com

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

HOUSING CHARACTERISTICS AND HEAT PERCEPTION: COMPARISON ACROSS FORMAL AND INFORMAL NEIGHBOURHOODS IN LAGOS, NIGERIA

Olumuyiwa Bayode Adegun[1], Tobi Eniolu Morakinyo[2], Ademola Akinbobola[3], Benjamin Obe[4] and Olawale Oreoluwa Olusoga[5]

[1,5]Department of Architecture, Federal University of Technology, Akure, Nigeria
[1]School of Architecture and Planning, University of the Witwatersrand, Johannesburg, South Africa
[2,4]School of Geography, University College Dublin, Ireland
[4]Department of Meteorology and Climate Science, Federal University of Technology, Akure, Nigeria

The increasing impacts of extreme temperatures disproportionately affects the diverse communities within cities. Yet there is limited empirical evidence of housing characteristics and heat exposure or perception especially in the global south countries. This precludes tailor-made interventions addressing heat-health impacts in the built environment. This study presents geo-spatial and quantitative data on housing characteristic across three neighborhoods in Lagos, Nigeria. The aim is to show how housing characteristics are linked to heat exposure and perception in both formal and informal urban areas, which represent diverse socio-economic and ecological contexts. It adopted a survey approach which involves deploying a webGIS-based questionnaire. The questionnaire contained questions related to socio-demographic factors, heat perception, health outcomes, and housing characteristics, and was administered during the cool seasons between July and August 2023. Statistical and geo-spatial analysis was conducted on data gathered. Data analysis reveals distinct differences in housing characteristics and heat perception between formal and informal communities, underscoring the unique challenges faced by each neighbourhood type. The findings also highlight housing conditions that limit the residents' capacity to adapt/cope with heat-related problems. This study contributes local evidence regarding heat and their interrelationship with housing and the built environment. The data reveals disparity between formal and informal communities, emphasizing the widespread housing-related vulnerability to heat stress.

Keywords: building materials, heat adaptation, slums/informal settlements, sustainable housing, thermal comfort

[1] muyiwaadegun@yahoo.co.uk
[2] tobi.morakinyo@ucd.ie
[3] aakinbobola@futa.edu.ng
[4] benjamin.obe@ucdconnect.ie
[5] ooolusoga@futa.edu.ng

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

IMPACT OF PCMC ROOF ON INDOOR THERMAL-HUMIDITY ENVIRONMENT AND AIR CONDITIONING ENERGY CONSUMPTION

Lina Jiang[1], Yafeng Gao[2], Shuli Liu[3], Jasur Rashidov[4], Xiaotong Zhang[5] and Zhixuan Fan[6]

[1,2,5,6]*Joint International Research Laboratory of Green Building and Built Environment, Ministry of Education, Chongqing University, 400044, Chongqing, China*

[3]*School of Mechanical Engineering, Beijing Institute of Technology, Beijing, 100081, China*

[4]*Tashkent University of Architecture and Civil Engineering, Faculty of Technology, Yunusabad district, Yangishakhar Street, 9, Tashkent, Uzbekistan*

The increasing energy consumption of building HVAC systems has underscored the significance of enhancing the heat insulation capabilities of building roofs to enhance energy efficiency and reduce emissions. To investigate the impact of Phase Change Material Cool (PCMC) roofs on indoor thermal and humidity conditions and energy usage, three types of experimental rooms were designed: an ordinary roof room, a phase change material (PCM) roof room, and a PCMC roof room. Measurements of indoor temperature, humidity, and air conditioning energy consumption were conducted under both air-conditioned and non-air-conditioned conditions. The findings revealed that under non-air-conditioned conditions, the PCMC room had an average temperature 0.56-1.8°C lower than the ordinary room. The PCMC room also exhibited a daily temperature difference 0.9-1.5°C lower than the PCM room. Under air-conditioned conditions, the PCMC room had an average daily temperature difference 1.1°C lower than the PCM room. Under typical summer weather conditions, the PCMC room achieved energy savings ranging from 5.1% to 13.5%, outperforming the PCM room's energy savings of 1.4% to 8.4%. These research findings provide a theoretical support for the promotion and quantification of the energy-saving effects of PCMC roof technology in Chongqing.

Keywords: air conditioning energy consumption, indoor thermal-humidity environment, PCM, PCMC roof

[1] linajiang2023@yeah.net
[2] gaoyafeng79@126.com
[3] shuli79@126.com
[4] jasrash55@gmail.com
[5] zxt19823353325@126.com
[6] fanzhixuan991226@163.com

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

NUMERICAL STUDY ON LATERAL BEHAVIOR OF COLD-FORMED STEEL COMPOSITE SHEAR WALL

Ran Xiaowei[1] and Shi Yu[2]
[1,2]School of Civil Engineering, Chongqing University, Chongqing, 400045, China

In this study, based on the experimental results and numerical analysis, the effects of diagonal bracing on the lateral stiffness, yield load, and load-bearing capacity of composite cold-formed steel (CFS) walls are studied. The modeling method of simulating single screw connection using connector function in ABAQUS is introduced in detail. On this basis, the finite element model based on test specimens is established, which makes the finite element analysis results agree well with the test results, and makes preparation for parametric analysis. In the parameter analysis, the important parameters, panel splicing type, are considered, in order to study the hysteretic behavior of the wall. Finally, the numerical results reveal that the integration of the wall panel plays an important role in the lateral strength and stiffness of the CFS shear wall, and a complete panel is recommended during the practical application.

Keywords: cold-formed steel composite wall, finite element analysis, lateral behaviour.

[1]hk18130@163.com
[2]shiyucivil@cqu.edu.cn

Xiaowei and Shi (2024) Numerical study on lateral behavior of cold-formed steel composite shear wall In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 893-902

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

RESEARCH ON THE STRUCTURAL REGULATION OF SEPIOLITE FIBRE AND APPLICATION AS SELF-HUMIDITY-CONTROL FUNCTIONAL BUILDING MATERIALS

Xiaoyu Han[1], Ruihao Tang[2], Lin Hao[3], Bin Dong[4], Lijuan Wang[5], Jinsheng Liang[6]

[1, 2, 3, 4, 5, 6] *Key Laboratory of Special Functional Materials for Ecological Environment and Information (Hebei University of Technology), Ministry of Education, Tianjin 300130, People's Republic of China*

[1, 2, 3, 4, 5, 6] *Institute of Power Source and Ecomaterials Science, School of materials science and Engineering, Hebei University of Technology, Tianjin 300130, People's Republic of China*

Sepiolite is a typical fibrous natural clay mineral with special pore structure and unique one-dimensional nanostructure. Sepiolite has porous microstructure, large specific surface area and surface polarity, thus exhibiting excellent adsorption performance for water molecules, which makes it have broad application prospects in the field of humidity control. Here, the structural characterization and potential applications of sepiolite mineral are reviewed through reference to the studies published worldwide over recent years. Based on the structure-activity relationship between the fiber morphology, pore structure, as well as surface characteristics of sepiolite and its moisture absorption/desorption performance, the high-efficiency functional materials derived from sepiolite fibers can be constructed through structural regulation and surface modification, which is further applied to self-humidity-control products. This review should provide a typical reference for the regulation and utilization of natural minerals to develop functional building materials.

Keywords: porous mineral, sepiolite, structural regulation, surface modification, humidity-control.

[1] hanxiaoyu9234@126.com
[2] rhtang0105@163.com
[3] hl@hebut.edu.cn
[4] dongbin@hebut.edu.cn
[5] wljhh@hebut.edu.cn
[6] liangjinsheng@hebut.edu.cn

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

SOCIOTECHNICAL SYSTEM FAILURE IN CONSTRUCTION PROJECTS: A DISTRIBUTED SITUATION AWARENESS OF SKY CENTRAL ROOF DAMAGE

Kingford Mkandawire[1], Shabnam Kabiri[2] and John Connaughton[3]
[1,2,3]*Construction Management and Engineering, Chancellor's Building, University of Reading, Whiteknights, Reading, RG6 6DF, UK*

Situation awareness (SA) is described as an important notion in ensuring that adverse incidents in complex sociotechnical systems do not occur. Until now, a study of how SA plays a role in minimising interface discrepancies that have the potential to cause installation incidents when incorporating offsite products into onsite construction has not been considered. When installation incidents occur, the lack of awareness of the errors and of what procedures were required are attributed to an individual. This paper argues that this approach has not helped to minimise installation incidents, instead offering a systems level view that has the potential to demonstrate how a project system, not just an individual, loses situation awareness. This is demonstrated through a Distributed Situation Awareness (DSA) theory-based description and analysis of the events preceding in a case study of Sky Central timber cassettes roof damage in the UK. Data were collected through technical investigation reports and published court proceedings. The findings show that loss of situation awareness in the project sociotechnical system that comprised the project participants and technologies hindered the exchange of knowledge and coordination during the timber cassettes roof design, offsite manufacturing and installation phases. The findings have an implication on the role of DSA in understanding knowledge exchange and coordination when incorporating offsite products into onsite construction. This is useful to organisational interfaces in construction projects to identify interface discrepancies at an early stage and seek ways to address these interface discrepancies.

Keywords: coordination, distributed situation awareness, interface discrepancies, knowledge exchange, offsite construction.

[1] k.mkandawire@pgr.reading.ac.uk
[2] s.kabiri@reading.ac.uk
[3] j.connaughton@reading.ac.uk

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

THE EFFECT OF MELANOPIC EQUIVALENT DAYLIGHTING ILLUMINANCE (M-EDI) ON SATISFACTION AND PRODUCTIVITY IN THE WORKPLACE

Zhongzhe Li[1], Runming Yao[2], Shouyuan Bai[3] and Yanfeng Zhu[4]
[1, 2, 3, 4]*Joint International Research Laboratory of Green Buildings and Built Environments, School of the Civil Engineering, Chongqing University, China*
[2]*School of the Built Environment, University of Reading, Reading RG6 6DB, UK*

This study examines the influence of melanopic equivalent daylighting illuminance (m-EDI) on occupants' satisfaction and productivity in office environments. A controlled experiment involving 16 participants explored various lighting conditions, assessing subjective performance, work passion, and alertness. Results indicate a significant correlation between m-EDI levels and light satisfaction, as well as subjective performance ratings. Findings suggest the potential for optimizing lighting design to enhance indoor environments, fostering improved productivity and satisfaction among occupants. Further research is warranted to validate these findings and explore the combined effects of m-EDI with other environmental factors. Integration of m-EDI considerations into lighting design practices can contribute to creating high-quality indoor environments conducive to occupants' well-being and productivity.

Keyword: light environment, m-EDI, productivity, satisfaction, workplace

[1] zhongzheli@cqu.edu.cn
[2] r.yao@cqu.edu.cn
[3] baishouyuan1759@163.com
[4] 807933806@qq.com

Li, *et al.* (2024) The effect of Melanopic equivalent daylighting illuminance (m-EDI) on satisfaction and productivity in the workplace In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 927-932

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

THERMAL PROPERTIES OF SURROUNDING ROCK IN DEEP-BURIED METRO STATION FRESH AIR SHAFTS ENHANCED BY PHASE CHANGE MATERIALS: A CASE STUDY FROM CHONGQING, CHINA

Zhili Ren[1], Yucheng Ren[2], Zehui Yang[3] and Yimin Xiao[4]
[1,2,3,4] *College of Civil Engineering, Chongqing University, Chongqing 400045, China*

Subway stations typically depend on fresh air shafts to bring in outdoor air, with the surrounding rock of these shafts and the inlet air forming a natural vertical earth-air heat exchange system (VEAHE). In this paper, two numerical models were established: the traditional VEAHE system and the PCM-VEAHE system. These models have been verified through field tests and experimental bench results. The verified models were then utilized to evaluate the heat transfer performance of both systems in Chongqing, China. Findings indicate that the average annual energy storage efficiency for the traditional VEAHE system stands at 17.47%, with the thermal unbalance rate being close to 0 during both winter and summer. Additionally, it was observed that thermal unbalance escalates with the length of the shaft. Improvements have been noted in the heat imbalance of the PCM-VEAHE system during summer, significantly enhancing the cooling effect on the air during the peak heat of July-August. These research outcomes may serve as a reference for enhancing energy conservation and emission reduction in subway stations.

Keywords: fresh air shaft, numerical calculation, phase change materials (PCM), vertical earth-air heat exchange (VEAHE), subway station

[1] renzhili@stu.cqu.edu.cn
[2] yucheng9011@163.com
[3] 958732868@qq.com
[4] xiaoyimin@cqu.edu.cn

Ren, *et al.* (2024) Thermal properties of surrounding rock in deep-buried metro station fresh air shafts enhanced by phase change materials: a case study from Chongqing, China In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 933-944

T7 CONSTRUCTION & PROJECT MANAGEMENT

A digital skills gap analysis of building inspectors: the case of the City of Johannesburg Metropolitan Authority – Gethe, F., Awuzie, B., Simbanegavi, P. and Chiloane, M. B. 125

Academia-industry linkages: a missing link in TVET institutions in Tanzania - Mhando, Y., Mamboya, F. and Chacha, M. 126

An evaluation of the quantitative risk assessment simulation undertaken during the planning stage of mega-projects – Zwane, S., Schutte, D., Maila, S. and Jones, R. 127

Ascertaining the knowledge of Ghanaian construction professionals on the use of clay bricks as a sustainable construction material – Darko, P., D., Nani, G., Mensah, N., A., A., O., Yusif, M. and Badii, P. 129

Barriers to digitalization of procurement – a review – Ojo-Fafore, E. and Laryea, S. 130

Bibliometric analysis of virtual reality in construction education – Kio, P., Ohochuku, C., Aduloju, T., and Agidani, J. 131

Bibliometric review of social value in construction literature – Laryea, S., Kwasafo, O., K. and Mensah, S. 133

Buried alive: the challenges facing the emerging contractors in the Limpopo province, South Africa – Moeti, M., Amoah, C. and Le Roux, L. 134

Challenges associated with differential measurements in stairs construction in low rise residential buildings – Boadi, E. O., Mensah, S., Ameyaw, C., Orgen, N. K. and Bondinuba, F. K. 135

Construction materials management techniques used in building projects in Kano Metropolis, Nigeria – Wudil, B. I., Bashir, K., K., Sani U., and Aikawa, I. U. 136

Detecting and preventing unbalanced bidding in South African public sector construction – Tilese, N., Makhaga, T., Mphahlele, M. and Zungu, Z. 137

Establishing success and failure factors of circular economy transitions in property development firms: a servitized business model approach – Nemakhavhani, R., Awuzie, B. and Aigbavboa, C. 138

Evaluating the new universities project outcomes using the PMBOK project performance domains – Mosalaesi, T. and Laryea, S. 139

Exploring the challenges in the performance of small-medium contractors in South Africa: a consultants' perspective – Simpeh, F., Baba, V. and Anugwo, I., C. 141

Fostering construction firm resilience through persuasive narratives of strategy: a conceptual framework – Zungu, Z., Laryea, S. and Nkado, R. 142

Investigate the potential impact of individual tracking technology in the Construction Industry – Lai, H., Y. and Essah, E., A. 143

Investigating management practices in the construction and delivery of electricity projects in Nigeria – Oladiran, O., J. and Oguntona, O., A. 144

Key barriers to green building implementation in South Africa – Mompati, L., Mandlate, M., Kabini, K. and Nomvalo, U. 145

Modelling leadership development determinants in Ghana's construction industry: the moderating role of professional capability – Sam, A.. Aigbavboa, C. O. and Thwala, W. D. 147

Perceptions of tender document quality and its impact on construction estimates – Nezambe, B. Laryea, S. and Govender, N. 149

Risk factors that contribute to the collapse of major construction companies: the case of fallen South African construction giants – Scholtz, R., Deacon, H., A., Le Roux, L. and Amoah, C. 150

Team communication in the built environment: the South African land surveyor's perspective – Harinarain, N. and Mbanjwa, S. 151

The job satisfaction of black female quantity surveyors – Punungwe, F. and Terblanche, R. 153

Understanding mason training in South Africa – Khuzwayo, B., Walker, M. and Graham, B. 154

Using dynamic BIM to improve construction safety culture – Amiri, M., Saghatforoush, E. and Laryea, S. 155

Wearable technology to reduce fatigue risks for construction workers: a scoping review – Mtetwa, S. I., Mollo, L., G. and Emuze, F., A. 157

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

A DIGITAL SKILLS GAP ANALYSIS OF BUILDING INSPECTORS: THE CASE OF THE CITY OF JOHANNESBURG METROPOLITAN AUTHORITY

Faranani Gethe[1], Bankole Awuzie[2], Prisca Simbanegavi[3], Maruping Broderick Chiloane[4]

[1,3]School of Construction Economics and Management, University of the Witwatersrand, Johannesburg, South Africa,

[2]Department of Construction Management Quantity Surveying, University of Johannesburg, Johannesburg, South Africa,

[4]Building Development Management, City of Johannesburg, Johannesburg, South Africa

The utility of digital technologies in improving building inspection functions has been elucidated by relevant literature. However, the ability of building inspectors to deploy these technologies remains contentious as a paucity of studies, highlighting the digital capabilities possessed by these cohort has been observed. To bridge this gap, this study conducts a digital skills gap analysis of building inspectors in Johannesburg, South Africa. The study adopts a case study research strategy with a selected building inspectorate unit in South Africa's Gauteng province serving as the case study. Data was elicited within case surveys, 41 building inspectors responded out of 70 total population sampling sent out. Data was analyzed using descriptive and inferential statistics in SPSS. Results show substantial levels of digital illiteracy among building inspectors in the City of Johannesburg yet little drive-in adoption of the digital technologies in conducting building inspections. It is clear from this study that essential competencies required for the adoption of digital technologies are not at the acceptable level for practical application in the case of Johannesburg. Besides elucidating the growing importance of digital technologies in the execution of building inspection functions in developing countries, the study provides considerable insight into the existence of a skills gap which limits the ability of building inspectors to engage in the increased uptake of these technologies.

Keywords: building inspectors, digital skills, digital technologies, gap analysis

[1] faranani.gethe@wits.ac.za
[2] boawuzie@uj.ac.za
[3] prisca.simbanegavi@wits.ac.za
[4] marupingbroderickC@joburg.org.za

Gethe, *et al.* (2024) A digital skills gap analysis of building inspectors: the case of the City of Johannesburg Metropolitan Authority In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 946-956

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

ACADEMIA-INDUSTRY LINKAGES: A MISSING LINK IN TVET INSTITUTIONS IN TANZANIA

Yusuph Mhando[1], Florence Mamboya[2] and Musa Chacha[3]
[1]*Department of Civil Engineering, Arusha Technical College, Arusha, Tanzania*
[2,3]*Department of Applied Sciences and Social Studies, Arusha Technical College, Arusha, Tanzania*

Linkages between Industry and Technical and Vocational Education and Training Institutions (TVETIs) have a bearing on innovative skills of graduates. However, TVETIs in Tanzania are far behind in the development of this relationship. This paper reviews the relevant literature to identify key factors impeding academia-industry linkages to form a basis for discussion on what measures should be taken to enhance sustainable collaboration that promotes the relevance and contribution of TVETIs to socio-economic development of the society. Findings indicate that the factors impeding effective linkages between industry and TVETIs include challenges in finance and basic infrastructure, lack of multidisciplinary research centres or institutes with industry buy-in, and lack of relevant public policies in place. Results suggest that there is a need of awareness on the factors impeding academia-industry linkages. This could help TVETIs, industry, policy makers, academicians and researchers to enhance TVETIs-industry collaborations.

Keywords: academia-industry, linkages, skilled graduates, Tanzania, TVET institutions

[1] ybmhando@gmail.com; yusuph.mhando@atc.ac.tz
[2] fmamboya@gmail.com; florence.mamboya@atc.ac.tz
[3] musa.chacha@atc.ac.tz

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

AN EVALUATION OF THE QUANTITATIVE RISK ASSESSMENT SIMULATION UNDERTAKEN DURING THE PLANNING STAGE OF MEGA-PROJECTS

Sibongile Zwane[1], David Schutte[2], Sue Maila[3] and Razaak Jones[4]
[1,2,3,4]*School of Construction Economics and Management, University of the Witwatersrand, South Africa*

This research examines how the absence of robust risk identification processes during the planning stage can significantly impact the quantitative risk assessment (QRA) outcomes and increase the likelihood of cost overruns in mega-projects in South Africa. By analysing specific mega-projects and their risk identification procedures, this study highlights the importance of a high-quality assessment of the QRA input stage in the context of these mega-projects. Through surveys and interviews with project managers and stakeholders, the study has provided deeper insights into the consequences of inadequate planning, such as project cost overruns and decreased project profitability. The research indicated that a robust risk identification process during the planning stage is pivotal in mitigating cost overruns in mega-projects in South Africa. Projects that prioritise structured methodologies involving all the relevant stakeholders and conduct comprehensive risk identification practices are better equipped to control project costs. The unanimous agreement on the significance of risk identification in cost overrun prevention emphasises its paramount importance. The findings will contribute to the risk management body of knowledge, offering valuable recommendations for improved risk identification and mitigation strategies to enhance project outcomes and positively impact project owners. Lastly, the paper sheds light on the nuanced landscape of risk identification, its impact on cost overruns, and the strategies for its improvement.

Keywords: construction risk, mega-projects, planning stage , quantitative risk assessment QRA, risk identification

[1] Sibongile.zwane@wits.ac.za
[2] djschutte7@gmail.com
[3] mailaskea@gmail.com
[4] jonesrazaak@gmail.com

Zwane, *et al.* (2024) An evaluation of the quantitative risk assessment simulation undertaken during the planning stage of mega-projects In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 967-977

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

ASCERTAINING THE KNOWLEDGE OF GHANAIAN CONSTRUCTION PROFESSIONALS ON THE USE OF CLAY BRICKS AS A SUSTAINABLE CONSTRUCTION MATERIAL

Priscilla Dufie Darko[1], Gabriel Nani[2], Nana Akua Afriyie Owusu Mensah[3], Mariama Yusif[4], Prosper Badii[5]

[1,2,3,4,5]*Department of Construction Technology & Management, Kwame Nkrumah University of Science and Technology, Ghana*

The world is working towards a sustainable planet by the year 2030, with the 17 interlinked Sustainable Development Goals (SDGs) acting as a roadmap. Due to this, construction of infrastructure needs to be done in a more sustainable way to provide a safe space for humanity in the years to come. Masonry is one of the key materials needed for construction of which clay bricks has been researched to be a more sustainable alternative. In Ghana, clay bricks are being considered as old-fashioned and so modern walling units are being preferred to them, leading to the decline of its use. This study considers the construction industry of Ghana, exploring the understanding and the awareness of construction professionals in the country on the use of clay bricks as a sustainable construction material in a world that is fast advancing. A mixed research approach was adopted where through purposive sampling, 65 structured questionnaires were administered to construction professionals in good standing with the Ministry of Works and Housing and the Ministry of Roads and Highways. Interviews were also conducted with 15 professionals from construction research institutions and some clay brick manufacturing firms. Statistical Packages for Social Sciences (SPSS) software version 26 was used to analyse the data using simple frequency analysis, a descriptive approach. Findings showed that overall, most professionals have a low level of knowledge on clay bricks being a more sustainable material including those that preferred its usage. In conclusion, education on the sustainability of clay bricks is recommended and also effective cooperation among construction professionals is required to adopt the use of clay bricks in construction in Ghana to contribute to the creation of a sustainable environment.

Keywords: clay brick, construction material, construction professionals, Ghana, sustainability

[1] priscilladufiedarko@gmail.com
[2] gnani.cap@knust.edu.gh
[3] nafriyie546@gmail.com
[4] iammariamayuif@gmail.com
[5] badiiprosper@gmail.com

Darko, *et al.* (2024) Ascertaining the knowledge of Ghanaian construction professionals on the use of clay bricks as a sustainable construction material In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 979-988

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

BARRIERS TO DIGITALIZATION OF PROCUREMENT – A REVIEW

Elizabeth Ojo-Fafore[1] and Samuel Laryea[2]
[1, 2] *School of Construction Economics and Management, University of the Witwatersrand, South Africa*

The concept of digital technology is making waves in the construction industry in developed countries; however, it is not the same story in other nations as there are several barriers militating the progress of adoption of the new concept. This study aims to investigate the barriers militating digitalization of procurement in Construction, to proffer solutions. This study investigated possible barriers affecting the implementation of digitalization of procurement using a descriptive literature review. Several past works were reviewed to fill the gaps and apply new methods that will enable the digitalization of procurement. The study discovered several barriers restraining the digitalization of Procurement, but there are three common barriers to the literature reviewed; insecurity, cost, and Lack of skilled expertise. This industry will bring overall improvements in project time, quality, cost, and safety standards as well as client requirements and satisfaction. This research paper is of the view that digitalization will increase productivity and the competitive advantage in the Construction industry. In conclusion, there is a need to prioritize investment in digital tools and technology to have ease of adoption of procurement digitalization.

Keywords: construction industry, digitalization, procurement, South Africa

[1] Elizabeth.ojo-fafore@wits.ac.za
[2] Samuel-Laryea@wits.ac.za

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

BIBLIOMETRIC ANALYSIS OF VIRTUAL REALITY IN CONSTRUCTION EDUCATION

Patricia Kio[1], Chinwennwo Ohochuku[2], Temidayo Aduloju[3] and Jummai Agidani[4]
[1]*Engineering Technology Department, Fitchburg State University, USA*
[2]*Department of Architecture, Rivers State University, Nigeria*
[3]*Department of Quantity Surveying, Lagos State University, Nigeria*
[4]*Department of Building, Baze University, Nigeria*

This bibliometric study determined the influence of documents, authors, countries, affiliation, and keywords from article publications on the use of virtual reality (VR) in, construction education and sustainability published by digital object identifier equipped journals listed in Dimensions database. The analysis focused on comparatively describing the characteristics and trends of the documents, authors, countries, affiliation, and keywords. The data analyzed were from 770 research publications in Dimensions from 2012 to 2024 and the searches used to establish the dataset were last updated on March 27, 2024. Descriptive statistical methods were used and a bibliometric analysis was conducted using Biblioshiny, an R-based app, to generate bibliometric maps. Li X. was the most influential author with 637 citations, published in the Automation in Construction Journal in 2018. Learning was the most influential keyword in the publications. China was the country with the most publications. Until now, no bibliometric research has investigated the influence of articles on VR education usage after the Covid-19 pandemic. This study provides evidence of practical adoptions of VR in construction, design, cost and culture revealing applications of VR technology in education and reducing technological bias.

Keywords: bibliometric, construction, education, sustainability, virtual reality

.

[1] pkio1@fitchburgstate.edu
[2] positive2ng@gmail.com
[3] temidayo.aduloju@lasu.edu.ng
[4] Jummai.agidani@bazeuniversity.edu.ng

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

BIBLIOMETRIC REVIEW OF SOCIAL VALUE IN CONSTRUCTION LITERATURE

Samuel Laryea[1], Oscar Kwame Kwasafo[2] and Sarfo Mensah[3]
[1,2]*School of Construction Economics and Management, University of the Witwatersrand, South Africa*
[3]*Department of Building Technology, Faculty of Built and Natural Environment, Kumasi Technical University, Ghana*

The construction industry plays a leading role in the provision of infrastructure projects that promote not only the primary objectives for which a project is intended but also the secondary objectives which relate to wider socio-economic development and social value aspects, as shown in the International Organization for Standardization (ISO 10845…2022) 10845 family of standards for construction procurement. While most papers in the construction literature have focused on the primary objectives of infrastructure projects such as costs, time, and quality, relatively little attention has been focused on the secondary objective aspects like economic, environmental, and social sustainability objectives. There has been an increasing focus on the social value aspects of infrastructure projects in recent years. This trend seems likely to increase and directions for future research can be generated from examining the current literature. This paper examines 78 articles relating to social value in construction to explore current understanding and key emerging themes in this area. The 78 articles were identified through a systematic search in Scopus and Google Scholar, then analysed using temporal co-word analysis to generate four key bibliometric themes: social sustainability, social procurement, social value, and employment. Two preliminary conclusions are presented from the bibliometric review. First, while using the 'social value' terminology may show this as a relatively new concept flowing from the social sustainability discourse, earlier studies and practices in this area precede the 'social value' terminology and appropriate linkages to earlier knowledge should be properly established. Secondly, different terminologies are used to refer to the same concept, creating duplication and significant overlaps across the different terminologies. It would be necessary to consolidate and align the various terminologies for consistency.

Keywords: bibliometric review, construction procurement, socio-economic development, social procurement, social value

[1] samuel.laryea@wits.ac.za
[2] okkwasafo@gmail.com
[3] sarfo.mensah@kstu.edu.gh

Laryea, Kwasafo and Mensah (2024) Bibliometric review of social value in construction literature In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 1009-1020

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

BURIED ALIVE: THE CHALLENGES FACING THE EMERGING CONTRACTORS IN THE LIMPOPO PROVINCE, SOUTH AFRICA

Mathopa Moeti[1], Christopher Amoah[2] and Liezl Le Roux[3]
[1,2,3] Department of Quantity Surveying and Construction Management, University of the Free State, South Africa

Emerging contractors are believed to be the engine of economic growth in any country, yet there are challenges in their business operations. There is thus an urgent need for policy renewal regarding emerging contractors' development programmes to adequately address SMEs' challenges to prevent business collapse and sustain employment generation. This study aims to investigate the challenges emerging contractors in the Limpopo Province, South Africa, face in their businesses. The study utilised the qualitative research approach by interviewing 17 randomly selected emerging contractors in the Limpopo province. A face-to-face interview with each participant was conducted using open-ended structured questions. Thematic content analysis was used to analyse the data collected. The findings indicate that the challenges that the emerging contractors face are multi-faceted, including Tender-related, work-related and financial-related. These challenges threaten emerging contractors' business sustenance. The findings implies that there is an urgent need for policy renewal regarding emerging contractors' development programmes to adequately address SMEs' challenges to prevent business collapse and sustain employment generation in the Limpopo province. More studies could be done to identify measures in addressing SMEs' challenges. This study provides emerging and potential contractors in the Limpopo province with the challenges they will most likely encounter. Thus, helping them put strategies in place to tackle the anticipated difficulties for business survival.

Keywords: challenges, contractors, development, emerging, strategies.

[1] moetimathopa@gmail.com
[2] AmoahC@ufs.ac.za
[3] LeRouxL4@ufs.ac.za

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

CHALLENGES ASSOCIATED WITH DIFFERENTIAL MEASUREMENTS IN STAIRS CONSTRUCTION IN LOW RISE RESIDENTIAL BUILDINGS

Ebenezer Offei Boadi[1], Sarfo Mensah[2], Collins Ameyaw[3], Nanyi Kobina Orgen[4] and Francis Kwesi Bondinuba[5]
[1,2,3,4,5]*Department of Building Technology, Kumasi Technical University, Ghana*

Vertical movements in most residential storey buildings in urban areas in developing countries are made using reinforced concrete stairs. However, there seem to be movement difficulties owing to poorly designed and constructed staircases. The objective of this study is to determine the existence and extent of differential measurements (DMs) in stair construction and their effects on building users. Using 120 residential storey buildings selected by purposive sampling in ten sub metropolitan districts in the Greater Kumasi area, the study adopted survey questionnaires, observations, and physical measurements of stairs to collect data. The study revealed that differential measurements in stair construction and associated problems exist in residential storey buildings. Its awareness level is low owing to the low number of publications on the health impact of building units in the country and the occupancy evaluation of existing buildings. We noted that professional bodies and other educational institutions should develop a complete guide/manual on the construction of residential storey stairs and agreeable standards for construction works for the Ghanaian construction industry. Further, it is recommended that on-site training for carpenters/joiners on the construction/erection of formwork for stairs and masons on working on and around stairs/staircase areas must be employed to avoid DMs on stairs.

Keywords: differential measurements, Ghana, residential storey buildings, stairs, stair construction.

[1] eboffei249@gmail.com
[2] sarfo.mensah@kstu.edu.gh
[3] collins.ameyaw@kstu.edu.gh
[4] nkorgen@ymail.com
[5] francis.kbondinuba@kstu.edu.gh

Boadi, *et al.* (2024) Challenges associated with differential measurements in stairs construction in low rise residential buildings In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 1034-1043

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

CONSTRUCTION MATERIALS MANAGEMENT TECHNIQUES USED IN BUILDING PROJECTS IN KANO METROPOLIS, NIGERIA

Bello Isah Wudil[1], Kabiru Bashir[2], Sani Usman Kunya[3] and Ibrahim UsmanAikawa[4]
[1]*Department of Quantity Surveying, School of Environmental Studies Gwarzo, Kano State Polytechnic, Nigeria.*
[2]*Department of Mechanical Engineering, School of Technology, Kano State Polytechnic Nigeria.*
[3]*Department of Building Technology, Faculty of Environmental Technology, Abubakar Tafawa Balewa University, Bauchi, Nigeria.*
[4]*Department of Mechanical Engineering, School of Technology, Kano State Polytechnic Nigeria.*

Efficient management of construction materials is essential for ensuring the timely completion and cost-effectiveness of building projects. This study investigates the practices and techniques employed in construction materials management in Kano Metropolis, Nigeria. Adopting a quantitative research approach, data was collected through a survey of active registered building construction professionals. The findings reveal that transportation efficiency, vendor evaluation, and procurement expenditure are primary strategies utilized in materials management, although vendor evaluation appears underutilized. Furthermore, the study identifies effective receiving and handling techniques, including material storage efficiency and designated storage areas. Recommendations are provided for enhancing project performance, emphasizing the importance of investing in human resource quality, work efficiency, and material quality. Coordinated planning, accurate assessment of material requirements, and sourcing high-quality materials are highlighted as essential measures for optimizing construction project outcomes. This research contributes valuable insights to the field of construction materials management, offering practical guidance for improving operational efficiency and project success in Kano Metropolis and beyond.

Keywords: construction, management, materials, projects, techniques

[1] bwudil@kanopoly.edu.ng
[2] kbmaisallah405@kanopoly.edu.ng
[3] snkunya@gmail.com
[4] ibrahimaikawa@kanopoly.edu.ng

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

DETECTING AND PREVENTING UNBALANCED BIDDING IN SOUTH AFRICAN PUBLIC SECTOR CONSTRUCTION

Neliswa Tilese[1], Thendo Makhaga[2], Matjelele Mphahlele[3] and Zamageda Zungu[4]
[1,2,3,4]*School of Construction Economics and Management, University of Witwatersrand, South Africa*

Unbalanced bidding in public sector infrastructure projects is a key challenge, involving the manipulation of unit prices without adjusting the overall bid. Unbalanced bidding increases the client's financial risks and the likelihood of project abandonment by the contractor. Existing literature provides guidelines for detecting and preventing bid price imbalances but inadequately addresses the practical implementation and efficacy of these approaches. This research aims to evaluate the practices for detecting and preventing unbalanced bidding in the South African public sector against existing formal models. This qualitative case study employs semi-structured interviews with quantity surveyors from public sector clients in Gauteng, South Africa. The purposive, non-probabilistic sampling targets professionals with relevant expertise. A thematic analysis of the interview data reveals insights into the awareness, consequences, and practices associated with unbalanced bidding in the South African public sector. The study findings highlight the need for strengthened governance and accountability, more robust strategies for detection of unbalanced bidding, and enhanced education of practitioners to promote fair competition and ethical practices in awarding projects.

Keywords: front-end loading, public sector construction projects, tendering, unbalanced bidding

.

[1]tileseneliswa@gmail.com
[2]thendomak@gmail.com
[3]mphahleleharry@gmail.com
[4]zamageda.zungu@wits.ac.za

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

ESTABLISHING SUCCESS AND FAILURE FACTORS OF CIRCULAR ECONOMY TRANSITIONS IN PROPERTY DEVELOPMENT FIRMS: A SERVITIZED BUSINESS MODEL APPROACH

Rotondwa Nemakhavhani[1], Bankole Awuzie[2], and Clinton Aigbavboa[3]
[1]*Department of Built Environment, Central University of Technology, South Africa*
[2]*Smart and Sustainable Built Environment, University of Johannesburg, South Africa*
[3]*SARChI in Sustainable Construction Management and Leadership in the Built Environment, Faculty of Engineering and the Built Environment, University of Johannesburg, South Africa*

In the wake of a global push towards engendering sustainable futures, the imperative to improve the circularity performance of built assets through Servitized Business Models (SBM) has gained urgency. However, the transition towards SBM remains challenging for property developers. This challenge has been exacerbated by the lack of studies articulating the pathway for engendering a successful transition. The purpose of this study is to establish the success and failure factors influencing the transition to Circular Economy (CE) through Servitized Business Models (SBM) in property development organizations by conducting a scoping review of the relevant literature. A scoping review is used to map the relevant literature to ascertain the factors influencing the transition to CE through SBM in the construction industry, particularly the property developers' organizations. The data was synthesized using thematic analysis, wherein major themes and patterns were identified within the literature. Key findings include the pivotal role of organizational culture, regulatory frameworks, technological readiness, and stakeholder collaboration in shaping the outcomes of circular economy initiatives. The study's substantial findings hold the potential to influence policy, shape developer strategies, and facilitate the integration of servitization practices, thereby supporting innovation and sustainability in the property development industry and contributing to a more circular economy. The study's findings offer an original contribution by establishing a set of multidimensional factors that property developers must navigate to implement SBM effectively.

Keywords: business models, construction industry, property developers, servitization, sustainability.

[1] rramafalo@cut.ac.za
[2] boawuzie@uj.ac.za
[3] caigbavboa@uj.ac.za

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

EVALUATING THE NEW UNIVERSITIES PROJECT OUTCOMES USING THE PMBOK PROJECT PERFORMANCE DOMAINS

Tsholofelo Mosalaesi[1] and Samuel Laryea[2]
[1,2]School of Construction Economics and Management, Wits University, Johannesburg, South Africa

The Project Management Institute (2021) PMBOK Guide seventh edition presents eight essential domains or activities that are crucial to ensure the success of a project. PMI (2021) defines these Project Performance Domains as a group of related activities that are critical for the effective delivery of project outcomes. The PMI's new focus on performance and project outcomes marks a significant shift away from traditional project management tools and techniques. This paper uses the eight PPDs as a framework to determine the critical factors that enabled the success of the new universities project based on the eight domains. A completed project with comprehensive data was used for the analysis. Hence, data from the project close out report was analysed using the thematic analysis method to identify the key project performance practices that were formulated and implemented to successfully achieve the intended outcomes. The key success factors identified relate to the role of the client as a leader, stakeholder's productive working relationship and the delivery of the project within 1% of the control budget. There may be a common assumption that all clients may employ project managers who may possess the skills to execute these critical functions successfully. However, this is not always the case on all projects, and there is also varying degrees of competency among project managers. Therefore, clients should ensure that those playing leadership roles in their projects are well equipped to perform these critical functions successfully as a condition to achieve better infrastructure project outcomes.

Keywords: document analysis, PMBOK, project performance domain, South Africa.

[1] tsholofelo.mosalaesi@wits.ac.za
[2] samuel.laryea@wits.ac.za

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

EXPLORING THE CHALLENGES IN THE PERFORMANCE OF SMALL-MEDIUM CONTRACTORS IN SOUTH AFRICA: A CONSULTANTS' PERSPECTIVE

Fredrick Simpeh[1] Vuyiseka Baba[2] and Iruka Chijindu Anugwo[3]
[1]*Department of Construction and Wood Technology Education, Akenten Appiah-Menka University of Skills Training and Entrepreneurial, Ghana*
[2]*Department of Building and Human Settlements Management, Nelson Mandela University, South Africa*
[3]*Department of Construction Management and Quantity Surveying, Durban University of Technology, South Africa*

The Limpopo Province is faced with a serious challenge of underperforming contractors. This, in turn, affects the Provincial Government's efforts to deliver quality infrastructure. This study first explores the challenges faced by small and medium enterprises (SME) construction firms from the consultants' perspective and proposes solutions to the identified challenges. The study utilised an exploratory qualitative research design. A non-probability sampling technique was chosen to select the respondents, and the semi-structured interview was used to collect the primary data. The data was analysed using thematic analysis. The study's findings revealed that poor planning, inadequate financial management, inexperienced staff, stakeholder interference, and lack of understanding of project scope were among the many factors contributing to poor contractor performance. Proposed strategies that can be utilised to overcome performance challenges were sub-contracting, adoption of project management tools, affiliation with professional bodies, cession agreements, capacity building, effective stakeholder engagement, and pre-construction training. Contractors and clients in the public sector could adopt the findings of this study to plan a strategic approach for the delivery of infrastructure projects.

Keywords: consultants, contractors' performance challenges, government sector, Limpopo province, school infrastructure.

[1] simfredy24@yahoo.com
[2] vuyibaba@gmail.com
[3] IrukaA@dut.ac.za

Simpeh, Baba and Anugwo (2024) Exploring the challenges in the performance of small-medium contractors in South Africa: a consultants' perspective In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 1083-1092

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

FOSTERING CONSTRUCTION FIRM RESILIENCE THROUGH PERSUASIVE NARRATIVES OF STRATEGY: A CONCEPTUAL FRAMEWORK

Zamageda Zungu, Samuel Laryea and Raymond Nkado
[1,2,3]*School of Construction Economics and Management, University of Witwatersrand, South Africa*

Amid macroeconomic, political, environmental and technological disruptions that have previously led to the failure of contracting firms, the construction industry faces the imperative to foster organisational resilience. While contemporary literature proposes diverse strategies to manage these disruptions effectively, it lacks clarity on how these strategies are conceptualised and practically mobilised within contracting organisations. However, a notable deficiency of the literature is that the manner in which these strategies are conceptualised and mobilised persuasively within contracting organisations remain unidentified. This study fills this void by conducting a comprehensive literature review, proposing a conceptual framework on the persuasive mobilisation of organisational resilience strategies within the construction sector. Through the lens of the strategy-as-practice perspective and drawing upon theoretical insights from narrative theory, this research intricately examines the interplay between contextual factors such as industry dynamics, organisational resilience strategies, narrative building blocks, strategic discourse and narrative persuasion. Specifically, this study underscores the significance of narrative infrastructure as the contextual canvas upon which strategic narratives are crafted and enacted. By elucidating the impact of narrative infrastructure on organisational actions and member perceptions, this framework not only advances theoretical understanding but also offers actionable insights for enhancing organisational resilience through strategic narratives. This research contributes to both academia and industry by shedding light on the pivotal role of narrative infrastructure in construction firms and providing pragmatic pathways for leveraging it effectively.

Keywords: construction firms, narrative infrastructure, narrative persuasion, organisational resilience strategies, strategy-as-practice

.

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

INVESTIGATE THE POTENTIAL IMPACT OF INDIVIDUAL TRACKING TECHNOLOGY IN THE CONSTRUCTION INDUSTRY

Hoi Yui Lai[1] and Emmanuel A. Essah[2]
[1,2]School of the Built Environment, University of Reading, United Kingdom

In the rapidly evolving landscape of the construction industry, BIM technology has proven beneficial towards on-site operations. With the recent rise of geo-fencing technology within the industry, it is vital to investigate the potential benefits and concerns to inform the industry's trajectory of ITT towards health & safety (H&S) and productivity. The research aims to explore the evolution of Individual Tracking Technologies (ITT) and gather insights from stakeholders within the UK's construction industry to ascertain the prospects of ITTs implementation within the industry. The research methodology involves conducting ten interviews with relevant stakeholders, including directors, associates, senior cost consultants, and graduates. The data obtained are followed by a thematic analysis and a high-level data analysis on on-site close-call data with and without ITT. Through the interviews, professionals within the industry provided numerous insights on the application of ITT, highlighting the ITT potential allows on-site safety enhancement and productivity improvements. However, the primary consideration of concerns are privacy, data protection, and integration into existing practices. Through the high-level data analysis, sites with ITT applications suggested a 5% increase in close calls compared sites without ITT. Moreover, the study has provided insight into the perspective of industry stakeholders on ITT, recognising ITT's potential to improve on-site H&S. However, it emphasises the need to prioritise ITT education due to privacy concerns. There is a positive acknowledgement on ITT's ability of real-time monitoring, allowing safety enhancement and possible productivity improvement. Furthermore, future research can delve deeper into the practicality of the technology across the construction industry.

Keywords: construction, GPS, health and safety, individual tracking technology, productivity

[1] id020919@student.reading.ac.uk
[2] e.a.essah@reading.ac.uk

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

INVESTIGATING MANAGEMENT PRACTICES IN THE CONSTRUCTION AND DELIVERY OF ELECTRICITY PROJECTS IN NIGERIA

Olatunji Joseph Oladiran[1] and Olusegun Aanuoluwapo Oguntona[2]
[1]*Department of Building, University of Lagos, Nigeria*
[2]*Department of Built Environment, Walter Sisulu University, South Africa*

Several management practices are used to coordinate resources to achieve projects objectives. This study focuses on solving the bottlenecks in the construction of electricity projects in Nigeria. This study assesses the management practices that are used in the delivery of electricity projects in Lagos State. The population of the study is organizations that are involved in electricity projects in Lagos State. A survey research involving a sample of 50 organizations were selected from the population via purposive sampling technique. Data were collected using structured questionnaires administered to respondents in the organizations and the response rate was 84%. Frequencies, percentage, mean and ANOVA were used to analyse the data. The result reveals that the management practices used for electricity projects include settlement of contractors, monitoring and feedback, effective communication, project scope definition, project charter and project description. The most important factors that affect electricity project delivery methods are project environmental and schedule issues. It is concluded that although as many as 31 management practices are used for electrification projects such as good leadership and effective communication, some of them like brainstorming and integrated change management are not well utilized. This implies that stakeholders and contractors that are not versatile with the most frequently used practices could have difficulties in successful delivery of electrification projects

Keywords: delivery method, electricity projects, management practices

[1] ooladiran@unilag.edu.ng
[2] oguntona@wsu.ac.za

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

KEY BARRIERS TO GREEN BUILDING IMPLEMENTATION IN SOUTH AFRICA

Lerato Mompati[1], Mike Mandlate[2], Karabo Kabini[3] and Usiphe Nomvalo[4]
[1,2,3,4]School of Construction Economics and Management, University of the Witwatersrand, South Africa

Due to climate change, South Africa is faced with economic and health challenges. Adopting green building technologies reduces the amount of energy usage, however the implementation of green building in South Africa has been slow.This research aimed to identify the barriers on the implementation of green building and the methods that can be adopted to enhance the growth of green building in South Africa.A qualitative research method was be adopted. The open-ended interviews were conducted with built environment professionals.The main barriers of green building implementation are: initial high cost, lack of awareness, lack of incentives, and resistance to change.Recommendations to enhance the growth of green building practices in South Africa include: updating building codes, expanding training programs, fostering collaboration between the public and private sectors, offering financial incentives, promoting the re-purposing of existing structures, and using performance-based contracts.The paper has highlighted the key barriers of green building implementation in South Africa and developed a database of the relevant studies which can further guide future researchers, stakeholders and policymakers in this area.

Keywords: green building, qualitative research, sustainability, South Africa

[1] rirhandzu.maluleke@wits.ac.za
[2] 1891498@students.wits.ac.za
[3] 2155613@students.wits.ac.za
[4] karabo.kabini@students.wits.ac.za

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

MODELLING LEADERSHIP DEVELOPMENT DETERMINANTS IN GHANA'S CONSTRUCTION INDUSTRY: THE MODERATING ROLE OF PROFESSIONAL CAPABILITY

Aloysius Sam[1], Clinton O. Aigbavboa[2] and Wellington D. Thwala[3]
[1,2,3]*Department of Construction Management and Quantity Surveying, University of Johannesburg, South Africa*

Although leaders play important roles in firm growth and development, the actual determinants of leadership development in the context of the Ghanaian construction industry are still mixed and inconclusive. This paper aims to examine the critical determinants of leadership development and the role of professional capability, with a focus on the Ghanaian construction industry. A quantitative research approach has been employed. A structured questionnaire has been used to gather field data from 520 participants across small, medium, and large construction firms. The analyses have been conducted using Partial Least Square Models. Our indicative results have shown that knowledge management of leadership; stakeholder participation, succession planning, and information and communication technology are significant determinants of leadership development. Moreover, the study has revealed that professional capability significantly moderates the relationships between the determinants identified in leadership development. These results have implications for factors affecting leadership development in the construction industry in Ghana. Moreover, the paper has established that professional capability strengthens the determinants of leadership development in Ghana. Practitioners and investors could use the findings of this paper as a guide in decisions involving leadership development in the context of the Ghanaian construction industry.

Keywords: construction industry, leadership development, leadership development determinants, professional capability

[1] aloysius.sam@kstu.edu.gh
[2] aigclinton@gmail.com
[3] didibhukut@uj.ac.za

Sam, Aigbavboa and Thwala (2024) Modelling leadership development determinants in Ghana's construction industry: the moderating role of professional capability In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 1137-1150

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

PERCEPTIONS OF TENDER DOCUMENT QUALITY AND ITS IMPACT ON CONSTRUCTION ESTIMATES

Bruce Nezambe[1], Samuel Laryea[2] and Neil Govender[3]
[1,2,3]School of Construction Economics and Management, University of the Witwatersrand, South Africa

Construction experts have noted the persistent concern about the quality of tender documents and its impact on the construction sector. Poor specification writing continues to be a weak link in the information chain that degrades the quality of tender documents and causes disputes, particularly in a competitive market where construction professionals strictly interpret the documents to prepare a competitive bid. The impact of tender document quality on the accuracy of project estimates is assessed to determine the determinants of good tender-quality documents. Additionally, interventions that can be implemented to improve tender document quality and the implications of poor tender document quality were also analyzed. Qualitative data was collected from construction professionals using an interview. Data was analyzed by Atlas-ti using thematic analysis where six key themes were extracted. The study concluded that poor-quality tender documents compromise the accuracy of project estimates and delivery of projects within the South African construction industry. The consequences of poor tender document quality included reduced project profitability, incomplete projects, project termination due to funding issues, misunderstanding of boundaries, misalignment of the programme, increased costs and a negative impact on construction estimates.

Keywords: construction professionals, project estimates, project quality, project schedule, tender documents

[1] bnezambe@gmail.com; 2632824@students.wits.ac.za
[2] samuel.laryea@wits.ac.za
[3] neil.govender@wits.ac.za

Nezambe, Laryea, and Govender (2024) Perceptions of tender document quality and its impact on construction estimates In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 1151-1158

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

RISK FACTORS THAT CONTRIBUTE TO THE COLLAPSE OF MAJOR CONSTRUCTION COMPANIES: THE CASE OF FALLEN SOUTH AFRICAN CONSTRUCTION GIANTS

Richard Scholtz[1], Henry A. Deacon[2], Liezl Le Roux[3] and Christopher Amoah[4]
[1,2,3,4]*Department of Quantity Surveying and Construction Management, University of the Free State, South Africa*

Established construction firms are necessary for developing countries' economic growth. However, in recent times, some of these giant construction firms have folded up in the South African construction industry. to identify the risk factors leading to the failure of construction companies in South Africa whilst identifying the risk management measures employed and investigating the impact of early business rescue interventions. A qualitative methodology was adopted. The research strategy was phenomenology. Structured interviews were conducted with purposefully sampled participants. Data gathered were thematically analysed and categorized into themes. Four key themes were identified in this study: diversification issues; project-related issues; cashflow issues; work-related issues. The study found that although stringent risk management strategies were implemented by the construction giants investigated, most of them collapsed. Indicating that monitoring and tracking activities are crucial components of risk management strategies and engaging in business rescue does not necessarily lead to successful recovery for organizations. The factors that contributed to their collapse were found to be diversification issues, project-related issues, cashflow issues and work-related issues. It was observed that diversifying clients and business models can positively contribute to the sustainability of construction companies. This study contributes towards enhanced understanding of risk factors, risk management insights, early business rescue interventions and creates awareness of critical risk factors, risk management strategies and provides guidance on diversification.

Keyword: business rescue, construction, construction giants, risk management, South Africa.

[1] 2014094961@ufs4life.ac.za
[2] DeaconA@ufs.ac.za
[3] LeRouxL4@ufs.ac.za
[4] AmoahC@ufs.ac.za

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

TEAM COMMUNICATION IN THE BUILT ENVIRONMENT: THE SOUTH AFRICAN LAND SURVEYOR'S PERSPECTIVE

Nishani Harinarain[1] and Sandiso Mbanjwa[2]
[1 2]*Land Surveying Discipline, School of Engineering, University of KwaZulu-Natal, South Africa*

In today's land surveying industry, professionals work together and use modern instruments and technology. Reliable data gathering, mapping, and site analysis require efficient team communication. Miscommunication, data consistency, and delays are common problems resulting in expensive surveying mistakes. This study examined the communication issues experienced by land surveyors and the methods employed to resolve these issues. This was a qualitative study in which semi-structured interviews were conducted with seven land surveying professionals in KwaZulu-Natal. The data was thematically analysed using the NVivo software. Some of the communication barriers described by the participants included communication of technical information, misinterpretation of projects, cultural differences, lack of trust, accuracy and timely data, and financial problems. Various ways in which communication can be improved were suggested, such as building trust, sharing resources and information, continuously improving communication channels and reporting, and using new technologies. Communication is critically important in addressing challenges in the built environment. Maintaining efficient communication among all stakeholders in a construction project is crucial to prevent difficulties and ensure the project's success.

Keywords: built environment, challenges, communication, miscommunication, professionals

[1] harinarain@ukzn.ac.za
[2] 218017975@stu.ukzn.ac.za

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

THE JOB SATISFACTION OF BLACK FEMALE QUANTITY SURVEYORS

Fungai Punungwe[1] and Rolien Terblanche[2]
[1,2]*School of Construction Economics and Management, University of Witwatersrand, Johannesburg, South Africa*

Black women face discrimination in the quantity surveying profession hence experiencing tension to balance their careers and life, which results in them not being satisfied with their jobs. The aim of this research is to assess the job satisfaction of black females in quantity surveying and examine if discrimination affects it. Data was collected through online interviews with Black females that are Quantity Surveyors. The results were analysed using thematic analysis to assess similarities in responses. Issues of harassment discrimination were significantly recognised through deep interviews with participants. The issue of job satisfaction of black female quantity surveyors is less explored in literature. The findings of this research can be used by bodies of knowledge and industry professional to improve measures on issues of inequality and alleviate any problems.

Keywords: black female, culture, job satisfaction, quantity surveyor

[1]fungai.punungwe1@students.wits.ac.za
[2]rolien.terblanche@uct.ac.za

Punungwe and Terblanche (2024) The job satisfaction of black female quantity surveyors In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 1185-1194

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

UNDERSTANDING MASON TRAINING IN SOUTH AFRICA

Bonga Khuzwayo[1], Mark Walker[2] and Bruce Graham[3]
[1]*Department of Civil Engineering and Geomatics, Durban University of Technology, South Africa*
[2,3]*Department of Mechanical Engineering, Durban University of Technology, South Africa*

Multiple studies shed light on the various challenges confronting the masonry construction industry (MCI). However, there has been little research on the technical aspects of practical instruction for masons. These individuals are in charge of producing high-quality structural masonry that meets designer specifications while also collaborating with other MCI stakeholders. The goal of this research is to identify deficiencies in formal mason training and propose improvements that better align with the MCI requirements. The study used a case study research approach, including a scoping review and immersion research, to identify areas for improvement in South Africa's mason training system. Untrained masons may use substandard materials and techniques. The study discovered, among other things, that trainees cannot simulate the process of mixing sand-cement mortar without cement, limiting their ability to receive instructor guidance and correction. In hot, arid, or windy weather, failing to cover the mortar with plastic after mixing during training to prevent water evaporation may give the impression that the practice is optional. Finally, the masonry walls were not cured. It is critical that masonry education and training prioritise understanding and application of National Building Regulations and Building Standards. This is essential for developing the expertise required to build high-quality structures. According to the research findings, masons require more training to improve their ability to construct high-quality structural masonry. The South African government and statutory bodies must develop effective strategies to address the issues raised in this study.

Keywords: bricklayers, masonry construction industry, masons, structural masonry, training

[1] bongak@dut.ac.za
[2] walker@dut.ac.za
[3] bruceg@dut.ac.za

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

USING DYNAMIC BIM TO IMPROVE CONSTRUCTION SAFETY CULTURE

Mojtaba Amiri[1], Ehsan Saghatforoush[2] and Samuel Laryea[3]
[1,2,3]School of Construction Economics and Management, Wits University, Johannesburg, South Africa

Among the various studies that have addressed the application of BIM dynamics in domain of health and safety management, the lack of research regarding the impact of BIM dynamics on safety culture is clearly visible. These days, it is apparent that more and more construction technologies are currently being used for safety and health management. These technologies can be used in different construction applications to mitigate workplace hazards. Among these technologies, BIM and IoT has been shown to have significant potential in high-risk Environment, Health, and Safety (EHS) industries. Several researchers have started to explore the potential synergy between BIM and IOT. Dynamic BIM presents an influential pattern for applications to improve construction safety management. The main purpose of this paper is to demonstrate the necessity of research on the use of dynamic BIM in improving construction safety culture. Hence, the literature review method was used to identify the domains in which dynamic BIM has been applied. Prominent application domains in which dynamic BIM has been applied are construction operation and monitoring, facility management (FM), construction logistic and management, health and safety (H&S) management. Results show that no research has addressed the impact of dynamic BIM on safety culture. Therefore, research related to dynamic BIM and its impact on construction safety culture is necessary.

Keywords: construction safety culture, dynamic BIM, health and safety management, technologies

[1] mojtaba.amiri@wits.ac.za
[2] ehsan.saghatforoush@wits.ac.za
[3] samuel.laryea@wits.ac.za

Amiri, Saghatforoush and Laryea (2024) Using dynamic BIM to improve construction safety culture In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 1205-1217

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

WEARABLE TECHNOLOGY TO REDUCE FATIGUE RISKS FOR CONSTRUCTION WORKERS: A SCOPING REVIEW

Sizolwakhe Innocent Mtetwa[1], Lesiba George Mollo[2] and Fidelis Abumere Emuze[3]
[1]*Built Environment, Central University of Technology, Free State, South Africa*
[2]*Built Environment, Central University of Technology, Free State, South Africa*
[3]*Built Environment, Central University of Technology, Free State, South Africa*

Construction workers are susceptible to injuries, musculoskeletal disorders, temporary or permanent disability, and fatalities posed by latent factors such as fatigue. Fortunately, the introduction of wearable technology (WT) powered with multiple sensors has made it possible to measure fatigue during construction undertakings on site. Over 13% of construction workplace injuries can be attributed to fatigue due to its undetectable nature when using traditional methods of health and safety monitoring. Therefore, proactive monitoring of fatigue risk areas such as work methods, work environment, and plant and equipment can help minimise fatigue risks on construction sites using WT. The study aimed to identify the best practices of using WT to leverage data metrics to investigate fatigue related risk areas. By means of scoping review, the research flagged various fatigue risk factors and investigated the best practices of using WT to monitor fatigue risks affecting workers on construction sites. 62 research papers were thoroughly reviewed to understand the phenomenon. The results highlighted that vast amount of research has been conducted on WT although the implementation of WT to monitor fatigue on construction sites is gradual. Fatigue has also been investigated by collectively detecting various practices, indicators, or epochs such as heart rate, pulse, brain activity, movement, etc.; rendering the process difficult since it requires a medical practitioner to analyse the WT data. As such, this study supports the use of wearable technology to detect fatigue for improved workers' health and safety monitoring on construction sites, provided that a clear wearable technology framework is developed to guide the adoption, implementation, and analysis of WT to detect fatigue during construction undertakings on sites.

Keywords: best practices, construction sites, construction workers, fatigue risks, wearable technology.

[1] smtetwa@cut.ac.za
[2] lmollo@cut.ac.za
[3] femuze@cut.ac.za

Mtetwa, Mollo and Emuze (2024) Wearable technology to reduce fatigue risks for construction workers: a scoping review In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 1219-1231

T8 REAL ESTATE AND PROPERTY MANAGEMENT

Assessment of void periods in residential buildings in Minna, Nigeria – Ogunbajo, R. A. and Kuma, S. S. 159

Prop-tech trend in Nigerian real estate practice: adoption and challenges – Araloyin, F. M., Fateye, T. B. and Adebowale, O. O. 160

Remote sensing to map and estimate the extent of flood damage – a South African case study – Malusi, B., Musonda, E. and Harinarain, N. 161

Residential choice and preferences in Ashesi University: comparative study of stated and revealed preferences – Doamekpor, N., A., A., Nyarko, G., K. and Adeku, V. 163

The impact of inflation on house prices in South Africa: effects of COVID-19 – Mpofu, B., Simbanegavi, P., Moobela, C. and Weaich, M. 165

Utilisation of digital elevation modelling to determine areas affected by floods in KwaZulu-Natal – Zwane, S., Musonda, E. and Harinarain, N. 167

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

ASSESSMENT OF VOID PERIODS IN RESIDENTIAL BUILDINGS IN MINNA, NIGERIA

Rukaiyat Adeola Ogunbajo[1] and Shien Stephen Kuma[2]
[1,2]Department of Estate Management and Valuation, Federal University of Technology Minna, Nigeria

The period of void is a major challenge faced by investors in residential buildings in Minna. Re-letting vacant apartments takes a while, and in many cases, newly completed residential buildings experience voids. Therefore, at what level of void periods, residential building types that are most vulnerable, as well as locational differences are the critical questions that informed this study. Thus, the study aims to provide an in-depth assessment of void periods in buildings among residential neighbourhoods in Minna, Nigeria. The objectives are to assess the level of void periods, analyse variations across residential building types, and explore neighbourhood-level differences in the study area. The study utilized a quantitative research design, employing a structured questionnaire that was distributed to ESVs, LEAs, and property owners who oversee the management of the 1,500 residential units that were selected for the sample in 13 different neighbourhoods. Levene's test of homogeneity of variance, Welch adjusted analysis of variance, and the Games-Howell post hoc test were used for data analysis. The findings revealed aggregate mean void periods of 4.87, 5.47, 5.13, and 7.03 months for tenement, 1-bedroom, 2-bedroom, and 3-bedroom residential building types. This outcome varies significantly among the building types across the 13 neighbourhoods in terms of those with high and low void periods. The study concludes that there are relatively high void periods in the Minna residential property market and the need for collaborative efforts towards stemming the tide.

Keywords: neighbourhoods, residential buildings, void periods

[1] rukaiyat.adeola@futminna.edu.ng
[2] kumass@futminna.edu.ng

Ogunbajo and Kuma (2024) Assessment of void periods in residential buildings in Minna, Nigeria In: Laryea, S. *et al.* (Eds) Proceedings of the WABER SuDBE Conference, 30 to 31 July 2024, Johannesburg, South Africa 1233-1244

WABER SuDBE Conference 2024
30 – 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

PROP-TECH TREND IN NIGERIAN REAL ESTATE PRACTICE: ADOPTION AND CHALLENGES

Funmilayo M. Araloyin[1], Tosin B. Fateye[2], and Olufunmilayo O. Adebowale[3]
[1]*Department of Estate Management, Obafemi Awolowo University, Ile Ife, Osun State, Nigeria*
[2]*Graduate School of Design, Harvard University, Cambridge, Massachusetts, United States*
[1,2,3]*Department of Estate Management, Redeemer's University, Ede, Osun State, Nigeria*

As technological innovation keeps advancing, it becomes imperative for professionals to keep abreast with the use of emerging technologies to ensure global best practices. We examine the progression in the knowledge and adoption of property technology as they keep evolving in Nigerian real estate practice, aiming to provide useful information that could enhance seamless tech-enabled real estate practice and guide institutional/policy direction. The experts in the real estate profession such as public estate office holders, estate firms, and academics in Lagos State constitute the study population. The study adopts purposive sampling techniques, and questionnaires were used to collect data. A total of one hundred and nine (109) questionnaires were distributed, properly filled, and retrieved, as follows: private (59), public (32), academic (18). The responses were analysed using statistical tools such as comparative mean score, mean rank, simple t-tests, and Kruskal-Wallis tests. We find appreciable progressive levels of knowledge about emerging property technologies, with a noticeable influence of age and experience of the experts. However, a drastic decline in the level of usage is observed as the latest version (Prop Tech 3.0) of property technology keeps evolving. The prevailing issues connected with education/training, data quality/databank, financial/operational cost, infrastructure, and expertise/specialist remain major contributors to setbacks experienced in the level of adoption of technology innovation in real estate practice. The study concludes that as prop-tech keeps advancing, the level of knowledge and adoption is declining among the members of the profession, signalling the need for deliberate commitment to capacity building through continuous education/training if real estate practice is to remain relevant in the fast-changing technology business environment.

Keywords: Nigeria, property technology (prop-tech), real estate

[1] araloyinf@run.edu.ng
[2] fateyet@run.edu.ng
[3] adebowaleo@run.edu.ng

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

REMOTE SENSING TO MAP AND ESTIMATE THE EXTENT OF FLOOD DAMAGE – A SOUTH AFRICAN CASE STUDY

Biyela Malusi[1], Evaristo Musonda[2] and Nishani Harinarain[3]
[1, 2, 3]*Land Surveying Discipline, School of Engineering, University of KwaZulu-Natal, South Africa*

Floods are among Earth's most devastating and hazardous natural disasters. Vast areas of the urban infrastructure are damaged or disrupted, lives are lost, and the country's economy is severely affected when this natural disaster occurs. This research aims to create maps for the regions impacted by the floods to assess the extent of the damages incurred by applying remote sensing technology using imagery from Landsat 8 satellite acquired from USGS and ERDAS Imagine software for image processing. These images of a 30 by 30 resolution were processed using ERDAS Imagine and ArcGIS processing software. The image differencing method proved to be helpful since the ground truthing process validated the classified change detected imagery with the overall classification accuracy of 85,33% and the Kappa coefficient, which measures the degree of agreement between the classified data and the ground truth data, the value of the kappa coefficient of 0.56. It was found that remote sensing is robust given that it is combined with other forms of data to enable coverage of the blind spots, and the type of processing software being employed plays a crucial role in the accuracy of the flood hazard map produced. In this study, the Erdas Imagine software proved to be a commendable remote sensing software for change detection in combination with Landsat 8 Level 2 imagery. The results produced can be used by relevant authorities in future to estimate the extent of damage caused by flooding. Identifying flood zones is the first element in proactive risk management of flooding. This provides authorities with enough data to take precautionary measures to minimise the impact of future flooding events.

Keywords: change detection, disaster management, flooding, Landsat 8, remote sensing.

[1] 220026159@stu.ukzn.ac.za
[2] musondae@ukzn.ac.za
[3] harinarain@ukzn.ac.za

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

RESIDENTIAL CHOICE AND PREFERENCES IN ASHESI UNIVERSITY: COMPARATIVE STUDY OF STATED AND REVEALED PREFERENCES

Naa Adjeley Ashiboe-Mensah Doamekpor[1] Gabriel Kofi Nyarko[2] and Victoria Adeku[3]
[1]*Department of Humanities and Social Sciences, Ashesi University, Ghana*
[2]*Department of Economics and Business Administration, Ashesi University, Ghana*

Residential choice amongst tertiary students has largely aimed to explore the preferences (e.g., location, dwelling characteristics, etc.) that guide or influence consumer behaviour. It is often assumed that the students' current living conditions are reflective of their preferences. However, residential choice studies have criticized this revealed approach in favour of the stated preference approach to studying students' preferences. Furthermore, studies on preferences tend to emphasize attributes that students prefer without underpinning the studies with an underlying theory or model. This study, therefore, seeks to explore the residential preferences of Ashesi Undergraduate students using the Means end chain model. The study investigated the students' residential preferences using the stated preferences approach. It investigated the attributes students ranked most important and the differences in the ranking of different genders. It also investigated whether students current living conditions was similar to their preferred living conditions. The study used a quantitative method design using a questionnaire, convenience sampling, and Garrett ranking technique to analyse the data. The study revealed that students ranked the Availability and frequency of utilities first and Mixed/single-gendered hostels tenth. The importance of different attributes varied between Males and females. The students' current and preferred living conditions based on the attributes measured were largely different. Understanding student residential choice and behaviour improves decision-making for hostel policies and resource allocation, enhancing students' well-being.

Keywords: hostel attributes, means-end chain, residential choice, residential preference, university hostel.

[1] ndoamekpor@ashesi.edu.gh,
[2] gabriel.nyarko@ashesi.edu.gh
[3] viclet45@gmail.com

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

THE IMPACT OF INFLATION ON HOUSE PRICES IN SOUTH AFRICA: EFFECTS OF COVID-19

Bekithemba Mpofu[1], Prisca Simbanegavi[2], Cletus Moobela[3] and Malcolm Weaich[4]
[1]*Integrated Properties, Harare, Zimbabwe*
[2,4]*School of Construction Economics & Management, Wits University, Johannesburg, South Africa*
[3]*School of Computing Engineering & the Built Environment, Edinburgh Napier University, UK*

This study investigates the impact of inflation on house prices in South Africa, with a particular focus on the effects of the COVID-19 pandemic. The research aims to elucidate the nature of the relationship between inflation and housing, and to determine how the pandemic has influenced this dynamic. Utilising monthly data from January 2010 to April 2022, the study employs Johansen cointegration and Granger causality tests to assess long-term and causal relationships, respectively. The findings confirm a positive long-term relationship between house prices and inflation, indicating that housing serves as an effective hedge against inflation. However, the results also reveal structural breaks in this relationship, with significant changes observed during the COVID-19 period. The Vector Error Correction Model (VECM) highlights short-run adjustments and the speed of return to equilibrium. This study provides valuable insights for investors and policymakers, demonstrating the resilience of housing investments during economic disruptions and underscoring the importance of considering regional and temporal factors in real estate investment strategies.

Keywords: Covid-19, granger causality test, house prices, inflation, Johansen cointegration, South Africa

[1] mpofub@intpro.co.zw
[2] prisca.simbanegavi@wits.ac.za
[3] C.Moobela@napier.ac.uk
[4] malcolm.weaich@wits.ac.za

WABER SuDBE Conference 2024
30 - 31 July 2024
Johannesburg, South Africa
ISBN: 978-0-7961-6032-4

UTILISATION OF DIGITAL ELEVATION MODELLING TO DETERMINE AREAS AFFECTED BY FLOODS IN KWAZULU-NATAL

Siphesihle Zwane[1], Evaristo Musonda[2] and Nishani Harinarain[3]
[1, 2, 3]*Land Surveying Discipline, School of Engineering, University of KwaZulu-Natal, South Africa*

Floods are frequent natural calamities that pose serious threats to both infrastructure and human life. Floods in the KwaZulu-Natal region of South Africa have traditionally resulted in significant loss and devastation to human life and infrastructure. To reduce these hazards and improve disaster preparedness, this study uses Digital Elevation Modelling (DEM) techniques to pinpoint the KwaZulu-Natal province's flood-prone areas. This study uses geospatial techniques to evaluate topographical characteristics, drainage patterns, and elevation data by analysing high-resolution DEM data. The study tries to identify locations at higher risk of flooding during significant rainfall events by combining previous flood data. In this study, 2m interval contour lines (Topographic data), landcover and rainfall were integrated to analyse floods on Umlazi Township in Durban, South Africa. Flood susceptible areas were identified and a flood risk map was prepared using ArcGIS software and the following four aspects were overlaid: land cover, amount of rainfall within the Umlazi, slope and the Euclidean Distance (Proximity to water sources) which is commonly used to calculate how far away each DEM cell is from the nearest body of water (such as a river or stream). It was thereafter, concluded that those areas in very close proximity to water bodies and low elevation were susceptible to floods. But also, areas located in low elevation were prone to floods, especially flash floods – which are caused by heavy rains and thunderstorms. These findings offer insightful information on flood-prone areas, assisting in creating focused mitigation programs and disaster management methods. It is recommended that municipalities form a team of specialists within their spatial planning departments, consisting of land surveyors, engineers and town planners, to assist with the preparation and updating of flood prone maps. This study adds to the information on managing and accessing flood risks, especially in areas prone to flooding. Decision-makers and stakeholders in KwaZulu-Natal and other flood-prone areas may protect lives and property by using the capabilities of digital elevation modelling.

Keywords: digital elevation modelling, disaster management, flood-prone zones, flood risk assessment, hydrological modelling

[1] 219018980@stu.ukzn.ac.za
[2] musondae@ukzn.ac.za
[3] harinarain@ukzn.ac.za

INDEX OF AUTHORS

A

Abdullahi, M., 4
Abdulzaziz, M., 15
Abubakar, M., 15
Abubakar, M., 4
Adebowale, O. O., 160
Adegun, O. B., 116
Adeku, V., 163
Aduloju, T., 131
Afful, M. O., 114
Agidani, J., 131
Ahmadu, H. A., 4
Ahou, Y., 6, 109
Aigbavboa, C., 138
Aigbavboa, C. O., 147
Aikawa, I. U., 136
Akinbobola, A., 116
Alam, B., G., 55
Ameyaw, C., 114, 135
Amiri, M., 155
Amoah, C., 134, 150
Anugwo, I. C., 79
Anugwo, I., C., 141
Ao, J., 21
Appau, W. M., 79
Araloyin, F. M., 160
Attakora-Amaniampong, E., 79
Awuzie, B., 125, 138

B

Baba, V., 141
Badii, P., 129
Bai, S., 67, 122
Bao, L., 63
Bartonova, A., 55
Bashir, K., 136
Boadi, E., O., 135
Bondinuba, F. K., 135

C

Canet, A., M., 55
Cao, G., 55
Chacha, M., 126
Chaulagain, A., 55
Chen, D., 33
Chen, G., 41
Chen, J., 33
Chen, W., 89
Chen, Y., 17
Chen, Z., 21
Cheng, L., 35, 105
Chiloane, M. B., 125
Connaughton, J., 121

D

Darko, P., D., 129
Deacon, H., A., 150
Ding Y., 88
Ding, Y., 23, 57, 65, 81, 83, 89, 101
Doamekpor, N., A., A., 163
Dong, B., 13, 120
Du, C., 21, 28, 37, 60, 68, 107
Duan, D., 7

E

E, Reaihan., 12
Emuze, F., A., 157
Essah, E., A., 29, 143

F

Fan, J., 39
Fan, S., 77, 87
Fan, Z., 117
Fateye, T. B., 160
Feng Y., 93
Fredriksen, M., 55
Fredriksen, T., 55
Fu, C., 22
Fu, Y., 45

G

Gambo, S., 113
Gao, J., 85
Gao, N., 30
Gao, Y., 117
Geng, Y., 3
Gethe, F., 125
Gong, C., 97
Govender, N., 149
Graham, B., 154
Guo S., 38
Guo, J., 41
Guo, L., 49, 66, 69
Guo, R., 66
Guo, S., 71
Gustavsen, K., 55

H

Han, X., 13, 120
Han, Y., 5
Hao, L., 120
Harinarain, N., 102, 151, 161, 167
He, B., 43
He, Y., 81, 88, 101
Høiskar, B., A., K., 55
Hou, Y., 101
Hu, C., 97

Hua, J., 80
Huang, D., 73
Huang, G., 14
Huang, L., 80
Huang, X., 68
Huang, Z., 92, 95

I

Ibrahim, A. G., 113
Ibrahim, Y. M., 4

J

Ji, W., 3, 111
Jiang, L., 117
Jiang, X., 57, 81, 83, 88, 101
Jiang, Y., 75
Jiao, S., 11
Jing, M., 60
Jones, R., 127

K

Kabini, K., 145
Kabiri, S., 121
Khuzwayo, B., 154
Kio, P., 131
Kuma, S. S., 159
Kunya, S. U., 136
Kusakana, K., 111
Kwanda, L, T., 111
Kwasafo, O. K., 133

L

Lai, H., Y., 143
Lai, W., 88
Laryea, S., 130, 133, 139, 142, 149, 155
Le Roux, L., 134, 150
Lei, H, 53
Lei, Y., 13
Li T., 93
Li, B., 19, 51, 112
Li, H., 19
Li, J., 50
Li, l., 99
Li, L., 98
Li, M., 35, 105
Li, N., 63
Li, S., 111
Li, T., 96
Li, X., 77
Li, Z., 22, 67, 95, 122
Liang, B., 95
Liang, J., 13, 120
Liao, X., 112
Lin, B., 3, 9
Lin, S., 107
Liu C., 93
Liu, C., 91, 96, 99
Liu, H., 41, 43, 45, 73
Liu, M., 22
Liu, Q., 5
Liu, S., 14, 111, 117
Liu, Y., 23, 39, 57, 85, 101
Long, W., 59
Luo, H., 20
Luo, H., 17
Luo, H., 95
Lyu, W., 77, 87

M

Ma, P., 37
Ma, X., 49
Maila, S., 127
Makhaga, T., 137
Makhwabe, S., 103
Malusi, B., 161
Mamboya, F., 126
Mandlate, M., 145
Mathisen, H., M., 55
Mbanjwa, S., 151
Mensah, N., A., A., O., 129
Mensah, S., 114, 133, 135
Mhando, Y., 126
Miao, T., 50
Ming, R., 50
Ming, T., 59, 87
Mkandawire, K., 121
Moeti, M., 134
Mogale, W., 102
Mohamed, A., 29
Mollo, L., G., 157
Mompati, L., 145
Moobela, C., 165
Morakinyo, T. E., 116
Mosalaesi, T., 139
Mphahlele, M., 137
Mpofu, B., 165
Mtetwa, S., I., 157
Musonda, E., 102, 161, 167

N

Nani, G., 129
Nasir, R. M., 15
Nemakhavhani, R., 138
Nezambe, B., 149
Nkado, R., 142
Nomvalo, U., 145
Nyarko, G., K., 163

O

Obe, B., 116
Ogunbajo, R. A., 159
Oguntona, O., A., 144
Ohochuku, C., 131
Ojo-Fafore, E., 130
Oladiran, O., J., 144
Olusoga, O. O., 116
Orgen, N. K., 114, 135

P

Pan, Y., 38, 71
Pang, Y., 12
Pei, X., 3
Punungwe, F., 153

Q

Qin, Y., 95
Qumbisa, N., 103

R

Rashidov, J., 117
Ren, Y., 12, 123
Ren, Z., 12, 123

S

Saghatforoush, E., 155
Sam, A., 147
Scholtz, R., 150
Schutte, D., 127
Shi F., 38
Shi, F., 71
Shi, W., 47, 61
Shi, Y., 115
Shibeika, A., 8
Simbanegavi, P., 125, 165
Simpeh, F., 79, 141
Song, B., 19
Su, Y., 5, 92
Sun Z., 38
Sun, H., 9
Sun, Z., 71
Syed, A. S. A. B., 91

T

Tang, C., 63
Tang, R., 120
Tang, X., 77, 108
Terblanche, R., 153
Thwala, W. D., 147
Tilese, N., 137

W

Walker, M., 154
Wan, H., 14
Wang H., 31
Wang Y., 61
Wang, B., 39, 50
Wang, C., 27
Wang, F., 25, 26
Wang, J., 33, 115
Wang, L., 13, 120
Wang, M., 7
Wang, W., 43
Wang, Y., 25, 39, 47
Weaich, M., 165
Wei, S., 27
Wu, M., 37
Wu, S., 9
Wu, W., 59
Wu, X., 5, 50, 92
Wu, Y., 9, 59, 87
Wudil, B. I., 136

X

Xia, Q., 6, 109
Xiao, Y., 12, 78, 123
Xiaowei, R., 119
Xu, D., 59
Xu, X., 14, 25, 26, 59, 77, 85, 87, 108

Y

Yahaya, M. W., 113
Yamusa, M. A., 15
Yamusa, M. A., 4
Yan H., 38
Yan, H., 71
Yan, J., 85
Yan, T., 14, 26, 59, 77, 87
Yang, C., 33
Yang, G., 85
Yang, X., 37
Yang, Y,, 11
Yang, Y., 3
Yang, Z., 6, 12, 109, 123
Yao, R., 17, 20, 74, 122
Ye Q., 93
Ye, Q., 96, 99
Yu W., 31, 61
Yu, S., 119
Yu, W., 27, 30, 47, 49, 60, 66, 68, 69
Yu, X., 83
Yu, Z., 23, 77, 108
Yuan, F., 17, 20
Yuan, M., 53
Yusif, M., 129

Z

Zeng, C., 96, 99
Zhang, C., 108
Zhang, H., 13
Zhang, L., 39
Zhang, N., 13, 60
Zhang, X., 65, 80, 117
Zhang, Y., 25, 26, 27, 49, 66, 69
Zhang, Z., 12, 78
Zhao, H., 9
Zhao, W., 81, 83, 88, 101
Zheng, P., 74
Zhiru, Z., 65
Zhong, T., 28
Zhou, H., 27, 61, 68
Zhou, S., 51
Zhu, T., 80
Zhu, X., 94
Zhu, Y., 19, 39, 122

Zungu, Z., 137, 142
Zwane, S., 127, 167

INDEX OF KEYWORDS

A

academia-industry, 126
accounting methods, 89
activity patterns, 20
African epistemologies, 103
aggregation analysis, 5
air conditioner, 39
air conditioner control, 50
air conditioner energy consumption, 21
air conditioning, 69
air conditioning energy consumption, 117
air conditioning environment, 49
air filtration intervention, 28
air infiltration, 108
air purifier, 17, 35
air source heat pump (ASHP), 3
air-conditioning, 68
air-conditioning system, 26
airflow comfort, 39
airtightness, 108
alertness, 105
ancient ecological smart, 97
Arcgis pro software, 102
art design, 93, 96
ASHP integrated central air-conditioning, 85
atmospheric environment, 55

B

background materials, 114
best practices, 157
bibliometric, 131
bibliometric review, 133
BIM technology, 109
black female, 153
block thermal environment, 92
BMI value, 61
bricklayers, 33, 154
buffer analysis, 102
building carbon emissions, 80, 89
building energy, 22
building energy conservation, 111
building energy saving, 9, 108
building finishes, 114
building information modelling, 79
building inspectors, 125
building life cycle, 109
building materials, 116
building sustainable development, 80
built environment, 103, 151
business models, 138
business rescue, 150

C

carbon dioxide sensor, 31
carbon emission monitoring framework, 81
case study, 8
central air conditioning, 83
CFD simulation, 25
challenges, 134, 151
change detection, 161
children, 28
Chinese traditional murals, 91
classroom, 17
clay brick, 129
climate adaptation, 6
cluster analysis, 21, 22
cold source configuration, 83
cold winter regions, 68
cold-formed steel composite wall, 119
cold-forming process, 115
collaborative learning, 103
COMFA model, 53
communication, 151
community public facilities, 96
compliance checking, 4
comprehensive comfort, 67
conceptual framework, 15
concrete mixture proportioning, 88
constitutional characteristic, 50
constitutive model, 115
construction, 131, 136, 143, 150
construction and demolition waste, 113
construction firms, 142
construction giants, 150
construction industry, 130, 138, 147
construction material, 129
construction phase, 88
construction procurement, 133
construction professionals, 129, 149
construction risk, 127
construction safety culture, 155
construction sites, 157
construction techniques, 88
construction workers, 157
consultants, 141
contractors, 134
contractors' performance challenges, 141
coordination, 121
correction factor, 31
correction principles, 23
correlated colour temperature (CCT), 105
correlation analysis, 92
Covid-19, 165
cultural education, 98
cultural sustainability, 99
culture, 153

D

decision tree model, 50
delivery method, 144
design factors, 74
design optimization, 83

development, 134
different air conditioning environments, 38
differential measurements, 135
digital elevation modelling, 167
digital exhibitions, 98
digital skills, 125
digital technologies, 125
digitalization, 130
disaster management, 161, 167
distributed situation awareness, 121
district cooling system, 63
DMFs, 15
document analysis, 139
double-layer hygroscopic materials, 14
dream analysis, 96
dynamic airflow, 39
dynamic BIM, 155
dynamic conditions, 66
dynamic environment, 51, 69
dynamic load characteristic, 83
dynamic moisture buffering capacities, 14
dynamic regulation strategy, 60

E

e[m]ergy, 6
eco-historic district, 97
ecological environment functional materials, 13
ecological revitalization, 97
education, 131
elderly, 30, 51
electricity projects, 144
elements, 89
elevated temperature, 113
emerging, 134
emission reduction strategies, 80
energy dynamic balance, 78
energy saving, 12, 83, 112
energy saving potential, 77
energy sustainability, 79
energy use behaviour, 79
energy-saving of air-conditioning, 85
energy-saving potential, 87
environmental control system, 101
environmental sustainability, 8
equivalent model, 77
evaluation, 107
evaporation and condensation, 59
experiment, 59
exposure temperature, 115

F

factor analysis method, 60
fatigue risks, 157
fenestration, 108
filter, 26
finite element analysis, 119
flexible policies, 7
flood risk assessment, 167
flooding, 161
flood-prone zones, 167
fractal theory, 22
fresh air shaft, 123
front-end loading, 137
functional materials, 13

G

gap analysis, 125
Ghana, 129, 135
government sector, 141
GPP, 15
GPS, 143
granger causality test, 165
green building, 4
green-certified building, 94

H

harmonious integration, 13
health and comfort, 107
health and safety, 143
health and safety management, 155
heat adaptation, 116
heat strain risk, 43
heating capacity, 3
high efficiency particulate air (HEPA), 17
high temperature, 43
higher education, 103
hostel attributes, 163
hot summer and warm winter zones, 49
hot summer regions, 68
house prices, 165
housing, 11
human adaptability, 38
human emotion, 96
human respiratory zone, 31
human thermal comfort, 53, 60
human thermal response patterns, 65
humidity-control, 120
Huo Xiang, 73
HVAC, 22, 63
hydrological modelling, 167

I

ice storage technology, 63
implementation, 15
index system, 89
indicators, 107
individual tracking technology, 143
indoor air, 33
indoor air quality, 20, 26, 35
indoor and outdoor temperature coordination, 85
indoor environment, 30, 66
indoor environment quality, 55
indoor environmental health, 37
indoor environments, 29
indoor light environment, 19, 107
indoor temperature control, 85

indoor thermal environment, 23, 47
indoor thermal-humidity environment, 117
infants and young children, 61
infection risk evaluation, 25
inflation, 165
influencing factors, 101
infrastructure, 102
installation art, 93
intangible cultural heritage, 99
integrated design, 94
interactive effects, 67
interactive installation, 96
interactive installations, 99
interface discrepancies, 121
interpretability analysis, 3
intrinsic ecology, 97
isolation ward, 25

J

job satisfaction, 153
Johannesburg, 11
Johansen cointegration, 165

K

Kappa coefficient, 75
kernel density analysis, 5
knowledge exchange, 121

L

Landsat 8, 161
leadership development, 147
leadership development determinants, 147
life cycle assessment, 80
light environment, 122
lighting environment, 105
Limpopo province, 141
linkages, 126
load forecasting, 63
local climate zones, 53
long-term thermal history, 45
low-carbon, 112
low-carbon concrete, 88
low-carbon energy system, 78
low-energy building, 59, 87

M

machine learning, 4, 51
management, 136
management practices, 144
masonry construction industry, 154
masons, 154
materials, 91, 136
means-end chain, 163
mechanical property, 115
m-EDI, 122
mega-projects, 127
method of indoor heating, 27
microbial contamination, 26
minerals, 13
miscommunication, 151
modern architecture, 91
modern ecological wisdom, 97
moisture transfer function, 14
monitoring points, 23
mood, 105
mould exposure, 37
multifractal detrended fluctuation analysis, 22
multi-indicator evaluation, 107
museums, 98

N

narrative infrastructure, 142
narrative persuasion, 142
narrative theory, 93
natural energy source, 77
natural lighting, 19
naturally slightly hotter environment, 65
neighbourhoods, 159
new standard effective temperature, 41
Nigeria, 160
NLP, 4
novel thermal diode, 9
numerical calculation, 123
numerical simulation, 12

O

occupant behavior, 112
occupant behaviour, 21
office, 105
offsite construction, 121
operating temperature, 69
optimal parameter, 39
optimal thickness distribution, 14
optimization of supply-water temperature, 85
optimization strategy, 63
organisational resilience strategies, 142
outdoor environment, 74
outdoor thermal comfort, 92
outdoor thermal environment, 53
overall sweat sensory mean value, 41

P

PAD emotional model, 19
painted wall surfaces, 114
paints defects, 114
particle resuspension, 20
particulate matter, 17, 20, 28, 35
passive design strategies, 7
PCM, 111, 117
PCMC roof, 117
perceived air quality, 55
percentage dissatisfied, 55
personal comfort system, 73
personal heating system, 73
phase change materials (PCM), 123
photocatalysis, 33

physical quantities of the optical environment, 95
pipe-embedded wall, 77, 87
planning stage, 127
PMBOK, 139
PMV, 47
POI, 5
policy control, 94
porous mineral, 120
postpartum, 47
postpartum mothers, 68
preschooler, 27
preservation, 99
procurement, 130
productivity, 122, 143
professional capability, 147
professionals, 151
project estimates, 149
project performance domain, 139
project quality, 149
project schedule, 149
projects, 136
promotion, 99
property developers, 138
property technology (prop-tech), 160
PTS model, 66
public art and design, 98
public health, 28
public sector construction projects, 137
pulmonary inflammation, 37

Q

qualitative research, 145
quantitative risk assessment QRA, 127
quantity surveyor, 153

R

radiative sky cooling (RSC), 87
random forest, 75
RC model, 111
real estate, 160
real-time, 81
recycled coarse aggregate, 113
regression analysis, 30
regulatory documents, 4
remote sensing, 161
repeated cross-sectional surveys, 27
residential building, 21, 108
residential buildings, 112, 159
residential choice, 163
residential preference, 163
residential storey buildings, 135
respiratory diseases, 27
respiratory system, 28
revised degree hour, 77
revised degree hour (RDH), 87
rheumatism symptoms, 30
risk assessment, 27
risk identification, 127
risk management, 150
road expansion, 102
rural building energy consumption, 78

S

safety assessment, 95
sandcrete blocks, 114
satisfaction, 122
satisfaction rate, 69
school infrastructure, 141
separated gravity heat pipe, 59
sepiolite, structural regulation, 120
servitization, 138
SHAP values, 75
shapefiles, 102
Shihezi, 5
skilled graduates, 126
skin temperature, 45, 51
skin wettedness, 41
sleeping hours, 47
slums/informal settlements, 116
smart building envelope, 9
social housing of rural areas, 7
social interaction, 99
social procurement, 133
social value, 133
socio-economic development, 133
solar energy utilization, 111
South Africa, 130, 139, 145, 150, 165
southwestern mountainous areas of China, 78
spatial and temporal characteristics, 71
split air conditioners, 60
split air conditioning, 71
stair construction, 135
stairs, 135
standards, 4
State characteristics, 23
strategies, 134
strategy-as-practice, 142
stress, 29
structural masonry, 154
student housing, 79
student perceptions, 8
subjective perception, 43
subway station, 123
superhydrophobic material, 9
surface modification, 120
sustainability, 129, 131, 138, 145
sustainable, 7
sustainable building, 94
sustainable consumption and production, 15
sustainable development, 11
sustainable housing, 116
symptoms of thermal discomfort, 61

T

Tanzania, 126
techniques, 136
technologies, 155

temperature gradient, 57
temperature regulation, 60
temperature transient, 41
tender documents, 149
tendering, 137
thermal adaptation, 38
thermal adaptation characteristics, 65
thermal and light composite environments, 67
thermal characteristics, 59
thermal comfort, 45, 47, 49, 50, 57, 61, 66, 68, 73, 74, 75, 116
thermal environment, 55, 71, 101, 111
thermal environmental demand, 57
thermal preference, 50
thermal radiation, 43
thermal reaction, 38
thermal response, 43, 45
thermal sensation, 45, 51, 69
thermal sensation representation sites, 65
thermal sensory vote, 41
thermal storage tank (TST), 12
thermocline thickness, 12
tiredness levels, 29
TOPSIS, 66
traditional dwelling of Yi, 6
traditional mural painting, 93
traffic risk level, 95
traffic safety, 95
training, 154
transportation, 11
Trombe wall, 111
TVET institutions, 126

U

ultra-high-strength steel, 115
unbalanced bidding, 137
uncomfortable glare, 19
underground station, 57, 101
universal thermal climate index, 92
university buildings, 8
university campuses, 79
university hostel, 163
urban centrality, 5
urban construction, 81
urban parks, 74
urban planning, 11

V

vehicle transmission, 29
ventilation strategy, 25
vertical earth-air heat exchange (VEAHE), 123
virtual reality, 131
visual biomass, 95
void periods, 159
volcanic ash, 113
VOSviewer, 112

W

wall decoration, 91
water diffuser, 12
wearable technology, 157
workplace, 122

Y

young people, 49



UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

