

# **Healthy Buildings 2023: Asia and Pacific Rim**

Tianjin East, China  
17-19 July 2023

Volume 1 of 2

ISBN: 978-1-7138-9085-0

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

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



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

Copyright© (2023) by International Society of Indoor Air Quality and Climate (ISIAQ)  
All rights reserved.

Printed with permission by Curran Associates, Inc. (2025)

For permission requests, please contact International Society of Indoor Air Quality and Climate (ISIAQ)  
at the address below.

International Society of Indoor Air Quality and Climate (ISIAQ)  
c/o Infinity Conference Group, Inc.  
1035 Sterling Road, Suite 202  
Herndon, VA 20170 USA

Phone: (703)-925-9455 x118

[info@isiaq.org](mailto:info@isiaq.org)

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

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

# TABLE OF CONTENTS

## VOLUME 1

### **BUILDING ENERGY**

An Energy-Efficient Room Air Conditioner Combined with Cooling Tower by Using Three-fluid Heat Exchangers in Indoor and Outdoor Units.....	1
<i>F. Zha, Y. Wang, W. Wang, S. Mao, J. Zhan, X. Li</i>	
State-Of-the-art Review on Improving Energy Performance of Mechanical Ventilation Systems in Buildings .....	9
<i>H. Sha, Y. Shen, D. Qi</i>	
Research on Photovoltaic-Driven Outdoor Toilet Ventilation Systems .....	17
<i>C. Sun, Z. Zhao, Z. Zhang, X. Ju, J. Zhang, J. Li, Y. Luo</i>	
Dynamic Anomaly Detection of Building Energy Consumption Data.....	25
<i>L. Lei, W. Liu</i>	
Improved Energy Performance by Applying Bio-Materials of Historical Buildings Used as Restaurants .....	32
<i>J. Choi, H. Yuk, Y. Kim, S. Kim</i>	
Efficient Heat Dissipation of Photovoltaic Panels Through In-Place Porous Hydrogels for Moisture Harvesting and Evaporation .....	36
<i>W. Zou, J. Mo</i>	
Optimum Indoor Environmental Parameters of Urban Office Building by Economic Analysis of Performance Benefits and Energy Costs .....	38
<i>Y. Shi, J. Lyu, J. Wu, Z. Lian</i>	
Energy Saving Potential for Fresh Air Handling with Stereo Camera-Based Indoor Occupancy Positioning System in a Classroom .....	45
<i>H. Wang, C. Liang, G. Wang, X. Li, X. Shao</i>	
Operation and Optimization of a Distributed PV System with Battery and Thermal Storage.....	53
<i>J. Luo, Y. Zhang, J. Li, X. Sun</i>	
Thermal Energy Consumption in Comfortable Showering Environments for Residential Buildings .....	55
<i>D. Zhang, K. Mui, L.-T. Wong</i>	
A Framework for Low-Carbon Composite Functional Building Design Based Onmulti-stage and Multi-objective Optimization .....	61
<i>X. Chen, Y. Song, Y. Chu, S. Shi</i>	
Study on Performance of Medium and Deep U-Type Borehole Heat Pump for Heating Buildings.....	69
<i>S. Huang, D. Lin, J. Li, J. Dong, Y. Jiang</i>	
Assessment of Demand Response Potential for City-Scale Buildings Underdifferent Control Strategies .....	77
<i>C. Peng, Y. Chen</i>	

Design and Technologies for Healthy and Low-Carbon Communities .....	85
<i>J. Liu, Y. Chen</i>	
Experimental Study on Thermal Performance of Thermosyphon Integrated with Distributed Energy Storage in Data Center.....	87
<i>L. Liu, Q. Zhang, S. Du</i>	

## **BUILDING ENVELOPE**

Influence of Building Surface Cooling Materials on Urban Ventilation and Wall Temperature in Nanjing Residential Neighborhood in Summer.....	95
<i>F. Xu, Z. Gao, J. Zhang</i>	
Impacts of Envelope Features on the Ventilation Efficiency and the Building Wall Temperature in 2D Street Canyons.....	103
<i>Y. Lou, J. Hang, D. Cui, Z. Yang, J. Liu</i>	
CFD Simulation of the Thermal Performance of Cool Facades and Cool Roofs in Urban Street Canyon .....	112
<i>Q. Li, J. Hang</i>	
Quantifying Cooling Benefits of Cool Roofs and Walls Applied at Neighbourhood Scale: Scaled Outdoor Experimental Study.....	116
<i>M. Lu, L. Zeng, J. Hang</i>	
Thermal Performance Test and Case Analysis of Buildings -- Take the Bell Tower, Mathematics Building, and Yunxiu Building of Soochow University as Examples .....	118
<i>X. Han, J. Wu, J. Shen, A. Candeias, Z. Li, W. Zhang, Z. Xue</i>	
Study on Radiative Cooling and Thermal Insulation Materials for Energy Saving in Building Roofs .....	126
<i>L. Xie, H. Wu, J. Liu, J. Gu</i>	
Experimental Study on the Photothermal Adaptive Regulation characteristics of Phasechange Photovoltaic Energy-Saving Windows in Cold Regions .....	135
<i>X. Lei, R. Yang, L. Wang, N. Li</i>	
Analysis of the Thermal Performance of Photovoltaic Glass Coupled with Phase Change Material (PCM) .....	138
<i>X. Lei, R. Yang, F. Han, D. Kong, C. Xu</i>	

## **CHEMICAL POLLUTANTS**

Real-Time Molecular Characterization of Air Pollutants in a Hong Kong Residence: Implication of Indoor Source Emissions and Heterogeneous Chemistry .....	140
<i>X. Lyu, Y. Huo, J. Wang, D. Yao, K. Li, H. Lu, Y. Zeren, H. Guo</i>	
Study on the Adsorption Performance of Low Concentration SO <sub>2</sub> on Alkaline Filter Media and Chemical Filters .....	142
<i>Y. Pan, J. Pei</i>	
Disability-Adjusted Life Years (DALYs) Attributable to Indoor and Outdoor Originated Nitrogen Dioxide in Chinese Urban .....	149
<i>Y. Hu, Y. Wang, B. Zhao</i>	

## **CHILDREN HEALTH**

Energy Consumption of Residential Buildings and Its Relationship Between Indoor Temperature and Humidity and Children's Respiratory Diseases in Shanghai, China .....	151
<i>Y. Luo, S. Hong, Y. Zhu, Z. Zou, C. Huang, C. Sun</i>	
House Dust Mite Allergen Levels in Households and Association of House Dust Mite Exposure with Children's Asthma and Allergy.....	153
<i>M. Wan, Y. Sun, S. Luo</i>	
Satellite-Based Ozone and NO <sub>2</sub> Exposure and the Development of Allergic Rhinitis in Preschoolers .....	155
<i>T. Chen, X. Zhang, C. Lu, Q. Deng, L. Zhang, W. Yu, B. Li, X. Zheng, H. Qian, T. Wang, D. Norback, S. Shi, X. Li, L. Zhou, X. Meng, Z. Zhao</i>	
Indoor Metabolites and Chemicals as Potentially Better Predictors on Childhood Asthma and Rhinitis than Indoor Microbiome .....	158
<i>Y. Sun, H. Tang, S. Du, D. Norback, J. Shao, X. Fu, Z. Zhao</i>	

## **COMFORT**

Development of a Thermal Sensation Model for Naturally Ventilated Indoor Environments Based on Deep Learning Algorithms .....	160
<i>L. Lei, S. Huang</i>	
The Fluctuant Wind Direction Characteristic of Airflows Using Power Spectral Analysis from the Perspectives of Azimuth, Elevation and Wind Components .....	162
<i>Z. Xie, J. Fan, B. Cao, Y. Zhu</i>	
Thermal Adaptive Behaviour and Thermal Environment: Vision-Based Non-contact Measurements and Correlation Analysis .....	170
<i>Y. Yang, Y. Geng, B. Lin</i>	
Structural Optimization of a Tree-Shaped Radiator Based on Fractal Theory .....	173
<i>M. Kang, J. Zhou, Q. Wang, Y. Li, N. Meng, C. Li, L. Li</i>	
Asymmetric Clothing Behavior and Thermal Comfort of Tibetan People .....	181
<i>D. Zhao, C. Song, Y. Liu</i>	
Comparison of Thermal Comfort Between City and Rural Areas Residential Buildings in China .....	193
<i>Z. Yang, W. Zhang</i>	
Application of Different Thermal Indices in Evaluating Outdoor Thermal Comfort in Spring in Cold Region of China.....	199
<i>S. Liu, B. Cao, O. Yume, Y. Xie, Y. Zhu</i>	
Study on the Effect of Cultural Background on Indoor Environmental Demand of Campus Environment in Cold Area of China .....	207
<i>Z. Xu, B. Chen, J. Deng</i>	
Research on Identifying Personalized Environment Preference of Summer Office Environment Based on Infrared Photos of Skin Temperature .....	214
<i>Y. Yang, B. Chen, Z. Xu, J. Deng</i>	
A Questionnaire Study on the Influence of Health Culture on Climate Adaptability .....	217
<i>W. Sun, B. Chen, S. Xu, J. Deng</i>	

The Influence of Fin Arrangement on Heat Transfer Performance for Built-In Finned Trombe Wall.....	225
<i>X. Chen, Y. Wang</i>	
Novel Evaluation Index and Method of Personal Comfort Systems Based on Thermal Manikin.....	233
<i>J. Fan, Y. Wu, Y. Hou, B. Cao, Y. Zhu</i>	
The Indices of Indoor Light Environment for Office Spaces: A Standard Review.....	241
<i>J. Zhou, Y. Zeng, J. Yu, B. Lin</i>	
Influencing assessment on the effect of face masks for outdoor thermal Comfort by Adopting Thermal Manikin.....	249
<i>X. Lu, J. Liu, Y. Zhai</i>	
The Impacts of Exercise Behaviour on Human Thermal Comfort to Improve Energy Efficiency in Sports Buildings .....	255
<i>Y. Gao</i>	
Effect of Indoor Air Environment in Classrooms on the Thermal Comfort and Learning Efficiency Among College Students.....	262
<i>Y. Xiao, W. Liu, J. Cai, S. Zhou, X. Duan, T. Liu, M. Yang, K. Liu, B. Ding, Y. Chen, G. Hao</i>	
Experimental Study on State Recovery of Human Body After High -Intensity Exercise in Outdoor Cold Environment .....	264
<i>T. Tian, G. Yang, J. Wang, R. Xu, J. Gui</i>	

## **DISEASE**

Numerical Evaluation of SARS-CoV-2 Transmission and Infection When Queuing in Outdoor Spaces.....	275
<i>W. Yun, F. Rao, S. Liu, R. Sun, D. Lai</i>	
Ventilation Performance Index Regarding Airborne Infection Risk Control of Respiratory Diseases .....	283
<i>S. Zhang, D. Niu</i>	
Field Monitoring-Based Infection Risk Evaluation and Mitigations of COVID-19 in Urban Public Transport.....	291
<i>Y. Feng, Z. Wang, Y. Zhang, X. Ding, S. Wang, Y. Fan, J. Ge</i>	
Subway Riding Behavior Before and During the COVID-19 Pandemic: A Case Study in Hong Kong.....	299
<i>S. Shang, N. Zhang</i>	
Host-Cell Dynamics Model Development and Specific Parameterization for a 3D Upper Respiratory Tract Model Coupled with CFPD Analysis.....	301
<i>H. Li, K. Kuga, K. Ito</i>	
Experimental Study on the Impacts of Respiratory Activity and Moving Speed on the Expiratory Buoyant Jet Flow Dispersion in Non-Uniform Environment .....	303
<i>F. Liu, H. Qian</i>	
Increasing Role of Airborne Route in SARS-CoV-2 Omicron Variant Transmission in Household .....	309
<i>S. Ji, H. Lei</i>	
Investigation on the Cross-Infection Control Performance of Interactive Cascade Ventilation in Multi-scenario of Winter .....	311
<i>Y. Lan, M. Fan, X. Kong, H. Li</i>	

Effectiveness of Air Cleaner on Mitigating the Transmission of COVID-19 Disease in a Dental Clinic Environment .....	320
<i>G. Yang, Y. Wang, S. Fu, K. Chan, K. Mui, T. Flemmig, P. Thomson, T. Ng, C. Chao</i>	
Transmission Routes of SARS-CoV-2: A Comparative Analysis of Inflight Outbreaks with Influenza and SARS-COV-1.....	327
<i>Y. Luo, Y. Li, S. Xiao, H. Lei</i>	
SARS-CoV-2 Transmission Via Close Contacts and Surfaces in a Hospital A&E Department .....	329
<i>L. Zhuang, B. Cao, Y. Li, N. Zhang</i>	
Influence of Face Mask Gap on the Source Control Effect .....	331
<i>Z. Jia, Z. Ai</i>	
Study on the Risk of Patient and Medical Staff Exposure in Real Wards and the Effectiveness of Control Measures .....	336
<i>N/A</i>	
The Risk of Airborne Cross-Infection in the Industrial Workshop .....	338
<i>Y. Wang, Z. Long</i>	
Translocation of Inhaled Nanoparticles to the Brain in Rat Model of Depression: Evidence and Mechanism .....	346
<i>R. Huang, J. Li, P. Ma, F. Feng, Q. Deng</i>	
Renewal Design of "LDK " Residential Unit Based on Distance Remodeling Theory.....	350
<i>N. Li, Q. Wang, L. Zhao, D. Fan, G. Jia</i>	
Effect of Temperature and Relative Humidity in Different Building Design Zones on the Relative Risk of COVID-19 Transmission .....	359
<i>Y. Wang, G. Gong, X. Shi, Y. Huang, X. Deng</i>	
Short-Term Effects of Air Pollution on Circulatory Disease Death in Zhengzhou City, China.....	367
<i>L. Liu, Q. Deng</i>	
Impact of Built Environmental Factors on COVID-19 Infection at High-density Communities: A Case Study in Shenzhen .....	369
<i>Y. Hu, Z. Lin, S. Jiao, R. Zhang</i>	
Healthy MPC Solution for Smart Ventilation Control in a Medium Office Building.....	377
<i>Z. Jiang, B. Dong</i>	
Transient Indoor Airflow and Virus-Laden Droplet Dispersion Affected by Interactive Human Movement at Different Moving Velocities .....	385
<i>J. Wu, W. Weng, M. Fu</i>	
Airborne Infection Risk Assessment in the Thermally-Stratified Indoor Environment -A Systematic Review.....	392
<i>L. Xiao, M. Chang, X. Hu, N. Gao</i>	
Construction of Medical Spatial Resilient Structure in Response to Public Health Emergencies .....	400
<i>Y. Liu, L. Chen, T. Wang</i>	
Risk Assessment of COVID-19 Infection in a Biosafety Laboratory Based on a Dose-Response Model .....	408
<i>H. Gao, J. Liu, L. Qiu, W. Wu, W. Qian</i>	

Effect of Wearing Face Masks on Minimizing the Risk of Respiratory Infection on a Long-Haul Flight.....	417
<i>L. Zhen, T. Zhang, F. Wang</i>	
Can Indoor Air Curtain or Fan Reduce Cross-Infection Risk in a Space with Displacement Ventilation?.....	425
<i>A. Robinson, Z. Zhai</i>	
If All Buildings Were Diluted Like Airplanes, There Would Not Be a Pandemic? .....	433
<i>A. Li, P. Cheng, W. Jia, Y. Li</i>	
A New Wells-Riley Equation for General Airflow Conditions.....	435
<i>W. Jia, P. Cheng, Y. Li</i>	

## **ENERGY & SUSTAINABILITY**

Study on Energy Consumption Distribution of Built Landscape Types Based on Local Climate Zoning - A Case Study of Zhengzhou .....	437
<i>G. Yang, Y. Li, Y. Fu, J. Wang, Z. Zhou</i>	
Energy Management Strategies Based on Usage Data Analysis for a Hospital Building in China .....	454
<i>Y. Li, C. Yang, J. Chen, L. Weng, J. Yao, S. Zong</i>	
Case Study of Life Cycle Carbon Emission Assessment for a Small Wooden Office Building in a Cold and Snowy Region of Japan.....	462
<i>Y. Tong, K.-I. Hasegawa S.-I. Matsumoto, J. Takeuchi</i>	
Exergy Analysis of New Spray Cooling System with PV/T and Heat Recovery in Sow House: As a Case in Nanchang, China .....	470
<i>N/A</i>	
Building Energy Simulation and Optimization for Traditional Residential Buildings in Tibetan Region of Sichuan, China.....	492
<i>Y. Zhang, M. Luo</i>	
Operation and Optimization of a Distributed PV System with Battery and Thermal Storage.....	500
<i>J. Luo, Y. Zhang, J. Li, X. Sun</i>	
Impact of Resident Environment and Energy Use on the Health of the Elderly in Rural Areas: An Empirical Study Based on Anshan City, Liaoning Province .....	502
<i>D. Gao, X. Wang, Z. Li, H. Zhang, X. Yang</i>	
Knowledge Mapping Analysis of Low Carbon Architecture and Urban Planning Research in China Based on Citespace.....	509
<i>Y. Qian, B. Wang, Y. Liu, X. Liu, J. Li</i>	
Heating Energy Simulation and Optimization for Traditional Residential Buildings at Tibetan Region of Sichuan .....	518
<i>Y. Zhang, M. Luo</i>	
Correlation Analysis of Subjective and Objective Assessment of Indoor Environment Performance of Green Office Buildings in Shanghai .....	527
<i>Y. Zhang, X. Qiu, J. Yang, Y. Sun</i>	



Study on Natural Ventilation Utilization of Nearly Zero Energy Consumption Buildings in Hot Summer and Cold Winter Zone Considering Outdoor Air Quality ..... 535  
*J. Yang, Y. Sun, L. Ji, Y. Hu, L. Wang*

Investigation on the Photovoltaic Thermal Heat Pump Assisted Heating and Cooling System Based on the Comfortable Indoor Environment Demand of Greenhouse Buildings ..... 543  
*C. Zhou, J. Wang*

## **HEALTH EFFECTS**

Estimating Indoor Radon Exposure in China - A Review ..... 550  
*C. Su, C. Huang, C. Sun, Z. Zou, H. Li*

The Prevalence and Time Trends of Medical Symptoms Among Adults in China and Associated Home Environmental Factors: A Repeated Cross-Sectional Study ..... 552  
*H. Cheng, B. Zhang, Z. Zhao, D. Norback, X. Zhang*

Sleep Staging Based on Skin Temperature: A Neural Network Prediction Model ..... 554  
*X. Xu, S. Zhou, Z. Lian*

Building Energy Saving Design for Indoor Thermal and Humid Environment in Cold Area Based on Cardiovascular and Cerebrovascular Health..... 561  
*G. Wang, D. Liu*

Research on Domestic and Foreign Total Residential Decoration Policy Standards and Discussion on Development Issues..... 569  
*G.-G. Jian, Q.-Q. Wang, D.-Y. Fan, N.-Y. Li*

Air Change Rates Measured by Two Different Tracer Gases of Residential Building in China and Its Association with Asthma and Allergy of Children ..... 577  
*J. Hou, Y. Sun, M. Bjorling*

An Efficient Target Oxygen Supply System for Improving Sleep Environment in High-Altitude Areas..... 579  
*H. Li, R. Gao, R. Jing, M. Liu, Y. Wang*

Effect of Indoor Air Quality on Elderly's Health and Satisfaction in Chess and Card Rooms During the COVID-19 Pandemic ..... 587  
*J. Fu, H. Su, H. Qian, X. Zheng*

Research on I/O Ratios of Japanese Cedar Pollen in Spring ..... 594  
*W. Wang, R. Ooka, H. Kikumoto, W. Oh*

Health Effects of Dampness-Related Exposures in Residence from 1990 to 2020: A Systematic Review and Meta-analysis..... 602  
*M. Yang, W. Liu, K. Liu, B. Ding, T. Liu, Y. Xiao, S. Zhou, Y. Chen, G. Hao, J. Cai*

Associations of Early-Life Exposure to Submicron Particulate Matter with Childhood Asthma and Wheeze: A Multi-city Study in China..... 604  
*L. Zhang, C. Wu, Y. Zhang*

Restorative Effects of Residential Green Space Environmental Features for the Older Adults: Does the Thermal Environment Matter?..... 606  
*S. Lu, L. Wang*

Study on the Change of Learning Behavior Pattern and the Improvement of Spatial Adaptability in Universities Under the Background of Epidemic Prevention and Control: A Case Study of Harbin Institute of Technology .....	609
<i>T. Zhao, T. Huang, M. Lu</i>	

## **HVAC**

N95 Respirator' Protective Impact on Healthcare Workers in a Diagnostic and Treatment Environment: An Experimental Investigation .....	619
<i>N/A</i>	
A Dynamic Optimal Control Strategy of HVAC System in Load Prediction Scenario in Office Buildings .....	621
<i>C. Li, Y. Geng, Z. Lv, T. Cao, X. Gu, B. Lin</i>	
A Review of Application and Development of Fresh Air Heat Pump System in Buildings .....	631
<i>M. Chang, L. Xiao, X. Hu, N. Gao</i>	
Study of Heat Transfer Characteristic of Supercritical CO <sub>2</sub> in Tubes.....	639
<i>M. Sun, B. Dong, X. Cheng, Y. Qin, W. Li</i>	
Pulse Tests in Highly Airtight Passivhaus Standard Buildings.....	647
<i>X. Zheng, L. Smith, C. Wood</i>	
Study on Heat Recovery of Top Warm Air of Large Space Buildings in Winter.....	655
<i>T. Shen, T. Yu</i>	
Experimental Investigation on the Energy and Economic Performance of an Ice-Slurry-based Dynamic Ice Storage System.....	663
<i>Y. Liang, X. Yuan, Y. Jiang, R. Kosonen, Y. Pan</i>	
Evaluation of Airborne Contaminant Distribution in an Office Room with Air Purifier Devices by CFD Modeling.....	671
<i>X. Shan, H. Zhao, H. Li, Y.-K. Lee, W. Wu</i>	
Simulation Method and Modeling Verification of Exhaust Duct Network.....	679
<i>C. Li, Y. Xue, T. Zhang</i>	
Ventilation Simulation and Layout Optimization of Underfloor Air-Cooled Condensers .....	687
<i>J. Tang, L. Sha, H. Sun</i>	

## **IEQ**

A Comfortable Thermal Sensation Evaluation Method Based on Facial Skin Temperature .....	689
<i>X. Tian, W. Liu</i>	
Measuring Ambient Light for Well-Being with a Miniature Multi-channel Spectral Sensor .....	693
<i>Y. Zeng, J. Yu, J. Zhou, B. Lin</i>	
Cluster Analysis of Screening Main Factors of Thermal Sensation Using ASHRAE Database II .....	701
<i>Y. Wu, B. Cao</i>	
Modification of the Standard Environment in the Calculation of the Standard Effective Temperature .....	709
<i>X. Jia, Y. Zhu, B. Cao</i>	

Air Supply Optimization for Differentiated Temperature Demand: Reliability Under Variable Demand Positions.....	715
<i>Y. Liu, Z. Zhu, C. Jin, X. Shao, X. Li</i>	

## VOLUME 2

Experimental Study on Human Multi-Node Thermal Sensitivity and Thermal Demand Under Uniform Environment .....	721
<i>N/A</i>	
Thermal Stratification in a Full-Scale Room Under Buoyancy-driven Displacement Ventilation .....	730
<i>L. Chew, N. Tan</i>	
Differences in Cognitive Performance Between Daylighting and Artificial Lighting.....	738
<i>Q. Liang, P. Xue, L. Jin, J. Shi</i>	
Perceived Indoor Environmental Quality and Health Symptoms During Exposures to Pure Carbon Dioxide.....	746
<i>N/A</i>	
Head Surface Temperature Distribution Characteristics and Sensitivity to Thermal Sensation Captured by the Thermal Camera.....	752
<i>J. Lyu, X. Miao, Z. Ji, Z. Zhao, H. Du, Z. Lian</i>	
How Mask Wearing Affect Outdoor Thermal Comfort in Summer? Effect of Mask Wearing Duration.....	760
<i>N/A</i>	
Improving the Thermal Comfort of Medical Protective Clothing Based on Micro-Encapsulation Phase Change Material .....	768
<i>W. Ji, Q. Liu</i>	
Correlation Characteristics of Galvanic Skin Response with Thermal Sensation Votes.....	776
<i>X. Zhao, Y. Yin, Z. He</i>	
Multiple Effects of Visual-Acoustic-thermal Perceptions on the Overall Comfort of Elderly Adults in a Humid Subtropical City.....	784
<i>M. Du, B. Hong</i>	
Utilizing Airflow from Air Conditioners for a Refreshing Awakening During Summer Sleep .....	786
<i>H. Jeon, C. Chun</i>	
The Effect of Traffic Noise in the Vertical Direction of Street Buildings.....	794
<i>Y. Zheng, L. Wang, X. Zhu, L. Luo</i>	
Modification of the UCB Comfort Model for Predicting Thermal Comfort in Electric Vehicle Cabins for Korean Drivers.....	803
<i>S. Kwun, J. Yoo, C. Chun, J. Park</i>	
A Study on the Relationship Between Changes in Skin Temperature and the Amount of Activity Using a Wearable Device.....	805
<i>J. Kim, C. Chun</i>	
Assessment of Daylighting, View and Air Quality Requirements: An Integrated Approach for Healthy Buildings.....	812
<i>M. Abdelrahman, U. Ogbonda, P. Coates</i>	

Development of the Data Acquisition System for Psychrometric Chamber in Universitas Indonesia .....	820
<i>Y. Ardiyansyah, J. Ryanson, W. Elang</i>	
Effect of Self-Oscillations Developed in Airflow on Thermal Comfort in Ventilated Spaces.....	828
<i>N. Ivanov, M. Zasimova, E. Stepasheva</i>	
Research on Outdoor Thermal Comfort of Elderly People in Hot and Humid Areas in Summer .....	836
<i>J. Wang, Q. Li, G. Zhu, Z. Qiu, H. Peng, M. Wei</i>	
Effect of Seasonal Adaptation on Indoor Thermal Comfort of Students in HSCW Zone of China – One Year Long-Term Field Study .....	844
<i>Z. Wu, A. Wagner, H. Wu</i>	
The Impact of Window Morphology in Micro-Residential Building on Light Comfort and Its Optimization- A Case Study in Tianjin.....	846
<i>T. Liu, P. Shu, W. Lijun</i>	

### **MICROBES**

Assessment of Bacterial Risks on Kitchen Surfaces in Residences.....	848
<i>N/A</i>	
The Influence of Instrument Table Position on CFU Level in the Operating Room with Laminar Airflow .....	860
<i>Y. Bi, R. Lundoy, T. Fecer, L. Stenstad, S. Edvardsen, T. Harsem, H. Mathisen, J. Skogas, Y. Liu, G. Cao</i>	
Analysis of Microbial Communities in Indoor Buildings in Lingnan Region.....	868
<i>H. Zhang, L. Jin, H. Zhang, E. Arens, L. Zhou, Y. He, J. Hu, P. Cong, J. Chen, B. Chen, X. Cai, Z. Long</i>	
Simulated UV Distribution of Upper-Room Ultraviolet Germicidal Device Comparing to Field Measurements.....	876
<i>T. An, C. Su, Y. Lu, Y. Feng, T. Zhang, T. Wu</i>	
Purification Efficiencies of Microorganisms by Low-Temperature Plasma in Indoor Environment: A Systematic Review.....	881
<i>S. Zhou, W. Liu, J. Cai, Y. Xiao, M. Yang, K. Liu, B. Ding, T. Liu, G. Hao, Y. Chen</i>	
Dwelling Characteristics and Occupant Behaviors as Determinants of Airborne Fungi in Overcrowded Dwellings During Hot-Humid Season .....	883
<i>N/A</i>	

### **PARTICLE & AEROSOL**

Spatial Distribution of Bioaerolsols in Two Mine Lands Under Marine and Continental Climate and Risks.....	885
<i>T. Zhang, D. Zhang, J. Zhang, X. Wu</i>	
Indoor Emissions Contributed the Majority of Residential Ultrafine Particles Compared with Outdoor Sources .....	888
<i>C. Chen, B. Zhao</i>	
Particle Exposure Risk to a Lavatory User After Fushing a Squat Toilet.....	892
<i>F. Wang, L. Yao, Z. Gao, T. Zhang</i>	

A Multi-Zone Simulation Method for Air Filter Media.....	900
<i>X. Zhang, J. Liu, H. Wu</i>	
Transmission of Droplet Aerosols in an Elevator Cabin: Effect of Ventilation Mode .....	908
<i>H. Yang, X. Li, J. Xia</i>	
Improved Whale Optimization Algorithm for Locating Time-Varying Particle Sources in Indoor Dynamic Airflow Field: An Experimental Study Based on Multi-robot Cooperation.....	916
<i>C. Tong, H. Cai, X. Guo, Z. Li, M. Jiang, H. Xiao</i>	
A Comprehensive Comparative Study of Lumped-Parameter Model and Multi-zone Model in Simulating Indoor PM <sub>2.5</sub> from Cooking Activity .....	928
<i>Y. Peng, Y. Qiu, S. Shi</i>	
Carbon Monoxide and Particulate Matter Emission Performances of Biomass Pellet Cookstoves in Rural areas? A Field Study .....	936
<i>P. Zhang, R. Ma, D. Wu, M. Deng</i>	
Field Measurement on Indoor PM <sub>2.5</sub> Concentration in a Chinese Urban Dwelling in Severe Cold Region of Winter Season .....	944
<i>Y. Liu, C. Li, H. Ma, Y. Jiang, J. Dong, X. Luo</i>	
Numerical Visualization of Particle Dispersion in a Biological Safety Cabinet Under the Prescribed Experimental Conditions by NSF/ANSI 49 .....	950
<i>R. Muta, K. Ito</i>	
Behavior of Artificial Droplet and Droplet Nuclei in All-Weather Dome Stadium.....	952
<i>N. Shinohara, N. Kurihara, A. Iwai, K. Tatsu, M. Ogata, T. Morioka, T. Takatsuji, W. Naito</i>	
Impact of Cooling Coils on Mold Contamination in Air-Conditioning System During the Plum-rain Period .....	954
<i>N/A</i>	
Aspiration Probability and Resulting Airway Deposition of Indoor Particles During Steady and Transient Breathings.....	956
<i>K. Kuga, K. Ito</i>	
Effect of Personalized Air Curtain on Aerosol Dispersion for People at Different Orientations During Close Contact .....	958
<i>J. Xu, H. Guo</i>	
A Study of Aerosol Generation and Dispersion in Sanitary Facilities .....	960
<i>C. Wang, J. Xu, H. Guo</i>	
Large Eddy Simulation of Airflow Patterns in the Human Upper and Lower Airway Up to the 16th Generation: A Comparison Study .....	962
<i>K. Nguyen, P. Nguyen, K. Ito</i>	
Double-Grafted Polyester Fibers with Regulated Surface Topography for Electrostatic Particle Capture and Long-term Ozone Removal .....	964
<i>Y. Gao, E. Tian, J. Mo</i>	
Accurate CFD Prediction of Particle Deposition in Turbulent Duct Flows: Three Key Issues .....	966
<i>J. Ye, Z. Ai</i>	
Characteristics of Droplets Emission Immediately Around Mouth During Dental Treatments.....	974
<i>C. Xing, Z. Ai, F. Liu, S. Cao, C. Mak, H. Wong</i>	

In Silico Investigation of Drug Delivery in Human Lower Respiratory Tract Via Mechanical Respirato.....	976
<i>S. Li, N. Khoa, K. Ito</i>	
Efficient Airborne Particle Sampling by a New Electrostatic Collector.....	978
<i>X. Liu, J. Mo</i>	
Dormitory PM2. 5 Exposure and the Health Consequences Among College Students in Lhasa: A Panel Study.....	980
<i>R. Qiao, W. Chen, Y. Liu, J. Gong, T. Zhu</i>	
Measuring Particle Emissions from Using Electric Toothbrushes.....	982
<i>W. Tang, Y. Li, Y. Hong, W. Ye</i>	
Bacterial Communities in Ultrahigh-Altitude Residences in Ngari, China: Altitude-Associated Trends and Residence Pan-microbiome .....	984
<i>Y. Lu, M. Duan, Y. Li, L. Liu</i>	
Estimating the Impact of Ventilation and Size-Dependent Viral Load on Short-Range Airborne Transmission.....	987
<i>X. Lyu, Z. Luo, L. Shao</i>	
The Inter-Flat Transmission of Aerosols Due to Stack and Wind Effect Via Vertical Drainage and Vent Pipes in Buildings: A Review .....	990
<i>X. Hu, L. Xiao, M. Chang, N. Gao</i>	
The Effects of Synergetic Electric Field on the Captured Pathogenic Microbes Based on an Electrostatically Assisted Air Filter .....	1001
<i>F. Xia, J. Mo</i>	
On Applicability of URANS Modeling to Infectious Droplets Transport Prediction .....	1003
<i>M. Zasimova, N. Ivanov, V. Ris, A. Tihomirov</i>	
Parametric Analysis of a Rotating Disk with Curved Spoke for Cooking Oil Fume Particle Removal .....	1011
<i>L. He, Y. Wu, J. Gao, C. Cao</i>	
Transport and Fate of Size-Resolved Expired Droplets.....	1013
<i>P. Cheng, W. Jia, Y. Li</i>	
Numerical Simulation of a Gas-oil Separation Device of a Closed Machine Tool in the Post-Environmental Area.....	1015
<i>X. Wang, T. Li, Y. Liu, J. Zhao, Y. Zhou, F. Wang</i>	
Induced Airflow and Generated Aerosols by Urinal Flushing in Lavatory .....	1023
<i>W. Dai, F. Wang, T. Zhang</i>	
Walking-Induced Particle Resuspension in the Aisle of a Twin-aisle Commercial Airliner Cabin .....	1032
<i>Y. Ma, T. Zhang, F. Wang</i>	
The Machine Learning Method to Reverse Design the Air Supply Speed in the Negative Pressure Operating Room to Reduce the Influence of Patients on Staff.....	1040
<i>Z. Liu, Z. Huang, H. Li, J. Chu, C. Lin, J. Chi, X. Xiao, J. He</i>	
The Key Parameters of Using Down-Side Ventilation to Efficiently Exhausting Aerosol Pollution in Residential Bathroom: An On-Site Intervention Study .....	1048
<i>B. Ding, W. Liu, J. Cai, T. Liu, M. Yang, K. Liu, Y. Xiao, S. Zhou, Y. Chen, G. Hao</i>	

Cross-Transmission of Exhaled Contaminants in a Hospital Ward with Impinging Jet Supply .....	1050
<i>C. Qin, Z.-T. Li, X.-P. Lyu, W.-Z. Lu</i>	
Multi-Scenario Validation and Assessment of a Particulate Matter Sensor Monitor Optimized by Machine Learning.....	1052
<i>H. Tang, Y. Cai, S. Gao, Z. Zhao</i>	
Benefits of Filtered Fresh Air Ventilation for School-Aged Children: A Randomized Crossover Intervention Study in Shanghai .....	1054
<i>S. Du, X. Gao, H. Tang, Y. Cai, J. Li, Y. Xu, Z. Zhao</i>	
Associations Between Illness-Related Absences and Ventilation and Indoor PM2. 5 in Elementary Schools .....	1056
<i>N/A</i>	
Comparison of the Correlation Between Urban Built Environment and PM2. 5 Concentration Based on National Stations and Mobile Monitoring .....	1058
<i>J. Xu, Y. Chao, H. Chen</i>	
Influence Mechanism of the Return Air Ratio on Inhalation Exposure to Airborne Pathogens Transport in the Ward .....	1068
<i>S. Liu, R. Wang, Y. Liu, L. Fu, Y. Wang, L. Liu</i>	

**PARTICLE & AEROSOL - (LAVATORY AEROSOL)**

Numerical Investigation of a Novel Ventilation Strategy with Localized Exhaust in an Aircraft Lavatory .....	1070
<i>Y. Chen, J. Wei, T. Zhang</i>	

**STERILIZATION**

Spatial Distribution of UV Irradiance from Typical Lamps .....	1075
<i>Y. Zhang, C. Su, W. Wen, J. Xiao, Y. Lu</i>	

**STERILIZATION**

Experimental Study on Sterilization Effect of E. Coli on SiC Composite Filter by Microwave Radiation .....	1081
<i>Y. Zhang, T. Yan, F. Wang, X. Xu</i>	

**STERILIZATION**

Effect of Temperature, Relative Humidity and Air Velocity on Removal Efficiency of Airborne Bacteria by the In-Duct Ultraviolet Radiati.....	1089
<i>X. Chen, Y. Li</i>	

**STERILIZATION**

An Improved Ultraviolet Disinfection Prediction Model Based on View Factor Method and Eulerian Model.....	1098
<i>Y. Pan, T. Xia, K. Guo, Y. An, C. Chen</i>	

## **VENTILATION**

Wind Tunnel Experiments on Pumping Ventilation of a Cubic Building Sheltered by Upwind And/or Downwind Buildings.....	1100
<i>H.-Y. Zhong, J. Sun, F. Qian, F.-Y. Zhao</i>	
Effect of Turbulent Inlet Boundary Conditions on Pollutant Emissions and Dispersion in an Indoor Environment.....	1109
<i>T. Hirayma, H. Yamasawa, K. Kuga, K. Ito</i>	
Experimental Study of the Natural Wind Outdoors and in an Office for Optimization of Indoor Air Environments.....	1111
<i>Y. Wei, S. Li</i>	
Temporal Urban Heat Island of Representative Local Climate Zones in Hangzhou City .....	1120
<i>S. Xiao, S. Wang, B. Yu, Y. Fan, S. Yin</i>	
Domain-Height-independence Test for Numerical Simulation on Buoyancy driven City Ventilation .....	1122
<i>X. Shi, X. Gui, Z. Huang, B. Yu, Y. Fan, S. Yin</i>	
Numerical Investigation on Thermal Performance of Radiant Heating Panel and Wall-Attached Ventilation .....	1124
<i>B. Zhou, Y. Guo, Z. Li, B. Yang, F. Wang</i>	
Instantaneous Formation of Scalar Concentration and Ventilation Characteristics of an Indoor Space Surrounded by Urban-Like Block Arrays Using LES.....	1127
<i>K. Fernandez, N. Ikegaya, K. Ito</i>	
Pollutant Removal Efficiency of a Restroom with Various Ventilation Modes .....	1129
<i>Y. Chen, Z. Fan, G. He</i>	
Investigation of Ventilation Performance in an Institutional High-Rise Building Using Tracer Gas Technique .....	1131
<i>I. Reda, E. Ali, D. Qi, L. Wang, T. Stathopoulos, A. Athienitis</i>	
Experimental Study on the Indoor Air Mixing Effect of Intermittent Ventilation .....	1139
<i>N/A</i>	
Reconstructing airflow path parameters of a multi-Zone building based on the Ensemble Kalman Filter.....	1145
<i>J. Zhang, Z. Gu, F. Li</i>	
Study on Non-Uniform Indoor Environmental Control Effects in Large Spaces Based on Column Attachment Ventilation .....	1148
<i>X. Tian, H. Yin, Y. Huo, D. Ji, J. Wang, S. Zu</i>	
Improvement of Airflow Uniformity at Multiple Outlets of Bypass Purification Station in Urban Highway Tunnels: Effect of a Deflector.....	1156
<i>N/A</i>	
Gaseous Contaminant Flow Produced by Localized Buoyancy Source in a Tunnel Under Natural and Longitudinal Ventilation .....	1160
<i>N/A</i>	



Impacts of Urban-Rural Fringe Development on Thermal Environment of the Downtown Areas: WRF/UCM Integrated with Urban LCZ.....	1168
<i>W. Ding, H. Chen</i>	
Investigation of the Longitudinal Temperature Accumulation and Mitigation Methods of an Ultra- Long Underwater Road Tunnel .....	1176
<i>W. Guo, J. Gao, L. Zeng, W. Ye</i>	
Impact of Physical Properties of Particles on Indoor Particle Movement and Deposition Using the Lattice Boltzmann Method .....	1178
<i>X. Wu, M. Han, H. Chen</i>	
The Visualization Analytics for the Airflow Inside Multi-Zone Buildings Based on Pressure Distribution: Airflow Mapping.....	1186
<i>N/A</i>	
Comprehensive Efficiency Tests and Simulation Analyzes of the Ventilation and Air Conditioning Systems in Underground Buildings with Long Tunnels .....	1193
<i>M. Ma, X. Yuan, T. Wang, Y. Xiao</i>	
Portable Air Cleaner-Assisted Mechanical Ventilation to Satisfy the Requirements for Occupants in an Open Office Using Multi-objective Optimization .....	1200
<i>Y. Li, W. Guo, D. Chen, M. Liu, W. Ye</i>	
One-Year Hourly Indoor Air Quality Parameters Monitored by Household Air Purifiers in 100 Chinese Residential Homes .....	1202
<i>J. Wei, J. Mo</i>	
Experimental Study on Effect of Ventilation Rate on Indoor Air Quality in Densely Occupied Spaces Under Displacement Ventilation.....	1204
<i>J. Hu, M. Liu, C. Wang, J. Guan, J. Li</i>	
Optimization Study of Block Morphology Based on Machine Learning Model to Mitigate the Impact of Traffic Pollutant .....	1212
<i>Y. Wu, H. Chen</i>	
Stress-Blended Eddy Simulation on the Transient Wind Flow Around an Isolated Building.....	1220
<i>N/A</i>	
Preliminary Analysis of Traffic Related Pollution Factors Around Primary and Secondary Schools During Commuting in Winter: A Case Study in Jinan City .....	1228
<i>L. Ren, S. Fu, T. Sun, J. Liu</i>	
Numerical Study on the Performance of Wind Towers with Different Structure Sizes Used in Underground Spaces.....	1236
<i>H. Su, Y. Zhao, N. Gao</i>	
Evaluating the Effect of Indoor Layout on Building Natural Ventilation at the Initial Stage of Design Based on the Real-Time Distribution Prediction of Indoor Aerosol Contaminant .....	1244
<i>Y. Yi, C. Zeng, X. Mei, C. Jiang, X. Sun, G. Gong</i>	
Performance Evaluation and Optimization Design of Natural Ventilation in Underground Corridors.....	1252
<i>X. Zhao, Y. Wu</i>	
Experimental Study on Airflow Uniformity Enhancement and Structural Optimization of Jet Generators for Attachment Ventilation .....	1260
<i>N/A</i>	

Solar Chimney Models for Design Purpose .....	1268
<i>G. He</i>	
Data-Driven Correction of the k- $\epsilon$ model Based on Multiple Expression Programming for Urban Airflow and Airborne Contaminant Dispersion.....	1276
<i>R. Zhao, S. Liu, J. Liu, N. Jiang, Q. Chen</i>	
Effect of Opening Windows and Wind Catcher on Natural Ventilation in A coach Bus .....	1284
<i>Q. Luo, C. Ou, J. Hang</i>	
Field Experimental Investigation of Particulate Matter Characteristics in Metal Machining Workshops with Displacement Ventilation Systems.....	1286
<i>C. Li, J. Xiong, D. Han, X. Wei, H. Zi</i>	
Pulse Tests in Highly Airtight Passivhaus Standard Buildings.....	1294
<i>X. Zheng, L. Smith, C. Wood</i>	
CFD Simulation of Specific Effects of Trees on Cross-Ventilation of a Generic Building .....	1295
<i>X. Zhang, A. Weerasuriya</i>	
Investigation on the Turbulent Development of a Reduced-Mixing Nozzle Jet for Personalized Ventilation .....	1297
<i>N. Li, W. Ma, N. Zhang, Y. Ren, C. Xu</i>	
Research Status of Utilizing Radiative Sky Cooling Technology to Alleviate Urban Heat Island .....	1299
<i>C. Li, H. Tang, Q. Long, W. Chen, W. Zhang</i>	
Numerical Study on the Shape Optimization of a Multi-Storey Solar Chimney .....	1307
<i>Y. Liu, S. Wei</i>	

## **VOCS & SVOCS**

Research on Optimization of a New Double-Skin Façade System Integrated with Photocatalytic/porous Materials for Purifying Pollutants.....	1314
<i>H. Li, J. Hu, H. Guo, X. Wang, X. Lu</i>	
Emission Characteristics, Sources and Airborne Fate of Speciated Organics in Particulate Matters in a Hong Kong Residence .....	1324
<i>Y. Huo, H. Guo, X. Lyu, D. Yao</i>	
Direct Ink Writed Adsorption Film with Hierarchical Porous Structures for Indoor VOCs Removal: Enable Better Adsorption Kinetics .....	1326
<i>Q. Chen, J. Mo</i>	
Predicting Long-Term Aldehyde Concentrations in an Occupied Residence Via Multi-factor Deep Learning Model .....	1328
<i>R. Zhang, J. Xiong</i>	
Evaluation of Total Exposure Risk and Health Effects of Indoor PAEs in Residential Buildings: A Case Study in Shanghai .....	1335
<i>J. Ma, L. Tian, J. Zhang, S. Wei, L. Yu, L. Zhu, C. Duan, R. Lu, C. Huang, C. Sun</i>	
Associations of Phthalate Concentrations in Indoor Dust with Air Temperature, Relative Humidity and Ventilation .....	1337
<i>Y. Zhao, Y. Sun, M. Wan, J. Hou</i>	

The Relationship of Residential Formaldehyde Pollution to Schoolchildren Pneumonia Prevalence on Actual Living Conditions in China: An On-Site Multi-city Study.....	1339
<i>X. Wang, X. Han, L. Fan, L. Li, C. Wang, S. Gong, J. Qi, T. Ge, H. Liu, X. Li, Y. Cao, M. Liu, Q. Wang, L. Su, X. Yao, X. Wang</i>	
Experimental Study on Correlation Between Total Volatile Organic Compounds (TVOC) and CO <sub>2</sub> in Densely Occupied Indoor Environments.....	1347
<i>C. Li, J. Li, Y. Zhang, M. Liu, J. Guan, J. Hu</i>	
Adsorption and Degradation of Volatile Organic Compounds by Metal–Organic Frameworks in Indoor Environments.....	1355
<i>S. Lyu, H. Dashan, Y. Xie, C. Cai, C. Lao, Y. Wang, K. Li</i>	
A Numerical Investigation of the Acetone Exposure Concentration and Local Tissue Dosimetry Under Various Ventilation Modes .....	1357
<i>C. Li, K. Zhang, S.-J. Yoo, K. Ito</i>	
Model Study on Phthalates Transfer Mechanism in Vasculature for Internal Exposure Estimation.....	1359
<i>R. Li, S. Wu, X. Wang, X. Zhou</i>	
Design Strategy for Sensing System with a Preconcentrator Toward VOC Detection Under Low Concentration .....	1366
<i>Y. Li, K. Frandsen, M. Hvelplund, Y. Lu, M. Duan, P. Nielsen, L. Liu</i>	
Impact of Indoor Ozone Exposure on Odouriferous VOCs Released by Fibre Boards.....	1373
<i>M. Hassan, M. Xue, J. Liu</i>	
VOC Emissions in Vehicular Environment: Observation and Prediction.....	1381
<i>H. Wang, J. Xiong</i>	

## **VOCS & SVOCS**

Emissions of Volatile Organic Compounds from Human Occupants Observed in a Student Office: Dependence on Ozone Concentration .....	1383
<i>Y. Qu, D. Xie, Y. Liu</i>	
Study on Indoor Formaldehyde Concentration of Typical Residence in Shanghai: Influence of Emission Rate and Ventilation Condition.....	1385
<i>H. Wang, J. Zhu, X. Fan, Y. Tang</i>	
Assessment and Prediction on Indoor Air Quality Based on Odour Evaluation.....	1393
<i>J. Chen, X. Huang, Y. Lao, Y. Tian, Y. Zhang, X. Wang, J. Li, C. Huang, C. Sun</i>	
The Measurement of SVOC Emission Rate from Flooring and Wall Materials of Houses.....	1400
<i>K. Tasaki, H. Kim, M. Koganei, Y. Masuzaki, S.-I. Tanabe</i>	
Characteristics and Gas-Solid Distribution of Polycyclic Aromatic Hydrocarbons Emitted from Indoor Candle Burning.....	1408
<i>J. Zhang, K. Zhang, M. Chen, Y. Zhao</i>	
Numerical Simulation of Formaldehyde Purification Process by Active Green Wall System.....	1420
<i>D. He, D. Wu, L. Zuo, M. Deng</i>	

**ADDITIONAL PAPERS**

Analysis of the Influence of Indoor Plants on the Respiratory Microbiome Ultra-High Altitude Migrants ..... 1428

*Y. Deng, M. Duan, Y. Lu, Y. Li, L. Liu*

Steady-State Model for Predicting Size-resolved Gas-particle Partitioning of Volatile Organic Compounds (SVOCs) in Indoor Environments ..... 1438

*J. Cao, Y. Han, Y. Zhu, X. Duan, L. Wang, H. Huang*

**Author Index**