Promoting Healthy City through ICT technologies. An experience of Particulate Matter low-cost monitoring

PLEA
STGO
2022

November 22 - 25, 2022

WILL CITIES SURVIVE?

The future of sustainable buildings and urbanism in the age of emergency.

BOOK OF PROCEEDINGS VOL 1 ONLINE SESSIONS

PLEA STGO 2022

PLEA STGO 2022: WILL CITIES SURVIVE?

Conference Chairman
Waldo Bustamante

Co-Chair
Felipe Encinas
Magdalena Vicuña

Editorial Team
Waldo Bustamante
Mariana Andrade
Pablo Ortiz E.

Hosting Organization
Pontificia Universidad Católica de Chile
Avenida Libertador Bernardo O'higgins 340

Graphic Design Project
Nicolás Gutierrez

November 22 - 25, 2022
Santiago de Chile

ISBN
978-956-14-3068-6

PLEA STGO 2022

November 22 - 25, 2022

ORGANISED BY

Passive and Low Energy Architecture (PLEA) — plea-arch.org

Centro de Desarrollo Urbano Sustentable — cedeus.cl

Facultad de Arquiectura, Diseño y Estudios Urbanos UC — fadeu.uc.cl

Universidad de Concepción — udec.cl

Agencia Nacional de Investigación y Desarrollo — anid.cl

PLEA STGO 2022

PLEA STGO 2022: WILL CITIES SURVIVE?

ABOUT

PLEA Association is an organization engaged in a worldwide discourse on sustainable architecture and urban design through annual international conferences, workshops and publications. It has created a community of several thousand professionals, academics and students from over 40 countries. Participation in PLEA activities is open to all whose work deals with architecture and the built environment, who share our objectives and who attend PLEA events.

PLEA stands for "Passive and Low Energy Architecture", a commitment to the development, documentation and diffusion of the principles of bioclimatic design and the application of natural and innovative techniques for sustainable architecture and urban design.

PLEA serves as an open, international, interdisciplinary forum to promote high quality research, practice and education in environmentally sustainable design.

PLEA is an autonomous, non-profit association of individuals sharing the art, science, planning and design of the built environment.

PLEA pursues its objectives through international conferences and workshops; expert group meetings and consultancies; scientific and technical publications; and architectural competitions and exhibitions.

Since 1982 PLEA has been organizing highly ranked conferences that attract both academia and practicing architects. Past Conferences have taken place in the United States, Europe, South America, Asia, Africa and Australia.

After almost a decade the PLEA conference is coming back to South America, Santiago (Chile), to be organized by the Pontifical Catholic University of Chile (PUC). Inevitably, the theme of PLEA 2022 is inspired by the current pandemic which has put the whole world on alert and makes us rethink our built environment in terms of health and safety. Whereas due to its current social unrest and significant social divide Santiago and South America in general provides a great ground to talk about inequalities and revisit social movements, that spanned around the globe from Lebanon, France to Chile and other countries just before the pandemic hit.

The aim of the PLEA 2022 is to question the whole idea of a city, the way we inhabit and use them generating the definitive inflection point that a sustainable city requires.

GOAL AND THEME

For decades, the climate crisis has been demanding our action and commitment. Numerous efforts to reach an international consensus via climate summits, such as COP25, and Paris Agreement have not had any expected results yet. However, even though the COVID-19 pandemic has intensified the sense of urgency, many talks about climate change were put on hold during 2020, when the new virus put the world on alert.

In no time it has become a global issue and provoked various reactions from political leaders around the world—from absolute denial to the harshest restrictions—adjusting and learning in the process by trial and error.

This process has not been easy as COVID-19 highlighted critical deficiencies in our built environment and urban design. Even though infections battered affluent areas too, the pandemic hit the hardest when the virus reached sectors with high rates of poverty. Dense neighborhoods and overcrowded buildings could facilitate the rapid spread of infections due to the difficulty of generating social distancing and the application of extensive quarantines.

Yet, various changes have been adopted rapidly. Hygiene protocols, wearing masks, social distancing and other strategies has become part of our ordinary life. On top of that, the use of public spaces, streets, parks, homes and all buildings had to be adjusted to control the spread of the virus transforming our habits and conception of them. Numerous studies showed great variations in the use of transportation during the pandemic too. But the questions are: are those changes here to stay? What does the future hold for our built environments?

Some even go as far as to question: Will cities survive? While many intellectuals and academics call for the end of cities (at least as we know them), some stakeholders urge to return to normality, or so-called status quo.

Is this the last opportunity to effectively build a healthy, livable and equitable city? It is clear that cities can no longer be conceived as before and it is time to question the way we inhabit and use them. What are the standards, mechanisms and criteria to define a sustainable city and building? Do they respond to the problems and deficiencies in the age of emergency? History shows us how cities reacted to and changed after health crises similar to COVID-19; this is the time to question everything around us and strive for environmentally sustainable and socially just cities.

The aim of PLEA 2022 is to be a relevant part of the discussion and bring about proposals to the developing and developed world. It is a great chance to talk about the changes that affected cities around the globe since the start of the pandemic and bring the scientific knowledge generated in this short time to the discussion.

Social inequality should also be a part of the debate as both health and climate emergencies may further increase the injustice and, at the same time, the inequality may make such crises worse. Latin America, as the most unequal region, and Chilean case might serve as a great example of such issues and could become a source of inspiration to find the definitive inflection point that a truly sustainable city requires.

WELCOME TO SANTIAGO DE CHILE

Dynamic and cosmopolitan Santiago is a vital and versatile city. Home to many events showcasing the very best of Chilean culture, it also hosts superb international festivals of sound, flavor and color. The Chilean capital breathes new life into all its visitors!

The city's diversity shines through in its many contrasting neighborhoods. Set out to explore the city streets and you'll discover beautiful and original art galleries, design shops and handicraft markets, as well as a great selection of restaurants, bars and cafes. Night owls can enjoy a taste of lively Latino nightlife in hip Bellavista!

Visit downtown Santiago to get a real feel for the city. Learn more about the country in its many fine museums, or wander around the famous Central Market – a gourmet's delight.

Fans of the great outdoors can head for the hills that surround the city and marvel at panoramic views of Santiago with the magnificent Andes as a backdrop. Take the opportunity to grab a picnic and visit one of the city´s many parks.

In Chile there are places that have not seen a drop of rain in decades, while there are others where the rain brings out the green in the millenial forests.

This diversity captivates and surprises its visitors. Because, as a consequence of its geography, Chile has all the climates of the planet and the four seasons are well differentiated. The warmest season is between October and April and the coldest, from May to September.
The temperature in Chile drops down as you travel south. In the north, the heat of the day remains during the day while the nights are quite cold. The central area has more of a Mediterranean climate and the south has lower temperatures and recurring rainfall throughout the year.

The conference will be held at the Centro de Extensión de la Pontificia Universidad Católica de Chile, located at Avenida Libertador Bernardo O'Higgins 390, Santiago, Metropolitan Region. Universidad Católica subway station, Line 1

The Center is located in the center of the city of Santiago, with excellent connectivity to the rest of the city and the most characteristic neighborhoods of the capital, either through the Metro network (Line 1) or other means of public transport such as Transantiago (Santiago's public bus network).

To make your hotel reservations, we recommend looking in the Providencia or Las Condes districts, close to Metro Line 1. We also have some suggestions for accommodation close to the conference venue.

WILL CITIES SURVIVE?: TRACKS

1. Sustainable Urban Development
– Regenerative Design for Healthy and Resilient Cities
– Sustainable Communities, Culture and Society
– Low Carbon Neutral Neighbourhoods, Districts and Cities
– Urban Climate and Outdoor Comfort
– Green Infrastructure
– Urban Design and Adaptation to Climate Change

2. Sustainable Architectural Design
– Resources and Passive Strategies
– Regenerative Design
– Energy Efficient Buildings
– Net-zero Energy and Carbon-neutrality in New and Existing Buildings
– Vernacular and Heritage Retrofit
– Building Design and Adaptation to Climate Change

3. Architecture for Health and Well-being
– Comfort, IAQ & Delight
– Thermal Comfort in Extreme Climates
– IAQ and Health in Times of Covid-19
– Comfort in Public Spaces

4. Sustainable Buildings and Technology
– Renewable Energy Technologies
– Energy Efficient Heating and Cooling Systems
– Low Embodied Carbon Materials
– Circular Economy
– Nature-based Material Solutions
– Water Resource Management and Efficiency

5. Analysis and Methods
– Simulation and Design Tools
– Building Performance Evaluation
– Surveying and Monitoring Methods
– User-building Interaction and Post-occupancy Evaluation

6. Education and Training
– Architectural Training for Sustainability & Research
– Professional Development
– Sustainable Initiatives and Environmental Activism
– Methods and Educational Practices
– Strategies and Tools

7. Challenges for Developing countries
– Energy poverty
– The Informal City
– Climate Change Adaptation
– Affordable Construction and Architecture Strategies
– Urban Planning and Urban Design Policies for Sustainable Development
– Housing and urban Vulnerability

CRISTINA DORADOR

Keynote speaker
CHILE

Between July 2022 and July 2022 she served as a member of Chile's constitutional convention. She is currently back to teaching at the Universidad de Antofagasta.

Chilean scientist, doctor and politician who conducts research in microbiology, microbial ecology, limnology and geomicrobiology. She is also an associate professor in the Department of Biotechnology of the Faculty of Marine Sciences and Natural Resources at the University of Antofagasta. From July 2021 to July 2022 she served as a member of the Constitutional Convention representing District No. 3, which represents the Antofagasta Region.

Her achievements include the coordination in Chile of the Extreme Environments Network for the study of ecosystems in the geographic extremes of Chile and having developed biotechnological tools to value the unique properties of some altiplanic

microbial communities such as resistance to ultraviolet radiation to elaborate cosmetic creams, joining the field of cosmetic Biotechnology. She has also led application projects such as the development of textile material using the photoprotective properties of altiplanic bacteria.

She was a member of the transition council of the National Commission for Scientific and Technological Research in 2019 that gave rise to the National Agency for Research and Development of Chile, and has been recognized nationally and internationally as one of the most relevant researchers in Chile.

ADRIANA ALLEN

Keynote Speaker
ARGENTINA

Professor of Urban Sustainability and Development Planning at The Bartlett Development Planning Unit (DPU), University College London and President of Habitat International Coalition (HIC).

Adriana has over 30 years of international experience in research, graduate teaching, advocacy and consulting in over 25 countries in the global South, she has specialized in the fields of development planning, socio-environmental justice and feminist political ecology.

She is currently President of Habitat International Coalition (HIC), as well as a regular advisor to UN agencies, positions from which she is actively engaged in promoting urban justice through advocacy and policy evidence, social learning and fostering international collaboration both within UCL and globally.Through the lens of risk, water and sanitation, land and housing, food and health, her work examines the interface between everyday city-making practices and planned interventions and their capacity to generate transformative social and environmental relations.

Adopting a feminist political ecology perspective, her work combines qualitative, digital/mapping, and visual research methods to decolonize urban planning practices and elucidate the "cracks" in which transformative planning can be reinvented, nurtured, and pursued. Her work focuses on three interrelated themes: urban justice, everyday city-making, and transformative planning.
Over the years, she has worked at the interface between insurgent practices and planned interventions and their capacity to generate socio-environmentally just cities.

This work stems from her engagement with the analysis of governance approaches to address structural deficits at the interface between "policy-driven" and "needs-driven" approaches and emerging improvements at scale – in water and sanitation, as well as in other areas such as food security, land, housing and health. Since 2008, she has explored the intersection of urbanization and climate change, with a particular focus on the generation and distribution of risks, vulnerabilities and capacities for action in southern cities. A third strand of her research focuses on urban planning as a field of networked governance and pedagogical strategies to decolonize planning education and shape pathways for urban equality.

ANACLAUDIA ROSSBACH

Keynote speaker
BRAZIL

Economist with a track record of more than 20 years working on the issues of slums, social housing and urban policy.

She is currently Director for Latin America and the Caribbean at the Lincoln Land Institute of Policy. She also serves as a member of the editorial board of Vivienda magazine of INFONAVIT – México. And previously she worked as a consultant on housing and urban development issues for the IDB (Inter-American Development Bank).

She worked in the Prefecture of São Paulo, supporting the Brazilian Ministry of Cities in the design and implementation of the Brazilian housing policy. She founded and served on the board of directors of the NGO INTERAÇÃO, which supported the development of high-impact projects in communities in the state of São Paulo and Recife.

As a senior consultant to the World Bank, she provided technical assistance for the development and implementation of Brazilian housing policy and slum upgrading for 10 years, including two major programs: the "PAC Favelas" slum upgrading and the "Minha Casa, Minha Vida" housing subsidy.

She acted as a senior specialist in social housing for the World Bank and other research and project organizations in Brazil and several countries around the world such as the Philippines, China, India, South Africa and Mozambique, among others.

She was Regional Manager for Latin America and the Caribbean for the Cities of Alliance Global Informality Program where the exchange of experiences and knowledge through different networks was consolidated and structured.

The main achievements in Latin America are the Urban Housing Practitioners Hub (UHPH), which brings together practitioners and networks working in the field of social housing. In the global south, multi-sectoral and disciplinary communities of practice on the theme of slum upgrading in the global south with emphasis on the countries: Mexico, Guatemala, El Salvador, Paraguay, Brazil, South Africa and India.

GIANCARLO MAZZANTI

Keynote Speaker
ARGENTINA

Born in Barranquilla, a port city in northern Colombia, Giancarlo Mazzanti is an architect graduated from Pontificia Universidad Javeriana with postgraduate studies in industrial design and architecture in Florence, Italy.

He has been a visiting professor at several Colombian universities, as well as at world-renowned academic institutions such as Harvard, Columbia and Princeton, and is the first Colombian architect to have his works in the permanent collection of the Museum of Modern Art in New York (MoMA) and the Centre Pompidou in Paris.

Giancarlo has more than 30 years of professional experience and his studio, El Equipo Mazzanti has gained notoriety due to its design philosophy based on modules and systems, which generate flexible elements capable of growing and adapting over time, seeking an architecture that is closer to the idea of strategy than to a finite and closed composition. The idea of architecture as an operation was born from exploring the different forms of material and spatial organization, considering concepts such as repetition, the indeterminate, the unfinished, instability, arrangement and patterns.

Equipo Mazzanti also stands out for its research on play and its link to the world of architecture. It is precisely this interest in the play-architecture relationship that has led it to seek new collaborations with professionals from different areas of knowledge, finding new opportunities for cooperation and developing projects and exhibitions that have been presented throughout the world under the We play You play brand.

Social values are at the core of Mazzanti's architecture, who seeks to realize projects that give value to social transformations and build communities. He has dedicated his professional life to improving the quality of life through environmental design and to the idea of social equality.

His work has become a reflection of the current social changes occurring in Latin America and Colombia, demonstrating that good architecture manages to build new identities for cities, towns and inhabitants, transcending reputations of crime and poverty.

CHAIR COMMITTEE

Waldo Bustamante
Mechanical Civil Engineer from the University of Chile. Master in Urban Development from the Pontifical Catholic University of Chile and PhD in Applied Sciences from Catholic University of Louvain, Belgium. Professor at the Faculty of Architecture, Design and Urban Studies from the Pontifical Catholic University of Chile. Director of the Centre for Sustainable Urban Development (CEDEUS).

Felipe Encinas
Architect from the Pontifical Catholic University of Chile. Master of Science from the University of Nottingham in the United Kingdom and a PhD in Architecture and Urbanism from the Catholic University of Louvain, Belgium. Academic Secretary at the Faculty of Architecture, Design and Urban Studies (FADEU). Researcher at the Centre for Sustainable Urban Development (CEDEUS) and Associate Professor at the School of Architecture in the Pontifical Catholic University of Chile.

Magdalena Vicuña
Architect from the Pontifical Catholic University of Chile. Master in Community Planning from the University of Maryland in the United States and PhD in Architecture and Urban Studies from the Pontifical Catholic University of Chile. Director of Research and Postgraduate Studies at the Faculty of Architecture, Design and Urban Studies (FADEU). Associate Professor at the Institute of Urban and Territorial Studies and Associate Researcher at CIGIDEN.

INTERNATIONAL ADVISORY COMMITTEE

PLEA STGO 2022: WILL CITIES SURVIVE?

Alessandra R. Prata Shimomura
Universidade de São Paulo. BRASIL.

Carlos Javier Esparza López
Universidad de Colima. MÉXICO.

Edward Ng
Chinese University of Hong Kong. HONG KONG.

Heide Schuster
BLAUSTUDIO. GERMANY.

Jadille Baza
Presidenta del Colegio de Arquitectos de Chile. CHILE.

Joana Carla Soares Goncalves
Architectural Association School of Architecture, UK. University of Westminster, UK. Bartlet School of Architecture, UCL, UK.

Jorge Rodríguez Álvarez
Universidade da Coruña, ESPAÑA.

Juan Carlos Muñoz
Ministro de Transporte y Telecomunicaciones. CHILE.

Luis Edo Bresciani Lecannelier
Pontificia Universidad Católica de Chile. CHILE.

Luis Fuentes Arce
Pontificia Universidad Católica de Chile. CHILE.

Mario Ubilla Sanz
Pontificia Universidad Católica de Chile. CHILE.

Pablo La Roche
Cal. Poly Pomona / CallisonRTKL Inc. USA.

Paula Cadima
Architectural Association Graduate School. UNITED KINGDOM.

Rajat Gupta
Oxford Brookes University. UNITED KINGDOM.

Rodrigo Ramirez
Pontificia Universidad Católica de Chile. CHILE.

Sanda Lenzholzer
Wageningen University. THE NETHERLANDS.

Sergio Baeriswyl
Presidente del Consejo Nacional de Desarrollo Urbano. CHILE.

Simos Yannas
Architectural Association Graduate School. UNITED KINGDOM.

Susana Biondi Antúnez de Mayolo
Pontificia Universidad Católica de Perú. PERÚ.

Ulrike Passe
Iowa State University. USA.

LOCAL ORGANISING COMMITTEE

María José Molina
Commercial Engineer from the Pontifical Catholic University of Chile. Master in Local and Regional Development from the Institute of Social Studies of Erasmus University Rotterdam, The Netherlands. Executive Director of the Centre for Sustainable Urban Development (CEDEUS).

José Guerra
Architect from the Catholic University of the North. PhD in Architecture, Energy and Environment from the Polytechnic University of Catalonia. Director of the School of Architecture from the Catholic University of the North. Director of the Research Center for Architecture, Energy and Sustainability (CIAES) at the Catholic University of the North.

Sergio Vera
Civil Engineer from the Pontifical Catholic University of Chile. PhD from Concordia University and Master of Science, Pontifical Catholic University of Chile. Director of the Interdisciplinary Center for the Productivity and Sustainable Construction (CIPYCS). Assistant Professor and Director of the Department of Engineering and Construction Management at the Pontifical Catholic University of Chile.

María Isabel Rivera
Architect from the University of Concepcion. Master of Architecture from the University of Washington, USA. PhD in Architecture from the University of Oregon. Researcher of the Centre for Sustainable Urban Development (CEDEUS) and Assistant Professor of the Department of Architecture, University of Concepcion.

Maureen Trebilcock
Architect from the University of Bio Bio. Master of Arts in Green Architecture and PhD from the University of Nottingham. Director of the PhD program in Architecture and Urbanism at the University of Bio Bio.

Nina Hormazábal
Architect from the University of Washington. Master of Architecture from the University of California, Berkeley. PhD in POE and Energy Efficiency in Housing from the University of Nottingham. Professor and Researcher of the Laboratory of the Bioclimatic Area in the Department of Architecture of the Federico Santa María Technical University.

M. Beatriz Piderit
Architect from the University of Bio-Bio. Master in Applied Sciences and PhD from the Catholic University of Louvain, Belgium. Associate Professor and researcher at the Faculty of Architecture of the University of Bio-Bio. Researcher of the research group in "Environmental Comfort and Energy Poverty" of the University of Bio-Bio.

Claudio Carrasco
Architect from the Universidad de Valparaiso. PhD in Architecture, Energy and Environment from the Polytechnic University of Catalonia. Master in Geographical Information Systems from MappingGIS. Professor at the Department of Architecture of the Federico Santa María Technical University. Professor and Researcher of the Civil Construction School and the City Science Laboratory (CSLab) at the Faculty of Engineering of the Universidad de Valparaiso, Chile. Associate Research of the Climate Action Center (CAC) of the Pontifical Catholic University of Valparaíso, Chile.

Massimo Palme
Materials Engineer from the University of Trieste. Master in Geographical Information Systems from MappingGIS. PhD in Architecture, Energy and Environment from the Polytechnic University of Catalonia. Professor at the Department of Architecture of the Federico Santa María Technical University.

PLEA STGO 2022

PLEA STGO 2022: WILL CITIES SURVIVE?

SCIENTIFIC COMMITTEE

Khandaker Shabbir Ahmed
Bangladesh University of Engineering & Technology. BANGLADESH.

Noelia Alchapar
CONICET Mendoza. ARGENTINA.

Fazia Ali-Toudert
Ecole Nationale d'Architecture Paris Val de Seine. FRANCE.

Hector Altamirano
University College of London. UNITED KINGDOM

Sergio Altomonte
Université Catholique de Louvain. BELGIUM.

Servando Álvarez
Universidad de Sevilla. SPAIN.

Mohammad Arif Kamal
Aligarh Muslim University. INDIA.

Shady Attia
University of Liege. BELGIUM.

Julieta Balter
CONICET Mendoza. ARGENTINA.

Gustavo Barea Paci
CONICET Mendoza. ARGENTINA.

Jonathan Bean
University of Arizona. USA.

Susana Biondi
Pontificia Universidad Católica del Perú. PERÚ.

Philomena Bluyssen
TU Delft. HOLLAND.

Denis Bruneau
ENSAP Bordeaux. FRANCE.

Vincent Buhagiar
University of Malta. MALTA.

Victor Bunster
Monash University. AUSTRALIA.

Waldo Bustamante
Pontificia Universidad Católica de Chile. CHILE.

Paula Cadima
Architectural Association. UNITED KING-DOM

Isaac Guedi Capeluto
Technion – Israel Institute of Technology. ISRAEL.

Alexandre Carbonnel
Escuela Arquitectura. Universidad de Santia-go. CHILE

Claudio Carrasco
Universidad Técnica Federico Santa María – Universidad de Valparaíso. CHILE

Giacomo Chiesa
Politecnico di Torino. ITALY.

Helena Coch
Universitat Politècnica de Catalunya. SPAIN.

Florencia Collo
Atmos Lab. ARGENTINA.

Erica Correa Cantaloube
CONICET Mendoza. ARGENTINA.

PLEA STGO 2022: WILL CITIES SURVIVE?

Manuel Correia Guedes
University of Lisbon. PORTUGAL.

Robert Crawford
University of Melbourne. AUSTRALIA.

Marwa Dabaieh
Malmö University. SWEDEN.

Richard De Dear
University of Sydney. AUSTRALIA.

Silvia De Schiller
Universidad de Buenos Aires. ARGENTINA.

Claude Demers
Laval University, Québec. CANADA.

Samuel Domínguez
Universidad de Sevilla. SPAIN.

Denise Duarte
Universidade de São Paulo. BRAZIL.

Felipe Encinas
Pontificia Universidad Católica de Chile. CHILE

Evyatar Erell
Ben Gurion University of the Negev. ISRAEL.

Carlos Esparza
University of Colima. MEXICO

Juan Carlos Etulain
Universidad Nacional de la Plata. ARGENTI-NA.

Arnaud Evrard
Université Catholique de Louvain. BELGIUM.

Lone Feifer
Active House Alliance. CANADA.

Jesica Fernández-Agüera
Universidad de Sevilla. SPAIN.

Gilles Flamant
Centro de Desarrollo Urbano Sustentable. CHILE.

Brian Ford
Natural Cooling Ltd. UNITED KINGDOM.

Miguel Ángel Gálvez Huerta
Universidad Técnica Federico Santamaría. CHILE.

Carolina Ganem
CONICET Mendoza. ARGENTINA.

Rodrigo García
Universidad del Bío-Bío. CHILE.

José Roberto García Chávez
Universidad Autónoma Metropolitana. MÉX-ICO.

Aritra Ghosh
University of Exeter. UNITED KINGDOM.

Mark Gilliott
University of Nottingham. UNITED KING-DOM.

Jorge Gironás
Pontificia Universidad Católica de Chile. CHILE.

Vanessa Gomes Silva
University of Campinas. BRAZIL.

Margarita Greene
Pontificia Universidad Católica de Chile. CHILE.

José Guerra
Universidad Católica del Norte. CHILE.

Rajat Gupta
Oxford Brookes University. UNITED KINGDOM.

Rafael Herrera-Limones
Universidad de Sevilla. SPAIN.

Marcos Hongn
Universidad de Salta. ARGENTINA.

Cecilia Jiménez
Pontificia Universidad Católica del Perú. PERÚ.

Nina Hormazábal
Universidad Técnica Federico Santa María. CHILE.

Cecilia Jiménez
CJD Arquitectos. PERÚ.

Alison Kwok
University of Oregon. USA.

Mauricio Lama
Pontificia Universidad Católica de Chile. CHILE

J. Owen Lewis
International Development Ireland. IRELAND.

Florian Lichtblau
Lichtblau Architects. GERMANY.

María Lopez de Asiain
Universidad de Las Palmas de Gran Canaria. SPAIN.

Sanyogita Manu
CEPT University. INDIA.

Leonardo Marques Monteiro
Universidade de São Paulo. BRAZIL.

Andrea Martinez
Universidad de Concepción. CHILE.

Juan Manuel Medina
Universidad de Los Andes. CHILE.

María del Pilar Mercader-Moyano
Universidad de Sevilla. SPAIN.

Ranny Michalski
Universidade de Sao Paulo. BRAZIL.

Aurora Monge-Barrio
Universidad de Navarra. SPAIN.

Michele Morganti
Universitá di Roma La Sapienza. ITALY.

Rafael Moya
Universidad de Concepción. CHILE.

Julia Mundo-Hernandez
Benemérita Universidad Autónoma de Puebla. MEXICO.

Emanuele Naboni
The Royal Danish Academy of Fine Arts. DENMARK.

Edward NG
The Chinese University of Hong Kong. HONG KONG – CHINA.

PLEA STGO 2022
PLEA STGO 2022: WILL CITIES SURVIVE?

Diego Palma
Pontificia Universidad Católica de Chile. CHILE.

Massimo Palme
Universidad Técnica Federico Santa María. CHILE.

Ulrike Passe
Iowa State University. USA.

Pablo Pastén
Pontificia Universidad Católica de Chile. CHILE.

Andrea Pattini
CONICET Mendoza. ARGENTINA.

Alexis Perez-Fargallo
Universidad del Bío-Bío. CHILE.

Marco Perino
Politecnico di Torino. ITALY.

María Beatriz Piderit Moreno
Universidad del Bío-Bío. CHILE.

Eduardo Pimentel Pizarro
Universidade São Judas Tadeu. BRAZIL.

Adrian Pitts
University of Huddersfield. UNITED KINGDOM.

André Potvin
Laval University, Québec. CANADA.

Alessandra Prata Shimomura
FAUUSP. BRAZIL

Jesús Pulido
University of Tokyo. JAPAN.

Rajan Rawal
CEPT University. INDIA.

Dana Raydan
Raydan Watkins Architects. UNITED KINGDOM.

Alexandra Rempel
University of Oregon. USA.

María Isabel Rivera
Universidad de Concepción. CHILE.

Susan Roaf
Heriot-Watt University. SCOTLAND.

Lucelia Rodrigues
University of Nottingham. UNITED KINGDOM.

Carolina Rodriguez
Universidad Piloto de Colombia. COLOMBIA.

Jorge Rodriguez
Universidade de A Coruna. SPAIN.

Jean-François Roger-France
Université Catholique de Louvain. BELGIUM.

Jeannette Roldán Rojas
Facultad de Arquitectura y Urbanismo. Universidad de Chile. CHILE

Carlos Rubio
Universidad de Sevilla. SPAIN.

Khaled Saleh Pascha
University of Applied Sciences Upper Austria, AUSTRIA.

Agnese Salvati
Universidad Politécnica de Cataluña. SPAIN.

Mattheos Santamouris
University of Athens. GREECE.

Marc E Schiler
University of Southern California. USA.

Heide Schuster
BLAUSTUDIO – Sustainability in Architecture and Urban Design. GERMANY.

Valentina Serra
Politecnico di Torino. ITALY.

Denise Silva Duarte
University of Sao Paulo. BRAZIL

Masanori Shukuya
Tokyo City University. JAPAN.

Joana Soares Goncalves
Architectural Association School of Architecture. UNITED KINGDOM.

Victoria Soto Magan
Swiss Federal Institute of Technology. SWITZERLAND.

Thanos Stasinopoulos
Izmir University of Economics. TURKEY.

Tomás Swett
Universidad del Desarrollo. CHILE

Kheira Anissa Tabet Aoul
United Arab Emirates University. UNITED ARAB EMIRATES.

Hideki Takebayashi
Kobe University. JAPAN.

Maureen Trebilcock
Universidad del Bío-Bío. CHILE.

Leena E. Thomas
University of Technology. AUSTRALIA.

Ola Uduku
Manchester Metropolitan University. UNITED KINGDOM.

Juan Vallejo
University of Westminster – Natural Cooling Ltd. UNITED KINGDOM.

Sergio Vera
Pontificia Universidad Católica de Chile. CHILE

Magdalena Vicuña
Pontificia Universidad Católica de Chile. CHILE.

Rufei Wang
Atelier Ten USA LLC. UNITED STATES.

Paulina Wegertseder
Universidad del Bío-Bío. CHILE.

Barbara Widera
Wroclaw University of Technology. POLAND.

Jan Wienold
École Polytechnique Fédérale de Lausanne. SWITZERLAND.

Feng Yang
Tongji University. CHINA.

Simos Yannas
Architectural Association. UNITED KINGDOM.

Aram Yeretzian
American University of Beirut. LEBANON.

Gabriela Zapata-Lancaster
Cardiff University. UNITED KINGDOM.

Daniel Zepeda
University of A Coruña. SPAIN.

Antonio Zumelzu
Universidad Austral de Chile. CHILE.

INDEX

PLEA STGO 2022
PLEA STGO 2022: WILL CITIES SURVIVE?

S05 SESSION 05 — page 191
Analysis and Methods (1) | Chair Felipe Encinas

1157	Lighting and Daylight Control Strategies Using LabVIEW for Optimizing Visual Comfort and Energy Savings	Budhiyanto, Aris; Chiou, Yun-Shang
1447	Simulation-based Assessment of Human-Centric Lighting Performance in Tropical Hospitals	Chen, Hong Yu; Chien, Szu-Cheng; Yong, Sam Kah Teck
1474	Analysis Of Summer Sky Types Using CIE Standard Sky Model For The Location Of Gurugram, India	Malhotra, Riya; Bhalla, Ankit; Seth, Sanjay; Thakur, Rohit
1238	An Integrated Approach for Performance Evaluation of Perforated Screens. Daylight Sufficiency, Solar Gains, Glare, Thermal Comfort, and Energy Use as Key Factors	Chi Pool, Doris Abigail
1312	Adaptation of Internal Venetian Blind for Office Spaces A Passive Strategy for Sustainable Daylight Design	Baten, Priyanka; Joarder, Md. Ashikur Rahman
1272	Energy efficiency strategies for a Netzero energy building in southern Brazil: analysis, diagnosis and retrofit proposal	Matana Junior, Sidnei; Frandoloso, Marcos Antonio Leite; Brião, Vandré Barbosa

S06 SESSION 06 — page 229
Sustainable Urban Development (2) | Chair Rajat Gupta

1403	Generative Design For An Urban Morphology Based On Solar Access Strategy	Koubaa Turki, Laila; Ben Saci, Abdelkader
1526	Practice and evaluation of sponge city strategies for flash flooding mitigation in Mediterranean coastal cities: a case study of El Poblenou, Barcelona	Zheng, Qianhui; Roca, Josep
1418	Sustainability Index: A Tool To Assess Performance of Indian Smart Cities	Bahadure, Sarika Pankaj; Kamble, Tanushri; Sable, Shreya
1193	Rhodanian Neighborhoods in Transition. Towards an Integrative Strategy Facilitating Decision-Making for New Sustainable Fluvio-Neighborhoods	Formery, Sara; Laprise, Martine; Rey, Emmanuel
1486	Urban Greening for Achieving a Sustainable Urban Environment for a Tropical City: Nagpur Through Geospatial Approach.	Girhe, Vinay Khushal; Ghuge, Vidya V.
1664	Courtyard with Ventilation as Climate Resilient Solution: Evaluating the New Houses against Traditional Sultanate of Oman	Al Mahrooqi, Yousuf; Hossain, Mohataz
1410	Spatial Mapping Approach To Target The Local Deployment Of Distributed Energy Resources In The UK	Gupta, Rajat; Gregg, Matt

S07 SESSION 07 — page 279
Education and Training (2) | Chair Arnaud Evrard

1152	University Trial Study of Indoor Air Quality Attributes of Interior Building Materials and Finishes	Hebert, Paulette Robert; Jayadas, Aditya; Nazmy, Hebatalla
1182	Integrating Sustainability Issues into a Comprehensive Architectural Design Studio: A Case Study Approach to the Development of a Framework	Jo, Soo Jeong; Jones, James; Grant, Elizabeth
1275	Delivering the Sustainable Development Goals: the role of the architecture professional framework in the Urban context	Gwilliam, Julie Amanda; Cerulli, Cristina
1391	Evaluating Irish Architectural Education: towards integrated equitable design excellence in our cities	O Dwyer, Sarah; Gwilliam, Julie
1641	A Thousand Thunbergs Collaborate Towards Net-Zero	Jayaram, Sreejith; Thounaojam, Amanda; Vakil, Gaurav; Venkatesh, Janani; Jain, Yashima
1467	Reflective Practice in Lighting Education For the Dialogue with the Breakthrough Changes	Martyniuk-Pęczek, Justyna; Sokol, Natalia; Peczek, Grzegorz

S08 SESSION 08 — page 317
Sustainable Architectural Design (2) | Chair Susel Biondi

1478	Thermal Performance Of Roofs In A Naturally Ventilated Classroom In Warm Humid Climate: a Case In Vijayawada, India	Amirtham, Lilly Rose; Ali, Abdul Mohsin
1219	Simplification of a vegetation arrangement for transport it to a computational thermal evaluation model	Tovar-Jimenez, Edwin Israel; Esparza-López, Carlos Javier
1252	Transferring Vernacular Passive Design Strategies To Modern Dwellings In Warm Humid Regions To Reduce Thermal Discomfort	Zhu, Di; Kiamba, Lorna Ndanu
1574	Testing the Comfort Triangles Tool: Improving Initial Design Decisions for Natural Conditioning	Evans, John Martin
1660	Bioclimatic Evaluations of Perforated Walls Built in Bahareque	Vargas Bustos, Angie Katherine; Garcia Cardona, Ader Augusto
1290	Thermal Performance Testing of Water Spray Window in Cooling Operation	Yang, Xiu; Jiang, He

S09 SESSION 09 — page 359

Architecture for Health and Well-being (2) | Chair Isabel Rivera

1463	Patient's Thermal Comfort Assessment Of A Government Hospital During The Warm-Humid Season: A Field Study In A Tropical Megacity Dhaka, Bangladesh	Anam, Sadia Israt; Ahmed, Zebun Nasreen; Debnath, Kumar Biswajit
1499	Experimental Assessment And Modeling Of A Radiant Solution For Open Spaces. Application At A Bus Stop	Castro Medina, Daniel; Palomo Amores, Teresa Rocío; Guerrero Delgado, María del Carmen; Sánchez Ramos, José; Álvarez Domínguez, Servando; Cerezo Narváez, Alberto
1588	The Way Forward to Aging: Developing a Preliminary Questionnaire Survey Instrument to Determine Elderly Peoples' Thermal Sensation in India	Sudarsanam, Niveditha; D, Kannamma
1118	Thermal Performance Evaluation of Perforated Solar Screen for Office Buildings in the Hot and Humid Climate	Vieira, Katia Fernanda Oliveira; Suzuki, Eliane Hayashi; Machado, Rodrigo Dias; Kurokawa, Fernando Akira
1689	Interior Courtyards And Vegetation: Impact On Users' Comfort And Energy Efficiency In Heritage Housing. Expansions In Cité Housing In Santiago, Chile	Piedra Astudillo, Katherine Macarena; Schmitt Rivera, Cristian
1545	From the Rise of Open-plan Office HQ to Working Anywhere Post-2020: How Australian Millennial Academics Rate Workplaces	Ghosn, Cida; Marzban, Samin; Durakovic, Iva; Candido, Christhina; Backhouse, Sarah

S10 SESSION 10 — page 403

Analysis and Methods (2) | Chair Joey Michelle Hutchison

1154	Urban Climate Recommendations for Urban Planning in Phnom Penh, Cambodia	Se, Bunleng; Katzschner, Lutz
1602	Developing An Urban Climate 'Site Risk Assessment' Toolkit: City of Birmingham Pilot Study	Futcher, Julie; Ferranti, Emma
1649	Urban Geometry And Microclimate Effects On Building Energy Performance: The Case Of Mediterranean Climate Districts In Turkey	Toren, Basak Ilknur; Sharmin, Tania
1650	BIM and EnerPHit-assisted Energy Efficient Refurbishment: A Case Study of a UK Georgian Terrace House	Dadagilioglu, Sinan Celal; Mohammadpourkarbasi, Haniyeh; Sharples, Steve
1563	Living Roofs for Cooling in Hot Dry Climates: Effects of Temperature and Swing	Rodriguez, Laura; La Roche, Pablo
1454	Glare Metrics for Glazed Façade with Side-view at Restaurants	Uriarte, Urtza; Zamora Mestre, Joan Lluis; Hernández Minguillón, Rufino Javier

S11 SESSION 11 — page 441

Sustainable Urban Development (3) | Chair Gilles Flamant

1188	Perceived Environmental Qualities, Satisfaction And Mental Health In Outdoor Public Spaces Of University Campus: A Survey Of University Students In China	Li, Hongrui; Du, Jiangtao
1242	Influence Of Pavement Materials On Pedestrians: Extent Of Impact On Simulated, Measured And Perceived Parameters.	Manoharan, Nuthana; Gopalakrishnan, Padmanaban
1411	Indicators To Evaluate The Introduction Of Telework: Post-COVID-19 Flexible Work Arrangements	Tsukahara, Sayaka; Ichinose, Masayuki; Ogata, Masayuki; Alkhalaf, Haitham
1340	Natural Ventilation as Sustainable Response to Covid-19: Designing an Airborne Disease Treatment Centre in Burkina Faso	Nigra, Marianna; Simonetti, Marco; Galleano, Luca; Serale, Gianluca
1668	The Post-COVID-19 Cities. A Field Study On Pedestrian Thermal Comfort In Outdoor Urban Spaces: The case of the esplanade la Bréche, Constantine, Algeria	Ouis, Afef; Benhassine, Nassira
1560	Development Of Tree Planting Rules For Urban Spaces Based On Expert Systems And Fuzzy Logic	Rodriguez-Potes, Lizeth

S12 SESSION 12 — page 479

Sustainable Buildings and Technology (1) | Chair Felipe Encinas

1197	Retrofit of Heavy Mass Building in Mediterranean Climates: A Method for Optimizing Insulation and Solar Control Strategies	Carbonari, Antonio
1286	Opportunities and Challenges for LCA in India for Innovative Technologies	Miriyala, Yogitha; Thounaojam, Amanda; Vaidya, Prasad; Mangrulkar, Amol
1296	Embodied Energy In Passive Architecture Strategies: A Balcony And A Glazed Gallery For A Dwelling In A Mediterranean Climate.	Carrillo Arancibia, Pamela; Pages-Ramon, Anna
1485	Net-Zero Building Design: Demonstrating The Use Of Agricultural Waste And Industrial By-Products From Rice Cultivation Belts	Hitawala, Ibrahim; Jain, Nishesh
1675	Retrofit Solutions For Existing Office Buildings In European Context: A Low-Tech Approach	Girdhar, Jyotika; Dhamankar, Namrata
1115	Exploring "Golden Fiber" Jute as Tensile Membrane Architecture In Dhaka	Choudhury Rana, Golam Morsalin
1344	Vacuum-glazed Windows: A Review on Recent Projects' Methods, Results, and Conclusions	Pont, Ulrich; Schober, Peter; Wölzl, Magdalena; Schuss, Matthias; Haberl, Jakob

S17 SESSION 17 page 669
Sustainable Buildings and Technology (2) | Chair Renato D'Alencon

1121	Economic Feasibility of a System to Reduce Waste of Water in Hot Water Building Systems: A Case Study in Multifamily Buildings	Dalmedico Ioris, Marcelo; Ghisi, Enedir
1233	Thermal Mass Study: Investigation Of The Thermal Mass Performance Of Adobe Walls In Saudi Arabia	Alayed, Essam; O'Hegarty, Richard; Kinnane, Oliver
1480	Low Energy Cooling Strategies for Public Housings in the Hot and Humid Climate through Window Design	Trihamdani, Andhang Rakhmat; Nurjannah, Amalia
1630	Wood-Textile Composites For Self-shaping Material Assemblies In Architectural Scale	Fragkia, Vasiliki; Worre Foged, Isak
1133	Adaptive And Dynamic Façade Modules For Serial Energy-Retrofit Of Residential And Office Buildings Using Active And Passive Building Components: A Pilot Study	Fuchs, Nico; Mohtashami, Negar; Hering, Dominik; Streblow, Rita; Müller, Dirk
1101	Renovation Of Old Bamboo Tubular Shaped House In South China: Application of Passive Energy Saving and Ventilation Methods	Y M (Jamin) Guan; Y M Sun; K X Xia; J Q Zhu

S18 SESSION 18 page 713
Challenges for Developing Countries (1) | Chair Margarita Greene

1173	Inhabiting industrial heritage as a practice of preservation: Cuareim Housing Complex, in Montevideo, Uruguay	Baldini, Guilherme Oliveira; Salcedo, Rosio Fernández Baca
1372	Modifying Microclimate By Introducing Green Floor In Multi Storey Buildings In Lahore Pakistan: A Review In Relation To Orientation, Microclimate Modifiers And Built Environment	Aleem, Sana; Borna, Mehrdad
1500	Surviving Overheating: From Land Surface Temperature Variations To Low-Energy Strategies	Gonzalez-Trevizo, Marcos Eduardo; Martinez-Torres, Karen Estrella; Rincon-Martinez, Julio Cesar; Armendariz-Lopez, Jose Francisco
1122	Climate Justice and Sea-level Rise	Mohsenin, Mahsan; Chin, Andrew
1349	Triple Bottom Line Redistribution in Mixed-Income Housing Through Transition Spaces	Rehman, Afshan

PLEA STGO 2022

PLEA STGO 2022: WILL CITIES SURVIVE?

S19 SESSION 19 page 749
Architecture for Health and Well-being (4) | Chair Carolina Karmann

1572	Wellbeing in Daylighting Studies: A literature review.	Abdelrahman, Mohamed Salah; Coates, Paul
1596	The Virtual Environments Lighting Quality Assessment Using the Virtual Reality	Mohamed Yacine, Saadi; Daich, Safa; Piga, Barbara.E.A; Bezziane, Akram; Daiche, Ahmed
1597	Impact of Brightness on Glare Perception when Using Shading Fabrics	Karmann, Caroline; Wienold, Jan; Andersen, Marilyne
1433	Comparative Overview of Lighting Credits from WELL Environmental Assessment Method	Ruiz, Veronica; Rodriguez, Roberto; Pattini, Andrea
1413	The Changing Needs in Residential Design Post-Pandemic	Elsharkawy, Heba; Rashed, Haitham Farouk

S20 SESSION 20 page 781
Analysis and Methods (4) | Chair Francois Simon

1229	The Concept Of A Data-Driven Platform For Mitigating Heat Stress At The Neighbourhood Scale	Ngo, Dung Hoang Ngoc; Kayaçetin, Cihan Nuri; Nguyen, Dung Tien; Tran, Phuong Thi Thu; Bui, Ngoc Phuong; Versele, Alexis
1594	Innovative Design Solution for The School Of The Future. The case Study of the secondary school Cino da Pistoia in Italy	Romano, Rosa; Donato, Alessandra; Gallo, Paola; Della Rosa, Luca
1424	Energy Modeling of the Residential Building-stock. Climate Change Impact and Adaptability of the Existing Housing Stock in Santiago de Chile	Rouault, Fabien; Molina, Constanza; Valderrama, Claudia
1264	Designing Thermal Factors: Modelling Heat Balance Variables For Thermal Adaptive Environments	Foged, Isak Worre
1492	Effect of Window opening schedule on Indoor Thermal Environment: An Investigation into the effect of Natural Ventilation in Low-rise Apartments in Warm and Humid Climate of India	Bhandari, Nikhil; Tadepalli, Srinivas
1402	Comparative Evaluation of Thermal Performance and Energy Conservation of Residential Buildings in Cold Climate of India	Das, Neha; Elangovan, Rajasekar; Chani, Prabhjot S.; Kansal, Aafsha; Garg, Tarun; Kumar, Satish; Vaidya, Prasad

S21 SESSION 21

Sustainable Urban Development (5) | Chair Cristhian Figueroa

page 819

1603	Comparative Approach of the Environmental Impact Induced by Different Architectural Visions of a New Periurban Neighbourhood	Aguacil Moreno, Sergi; Lufkin, Sophie; Laprise, Martine; Rey, Emmanuel
1611	Study Of Land Use/Cover Change Impacts On Thermal Microclimate Using QGIS In Urban Agglomeration. Case Study: City Of Biskra, Algeria.	Daich, Safa; Saadi, Mohamed Yacine; Khelil, Sara; Piga, Barbara.E.A; Daiche, Ahmed Motie
1618	Urban Agriculture: For The People, By The People	Buddhivant, Pornima Anil; Sujata Karve
1321	Methodology for Scenario-based Analysis of Future Energy Performance of Swiss Settlements at Urban, Sub-urban, and Rural Scale	Popova, Anastasiya; Hsieh, Shanshan; Schlueter, Arno
1395	From Repetition to Diversity: A Workflow for Energy-driven Optimization of Heterogeneous Urban Blocks in Hot Climates	Natanian, Jonathan; De Luca, Francesco; Naboni, Emanuele
1683	Carbon Neutral Music Venue: A Sustainable Urban Development	Tucker, Simon; Edesess, Ariel

S22 SESSION 22

Sustainable Buildings and Technology (3) | Chair Felipe Encinas

page 855

1117	Climate Change, Energy Performance and Carbon Emission in a Prefabricated Timber House in Northern China: A Dynamic Analysis	Zhang, Xi; Du, Jiangtao; Sharples, Steve
1205	Embodied Carbon in Domestic Timber, Concrete and Steel structures: A Study Of Tools, Material Substitutions And Socio-Cultural Factors Based On A UK Passivhaus Home	Yu, Jiacheng; Stevenson, Fionn
1217	Impact of COVID-19 Pandemic on Building Energy Consumption and CO2 Emission in the U.S.	Rashed-Ali, Hazem; Ghiai, Mohammad Mehdi; Soflaei, Farzaneh
1431	FireSURG: Fire Mitigation System In Urban Areas Through Reuse Of Rainwater And Gray Water	Candia Cisternas, Loreine Makarena; Hormazabal, Nina; Sills, Pablo
1472	Modeling Ceiling Fan Flow Patterns: Creating A Simple Tool For Predicting Comfort With Breeze	Enevoldsen, Sebastian Glaesel; Kessling, Wolfgang; Engelhardt, Martin; Negendahl, Kristoffer
1475	Comparison of the Embodied Energy of Three Architectural Forms in Rural Areas of Southwest China	Chi, Xinan; Zhou, Lai; Wan, Li
1510	Integration Of An Innovative Dual Day-Night Technique For Air Conditioning Of Public Spaces	Castro Medina, Daniel;Palomo Amores, Teresa Rocío; Guerrero Delgado, María del Carmen; Sánchez Ramos, José; Álvarez Domínguez, Servando; Molina Félix, José Luis

S23 SESSION 23

Sustainable Architectural Design (4) | Chair Cesar Osorio

page 897

1185	Humanscapes Habitat - Integrated Design For Sustainable Living: Design For Adaptive Comfort For Reduced Operational Energy Consumption	Ayer - Guigan, Suhasini; Prasad, Ramya; Kamal K, Niraj
1581	CLIMATESCOUT® A Design Tool For Low Carbon Architecture	La Roche, Pablo; Ponce, Arianne; Hutchison, Joey-Michelle; Beroiz, Jorge
1479	Benchmarking Buildings in the Context of Net-Zero Targets: Tracking Energy Performance of a Case Study from Design to Operation	Wismadi, Fathin Sabbiha; Jain, Nishesh; Kourgiozou, Vasiliki
1429	CFD Simulation on Ventilation Performance of Existing Apartment Buildings in Indonesia	Nurjannah, Amalia; Trihamdani, Andhang Rakhmat
1398	The Literature Review on Boundary Conditions of Use For Non-Residential Buildings	Sokol, Natalia; Kurek, Julia; Martyniuk-Peczek, Justyna; Amorim, Claudia Naves David; Vasquez, Natalia Giraldo; Kanno, Julia Resende; Sibilio, Sergio; Matusiak, Barbara
1685	Keep It, Mix It, Grow It	Young, Juan Lucas; Lahiri, Lina; Herrmann, Falco; Alonso, Lucia; Hartmann, Vera; Wörner, Johanna; Pürschel, Henning; Fernandez Rosso, Sofia
1273	Passive Low Energy Earth Architecture. Sustainable buildings for anyone and everyone, anywhere	Hickson, Peter Garfield

S24 SESSION 24

Sustainable Urban Development (6) | Chair Claudio Carrasco

page 941

1208	Carbon Footprint, LEED Criteria And Cost Effectiveness: Comparative Analysis Of 5 Technical Solutions For The Design Of The Non-Potable Water Network Of The MIND Area In Milan	Merla, Marco
1461	ESG Trends In Real Estate Investment In Europe: Drivers, Challenges, And Good Practices	Etienne-Denoy, Ella; Clech, Théo; de Kerangal, Christian; Marquez, Timo
1517	Validating a Cycle-based IoT Sensor for Mapping Intra-urban Air Temperature and Humidity	Cecilia, Andrea; Peng, Zhikai
1207	Measuring Impact of Building Height Randomness on Daylight Availability	Bansal, Parth; Li, Na
1180	Thermal Assessment in an Urban Canyon in Brazil:A Chrono-Morphological Approach from 1940 to a Future Scenario	Lemos, Daniel; Barbosa, Sabrina; Lima, Fernando
1159	Simulation Study on the Thermal Effects of Vertical Greening System under the Influence of Local Climate Zones in Shanghai	Jiang, Zhi-Dian; Yang, Feng

S25 SESSION 25

page 979

Challenges for Developing Countries (2) | Chair Muriel Díaz

1222	The Impact of Urban Forms on Psychological Restoration and Bioclimatic Performance in High-density Neighbourhoods: An Integrated Analysis in Shanghai	Zhang, Dixin; He, Yong; Du, Jiangtao
1261	Sustainable Construction in Humanitarian Action. Criteria for Humanitarian Building Sustainability	Ullal, André; Steullet, Anne; Roman, Justine; Michel, Kyra; Duque, Sebastian Mahecha; Celentano, Giulia; Habert, Guillaume; Al Laham, Hager; Tamvakis, Pavlos; Aguacil Moreno, Sergi
1310	Community Resilience during Time of Crisis: Case of Mahdibagh Colony, Nagpur	Badar, Rukhsana Nazir
1354	Will Favelas Survive? A study of urban heat islands and climate emergency at Maré, Rio de Janeiro	Galeazzi, Carolina Hartmann
1388	Housing for the Poor: Analysis of Community-led Housing in Yangon	Naing, Yin Mon; Kobayashi, Hirohide
1232	Climatic Recommendations for Informal Areas in Brazil: UCMaps and Brazilian Technical Standards	Ferreira, Daniele Gomes; Souza, Vladimir Sobral; Hirashima, Simone Queiroz da Silveira; Katzschner, Lutz; Assis, Eleonora Sad

•

PLEA STGO 2022
PLEA STGO 2022: WILL CITIES SURVIVE?

PLEA STGO 2022

November 22 - 25, 2022

ARCHITECTURE FOR HEALTH AND WELL-BEING

DAY 01
12:00 — 13:30

CHAIR
CARMEN FREED

PAPERS
1448 / 1613 / 1126 / 1235 / 1435

14TH PARALEL SESSION / ONLINE

WILL CITIES SURVIVE?

PLEA SANTIAGO 2022
Will Cities Survive?

Promoting healthy city through ICT technologies

An experience of particulate matter low-cost monitoring

MATTEO GIOVANARDI[1] MATTEO TRANE[2] EDOARDO GIUSTO[3] GUSTAVO ADOLFO RAMIREZ ESPINOSA[3] PIETRO CHIAVASSA[3] BARTOLOMEO MONTRUCCHIO[3] RICCARDO POLLO[2]

[1] Polytechnic of Turin, Department of Architecture and Design, Italy
[2] Polytechnic of Turin, Interuniversity Department of Regional and Urban Studies and Planning, Italy
[3] Polytechnic of Turin, Department of Control and Computer Engineering, Italy

ABSTRACT: The Pandemic emergency related to COVID-19 has renewed the interest in the Healthy City promotion and design. Ensuring a genuine life quality for all in healthier urban environments is a central issue in the contemporary architectural debate, as well as fundamental to achieve Sustainable Development Goals 11 and 3. In the urban context, both natural and anthropogenic factors drastically affect health and economy. Monitoring, simulating, assessing, and controlling such environmental factors is a prerequisite in promoting the Healthy City. In this perspective, ICT technologies and data processing offer new opportunities and tools to understand and manage complex and heterogeneous urban phenomena. The aim of this paper is to demonstrate the effectiveness of low-cost ICT technologies in widespread air quality monitoring. To this, the Particulate Matter (PM) 2.5 and 10 sensors developed by the research group is tested in a real world case-study. Results obtained from field monitoring campaigns in most relevant seasons, compared to data by the official meteorological municipal station, highlight benefits and barriers for developing a widespread urban monitoring infrastructure in a Healthy City site-specific design perspective.
KEYWORDS: Healthy City, ICT, Particulate Matter, ENVI-met, SDG11

1. INTRODUCTION

The urban environment drastically affects human health. Atmospheric Particulate Matter (PM), as well as nitrogen dioxide and tropospheric ozone, is considered among the risk factors for cardiovascular, respiratory, and carcinogenic diseases [1]. Data produced by the scientific community reports a worrisome picture. In the World, each year about 4.2 million premature deaths due to stroke, heart disease, lung cancer, and chronic respiratory illnesses are attributable to excessive exposure to PM [1]. For the same causes, in Europe, where 15% of premature deaths are due to environmental factors, life expectancy has been reduced by about 8 months [2]. In this context, the pandemic emergency related to COVID-19 has further highlighted how the strong correlation between environmental factors (on virus spread and exacerbation of symptoms and effects) and human health is to be considered in the promotion of healthier urban environments [3]. The complexity of phenomena determining air quality – at a local, continental, and hemispheric scale – is related to anthropogenic activities (e.g., domestic heating, mobility, industries, etc.) and microclimatic conditions turning primary emissions into secondary ones, thus facilitating their dispersion [4]. In this scenario, low-cost ICT technologies enable a digitally integrated urban environment. On the one hand, they may represent a fundamental tool for widespread monitoring and, on the other hand, a highly effective mean to actively engage people by raising awareness on health issues and fostering the ecological transition [5][6]. Several ongoing researches are moving towards the use of a widespread network of air quality sensors embedded in light poles, cars, bicycles, building components, flowerpots, or wearable devices [7][8][9][10]. Specifically, the development of IoT (Internet of Things) technologies and their widespread application in cities foster monitoring several variables that may affect air quality, thus human health. Furthermore, the spread of integrated technologies supports a growing number of open urban platforms [11] that monitor input and output flows of energy and matter in real-time urban metabolism models [12].

Starting from these premises, this paper presents the first results of an air quality monitoring campaign carried out at the neighbourhood scale in Turin, northern Italy, one of the most critical areas in Europe due to the orography and population density. The aim of this research is twofold: first, to demonstrate the effectiveness of low-cost ICT technologies for widespread air quality monitoring; second, to investigate the effect of the urban fabric on the distribution of pollutants. The methodologic approach and the main results obtained are presented by the description of a test carried out within an ongoing national research project. Finally, in the Conclusion section, perspectives and barriers in the ICT development for urban monitoring infrastructure are discussed, in the perspective of a site-specific Healthy City design.

2. METHODOLOGY

The article describes the experience of a monitoring campaign on air quality (PM2.5 - PM10) and environmental parameters (i.e., air temperature, humidity, and pressure) carried out at a neighbourhood scale at high temporal resolution. The campaign at micro-urban scale allowed us to investigate a possible more direct relationship between some built environment features (e.g., morphology, presence of green areas, exposure to the street, height of buildings, orientation, etc.) and the distribution of pollutants, to potentially inform climate change planning policy and design [13]. Before the monitoring campaign, the plot was modelled in ENVI-met^{TM}, a Computational Fluid Dynamics software (CFD). Microclimatic simulation was necessary for interpreting the propagation of pollutants. Through 3 monitoring campaigns, lasting about two weeks each for over a period of 1 year (March 2021-February 2022), the research compares data acquired from different 4 monitoring stations distributed in the area. Acquisitions by low-cost sensor stations developed by the research group at Polytechnic of Turin – DAUIN (Department of Control and Computer Engineering) are compared with data provided by the official urban measurement network of ARPA (Regional Environmental Protection Agency), the municipal authority in charge of urban air quality control. Data coming from the nearest official station (namely Torino Grassi – Reiss Romoli), approximately 4 km as the crow flies from the analysed area, was used for the comparison. Furthermore, data analysis over different seasons and different exposures to primary emission sources is performed to investigate the incidence of seasonal anthropogenic phenomena.

3. CASE STUDY

3.1 The neighbourhood

The case study is in the north-eastern suburbs of Turin (Italy), a city characterised by Cfa climate conditions (Humid subtropical climate; coldest month averaging above 0 °C, at least one month's average temperature above 22 °C, and at least four months averaging above 10 °C) according to Köppen–Geiger classification. The neighbourhood, namely Milan Barrier (45°05'N 7°42'E), is located near the Po River and some main green infrastructures. The plot is approximately 22.000 m^2, and it is characterized by a large presence of public housing facilities (Fig. 1). More precisely, the area consists in two 3-4 storeys building block courtyards, built in the 1920s and 1940s. The residential complex is owned by ATC (Housing Territorial Agency in Piedmont Region). Both courtyards were renovated from a technological and functional point of view in 2012, upgrading façades, adding external lifts and new balconies, and renewing of water systems. About 200 people currently live in the two courtyards, with about 30% of the population over 60 years old. The choice of the plot is due to the heterogeneous presence of natural and artificial elements allowing to evaluate how the distribution of pollutants propagates in the urban fabric. In particular, the closed-courtyard morphological type, recurrent in the Turin historical fabric, was chosen to assess possible differences between the façades facing the street (therefore more exposed to car emissions) and those facing the internal green area. The whole area borders an old railway path in the North, which is about to be part of the new metro line infrastructure and with a great environmental potential (see section 3.2). All the monitoring stations were placed on balconies at a similar height above the ground (about 6 m), in order to not to have different possible pollution patterns due to height.

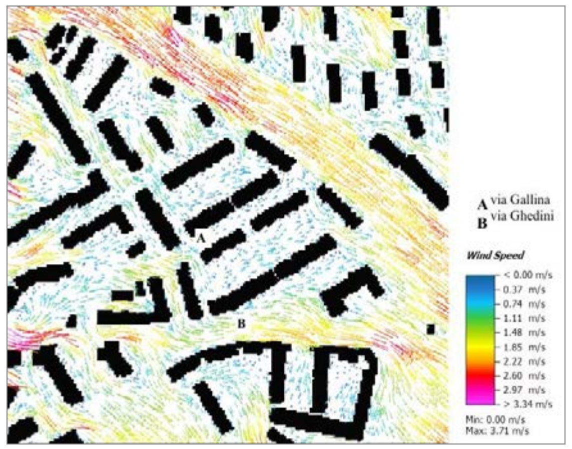
Figure 1:
Aerial view of the case study.

3.2 CFD simulation

Prior to the installation of the sensors, an outdoor CFD analysis was carried out on the area (Fig. 2). Considering that the propagation of pollutants is strictly linked to ventilation, it was necessary to understand how this could affect the results. The analysis of the area was made using ENVI-met, one of the most used tools in academic and professional fields. It is a prognostic non-hydrostatic CFD model used to assess complex interactions between built and natural environment

[14]. Once modelled the plot and set built environment features (e.g. material albedo, greenery typology, soil humidity, etc.), it is necessary to set meteorological boundary conditions on weather (e.g., temperature, humidity, wind, solar radiation, etc.). The simulation provides results on many outdoor parameters (e.g., PAT – Potential Air Temperature, SF – Surface Temperature, WS – Wind Speed, etc.) and thermo-hygrometric comfort indices (such as PET – Physiological Equivalent Temperature). The case study analysis identified how the linear area to the north-east of the plot (the former railway yard) drastically favours ventilation. The simulation was carried out injecting initial wind speed and direction provided by ARPA in 2020 hottest summer day (1.70km/h, NW). Although simulation results are representative for a specific microclimatic condition, these wind speed and direction are quite typical values in Turin. Two main exposures in the positioning of the sensors facing the street were defined to investigate how PM propagation is affected by wind: one towards a more open road (via Ghedini) and one towards a more closed one (via Gallina). The other 2 sensors were positioned facing towards the court, where less wind was expected according to the simulation output.

Figure 2:
CFD analysis in the plot by ENVI-met. Wind speed and direction at 2:00 PM.



3.3 Monitoring board station

Specifically, the monitoring results report the values acquired by PM 10 and 2.5 sensors (Fig. 3), temperature, humidity, and pressure. More precisely, the following hardware components for the board station are used.

Monitoring board: The Raspberry Pi 0 Wireless was chosen as the single-board computer. The operating system chosen for this project is Arch Linux for ARM, which ensures that just the essential OS components are running and that no resources are wasted. All sensors are questioned using Python scripts that are run as System Units.

PM sensor: Honeywell HPMA115S0-XXX. Detecting PM2.5 and PM10 particle concentrations in the air. Its output values range from 0 to 1000 μg/m³, with a 15% accuracy, which corresponds to a price of around $25 to $30 USD. The Light Scattering technique is used in this gadget. In simple terms, a rotating fan flows air into a chamber, which is subsequently hit by a laser beam, and a proprietary algorithm inside the device estimates particle concentration using a photodiode. The sensor communicates with the board through UART (Universal Asynchronous Receiver Transmitter) communication, with the sensor writing a new datum every second.

Temperature and Humidity: the DHT22 is a low-cost digital temperature and relative humidity sensor that is both cheap and accurate. Its humidity readings range from 0% to 100% with a 2 percent to 5% accuracy; temperature readings range from 40 to 80 degrees Celsius with a 0.5-degree Celsius precision, and the sample rate is roughly 0.5 Hz. Dedicated APIs are used to interact with the sensor. Pressure: Bosch's BME280 is a precise barometer pressure and temperature sensor. Barometric pressure sensing range: 300-1100 hPa; resolution: 0.03 hPa/0.25 m; operational range: 40-85°C, with 2°C temperature precision; values are conveniently retrieved via I 2 C interface utilizing specific APIs.

Time: a clock for Unix time is used to temporal data synchronisation.

Although the experimental data collected by the board stations do not have normative value because measured with instruments that have not been officially calibrated, they do allow qualitative considerations to be made regarding the system's potential.

Figure 3:
Monitoring board station designed by DAUIN, Polytechnic of Turin.

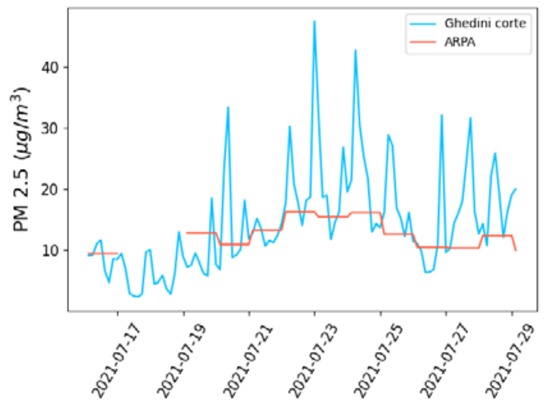
4. RESULTS

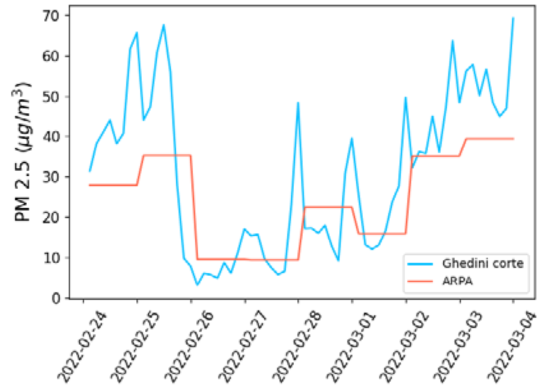
The results obtained from the experimentation have a twofold purpose. First, to evaluate the benefits offered by widespread low-cost monitoring compared with the current official monitoring system provided by ARPA; second, to investigate the effect of the urban fabric and traffic on their propagation. The time frequency of monitoring made it possible to build up a significant dataset for analysis. Over the three monitoring campaigns, approximately 30,000 data were collected on PM levels and approximately 14,000 on temperature and humidity. The collected data were reprocessed, outliers removed, and the data grouped according to different time frames.

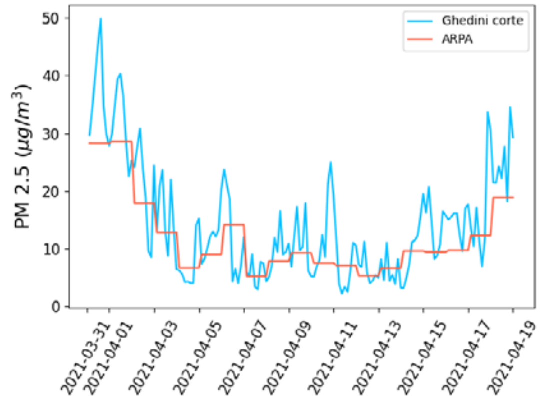
A first significant insight can be drawn from the granularity of the data. While ARPA only reports a daily average, the low-cost stations can map the hourly and daily trends highlighting any critical periods. The graphs below (Fig. 4) show PM2.5 values from the same sensor in the three different monitoring campaigns compared with the official data provided by ARPA. Although the trends and daily average values of the low-cost stations are similar to the official one, it is evident that the daily PM trend can show significant differences. Especially in the winter period, where the PM presence is higher, deviations of 25-30 μg/m³ can occur on the same day.

In the first two campaigns, carried out in spring and summer seasons, there is a more significant difference between the monitored data and the official data. This, confirmed by other ongoing research, seems to indicate that the accuracy of the low-cost sensors used is directly proportional to the PM values. The higher the PM value, the greater the margin of accuracy of the data.

Figure 4:
PM2.5 trends in the three monitoring campaigns (a. April; b. July; c. February). In red, the official data provided by ARPA

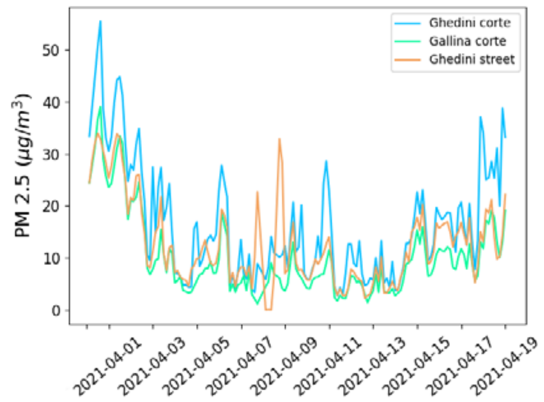






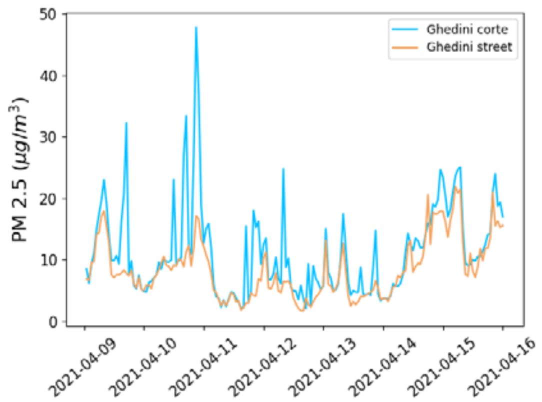
To answer the second research question, two main analyses were carried out. The first one compares the four points monitored during the same period. The second one compares a sensor facing the road and one facing the street (therefore more subject to the presence of traffic and wind). Fig. 5 shows the PM2.5 trend during the first monitoring campaign, considered by authors the most significant for the comparison. The average variation between different points is around 6 μg/m³, a relatively low value considering the total. For all three campaigns monitored, no significant differences between four station sensors emerged.

Figure 5:
PM2.5 trends in the same campaign monitoring by different stations.



A more in-depth analysis on the differences between the sensors placed in the inner courtyard (namely "corte" in the figures) and on the balcony facing the road were presented (Fig. 6). By analysing a shorter period, it is possible to highlight the daily trend of PM2.5 values without any significant variation. The action of wind and the presence of cars for the specific context considered cannot be assessed. Nevertheless, the simulated wind speed (Fig. 2) showed homogeneous values in the streets as well in the courtyards of the experimental field, thus confirming possible similar PM values.

Figure 6:
PM2.5 values comparison between sensor facing courtyard (blue) and street (red)



5. DISCUSSION

The values obtained depict a worrying picture of air quality in the city of Turin. The average values of the campaigns carried out, in line with official data, show values above the limits set at European level. The technologies proposed and the results obtained, although still at an experimental stage, may open new scenarios for monitoring environmental parameters that affect the healthiness of neighbourhoods. The acquisitions confirm that the winter season is more subject to the pressure of pollutants in the context analysed.

It must be stated that the values obtained from the monitoring campaigns are to be considered in a qualitative way as they are monitored with sensors that are not officially calibrated and are specific to particular times of the year. However, the calibration of the data carried out by the research group allows us to report greater reliability of the data collected in the winter period, where PM levels are higher. Among the limitations of the research carried out, the case study analysed did not prove particularly efficient in validating the comparison between urban fabric and the proximity to streets. The low traffic volume in the area does not allow for further analysis. The same approach used in denser and busier city areas could bring quite different results. Finally, the question of scale is a central issue. Although air quality is a complex issue influenced by global and regional factors, local monitoring can be crucial in understanding the impact of anthropogenic actions and influencing the citizen behaviour.

6. CONCLUSIONS

The ongoing pandemic and climate emergency require to drastically renew the urban environment by promoting the Healthy City, thus fostering the role of cities as major implementer of the Sustainable Development Goals and challenging the way cities are currently built [15]. Among the few positive effects of the pandemic, the reduction of car traffic resulted in the increase of the air quality and perceived road safety, thus improving the quality of life [16]. Besides, many positive externalities could be generated by the air quality improvement and pro-environmental citizen behaviours, although challenging to assess (such as economic benefits by reducing the costs of the national health service expenditure). Greater knowledge about the interlinkages between phenomena of a different nature occurring in cities is evolving fast thanks to technologies [17]. In this context, ICT and IoT become enablers of the ecological transition. Data-driven approaches are entering increasingly the management and planning of the territories, by providing deeper understanding on parameters determining health and supporting evidence-based planning. As planners, we are now called upon to rethink an urban environment that, as history has been teaching, necessarily evolves after each pandemic. In the Healthy City perspective, a widespread IoT network for real-time measurements, supported by advanced environmental simulations, become essential tools for promoting data-driven design.

In this perspective, urban neighbourhood scale represents the ideal dimension at which to intervene, as the patterns of land-use, building type, technologies and behaviour affecting environmental quality may vary significantly throughout the city. As such, the implementation of an auxiliary monitoring network to the official one may offers greater awareness on site-specific issues closely related to health. Nowadays, the technological maturity of low-cost sensors systems makes it possible to think of a real widespread application in the urban context. Advances in the field of sensors, ICT, and algorithms for data processing open up an extremely interesting scenarios. At the same time, some critical issues are still present. If, on the one hand, the overabundant production of data can represent a problem both in the management of the information flow and from an environmental point of view, on the other hand, management aspects with respect to data ownership and privacy issues still need to be regulated. Given data's primary role, future research will still have to focus on creating new public-private relationships in which the production of such data is regulated and valuable.

ACKNOWLEDGEMENTS

This paper presents the results from the research developed by the Unit of Polytechnic of Turin as part of the National Research Project PRIN TECH-START. The authors would like to thank "LiberiTutti" Cooperative and Agenzia Territoriale per la Casa del Piemonte Centrale for providing part of their apartments for the monitoring campaign.

Author contributions: conceptualization, R.P. (Riccardo Pollo), B.M. (Bartolomeo Montrucchio); coordination: R.P.; data collection and analysis: Matteo Giovanardi (M.G.), Matteo Trane (M.T.), Edoardo Giusto (E.G.), Gustavo Ramirez Espinosa (G.R.), Pietro Chiavassa (P.C.); writing – draft: M.G., M.T., E.G., G.R., P.C.; writing – review and editing: R.P., B.M. All authors have read and agreed to the published version of the manuscript.

REFERENCES

1. WHO - World Health Organization (2021). World health statistics 2021: monitoring Health for the SDGs. [Online] Available: https://www.who.int/data/gho/publications/world-health-statistics [16 November 2021].

2. EEA - European Environment Agency (2020). Air quality in Europe – 2020 report. [Online] Available: https://www.eea.europa.eu/publications/air-quality-in-europe-2020-report [10 December 2021].

3. Wu, X., Rachel N.C., Benjamin, M.S., Braun, D. and Dominici, F. (2020). Exposure to air pollution and COVID-19 mortality in the United States: A nationwide cross-sectional study. *Science Advances*, 6(45): p. 1-6.

4. Pollo, R., Biolchini, E., Squillacioti, G. and Bono, R. (2020). Designing the healthy city: an interdisciplinary approach. *Sustainable Mediterranean Construction*, 11: p. 150-155.

5. Montrucchio, B., Giusto, E., Ghazi Vakili, M., Quer, S., Ferrero, R. and Fornaro, C. (2020). A Densely-Deployed, High Sampling Rate, Open-Source Air Pollution Monitoring WSN. *IEEE transactions on vehicular technology*, 69(12): p. 15786-15799.

6. Atzori, L., Campolo, C., Da, B., Girau, R., Iera, A. et al. (2019). Smart devices in the social loops: Criteria and algorithms for the creation of the social links. *Future Generation Computer Systems*, 97: p. 327-339.

7. Mora, S., Anjomshoaa, A., Benson, T., Duarte, F. and Ratti, C. (2019). Towards large-scale drive-by sensing with multi-purpose City Scanner nodes. *IEEE 5th World Forum on Internet of Things*: p. 743-748.

8. Kane, F., Abbate, J., Landahl, E.C., Potosnak, M.J. (2022). Monitoring Particulate Matter with Wearable Sensors and the Influence on Student Environmental Attitudes. *Sensors*, 22(3): 1295.

9. Wesseling, J., Hendricx, W., de Ruiter, H., van Ratingen, S., Drukker, D. et al. (2021) Assessment of PM2.5 Exposure during Cycle Trips in The Netherlands using Low-Cost Sensors. *International Journal of Environmental Research and Public Health*, 18(11): 6007.

10. Giovanardi, M., Giusto, E., and Pollo, R. (2021). Digital infrastructures in façade components for building management. Perriccioli, M. et al. (eds.), *Design in the digital age. Technology, Nature, Culture*, Sant'Arcangelo di Romagna:Maggioli, p. 243-248.

11. Viglioglia, M. Giovanardi, M., Pollo, R. and Peruccio, P.P. (2021). Smart District and Circular Economy: The Role of ICT Solutions in Promoting Circular Cities. *Sustainability*, 13(21): 11732.

12. Pollo, R., Trane, M. and Giovanardi, M. (2021). Urban metabolism, interdisciplinary models, and design at micro-urban scale. *TECHNE – Journal of Technology for Architecture and Environment*, 21: p. 154-164.

13. Kellett, R., Christen, A., Coops, N.C., Van der Laan, N., Crawford, B., Rory Tooke, T. and Olchovski, I. (2018). A system approach to carbon cycling and emissions modelling at an urban neighborhood scale. *Landscape and Urban planning*, 110: p. 48-58.

14. Rui, L., Buccolieri, R., Gao, Z., Gatto, E. and Ding, W. (2019). Study of the effect of green quantity and structure on thermal comfort and air quality in an urban-like residential district by ENVI-met modelling. *Building Simulation*, 12: p. 183-94.

15. Krellenberg, K. and Koch, F. (2021). Conceptualizing interactions between SDGs and Urban Sustainability Transformations in Covid-19 times. *Politics and Governance*, 9(1): p. 200-210.

16. Honey-Rosés, J., Anguelovski, I., Chireh, V., Daher, C., Konijnendijk van den Bosch, C. et al. (2020). The impact of Covid-19 on public space: An early review of the emerging questions: Design, perceptions and inequities. *Cities & Health*, 5: p. 263-279.

17. Ramirez-Rubio, O., Daher, C. Fanjul, G., Gascon, M., Mueller, N. et al. (2019). Urban health: an example of a "health in all policies" approach in the context of SDGs implementation. *Global Health*, 15: 87.

PLEA
STGO
2022

November 22 - 25, 2022

WILL CITIES SURVIVE?

The future of sustainable buildings and urbanism in the age of emergency.