



Welsh School of Architecture
Ysgol Pensaernïaeth Cymru

2021 RESEARCH ANNUAL

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Constructing the Urban Imaginary

Clarice Bleil de Souza:

Decision-Making in Emergency Management and Post-Disaster Recovery;

Decision-Making in Regenerative Design and Development; Occupants in the Building Design Decision-Making Process; Regenerative Design and Modelling in Environments with Extreme Conditions

Laura Bowie:

The Contested Urban Experience of Post-War West-Berlin

Marie Davidova:

Co-Performative Bio-Climatic Layers of Built Environment; Systemic Approach to Architectural Performance

Juliet Davis:

Care and the City; Urbanising Suburbia

Hu Du:

Developing Optimal Domestic Low Carbon Ventilation Technologies to Improve Air Quality and Reduce Health Risks from Indoor and Outdoor Air Pollutions; PLUG-N-HARVEST

Ed Green:

Homes of Today for Tomorrow

Julie Gwilliam:

The Central Role of Architectural Precedent in Sustainable Architectural Design

Adam Hardy:

Tamil Temple Towns

Wassim Jabi:

Topologic

Phil Jones:

Developing Optimal Domestic Low Carbon Ventilation Technologies; Low Carbon Built Environment (LCBE) SPECIFIC 2; PLUG-N-HARVEST

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Social and Spatial Forms; Urbanising Suburbia

Simon Lannon:

Homes of Today for Tomorrow; Social Housing Research on Energy from Welsh Data (SHREWD); Topologic

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CircuBED

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Embodied Pedagogies

Hiral Patel:

Managing the Brief for Better Design; University Spaces Fit for the Fourth Industrial Revolution

Joanne Patterson:

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Nastaran Peimani:

Forms of Informal Urbanism; The Handbook of Urban Design Research Methods; Negotiating Livelihoods and Rights in Contested Urban Space

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Harbourview; Hygrothermal Monitoring of Timber-Frame Replacement Infill Panels; Shelf-Life; Tamil Temple Towns

Magda Sibley:

BECAMI Belle Epoque Cairo Museums Itineraries; Eco-Hammam

Vicki Stevenson:

Exploring how Sources, Behaviour and Mitigation Strategies Influence Indoor Air Quality; South Wales Indoor and Outdoor Air Quality; Urban Food Growing; Use of Storage and Renewable Electricity Generation to Reduce Domestic and Transport Carbon Emissions

Christopher Tweed:

CircuBED; Eco-Hammam; Social Housing Research on Energy from Welsh Data (SHREWD); University Spaces Fit for the Fourth Industrial Revolution

Chris Whitman:

Hygrothermal Monitoring of Timber-Frame Replacement Infill Panels

Federico Wulff:

Euro-Mediterranean Urban Voids Ecology (EMUVE); The 2013-2017 Restoration of the Oratory of the Partal Palace

Gabriela Zapata-Lancaster:

INDAIRPOLLNET (INDoor AIR POLLution NETwork)

Research staff project index

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Shelf life

Richard Hoggett:

EnergyREV

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PLUG N HARVEST

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Low Carbon Built Environment New Build
Home Performance Evaluation

Mariangela Parisi:

Shelf life

Emmanouil Perisoglou:

Low Carbon Built Environment New Build
Home Performance Evaluation

Camilla Pezzica:

Eco-Hammam; Shelf life

Marianne Solomon Popa:

EnergyREV

Esther Tallent:

EnergyREV

Introduction to the Welsh School of Architecture Research

The Welsh School of Architecture (WSA) is one of seven schools in the College of Physical Sciences and Engineering and has 57 academic staff members (summer 2020). Our ethos of 'grounded creativity' shapes our collaborative, diverse research and supports dialogue with communities of practice. The School has a strong relationship with the Welsh Government, underpinned by a long-standing reputation for sustainability research and impact-delivering projects.

Our research is currently organised in six Research and Scholarship Groups (RSGs), which bring together staff and postgraduate research (PGR) students, recognising the essential contribution they all make to generating knowledge, stimulating debate and creating impact. The groups sustain and support the WSA's research culture, mentor and nurture early career researchers and PGRs, organise research events, run internal grant peer-review processes and joint applications. Our groups are **Computational Methods in Architecture; Design, Practice, Materials and Making; Energy, Environments and People; Heritage and Conservation; History and Theory, and Urbanism.**

WSA's research is translated to external organisations primarily through collaborative research centres and consultancies and a key University research institute: Design Research Unit Wales (DRUw) engages in architectural design projects that address key topics in contemporary architectural design, including low carbon design, landscape and placemaking; Practice, Research and Advancement in South Asian Design and Architecture (PRASADA) focuses on historical traditions of the Indian subcontinent; Centre for Sustainable Design of the Built Environment (SuDoBE) specialises in research concerning sustainability, people and the built environment. We are also invested in Cardiff University's Energy Systems Research Institute, a successor to our Low Carbon Research Institute, and a leader in research into low-carbon and energy in the built environment.

This research annual samples long-term research projects that are taking place in 2021 at WSA. Some are ongoing, some have concluded this year, while others have only launched recently. While the annual is neither comprehensive nor exhaustive, it nevertheless provides an overview of the very diverse research taking place at WSA, spanning a vast territory of expertise, of geographies, and of project types.



Research and Scholarship Groups

Energy, Environment and People

The Energy, Environment and People Research and Scholarship Group aim to improve sustainability and the quality of life for people through improving the built environment across all scales from components to buildings, neighbourhoods to regions and at a national level. Research provides evidence from design and planning through to implementation and performance evaluation and demolition to initiate long term improvements.

Group lead: Joanne Patterson

Design, Practice, Materials and Making

Members of the Design, Practice, Materials and Making (DPMM) research group engage in traditional, practice-based and practice-led research, with a collective focus on design, practice, materials and making.

Group members seek to understand material and making cultures, affect processes and products in industry and practice, and explore the intersection of academic and professional domains. The group supports original, rigorous research through collaboration and knowledge sharing, and connects research within the school to relevant activities outside.

Research areas include: conducting design-based research projects; reflection on (and evaluation of) built projects; research with a focus on material performance and properties; development and evaluation of construction techniques; research with a focus on making or prototyping; practice-based research.

Group leads: Ed Green, Steve Coombs

History and Theory

The epicentre of humanities research at the Welsh School of Architecture.

With architectural history and theory as our point of departure, our work engages cultural and visual studies, urban history, aesthetics, cognitive linguistics, and social and political theory. The group's strength is its scholarly research, broad expertise, critical perspective and urban focus. Our key research topics include: the history of Chicago; the use of visual images in urban development; the urban spectacle; the symbolic; contracting; architectural agency; the relation of spatial to social form.

We are all involved in international networks and contribute to sustaining our field through reviews of papers for journals and manuscripts for publishers.

Group lead: Tahl Kaminer

Heritage and Conservation

Seeking to forge bridges between the critical philosophical and technical challenges of contemporary building conservation, our group addresses the future role of cultural heritage as a inclusive cultural resource that drives sustainable development through a principle of "do no harm."

Our key areas of expertise are: sustainable building conservation; vernacular architecture heritage valorisation and digital documentation; heritage-led urban regeneration; heritage design management and public engagement; energy use in historic buildings; energy transitions in heritage buildings.

The Heritage and Conservation research group builds from its members' established expertise in practice, research and advocacy both nationally and internationally. These skills include specialist architectural conservation in theory and practice, energy and condition monitoring and measurement, digital documentation and augmented reality underpinned by architectural history and theory, heritage-led urban regeneration, and energy transition in heritage contexts. Its research findings extend its remit into both policy and practice at both a national and international level, in an area closely aligned to Sustainable Development Goal 11.

Group lead: Oriel Prizeman, Magda Sibley

Computational Methods in Architecture

Enhancing architectural design through the use of innovative computational methods.

This group researches innovative computational methods for use in the creative and design industries. In particular, we look at form-finding using parametric and generative methods, preparing digital information for further rigorous analysis, and integrating the logic of digital fabrication into the early stages of design.

Group lead: Wassim Jabi

Urbanism

The Urbanism Group undertakes leading-edge and collaborative research on theories and practices for transforming cities.

The Urbanism Group is a relatively young and dynamic group in the Welsh School of Architecture which brings together diverse academics, researchers and doctoral students to share our work, to exchange different ideas, and to collaborate on research that moves the field in new and exciting directions.

The group is primarily a forum for intellectual exchange and collaborative projects on various aspects of urbanism as an interdisciplinary, critical and engaged field of design.

Group lead: Aseem Inam

WSA LEAD:	Federico Wulff Barreiro
WITH:	Melina Guiraldos (Co-I), Lui Tam (RA)
FUNDING:	The Council of the Alhambra (Spain), World Monuments Fund (WMF), Europa Nostra- European Commission
YEAR:	2017-

The 2013-2017 Restoration of the Oratory of the Partal Palace, a Fourteenth-Century Palatine Mosque in the Alhambra.

Research outcomes of the latest restoration of the Oratory of the Partal Palace (2013-2017), Alhambra (Spain). Grand Prix Europa Nostra 2019. Innovative Nasrid carpentry techniques and new construction dating.

This research focuses on the innovative outcomes of the latest restoration of the Oratory of the Partal Palace (2013-2017), authored by Dr Federico Wulff.

The Oratory of the Partal Palace is a unique fourteenth-century palatine mosque for the exclusive use of the sultans of the Nasrid dynasty of the medieval Kingdom of Granada (Spain) and forms part of the Alhambra heritage complex. Since 1984, the Alhambra is a UNESCO World Heritage Site, key to understanding the history of intercultural syncretic processes in Western European medieval architecture.

This restoration and its research outcomes were awarded with the Europa Nostra Grand Prix 2019, the most prestigious European heritage award, promoted by the European Commission. It has revealed original inscriptions, new decorative elements and unknown to date constructive solutions from the Nasrid period. Their interpretation allowed a deeper understanding of Nasrid carpentry techniques as more sophisticated and distinctive from their Christian-mudéjar counterparts.

The dendrochronology tests of the original decorated timber framework covering the main praying space consistently dated its timber elements as been cut during the Autumn/Winter of 1332-1333. This would prove that the Oratory had been conceived and its construction initiated on an earlier date to its widely accepted attribution to Yusuf I (1333-1355) in previous published research. This new dating for the building has been redefined during the rule of the earlier sultan Ismaï'l I (1314-1325), who had already made several interventions in the Partal Palace. The improved legibility of its last two historical restorations, the 1846 orientalist-eclectic and the 1930 rational-scientific together with the research findings of 2013-2017 restoration, has enabled the interpretation of the Oratory of the Partal Palace as a compendium of the Spanish heritage preservation approaches of the last 180 years.

Publications:

Federico Wulff, 'The Restoration of the Oratory of the Partal Palace in the Alhambra of Granada, Grand Prix Europa Nostra 2019', *Built Heritage* 6: 3 (Springer Nature, 2021) <https://doi.org/10.1186/s43238-021-00026-w>

Federico Wulff, 'The Restoration of the Oratory of the The Partal Palace and the House of Astasio de Bracamonte in the Alhambra of Granada, Spain' (Cardiff University. REF by-design output, 2021).

WSA LEAD:	Magda Sibley
WITH:	Galila Elkadi (PI), Co-Is: Doaa Abouaelmagd and Gehan Selim
FUNDING:	AHRC, Newton/Mosharafa
YEAR:	2016 -

BECAMI Belle Epoque Cairo Museums Itineraries

Belle Epoque Cairo Museums Itineraries creatively engages school and university students with twelve forgotten and hidden museums to co-produce physical and virtual itineraries for visibility, accessibility and connectiveness.

The concept of heritage in Egypt has been extended in the 1990s to include artefacts and sites of the late nineteenth and early twentieth centuries. This coincides with the era, known as the 'Belle Epoque', during which Egypt rediscovered its Mediterranean roots and witnessed the emergence of cosmopolitan cities with their ethnic diversity, plural and eclectic architecture, and the flourishing Arts. The entire Egyptian cultural landscape had reached its golden renaissance era, when museums were introduced as strong educational tools for future generations. Unfortunately, these museums are today hidden and unknown to most Egyptians. 'Belle Epoque Cairo Museum Itineraries' (BECAMI) is a project that develops innovative public engagement strategies for university students and school children through processes of co-production of games, physical and virtual itineraries and innovative architectural and urban interventions.

The project demonstrates how a process of emotional re-appropriation of these museums by the new generation of Egyptians can lead to self-sustaining processes of innovative engagements. It also highlights how the Belle époque Cairo museums can play a catalyst role for connecting the new generation of Egyptians with the collective memory of their parents and grandparents associated with diverse identities, values and histories.

The project resulted in the inclusion of the belle époque history of this era in schools and universities curricula generating a new dynamic of students' led research and innovation initiatives.

The project received, an Award for Best Practice from the International Council of Museums in Egypt in May 2017. It has also been recognised by AHRC as an exemplar project meeting the Sustainable Development Goal for Quality Education. See <http://becami.com/> for more information.

Publications:

Elkadi Galila and Sibley Magda, 'Hidden and Unknown: Twelve "Belle Epoque" Cairo Museums Rediscovered Through Students' Engagement', the proceedings of the 4th Biennale of Architectural and Urban Restoration BRAU4. Itinerant Congress Hidden Cultural Heritage: Underwater, Underground and Within Buildings. CICOP Italia ONLUS (2018), pp. 445-54.

becami.com

WSA LEAD:	Juliet Davis
FUNDING:	Grosvenor Estate Management
YEAR:	2016 – 2021

Care and the City: Ethics of Urbanism

The aim of this project is to consider the role of Urban Design in the provision of care and, ultimately the potential to create caring cities.

Care and the City considers the role of Urban Design in how cities organise, situate and provide care. It begins from the premise that, as populations and welfare states in the UK and more widely struggle to cater to different needs and vulnerabilities, Urban Design is an increasingly important area of focus and care. Across its eight chapters, the book argues that many different aspects of Urban Design are significant, related both to the form and layout of urban spaces and how it changes over time. Accessibility, atmosphere, continuity and openness, can all be seen as relevant to care practices and relations in a broad sense. However, drawing on feminist care ethics, the book argues that care through crucially relies on attunement to care needs - it involves recognising specific

situations and circumstances of need, vulnerability or experience amid the general requirements of an urban fabric. Care is never just give, but is relational, implying a recognition of the role of the user, or of communities, in design as well as alertness to how design might help configure caring communities. Finally, care is future-orientated suggesting an emphasis on the potential of diverse urban citizens to flourish, and how design anticipates and shapes the future, including the well-being of future generations. Across its thematic chapters and drawings on research from twelve internationally-distributed case studies, the book shows how these aspects of care can be developed through Urban Design. It offers a new framing of care ethics in terms of urban design and a theory of caring cities.

Publications:

Juliet Davis, Care and the City: Ethics of Urbanism (Bristol: Bristol University Press, 2022 forthcoming)



Meidlinger Hauptstrasse
Perspective View (Source: WES)

The Central Role of Architectural Precedent in Sustainable Architectural Design

Promoting Critical Evolution Through an Integration of the Language of Sustainability and Design Quality

Achieving peer acknowledged excellence in architectural design is widely considered to be the pinnacle of achievement for any practicing Architect. Indeed, at the heart of the learning outcomes of any architectural education is an emerging notion of what Architectural excellence is and indeed, notably, this includes knowing how to speak about it. Thus, conveying the professional skill of understanding and knowledge of architectural design language. Living alongside this is the widely acknowledged need for the built environment broadly and buildings specifically to respond to the environmental, economic and social requirements of sustainability. This has brought about a schism in design practices, whereby sustainable buildings are largely perceived as worthy, pragmatic, but perhaps soulless, while outstanding architecture remains something other.

This work sets out to engage in transformative research to promote a paradigm shift in architectural practice such that the diverging worlds of architectural design excellence and sustainable performance can be synthesised to inform a new more complete, critical and robust language for architectural precedent, with wide reaching impacts. During this work I will endeavour to promote engagement with the architectural and interdisciplinary design process, meaningfully and accessibly in order to transform it into a more complete critique of design quality, sustainability and performance than currently exists.

Publications:

Gwilliam JA & O'Dwyer, S (2018). Architectural Design and / or Sustainable Building: A Question of Language?". The Fifth International Conference S.Arch, Venice, 22 – 24th May 2018.

Gwilliam JA & O'Dwyer, S (2018). Delivering Sustainable Design Excellence: The potential role of architectural precedent. Submitted to PLEA 2018, Smart & Healthy within the 2 degree limit, Hong Kong, 10-12 December 2018

Gwilliam, J. and O'Dwyer, S. 2020. Delivering sustainable design excellence: the potential role of holistic building performance evaluation. Architectural Science Review (10.1080/00038628.2020.1825319)



Sustainable Architectural Excellence: Outhouse by Loyn + Co Architects. 2016: Winner of the Manser Medal & Stirling Prize Shortlisted.

WSA LEAD:	Marianna Marchesi
WITH:	Chris Tweed
FUNDING:	European Union's Horizon 2020 Research and Innovation Programme [Grant Agreement n. 793021
YEAR:	2018–2021

CircuBED: Applying the Circular Economy to the Design of Social Housing

The project explored how social housing communities can contribute to a circular economy in cities by social innovation, and how they can be engaged and empowered by it.

This project explored how social housing communities can contribute to the transition to a circular economy (CE) in cities and how they can be engaged and empowered in envisioning possible scenarios for a circular community.

Resource efficiency in cities is connected to people behaviours, but until now, the CE has placed limited attention on social practices and behavioural change. On the other side, behavioural change for sustainable living shows being effectively encouraged through initiatives of social innovation (SI) that involve communities and groups of interest in alternative social practice.

Therefore, this study pointed at understanding the phenomenon of SI on resource efficiency and circularity in cities to define the potential contribution of social housing communities. Through case study analysis, the project provided an overview of contemporary SI initiatives implemented by urban communities and groups of interest among citizens aiming at promoting alternative production and consumption practices.

The developed database was categorized from theoretical knowledge and empirical analysis supporting the identification of seven types of SI for resource circularity. Based on this typology, the study defined potential opportunities for social housing communities as well as benefits and challenges. The findings also identified a complementary role that SI can play in the CE implementation in cities. Therefore, the project suggested the introduction of emerging SI concepts into the current CE approach to support the development of opportunities.

Based on these results, the study is exploring the ability of playful practices to engage residential communities, promote bottom-up knowledge and support collaborative discovery on how to contribute to a CE. A game design concept for a serious application on SI for a CE will be also outlined. Finally, preliminary recommendations regarding support strategies and measures to be implemented in policymaking for facilitating emerging SI initiatives in the field will be formulated.

Publications:

Marchesi, M. & Tweed, C. (2021). Social innovation for a circular economy in social housing. *Journal of Sustainable Cities and Society*. (accepted for publication)

Marchesi, M., Tweed, C. and Gerber, D. "Applying circular economy principles to urban housing", IOP Publishing: Conference Series, vol. 588, pp. 1.15-1.19, 10.1088/1755-1315/588/5/052065



Social innovation types for a circular economy in urban communities.

WSA LEAD:	Wes Aelbrecht
WITH:	Alistair Black (Illinois Urbana Champaign) (Co-I), Christopher Jones (CU COMSC) (Co-I)
FUNDING:	AHRC and Fulbright Fellowship
YEAR:	2019 -

Constructing the Urban Imaginary: Photography, Decline and Renaissance

This book discusses the construction of three distinct “urban imaginaries” during two cycles of urban redevelopment: urban renewal (1940s-1960s) and downtown renaissance (1970s-1990s) in Chicago and Detroit.

This book discusses the construction of three distinct “urban imaginaries” during two cycles of urban renewal (1940s-1960s) and downtown renaissance (1970s-1990s) in Chicago and Detroit. It uses a wide variety of images to do so: photographs, films, maps, graphs, and murals. It explores how these images were initially used for research, education and promotion supposedly to save the city from obsolescence; and later for social and political activism to gather support for preservation of landmarks and communities. To study how “urban imaginaries” shape the rebuilding of the city, in other words, how visuals shape thoughts, actions and interactions that could justify one mode of city building over another, I focus primarily on the visual and material exchanges between images, the city and its citizens.

During the period of urban renewal (1940s-1960s), I investigate how voluntary Citizens’ Councils in both Detroit and Chicago used blighted images as “reform publicity” to rally private organisations, public institutions and individuals to support and help organise the clearance and selling of large tracts of land to private developers. By contrast, during the period of downtown renaissance (1970s-1990s), I track how public-private partnerships produced images of iconic buildings, skylines and multicultural festivals to pave the way for efforts to revitalize both downtowns. But even as downtown renaissance booster campaigns attempted to create a community of believers (and eventually consumers), images of decline resurfaced, disseminated by individuals and groups who together constructed a powerful counter-imaginary in order to spur popular resistance to the wholesale destruction of buildings, neighbourhoods and communities.

Publications:

Aelbrecht, W. 2021. “Detroit in Memoriam: The Spectre of Demolished by Neglect, Urban Imaginaries and Performative Photo-Installations”. *Cultural Geographies* [under review].

Aelbrecht, W., ‘Seeing is Believing: The Social Life of Urban Decay and Rebirth’, in: Campkin, B. and Duijzings, G. eds. *Engaged Urbanism: Cities and Methodologies*. I.B. Tauris, 2016), pp. 155-62.

Aelbrecht, W., ‘Decline and Renaissance’, *Journal of Urban History* 41(2), 2015, pp. 307-25.

WSA LEAD: Laura Bowie

FUNDING: Edinburgh University
Principal's Career
Development
Scholarship

YEAR: 2014 -

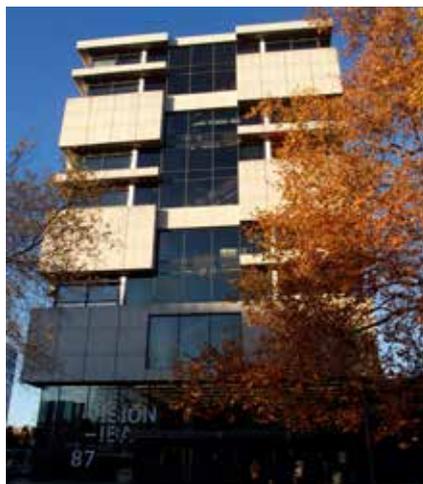
The Contested Urban Experience of Post-War West-Berlin

A project exploring the symbiotic relationship between city-dweller, urban change and identity in post-war West-Berlin

This research explores the relationship between changes in the urban environment and political protest. Specifically, the post-war experience of students involved in the 1968 protest movements in West-Berlin and how their understanding of the world was mediated through and by the built environment. Urban planning decisions came to be seen as physical manifestations of wider social, political and cultural ills and became embroiled in fundamental debates about what society stood for. Much research has been published on the '68 movement and on the urban history of Berlin, this research extends and builds on this analysis to consider the lived experience of city-dwellers and explores the symbiotic relationship between protester and city space. Considering the local interactions between city-dwellers and a myriad of contested urban identities, set within regional, national and global networks, a more complex understanding of the urban is developed when architectural objects are understood in conjunction with the flow of people, ideas, and actions.

Using cultural outputs such as film, novels, art as well as student publications, magazines, newspapers and interviews, this research investigates the embodied city-experience and the city as agent in developing and instigating political action. Lived experience is therefore used as a means to bridge the objective and subjective.

Considering how city-dwellers appropriated urban change, understood their place in society and the transnational context through their interactions with the immediate built environment develops a greater understanding of how change in cities is directed and negotiated.



Publications:

Bowie, Laura, 'Berlin Not for Sale: The Film Lens as a Tool of Urban Exploration in 1960s Berlin', *Journal of Urban History*, 2020, <https://doi.org/10.1177/0096144220953419>

Bowie, Laura, 'Protest and Marginalised Urban Space: 1968 in West Berlin', *Studies in the History and Theory of Architecture*, 4, 2016, pp. 225-240.

Bernhard Hermkes, TU-Faculty of Architecture, West-Berlin, 1968. Extension by Hans Scharoun, 1969. (Laura Bowie, 2014)

Co-Performative Bio-Climatic Layers of Built Environment: The Larger Context Cases of Systemic Approach to Architectural Performance

The book discusses possible routes to transition towards Post-Anthropocene scenario where humans live in synergy with other living and non-living beings.

The book discusses possible routes to transition towards Post-Anthropocene scenario where humans live in synergy with other living and non-living beings. This is being exemplified on several hyper-objective research by design cases, their systemic methodologies, and historical references from vernacular culture. It is layer by layer uncovering such possibilities within built environment and their relations with the digital space and technology. These relations and actions are addressing social and environmental justice of the coming era.



WSA LEAD:	Clarice Bleil de Souza (UK Participant)
WITH:	Valerio Cutini & Camilla Pezzica - DESTEC University of Pisa - Italy
FUNDING:	ERASMUS Intra-European Agreement / PhD Project
YEAR:	2017 - 2021

Decision-Making in Emergency Management and Post-Disaster Recovery

This project examines how decision making in post-disaster regenerative design processes can be better informed and evidence-based using different computational workflows and mixed methods approaches.

This is a research partnership between the DESTEC and the WSA which includes PhD joint supervision, MSc teaching (ERASMUS exchanges for both staff and students), organisation of thematic sessions in international conferences, joint peer reviewed research publications and joint research grant applications.

Research areas include:

1) Sustainable housing provision in disaster-hit cities

- Approaches and techniques for rapid adaptive urban planning and design decision-making in crisis situations.
- Integration of bottom-up collaborative mapping processes in top-down urban analysis workflows.
- Multi-domain modelling and simulation (e.g., bridging daylighting and space syntax analysis).

- Digital process modelling and information management possibly bridging simulation into practice in collaboration with stakeholders.
- Exploring formal features of informal settlements and services accessibility for building adequate housing in underprivileged communities.

2) Design of safe and resilient urban infrastructure and public spaces

- Identification of drivers, barriers, and benefits of building resilient urban infrastructure for sustainable cities and societies (SDG 11)
- Exploring decision-making dynamics and information management systems for informing restorative urban regeneration choices.

- Developing climate and culturally responsive directives for designing and building environmentally and socially sustainable public spaces.
- Exploring relationships between public open spaces, policies, and urban form.

Publications:

Pezzica, C., Cutini, V., Bleil de Souza, C. 2021. Mind the gap: state of the art on decision-making related to post-disaster housing assistance. *International Journal of Disaster Risk Reduction*. Paper featured in the UN Office for Disaster Risk Reduction (UNDRR) PreventionWeb global knowledge sharing platform:
#openaccess #DRR #decisionmaking #UN #10.1016/j.ijdr.2020.101975

Pezzica, C., Chioni, C., Cutini, V. and Bleil de Souza, C. 2020. Assessing the impact of temporary housing sites on urban socio-spatial performance: the case of the Central Italy earthquake. Published in: Gervasi, O. et al. eds. *Assessing the Impact of Temporary Housing Sites on Urban Socio-spatial Performance: The Case of the Central Italy Earthquake*. Lecture Notes in Computer Science, vol. 12251. Springer, Cham, pp. 324-339. 10.1007/978-3-030-58808-3_24

Pezzica, C., Piemonte, A., Bleil de Souza, C., Cutini, V. 2019. Photogrammetry as a participatory recovery tool after disasters: a grounded framework for future guidelines. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences (ISPRS)*. pp. 921-928., 10.5194/isprs-archives-XLII-2-W15-921-2019.



Temporary Housing site, surviving buildings and ruins seen from the destroyed historic centre of Arquata del Tronto, Italy.

WSA LEAD:	Clarice Bleil de Souza (UK Participant)
WITH:	EU COST Action RESTORE – Rethinking Sustainability Towards a Regenerative Economy
FUNDING:	EU COST Action
YEAR:	2017 - 2021

Decision-Making in Regenerative Design and Development

Integrating net-zero and regenerative design processes with digital technologies in performance-based design and planning.

EU COST Action RESTORE is a funded Pan-European network of researchers and industry representatives from more than 40 countries. It focuses on pushing the built environment beyond net-zero towards regenerating and restoring it, working within the sustainable capacity of its ecosystems to prevent future adverse effects rather than mitigating them.

Specific objectives of RESTORE include:

- Investigating and deploying strategies and best practice that enriches places, people, ecology, culture and climate so they are at the core of the design task;
- Promote forward thinking and multi-disciplinary knowledge which contributes to enriching design within a use-centric approach towards comfort, health and wellbeing in harmony with urban and natural ecosystems reconnecting people and the built environment with nature.

Dr. Bleil de Souza's involvement in this project focuses on integrating regenerative design processes with digital technologies in performance-based design and planning, more specifically on:

- Mapping, recording, and transferring knowledge from design decision-making in multiple disciplines to understand how they use different types of digital tools to produce evidence to substantiate design arguments and assess design proposals;
- Experimenting with different design methods seeking for transparency in design decision making by examining the role of design specifications and the production of evidence in enabling scrutiny and accountability of design proposals in relation to fulfilling sustainability goals and fighting climate change at different design scales (regional, neighbourhood and building).

These objectives feed to planned activities related to the development of guidelines to practitioners in the use of different design methods, evidence, and digital tools for design decision-making.

Publications:

Reith, A., Bleil de Souza, C. "Regenerative Buildings and Beyond: Scale Jumping Sustainable and Net-Zero Designs to Regenerative Neighbourhoods, Districts, Communities, and Cities" Special Issue in Sustainability MDPI. https://www.mdpi.com/journal/sustainability/special_issues/regenerative_buildings_beyond

Forsberg, M. Bleil de Souza, C. 2021. Implementing regenerative standards in politically green Nordic social welfare states: Can Sweden adopt the Living Building Challenge? Sustainability MDPI Dec 2020. Sustainability, 13, 738. <https://doi.org/10.3390/su13020738>

Naboni, E. Bleil De Souza, C., Peters, T., Havinga, L. 2019. Tools and data for holistic modelling: Simulating regenerative futures. (Book section) In: Naboni, E. and Havinga, L. eds. Regenerative Design for digital practice: A handbook for the built environment. Bolzano IT, EURAC. https://www.researchgate.net/publication/336121907_Regenerative_Design_In_Digital_Practice_A_Handbook_for_the_Built_Environment

WSA LEAD:	Phil Jones
WITH:	Hu Du (Co-I)
FUNDING:	Welsh European Funding Office
YEAR:	2019-22

Developing Optimal Domestic Low Carbon Ventilation Technologies to Improve Air Quality and Reduce Health Risks from Indoor and Outdoor Air Pollutions

In partnership with leading ventilation manufacturer Nuaire, Cardiff University will support a 3-year PhD studentship to develop optimal low carbon ventilation strategies and technologies for domestic buildings in the UK.

The Knowledge Economy Skills Scholarships (KESS 2) has announced funding to support a 3-year PhD studentship to develop optimal low carbon ventilation strategies and technologies for domestic buildings in the UK. This funding offered the opportunity to link the world leading ventilation manufacturer Nuaire (Polypipe PLC) and the Welsh School of Architecture and Energy Systems Research Institute to undertake collaborative research.

The PhD student will be jointly supervised by Prof Phil Jones, Dr Hu Du at Cardiff University and Colin Biggs, Technical Director of Nuaire. This KESS PhD project aims to develop optimal low carbon ventilation strategies and technologies for domestic buildings in the UK, to fulfil the requirement of good air quality and to reduce health risks from indoor and outdoor air pollution.

The core objectives of this project include the analysis of the current practice of domestic ventilation technologies and strategies around the UK with focuses on East Wales, the development of optimal low carbon ventilation strategies for domestic buildings, and to make contributions to the International Energy Agency's Energy in Buildings and Communities Programme (IEA EBC) Annex 78.

The KESS 2 programme is a major pan-Wales operation supported by European Social Funds (ESF) through the Welsh Government.

GROUP LEADER:	Magda Sibley
WITH:	Chris Tweed (Col / WSA)
FUNDING:	AHRC Follow on Funding for Impact and Engagement (GCRF highlight notice)
YEAR:	2020–2021

Eco-Hammam: Engaging Key Stakeholders with Bespoke Low-Carbon Technologies for Lighting, Heating and Water Recycling to Sustain a Moroccan Heritage

Eco-Hammam aims to accelerate ecological transitions in Moroccan public bath-houses. Key stakeholders are creatively engaged to communicate and co-produce co-ordinated integrated strategies for energy transition, enhanced indoor conditions and responsible water consumption and recycling.

This impact and engagement project follows on from developments arising from a previous AHRC funded project during which all the surviving and still functioning historic hammams (public bathhouses) of the North African heritage cities were surveyed and documented by the PI. Morocco is where the largest number of still functioning heritage hammams was surveyed and where new hammams are part of the cluster of key urban facilities introduced in every newly residential neighbourhood. This proposal is based on new developments that have emerged from the UN climate change conference COP22, held in Marrakech 2016 and during which Moroccan hammams were presented as major contributors to air pollution, deforestation and environmental degradation as well as high water consumption and wastage. It was estimated at COP22 that Morocco has at least 12 000 hammams, operating with wood burning traditional furnaces.

Each hammam consumes on average 1.5 tonnes of wood and between 60 to 120 cubic meter of water per day. The accumulated environmental impact of hammams is significant. Various uncoordinated attempts were made by both National and International Renewable Energy and Energy Efficiency organisations to reduce their environmental impact by facilitating their energy transition. However, it is estimated today that only 67 hammams out of the 12 000 have made some progress in their energy transition. The main aim of this Follow-on Funding for Impact and Engagement is to facilitate the acceleration of ecological transitions processes in Moroccan hammams. This will be achieved through the establishment of regional key stakeholders' networks in each of Rabat, Fez and Marrakech in order to creatively engage them to communicate and co-produce integrated strategies for multi-sectorial coordinated actions for energy transition, enhanced indoor conditions and responsible water consumption and recycling. See ECO-HAMMAM – Share the resources, save the planet!

Publications:

Magda, Sibley . Camilla, Pezzica and Chris, Tweed 2021. 'Eco-hammam: The complexity of accelerating the ecological transition of a key social heritage sector in Morocco'

MDPI Sustainability Journal: Special Issue "Innovation and Governance in the Global Energy Transition"
(submitted and waiting for outcome)

Project website:

[ECO-HAMMAM – Share the resources, save the planet!](#)



Hammam Dahab in Marrakech: (a) Entrance; (b) Traditional Furnace using wood shavings as fuel and hot ashes as a slow oven for Tadjine (Photo taken by Magda Sibley 2008).

WSA LEAD:	Dimitra Ntzani
WITH:	Sophia Banou Aikaterini Antonopoulou
YEAR:	2016 -

Embodied Pedagogies: Introducing ‘Otherness’ in Architectural Education

The research-examines the educational and ethical value that embodied pedagogies and pedagogies of alterity hold for architectural education.

In the context of UK-architectural education, unstable, diverse and ephemeral bodies are usually absent from design studios, or find ‘thin’ passages to their briefs through the ARB (GC5-GC6) criteria. In their common manifestations, these bodies become a learning vehicle for introducing basic architectural tools and qualities (scale, orientation, views, materiality) in 1st year. However, during these initiations to embodied thinking, discussions on their complexity, diversity and ephemerality are often limited to sensory explorations of architecture or to debates on ergonomic design. These same qualities are rarely addressed in 3rd and 4th-year studios, where students usually work on large-scale public programmes, and manage the needs of ‘average’ users and diverse social groups. As a result, complexity, diversity and ephemerality are then predominantly explored discursively in history and theory modules and dissertations, keeping safe distance from the design studio.

The research-examines the educational and ethical value that embodied pedagogies and pedagogies of alterity hold for architectural education. It-looks at how ‘other’ bodies can help us navigate aesthetical/technological aspects of design, promote synergies with other disciplinary-areas, raise awareness on unstable bodies and contexts, and positively infiltrate studio cultures.

Publications:

Dimitra Ntzani, ‘Troublesome pedagogies: introducing ‘otherness’ to 1st year design studio’, in *Initiations: practices of teaching 1st year design in architecture*, Chatzichristou, C., Iacovou, P. and Koutsoumpou, L. eds. 2021, pp. 195-204.

Student Workshop, funded and awarded by the Festival of Innovative Learning, run and funded by the University of Edinburgh 2016.

WSA LEAD:	Joanne Patterson (Co-I)
WITH:	Led by Strathclyde University. 22 Universities 22 Universities, 50+ researchers
FUNDING:	EPSRC/UK Industrial Challenge Fund Prospering from the Energy Revolution (PFER) Programme
YEAR:	2018-23

Energy Revolution Research Consortium: EnergyREV

The EnergyREV Consortium is providing evidence for scaling up smart local energy systems - maximising the use of sustainable resources, engaging and empowering communities and people, delivering an equitable move to a zero-carbon future whilst enhancing the UK economy.

The primary objective of the Energy Revolution Research Consortium (EnergyREV) is to coordinate and integrate existing UK world-class knowledge, research teams and facilities to provide advice, research and innovation support to help ensure the success of the Industrial Strategy Challenge Fund Prospering from the Energy Revolution (PFER) programme. EnergyREV are working together as a strongly managed, closely coordinated, highly multi-disciplinary, group of researchers from across 22 Universities in the UK involving more than 60 academics. £12 million has been secured by the EnergyREV Consortium.

The consortium are undertaking a strategic programme of interdisciplinary research, interacting with all aspects of the PFER Challenge programme to ensure that UK academic expertise delivers impact and is enhanced through detailed engagement with BEIS, industry, the Energy Systems Catapult and all key stakeholders. The consortium are strongly engaging with stakeholders and existing capability through key partners at all levels to ensure strategic leadership, strong Consortium management and effective research, analysis and learning. The flexible research programme, informed by early analyses and to be focused at the later stages on knowledge gaps, priority tasks or results from the emerging PFER demonstrators and design projects and broader case studies where smart local energy systems are being demonstrated.

There are six key research themes:

- **Infrastructure:** Adapting advances in AI, data analytics and controls;
- **Business:** Understanding current local energy business sector to accelerate innovation;
- **Institutions:** Assessing policy, regulation and markets for local energy sector change;
- **Users:** Investigating how user preferences and practices evolve overtime;
- **Developing a whole systems understanding:** Capture and synthesise knowledge from all aspects of the value chain and integrating learnings.
- **Supporting scale-up:** Understanding potential constraints that can prevent scale up of local energy systems and solutions to overcome them.



The WSA has secured £900,000 to lead Knowledge Management, Engagement and Dissemination across the Consortium and to be part of the Executive Committee and Management Committee.

WSA LEAD:	Vicki Stevenson
WITH:	Archit Mehra (Chester), Zaheer Nasar (Cranfield), Stefano Rolfo (STFC), Stephanie Gauthier (Southampton), Alejandro Rangel (Lancaster), Jo Zhong (Nottingham Trent), Rob Ferguson (Essex), Douglas Booker (NAQTS)
FUNDING:	Science and Technology Facilities Council – Air Quality Network
YEAR:	2020 – 2021

Exploring how Sources, Behaviour and Mitigation Strategies Influence Indoor Air Quality: A Pilot Study

Developing interdisciplinary monitoring and modelling relating to indoor air quality as a pilot study

The average person in the UK spends more than 90% of their time indoors, but there are many issues affecting indoor air quality (IAQ). This short pilot project will analyse IAQ issues relating to particulates and biological pollutants generated during cooking, dishwashing and house cleaning in relation to low and high ventilation. The behaviour to be monitored has been guided by the UK Time Use Survey and considers confounding factors such as household size and weekday vs weekend.

The physical experiments will take place at the DOMestic Systems and Technology InCubator (DOMESTIC) at Chester University. This is being fully mapped in relation to base line emissions as well as airflow prior to experiments commencing.

Detailed monitoring of the IAQ during specific activities and ventilation flows will be used to evaluate low cost environmental diagnostic equipment. It will also develop appropriate CFD models utilising STFC high performance computing facilities to facilitate future investigations.

This work is intended as a proof of concept to allow future work to investigate further real-world indoor environments both experimentally and numerically.

WSA LEAD:	Federico Wulff Barreiro
WITH:	Noha Nasser-MELA (Co-I), Oscar Brito CSM-UAL (Co-I)
FUNDING:	European Commission (2013-2015)/ WSA Research Grant 2021 (under assessment)
YEAR:	2013 -

Euro-Mediterranean Urban Voids Ecology (EMUVE)

EMUVE (Euro-Mediterranean Urban Voids Ecology) as spatial catalysts for new forms of citizenship and identity based on mutual respect, recognition and empowerment for urban and social transformation.

Since 2013, the European Commission-funded project EMUVE (Euro-Mediterranean Urban Voids Ecology) has explored alternative design research strategies for reactivating contemporary European urban landscapes in crisis. From 2016 onwards, EMUVE is focusing on the migration and refugee crisis impacting social and urban degradation, exploring Inter-Cultural Nodes (ICN) as spatial catalysts for new forms of citizenship and identity based on mutual respect, recognition and empowerment.

According to Bhabha (1994) and Bloomfield (2007) approaches, an Inter-Cultural Node (ICN) could be identified as a third space, a pluralist space that develops relational practices at multiple scales (urban, public space, architectural), where the participants, including locals and all kinds of culturally-diverse migrants that have been frequently subjected to exclusion, could collaborate together in creative expression and dialogue on joint projects within shared ethical bounds – such as openness, cultural recognition, equality, anti-discrimination, dialogue and sharing of knowledge (Bloomfield, 2013; Landry and Wood, 2008).

Our aim is to expand current knowledge on the multiple relations between interculturality and contemporary architecture, focusing on the production of ICNs.

EMUVE research includes two design research Units within MA Architectural Design (MA AD) which are exploring multi-scalar ICNs. The Units are working within the logic of design research think tanks, in collaboration with public institutions and local stakeholders with different degrees of influence on the social and urban transformation of their cities.

The research outcomes, including collaborations with local stakeholders and the design research process within the think tank Units, have been and continue to be published in academic journals and books. The aim of this research would be to form part of the debates within intercultural International networks such as the Council of Europe Intercultural Cities network (<https://www.coe.int/en/web/interculturalcities>) with the aim of applying for a European-funded research project.

Over the medium term, our research aim will be to articulate a REF Impact Case Study on interculturality and its multi-scalar spatialisations for urban and social transformation for the urban and social transformation of excluded and marginalised communities.

Publications:

Federico Wulff, Oscar Brito, 'Intercultural spatial practices as an opportunity for the alternative reactivation of historic urban landscapes – The case of Palermo', *Urban Design International*, 25: 250-265 (London: Springer Nature, 2020). <https://doi.org/10.1057/s41289-020-00126-6>

Federico Wulff, Renzo Lecardane, Paola La Scala, 'PROGETTARE LO SPAZIO INTERCULTURALE. Approccio multi-scalare nel quartiere Albergheria a Palermo. DESIGNING THE INTERCULTURAL SPACE. A multi-scalar approach in the Albergheria neighbourhood in Palermo', *AGATHÓN – International Journal of Architecture, Art and Design* 07: 82-91 (Palermo: Demetra/Palermo University Press, 2020). <https://doi.org/10.19229/2464-9309/792020>

Federico Wulff, Oscar Brito, 'Multi-scalar Intercultural Spatial Practices of migrants and local communities as an opportunity for an alternative reactivation of deprived historic urban landscapes. The case of Palermo (Sicily, Italy)' in *Generosity and Architecture*, Kite S., Drozynski Ch., McVicar M. (eds.). (London: Routledge, 2021; In preparation).



San Benedetto il Moro, Saint Patron of Palermo: a thirteenth-century black African (Igor Scalisi Palmintieri 2016)

WSA LEAD:	Nastaran Peimani
WITH:	Hesam Kamalipour (School of Geography and Planning, Cardiff University)
YEAR:	2019 -

Forms of Informal Urbanism

Studying forms of urban informality at the intersections between sociality and spatiality across cities of the global South

Forms of informal urbanism – ranging from informal settlements to informal street vending and informal transport – have become integral, yet not necessarily limited to the ways in which cities of the global South work. These forms of urban informality work as resources to manage the pressing challenge of poverty and, as such, become integral to sustain livelihoods. While forms of informality may invoke images of poverty and disorder, they cannot be simply conflated with each other. The critical role of urban design in addressing this challenge is yet to be explored.

There is a distinction between the studies of informality in the context of Global North and South. There is thus a need to explore different types of informality and the role of urban design in it. This project focuses on the ways in which urban design thinking and practice can most effectively engage with the capacities and challenges of informality. The primary focus would be on different forms of informality and the relations between informal and formal in cities across different contexts and scales.

Publications:

Kamalipour, Hesam, and Nastaran Peimani. "Informal Urbanism in the State of Uncertainty: Forms of Informality and Urban Health Emergencies." *Urban Design International* (2020).

Kamalipour, Hesam, and Nastaran Peimani. "Negotiating Space and Visibility: Forms of Informality in Public Space." *Sustainability* 11, no. 17 (2019): 4807.

Kamalipour, Hesam, and Nastaran Peimani. "Towards an Informal Turn in the Built Environment Education: Informality and Urban Design Pedagogy." *Sustainability* 11, no. 15 (2019): 4163.



Informal Street Vending (Photo Credit: Hesam Kamalipour)

WSA LEAD:	Nastaran Peimani
WITH:	Hesam Kamalipour (School of Geography and Planning, Cardiff University); Patricia Aelbrecht (School of Geography and Planning, Cardiff University)
YEAR:	2020 –

The Handbook of Urban Design Research Methods

The first extensive collection of urban design methods cutting across a range of studies in the Global North/South to bridge the knowledge gap between social sciences and built environment disciplines and between academia and practice

This handbook adopts an innovative approach in terms of structure. Rather than providing a conventional compilation of methods of data collection and analysis, it draws on key questions in urban design, which have been the main drivers of the production of its knowledge. Addressing some of the key urban design questions with a focus on spatial analysis in relation to sociality plays a key role in defining the scope of this handbook, which illustrates the use of particular ways to explore and

analyse different urban design issues as well as the processes and agents that shape them. The specific framing of the handbook as well as its socio-spatial and cultural analysis will be of interest to different audiences, including undergraduate and postgraduate students, researchers, practitioners and policymakers engaged with urban design in particular and a range of relevant subject areas, including urban planning, architecture, landscape architecture, cultural studies, human geography, urban studies, social policy, sociology, and anthropology.

WSA LEAD:	Oriel Prizeman
WITH:	Beth Shotton, University College Dublin
FUNDING:	ESRC
YEAR:	2020 - 21

Harbourview

ESRC-IRC Networking Grant

The ambition of the proposed Irish-Welsh network is to raise awareness of importance of harbours as coastal heritage, which need to be studied as systems interlinked across the Irish Sea to identify the shared heritage of Wales and Ireland, and the importance of their robust documentation in face of growing threats from climate change. To achieve this we plan to bring together academics from archaeology, architecture, engineering, history and Celtic studies, with public policy makers, such as the Irish Heritage Council and the RCAHM in Wales, local county council officials,

and local historians and communities for a series of 4 autumn seminars to discuss the significance of harbours as part of a shared cultural history between Ireland and Wales; the imminent threat to their preservation due to climate change; and the need for rapid documentation.

The objective of the seminars is twofold: to encourage future interdisciplinary and cross-cultural research and; to engage local communities in the subject to generate community participation in the documentation of harbours under threat, using accessible technologies

such as photogrammetry, in a series of four local workshops in the spring of 2021. The documentation from the workshops, uploaded to a shared website, will be used to generate 3D digital representations of the harbours, which will be shared on the website and form the basis of a limited case study to identify knowledge transfer between Ireland and Wales. The ambition is that this public forum will generate further interest from other local communities to document and share their own cultural heritage, thus addressing the need for rapid documentation. A final symposium and edited case study book will share the results from the network exchanges with a wider audience to open up the discussion and potential for collaboration to a wider community.



Speed, John 1610 - Glamorganshyre with the situations of the cheife towne Cardyff and ancient Landaffe described

WSA LEAD:	Ed Green
WITH:	Simon Lannon, Joanne Patterson
FUNDING:	Welsh Government
YEAR:	2018 – 2021

Homes of Today for Tomorrow: Decarbonising Welsh Housing Between 2020 and 2050

This study was commissioned to understand the implications of recent recommendations for Welsh Government decarbonisation policy by developing, testing, costing and analysing retrofit strategies for the existing Welsh social housing.

The 'Better Homes, Better Wales, Better World' Independent Advisory Group report to Ministers (July 2019) advised that "Welsh Government should urgently commence a 10-year programme to prioritise the retrofit of certain homes... [and] set a target of EPC 'A' for homes in social ownership."

This research identifies that decarbonisation of the Welsh housing stock presents a more complex challenge than the ongoing Welsh Housing Quality Standard programme (2002 to 2020). A component-led approach is embedded in the organisational operations of many Social Housing Landlords. Successful decarbonisation requires a more holistic understanding of stock, alongside carefully coordinated retrofit actions.

Learning from the delivery of WHQS suggests that some Social Housing Landlords (SHLs) will struggle with decarbonisation targets. Without in-house skills and expertise alongside coordinated advice and guidance at a national level, it will be difficult for SHLs to develop and evolve successful decarbonisation strategies.

Ten case studies and underpinning modelling are used to draw conclusions about the potential to decarbonise the Welsh housing stock (meeting international targets), while giving due consideration to affordable warmth and fuel poverty.

The studies demonstrate that by retrofitting dwelling fabric to an 'enhanced standard', it becomes feasible to replace existing (typically mains-gas) carbon-heavy heating systems with lower carbon heat sources such as ASHP, with only minor differences in fuel bills for tenants. Photovoltaics may not be an essential part of retrofit for decarbonisation in the future if energy supply continues to decarbonise, but remain a useful measure for reducing fuel bills and incentivising retrofit. The best-fit specification for decarbonisation will vary from project to project, and is best understood through accurate modelling.

Tools were also developed within this work to support better retrofit decision-making.

Publications:

Edmund Green and Simon Lannon, 'Homes of today for tomorrow: Decarbonising Welsh housing between 2020 and 2050 stage 3: Decarbonising social housing. Homes of Today for Tomorrow', 2020, Welsh Government. [link](#)

Ed Green, Simon Lannon, Joanne Patterson, Fabrizio Varriale and Heledd Iorwerth, 'Decarbonising the Welsh housing stock: from practice to policy'. *Buildings and Cities* 1 (1), pp. 277-292. 2020 10.5334/bc.19 [link](#)

Ed Green, Simon Lannon, Joanne Patterson and Fabrizio Varriale, 'Homes of today for tomorrow: Decarbonising Welsh Housing between 2020 and 2050'. [Project Report]. 2018 Welsh Government. [link](#)

WSA LEAD:	Chris Whitman
WITH:	Oriel Prizeman (Co-I); Pete Walker (Co-I, Bath)
FUNDING:	Historic England
YEAR:	2019 - 2022

Hygrothermal Monitoring of Timber-Frame Replacement Infill Panels

The project aims to assess the risk of interstitial condensation and increased moisture content within replacement infill panels for historic timber-framed buildings, through the monitoring of physical test panels.

It is known that inappropriate energy retrofits of traditionally constructed buildings may lead to moisture accumulation within their external envelope. Whilst numerical modelling can assist in identifying these threats, it is acknowledged that physical testing is still required. Research to date has focused on solid masonry construction. This project looks at the previously under-researched area of the impact of energy retrofits of historic timber-framed buildings, of which approximately 68,000 survive in the UK.

Due to the limitations of computer simulations such as WUFI, which model only idealised, homogeneous, continuous layers, with limited material data for traditional building materials in the UK, and the physical constraints of monitoring within real walls, the project utilises the monitoring of mock-up infill panels constructed within a physical test cell. Initial tests of panels installed between two climate-controlled chambers over the period of one month have shown that interstitial condensation can occur in some panel build-ups under forced artificial conditions. This project continues this research by allowing the monitoring of panels under real climatic conditions, over a two year period. The infill panel constructions under review are traditional wattle-and-daub, expanded cork, woodfibre and woodwool boards, and hempcrete.

Publications:

Whitman, C. J., Prizeman, O., Gwilliam, J., Shea, A. & Walker, P. 'Physical monitoring of replacement infill panels for historic timber-framed buildings in the UK: Comparing hygrothermal simulations and dual climate chamber testing', Presented at: Passive and Low Energy Architecture (PLEA) 2018, Hong Kong, China, 10-12 December 2018. (Winner of Certificate of Merit PLEA2018).

Whitman, Christopher J., et al. 'Energy retrofit infill panels for historic timber-framed buildings in the UK: physical test panel monitoring versus hygrothermal simulation', *Architectural Science Review* (2020): 1-12.



Test cell with test panels seen on the right.



Hempcrete test panel under construction.

WSA LEAD:	Gabriela Zapata-Lancaster
WITH:	Nicola Carslaw, University of York, Chair Marzenna Dudzinska, Lublin University of Technology, Leader of WP5
FUNDING:	European Cooperation in Science and Technology, COST Action CA17136
YEAR:	2018 – 2021

INDAIRPOLLNET (INDoor AIR POLLution NETwork)

INDAIRPOLLNET analyses the cause of high concentrations of indoor air pollutants, defining the optimal indoor air characterisation relevant to buildings.

In developed countries, we spend 80-90% of our time indoors, where we receive most of our exposure to air pollution. However, regulation for air pollution focuses mainly on outdoors and the indoor environment is much less well characterised. The concentrations of many air pollutants can be higher indoors than out, particularly following activities such as cleaning and cooking. With increasing climate change impacts, related energy efficiency measures are making buildings considerably more airtight.

Such measures can increase indoor pollutant concentrations even further. Therefore, to reduce our exposure to air pollution, we must consider both the indoor and outdoor environments and the role of ventilation, in order to mitigate through appropriate building operation, use and design.

WSA LEAD:	Joanne Patterson
WITH:	Emmanouil Perisoglou, Shan Shan Hou, Miltiadis Ionas, Simon Lannon
FUNDING:	ERDF, WEFO
YEAR:	2016–21

Low Carbon Built Environment (LCBE) SPECIFIC 2 Programme

The SPECIFIC 2 LCBE Research team aim to optimise a ‘whole systems-based approach’ combining renewable energy supply, energy storage and demand reduction technologies to create a replicable and affordable low-carbon built environment.

The Low Carbon Built Environment (LCBE) Research Team at the Welsh School of Architecture (WSA), Cardiff University have secured £3million to take forward the implementation of affordable and replicable low carbon technologies in the built environment in Wales as part of the SPECIFIC WEFO programme of works. The LCBE Team are collaborating with industry, government, academia and the public on 15 demonstration projects to optimise a ‘whole systems-based approach’ combining renewable energy supply, energy storage and energy demand reduction technologies to create a low carbon built environment that is replicable, affordable and appropriate for the context. This investment is part of a £26 million, EU-backed project involving a consortium of academic and industrial organisations led by Swansea University in partnership with Cardiff University, BASF, NSG Pilkington, Tata Steel and a wide range of other business and academic partners and will run until 2021.

The LCBE team are developing and trialling the whole systems-based approach undertaking modelling and monitoring the energy and environmental performance of a broad range of built environments to propose an affordable and replicable suite of solutions with evidence of carbon savings, cost of technologies, energy supply, storage and consumption capabilities and energy cost savings. Modelling and monitoring outcomes are used to inform the decision-making process on a set of solutions that have been demonstrated in a range of buildings including groups of social and owner occupied housing. Once the technologies are implemented in practice monitoring continues to provide evidence of energy and environmental performance in practice.



Publications:

Phil Jones, XiaoJun Li, Emmanouil Perisoglou, Jo Patterson, *‘Five Energy Retrofit Houses in South Wales’*, Energy and Buildings 154 (2017), 335–42.

Coma Bassas, Ester, Patterson, Joanne and Jones, Phillip 2020. A review of the evolution of green residential architecture. Renewable and Sustainable Energy Reviews 125, 109796. 10.1016/j.rser.2020.109796

Jones, Phillip, Li, XiaoJun, Coma Bassas, Ester, Perisoglou, Emmanouil and Patterson, Jo 2020. Energy-positive house: performance assessment through simulation and measurement. Energies 13 (18), 4705. 10.3390/en13184705

Jones, Phillip, Li, XiaoJun, Coma Bassas, Ester, Perisoglou, Emmanouil and Patterson, Jo 2020. Energy-positive house: performance assessment through simulation and measurement. Energies 13 (18), 4705. 10.3390/en13184705



WSA LEAD:	Joanne Patterson
WITH:	Emmanouil Perisoglou (Co-I), Miltiadis Ionas (Researcher)
FUNDING:	Swansea Council
YEAR:	2021-24

Low Carbon Built Environment – New Build Home Performance Evaluation

59 low carbon homes designed and built by Swansea Council will be monitored over 4 years to provide evidence on what works in practice in the steps towards a zero-carbon future.

Working closely with Swansea Council the WSA will undertake a series of short-term and long-term monitoring activities on 59 of their low carbon new build homes across 3 sites over a period of 4 years. Drawing on significant experience of the WSA, we will provide a holistic assessment and evaluation of the performance of the low carbon design of the homes together with the performance of the technologies, systems and the environments that they create.

By gathering, analysing and interpreting detailed information about the buildings and site design, construction, commissioning and operation, we will obtain a clear picture of the benefits of incorporating a whole energy systems-based approach in real homes. Extensive in-situ fabric and services tests will be carried out together with the monitoring of long-term comfort and energy data. The fully automated wireless monitoring system used provides us with valuable information about instantaneous, daily or seasonal performance characteristics of the building, its use and the effectiveness of the integrated innovative technologies such as photovoltaic panels, electric batteries, mechanical ventilation with heat recovery, ground source heat pumps and highly insulated fabric.

This will enable problems to be identified and rectified both at the commissioning and occupancy stages and for supply chains to continue to use low carbon solutions in the future whilst reducing errors in future projects.

This will enable Swansea Council and, through wider dissemination and publications, other housing designers and developers to be aware of the benefits and challenges in the steps towards a net zero future.



Thermographic image indicating areas of heat loss



Low carbon technologies installed in new homes



Low carbon new build housing being monitored



WSA LEAD:	Hiral Patel
WITH:	Alastair Blyth (University of Westminster), John Worthington (Co-founder, DEGW) and Fiona Young (Hayball/University of Melbourne)
YEAR:	2021-2022

Managing the Brief for Better Design: Third Edition

Briefing is an integrative, iterative, creative, communicative and political process. Design and briefing are mutually dependent for successful outcomes.

There are profound changes in the way people work and live driven by changes in technology, but also societal attitudes. The third edition of 'Managing the Brief for Better Design' recognises the changing technological, workplace and societal contexts to show how the solution may be a building, organisational, or technological project, or combination of these.

The creation of the book will be carried out in parallel to developing an international academia-practice network of a wide-ranging experts from the demand as well as supply side of the construction industry. The network will create a knowledge-exchange forum and while initially informing the development of the

book, will continue to evolve as an expert community on the topic of briefing. A digital platform will be created to supplement the book as a 'living archive' of thought pieces, case-studies, and thematic papers.



WSA LEAD:	Nastaran Peimani (Co-I)
WITH:	Hesam Kamalipour (PI, School of Geography and Planning, Cardiff University); ODA partner: Debdulal Saha (IISER Mohali)
FUNDING:	GCRF - HEFCW
YEAR:	2020 -

Negotiating Livelihoods and Rights in Contested Urban Space: Politics of Street Trading in Mumbai

Addressing the challenge of informal urbanism with a particular focus on the ways in which forms of street trading work in relation to gender, politics, and types in public space

Street trading cannot be simply wished away as it plays a key role in the informal economy across rapidly urbanising cities of the Global South by providing employment opportunities and generating income for the urban poor. In this project, informal street trading is considered as by no means marginal, but rather integral to how many cities work.

Exploring the prospects for change and its impacts on the ways in which forms of street trading generate livelihoods relies on a sophisticated understanding of how rights to access and appropriate public space play out in relation to gender, politics and urban governance.

This is a multidisciplinary research project focusing on informal economies and forms of street trading in cities of the Global South. This research raises questions about the practices of formalisation and politics of everyday negotiation and resistance. This is particularly at stake in Indian cities where the aftermath of the Street Vendors Act 2014 is yet to be investigated. The project engages with the dynamics of street trading in Mumbai and explores the synergies and contradictions among multiple agents in public space.

WSA LEAD:	Clarice Bleil de Souza (UK Participant)
WITH:	International Energy Agency – IEA Annex 79g School, Cardiff University); ODA partner: Debdulal Saha (IISER Mohali)
FUNDING:	EPSRC UK
YEAR:	2019-2024

Occupants in the Building Design Decision-Making Process

This stream of the IEA Annex 79 project examines data production and analysis on occupancy and occupant behaviour specifically related to design decision-making.

Annex 79 disputes the idea that energy efficiency and comfort are mutually exclusive and proposes occupants can be actively involved in improving building performance, therefore presenting an occupant-centric approach to building design and operation.

Specific objectives of Annex 79 include:

- Improve understanding of occupants' interaction with technologies and how they respond to different building technology interfaces designed to improve building energy efficiency;
- Investigate the role of data mining and machine learning techniques to develop comprehensive modelling strategies which include occupant behaviour in a suitable way;
- Developing guidelines and recommendations for standards to apply occupant behaviour in building design and operation.

This specific stream of the Annex project focuses on examining data production and analysis on occupancy and occupant behaviour specifically related to design decision-making, responding to the following objectives:

- How occupant modelling can be taken into consideration while designers are setting up design aims (brief development and conversations with clients and consultants);
- How occupant modelling can fit into the different types of analysis designers undertake while designing, considering the different types of questions designers ask about performance while undertaking design experiments in the different design stages;
- The identification of appropriate metrics and display systems useful to design decision making which consider occupant behaviour and interaction with controls and are also useful to communicate with clients and the different consultants involved throughout the design process;

These objectives feed to planned activities related to the development of guidelines to choose occupant model approaches to be used throughout the design process, considering design aims, climate, building typology etc. as well as the development of simulation-based design procedures and effective ways of communicating occupant-related information between different stakeholders.

Publications:

Bleil de Souza, C., Tucker, S., Deme Belafi, S., Reith, A., Hellwig, R., "Occupants in building design decision-making" In: O'Brien, W., Tamasebi, F. "Simulation-aided occupant-centric building design: Theory, methods, and detailed case studies." International Energy Agency IEA Annex 79 Book – Routledge, Taylor & Francis.

Bleil de Souza, C., Pezzica, C., Hahn, J. 2021. "Digital collaborative approaches for smart cities: when top-down meets bottom-up." In: Golubchikov, O. and Yenneti, K. Smart cities, energy and sustainability: Governing cities to a low-carbon future. Wiley.

Tahmasebi, F., Ouf, M., O'Brien, L., Abuimara, T., Tabadkani, A., Hong, T., Sun, K., Bleil De Souza, C. "Advanced simulation methods for occupant-centric building design" In: O'Brien, W., Tamasebi, F. "Simulation-aided occupant-centric building design: Theory, methods, and detailed case studies." International Energy Agency IEA Annex 79 Book – Routledge, Taylor & Francis.

GROUP LEAD:	Hu Du
WITH:	Phil Jones (Co-I)
FUNDING:	European Commission
YEAR:	2017-21

PLUG-N-HARVEST: Plug-n-play passive and active multi-modal energy HARVESTing systems, circular economy by design, with high replicability for Self-sufficient Districts Near-Zero Buildingse

An international consortium across Europe, including academics at Cardiff University, have received €6m in funding from the European Commission to develop a next-generation, energy-harvesting façade to retrofit existing buildings.

The aim of PLUG-N-HARVEST project is to create an energy efficient building façade with the ability to harvest solar energy and convert it into either electricity or heat, for use in the building itself or nearby buildings.

By harvesting renewable energy, it is hoped the technology will help to significantly reduce our reliance on traditional energy resources, such as coal and gas, and also help to lower energy bills.

Researchers from Cardiff University's Welsh School of Architecture are working on a range of research tasks including site survey, engineering requirements, system performance optimisation and evaluation, and demonstration. Once the façade has been developed, it will be tested in four different pilots in Germany, Spain, Greece and the UK.



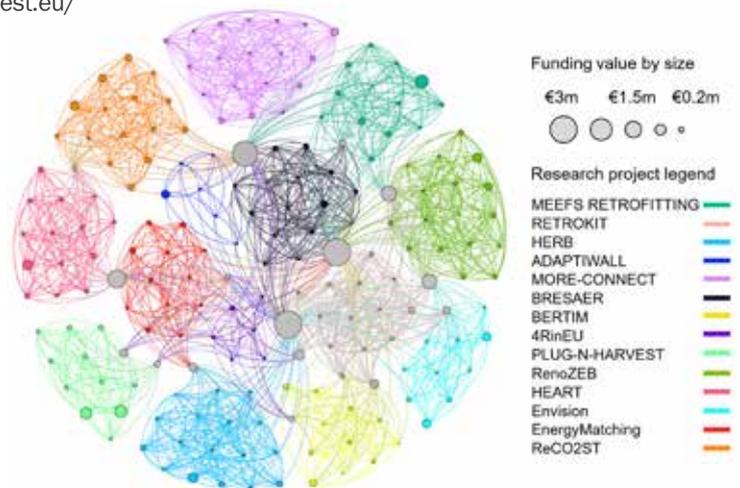
This Horizon 2020 project brings together 13 partners in Greece, Germany, Spain, Romania and UK, including universities, industry partners and local authorities – including Cardiff City Council. The project tackles the challenge of integrating energy-harvesting technologies into existing buildings, and provides an excellent platform to enhance our relationships with world-leading industrial partners.

Please find more information on our project website: www.plug-n-harvest.eu/

Publications:

Hu Du, Huang, P. and Jones, P. 'Modular facade retrofit with renewable energy technologies: The definition and current status in Europe', Energy and Buildings (2019) 205, article number: 109543. doi: <https://doi.org/10.1016/j.enbuild.2019.109543>

Hu Du, Streblow, R., Montalbá, L.M., Sendra, C. 'Post-Workshop Report for Plug-N-Harvest Modular Façade Retrofit Workshop on Sustainable Places 2019', Proceedings (2019), 20 (1), 14. doi: <https://doi.org/10.3390/proceedings2019020014>



WSA LEAD:	Mhairi McVicar
WITH:	Neil Turnbull (Co-I), Community Gateway, Grange Pavilion CIO, and students of the Welsh School of Architecture.
FUNDING:	RIBA Research Trust Award (2015)
YEAR:	2012 -

Practicing Engagement: The Value of an Architect in a Community Asset Transfer

This research within the partnership redevelopment of the Grange Pavilion by Grangetown communities and Cardiff University’s Community Gateway investigates the role of architectural education and practice in supporting community-led development.

The Grange Pavilion project began in 2012 as a partnership between residents of and Cardiff University to redevelop a vacant Bowls Pavilion and Green in a neighbourhood park in Grangetown, Cardiff as a Community Asset Transfer. This research project has been embedded in the project since its inception, pursuing questions it has raised along the way. What does a ‘space for all’ mean? How do ambitions for quality reconcile fears of gentrification? How is ‘value’ defined? What role does the architect play before and after design? How can care be constructed? What are the ethical consequences of a Community Civic Transfer? How can a small building in a small park act as a catalyst for actions amongst fluid networks of residents and private, public and third sector partners?

Action research and live teaching has been employed throughout each stage of the project’s development to explore these questions and to precisely document the complex and demanding processes involved in undertaking a Community Asset Transfer, supporting the launch, growth, fundraising, and construction of the project and of a community defined by a civic space. With the launch of the redeveloped Grange Pavilion in 2020, current research and live teaching is progressing into post-occupancy analysis to support the successful activation and long-term viability of this civic space, and to test its role as a catalyst for further community-led neighbourhood action.

Publications:

Mhairi McVicar, ‘Gathering-In-Action: the Activation of a Civic Space’, *Architecture and Culture*, 8 (3+4), October 2020.

Mhairi McVicar and Neil Turnbull, ‘The live project in the participatory design of a common ethos’ *Charrette, Journal of the Association of Architectural Educators*, 5 (2) Autumn 2018.

Mhairi McVicar, ‘Engender the confidence to demand better? The value of architects in community asset transfers’, *Architectural Design* 90 (4) (2020) pp. 46-51.



Mapping one year of a Community Asset Transfer. Image by Sarah Ackland, supervised by Mhairi McVicar.



Grange Pavilion, Dan Benham Architect and IBI Group. Image by Dan Benham.

WSA LEAD:	Clarice Bleil de Souza (UK Participant)
WITH:	Ilya V. Dunichkin – Moscow State University of Civil Engineering (MGSU) – Russia.
FUNDING:	RIBA Research Trust Award (2015)
YEAR:	2019 -

Regenerative Design and Modelling in Environments with Extreme Conditions

Experimenting with and developing guidelines to design regenerative and human-centric urban spaces in cold climates and difficult environmental conditions.

This is a research partnership between MGSU and the WSA which includes joint peer reviewed research publications and joint research grant applications. The cooperation of the two parties attracted the attention of other universities, whose representatives showed interest in cooperation with the WSA: State University of Land Use Planning, Higher School of Economics, Moscow Polytechnic University, Gubkin Russian University of Oil and Gas, Russian International Academy of Tourism.

Research areas include urban resilience to climate change, through modelling of environments in extreme conditions, based on unique design approaches, as well as advanced computational methods and experimental studies (mainly wind tunnel experiments) with various types of modeling techniques.

The partnership yielded publications which include theoretical discussions up to practice-based proposals in the development of guidelines to design liveable urban spaces in cold climates as well as human-centric perspectives to regenerate, upgrade and transform existing Soviet infrastructure (sustainable transport interchange hubs and residential neighbourhoods suitable for a more comfortable life). It also included publications in the urbanization of the areas around the Northern Sea Route as part of the strategic development of the Arctic Zone, which forms part of 40% of the Russian territory and raises sensitive issues of international importance.

The partnership is supposed to be strengthened by future bi-national funding opportunities which include outreach and dissemination of activities in important events such as for instance the Arctic Forum, led by the Russian Federation in collaboration with other members and observer countries of the Arctic Council and the EU.

Publications:

Bleil de Souza, C. Dunichkin, I.V. 2021. Axiomatic Design in regenerative urban climate adaptation In: Andreucci, M.B., Marvuglia, A., Baltov, M., Hansen, P. (eds.) "Rethinking Sustainability Towards a Regenerative Economy" Springer. ISBN: 978-3-030-71818-3. <https://www.springer.com/gp/book/9783030718183>

Bleil de Souza, C., Dunichkin, I. V. and Pezzica, C. 2019. A user-centred approach to design Transport Interchange Hubs (TIH): A discussion illustrated by a case study in the Russian Arctic. Presented at: ICCSA 2019, St. Petersburg, Russia, 1-5 July 2019. Computational Science and Its Applications, Vol. 11621. Springer pp. 489-504. (10.1007/978-3-030-24302-9_35).

Dunichkin, I.V., Bleil de Souza, C. 2020. An integrated solution to urban and sea waste management systems: using Axiomatic Design to discuss urban development risks. Far East Conference – International Multi-Conference on Industrial Engineering and Modern Technologies, Vladivostok, Russia, 1-4 October 2019, Vol. 459. Vol. 5. IOP Publishing Ltd. pp. 62084., (10.1088/1755-1315/459/6/062084). Nominated best Axiomatic Design paper 2019-2021 from the Axiomatic Design Research Foundation (ADRF).



Delivering joint lectures in Russian Universities, Moscow 2019.

WSA LEAD:	Oriel Prizeman
WITH:	Alistair Black (Illinois Urbana Champaign) (Co-I), Christopher Jones (CU COMSC) (Co-I)
FUNDING:	AHRC
YEAR:	2017-21

Shelf-Life: Re-imagining the Future of Carnegie Public Libraries

Shelf-Life seeks to address a problem of redundancy that threatens to waste high quality public buildings that are a century old.

Shelf-Life asks if the uniquely controlled procurement of over 2600 public buildings across Britain and America around 100 years ago by the Carnegie Library Programme could benefit from some systematic thinking for their re-vitalisation at a time of crisis. Using and developing new techniques of Historic Building Information Modelling (HBIM), the proposal aims to develop a parametric library of building components for Carnegie Libraries of the UK. A digital resource of common elements would enable better-informed, more sensitive and economic proposals for the rehabilitation and re-use of these buildings and set an example for others.

HBIM is limited by the availability of adequate object libraries because historic buildings do not generally have standard construction methods or

components and 3D scans, although geometrically accurate, can capture surface information only. 3D scans cannot determine the actual materials or structural elements of existing buildings that lie behind the surface. The number of Carnegie Libraries designed under a very controlled regime provides a unique resource. The deeper cataloguing of available information and technical guidance that is proposed here aims to make a step forward in enabling HBIM to facilitate informed conservation and design within these existing buildings.

Carnegie funding was critical to the public library movement in the UK and many of their features are common to other libraries of the time also. The research will focus upon British libraries but will make reference to the 2000+ US Carnegie libraries.

www.carnegielibrariesofbritain.com

Publications:

Prizeman, O., Boughanmi, M., Pezzica, C. 'Carnegie Libraries of Britain: Assets or liabilities? Managing Altering Agendas of Energy Efficiency', *Public Library Quarterly* DOI: 10.1080/01616846.2020.1826242.

Black, A. and Prizeman, O., 'The Design of the Carnegie library in Danville, Illinois (1904): Re-Reading the Reputation of the Carnegie library built-form in America', *Libraries: Culture, History, and Society* (forthcoming 2021).

Black, A. and Prizeman, O. E. C., 'Revisiting the Carnegie Public Library Built Form: The Design and Early History of Three Illinois Carnegie Library Buildings', 2020. *Library and Information History* 36(2), pp. 89-115. (10.3366/lih.2020.0019).

Prizeman, O. E. C., Pezzica, C., Taher, A., Boughanmi, M., 'Networking Historic Environmental Standards to Address Modern Challenges for Sustainable Conservation in HBIM', *Networking Historic Environmental Standards to Address Modern Challenges for Sustainable Conservation in HBIM*, *Appl. Sci.*, 10, 2020, 1283.

Prizeman, O. E. C., Jones, C., Parisi, M., Pezzica, C., 'How Can Century-Old Architectural Hierarchies for the Design of Public Libraries be Re-Interpreted and Re-Used?', *Journal of Cultural Heritage Management and Sustainable Development*, Vol. 8 No. 4, 2018, pp. 481-494.



Social and Spatial Forms

The study of the relationship between spatial and social forms through a series of case studies

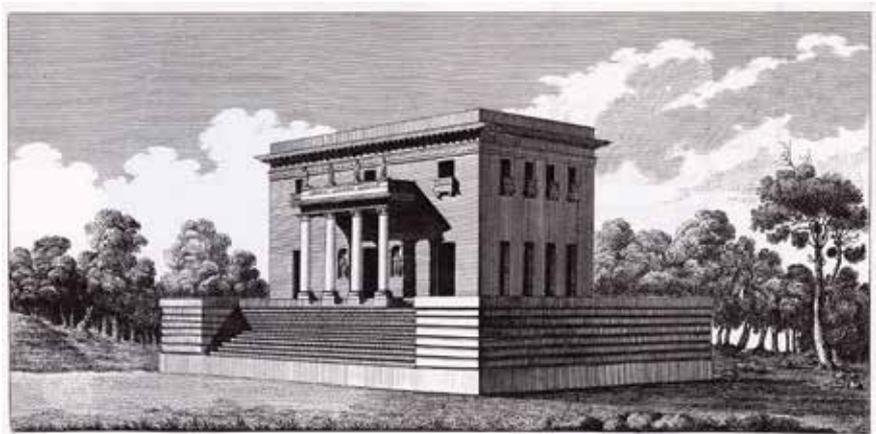
When architects in the 1960s read Claude Levi-Strauss's study of Amazonian tribes in his *Structural Anthropology*, they were struck by the diagram and description of the Bororo village: the spatial form of the village reflected with precision the social organisation of the tribe. Thanks to its directness, the diagram of the village made visible a relationship that is usually veiled, a relationship that stands at the centre of architecture and urban design.

The relation of societal organization to spatial organization is tacitly situated at the centre of the spatial practices of architecture, urban design and planning. Tacitly, because this relation is not ordinarily the preoccupation of their discourses. The spatial practices usually operate within a preconceived understanding of societal conditions and structures in which the "palette" available to them is pre-determined, and consequently the question of relation of spatial to social form remains a subtext, while, in effect, being central to them. Only at moments in which societal transformation is experienced, in which new social forms emerge and demand a spatial response, does the issue move to the fore of concerns.

In eras of societal restructuring, architects, urban designers and planners are called upon to find adequate spatial forms for new, emerging social forms. Such moments explain the intense interest in the form of the socialist city in 1929-31 Soviet Union, or in the 1960s discussions in Italy among the architect Aldo Rossi (1991), architectural historian Manfredo Tafuri (1976) and others. This research interrogates the relation of social to spatial form through a series of cases, each of which brings to the fore disparate conditions and highlights very different issues. It is an expansion of earlier research published in the third part of *The Efficacy of Architecture*.

Publications:

Tahl Kaminer, 'Von Ledoux bis Mies: The Modern Plinth as Isolating Element', *ARQ*, 23.1, 2019, pp. 21-32.



Ledoux, Jarnac House.

WSA LEAD:	Chris Tweed and Simon Lannon
WITH:	as partners in the wider Smart Energy Research Laboratory (SERL): University College London (UCL) (lead institution); University of Essex – UK Data Archive; University of Edinburgh – School of Informatics; Leeds Beckett University; Loughborough University; University of Southampton; Energy Saving Trust;
FUNDING:	EPSRC
YEAR:	2017-2022

Social Housing Research on Energy from Welsh Data (SHREWD)

An energy database for social housing in Wales through to inform housing and energy efficiency policies, such as the Welsh Housing Quality Standard (WHQS) that will allow the impact of interventions to be evaluated.

The SHREWD project is funded as part of the Smart Energy Research Laboratory (SERL) and will create an energy database for social housing in Wales to inform housing and energy efficiency policies, such as the Welsh Housing Quality Standard (WHQS).

SHREWD will recruit households from the social housing sector and use data obtained from social landlords to monitor the impact of interventions. The SERL observatory will be used as a control to compare results with the wider UK housing stock.



Smart meter

South Wales Indoor and Outdoor Air Quality

Use of low cost Enviroplus particulate sensors to compare outdoor and indoor air quality in Bridgend, South Wales

Two low cost Enviroplus particulate sensors have been deployed in Bridgend, South Wales. The indoor sensor is located in a study used in the daytime during weekdays. The outdoor sensor is located in a garden adjacent to a railway line and within 0.5 km of a dual carriageway and the M4. Traffic flow on the M4 is recorded via photographs taken on two mornings per week. The correlation between the outdoor and indoor particulates will be assessed against the traffic flow.



Systemic Approach to Architectural Performance

SAAP is a fusion of process based fields formally initiated by the integration of Systems Oriented Design and Performance Oriented Architecture. It develops methodology and generates theory through experimental practice. SAAP involves Time Based EcoSystemic TransDisciplinary CoDesign that is performed by both biotic and abiotic agents, including humans. It belongs to the broader field of Systemic Design, considering the overall ecosystem.

Systemic Approach to Architectural Performance (SAAP) design field discusses the question of cities' adaptation to climate change and biodiversity loss. Current environmental ecology research shows that species that have adapted to agricultural land hundreds of years ago are recently adapting to life within the cities. Our agricultural land has become so toxic, due to pesticides, etc., that the built environment now offers them better-living conditions. Our cities, therefore, need to adapt to such coliving situation.

The research demonstrates such adaptations through full-scale ecosystemic prototypical urban interventions, their and the ecosystem's tokenisation and the prototypes' historical context studies. It considers not only the prototypes' design and creation process but also their performance within the 'real-life' environment. The research covers observations of prototypes' generative codesigning agency across the ecosystem and speculations of their futures. The agency is including human and non-human, living and non-living communities. Further on, the work reaches a larger scale and layer through spreading its parametric DIY recipes and codes for prototypes' locally adapted iterations for communities across the world.

Publications:

Davidová, M. & Zímová, K. (2021). COLreg : The Tokenised Cross Species Multicentred Regenerative Region Co Creation. *Sustainability*, 13(12), 1-23. <https://doi.org/10.3390/su13126638>

Nousala, S., & Davidová, M. (2021). The Inter/trans-disciplinary balancing act: The exclusive/inclusive determinants, processes, and consequences that impact our socio-economic systems. *Journal of Systemics, Cybernetics and Informatics*, 19(1), 145-157. Retrieved from <http://www.iiisci.org/journal/sci/FullText.asp?var=&id=IP124LL21>

Davidova, M. (2020). Cocreative roles, agencies and relations in post-Anthropocene: the real life gigamaps and full-scale prototypes of SAAP. *Strategic Design Research Journal*, 13(2), 185-212. <https://doi.org/10.4013/sdrj.2020.132.06>

Davidová, M. (2020). Synergy in the Systemic Approach to Architectural Performance: The Integral Multi- and Cross-Layered Agencies in Eco-Systemic Generative Design Processes of the Post-Anthropocene. *FormAkademisk - Research Journal of Design and Design Education*, 13(2), 1-30. <https://doi.org/10.7577/formakademisk.3387>

WSA LEAD:	Adam Hardy
WITH:	Co-Is : Oriel Prizeman, Crispin Branfoot (SOAS), Ajay Khare (SPA Bhopal), Shikha Jain (DRONAH Delhi)
FUNDING:	AHRC
YEAR:	2016-2021

Tamil Temple Towns: Conservation and Contestation

The project aims to provide an authoritative body of research to inform inclusive and sustainable guidelines for heritage conservation and in the living temple cities of Tamil Nadu, India, focusing on Madurai and Kumbakonam.

The project arises from pressing issues of contested heritage in the great, living temple complexes at the heart of rapidly growing cities in Tamil Nadu. It examines two distinct temple cities of Tamil Nadu, Madurai and Kumbakonam, to address current concerns over the ways in which some functioning temples are being restored. Such concerns have recently led to court cases, and the involvement of UNESCO in an attempt to find ways to create appropriate conservation guidelines acceptable to different stakeholders. These must take into account the prescriptions of ancient Sanskrit ritual and architectural treatises, still much revered though not sufficiently understood. The project therefore aims to provide an authoritative body of research to inform inclusive and sustainable guidelines for heritage conservation and management in the temple cities. It will provide a well-researched history of the architecture,

urban settings, and phases of renewal of the representative temple structures, and articulate the different narratives and perceptions about these sites. The nature of recent restorations will be ascertained and evaluated. Sanskrit texts will be studied for an overview of their relevant instructions, and to show how their theoretical concepts relate to the actual practice of temple design and conservation.

Digital models are being created to encapsulate the research findings, to provide data for architectural analysis, and as a tool to elicit and express the multiple viewpoints of the community and stakeholders. The findings, as a basis for the future guidelines, will be presented in a report, which will appear on the project website along with the models.

Publications:

Prizeman, O. et al. 'Proposing digital models for the discussion of contested conservation practice: Case studies from Tamil Nadu, India', 27th CIPA International Symposium 'Documenting the past for a better future', Avila, Spain, 1-5 Sept 2019 ISPRS Annals of Photogrammetry, Remote Sensing and Spatial Information Sciences, Vol. IV-2/W. Copernicus pp. 133-140., (10.5194/isprs-annals-IV-2-W6-133-2019)



WSA LEAD:	Wassim Jabi
WITH:	Simon Lannon, Aikaterini Chatzivasileiadi, UCL
YEAR:	2019 -

Topologic: Enhancing the Representation of Space in 3D Modelling Environments

The goal of this research project is to use computational topology to support the creation and analysis of the lightest, most understandable conceptual building information models.

Buildings enclose and partition space and are built from assemblies of connected components. However, conventional building information modelling (BIM) applications do not explicitly model the enclosure of space. Although it might be possible to indirectly infer the enclosed spaces from the position of the physical building components, the fidelity of this representation depends on the precise connectivity of the bounding physical components, which cannot be relied upon. Even if this approach was viable, the level of detail of BIM models is often too complex for this type of analysis. One possible solution is to use formal topology to represent the many different forms of spatial and material partitioning and connectedness found within buildings. Thus, the objective of this research project was to develop computational design tools based on precise topological principles but presented in ways which are understandable by architectural users who may have little previous experience of topology. The research project resulted in the open-source “Topologic” software library which integrates several architecturally relevant topological concepts into a unified application toolkit. The goal of the Topologic toolkit is to support the creation of the lightest, most understandable conceptual models of architectural topology.

The intention is that Topologic can be an effective intermediary between the abstract world of topology and the practical world of architecture and building engineering. The challenge in developing the software has been to maintain the theoretically consistent use of topological concepts and terminology yet relate these to the more ambiguous concepts of space and “connectedness” found in architecture. Because the formal language of topology is well-matched to the data input requirements for applications such as energy simulation and structural analysis, Topologic encourages design exploration and performance simulation at the conceptual design phase.

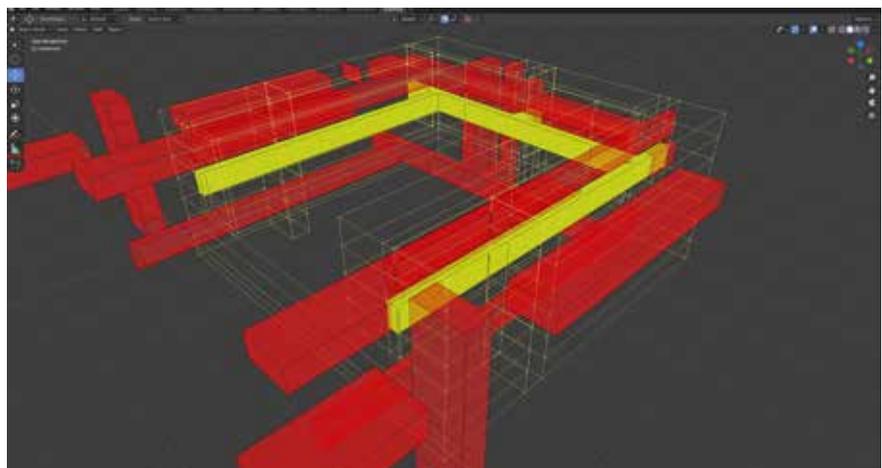
This project is a collaboration between Cardiff University and UCL.

Publications:

Jabi, W., Soe, S., Theobald, P., Aish, R., & Lannon, S. (2017). Enhancing parametric design through non-manifold topology. *Design Studies*, 52, 96–114. <https://doi.org/10.1016/j.destud.2017.04.003>

Jabi, W., & Chatzivasileiadi, A. (2020). Topologic: exploring spatial reasoning through geometry, topology, and semantics. In S. Eloy, D. L. Viana, F. Morais, & J. V. Vaz (Eds.), *Formal Methods in Architecture Proceedings of the 5th International Symposium on Formal Methods in Architecture (5FMA)*, Lisbon 2020 (pp. 277–285). Springer, Cham. <http://orca.cf.ac.uk/132847/>

Jabi, W., & Alymani, A. (2020, May). Graph machine learning using 3D topological models. *SimAUD 2020 Conference*. <http://orca.cf.ac.uk/131855/>



Topological model illustrating how to find adjacent cells in a CellComplex

WSA LEAD:	Hiral Patel
WITH:	Chris Tweed (Co-I) Reem Okasha (RA) Simon Johns (RA, School of Social Sciences, Cardiff University)
Funding:	ESRC Impact Acceleration Account, Cardiff University
YEAR:	2021–2022

University Spaces Fit for the Fourth Industrial Revolution

In the context of the fourth industrial revolution and COVID-19 pandemic, the project aims to develop new ways of designing and managing higher education spaces in collaboration with universities, architectural firms and education consultancies.

The fourth industrial revolution (4IR) is characterised by proliferation of technological advances such as the internet of things, augmented reality, big data, virtual reality, 3D printing, artificial intelligence and robotics. Klaus Schwab, the founder of the World Economic Forum who coined the term, argues that 4IR is the fusion of advancing technologies across the physical, digital and biological domains. These developments are anticipated to reshape the nature of work, some of which are evident in current trends of decentralised working and automation of jobs.

Due to the changing nature of work, substantial national programmes will be required to retrain and upskill people whose jobs will be affected by these disruptive technologies, and lifelong learning will require renewed importance. These developments suggest a need for new higher education (HE) models which will have a profound impact on the UK HE institutions and the nature of learning spaces that will be required.

COVID-19 also initiated a rapid digital transition towards the online delivery of study programmes. Learning activities have been re-designed for online delivery, and insights into the experiences of staff and students are emerging highlighting the need to reconsider the role of physical university spaces. However, the impact of these new HE models on university spaces remains to be known. New ways of designing and managing learning spaces are required to ensure an alignment is achieved between evolving curriculum and learning spaces.

This project aims to co-create a research agenda with industry partners for lifelong learning spaces within HE institutions fit for the 4IR and develop new ways of designing and managing the university spaces.

Summary of events, case studies and podcasts can be found at: futurelearningenvironments.org

Urban Food Growing – What Are Our Options?

In a context of increasing urbanisation and industrial food production – how can people reduce the impact of their food?

Global populations are becoming more urbanised. Agriculture is becoming more industrialised. In this context – what are the most space efficient methods of growing food in an urban environment? Can this reduce environmental impact compared to shop bought? Experiments with greenhouse hydroponics (deep water culture), greenhouse growing with artificial substrate, outdoor peat free compost in pots and outdoor small planting beds are used to compare different approaches and results. This is not a comparison of growing one plant in each growing type (as many plants are not suitable for all approaches) rather an exploration of best use of these options.



Anaheim Chilli Peppers – growing in December 2020



Oca roots – harvested in December 2020

WSA LEAD:	Tahl Kaminer
WITH:	Maros Krivy, Leonard Ma (EKA); Helen Runting, Karin Matz, Rutger Sjögrím (KTH); Juliet Davies (WSA/CU); Alex Maclaren (Heriot-Watt); Timothy Moore (Monash)
FUNDING:	Leverhulme Trust (Kaminer)
YEAR:	2021-

Urbanising Suburbia: Hyper Gentrification and the European Global City

A research into the effects of inner-city hyper-gentrification on the suburban rings of European global cities

Up until recently, gentrification studies, architectural and urban projects have focused on the ‘revitalisation’ of inner cities. But the effects of recent ‘super gentrification’, driven by international investment and operating on already-gentrified inner-city neighbourhoods, are now impacting the suburban belts of global cities such as Vancouver, New York and London: the outward migration of poor and middle class is urbanising suburbia, upping densities, altering local culture, modifying political outlooks and introducing new morphologies and typologies.

In the process, the clear distinction between the urban role of inner-city neighbourhoods and that of the suburban belt has been eroded.

Urbanising Suburbia studies ‘super gentrification’ through the lens of Europe’s global cities. It will attempt to explain the causes of ‘super gentrification’, identify its spatial and cultural manifestations, and outline the trajectory of the process. The session will include papers interrogating gentrification theories’ upending by ‘super gentrification’, as well as papers analysing the social, cultural and

formal changes taking place in the suburban belts of Amsterdam, Berlin, London and Stockholm. The session will attempt to identify correlations and disparities in the effects of ‘super gentrification’ in these cities in order to develop a more rigorous conception of the phenomenon and a better understanding of the form and logic of the emerging ‘urbanised’ suburbia.



Publications:

Ross Exo Adams, Tahl Kaminer, Maroš Krivý, et al, ‘Hyper Gentrification and the Urbanisation of Suburbia’, in Penny Lewis (ed.) Architecture and Collective Life (London: Routledge, forthcoming).

Royal Military Academy, Woolwich, London, by diamond geezer, licensed under CC BY-NC-ND 2.0.

Use of Storage and Renewable Electricity Generation to Reduce Domestic and Transport Carbon Emissions – Whole Life Energy and Cost Analysis of Single Dwelling Case Study (UK)

Investigating the whole life energy, carbon and cost of an integrated renewable energy generation system

The case study is a detached dwelling situated in South Wales, UK. It had a 3.6kWp vertical PV installed in 2014 and a 6.12 kWp roof mounted PV installed in 2020 along with a 13.5 kWh electricity storage device, closely followed by an electric vehicle and charger.

The impact of these interventions on reduction of domestic and transport carbon emissions is considered in relation to energy tariffs which encourage the user to shift consumption from “high carbon” generation times (generally matching peak consumption in the evening) to “low carbon” generation times (generally overnight or during peak renewable energy generation).

First year monitored data is used to assess the validity of the pre-installation cost-benefit analysis which was used as a basis for carrying out the investment. It is also used to consider the whole life payback of the embodied energy and carbon.



Image of case study dwelling with South Façade PV and West Roof PV – ©David Hassett 2020

Welsh School of Architecture

Research Centres and Consultancies

Design Research Unit Wales (DRUw)

Our work spans design-based research and consultancy commissions, addressing low carbon design, landscape and placemaking.

DRUw was established at the turn of the millennium to implement architectural, urban design and landscape projects from the position of research in order to ensure the discipline of design was properly represented within the academy.

DRUw's work spans design-based research and consultancy commissions, addressing low carbon design, landscape and placemaking. We provide a vehicle for cross-disciplinary working, potentially connecting all the research centres and exploring the potential of design-based research.

Since winning RIBA awards in 2002 for the Baglan Eco-Factory and 2010 for the Margam Environmental Study Centre including Welsh Passivhaus at Ebbw Vale, the development of a low cost housing system called Tŷ Unnos funded through Innovate UK and innovative care schemes at Aberafan and Cwm Aur, Llanydydder have been completed.

Recent focus has been on innovative housing projects and buildings for care. DRUw will be closely aligned to the Design, Practice, Materials and Making RSG in the future and will enhance its industry-focus (such as expanding collaborations with Welsh housing associations and their supply chains).

Contact: Wayne Forster; Ed Green; Steve Coombs

Low Carbon Research Institute (LCRI) & ESRI

Set up in 2008 as a research networking group, LCRI's activities have been taken forward by the Energy Systems Research Institute.

Low Carbon Research Institute (LCRI), a networking group that brought together 120 contributors from different universities, led the development of a low carbon agenda. Its work has been taken forward in the Energy Systems [University] Research Institute (ESRI), which is co-directed by Jones. LCRI and ESRI's research has contributed to impact through projects such as Microclimate Modelling and two of our Impact Case Studies, developing the 'whole house' approach and addressing carbon emissions and fuel poverty.

Contact: Phil Jones

Practice, Research and Advancement in South Asian Design and Architecture (PRASADA)

We are an established centre for studying the architectural traditions of South Asia and its Diaspora.

We aim to integrate academic research with creative practice through research projects and publications, design consultancy work, teaching and postgraduate research programmes.

Our current projects include Hardy and Prizeman's Tamil Temple Towns and the construction of a PRASADA-designed temple in India.

Contact: Adam Hardy

Centre for Sustainable Design of the Built Environment (SuDoBE)

We are a joint venture between the Building Research Establishment (BRE), the Welsh Assembly Government and the Welsh School of Architecture in Cardiff University.

The Building Research Establishment and Welsh School of Architecture are both recognised as centres of excellence for research in the built environment and have both been contributing to the body of knowledge about sustainability in the built environment for many years.

Established in 2007 with the appointment of its Director, Professor Chris Tweed, we bring the two organisations together to focus on promoting sustainable design in Wales, the UK and internationally.

Contact: Chris Tweed

Welsh School of Architecture PGR students 2021

Abdulrahman Aljhadali

Value of Architects in the Era of Artificial Intelligence

Abdulrahman Ahmed A Alymani

Rediscovering a Contemporary Relationship Between Building, Envelope and Ground

Abeer Qaed

Colonial and Post-Colonial Heritage Influence on local Cultural Identity: the case of Old Districts in Bahrain

Adell Salem Emhemed Awaj

Enhancing the Quality of Urban Public Open Spaces in Tripoli Through Socio-Culturally Sensitive Design Intervention

Ahmed Abdullatif Alyahya

The Practice of Ecomimicry in Optimizing the Building Envelope Design to Reduce Energy Demands in Hot-Dry Desert Regions.

Amalia Banteli

Whole Building Embodied Energy and Carbon Calculation Potential and Its Inclusion to Early-Stage Design Through Building Information Modelling

Ammar Alammar

Design, Methods and Technologies for Innovated Facades

Anas Lila

Urban Fabrics as a Tool of Urban Heat Island Mitigation

Anne Sarah Bellamy

Designing Dying Well: Towards a New Approach to the Design of Palliative Care Environments for the Terminally Ill

Azamat Chinaliev

Mapping and Understanding Urban and Rural Fuel Poverty in Wales

Basak Toren

Climate Responsive Building Envelope Design & Thermal Resilience

Bayan Faisal Fathi El Faouri

Heritage-Led Urban Regeneration in The Context of Unesco World Heritage Nomination: Critical Sustainable Alternatives for The City of As-Salt in Jordan

Baraah Muqaddam

Changing Sides: The Place of the Wall, the Gate and the Community in 21st Century Jeddah

Benjamin (Chidiebube) Okenwa

Using Computer Walkthrough Simulation to Engage Design Strategies that Enhance Physical Activity in Urban Open Spaces.

Bingyu Liu

The Evolutionary Process of the Seaweed House in Jiaodong Peninsula

Bo Lin

Exploration of the Potential Use of Artificial Intelligence in Urban Design

Cennet Ascioğlu

The Relationship Between Architectural Form and Social Behaviour in the Case of Social Housing Projects in the Twentieth Century

Chinedu Esther Onyekwere

Impact of Reuse and Recycling of Construction and Demolition Waste on Construction Projects

Clara Larissa Lorenz

Daylight Design Optimization Using Artificial Neural Networks

Cynan Jones

Energy Efficient Edible Mushroom Cultivation

(Ade)Damola Ojerinde

The Use of Rice Husk Ash as a Stabilizer for Compressed Earth Blocks to Construct Affordable Houses

Diana Waldron

Plants & Architecture: Nature Inspired Design and Biomaterials

Elys Steven John

Fundamentals for Architecture

Emmanouil Perisoglou

Effective Control of Transpired Solar Collectors

Fahad Alshiddi

Examining the Sustainability of Mosque Design in Saudi Arabia Through The Global Sustainability Assessment System (Gsas)

Faisal Farooq

Developing Optimal Domestic Low Carbon Ventilation Technologies to Improve Air Quality and Reduce Health Risks from Indoor and Outdoor Air Pollution

Francisca Melina Guiraldos Diaz

Heritage Preservation: Exploring New Architectural Strategies Through the Intangible Values.

Gizem Parlak

Contributions of Citizen Professional Role for Community Involvement in Urban Conservation Projects in Turkey

Hadjer Messabih

A Diverse Architectural Heritage to Understand the Cultural History of Algeria: Algiers, Oran, Timgad, And Ghardaia

Hameda Janahi

Transformation of Housing Typologies in Qatar: The Effect on Inhabitants' Behaviour and Wellbeing.

Welsh School of Architecture PGR students 2021 (continued)

Hashem Abdulrahman Alhumayani

Saudi Vision 2030: The Using of Digital Fabrication in Designing Affordable Housing

Hester Medi Rowe Buck

Regenerative Architecture: Learning About Moss: Exploring the Link Between the Climate Crisis, Education and Participatory Architectural Practice Through a Case Study and Live Research

Hilary Wyatt

Towards the Development of a Sustainable Framework for the Coherent Conservation of Maritime Heritage Settings in The UK & Ireland

Irini Iraclitza Gaia Barbero

Towards Restorative Spaces: The Function of The Poetic Experience in the 21st Century

Gizem Parlak

A Study on the Relationship Between Informal Learning and Public Environments on Typical University Campuses in China

Houda Almutairi

Fragmented Sensespaces: The Life and Death of Bodily Architecture

John Christopher Daw

What Works for Big Data in Public Policy Making

Juan Fernando Usubillaga Narvaez

Political Activism as Urban Design: Investigating the Production of Informal Settlements Through Practices of Political Activism

Juan Pablo Fernández Goycoolea

Rethinking Values in Sustainable Housing: Relations Between Grid Dependency Levels and Social Empowerment

Jue Zhou

Building Assessment Standards: From Discourse Shifts in Sustainable Development to Implementation in Practice

Lei Chen

Research on Sustainable Strategies in Building Retrofit Based on Multiple Factors Related to Human Health

Likun Yang

Redesigning Abandoned Industrial Buildings in Taiyuan City for Ecological and Social Sustainability

Lin Geng

Building in Turbulent China: The Baptist Missionary Society and Building Fusion and Localization

During the Early 20th Century in China

Lizzie Wynn

Solid Waste as a Construction Material Solution

Lui Tam

Sustainable Conservation of Timber Architectural Heritage in East Asia

Luma Sallam Saleh Daradkeh

Understanding the Social Production and Reproduction of Camp-Cities Urban Eco-Systems: Towards a Holistic Multi-Scalar Urban Design Approach

(Maria) Luz Navarro Eslava

The Topology of Urban Conflict and the Transformative Potential of Dissensus

Mamuna Iqbal

A Comparative Study of The Schools of Architecture of Lahore (Pakistan) To Understand the Influences of the Context on Learning Ability of Architectural Design.

Miltiadis Ionas

Building a GIS-Based Energy Monitoring System at a Regional Level, as a Tool for Large Scale Holistic Energy Management in Built Environment

Ming-Yeung Tse

Optimised Model for the Thermal Environmental of Building Transitional Spaces

Mohamed Em Ab Dgali

An Investigation into the Energy Efficiency of Traditional and Modern Buildings In Libya and the Development of Culturally Sensitive Low Energy Buildings

Mohammad Abukeshek

Defining Practical Features for Creating Green and Sustainable Interior Environments in Jordanian Healthcare Facilities

Mohammed Alghafis

Conventional Identity Crisis in the Built Environment of the Ksa Regions: The Traditional Town of Al-Qassim

Mohd Luqman Hussin

Machine Learning and Big Data Analytics for Disruptive Building Energy Management in Occupant Behaviour

Monisha Margaret Peter

The Global City Vs the City Of Refugees: Designing The Future Of Urbanism

Nilsu Erkul

An Investigation of The Contested Heritage of Ghost Town Varosha, Cyprus

Noah Gethsemane Akhimien

A Framework for Incorporating Circular Economy in The Design of Energy Efficient Residential Buildings in Nigeria

Nooridayu Binti Ahmad Yusuf

The Traditional Muslim-Malay Marketplaces of The East Coast of Malaysia: Architectural and Socio-Cultural Patterns

Welsh School of Architecture PGR students 2021 (continued)

Nur Abd Salam

Sustainable Retrofitting of Double-Storey Terraced Houses in Tropical Climate for Balancing Daylighting, Privacy, Thermal and Visual Comfort Using Computational Approach

Phakthima Wangyao

Sustainability through designing for adaptive reuse of industrial heritage in Thailand

Rawan Jafar

Investigating the role of vegetation in Integrating Building Information Modeling (BIM) and Positive-Impact in Regenerative Architecture Design

Reem Okasha

Design of Schools in Egypt: A Regenerative Perspective

Sarah O'Dwyer

Establishing the Commonality Between Aesthetic and Sustainable Architecture to Deliver Design Excellence in Form and Performance.

Salwa Albarssi

The Potentiality of Altering Existing Residential Buildings to Improve Their Energy Efficiency: A Path Toward a Sustainable Future

Shariffah Sy Yusoff Fadzil

Flood Victims Shelter Focusing on Sustainability Issue of Life Cycle of Shelters in Kelantan and Trengganu, Malaysia

Shuye Wang

A Community-Based Approach to Promote Energy Retrofit of Rural Houses in China

Siyu Duan

Reducing the Energy Performance Gap from A Technical and Occupants' Perspective and Achieving Better Thermal Comfort in UK Housing

Suet-In Tsang

Multi-Parametric Analysis for Green Building Design

Warangkana Juangjandee

Indoor Air Dehumidification of Residential Buildings with Passive Cooling and Recycled Materials Installation: A Case Study of Thailand Urban Areas

Weronika Tadrak

Impact of Scaling Up Smart Houses to Smart Energy Systems on Urban Infrastructure - Case Study Cardiff, South Wales

Xiao Hu

Sustainable Design of Hillside Development in Guizhou, China

Xuan Shen

Towards Sustainable Streets Design: Indicator System of Sustainable Evaluation for Shanghai Streets.

Yagmur Burcu Gunes

A Model for The Social and Spatial Integration of Urban Coastal Fill Areas

Yangluxi Li

Sustainable System in Building Integrated Design

Yue Hou

Explore the Contribution of Urban Public Space to Enhancing the Sense of Belonging of Immigrants (In Cases of Shenzhen And London)

Zein Al-Doughmi

Post-Occupancy and Performance Evaluation of Climate Adaptive Facades

Zhehao Cui

Towards a Systematic Methodology to Improve the Accuracy of Prediction Results For Energy Consumption in Buildings