All contributors granted Massachusetts Institute of Technology (MIT) worldwide rights and permission to reproduce, distribute, publicly display, and publicly perform the following Work in electronic format on the ArchNet Internet web site at URL http://archnet.org.

Views, opinions, and research results are the responsibility of the contributors. Images and figures are provided by the contributors.

Copyright © 2018 Archnet-IJAR, Archnet, MIT- Massachusetts Institute of Technology

Archnet-IJAR is published and archived by ARCHNET, the most comprehensive online community for architects, planners, urban designers, interior designers, landscape architects, and scholars working in these fields, developed at the MIT Libraries-Aga Khan Documentation Center, MIT School of Architecture and Planning in close cooperation with, and with the full support of The Aga Khan Trust for Culture, an agency of the Aga Khan Development Network.

Copyright Permission
Attribution Non-Commercial No Derivatives (CC-BY-NC-ND)
Users are free to copy, distribute, or display the work for non-commercial purposes only, but must credit the copyright holder (author, photographer, etc.). Derivatives are not permitted.
ArchNet-IJAR is an interdisciplinary scholarly open access journal of architecture, planning, and built environment studies. The journal aims at establishing a bridge between theory and practice in the fields of architectural and design research, and urban planning and built environment studies. The journal has two international boards; advisory and editorial. The range of knowledge and expertise of the boards members ensures high quality scholarly papers and allows for a comprehensive academic review of contributions that span wide spectrum of issues, methods, theoretical approaches and architectural and development practices.

ArchNet-IJAR is indexed and listed in several scientific and research databases, including Avery index to Architectural Periodicals, EBSCO-Current Abstracts-Art and Architecture, INTUTE, Directory of Open Access Journals, Pro-Quest, Scopus-Elsevier, Web of Science, CNKI-China National Knowledge Infrastructure, and many university library databases. It is also archived by ArchNet, the most comprehensive online community for architects, planners, urban designers, interior designers, landscape architects, and scholars working in these fields, developed at the MIT School of Architecture and Planning in close cooperation with, and with the full support of The Aga Khan Trust for Culture, an agency of the Aga Khan Development Network.

All contributors grant Massachusetts Institute of Technology (MIT) worldwide rights and permission to reproduce, distribute, publicly display, and publicly perform the following Work in electronic format on the ArchNet Internet web site at URL http://archnet.org

ArchNet-IJAR was established in 2007 and is led by the Chief Editor Professor Dr. Ashraf M. Salama with support from co-editor: Dr. Farzad Pour Rahimian. Two international boards (advisory and editorial) ensure the quality of scholarly papers and allow for a comprehensive academic review of contributions spanning a wide spectrum of disciplinary issues, methods, and practices.

Focus and Scope

ArchNet-IJAR Objectives
ArchNet-IJAR objective is to establish a bridge between theory and practice in the fields of architectural and design research, urban planning, and built environment studies. It reports on the latest research findings and innovative approaches for creating responsive environments, with special focus on architecture and planning in developing countries. ArchNet-IJAR is truly international and aims at strengthening ties between scholars from different parts of the world with contributors and readers reaching across geography, boundaries, and cultures.

ArchNet-IJAR publishes research studies, criticisms and critical analyses about the creation, use, and evaluation of different types of environments at the macro and micro scales. The journal includes original empirical research papers, analytical case studies, and high quality position papers that contribute to the advancement of knowledge in architecture and urbanism.

Four major areas are covered by ArchNet-IJAR:

Architectural and Design Research
Topics include - but not limited to: architectural pedagogy and design studio teaching practices; architectural and sustainable design; design methods and architectural theories; architectural criticism; design and project programming; environment-behavior studies; information technology; Islamic architecture; computer applications and virtual environments.
post occupancy and facility performance evaluation; and social and cultural factors in design.

**Urban and Built Environment Studies**
Topics include --but not limited to: administrative and political factors contributing to the shaping of communities, cities and urban regions, community planning; sustainable urban conservation; environmental planning and eco development; housing policy, planning, and design; new urbanism; everyday urbanism; sustainable development; space syntax and GIS applications; and way-finding and signage systems.

**Critical Essays on Architectural and Planning Projects**
Essays that cover the above topics; critically discussing projects in use; after they have been designed, built and occupied. Articles are preferred to utilize the case study approach as a critical method in built environment research.

**Reviews and Trigger Articles**
In this section, non-refereed, thought provoking articles are published while book reviews, conference announcements of interest to ArchNet-IJAR readers are outlined and summarized including critical reviews of recent books. The intention of this section is to give room for more voices so that the debate goes beyond pure academic writing. Therefore, this section represents a means of rapidly disseminating innovative ideas or lessons learned from experience and practice. However, while following the same graphical format, submissions are reviewed by the chief editor and interested board members principally on the basis of usefulness and interest to ArchNet-IJAR readers. However, this section is not necessarily a regular section and it will be available based on the quality of submissions received.

**Notes to Contributors**

**Publication Ethics - Malpractice**
ArchNet-IJAR: International Journal of Architectural Research is committed to adopting and implementing the highest standards of publication ethics and takes all possible measures against any publication malpractices. Contributors submitting their works to the ArchNet-IJAR for publication as original articles attest that the submitted works represent their actual contributions and have not been copied or plagiarized in whole or in part from other works. By submission of manuscripts to the chief editor, the authors acknowledge that they have disclosed all and any actual or potential conflicts of interest with their work or partial benefits associated with it.

ArchNet-IJAR: International Journal of Architectural Research is committed to objective and fair double-blind peer-review of the submitted contributions for publication and to preventing any actual or potential conflict of interests between the editorial and review personnel and the reviewed material.

Papers are reviewed based on the following criteria:

1. Originality: Does the paper contain new and/or significant information adequate to justify publication?

2. Relationship to Seminal Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?
3. Research Methodology: Is the paper's argument built on an appropriate base of theory, concepts, or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed, robust, defendable and appropriate?

4. Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together all elements of the paper?

5. Interpretation, Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?

6. Quality of Communication: Does the paper clearly express its case, measured against the technical language of the field and the expected knowledge of the journal’s readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc. Do the figures/tables aid the clarity of the paper?

Publication Frequency
ArchNet-IJAR is published three times a year, in March, July, and November. An archive of all previous issues can be found here:
http://archnet-ijar.net/index.php/IJAR/issue/archive

Archiving
An archive of all previous issues with downloadable articles in PDF format is available here:
http://archnet-ijar.net/index.php/IJAR/issue/archive

ArchNet-IJAR utilizes the LOCKSS system to create a distributed archiving system among participating libraries and permits those libraries to create permanent archives of the journal for purposes of preservation and restoration. More...

ArchNet-IJAR Registration and Indexing
ArchNet-IJAR ISSN - United States (Online) 1938-7806

The journal was first registered in the following portals:
- OCLC & World Cat (Online Computer Library Center and World Catalogue) # 145980807
- Library of Congress Catalogue, LOC # 2007212183


ArchNet-IJAR is led by the Chief Editor Professor Ashraf M. Salama with support from collaborating editor Dr. Farzad Pour Rahimian. Two international boards (advisory and editorial) ensure the quality of scholarly papers and allow for a comprehensive academic review of contributions spanning a wide spectrum of disciplinary issues, methods, and practices.
ArchNet-IJAR is indexed and listed in several databases, including:
- Avery Index to Architectural Periodicals
- EBSCO-Current Abstracts-Art and Architecture
- CNKI: China National Knowledge Infrastructure
- DOAJ: Directory of Open Access Journals
- Pro-Quest
- Scopus-Elsevier
- Web of Science Core Collection of Clarivate Analytics (formerly Thomson Reuters)
- Many university library databases

ArchNet-IJAR: Editors, International Advisory and Review Boards

ArchNet-IJAR is led by the Chief Editor Professor Ashraf M. Salama. The journal is co-editor: Dr. Farzad Pour Rahimian.
- For more information, visit this page: http://archnet-ijar.net/index.php/IJAR/about/editorialTeam

ArchNet-IJAR has two international boards; advisory and editorial. The range of knowledge and expertise of the boards members ensures high quality scholarly papers and allows for a comprehensive academic review of contributions that span wide spectrum of issues, methods, theoretical approach and architectural and development practices.

- For more information on the International Advisory Board, visit this link: http://archnet-ijar.net/index.php/IJAR/about/displayMembership/5
- For more information on the International Review Board, visit this link: http://archnet-ijar.net/index.php/IJAR/about/displayMembership/6

ArchNet-IJAR: Authors and Readers

ArchNet-IJAR Authors
ArchNet-IJAR articles come from architects, interior designers, planners, and landscape architects, and from those working in these fields in academic institutions, universities, research centers, government agencies, and professional practice. For more information, visit the authors page: http://archnet-ijar.net/index.php/IJAR/information/authors

ArchNet-IJAR Readers
ArchNet-IJAR addresses academics, practitioners, and students of architecture, planning and interior design. It addresses those who are interested in developing their understanding and enhancing their knowledge about how environments are designed, created, and used in physical, social, cultural, economic, and aesthetic terms. ArchNet-IJAR content keeps readers up-to-date on the latest ideas, designs, and developments in built environment related fields. For more information, visit the readers’ page: http://archnet-ijar.net/index.php/IJAR/information/readers
Author Guidelines

Registration and login are required to submit items online and to check the status of current submissions.

Two submission files are requested: one is in Microsoft Word or RTF document file format that includes author names and the other is in PDF format without the author names. A representative image of the paper should be uploaded as a supplementary file during the initial submission of the paper. The image is of high quality and high resolution in JPEG or TIFF formats.

Following the IJAR Template, submissions should adhere to the formatting and requirements listed. Submissions may be returned to authors or rejected based on their technical and academic qualities and also based on adherence to the requirements.

Book Reviews and Notes

A book review should normally run between 700-1200 words, which gives scope for an assessment of the book and its contribution to knowledge and debate within the broad field of architecture, planning and design. Reviews should be typed following the IJAR Template, and should be submitted with a JPEG/TIFF image of the cover. The heading should include the title, author, origin, publisher, date, number of pages, price and ISBN number. Name, affiliation and address (e-mail) of reviewer should be provided.

Submission Preparation Checklist

As part of the submission process, authors are required to check off their submission’s compliance with all of the following items, and submissions may be returned to authors that do not adhere to these guidelines.

1. The submission has not been previously published, nor is it before another journal for consideration (or an explanation has been provided in Comments to the Editor).
2. The main submission file is in OpenOffice, Microsoft Word, RTF, or WordPerfect document file format.
3. Another PDF file of the submission is submitted without author names and uploaded as a supplementary file.
4. A representative image of the paper is uploaded as a supplementary file during the initial submission of the paper. The image is of high quality and high resolution in JPEG or TIFF formats.
5. The text is single-spaced; follows the IJAR Template.
6. The text adheres to the stylistic and bibliographic requirements outlined in the Author Guidelines, which is found in About the Journal.
7. If submitting to a peer-reviewed section of the journal, the instructions in Ensuring a Blind Review have been followed.
8. All authors have signed the copyright permission form. IJAR editorial team prefers uploading the signed copyright permission form as a supplementary file during the initial submission of the paper.

Copyright Notice

Authors must manage reproduction rights to any third party. The submission of an article to ArchNet-IJAR implies that the author(s) certifies that neither the article nor any portion of it is copyrighted. It is expected that all submissions are original and have not been published before, and are not currently under review for any journal or conference. However, papers previously presented at conferences can be submitted for possible publication provided that
a written permission from the conference organizers is submitted before publishing.

Accepting a paper for publication in the journal means that copyrights are granted to the individual author(s), ARCHNET, Archnet-IJAR. However, view points and responsibilities on opinions submitted are the sole responsibility of the author.

All contributors should sign a copyright permission form in which they indicate that they have granted Massachusetts Institute of Technology (MIT) worldwide rights and permission to reproduce, distribute, publicly display, and publicly perform their work in electronic format on ArchNet Internet website at URL: http://www.archnet.org and on this site: http://www.archnet-ijar.net/index.php/IJAR/index

Contributors should submit a signed copyright permission form together with the final revised version of their papers. copyright permission forms can be downloaded from this link.

Starting from Volume 4 Issue 1, articles are licensed under the Creative Commons license BY-NC-ND (attribution, non-commercial, no derivatives).

A “CC-BY-NC-ND” license means that users are free to copy, distribute, and display your work for non-commercial purposes only, but they must credit the copyright holder (author, photographer, etc.). Derivatives are not permitted. For more information about the CC-BY-NC-ND license, see the Creative Commons website: http://creativecommons.org/licenses/by-nc-nd/3.0/
Contents: Original Research Articles

RECENT DISCOURSE AND THE PROMISE FOR GLOBAL NETWORKS ON ARCHITECTURE AND URBANISM (02/10)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1833
Ashraf M. Salama

SUSTAINING SUBURBIA – THE IMPORTANCE OF THE PUBLIC PRIVATE INTERFACE IN THE CASE OF CANBERRA, AUSTRALIA (11/26)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1793
Milica Muminovic and Holly Caton

WOMEN'S ATTACHMENT AND CHILDHOOD EXPERIENCES OF RECREATIONAL PARKS IN KLANG VALLEY, MALAYSIA (27/39)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1683
Nadzirah Kaimussalleh, Norhuzailin Hussain, Norsidah Ujang

DETERMINING THE FACTORS AFFECTING SOCIAL INTERACTION IN THE PARKS OF BAGHDAD CITY, IRAQ (40/52)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1658
Sarah Salih and Sumami Ismail

THE URBAN TRANSFORMATION OF TRADITIONAL CITY CENTRES: HOLY KARBALA AS A CASE STUDY (53/67)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1625
Sabeeh L. Farhan, Mohamed Gamal Abdelmonem, Zuhair A. Nasar

UNDERSTANDING SOCIO-CULTURAL SPACES BETWEEN THE HADHAR AND BADU HOUSES IN KUWAIT (68/89)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1712
Yousef Al-Haroun, Mohammed Al-Ajmi

TEMPORARY USES OF URBAN SPACES:
HOW ARE THEY UNDERSTOOD AS ‘CREATIVE’? (90/107)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1673
Quentin Stevens

HISTORY MATTERS: THE ORIGINS OF BIOPHILIC DESIGN OF INNOVATIVE LEARNING SPACES IN TRADITIONAL ARCHITECTURE (108/127)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1655
Mohamed S. Abdelaal, Veronica Soebarto

HEALING AND THERAPEUTIC LANDSCAPE DESIGN – EXAMPLES AND EXPERIENCE OF MEDICAL FACILITIES (128/151)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1637
Ingrid Belcáková, Pavla Galbavá, Martina Majrošová

SENSORY SPACES: SENSORY LEARNING – AN EXPERIMENTAL APPROACH TO EDUCATING FUTURE DESIGNERS TO DESIGN AUTISM SCHOOLS (152/169)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1704
Joan Love
Volume (12) - Issue (3) - November 2018

Contents: Original Research Articles

DESIGN FRAMEWORK FOR URBAN MOSQUE IN THE CITY OF KUALA LUMPUR: A QUALITATIVE APPROACH (170/182)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1586
Nayeem Asif, Nangkula Utaberta, Aman Sarram, Sumarni Ismail

FINDING HARMONY IN CHAOS: THE ROLE OF THE GOLDEN RECTANGLE IN DECONSTRUCTIVE ARCHITECTURE (183/205)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1696
Luai Aljubori and Chaham Alalouch

INFLUENCE OF PARAMETRIC TOOLS ON THE COMPLEXITY OF ARCHITECTURAL DESIGN IN EVERYDAY WORK OF SME’S (206/227)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1665
Adeline Stals, Sylvie Jancart, Catherine Elsen

LOCATION BASED DATA REPRESENTATION THROUGH AUGMENTED REALITY IN ARCHITECTURAL DESIGN (228/245)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1675
Faruk Can Ünal*, Yüksel Demir

AN EDUCATIONAL APPLICATION BASED ON VIRTUAL REALITY TECHNOLOGY FOR LEARNING ARCHITECTURAL DETAILS: CHALLENGES AND BENEFITS (246/272)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1719
Sayed Amir Hossain Maghool, Seyed Hossein (Iradj) Moeini, Yasaman Arefazar

PROPOSING A NOVEL KINETIC SKIN FOR BUILDING FACADES USING SCISSOR-LIKE-ELEMENT STRUCTURES (273/287)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1607
Maziar Asefi, Sepide Shoaee

THE GREEN ROOF THERMAL PERFORMANCE EVALUATION IN COMPARISON TO ASBESTOS CEMENT TILES APPLIED TO LIGHT STEEL FRAME BRAZILIAN BUILDINGS (288/307)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1709
Angélica Felicidade Guião Marcato Costa, João Alexandre Paschoalin Filho, Tatiana Tucunduva Phillipi Cortese, Brenda Chaves Coelho Leite

Review Articles

DESIGNING FOR AUTISM: AN ASPECTS™ POST-OCCUPANCY EVALUATION OF LEARNING ENVIRONMENTS (308/326)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1589
Magda Mostafa

BOOK REVIEW: MAKING DYSTOPIA — THE STRANGE RISE AND SURVIVAL OF ARCHITECTURAL BARBARISM, BY JAMES STEVENS CURL, OXFORD UNIVERSITY PRESS. 2018 (327/332)
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1828
Nikos Salingaros
RECENT DISCOURSE AND THE PROMISE FOR GLOBAL NETWORKS ON ARCHITECTURE AND URBANISM

DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1833

Ashraf M. Salama

Keywords

architecture; architectural education; architectural and urban heritage; cities; design studio; social sustainability; environmental sustainability; urbanism; urban studies; virtual reality; digital technologies

Abstract

ArchNet-IJAR: International Journal of Architectural Research has recently published an outline article that commemorated a decade of discourse and published research on architecture and urbanism since its inaugural issue of March 2007 and up to March 2017. The article offered a comprehensive coverage of the distinguished status of the journal being one of the top high quality journals. The purpose of the present article is provide reflections on some of what the journal has published since March 2017 and presents thoughts on latest developments including collaborations with academic and professional organizations and the move to Emerald; one of the prestigious global publishers in various areas and disciplines including relevant fields in built environment, place making, and urban planning and design. This will enable deepening and broadening existing relationships with various international research organizations and ensure that Archnet-IJAR remains a key channel for those organizations while meeting its promise for global coverage and presence.

ArchNet-IJAR is indexed and listed in several databases, including:

- Avery Index to Architectural Periodicals
- EBSCO-Current Abstracts-Art and Architecture
- CNKI: China National Knowledge Infrastructure
- DOAJ: Directory of Open Access Journals
- Pro-Quest
- Scopus-Elsevier
- Web of Science

A. M. Salama
Professor of Architecture
Head of Department of Architecture, University of Strathclyde,
Research Lead of CRAUCGS: Cluster for Research on Architecture and Urbanism of Cities in the Global South
Research Lead of BEEAPRU: Built Environment Education and Architectural Pedagogy Research Unit
75 Montrose Street, Glasgow G1 1XJ United Kingdom

*Corresponding Author’s email address: ashraf.salama@strath.ac.uk
INTRODUCTION

Archnet-IJAR: International Journal of Architectural Research has recently published an outline article that commemorated a decade of discourse and published research on architecture and urbanism since its inception and up to Volume 11, Issue 1, March 2017. The article offered a comprehensive coverage of the distinguished status of the journal being a Q1/Q2 journal in architecture and urban studies as one of the top high quality journals (Salama et. al, 2017). The purpose of the present article is provide reflections on some of what the journal has published since March 2017 and present thoughts on latest developments including collaborations with academic and professional organizations and the move to Emerald: one of the prestigious global publishers in various areas and disciplines including relevant fields in built environment, place making, and urban planning and design.

Over the past two years, Archnet-IJAR continued to receive regular submissions from academics across the world. Notably however, the journal has collaborated with the Fifth Architectural Jordanian International Conference of the Architecture Chapter of the Society of Engineers, Amman, Jordan (Salama, 2017). A special issue on heritage conservation in the digital era has been published and guest edited by Nottingham Trent University’s lead of the world-leading Research: Global Heritage: Science, Management and Development (Abdlemonem, 2017). This is followed in 2018 by a collaboration with Passive and Low Energy Architecture (PLEA) by including a section which was exclusively dedicated to selected papers from the Education and Training Forum of PLEA International Conference – Design to Thrive, Edinburgh – July 2017 (Roaf, Brotas, and Nicol, 2018, Salama, 2018).

In July 2017 Archnet-IJAR, volume 11, issue # 2 was produced to demonstrate the essence of being a truly international journal covering issues of interest and concern to the global academic and professional community (Salama, 2017). Various topics that manifest plurality and diversity as inherent qualities of architectural and urban research published in Archnet-IJAR were covered. Topics included architectural education and design studio teaching, urban and rural slums, heritage and historic environments in various contexts, participatory planning and the charrette process in the context of Scotland, assessment of public spaces and plazas, and human perception of the built environment. These topics were debated and analytically discussed within cities, settlements, and urban environments in Bahrain, Bangladesh, California-USA, Libya, Scotland, and Spain. The issue also included three papers selected from the Fifth Architectural Jordanian International Conference – 1-3 November 2016, which focused on the context of Jordan and the wider Middle East.

On architectural education and design studio teaching practices Marta Masdéu and Josep Fuses argued for the need to re-conceptualize the design studio and to incorporate pedagogical approaches such as distance learning and blended learning in order to revolutionize the studio environment as a space and a learning paradigm that needs to be continuously updated. (Masdéu and Josep, 2017). On the other hand, in a different context, Fay Al Khalifa discussed the notion of autonomy in learning architecture in the context of the University of Bahrain. Her work examined the effect of using a mixed methods approach to integrate theoretical and practical assignments relevant to students’ performance and understanding of complex architectural phenomena (Al Khalifa, 2017).

On the issue of slums or squatter settlements, Aisha Abubakar et al. embarked on a journey to define slums through a rigorous and rational thinking process. Summarising various trends, definitions and approaches to solutions of slums, their work critically analysed more recent and structured approaches that attempt to grasp the complexity of all realities constituting the slum as a crucial key to their management (Abubakar et al., 2017). Their work concluded with a proposed Slum Property Map as a dynamic way that enables a
deeper and a comprehensive understanding of slums and their underlying characteristics and parameters.

In the context of the United Arab Emirates and the wider Gulf region, Joseph Hobbs (2017), from a geography-discipline perspective, examined how the architectural, social, and cultural heritage of this unique context may contribute to better development of this region’s lived environment. His work proposed that adopting and adapting the vernacular architectural heritage to the modern built environment should not be the fundamental goal for heritage-informed design. He called for understanding and examining the social processes underlying the traditional lived environment with the ultimate goal of reaching social sustainability. Likewise, but totally different context, the argument for heritage conservation persisted where Rahman and Imon discussed the socio-political forces that shape human interventions in waterfronts in the context of Dhaka (Rahman and Imon, 2017).

An analytical overview of the charrette process in the context of Scotland was presented by Ainslie Kennedy, while focusing on key aspects of commissioning, construction, and delivery (Kennedy, 2017). Her work offered a typology of charrette-approaches unique to the context of Scotland. The work of Georgia Lindsay explored the United Nations Plaza in San Francisco by arguing that the introduction and construction of the new Plaza has not fulfilled its promise to fully transform the social and economic life of the area. Yet, it has achieved a public space and a new scene of urban culture (Lindsay, 2017).

The interest in understanding social and economic dynamics as they relate to public spaces was evident in that edition of Archnet-IJAR. Salama, Remali, and MacLean (2017) responded to the question of how successful urban spaces could impact the growth and performance of an urban context, not only as a physical urban reality, but also as a generator of social life. Utilizing St. Enoch Square as a case study, their work employs a multi-layered methodological approach constituted in a series of tools that include behavioural mapping, visual preference survey, walking tour assessment, contemplating settings, and observing physical traces and by-product of use in order to interpret various forms of experiences that take place (Salama et al., 2017). On the other hand, the work of Agael and Özer is innovative in the sense that it applied two contrasting theories; Mental Map and Space Syntax on two Libyan cities, Al Khums and Bani Walid. Their work offered an advanced understanding of the way in which various qualities and properties of the built environment affect human perception (Agael and Özer, 2017).

Identifying three articles from the Fifth Architectural Jordanian International Conference – 1-3 November 2016, the issue has expanded to include the work of Al-Jokhadar and Jabi who presented the different qualities of vernacular houses and neighbourhoods in the different regions of the Middle East and North Africa in an attempt to build a vernacular model and apply it to high-rise residential developments. Additionally, the work of Fakhouri and Haddad offered a definition of the key constraints and opportunities through conserving architectural and urban heritage in the historic cores of As Salt and Irbid (Fakhouri and Haddad, 2017). Abu-Alatta and Freewan (2017) argued that the recent developments in Information Technology (IT) and digital media have introduced new opportunities to design studio teaching and learning and new dimensions to design and architecture. They examined the way in which the immersion of Virtual Reality (VR) affects spatial perception within the design process in the architectural design studio.

In November 2017, the special issue on architectural and urban heritage (volume 11, issue 3), guest edited by Abdlemonem (2017), included important articles that have emerged from Virtual Heritage Cairo (VHC) Network’s International Conference, “Sustaining Heritage in the Digital Age: Towards Virtual Environments for Middle East’s Cultural
Heritage”, that took place on 20-21 February 2017 at the National Museum of Egyptian Civilisation, Cairo, Egypt.

The article of Patrizia Riganti, “Smart Cities and Heritage Conservation: Developing a SmarterHeritage Agenda for Sustainable Inclusive Communities” (Riganti, 2017), discussed advancements in Information Communication Technologies (ICT) for cultural heritage preservation highlighting the potential of virtual environments to assess the impacts of heritage policies on urban development while using virtual globes and crowdsourcing to support the participatory valuation and management of cultural heritage assets. On the other hand, the article on Virtual Platforms for Heritage Preservation in the Middle East: The Case of Medieval Cairo” (Abdelmonem et al, 2017), reported on a research process to investigate and incorporate a cultural-feed into digital platforms of Virtual Heritage, analysing current practices and projects of the virtual heritage technologies. Mohamed Khalil’s paper, “Talent Management as a Novel Approach for Developing Innovative Solutions for Egyptian Heritage Communities Development” (Khalil et al, 2017), interrogated aspects of intangible heritage such as stories, memories and traditions.

Stuart Burch’s article, “A Virtual Oasis: Trafalgar Square’s Arch of Palmyra” (Burch, 2017), questioned the destruction of the Arch of Palmyra in Syria in 2015 and its temporary reconstruction a year later in London’s Trafalgar Square. This was undertaken by scrutinizing the processes involved in the artistic production of public memorials and art’s commemorative function. The work of Neveen Hamza and colleagues attempted to validate the notion that market halls offer the chance to enable the instigation and operation of sustainable local economies that are creative and inventive (Hamza et. al, 2017).

A series of papers introduced various aspects of heritage conservation, representation, and modelling which included the work of Ramsey (2017) on virtual Wolverhampton; Gehan Selim on contested heritage in Northern Ireland (Selim et al, 2017); Mohamed Soliman on the Islamic Water System in Cairo (Soliman, 2017); Khairi Abdulla on Walkability in the historic urban environment in the context of Tripoli, Libya; Aggour on public awareness of heritage conservation in Alexandria, Egypt; Arafa on marketing tools for virtual heritage applications (Arafa, 2017).

Offering insights into the impact of socio-cultural and political contexts on the identity and characteristics of architectural heritage a number of papers are addressing these aspects of heritage conservation in various contexts in Bosnia and Herzegovina (Harrington et al, 2017); Iran (Eshrati et al, 2017), and Kazakhstan (Yussupova et al, 2017). Notably, the preceding outlines of the papers published in the special edition demonstrated various possibilities for sustaining heritage in the digital era. The papers offered insights into advanced understandings of the ever-changing landscape of contemporary architectural and urban heritages.

In March 2018 Archnet-IJAR, volume 12, issue # 1 the edition encompassed a wide spectrum of topics that range from architectural theory and history, to urban studies, and from spatial analysis and technical systems in building design and components, to education for sustainable development, and architectural and planning education. This was coupled with selected papers from the Education and Training Forum of PLEA International Conference – Design to Thrive, Edinburgh – July 2017 (Roaf, Brotas, and Nicol, 2018, Salama, 2018).

In the area of History and theory four papers can be identified in four different contexts and historical periods Emina Zejnilovic, Erna Husukic in the context of Sarajevo, Bosnia
In the same edition seven papers have addressed various contexts in Australia, Europe, the Middle East, the Far East, and Southeast Asia including Shehab and Salama in Glasgow, Mikkelsen and colleagues in Melbourne, Capitano in small settlements of Japan (Shehab and Salama, 2018; Mikkelsen et al., Capitano, 2018). Other explorations in urban studies examine various contexts as they relate to formal housing and supporting social infrastructure in the context of Indonesia (Yuliastuti et al., 2018), to historic urban quarters (Dastgerdi and De Luca, 2018), and spatial transformation processes in the historical peninsula of Istanbul (Mutman and Turgut, 2018). They all offer lessons important to their contexts as well as to the wider community of urban researchers. In the milieu of Arab cities, the contribution of Ahmed El-Kholei traces the development of the capitalist agenda, its concomitant societal schematic transformations, and their implications for cities in the Arab region. In a thorough comprehensive manner, he reviews the development of planning theory and practice in the developed world and its implication for Arab cities. The work is important in the sense that it offers narratives on the challenges and opportunities while suggesting remedial scenarios for actions within the remits of theory research, practice, and education (El-Kholei, 2018).

Three papers demonstrate the expanding scope of architectural and urban research including spatial analysis and assessment studies (Tarabieh et al., 2018; Arranz et al., 2018; and Elbakheit, 2018). Additional substantial and important series of contributions in the area of architectural and built environment education were included. The paper of David Grierson and Karen Munro surveys the relationship between education for sustainable development (ESD) and interdisciplinarity in the context of architecture and engineering higher education. Grierson and Munro present a case study of the University of Strathclyde Glasgow’s Sustainable Engineering (SE) postgraduate programme, within the wider context of common principles and practices present across higher education in the UK (Grierson and Munro, 2018). Utilizing experimental and empirical approaches, the work of Han Hee Choi and Mi Jeong Kim explores different strategies to overcome design fixation, which is defined as a lack of flexibility in relation to a limited set of design ideas. They call for introducing the digital context as one of the promising strategies that enhance design thinking while promoting creativity (Choi and Kim, 2018). Discussing the studio learning environment, Mohd Zairul (2018) reports on the initial results of the exploratory research related to student-centered learning (SCL) in final year architecture studio education at the UPM—University Putra Malaysia, which offers an additional capacity for a dynamic reconstruction of knowledge.

The preceding contributions offer key lessons relevant to the way forward in education in built environment related fields at various levels, ranging from curriculum development to design thinking and students abilities. Five papers have been selected from the Education and Training Forum of PLEA International Conference – Design to Thrive, Edinburgh – July 2017. The papers were submitted to the journal and have been subjected to a second layer of peer review process. In this context it is important highlight some key aspects of the forum including the scope, plurality of topics, and emerging themes (Salama, 2018).

The theme of “Community and Social Responsibility in Architectural and Urban Education” was clearly articulated by Rachel Sara and Matthew Jones on the co-creation of live community architecture clearly articulates this theme (Sara and Jones, 2018). The theme of Renovation, Technology, and Materiality in Design Pedagogy: was evident in the work of Bibbings et al. which included the introduction of a design competition module as a primary motivator for learning about sustainable technologies (Bibbings, Bieluga, and Mills, 2018), utilizing design frameworks and full-scale construction, and the development of guidance...
documents for sustainable construction. The theme of “Architectural Education Across the Boundaries of Cultures and Regions” was demonstrated in various contexts including a discussion and analysis of the vernacular context of Egypt (Dabaieh et al., 2018); and teaching processes for the final year projects in Technion, Haifa, Israel (Natanian and Aleksandrowicz, 2018). Key approaches, perspectives, experiences, and experiments were deliberated. Topics included experiential aesthetics; institutional challenges facing architectural education, diploma and graduation projects, as well as incorporating sustainable traditional construction techniques in the architectural curriculum. Additional the theme of “Design Learning for Efficiency was clearly evident in the work of Domínguez-Amarillo and colleagues (Domínguez-Amarillo, J. Fernandez -Aguera, P. Fernandez-Aguera, 2018).

While future review articles or editorials will refer to some of the latest articles published in 2018 including those which are published in this edition, it is important to inform the contributors to and readers of Archnet-IJAR that the journal has been recently acquired by Emerald Publishing which is part of Emerald Group. The new acquisition complements Emerald’s existing portfolio of journals in Property Management and Built Environment, introduces new areas in architectural and design research, while also expanding coverage in areas such as urban design, urban planning, and cities and sustainable urbanism (Vare, 2018). Archnet-IJAR, which will be free access throughout 2019 then a subscription journal in 2020, adds significant value to Emerald’s existing journal collection, particularly to Emerald’s offering in the European and Middle Eastern market. The journal has close associations with scholars working with several societies that include Environmental Design Research Association (EDRA), International Association for People-Environment Studies (IAPS), Architecture and Urbanism in the Mediterranean and the Middle East (AUMME), International Association for the Study of Traditional Environments (IASTE), to name a few. Being part of Emerald will enable deepening and broadening these existing relationships to ensure that Archnet-IJAR remains a key channel for those memberships while meeting its promise for global coverage and presence.

REFERENCES


SUSTAINING SUBURBIA – THE IMPORTANCE OF THE PUBLIC PRIVATE INTERFACE IN THE CASE OF CANBERRA, AUSTRALIA
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1793

Keywords
sustainable city; sustainable suburbia; public-private interface; green space

Abstract
Among existing and anticipated changes in global urbanisation and population growth, the challenge of retrofitting suburbia within sustainable cities needs to be considered. However, given the opposing nature of sustainability and suburbia, this task is not easy. Different approaches have tried to define the theory for achieving sustainable cities, but the nature of suburbia presents issues in densification, as density is perceived to limit the liveability and importantly the private sphere that makes suburbia desirable. To begin addressing sustainability in suburbia, the question of how to densify suburbs while maintaining their liveable quality, needs to be addressed. Focusing on the case of Canberra the paper builds a framework for discussing these questions within analysis of suburb density, behavioural studies and the public private interface. In doing so, it is evident that sustaining suburbia through densification, within the context of sustainable cities, cannot be considered without recognising morphology and the need for, and integration of, the public private interface.

M. Muminovic & H. Caton
Assistant Professor, Faculty of Arts and Architecture, University of Canberra, Locked Bag 1, 2601, Canberra Australia
Honours, Faculty of Arts and Architecture, University of Canberra, Locked Bag 1, 2601, Canberra Australia

*Corresponding Author’s email address: milica.muminovic@canberra.edu.au
INTRODUCTION

With the current and predicted growth of urban populations, there is a necessity to reconsider the sustainability of cities (Adams, 2011). As part of this process of global urbanisation, one of the most important challenges will be retrofitting the existing suburbs (Talen, 2011). The questions of how to make suburbs more sustainable are listed as one of three major tasks for cities (Bugliarello, 2006). One of the central concerns within this trend is urban sprawl and the integration of density and concentration. In recent years there has been an increase in research that focuses on the sustainability of suburban neighbourhoods. However, sustainability and suburbia are two, almost paradoxical, concepts in their essential meaning. Suburban development predominantly consists of detached houses one or two stories high, producing a very low density in addition to mono-functional spaces and vast distances; thus resulting in a heavily car dependent way of life. In contrast with suburbia, sustainable cities promote high density, compact urban form and mixed-use function with integrated public transport.

On the other hand, if sustainability is defined as the survival of society, then it is most often linked with liveability and the quality of life (Bugliarello, 2006: 24). Privacy is highly affected in dense areas and we might argue that those positive aspects of the suburban way of life, which make it more liveable, are discarded as part of sustainable development agendas. Living in detached housing, having space, privacy and a rural sense of connection to land, together with separation of functions and having quiet neighbourhoods, are some of important elements which influence why people still chose to live in suburbs (Grant, 2002: 78) and define them as ‘liveable’. In addition, increasing density and generating a more compact way of living, is often associated with neoliberal intentions of maximising profit and minimising the quality of living space (Crabtree, 2005). While it does create a more energy efficient way of living, it neglects some aspects of liveability; the sustainability agendas are currently focusing on generating more dense areas without looking at the quality of these spaces and how to transform suburbia to be more sustainable.

There are various approaches to sustainable cities, Green City, Smart City and Compact City are some of the most prominent current approaches in theory. However, almost no discussion is focusing on sustainable suburbs (Davison, 2006). Usually suburbia in literature is treated as ‘other’ urban areas that need to be retrofitted to become more compact and denser (Kashef, 2009: 89). There are four approaches identified in literature that aim to overcome the problems of current unsustainable cities. There are those that are inspiring from middle age European small cities (Neotraditional Developments, such as New Urbanism) or those related with legislation (Urban Containment, an approach proposing to simply define the boundary and stop further spread of the city) and Compact City and Eco-City approaches (Jabareen, 2006). All these concepts are observing sustainable suburbs from the aspects of densification. In addition, when discussing sustainable suburbia in research, most often, densification, mobility strategies and walkable distances to everyday functions are put forward. Sustainable urban form is defined through density, diversity, connectivity, accessibility and connectedness to other places (Talen, 2011:961). However, there are other important aspects of sustainability, such as social and cultural (Roisman, 1998), which are rarely discussed as part of sustainable suburbia. Because these approaches aim to transform suburbia into urban areas, there is a lot of rejection of dealing
with the sustainability of suburbia. However, the population living in suburban developments continues to rise and if we do want to consider a more sustainable future, this issue will need to be addressed.

There are also almost no discussions on what we are trying to sustain in the definition of suburban sustainability. Depending on how we define sustainability, we could discuss various forms of sustainable cities. In addition to lack of discussions on what we are trying to sustain in our current cities, there is a question of the measurability of sustainability. Although it has been recognised in literature that there is a challenge to applying the compact city principles to existing suburbs (Williams, Joynt, & Hopkins, 2010), there are almost no considerations on characteristics of new suburbs that are claiming to be sustainable. Nearly all cities have, as part of their future planning developments, the word sustainability in their agendas; with some cities already applying sustainability measures. However, aside from the governments saying that they are developing sustainable suburbia, without any clear definition of the aspects of sustainability that they are focusing on, it is difficult to say how successful these attempts are; especially given suburbia’s paradoxical situation.

To begin addressing sustainability in suburbia, the challenging question remains, how do we densify and at the same time maintain the quality of suburbia? How do we redesign existing suburbs, but generate more sustainable living? How do we capture the quality of suburban spaces and go beyond the oversimplifying measures of suburb densification?

This paper aims to open the discussion of the above issues and uses the example of Canberra’s recently developed suburb Franklin that is claiming to be sustainable. We aim to take the discussion beyond the usual way of looking at the simple densification of suburbs. We argue that the boundary between public and private spaces provides a basis for the qualitative character of suburbia, and that the structure of this space can be used as a framework to discuss sustainable living in suburbia. The paper aims to map and analyse the boundary space between built and un-built spaces and tests if public-private interface spaces could reveal some of the qualitative aspects of suburbia and provide an overview of sustainability beyond simple densification measures. The aim of the paper is not to promote sustainability of suburbia, but to provide a framework for discussion if the concept of suburbia were to be transformed to be sustainable without losing its essential qualities.

To open the discussion on quality and the challenges of suburban living, we will first examine the relationship between urban and rural; outline a concept of urbanity and connection with landscape, and their manifestations within the public-private boundary spaces. This relationship is also very important for the context of Canberra, as it was designed with the strong consideration of the landscape where the “bush” has also become an important part of the city identity (Vernon, 2006). Secondly, the paper will define the public-private interface spaces and generate types based on the fieldwork observations.

PUBLIC-PRIVATE INTERFACE AND RELATIONSHIP BETWEEN URBAN AND RURAL

The discussion between urban and rural spaces is not a new one. At the beginning of 20th century there was a considerable shift from urban and dense conditions in cities as a
response to overcrowding, diseases and difficult living situations (Choay, 1969). This is when the idea of urban, considered as positive and sophisticated way of life (Ramage, 1973), has started to change its meaning. With the industrial revolution and migration to cities, nature has gained importance in everyday life in the cities. This period can be characterized by some of the most prominent plans from Ebenezer Howard, Le Corbusier and Frank Lloyd Wright, all focusing on a way to bring nature back into the city and deal with overcrowding.

Those responses to the overcrowding could be grouped into two major categories, depending on the relationship to the landscape (the ground). One response is the horizontal spread of the city with lower density and organization around the centres of activity and networks. The idea central to this approach is keeping the connection with the ground and organizing everything horizontally. One of the most prominent concepts of this kind was Garden Cities (Aalen, 1992). The Garden City concept was developed in England to reduce density and regain the connection to nature. The main characteristics of the proposed diagrammatic idea of the Garden City were around zoning that separated centres of activity such as residential and industry, with limitations in density, planned parks and connection to green spaces (Ward, 1992). It might be argued that suburbia belongs to this category of development. The second extreme approach deals with the vertical city and its connection with the sky. The expansion of the city is thus vertical and promotes high density (for example Le Corbusier’s plans for Contemporary City for Three Million People).

Development of suburbs has its place within this dichotomy between urban and rural aspects of the city. Although the perception of suburban developments has been shifting from pro to anti-suburbia, where positive aspects of democracy, freedom and escape from the urbanity and industrial city have changed to fairly negative views at suburban developments within frameworks of sustainability (Davison, 2006: 208), suburban developments keep expanding and creating the problems of sprawl. In Australia, Davison argues that suburbia is where Australian identity is created, influencing “Australian self-understanding” (2006: 207). Suburbia promotes the importance of nature and connection to the land, but it is also generating sprawl through its consumerist approach to mass production and car dependence.

One of the most important parameters that define suburbia is the private aspect of everyday life, the idea of the detached house and a connection to the landscape. Thus, it could be argued that the central element ensuring the quality of suburban life is the way in which the house meets the ground, firstly, the threshold between public and private spaces and secondly private garden. It is this aspect of sustainable suburbia that will be the most affected with densification. That is why this paper is exploring the question of the level of densification in relation to the interface space and discusses when dense becomes too dense and loses the liveable aspects of suburbia.

Public private interface is defined as the space between the public of the street and the private spaces in the house. This threshold space is recognised as the most important space in architecture, with some theories arguing that this is the space where architecture emerges, as it not only defines how the building contributes to the city but also how people experience the private space of the house. In addition, this space is identified as the space that needs to be carefully considered by urban planners and architects (Bobic, 2004: 46). The way in which this space is generated, defines the atmosphere and level of urbanity of the city (see for example Jacobs (1961), Gehl (2011)). This boundary space consists of interface area and transition area. Interface area is the space that stands between building and the public.
space, for example the front garden of residential houses. Transition area, is the point where interior and exterior spaces meet, such as entrance point (Bobic, 2004).

**METHODS AND CASE STUDY**

To open the discussion on sustainable suburbia from a qualitative perspective, this paper will use the case study approach and outline the relationship between density and public-private interface. The hypothesis is that results from comparative analysis will demonstrate firstly the importance of the thresholds to understand sustainability beyond energy efficiency, and secondly, the directions of sustainable suburban developments in Canberra. Latter results are of a subordinate nature, as we have been testing the methods for analysis, rather than trying to generate conclusions about Canberra. To have more solid conclusions about state

![Contextual map showing recent Canberra suburb developments](image)
of suburbia in Canberra, we would need to study all new developments and compare them with the old suburbs. Since the aim of this study is to discuss how to approach the sustainability of suburbia, at this stage we are testing the methods.

The paper uses mapping of public-private interface and density as elements to analyse sustainability and suburban character. Public-private interface is proposed in this analysis as a tool for understanding the relationship between sustainability and liveability. This element is compared with the integrated methodological approach combining the density and behavioural observations usually applied in discussions of sustainable cities. To define public-private interface, the paper uses sectional analysis and generates eight main types of transitional spaces that are identified during the fieldwork and analyses them through sectional drawing and mapping. Types are defined based on size of the threshold and character of the build space. Permeability of the interface was not considered, as most of the types had the same low permeability characteristics, and, as such, this quality was omitted from the generation of types. The number and sizes of types were mapped and visualised to define the density and character. Public-private interface is, for this study, considered as the space between two buildings, comprising the space of the street or public green and spaces in between the street and the building itself. This was due to the convenience of the mapping and obvious connection and fluidity of the spaces on both sides of the streets. Density is measured through morphological study that focuses on the build form and population. Behavioural observations were conducted in four strategically selected locations (Figure 5.) based on the distribution and functional analysis in Franklin (Figure 2.). The four locations include: (1) Henry Kendall Street dominantly single and medium density residential areas; (2) Gwen Meredith Loop single and medium density residential areas adjoining community facilities; (3) Oodgeroo Avenue dominated with single residential area and large open community green space and (4) Hoskins Street dominantly single residential area. The observations were conducted during four weeks period in Jun 2017 and comprise both weekdays and weekends. The direct and counting observations occurred in 15min counting sessions followed with 15min direct observation sessions to capture both peak and after peak activities following the adapted approach by Jan Gehl (Gehl and Svarre, 2013). All the results are represented through maps, demonstrating not only a visualising tool, but a tool that enables comparison of results.

The density data was gathered from document analysis and statistical data of government reports, direct observation and recordings from the fieldwork. The comparison between public-private types and density and behavioural analysis provide the basis for the discussion on the evaluation of sustainability and questions of sustainable suburbia. Data for maps was derived from ACT Government Open Geospatial Data and were mapped and visualised using Arc GIS 10 software.

The case study was selected as one of the recent suburbs built in Canberra that is claiming to apply the sustainability agenda for the city development. Canberra is a designed city that follows some of the principles of Garden City and City Beautiful Movement (Headon, 2013). These aspects are bringing together the importance of the landscape and connection with nature that were incorporated from the beginning of the plan for the city (Taylor, 2007; Watson, 1927). In addition, suburbia has an important place in Australian cities. Thus, it is a good place to test some of the ideas of sustainable urban form, as the city was designed to incorporate low density and connection to the nature; the Bush Capital (Vernon, 2006). While this city structure was aimed to have the connection with land, sprawl in recent decades has created car dependency. There have been attempts to achieve more sustainable living in
Canberra and the ACT (2012) Government has adopted a plan that focuses on a more compact approach to building, working towards more sustainable suburbia. This aligns with the recent “Time to Talk Canberra 2030: Outcomes Report” which showed that people desire more dense, accessible and connected suburbs (ACT Government and Elton Consulting, 2010). As such, the ACT Government has been integrating sustainable approaches through a focus on social properties or sustainable communities (ACT Government, 2012; 2009; 2008).

Table 1. Comparison of Franklin with other suburbs in Canberra (based on ABS accessed Sep 2018).

<table>
<thead>
<tr>
<th>Suburb</th>
<th>Year established</th>
<th>No. of residents</th>
<th>Size</th>
<th>Density</th>
<th>Single detached dwellings</th>
<th>Semi detached dwellings</th>
<th>Apartments</th>
</tr>
</thead>
<tbody>
<tr>
<td>O’Connor</td>
<td>1928</td>
<td>5481</td>
<td>4.9km²</td>
<td>1119/km²</td>
<td>65.8%</td>
<td>14.4%</td>
<td>19.3%</td>
</tr>
<tr>
<td>Curtin</td>
<td>1962</td>
<td>5238</td>
<td>4.8km²</td>
<td>1091/km²</td>
<td>84.1%</td>
<td>5.1%</td>
<td>10.8%</td>
</tr>
<tr>
<td>Kaleen</td>
<td>1974</td>
<td>7271</td>
<td>6km²</td>
<td>1212/km²</td>
<td>93.8%</td>
<td>5.2%</td>
<td>1%</td>
</tr>
<tr>
<td>Franklin</td>
<td>2007</td>
<td>6419</td>
<td>2.3km²</td>
<td>2790/km²</td>
<td>50.5%</td>
<td>19%</td>
<td>30.5%</td>
</tr>
</tbody>
</table>

Figure 2. Distribution of building types in Franklin (Source: Authors, 2018).
Within the aspects of density, ACT Planning Authorities are committed to achieving the sustainability of the suburbs, while also ensuring that green spaces are created so as to align with the importance of the “bush” in the Australia’s capital. Having this in mind, all suburbs built after 2004 are those that have been implementing the sustainability agendas and promoting the identity of Canberra as a city integrated within the landscape. There are seven suburbs in Canberra built after 2004 (Jacka, Bonner, Forde, Harrison, Franklin, Crace and Lawson see Figure 1.). Within all these suburbs, Franklin was one of the first designed under the 2004 Canberra Spatial Plan, with majority of development commenced in 2007 and completed in 2009 (ACT Government, 2017a). Since the suburb is already developed and time has passed since its development, this suburb is good case to observe implementation of sustainable strategies. The 2016 census shows a current population of 6419 people, with the prediction of 2% growth in next five-six years (Australian Bureau of Statistics [ABS], 2017a; ABS, 2017b, ABS, 2012). The comparison of Franklin with earlier suburbs in Canberra is shown in the Table 1 indicating the changes in suburb density and morphology over time.

Franklin has been designed to provide a variety of housing options to accommodate the growth following “new sustainable suburbs” agenda developed under the ACT Government. The structure of the residential typology is 50.5% single detached dwellings, 30.5% apartments, and 19% of semi-detached or townhouse dwellings (ABS, 2017a). The suburb also follows the connectedness and public transport accessibility required by ACT Government (2008).

In addition to residential types, Franklin also has its own local shops, school and recreational facilities, with open spaces and natural landscape incorporated to meet the requirements outlined as part of Canberra’s identity. The proximity of Gungahlin, a major central node for North Canberra, orientates Franklin towards local mobility (for example, 43.2% of the surrounding suburb population, among which is Franklin, is employed in Gungahlin town centre according to ACT Government, 2012). Franklin is also located in the proximity of Civic (a central commercial and office district in Canberra) and Mitchell (an industrial suburb in Canberra). As it belongs to RZ3 urban residential zone categorisation in accordance with “Territory Plan”, this provides predominantly residential, low to medium density (RZ3- Urban Residential Zone (ACT), 2016, 1). However, Franklin also has RZ5 mixed-use zones that are fostering higher density residential development, with better accessibility and public transport, “efficient and sustainable urban environment”, “using the best practice environmentally sustainable development principles” and encouraging street activity (CZ5 Mixed Use Zone (ACT), 2016, 1). The neighbourhood centre is around recreational facility that serves as community centre and other commercial facilities are located in the mixed-use developments (Figure 2). The suburb also has RZ4 medium-density residential zones and CZ4 local culture zones. All these zones are designed to generate a sense of community and certain level of locality and independence. Thus, Franklin is selected as representative of sustainable processes accepted in Canberra’s recent suburban developments.

**ANALYSIS AND RESULTS**

**Density**

Residential density in Franklin is 16.74 dwellings per hectare, which belongs to the low-density development range. In addition, single dwellings comprise 50.5% of the built form (ABS, 2017a) (Figure 2). The sizes of plots in Franklin are 300-500m2 indicating higher
density compared with other suburbs in Canberra. However, this is a general trend found in new suburbs that reduces the size of plot and increases the size of the house, thus generating smaller and smaller backyards (Hall, 2015). Appearing to increase in density is not an actual increase, but increase in building area ratio. Overall, density data in Franklin showed that this suburb is statistically denser than earlier Canberra suburbs, but on the ground is visually not much different from suburbs in Canberra, planned and built before the implementation of sustainability agendas.

In addition to the low density of built environment, Franklin has vast amounts of public open spaces, with approximately 47 hectares easily accessible and spread throughout the whole suburb (Figure 3). With a population of 6419 people, the amount of green space, in the form of natural landscape, recreational park and natural grassland (Figure 4), is more than double the recommended Australian Standard of 3 ha every 1000 people (Ambrey & Fleming, 2014). This means that there is enough space for significant increase in population.

![Figure 3. Open space and 15 minute walking radius (Source: Authors).](image)

![Figure 4. Natural landscape, recreational park and natural grassland in Franklin (Source: Authors).](image)
Behavioural Analysis

Based on the study conducted in 2017 there were four main activities in the space observable: vehicle traffic, cycling, walking and ruining, kids play and people with pram and people waiting for bus. There were significant differences in numbers of cars during the weekday and weekend, the numbers plunging to more than a half during the weekend. However, in all cases the number of vehicles has been significantly larger than number of pedestrians in the street. There were substantial differences in the number of people present on the street, the largest of those were located in the observation area 2 comprising 26% of all activities. This space is located close to community areas; thus it was expected to have larger numbers, however, they are very low, compared to car traffic. The completely residential space in area 4 demonstrates very low pedestrian activities. Area 3 shows moderate activities, which are connected to the open green space and similarly, area 1 which is located in proximity to mixed-use spaces has moderate pedestrian activity (Figure 5).

![Figure 5. Distribution of activities in Franklin (Source: Authors, based on fieldwork conducted in 2017).](image)

Public-private interface analysis

The analysis of open and built spaces as part of the public-private interface indicates that there is large amount of public open space and fairly small amounts of private open space. The types of street section demonstrate the condition in suburb (Figure 6 and Table 2.).
There were eight types of boundary spaces identified in the suburb, based on the size of the interface area and the condition of the transition area.

The results of mapping the types of transitional spaces show that the most dominant type of the boundary space is type 2 covering 51.5% of the area. It is followed with type 1 (30%), type 3 (9%), type 4 (3.5%), type 5 (3%), type 7 (2%), type 8 and type 6 (less than 1%) of the whole interface area (Figure 7). We might argue that type 1 is the space that comprises that essential quality of connection to the green spaces to the land; despite the fact that this green space is public. On the other hand, type 2 still preserves some of the qualities of the connection with the ground, but limited by the street and without extension beyond it. Both types are promoting low density. Furthermore, all the interface types with higher density are disconnected from the ground, instead generating a visual connection to the sky. Thus, the street space becomes only transport space, without extension of the private space into the public, and therefore loses the character of suburbia, the connection to the ground and semi-private space, as well as neighbourhood feeling. At the same time, that boundary does not create the sense of urbanity, as the street becomes only transient area to go through. The protection of private space in the apartment building, due to the proximity of the public and higher density, does not generate sense of urbanity nor a sense of suburban qualities.

<table>
<thead>
<tr>
<th>Type of public private interface</th>
<th>Interface area (area between the buildings and the public space)</th>
<th>Transition area (entrance point)</th>
</tr>
</thead>
<tbody>
<tr>
<td>type 1</td>
<td>Extends from single dwelling all the way to open green space. The physical boundary is marked with the line of the pavement that separates pedestrian path from the front garden. However, the visual boundary extends to the open public green space creating fluidity that crosses the road barrier. The physiological boundary extends from the private space of the house to the public space of the street and open green space.</td>
<td>Defined with single family house that has direct entrance from the open space of interface area.</td>
</tr>
<tr>
<td>type 2</td>
<td>Marked between single dwelling and the street. Physical boundary is marked with the line of the pavement between private garden and pedestrian path. Visual and physiological boundary overlaps with physical boundary, because of the single dwelling across the street.</td>
<td>Defined with single family house that has direct entrance from the open space of interface area.</td>
</tr>
<tr>
<td>type 3</td>
<td>Marked between single dwelling and townhouse. Physical boundary is denoted on the pavement for the single-family house and the townhouse defines a wall generating a visual barrier from the street. While visual and psychological barriers extend to the street, the townhouse is clearly separated with the wall. Visual connection happens on the first floor and it is cut off at the ground level.</td>
<td>Single family house has direct entrance from the street. Townhouse entrance happens on the wall barrier in front of the house.</td>
</tr>
<tr>
<td>type 4</td>
<td>Marked between two townhouses. The boundary is clearly defined with the fence. Visual boundary is marked with the fence on the ground level and extends from the first floor to the street. Physiological boundary overlaps with physical boundary.</td>
<td>Townhouse entrance happens on the wall barrier in front of the house.</td>
</tr>
<tr>
<td>type 5</td>
<td>Marked between townhouse and open green space. Physical boundary is defined with the fence and overlaps with psychological and visual boundary on the ground level but extends from the first floor towards green space.</td>
<td>Townhouse entrance happens on the wall barrier in front of the house.</td>
</tr>
<tr>
<td>type 6</td>
<td>Marked between apartment block and single dwelling. Single dwelling physical boundary defined with the front garden and apartment building generates interface space inside the block. There is no clear connection to the ground. Floor apartments are separated with the fences. Physiological and visual boundaries.</td>
<td>Defined with single family house that has direct entrance from the open space of interface area. Apartment building</td>
</tr>
</tbody>
</table>
are located towards the street and connect to the street space only from the first floor upwards.

| Type 7 | Marked between apartment building and the townhouse. Clearly separated with the fences on both sides of the street. Visual and psychological connections are extending towards the street on the first floor upwards. | Townhouse entrance happens on the wall barrier in front of the house. Apartment building entrance is not visually clear (it might be argued that it shifts to the interior of the building to the door of single dwelling unit). |
| Type 8 | Marked between two apartment buildings. Boundary is not clearly defined. Visual and psychological extend on the first floor and upwards, no clear connection to the ground. | Apartment building entrance is marked on the ground level (it might be argued that it shifts to the interior of the building to the door of single dwelling unit). |

Figure 6. Diagrammatic representation of public private interface types (Source: Authors).
CONCLUSION

Comparison of the density, behaviour and public-private interface results shows that there are similarities in analysis’ outcomes (such as the fact that single dwellings were present in 50.5% of dwellings and that type 2 comprises similarly 51.5% of interfaces). Observational studies have shown an expected outcome, in that where there is very low pedestrian activity on the street there is greater car dominance. The studies also indicated that most pedestrian activity occurred within the proximity of communal spaces and open green spaces. However, the interface results reveal detailed information about the quality of the spaces in the suburb. According to density information, we could conclude that for Franklin to be more sustainable, it should increase its density. Similarly, according to behavioural study we could conclude that Franklin needs more mixed-use spaces to have more sustainable mobility and lifestyle. Nevertheless, results deriving from public private interface show that considering aspects of liveability and suburbia, the conclusion is not that simple.

Analysis of already densified interface types (6-8), demonstrates that they are not providing suburban nor urban qualities. The results show that main quality of suburbia is lost already in type 1 and 2 because of the limitation of private green spaces. The public open green space compensates for that lost (such as in type 1). However, the vast amount of open space is grouped and generates more of a barrier than a sense of connection and community in the suburb. Thus, instead of providing a positive effect for processes of reduction of the private land and possibility for higher density, it seems to be having the opposite outcome of generating even less sustainable conditions. Nevertheless, in relationship with the single
dwelling (type 1), it extends the private sphere of the house and thus contributes to quality of private spaces connection to landscape. Thus, we might argue that open public green space has the potential to act as essential in preserving the quality of suburbia. The way in which it is designed could be reconsidered from the aspects of size and accessibility, so that it does not create a barrier but can be accessible from most of the dwelling units.

Furthermore, an important aspect revealed from the public-private interface study is related with the connection to ground. Making the blocks smaller and houses larger reduces the size of private garden, thus the connection with ground starts to diminish. Therefore, the front public-private interface becomes an important space that connects to the ground.

There is also misunderstanding that density affects the qualities of suburban connection to the landscape in which those qualities are lost. That disconnection is happening before the density is reached as part of the new developments, developments that reduce the size of the plot and disconnect the house from the street under the goal of the protection of privacy and better comfort.

Furthermore, introducing densification of suburbia does not really generate dense enough spaces, nor does it preserve the quality of suburban life. We need to consider the quality of the connection to the ground to enhance sustainability; otherwise we will end up repeating the developments of compact cities (in the best case scenario). Densification of suburbia might be the solution towards more sustainable future of our cities, however, that densification needs to be reconsidered from the aspects of public-private interface, if we still want to build sustainable suburbia.

REFERENCES


ACT Government (2009) People, Place, Prosperity: The ACT’s Sustainability Policy, Retrieved from:


Copyright © 2018 | Copyrights are granted to author(s), Archnet-IJAR, and Archnet @ MIT under the terms of the “CC-BY-NC-ND” License.


WOMEN’S ATTACHMENT AND CHILDHOOD EXPERIENCES OF RECREATIONAL PARKS IN KLANG VALLEY, MALAYSIA

DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1683

Nadzirah Khairrussalleh, Norhuzailin Hussain, Norsidah Ujang

Keywords
- place attachment; childhood experience; health; women; recreation

Abstract
Childhood experiences influence attachment to recreational parks and green spaces in women’s adulthood. Studies have shown that the adults’ frequency of visiting recreational parks is correlated with the frequent visits during their childhood. This study examines women’s attachment and their childhood experiences. Questionnaire surveys were distributed to 510 women (as park users) involving two public parks namely Bukit Kiara and Bukit Jalil Recreational Parks. Results show majority of the respondents spent their leisure time in the parks for relaxing with family members. Most of the women were attached to the greenery of the landscape in the parks, as they associated the recreational park with relaxation and peaceful. The women’s childhood experiences with nature were identified as having a memorable family time, which was correlated with their positive attachment of the recreational park as adults. The findings can guide the park managers, planners and designers in providing a park that is responsive to the women’s needs and demands that can contribute to their emotional and social well-being.
INTRODUCTION

Childhood experience with nature is seen as a benefit to the children and extends far beyond the individual to all aspects of society later in adulthood. Women who are exposed to nature during childhood influence their attitudes and preferences towards recreational activities. In this regards, children's participation with outdoor activities has a significant positive association with adults' environmental behaviors and the development of a sense of belonging to recreational parks. For instance, participation in “wild” nature such as hiking or playing in the woods, camping, hunting, or fishing and the experience of “domesticated nature” such as picking flowers or produce, planting, and caring for plants during childhood have a positive relationship to adult environmental behaviors. The childhood experience in nature is influenced by many factors such as the environment in which they were grown-up, participation in natural activities, and the attitudes of their parents in raising them (Wells & Kristi, 2006).

Many scientific studies on urban green spaces stressed the various benefits of parks and other green spaces (Lyytimaki & Sipila, 2009). The potential benefits of urban green spaces are for the benefits of human health and well-being. Activities within these spaces give a positive impact mentally and physically, through recreational and leisure activities. By keeping oneself physically active, a person can fulfil the psychological and physiological needs (Zambri et al., 2013). Nowadays, people especially women are concerned about being active in the urban green spaces in order to maintain good health. However, women’s opportunities to do recreational and leisure activities are limited in comparison to men. In this regards, women are less likely to participate in active leisure activities compared to men (Miller & Brown, 2005; Azevedo et al., 2007). This is true in Malaysia where women have a lower physical activity level (10%) compared to Malaysian men (15%) (Poh et al., 2010). Women in general, especially married women with children are mainly occupied with responsibilities as mothers, taking care of the children, doing household activities, and career commitments. On a similar note, Tam et al. (2016) argued that men were more physically active than women, engaging in both moderate and vigorous types of activities. Due to those constraints, this study aims to investigate what makes women visit recreational parks and meanings attached to the parks according to the women’s perspectives. We believe that women’s attachments to recreational parks are associated with several factors such as their childhood experience.

PLACE ATTACHMENT THEORY

Place attachment is the most commonly used term that relates to the concept of familiarity as it deals with humans connecting or a sense of belonging to the green environment (Williams et al., 1992; Altman & Low, 1992; Tuan, 1980). Familiarity is associated with the elements of the place attachment. It can be split into four dimensions; first an understanding of the location; the second dimension is visual recognition that is associated with the opportunity to recognize the location. The third dimension is the place-title recognition, and lastly the interactions of using the place (Ayeghi & Ujang, 2014). In the context of this study, it is expected that the frequency of going to green spaces during childhood will develop an attachment to the place as a result of constant engagement and familiarity.

Relph (1976) stated that place attachment develops as a result of the activities and behaviours of people in a particular environment. Place attachment is also reflected in the functional (Smaldone et al., 2005) and emotional bonds that influence how people perceive
their identity (Altman & Low, 1992). Place attachment incorporates several aspects of the people-place bonding of effect, emotions, knowledge, beliefs and behaviour in connection with a place (Chow & Healy, 2008). A previous study has suggested that being at and engaging with a place; one’s companions; ritualized behaviours; family history in the outdoors; childhood socialization; and informal training and social learning fostered an attachment to a place (Brooks et al., 2006).

Place attachment relating to the feelings towards an environment begins at a young age. The development of place attachment in a child is influenced by the association between the child and the place and also with the recurring experiences and the social meaning given to that place. The development of place attachment is a continual process in which individuals experience spaces on both an interpretive level and existential level when the environment accommodates certain forms of social bonding (Shabak et al., 2015). Childhood is arguably where the development of adult’s emotional attachment to place begins (Chawla, 2007). Spencer (2005) emphasized the essential role of place to develop self-identity in children and provide a sense of stability and security. The sense of place developed in childhood has a positive repercussion on pro-environmental behaviour in later years (Kahn & Kellert, 2002).

Ramkissoon et al. (2012) examined the influence of place attachment on pro-environmental behaviour intention in a national park. A conceptual framework depicting relationships between an attitudinal dimension of place attachment, place satisfaction and pro-environmental behaviour intention was established. The findings indicate that the dimensions of place attachment included visitor’s place dependence, place affect, place identity, and place social bonding positively influence pro-environmental behavioural intentions in the national park. Similar with Ramkissoon et al. (2012), the definition of place attachment as a multi-dimensional concept has been mentioned by other researchers (Hammitt et al., 2006; Sakip et al., 2013). Place attachment is also defined as a one-dimensional concept (Fornara et al., 2006). However, Shamai (1991) has described different dimensions of place attachment (from lower to highest level of strength) which is comprised of place familiarity, place belonging, place dependence, place identity, and place rootedness.

Another study by Wu et al. (2010) indicates that a visitor’s experience has an impact on place attachment and moderates the relationship of the leisure activity involvement and place attachment. Place attachment does not always directly result from the leisure activity involvement, but rather from the visitor’s experience after visiting the place. Hidalgo and Hernandez (2001) measured the place attachment within three spatial ranges (house, neighbourhood, and city) and two dimensions (physical and social). The researchers found that the degree of attachment was varied with age and gender resulting in the women being attached more than men, and the social attachment is greater than the physical attachment while the weakest attachment is among the neighbourhood.

Place attachment was linearly negatively related to community size: the people in rural communities, which have smaller populations than urban areas, expected to be more attached (Lewicka, 2010). Later, a study by Anton and Lawrence (2014) suggested that people who lived in the countryside were more attached to their homes and local areas than people in the urban areas. Previous studies on place attachment were largely focused on the factors which determined place attachment and its dimensions. For example, Ayeghi and Ujang (2014) studied the impact of physical features of an urban park on user attachment to the park in Kuala Lumpur. Others explored the relationship between landscape heritage elements and place attachment among visitors in Taiping Lake Garden (Abd Ghani et al., 2015) while Wu et al. (2010) investigated the relationship between leisure activity...
involvement and place attachment in the cultural park. Previous studies also examined place attachment dimensions and the development of the child’s self-identity (Spencer, 2005). Studies on the green spaces in relation to childhood experiences were also conducted; however the study did not focus on women as the key subjects of investigation. In our study, place attachment is defined as the affective relationship between the women as park users and the selected parks as a place.

MEANING AND USE OF GREEN SPACES

Places are interpreted, narrated, perceived, felt, understood, and imagined by people (Soja, 1996). The identification or representation by people makes a place meaningful (Ujang, 2012). Cultural aspects of human experience towards places also defined the places in a situation when the setting’s physical and cultural characteristics merge with a person’s affective perceptions and functional needs (Bott et al., 2005). The affective perception is generated from the psychological process relating to meaning and attachments rooted in the setting. In this regards, social and cultural relationships, memory and personal meanings contribute to the place attachment (Ujang, 2014). The sense of place also is discovered through the identifications of user’s feelings and reactions towards the attributes and characteristics of the place (Ujang, 2012). The study regards that the emotional bond between people and the green spaces makes the place more recognizable as functional spaces that gives meanings and attachment to the green spaces.

People especially women have some restrictions in choosing a time to be in any public park or open green spaces. However, the women will use the parks if they found the parks very comfortable and secure at any time. Based on a study about a night time urban park use among 51 samples at Putrajaya and 332 samples at Shah Alam, Ngesan and Zubir (2015) found that night visits at urban parks were safe for people to visit as many of the respondents were actively using the park spaces for night-time leisure activities at peak hour of 10.30 p.m until after midnight. In addition, Ujang’s et al. (2018) suggested that less visual obstacles within the parks and improved clarity of structure in terms of smooth edges encouraged interactions in neighbourhood parks. Integrating the different park activities and connecting them with well-designed and comfortable paths can lead to better park use.

The sense of comfort as one of the important attributes that influence meanings attached to places (Ujang et al., 2015). This attribute links closely to convenience, and the feeling of at ease with the places. The sense of familiarity and sense of belonging to a place contributes to the psychological comfort that can be achieved by longer place engagement and the feeling of safety and security.

Based on the literature reviews, it is evident that studies on place attachment and meanings have not focused on the women’s childhood experience that can affect place attachment in recreational parks. It is important for park managers, planners and designers for providing a park that is responsive to women’s needs and demands that can support their emotional and social well-being.

METHODS

A set of questionnaire was distributed to respondents at two recreational parks in Klang Valley. Those are Bukit Kiara Recreational Park and Bukit Jalil Recreational Park. Both parks are located in the suburbs of Kuala Lumpur. Both parks are surrounded by residential areas
and popular among locals. The parks are also equipped with basic facilities. The overall size of Bukit Kiara Recreational Park is 164.63 hectare. The survey at Bukit Kiara Recreational Park covered only the park areas (17 hectare) while the jungle and hiking trails were excluded. The size of Bukit Jalil Recreational Park is 31.42 hectare.

The surveys

The survey was conducted from March 2016 to May 2016. These were carried out on both weekdays and weekends in the morning (7.00 am to 10.00am) and in the evening (4.00pm to 7.00pm). The parks are surrounded by rubber plantations, with a combination of flat and undulating land. Thus, the ambiance of the parks is interesting for recreational activities and comfortable with many trees providing shade. There are basic facilities provided for users such as pedestrian walkways, jogging tracks, par course, gazebos, seating areas and ponds. For Bukit Kiara, there is a small stream across the park. Based on the observations, many of the users are from Chinese ethnicity. Chinese and Malay users were mostly involved in ‘senamrobik’ and ‘zumba’ on weekends. The Chinese also liked to do yoga exercise. Other activities the women engaged in were leisure type of activities such as feeding the fish, observing other people’s activities and enjoying the scenery.
The respondents

The respondents were chosen by using quota random sampling involving the three main ethnic groups in Malaysia (Malay, Chinese and Indian). According to the Department of Statistics Malaysia (2010), the Malaysian population consists of the Malay including other Bumiputera (67.4%), Chinese (24.6%), and Indian (7.3%) and others (0.7%). Based on the sample size from the Krejcie and Morgan Table (Krejcie and Morgan, 1970), a total of a sample size of 510 was required (230 respondents in Bukit Jalil Recreational Park; and 280 respondents at Bukit Kiara Recreational Park). Initially we wanted to get the samples based on the current population; however, due to limited human resource and time, we could not get the Malay and Indian samples as intended. Therefore, the Krejcie and Morgan sampling formula was adopted.

In Malaysia, generally, people complete their high school at the age of 18; and for a government servant the retirement age is 56 or 58. The study involved teenagers, young and middle-aged adult women who were represented by students, workers, and retirees. Based on these figures, the age groups in the survey are categorized into 5: 18 - 25 years, 26 - 35 years, 36 - 45 years, 46 - 56 years, and 57 years and above. Table 1 indicates demographic characteristics of the respondents participated in the study.

Table 1. Demographic characteristics (Source: Authors).

<table>
<thead>
<tr>
<th>Category</th>
<th>Demographics</th>
<th>Frequency</th>
<th>Percentages (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ethnicities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malay</td>
<td>180</td>
<td>35.3</td>
<td></td>
</tr>
<tr>
<td>Chinese</td>
<td>317</td>
<td>62.2</td>
<td></td>
</tr>
<tr>
<td>Indian</td>
<td>13</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-25</td>
<td>126</td>
<td>24.7</td>
<td></td>
</tr>
<tr>
<td>26-35</td>
<td>207</td>
<td>40.6</td>
<td></td>
</tr>
<tr>
<td>36-45</td>
<td>118</td>
<td>23.1</td>
<td></td>
</tr>
<tr>
<td>46-56</td>
<td>44</td>
<td>8.6</td>
<td></td>
</tr>
<tr>
<td>57 and above</td>
<td>15</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td><strong>Employment status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private servant</td>
<td>218</td>
<td>42.7</td>
<td></td>
</tr>
<tr>
<td>Government servant</td>
<td>48</td>
<td>9.4</td>
<td></td>
</tr>
<tr>
<td>Self-employed</td>
<td>73</td>
<td>14.3</td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>76</td>
<td>14.9</td>
<td></td>
</tr>
<tr>
<td>Retiree</td>
<td>35</td>
<td>6.9</td>
<td></td>
</tr>
<tr>
<td>Housewife</td>
<td>58</td>
<td>11.4</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>2</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td><strong>Education levels</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school/below</td>
<td>37</td>
<td>19.0</td>
<td></td>
</tr>
<tr>
<td>Vocational/diploma</td>
<td>131</td>
<td>25.7</td>
<td></td>
</tr>
<tr>
<td>First degree</td>
<td>244</td>
<td>47.8</td>
<td></td>
</tr>
<tr>
<td>Master/PhD</td>
<td>37</td>
<td>7.3</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>193</td>
<td>38.0</td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>317</td>
<td>62.0</td>
<td></td>
</tr>
</tbody>
</table>

The questionnaire

The questionnaire consists of five sections (Nature of visits to recreational park; Feelings related to this park; Childhood experience with nature; Meaning attach to recreational park and Demographic information). There are 10 questions using nominal-type of questions and one multiple-choice question (activities engage in park). Items in Section 1 were developed to elicit the pattern of use of park users such as time of visit, frequency of visits, and activities they engaged in. Section 2 consists of 15 questions aiming to understand the respondents’ feelings while in the park. The items were measured using the 5-Likert rating scale; 5:
The data collected was analyzed using IBM SPSS Statistics. The data was analyzed using descriptive statistics to present the research results supported by inferential statistics showing degrees of significance. Open-ended questions were analyzed using content analysis. For example in Table 2, the authors categorized the similar words into 23 items from the respondents’ answer. However, the authors will discuss the top five items only.

**Meanings attached to parks according to ethnicity**

The results show that about 62% Chinese, 35% Malays and about 3% Indians respondents answered the question. The Chinese respondents associated the meaning attached to the recreational parks as ‘Relax/ Cool/ Rest’ (68.5%), ‘Nature/ Green’ (71.2%), ‘Enjoy/ Happy/ Fun/ Enjoyment/ Excitement/ Joyful/ Cheerful’ (73%) and ‘Beautiful/ Nice/ Interesting/ Attractive’ (63.8%). On the other hand, more than half of the Malays associated the parks with ‘Peaceful/ Serenity/ Calm’ (see Table 2). These results show that the recreational parks give environmental and aesthetic functions in terms of ambiance. It brings positive vibes to the respondents as mentioned by them such as happy and joyful. The Chinese women respondents felt relax and cool due to the abundance of trees, plants and water elements in the recreational parks, which provided the places with comfort. The appearance of the recreational parks was regarded as important thus could influence their positive feelings about the parks. This is evident by a response by the Chinese women who mentioned that the recreational parks are beautiful and attractive. To the authors’ knowledge, generally, the Malays are familiar with the view of forests, mountains and rivers ambience. This could be linked to the fact that the Malays were mainly settled and lived in villages or ‘kampong’ situated in rural areas. In addition, it is a normal practice that the urban Malays regularly visit their parents or grandparents, or relatives who stayed in the villages. This factor could influence the response of the Malay respondents who described the recreational parks as ‘Peaceful/ Serenity/ Calm’.
Attachment to parks

In Section 1, the results indicate that most of the respondents (99%) felt attached to Bukit Kiara and Bukit Jalil Recreational Parks. The attributes that associated the attachment to the parks include greenery (34.5% in Bukit Jalil Recreational Park and 32.5% in Bukit Kiara Recreational Park) followed by water elements (18.7%) in Bukit Jalil Recreational Park and the facilities and amenities (17.1%) in Bukit Kiara Recreational Park. These results show that greenery, water features, and well-maintained facilities and amenities contribute to women’s attachment to the parks. It is claimed that green colours could bring a peaceful mind and feeling of harmony into people’s hearts (Clay, 2001). Besides, the water features bring a positive psychological benefits such as cooling and refreshing (Mohamed & Othman, 2012), and the water features are crucial in fulfilling the park users’ need (Ayeghi & Ujang, 2014; Ujang et al., 2018). It is unarguable that a recreational park functions as a place for people to release their stress and gain a positive psychological effect (Mohamed & Othman, 2012). The parks give a positive impact on public mental well-being in terms of feelings of pleasure,
enjoyment, relaxation, peaceful and comfort (Stigdotters et al., 2010). The park users could experience the parks as peaceful and quiet places to observe and get close to nature, be relieved from stress, or as social spaces, and sense of life (Mohamed & Othman, 2012). These describe the positive feeling of attachment associated with the recreational parks. The women also come because of the facilities and amenities provided in both parks such as children playground and exercise equipment (see Figure 1 and 2). It is important that facilities in parks be in good condition where Zhang’s study found that poor maintenance and lack of fitness equipment are the main reasons for low satisfaction levels of use towards the urban parks (Zhang et al., 2015). The women are also keen on doing physical activities in the parks and spending time with family members for relaxation. These activities generate positive feelings that may reduce feeling of stress.

**Figure 3. The influencing attributes of park attachment (Source: Authors).**

### Relationship of childhood experiences and park attachment

Respondents were asked about their childhood memories in relation to place attachment. About 60% of the respondents agree that childhood memories were related to their attachment to the parks. In response to the memories that they can recall, the responses can be categorized into five groups; ‘family time’ (26%), ‘exercise and activities’ (23%), ‘good feelings and memories’ (22%), ‘playground and facilities’ (15%) and ‘nature landscapes’ (14%) (see Table 3). Some of the respondents remembered experiencing nature and spending time with family members during their childhood. For example, a respondent mentioned, “I enjoyed viewing the beautiful scenery of green elements in the park, while walking with my late parents”. Another woman responded “I like nature, I had an experienced chasing butterfly in the field, [and] it was interesting”. A few of them associated the greenery in the recreational parks with their memories of their villages. A respondent recalled her memory “My grandpa reared chicken and there was a lot of fishes too, that was nice being there in the village”. These responses indicate the importance of the role of parents or family members in engaging in recreational activities in parks and green spaces. Women, especially mothers suggested visiting recreational parks regularly so their children can have similar experience with nature or green spaces. Therefore, their children will have normal healthy development. In this regard, association and engagement with family and friends creates a positive relationship with physical activity and thus a positive use of recreational park and green spaces as adults (Ward Thompson et al., 2008). Particular experiences recalled by the respondents evoked their emotions, such as the childhood memory of being in the streets with family, and creates the attachment to the particular places (Ujang & Zakariya, 2018).
Table 3. Respondents' childhood experiences (Source: Authors).

<table>
<thead>
<tr>
<th>No.</th>
<th>Keywords</th>
<th>Frequency</th>
<th>Percentages (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Family time</td>
<td>74</td>
<td>26.2</td>
</tr>
<tr>
<td>2</td>
<td>Exercise and activities</td>
<td>65</td>
<td>23.1</td>
</tr>
<tr>
<td>3</td>
<td>Memories and good feelings</td>
<td>62</td>
<td>22.0</td>
</tr>
<tr>
<td>4</td>
<td>Playground's facilities</td>
<td>42</td>
<td>14.9</td>
</tr>
<tr>
<td>5</td>
<td>Nature landscapes</td>
<td>39</td>
<td>13.8</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>282</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

In terms of frequency of visits, the results in Figure 4 show that the respondents who visited recreational parks daily as children were much more likely to visit such places several times a week as adults (19.6%). The chi-square test result shows there was a significant association between the frequency of visits to the recreational parks in adulthood and the frequency of visits to other recreational parks in childhood: $\chi^2 = 48.32$, df = 9, n = 453, p = 0.00. Similar patterns were observed for those who visited recreational parks monthly as children. In line with the findings, Ward Thompson et al. (2008) stated that the childhood experience of woodlands and other green or natural places give an impact to the adult patterns of use and behavior to such places. In this case, the adults' frequency of visiting recreational park is also correlated with the frequent of visit during their childhood. In contrast, our study found that those who visited recreational space the least during their childhood (yearly/never), also tend to visit frequently (daily/weekly). This is probably due to the lifestyle changes among the urban people, where the awareness on their well-being is increasing.

CONCLUSION AND IMPLICATIONS

This study contributes to the knowledge regarding the recreational park’s use, place attachment and women’s childhood experience. The aim of this study is to examine what makes women visit recreational parks and meanings attached to their experience. The
findings provide an understanding of the issues relating to the women’s attachment to parks across multi-ethnic culture of Malaysia. The finding has also identified the relationship of childhood experiences and the frequency of park use where there was a significant association discovered.

We suggested several factors to be considered in designing future recreational parks that are responsive to women’s physical and psychological needs and well being. An attractive and comfortable park ambiance can generate positive emotional feelings such as relaxing and peaceful that could encourage frequent visits to the parks. In terms of planning, planners should locate recreational parks at multi-ethnic neighbourhood areas so that urbanites especially women can use the parks frequently for socialising. By visiting recreational parks regularly, women could develop stronger attachment to green spaces and natural settings, thus can inculcate the love of nature to their children or to younger family members. In addition, visiting recreational parks can be regarded as a family tradition for future generations based on the finding that ‘family time’ was rated the highest childhood experience by the respondents. The majority of the users in the recreational parks are Chinese so the results need to be interpreted cautiously. This study can be replicated to other areas within Asian countries that have similar demographic backgrounds. The findings will assist the park managers, planners, and designers to develop a park according to the women’s needs and demands. Further research using a qualitative framework could provide an in depth understanding on women’s attachment and meanings towards green spaces.

ACKNOWLEDGEMENTS

The research was funded by The Ministry of Higher Education (MOHE), Malaysia under the Fundamental Research Grant Scheme (FRGS: 05-02-14-1560FR).

REFERENCES


DETERMINING THE FACTORS AFFECTING SOCIAL INTERACTION IN THE PARKS OF BAGHDAD CITY, IRAQ

DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1658

Sarah Salih and Sumarni Ismail

Keywords

- social interaction
- open spaces
- quantitative survey method
- Baghdad
- Iraq

Abstract

Since the war in 2003, Baghdad has suffered from different aspects of political, administration, economic, ethnic, sectarian, etc. that led to the loss of lives, social capital, destruction of Iraqi infrastructure and important buildings, increased crisis aggravation between different ethnicities, as well as the disappearance and destruction of many Baghdad's open spaces, parks, and recreational places. This paper addresses the issue of social interaction in Baghdad city, resulting from the lack of open spaces, parks, and recreational activities. The objective of this paper is to determine the key factors affecting social interaction of Baghdad residents in the parks of the city. This study employed Creswell recommendations (Creswell, 2014) to design the research methodology in general. A quantitative method was adapted to collect and analyse the data of this study by using a survey, i.e. questionnaires, to assess 270 respondents' opinion about the issue of the study. Respondents were selected randomly in a single-stage procedure by using a simplified formula (Yamane, 1973). Closed-ended questions were used to collect the data of the study from the Karkh district in Baghdad city. Findings of this study confirmed that the factors and criteria of the parks are essential means to achieve sound social interaction in Baghdad, in which, the most influencing factors towards Karkhs' parks users are crowding of visitors and noise, followed by availability of high quality diverse activities. The results of this study are a useful reference for urban and landscape planners, architects, social psychologists, the Municipality of Baghdad, and researchers in this field.

S. Salih & S. Ismail
S. Salih, Doctor of Philosophy Student at Department of Architecture, Faculty of Design and Architecture, Universiti Putra Malaysia, Jalan UPM, Serdang, Selangor, 43400, Malaysia
S. Ismail, Lecturer at Department of Architecture, Faculty of Design and Architecture, Universiti Putra Malaysia, Jalan UPM, Serdang, Selangor, 43400, Malaysia

*Corresponding Author’s email address: sarah_alsaadi1990@yahoo.com, sumarni.upm@gmail.com

ArchNet-IJAR is indexed and listed in several databases, including:

- Avery Index to Architectural Periodicals
- EBSCO-Current Abstracts-Art and Architecture
- CNKI: China National Knowledge Infrastructure
- DOAJ: Directory of Open Access Journals
- Pro-Quest
- Scopus-Elsevier
- Web of Science

Copyright © 2018 | Copyrights are granted to author(s), Archnet-IJAR, and Archnet @ MIT under the terms of the "CC-BY-NC-ND" License.
INTRODUCTION

Green open spaces allow people to meet on ostensibly neutral grounds in planned and unplanned ways, to interact with others within the context of the whole community, so they can contribute to the cohesion of communities (Holland et al., 2007). Meanwhile, social interaction is an exchange between two or more individuals and is a building block of society; it influences through particular forms of externalities such as reference groups who influence the actions of individuals’ preferences, as well as space context (Scheinkman, 2008). Recently, the growth and development of communication technologies have dramatically affected social interaction, where people incorporated these emerging technologies into their social interactions, which led to the loss of touch with social nuances and the characteristics of traditional society (Huang and Deng, 2008). Some technological advances also cause people to become overly stressed, increasingly isolated, and reduce their well-being (Baruah, 2012).

Baghdad is the capital and largest city in Iraq, located along the Tigris River, which runs through Baghdad centre and divides it into two parts: Karkh district, which is located on the western bank of the Tigris, and Rusafa district that is located on the eastern bank. Since the establishment of Baghdad city by the Abbasid caliph, Al-Mansur (766 AD), it has become a cultural, historical, and social centre for Arab and Islamic civilisation. Baghdad is characterised by gardens, orchards, and cultural and social diversity (Al-Rajhy, 2006). Presently, Baghdad is exposed to multiple changes as a result of political, religious, ethnic, administrative diversities, and technological developments. This also led to the disintegration and change in social interaction, neglecting many recreational facilities and open spaces in Baghdad nowadays (Al-sadi, 2015). Existing parks in Baghdad do not perform their role functionally and effectively, this in turn reflects on residents’ social-recreational activities and interaction, which are limited to indoor spaces for a limited number of times only (Salih and Ismail, 2017).

This paper elaborates the problems concerning the lack of social interaction due to issues of open spaces and parks in the city of Baghdad. Thus, the aim of this paper is to identify the appropriate characteristics of successful parks to promote social interaction of residents in Baghdad city, whereby the focus is only on factors of successful parks and open spaces to achieve social interaction in the Karkh district, Baghdad. It does not cover social interaction or open spaces issues in general. The study employed a cross-section survey in terms of questionnaires. Therefore, the findings of this paper essentially depended on the integrity and honesty of respondents' answers and the descriptive statistics and frequency as the main method of data analysis according to recommendations of (Creswell, 2014). Nonetheless, there were difficulties in the data collection process, where the general security situation in Baghdad was unstable. Thus, it was difficult to find a suitable respondent number according to individual respondent characteristics. Moreover, it was difficult to obtain accurate sample characteristics information from the survey due to security issues.

SOCIAL INTERACTION TYPES, FORMS AND FACTORS

Social interaction has the ability to unite and harmonise communities, particularly in the context of multi-cultural diversity. Meanwhile, (Williams, 2006) stated that design approach and design factors are primarily responsible for the strength of social relations in the community. He also mentioned that proximity has great influence on patterns of socialising, and confirmed that users must be involved in the design process of their own social
environment to create a more cohesive social environment. Social relationships vary according to age, gender, and place (space), where, physical spaces e.g. open spaces and parks, and their elements could be a key factor to solve social interaction issues. Talk exchange between two or more people can occur in a public place as a form of communication and social interaction (Holland et al., 2007). They stated that such interactions in public spaces could be influenced by many factors, including how the spaces connect, the design, maintenance, and management of nature, and the built environment. (Huang and Deng, 2008) stated that cultural activities perform a social function by creating cohesiveness in families and communities and by offering a habitual practice that can be passed on from one generation to another. For instance, traditional tea drinking in Taiwan improves people’s social relationships in three different aspects: personal social range, social ties, and the cohesion and identification of the family. They also mentioned that social cultural activities can naturally be a part of people’s daily lives, as a result of the outstanding effects in socialisation.

On the other hand, modern technologies and social networks have led to the emergence of a certain type of interaction (virtual social interaction) among social networking sites and social media applications. Although social media has led to positive changes in people’s interaction methods, it has a dark side as well (Sari, 2008). He also mentioned that social communication via networking sites has led to critical changes in social, cultural, economic, and political communities in various ways. On the surface, it appears that social networking brings people together across the Internet, but in a larger sense, it leads to negative outcomes, some with long-term consequences such as social isolation, and restricts real social cohesion (Scott et al., 2010). They highlighted that hyper-networking is associated with social, mental, psychological, emotional, and physical problems including depression, substance abuse, poor sleep patterns, suicide, poor social interaction, and poor academic performance.

According to (Bekker et al., 2010), interactive play objects contribute in creating and enhancing social interaction between two or more individuals in public spaces. The community (players) in recreational zones (recreational parks) can create a wide range of physical games to be shared and participated as a type of social interaction. (Moffitt, 2017) stated that social interaction includes those acts that people perform towards each other and the responses they give in return, which include a large number of behaviours. In sociology, interaction is usually divided into five categories, namely exchange, competition, cooperation, conflict, and coercion. Social exchange is based on a common interest among individuals, while collaborative interaction (cooperation) could be coerced, voluntary, or unintentional, and any group behaviour is an example of cooperation. Cooperation enables social reality by laying the groundwork for social institutions, organisations, and the entire social system, and without cooperation, no institution beyond the individual would develop. On the other hand, social conflicts affect social interaction of communities, especially the conflicts that result from cultural and social differences in societies. Social competition can also create interaction in communities. Positively, competition may serve as a form of recreation or a challenge provided that it is non-hostile; for instance, sports rivalry can create many forms of interactions between people. (Motfitt, 2017) also mentioned that the process of communication may be nonverbal through people’s clothing and style, and gestures and posture (according to the cultural context).
GREEN OPEN SPACES FOR SOCIAL INTERACTION

The design of open spaces has a great role to lead individuals to these spaces, where they can socialise and mingle with each other. Space design tools can also be used to provide social interaction (Uslu and Gokce, 2010). They stated that complex social diseases could be cured through different house surroundings, parks, and new spatial arrangements. (Kara et al., 2011) stated that parks have crucial roles to develop and enhance cities; they are not only places where people join the nature, but also to communicate and interact with each other. Moreover, they noted that activities and maintenance of parks could be the main factors affecting the quality and conditions of these parks. Therefore, to achieve social interaction, physical space (parks, landscapes, etc.) must be provided. This is in line with (Larson et al., 2014) suggestion that more efforts should be made to promote physical activities in outdoor recreational spaces, which could promote health and well-being.

On the other hand, to increase social interactions in green open spaces, some factors must be considered, e.g. safety and security, traffic restrictions, presence of various activities for all ages, and urban design of the space (Poodeh and Vali, 2014). For a successful public park design, good accessibility and linkage (GAL) should be the main factor in designing a park, followed by sociability (SOC), user and activities (UAC), and degree of comfort and image factors (DCI) (Skip et al., 2014). They also mentioned that park is an important space in the relationship of man and nature to promote physical activities, health behaviour, and community interrelationship, and to increase the value of property. (Mamaghani et al., 2015) stated that specific spaces such as open spaces and parks should be used to overcome the loss of human communication and interaction by implementing the use of interaction design approaches. Moreover, quality nearby recreational area is an important condition for a residential area and its residents as is the importance of easy access to these areas. Inhabitants’ satisfaction with the recreational areas, their activities and interaction level within the recreational areas, as well as the time spent in the recreational areas appear to be more relevant to the frequency of visits in these areas (Matthias and Degenhardt, 2015). They also confirmed that with the shift to a service-based society, providing opportunities for outdoor recreation (that enables mental and physiological self-regulation) has become an increasingly important landscape function.

SOCIAL LIFE, RECREATION AND PARKS IN THE CITY OF BAGHDAD

Since the founding of Baghdad city, a special interest has been given for recreational facilities, open spaces, green areas, and parks, for the reason that Baghdad’s name has been accompanied to the names of paradise, garden, and orchard. The tributary of the Tigris River flows into all districts of Baghdad to give it special beauty and splendour. On the other hand, the first zoo in the world was established in 797 AD in Baghdad during the rule of Harun al-Rashid (786 - 809) AD, which contained various types of birds, rabbits, fishes, monkeys, lions, etc. Some open spaces were also used to play golf or horsemanship (Al-Samarrai, 2002). The social life in Baghdad city during the Abbasid era (762 - 1258) AD was based on two different social layers; the first layer consisted of caliphs and ministers, who lived a comfortable and luxurious life, whereas the second layer comprised the local people, who lived a simple life with high social interaction, where some poor people shared the same house. However, these various social layers in Baghdad met in the markets, mosques, riverbanks, parks, orchards, and streets. The community of Baghdad also varied in terms of ethnicity and religion, but it was open and amicable, e.g. many Muslim men married Christian women. Baghdad’s residents shared important social events together, e.g. Friday prayers.
(holiday) Eid, Ramadan, promenade after (holidays) Eid, weddings, festivals etc. (Al-Rajhy, 2006). Ottoman and British invasions of Iraq (1532 - 1920) AD have created a vast gap between the authority and local people, which led to various crises in Iraq (Al-Wardi, 2007). The period of founding the first Iraqi state in 1920 had a great influence on the Iraqi society, where political awareness, attention to follow the news and newspapers, movement of constitutional claim, national movement, political awareness, and referendum have emerged for the first time in Iraq. The 20th century revolution also changed a lot in the culture of Iraqi society, where it became a more coexisting community (Al-Wardi, 2007).

The war in 2003 has led to loss of lives, loss of social capital, and destruction of Iraqi infrastructure. This substantially lowered the quality of life and inability to provide essential services, and rendered state-building activities even more difficult (Ihsanoglu, 2007). Ethnic relations in Iraq were also strained since the last war in 2003, where crisis aggravation among different ethnicities in Iraq led to the decline of interaction among them (Rydgren and Sofi, 2011). Since 2003, the establishment of military-controlled zones, lengthy strips of T-walls, roadblocks, and checkpoints interrupted movement along the arterial roads linking the different areas of Baghdad. Hence, local residents prefer to shop, work, and socialise within their neighbourhood without interacting with other neighbouring areas (IAU et al., 2011). They mentioned that many local open spaces have become dumping sites for garbage or collection areas for sewerage and stagnant water. Recreational places, parks, and activities either are closed or off limits since 2003 (IAU et al., 2011). Responsible authorities of Baghdad city should make more efforts for open spaces and parks construction, maintenance and administration, due to the fact that existing parks in Baghdad do not perform their role effectively, which reflects on residents' life, according to (Rikabi and Ali, 2013) findings. They mentioned that the responsible authorities must provide various facilities in the parks and improve their function and condition. They also confirmed that governmental efforts towards this matter are inadequate due to political and economic issues experienced in the country since 2003.

Figure 1. Neglected Park in Karkh, Baghdad, 2012 (Source: Author Records, 2016).
METHODS

A quantitative method was adopted in this study in terms of a survey by using questionnaires to assess the population’s opinion about the factors affecting social interaction of Baghdad residents in open spaces and parks. This paper aims to determine the appropriate characteristics of parks and open spaces to increase social interaction of the residents in Baghdad city. This study employed (Creswell, 2014) recommendations to design the research methodology in general. Closed-ended questions were used as a basic tool to collect data, where the *International Handbook of Survey Methodology* of (Edith et al., 2008) was used to design the questionnaires (closed-ended questions) of this study.

This study used content validity, face validity, and test-retest reliability. After the questionnaire was designed, it was reviewed by specialists to examine and analyse its content to ensure it covered all aspects needed to be measured. Then, it was translated into Arabic from English, and the sample questionnaire was sent to ten respondents who were required to answer the questionnaire twice (the revised second questionnaire was three weeks apart from the first questionnaire). This is to examine its clarity and accuracy and confirm the extent of the questionnaire’s validity before applying it to the basic samples. The results were calculated by using Statistical Package for the Social Sciences (SPSS) version 23, and the correlation coefficient \((r)\) value was \(\geq 0.70\). Therefore, the questionnaire of this study was considered reliable to be used according to the correlation coefficient in the test-retest reliability.

The *Karkh* district in Baghdad city was chosen as a research site with an area about 2,650 km\(^2\), and it consists of about ten basic sections (neighbourhoods) (Al-Janabi and Ali, 2015). The population of *Karkh* is approximately 800,000 persons, according to the Ministry of Planning of Iraq (2009). Respondents involved in this study were selected by using a simplified formula (Yamane, 1973) to represent the whole *Karkh* district, where \(n\) is the sample size, \(N\) is the population size (800,000), and \(e\) is the level of precision (±6%). Therefore, the number of respondents is 270, selected randomly in a single stage from the specific neighbourhoods. Individual characteristics of respondents varied in terms of age groups (18 - 55), gender, income levels, education, and occupation.

\[
n = \frac{N}{1 + N(e)^2}
\]


The survey was conducted in a period of two months (May and April of 2016). Based on the returned survey questionnaires, many of the respondents were not willing to provide their personal information or opinions, especially due to the insecurity in Baghdad. Almost all of the respondents refused to be photographed during the survey. The collected survey data was then analysed using a statistical analysis (descriptive statistics and frequency) by SPSS. Firstly, it analysed the respondents’ characteristics, which include gender, age, occupation, education level, and income level. The questionnaire format consisted of multiple choices and dichotomous questions. The respondents came from different locations within the ten neighbourhoods such as universities, work sites, streets, and shops. Secondly, it analysed the factors affecting users’ interaction and activities in open spaces and parks. Respondents were asked matrix questions (Likert scale) about six factors of open spaces and parks, including: design and image, activities, and quality in terms of availability of various high quality activities, crowds of people and noise, accessibility and linkage, safety and security,
and management and maintenance. These factors have been identified and mentioned in the previous literature section.

![Map of Karkh District in Baghdad City](source: Jabr and Jassem, 2016)

**Figure 2.** Karkh District in Baghdad City Map (Source: Jabr and Jassem, 2016).

**Stage 1**
Population size (800,000) p.

**Stage 2**
Data Collection Instrumentation Design

**Stage 3**
Samples Selection (Yamane, 1967) Simplified Formula

**Stage 4**
Characteristics of Individual

**Stage 5**
Questionnaire Application

In April and May of 2016

**Karkh, Baghdad**

**Cross-section Survey With (Questionnaires)**

by Close-ended Questions

Validity

Reliability

270 Respondents

Aged 18-55

Genders

Income Level

Education

Occupation

**Figure 3.** Process of Sample Selecting from the Population of Karkh District (Source: Authors, 2016).
RESULTS AND DISCUSSION

Demographic Characteristics

The gender balance of respondents in this study was reasonably fair, with 51.9% female, 47.4% male, and 2 missing answers for the gender criterion. All respondents were found to fall within the age range of 18 to 55 years, where most of the respondents were between 18 to 24 years (41.9%). Meanwhile, only a few respondents were aged between 47 to 55 years (6.3%), as it was very difficult to get respondents within this age group from the selected places for the survey. 25.6% of the respondents were between 25 to 31 years, 14.8% were between the ages of 32 to 38 years, and 11.5% were between 39 to 46 years.

In terms of income, a majority of the respondents (81.1%) were in the middle-income level, 15.2% of them were in the high-income level, and only 3.7% were in the low-income level. Regarding occupation, 49.3% of the respondents were students, 40.4% were employees, while only 8.5% were unemployed.

Factors Affecting Social Interaction in the Parks

The respondents were asked matrix questions about six factors that would affect the use of parks and open spaces, in order to determine the main factor that affects their use of open spaces and parks in Baghdad. The six factors are design and image, activities, and quality in terms of availability of diverse activities with high quality, accessibility and linkage, crowds of people and noise, safety and security, and management and maintenance. These factors have been identified according to the previous literature and studies.

The mean, median, and mode values of the design and image factor of parks are 1.99, 2.00, and 2, respectively, where 1 refers to “strongly agree”, 2 refers to “agree”, 3 refers to “undecided”, 4 refers to “disagree”, and 5 refers to “strongly disagree” (Table 1). A majority of the respondents (54.4%) agreed that design and image is the key factor in Karkh’s parks to promote social interaction, while only 2.6% showed strong disagreement towards that statement. 27.8% of them strongly agreed, whereas 6.7% of the respondents disagreed (Table 2). The mean, median, and mode values of the availability of high quality diverse activities factor are 1.79, 2.00, and 2, respectively (Table 1). Most respondents (46.3%) agreed that high quality diverse activities in the parks is the key factor to achieve social interaction, while none of them showed strong disagreement. 39.3% of them strongly agreed to that statement, whereas 5.9% disagreed (Table 2).

On the other hand, the mean, median, and mode values of the access and linkage factor are 1.92, 2.00, and 2, respectively (Table 1). A majority of respondents by 50.4% agreed that accessibility and linkage is the key factor of the parks to promote social interaction, and only 0.7% of them showed strong disagreement to that. 30.0% of the respondents strongly agreed, while 4.4% of them disagreed. The mean, median, and mode values of the crowding of visitors and noise factor of the parks are 1.60, 1.00 and 1, respectively. A majority of the respondents (56.3%) strongly agreed that visitors’ crowd and noise is a negative factor in the parks that affect social interaction negatively, and there were no respondents who showed strong disagreement to that factor; 31.1% of them agreed, while only 4.8% disagreed (Table 2). The mean, median, and mode values of the safety and security factor are 1.90, 2.00, and 2, respectively (Table 1). 51.5% of the respondents agreed that safety and security is the key factor to achieve social interaction, and none of the respondents showed strong...
disagreement to that statement. 29.3% of them strongly agreed and only 1.5% of them disagreed (Table 2). Meanwhile, the mean, median, and mode values of the management and maintenance factor are 2.23, 2.00, and 2, respectively (Table 1). A majority of the respondents by 50.4% agreed that management and maintenance is the key factor to achieve social interaction and only 0.7% strongly disagreed. 21.1% of the respondents strongly agreed, while 14.8% of them disagreed (Table 2).

The influence of these factors on sample characteristics was computed using the correlation coefficient (Spearman's rho) between these variables (Table 3). The correlation analysis shows that there is a correlation between design and image with the gender of respondents (female respondents care about the design of the parks 0.165 times more than male respondents). It also shows a small correlation between activity and quality with gender (male respondents care about the activities of the parks 0.342 times more than females) and age of respondents (older respondents care about the activities of the parks 0.162 times more than young respondents).

There is a less significant correlation between accessibility and linkage with gender (male respondents care about the accessibility and linkage of the parks 0.351 times more than females), crowding and noise factor with gender (female respondents suffer from people crowding and noise 0.162 times more than male respondents). As well as a small correlation between management and maintenance with age (older respondents care about the management and maintenance of the parks 0.380 times more than young respondents), and occupation (if the respondents are student so the interest about the management and maintenance of the parks decreases 0.380 times less than if the respondents are employed and so on). However, Spearman's rho coefficient shows an insignificant relationship between park factors and respondents' characteristics, where respondents' characteristics do not affect the answers and results of the study.

<table>
<thead>
<tr>
<th>Table 1: Descriptive Statistic: Factors of Karkh's Parks to Achieve Social Interaction (Source: Authors, 2016).</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>Median</td>
</tr>
<tr>
<td>Mode</td>
</tr>
<tr>
<td>First Value*</td>
</tr>
<tr>
<td>Last Value*</td>
</tr>
</tbody>
</table>

Values are: 1=Strongly agree, 2=Agree, 3=Undecided, 4=Disagree, 5=Strongly disagree
<table>
<thead>
<tr>
<th>Table 2: Frequency: Factors of Karkh’s Parks to Achieve Social Interaction (Source: Authors, 2016).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design &amp; Image</td>
</tr>
<tr>
<td>Valid</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Missing System</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Values are: 1=Strongly agree, 2=Agree, 3=Undecided, 4=Disagree, 5=Strongly disagree

<table>
<thead>
<tr>
<th>Table 3: Correlations: Factors of Karkh's Parks to Achieve Social Interaction and Sample Characteristics (Source: Authors, 2016).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and Image Correlation Coefficient</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>Activity and Quality Correlation Coefficient</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>Accessibility and Linkage Correlation Coefficient</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>People Crowding and Noise Correlation Coefficient</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>Safety and Security Correlation Coefficient</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>Management and Maintenance Correlation Coefficient</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
</tr>
<tr>
<td>N</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Therefore, according to the results above, the key factor that affect park users is visitors’ crowd and noise, followed by availability of high quality diverse activities, safety and security, good access and linkage to the park, design and image of the park, and good management and maintenance of the park. All the mentioned factors are clearly influential on park visitors in Baghdad city. Based on the respondents’ answers, all these factors must be taken into consideration in park construction and maintenance in order to achieve an effective park for social interaction in the Karkh district of Baghdad. This is parallel with CAUB’s (2005) finding, which confirmed that visitors of Zawraa Park in Baghdad city suffered from frequent overcrowding and noise. The community in recreational zones can create and participate in a wide range of activities as a type of social interaction (Bekker et al., 2010). The diversity of
activities could be the main factor affecting park quality and frequency of visits to these parks (Kara et al., 2011). However, good accessibility and linkage (GAL) should be the main factor in designing a successful park in Malaysia (Skip et al., 2014). Furthermore, the key factor of public open spaces could also be safety and security, and management and maintenance (Holland et al., 2007). (Sinou and Kenton, 2013) stated that the key factor for the design of a successful park varies according to the place or location. Meanwhile, a study of (Rikabi and Ali, 2013) found that existing parks in Baghdad did not perform their role effectively, due to administrative negligence and poor organisation. On the other hand, the key factor for the design of a successful park is varying according to the place or location (Sinou and Kenton, 2013).

Table 4: Characteristics to Enhance Social Interaction in the Parks of Baghdad.

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Results</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Obj.</strong></td>
<td><strong>Support Pervious Literatures:</strong> Parks with an appropriate factors and characteristics are essential to achieve social interaction.</td>
<td><strong>Factors of Karkhs’ Parks to achieve social interaction:</strong></td>
</tr>
<tr>
<td>Factors of parks to achieve social interaction in Karkh district, Baghdad.</td>
<td>1. Avoiding visitor’s crowd and noise.</td>
<td>1. Avoiding visitor’s crowd and noise.</td>
</tr>
<tr>
<td></td>
<td>2. Diverse high quality activities.</td>
<td>2. Diverse high quality activities.</td>
</tr>
<tr>
<td></td>
<td>4. Good accessibility and linkage.</td>
<td>4. Good accessibility and linkage.</td>
</tr>
<tr>
<td></td>
<td>5. Design and image.</td>
<td>5. Design and image.</td>
</tr>
</tbody>
</table>

CONCLUSION

The factors and criteria of the parks are important means to achieve sound social interaction, while the most influencing factor on Karkh' park users is crowding of visitors and noise, followed by activities and quality, safety and security, accessibility and linkage, design and image, and management and maintenance, respectively. Therefore, the authorities responsible of Baghdad city need to make more efforts for the construction and maintenance of open spaces and parks in Baghdad according to visitor requirements. This is due to the fact that the current parks in Baghdad are inadequate and unable to accommodate the influx of visitors and the many service problems. Thus, achieving all these factors in the parks of Karkh is essential to enhance social interaction, which will lead to enhanced physical, health, mental, social, environmental, and aesthetic aspects for residents and residential areas of the Karkh.

The results of this study are a useful reference for urban and landscape planners, architects, social psychologists, the Municipality of Baghdad, and researchers in this field. This research evaluated the effect of factors concerning parks on social interaction, and it found the appropriate and effective factors of parks to enhance social interaction of Baghdad communities. This study also aimed to provide a theoretical foundation to improve and enhance effective social interaction in open spaces. The significance of this study lies in linking social psychology to architectural and landscape researches. Future research can improve this study by employing more members of respondents to achieve the largest possible number of views of the total society, so the results can be more accurate and reliable. Future studies can also ameliorate this study by using other research methods such
as the mixed-method (quantitative and qualitative) to ensure that the data obtained is more accurate and better reflects social interaction in open spaces.

REFERENCES


THE URBAN TRANSFORMATION OF TRADITIONAL CITY CENTRES: HOLY KARBALA AS A CASE STUDY
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1625

Sabeeh L. Farhan, Mohamed Gamal Abdelmonem, Zuhair A. Nasar

Keywords
holy Karbala; urban transformation; architectural preservation; traditional urban fabric; holy shrines

Abstract
Karbala is one of the metropolitan cities in Iraq, its historic and religious centre has a long history, yet many of its buildings are under threat because of unclear conservation management due to urban transformation. The history of religious rituals and processions reflects an array of values, concepts and planning philosophy that has used the power of religion and holiness of the city as a source of homogeneity and integration. By looking at the mass-pilgrimage spatial practices to the Holy Shrines in Karbala city centre and the adaptation by its residents of their domestic neighbourhoods, this paper analyses the spatial conditions of the city and offers insights into a set of factors that have shaped its historical evolution and urban spaces. The paper is in three parts; first, it discusses the causes of the urban transformation in this holy city. Secondly, it documents a set of everyday practices and problems in Karbala city, focusing on the urban level (the traditional fabric), following the analytical method of the historic evolution of Karbala as a religious centre as well as the incompatibility of the modern development with the centre’s historical heritage. Thirdly, it analyses the transformation of the urban structure by discussing the characteristics of the historical centre and the role of legislation in urban transformation of traditional city centres.
INTRODUCTION

Cities with holy Islamic shrines are characterized by similar features (Akbar, 1988), where the mosque represents the core of the city morphology surrounded by the traditional markets (bazaars or souqs) (Hakim, 1986) and then followed by the residential areas, and in some cases, a fortified wall to protect it (Abdelmonem et al., 2017). The only difference with the traditional Islamic Cities is that the Holy Shrine and its mosque represent the city's urban centre (Nasar, 2015). Many factors have transformed the urban structure of traditional holy cities including social, economic, legislative and functional (Demet, 2018). The transformation of the urban structure may end up to the point of interruption (Hussam, 2013 and Rossi, 1973). Likewise, that transformation is measured not only by space but by its timeline (Shimma & Habibi, 2004; Rossi, 1973). Changing needs create new urban functions that must be responded to by the urban structure (Bilal, 1995), which leads to the introduction of new architectural and urban forms (Rossi, 1982). The urban structure is not just an independent and steadily evolving entity, (Abdelmonem, 2017) but rather part of an ongoing developmental and evolutionary process (Nakanishi, 2014).

There are two approaches to understanding the transformation of the urban structure (Laursen, 2009). Such transformation cannot occur unless the residents gain special meaning from the surrounding environment (Montgomery, 2004). Urban transformation has two aspects: either positive, via interacting the new elements with the existing components of the old city and its traditional functions (Atanur, 2006), or negative, as in 1960s Turkey when the migration and displacement of the countryside and villages to the city began in parallel with rapid industrialization and economic development. The negative pressures caused by the concentration of the country’s population into urban centres, lead to unplanned urbanization, destruction of agricultural land, lack of transportation, poor infrastructure and environmental problems (Sophia, 2012). This type of event may lead to unplanned urban land use, mainly when there is a weak or absent supervisory role to regulate the administration of the city.

The holy city of Karbala is considered one of the most important spiritual and ideological cities amongst both Iraqi Shi’ite Muslims and Shi’ite Muslims in other parts of the Islamic world (Khalili, 1978). Karbala contains the tomb of Imam Al Hussein (grandson of the Prophet Muhammad) and his brother Abbas, and all the heroes of the Al Taf massacre (Attia, 1997). Thus, visitor numbers to this city throughout the year have been increasing steadily. According to The General Administration, Secretariat of Imam Hussein Holy Shrine, there are 36 holy events during the Shi’ite Islamic Calendar (The General Secretariat of the Holy Husseiniya, 2017). However, two events are considered the busiest where millions of Shia Muslims visit the site twice a year. The first is the anniversary of Imam Hussein’s death, where up to 8 million pilgrims visit the city to observe the tenth of Muharram; and the second, larger event, is forty days later, when up to 30 million pilgrims visit the Holy Shrine. This second event continues for about two weeks (Husein, 2018), and most of the pilgrim’s travel by foot from all over Iraq and many other countries. Additionally, there are two other events where up to 4 million Shia Muslims gather near the Holy Shrines (Al Baladiyya, 1988). One is the 15th of Shaban (the birthday of the last Imam of Shia) and the other is the 9th of Dhul Hijjah, the Day of Arafah which is the second day of the Hajj pilgrimage in Mecca (Hiyam, 2012).

Due to the gradual increase in the numbers of pilgrims, the old traditional city centre has transformed with urban renewal, expansion, development, etc., all carried out with one approach, namely demolition and destruction of the traditional urban fabric (Faraj, 2012).
Karbala currently has two main challenges. First, it is historically similar to the rest of the Arabic and Islamic world on several issues, and most importantly, its growing importance as a pilgrimage destination. Secondly and more significantly, because Karbala is more complicated than other pilgrimage cities, due to the unlimited high number of visitors throughout the year (Attia, 2008). This puts a large burden on the city’s services as the population swells from a few thousand permanent residents to several million people in times of pilgrimage. The impact of this rapid commercial growth in the city, which is an outcome of the continuing increase in visitors, has initiated the growth and random expansion of commercial areas with these now overtaking the residential areas. It is worth mentioning that the old city of Karbala comprises of 6 neighbourhoods which are Bab Baghdad, Bab Al Taq, Bab Al Salalima, Bab Al Khan and Bab Al Najaf (Al-Kalidar, 1971). The open area between the shrines was created by demolishing a huge number of housing units after the Shabaniyya Revolution in 1991, after which no signs of urban development occurred. Karbala has expanded towards the south and south-west side, due to the existence of green areas (figure 2).

Even though there is an urgent need to improve the urban infrastructure, this improvement must be studied, planned, and very well designed, taking into consideration the spiritual history, the heritage, and urban aspects of this ancient city centre. Therefore, it could be said there is a lack of awareness of how the historical centre is changing, consequently deforming its character. This research paper aims to study the architecture of the historical city centre of Holy Karbala. It attempts to identify the nature of the urban transformation in the face of the evolving pilgrimage routes and the subsequent socio-economic forces with a view to recommending how to manage this change and preserve the urban characteristics and history of the city centre.

**METHODOLOGY**

This paper is based on the descriptive and analytical approach. By collecting data from different sources, such as previous studies, official reports and government documents, there is evidence to show how the historical city centre of Karbala has changed. The Directorate of Urban Planning in Karbala also provided materials: namely the two main master plans of Karbala post 2003. The first study was conducted in 2007 by World Research Centre, in association with the Ministry of Municipalities and Public Works. The study attempted to set out the master plan of Karbala city, including the old town. In 2011 the Ministry of Municipalities and Public Works / General Directorate of Physical Planning contracted Dewan Architects and Engineers to set out the urban renewal of the historical centre of Karbala.

The Karbala archives had insufficient materials. Interviews have proved to be one of the most powerful ways of gathering information to understand specific approaches to urban transformation. Therefore, this paper depends on the theoretical investigation, spatial analysis and analytical discussions with local authorities (provincial councils), architects, planners, decision-makers (government officials), religious scholars, local residents and people who have visited the city frequently. Twenty interviews were conducted in Karbala. The information was gathered through talking with experts in the city and asking about their experiences, perceptions and practices. The questionnaire for experts in urban planning and architecture was limited to this specific sample because the research is specialized, requiring academic opinion coupled with scientific experimentation to provide an accurate assessment.
of the situation. This methodology offers the opportunity to answer the question about Karbala’s urban transformation.

HISTORIC EVOLUTION OF KARBALA AS A RELIGIOUS CENTRE

The city of Karbala is located 100km south of Baghdad (Capital of Iraq) (Figure 1). It covers an area of 5023 km2 (Iraq- Ministry of Planning, 2010 and Republic of Iraq Ministry of Planning Central Statistical Organization, 2010). Demographic statistics are available from http://cosit.gov.iq/en/joomla-templates.

According to Iraqi Central Statistical Organization, Karbala Governorate has a population of 1,003,516 citizens, (Al-Mufid, 1981) and the city dates back to Babylonian times about 1736 BC. It has been called Karbala, Karbala+Ta, in the cuneiform plates, since the first millennium BC. However, it became significant after the martyrdom of Imam Hussein and his family and supporters, in the Battle of Karbala, in 680 AD (al-Tabari, 1991). This coincided with year 61 in the Islamic or Hijri calendar. Imam Hussein is buried in Karbala, on the site of his death and the battle.

According to Al-Qarashi (2007) and Nakash (1993), Imam Hussein was a grandson of the Islamic Prophet Muhammad, and the second son of Ali ibn Abi Talib (the first Shia Imam and the fourth Rashid caliph of Sunni Islam). He is an important and honoured figure in Islam as he was a member of Ahl al-Bayt of Muhammad, the Prophet family, as well as being the third Shia Imam, after his father and his older brother Imam Al-Hassan.

As reported by Abu al-Faraj al-Isfahani (897– 967AD), historian of Arab-Quraysh, the battle of Karbala is also called Al-Taff battle. It was an epic event that took place on 10 Muharram,
year 61 of the Hijra, Islamic calendar, (Nakash, 1993) which corresponds to October 10, 680 AD. The battle took place between a small group of around 70 supporters and relatives of Imam Hussein, and a larger military detachment from the forces of Yazid, the Umayyad caliph (Faraj, 2012). Although this battle is of little military importance, the battle has a central place in Shia history, tradition and theology, and it has frequently been recounted in Shia Islamic literature (Howard, 1990). The tomb of Imam Al-Hussein in Karbala became a holy place for Shias where visits are accompanied by the echo of special supplications during the various events.

After the tenth of Muharram, which is the first month in the Islamic calendar, (61 AH / 680 AD), many pilgrims visit his holy grave. Consequently, many of them settled nearby. This led to the beginnings of the holy city of Karbala, which has evolved and expanded since that time. Initially, the various settlements were very small due to severe water shortages in the area (Aqil, 2004). The most significant change was in the early 18th century when a dam was built at the head of the Husseiniyya Canal, and consequently the old city started to expand tremendously from that point.

Due to the influx of visitors, many residential and religious buildings were constructed around the mausoleum (Al-Kildar, 1967). The ancient city of Karbala is densely built up around the mausoleum in the form of elongations due to the characteristics of the site. Narrow paths have penetrated the area leading to the formation of seven irregular neighbourhoods (Ansari, 2006).

THE CITY OF KARBALA AND ITS CURRENT URBAN SITUATION

There are four major types of land use within the city: religious and scientific, commercial, residential and transportation (Sadiq, 2007). Based on the analysis of land use in the study area in 2017 compared with 2007, one of the main changes is the relatively massive decrease in residential land use and how this has converted into commercial uses, due to the improved economic situation and the need for visitor-related services. Figure 3 shows how commercial use has started to dominate the old city, 2007 vs. 2017. Moreover, by enumerating these uses with GIS software, the increased density of commercial use and its replacement of residential use, is clear to see, especially in the southern areas of the old city and around the area between the two Holy Shrines (Error! Reference source not found.).

The city of Karbala reached the summit of urban integration when it acquired the basic components of an Islamic city. It consists of a religious centre with all other public activities such as the bazaar, gathered around the sacred centre. Going out from there are the residential neighbourhoods, just like other old-historic cities such as Al-Najaf, (Doxiadis, 1958) see Figure 8. The city of Karbala achieved the characteristics of the original Islamic city, as the result of various activities, ideologies, and civilizations, which have led to the current balance of land usage. After many transformations in the urban fabric - for example, the construction of wide straight streets and the removal of traditional areas - there has been a substantial negative impact on the mix of land use. The religious, educational and residential functions have been squeezed out by the new commercial uses, for example more restaurants and hotels opening, while the traditional areas near the Holy Shrines have been demolished.
Figure 2. Distribution of land use in Karbala city centre, Left 2007 – Right 2017 (Source: Authors by the Foundation of Physical Planning of Karbala, 2017).

Figure 3. The increased density of commercial use replacing the residential use, (Authors by Ministry of Municipalities, 2017).
There were seven significant demolitions starting in 1947, where much of the residential area surrounding the Holy Shrines and religious schools, was removed to expand the Holy Shrine courtyard. The pretext for this was organising the traffic for cars and visitors; this led to isolating the Holy Shrine from the urban organic fabric. The second was the removal of the famous minaret of the Holy Shrine (Attia, 2013), which was considered one of the most beautiful architectural monuments in the city, as well as the small courtyard attached to it and some religious schools and mosques. Thirdly, isolating the Shrine from the surrounding urban fabric, so that the Shrine has a wall separating it from the street, while the only parts of the wall which could be seen from the outside, were the gates of the Holy Shrine (Department of Planning and Engineering, 1977), (Figure).

In 1978, because of the construction of the pedestrian pathway between the Holy Shrines of Imam Hussein and of Al-Abbas, there was destruction of a part of the famous market (Souk Al-Hussein) northeast of the Holy Shrine of Imam Hussein. Also, Al-Safi Mosque, the school of Hassan Khan, and many heritage buildings have been destroyed. Then, in 1980, the neighbourhoods surrounding the Holy Shrines were removed; this was considered essential to annex the shrines, as shown in (Error! Reference source not found.). The sixth removal was in 1991 after the civil rebellion, when large areas of the city centre, between the two Holy Shrines, were removed (Figure 4). Finally, in 2006, the upgraded masterplan for the city of Karbala was approved, which included more removal and distortion of the old city centre and its urban fabric (Jinan, 2011), see (Figure 4).

The indiscriminate removal of the sacred centre of Karbala under the pretext of providing car parks, traffic networks, open spaces and guest/rest houses during religious events, has caused massive urban upheaval over the past few decades. While alternative solutions could have been developed for exceptional and extraordinary events to provide visitors with comfort and ease, while also preserving the historic structure, this was not done, and many of the unique architecture has disappeared forever. This emphasises the need to preserve the ancient buildings and character of the old city that remains.

The uniqueness of the historical centre of Karbala has not happened in a vacuum, but through the characteristics and advantages that have been singular to it and that distinguish it from other cities. Figure 7 illustrates the most important shrines and mausoleums in the city centre that are accessible to visitors, in addition to the two Holy Shrines which host the Imam Al Hussein’s household members in their martyrdom locations.

Some include documentation regarding certain events such as the Imam Al Hussein’s standers and speakers with Omar Bin Saad, as well as Tal Zainabiyya, where Al Hussein’s sister (Zainab) stood to monitor the course of the battle on a small hill which is slightly elevated (the land is still there to this day). These historical sites are linked to events that have a high symbolism among Shiites and to the movement of visitors within the city. It is also worth mentioning that the city centre is full of heritage sites and houses such as the houses of Islamic theologians, Ayatollah Al-Sayed Al-Khoei and Ayatollah Saqakhana.
Figure 4. (Left) Holy Shrine after isolating it from the urban fabric, 1947 (Library of Hadara Abbasiya, 2005); (Right) Holy Shrine after isolating it from the urban fabric, 1947 (Dywan, 2011).

Figure 5. (Left) the pedestrian pathway between 1978-1981 (Rasha, 2001); (Right) the construction of the pedestrian pathway 1978-1981, Aerial view (www.ahl_bayat.org).

Figure 4. (LEFT) the removal of large areas of the city centre, between the two Holy Shrines dorar_aliraq.net/, 2006); (RIGHT) removal and distortion of the old city centre and urban fabric (Source: Authors, 2012).
The two Shrines of Imam Husain and Al-Abbas are very important architectural and cultural features, as well as being spiritual centres for Shiite Muslims. As a result, their location and siting have a direct impact on both the local area of the old city centre and on the city of Karbala as a whole.

MODERN DEVELOPMENT INCOMPATIBILITY WITH THE HISTORICAL HERITAGE OF THE CENTRE

There is increasing development, most of it focusing on the construction of new hotels and restaurants to accommodate visitors during religious events. The vast majority of this development does not reflect the traditional architectural design or the use of traditional materials. The facades of these modern buildings have created a huge visual confusion by using modern colours and finishing materials, such as aluminium panels and steel frames with glass, which are very different to the local architecture, see (Figure 8).

The Master Plan of Karbala in 1992, for example, attempted to exploit the available land for serving visitors and creating shady areas for them (terraces and landscaping). This neglected all of the surrounding urban considerations (mass/space relations - functions and visual relations) and the architectural aspects of the city. Additionally, because of increasing numbers of visitors and cars, the study pointed to the transformation of the streets from two-way to one-way. The study has resulted in the disruption of the activity of the old commercial areas and the removal of large parts of them, some of have disappeared, such as “Saphapher market” in the city centre and “Souq Hussein”, which contains many ancient qaiserat (Ali et al., 2014). Also, the 1992 plan’s reported emphasis on the commercial areas in the main streets, which replaced the narrow alleys that characterized the traditional fabric.
of Karbala. Hence, the Directorate of Karbala Municipality approved many commercial buildings such as restaurants and hotels in these new straight streets surrounding the two shrines such as in Al-Furat Street. These buildings (such as the Ard Al Nakheel Hotel, the Noble Hotel, Al- Ritaj Restaurant, and the Dur Al Najaf restaurant) were characterized by architectural details that did not conform to the city's unique style in terms of the quality of building materials, architectural style, etc.

Particularly important, the height of these new buildings has obscured the fence of the shrine of Imam Hussein. There have been some attempts to use some traditional elements in the architecture of these modern buildings, using the collage method according to the postmodern style, however, these efforts are weak and there is still a lack of real coordination.

Questionnaire

The questionnaire (Appendix 1) was prepared to assess the state of the urban structure in the historical centre of the holy city of Karbala and its current urban transformation. This questionnaire includes four questions focused on the evaluation of the current situation of the urban structure and its transformation.

The questionnaire was asked of 40 urban planning and architecture experts and was limited to this specific sample because the research problem is specialised, which requires academic opinions coupled with scientific rigour to provide an accurate assessment of the situation. 80% of the participants have more than ten years professional experience and 17.5% had 5-10 years’ experience; only 2.5% had 1-4 years. 65.5% of them are PhD, 22.5% have Master’s degrees, and the remainder have Bachelor’s degrees. 62.5% work in academic institutions, 25% in government bodies and 12.5% in the private sector.
ANALYSIS OF THE URBAN TRANSFORMATION IN THE URBAN STRUCTURE CHARACTERISTICS OF THE REALITY OF THE HISTORICAL CENTRE OF THE HOLY CITY OF KARBALA

When asked to think about the problems with the historical centre and its causes, more than half (52.5%) of the respondents indicated that it is the steady increase in the population and the disproportionate number of services provided to them, that are the main problems. While nearly half of the experts (45%) believe that a lack of awareness amongst the general public of the concept of a local environment and urban fabric, and the emergence of individuality in the local community, are the reasons for these problems. About one-third (35%) of the experts said that the issues are caused by people not missing the traditional spatial values, while 30% indicated that there is a need to change the economic functions of the traditional city centre.

These percentages show us that these experts believe that population growth rates are not compatible with various strategical plans and services because the city is growing in population. That has led to moving the economic activities and changing the land usage according to the economic aspects and omission of spiritual and moral aspects of the city, along with the weaknesses of architectural planning.

The population numbers in Karbala governorate have increased in the last three decades. There were several reasons for this, namely: the presence of the two shrines which makes it a popular and active tourist attraction, as well as the barbaric action in 2003 which forced people to migrate. These actions have affected Karbala’s demography, especially increasing the numbers of people looking for jobs, as Karbala has many areas of employment which are active throughout the year.

Despite the increase in Karbala's population, all the residential expansion has occurred in the new areas, whether planned or not (like Al Gaber area and Al-Abbas area) but the population in the old city has decreased due to the huge population influx in the fifties which led to the need for establishing modern neighbourhoods with larger houses. This encouraged people to move out of the old city into these new neighbourhoods, as well as the expansion and construction of new streets, especially in the city centre, many homes were removed, and front sections and ground floors of those houses were transformed into commercial shops to bring an economic return.

Holy Karbala city is facing many challenges in planning and design. We mention here random commercial activities: as these businesses are not in harmony with the religious status of the city - they are spreading randomly which could disturb the religious spirit of this city, by not respecting religious privacy and its importance, especially of the architectural trends and buildings in the shrine area. Our interviewees said that there is no harmony between the pedestrian areas and streets; there are huge buildings and car parks in the old city which may destroy the urban fabric of this area and there is inefficiency in the way land is used, and no rigour applied to what is built or how these will coexist with functions related to religion and services such as hotels, cafes, shops, public services, police stations, etc.
CURRENT FACTORS AFFECTING THE URBAN STRUCTURE

Due to the predominance of commercial and tourism related construction, there is a direct threat to the visual dominance of the Holy Shrines. Therefore, the majority of the participants (82.5%) pointed out that the economic reasons are the main driver of the transformation of the historic centre. The urban fabric has been exposed to many factors due to the extensive and unplanned development of the area, which poses a serious threat to the urban and social cohesion of the Old City. Consequently, there has been an effect on the historical values that are embodied in this fabric. It also has affected the privacy of the city, with the loss of the distinctive urban fabric of the old city which consisted of residential neighbourhoods, small shops, places of worship and education.

Most of the respondents (92.5%) agreed that the laws and legislation contribute to limiting the impact of transformation on the urban historical centre. Half of the experts (50%) stressed the importance of ensuring the preservation of the original urban landscape of the historic centre, with 42.5% emphasizing the need for establishing a legal and legislative framework controlling the participation of the local and regional councils within the urban landscape of the historic centre. Also, confirmed by nearly half of the experts (45%), there is a need to change the laws and legislation on long-term plans to ensure that the future development of the historic city centre is positive.

The experts pointed out the necessity of establishing structural controls to determine the height of buildings in the old city to ensure that the shrines dominate on the skyline, while members of Karbala province council pointed out the need to develop special legislation for the old city to ensure the preservation of the style of the traditional urban fabric, especially with respect to the architectural details. On the other hand, the municipal engineers interviewed explained that they are keen to apply urban laws, but the law itself may need to be reviewed or added to be commensurate with the spirit of the times.

DISCUSSIONS

The Holy Shrines of Imam Hussein and Abbas in the holy city of Karbala, have influenced the urban structure of the historic centre. Currently, the historical centre of the city of Karbala is under tremendous pressure, as there are a series of urgent needs; the enormous numbers of pilgrims means that there is a growing demand for more hotels and restaurants. This has led to a transformation in the urban structure, with economic factors playing the main role in this change.

Likewise, there are mosques, libraries and religious schools in the historic centre, in addition to empty spaces. The destroyed buildings offer opportunities for renovation or redevelopment with an appropriate design to assist in accommodating visitors. The main feature of the historical centre is the solidity of its historical and urban areas. Despite the recent destruction and reconstruction of roads, the historical centre is a distinct entity, characterised by a series of features that distinguishes it from the new development areas. These features include: visual and urban control of the Holy Shrines of Imam Hussein and Al-Abbas on the urban landscape of the old city, the planning of streets and narrow alleys unsuited to vehicle movement, the traditional brick-built buildings, which dominate the irregular streets.

Without a comprehensive study of the characteristics of the urban structure, it is inappropriate to construct straight, grid-like streets in the heart of the historical centre of
Karbala. There should be a redevelopment plan to meet the requirements of the pilgrims without this tremendous indiscriminate transformation, which has a huge impact on the traditional urban fabric. Protecting the historical centre and its urban structure should be the priority in any redevelopment plan that is specific to the holy city of Karbala, not the changing needs (for example the increase in visitors that has varied throughout history). Tourism planning should be based on assimilation and organisation so that tourism is not affecting the shape of city itself.

CONCLUSIONS

There are a series of dangers that may hinder the process of historical re-development and planning. While the increasing commercial functions, such as hotels and restaurants, represent the most significant threat to the original urban fabric, which includes unique architectural structure, the most pressing problem in the historical centre of Karbala could be defined as the difficulty of absorbing the tremendous movement of pilgrims to the Holy Shrines during the numerous religious events. Additional threats could be changes in the demographics of the area; lack of maintenance of public services; the shortage of public investment in the infrastructure; the increasing industrial activity in the old residential neighbourhoods; transportation problems due to access difficulties; and the decline and loss of green areas.

The pressures, which have been exerted by the private sector on the development process in many areas of Karbala’s historic centre, has been identified. Also, the visual dominance of the Holy Shrines (Imam Hussein and Abbas) is directly threatened by the increase of these developments. Additionally, the lack of investment in the maintenance of existing buildings threatens the future of them in the long term, and there are many buildings that have been demolished or destroyed. Therefore, there must be an immediate law to protect the historic fabric of the old city from any further destruction.

The historical and urban shape of the historical centre of Karbala is still largely intact. However, there are many examples of dismantling due to unresearched development and demolition. For example, many historical, religious and non-religious buildings, with great architectural design have been destroyed due to the collapse of the building, a lack of investment and all social and political conditions have contributed to this collapse. Additionally, many people own these historic buildings, making it very difficult to renew and re-develop these areas sympathetically to modern standards.

A large part of the historic centre, between the two Holy Shrines, was removed by the Directorate of Urban Planning, to start the urban redevelopment of the area. Furthermore, some other historical spaces, houses and religious schools, were demolished due to the construction of many new grid streets and new hotels. The visual and physical control of the Holy Shrines of Imam Hussein (PBUH) and Al-Abbas emphasize the main role of the city, which hosts two of the most important Muslim shrines in the world. Likewise, the golden domes are a focal point and treated as the most important the visual axes. Therefore, the two Holy Shrines are at the core of the religious activities, and since they are the focal points of the religious and Islamic culture, it is very important that the dominance of the Holy Shrines prevails over the urban redevelopment plans in the historic centre.
REFERENCES


Jinan, A. S. (2011). *The Role Of Redevelopment In Highlighting The Height Of The Urban Landscape In The Holy Cities*, A thesis for the Degree of Master of Science in urban and regional planning, Baghdad University.


UNDERSTANDING SOCIO-CULTURAL SPACES BETWEEN THE HADHAR AND BADU HOUSES IN KUWAIT

DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1712

Yousef Al-Haroun, Mohammed Al-Ajmi

Keywords

housing; Kuwait; Hadhar; Badu; tradition; modernity; globalization

Abstract

This study examines the socio-cultural spaces of the two major groups in Kuwait: the Hadhar and Badu. These groups are not an ethnic classification but are rooted in their historic settlements. The Hadhar refer to people who lived in old Kuwait town and were mostly merchants and artisans who made their living from the sea. The Badu on the other hand, most commonly referred to as Bedouins, are nomadic tribes who lived on the outskirts of old Kuwait town or in the Arabian Desert. This study employs cognitive maps to reveal fascinating insights into the lifestyles and cultural differences of these two groups as it relates to their domestic built environment. This study argues that house spatial organization is tightly coupled with a family’s socio-cultural traditions and values; hence, there are major spatial distinctions between the houses of the Hadhar and Badu. These differences are apparent in the houses’ main spaces such as the living hall, male guest reception space or diwaniya, and main entrance. This paper also contends that these differences are rooted historically in the traditional Hadhar mud brick courtyard houses and the traditional Badu Arabian tents. Although the oil boom and consequent impact of globalization transformed Kuwait’s houses into modern villas, on the inside they are still linked to each group’s traditional use of space.
INTRODUCTION

Historically, it has always been thought that the traditional Kuwaiti house was the well-known mud brick courtyard house. As such, researchers have focused on its elements and functions within the urban fabric (AlJassar, 2009; AlAjmi, 2009; AlHaroun, 2015). However, other forms of housing have been neglected. There was the Ashsish in the outskirts of the old town, the Dhow which was a dwelling for merchants and pearl divers who spent months at sea (AlAnsari, 2011), and the traditional Arabian Tent that sheltered the nomadic Bedouin. Why were these housing types not highlighted in prior research as being part of Kuwait’s traditional dwellings? One explanation may be that the courtyard house was the most prominent element in the old town’s urban fabric and the other housing forms were not within the walls of the old town, and thus not considered as a representation of the vernacular.

This study acknowledges these other forms of housing and pays particular attention to the comparison between the traditional courtyard house and the traditional Arabian Tent. Understanding these two forms of housing and the people who lived in them is key to understanding Kuwait’s domestic built environment. It also sheds light on the identity of the Hadhar and Badu peoples of Kuwait and the evolution of their contemporary households.

The observation of the Hadhar-Badu dichotomy originated from the authors’ backgrounds; the first author is from the Hadhar group, while the second is from the Badu group. For this study, these terms have been used to classify, research, and study the above-mentioned social-cultural groups of Kuwait. It aims to understand and highlight the differences and similarities of these two groups. Specifically, whether belonging to a distinct social group Hadhar or Badu in Kuwait would result in a specific house design and form, spatial arrangement, and identity. If so to what extent has globalization impacted their cultural lifestyle practices, characteristics, and behaviours? And what are the implications on practice in Kuwait’s contemporary residential development? In order to further understand this phenomenon the method chosen for this study is cognitive maps. Thus, participants from the Hadhar and Badu groups have been selected and asked in a survey to sketch their houses. The data collected reflected interesting perceptions of space as it relates to each group. These observations have not only reinforced discussions from the literature review but also clarified the links between the past and the present in Kuwait’s domestic built environment.

HADHAR AND BADU

Who are the Hadhar?

The name Hadhar is derived from the Arabic word ‘Hadhar’ meaning cities, towns, or villages and the people who live in them (AlMawrid, 1988). Even though most of the Hadhar can trace their routes to Bedouin ancestors, the term characterizes their settling down and flourishing in urban life. They are comprised of mostly immigrant tribes who fled from famine in the heartland of Arabia now Saudi Arabia (Abu Hakima, 1983); some also originated from southern Iraq and Iran. This melting pot brought together diverse peoples from different backgrounds who turned to the sea for trade and pearl diving. Furthermore, Kuwait’s rich maritime history exposed its people to different cultures, which made them more tolerant and understanding.

Kuwaitis use the term Hadhar for the people who used to live inside AlSoor or the Wall of Kuwait. Longva (2006) acknowledged “the term hadhar designates Kuwaitis whose forefathers lived in Kuwait before the launch of the oil era (1946) and worked as traders,
sailors, fishermen, and pearl divers" (Longva, 2006). The wall was not only a shield against tribal attacks but was a physical manifestation of the separation between the old town and the desert. Five gates allowed people access to the city and to engage in trade with the Badu in Safat Square.

Who are the Badu?

The Badu, better know in English as Bedouins, are typically known as the nomadic/pastoral animal herding Arabs who usually lived in the Arabian Desert (Britannica, 2018). They are also known as tribesmen or 'qabael' in reference to the tribe, which refers to a socio-political system formed through common patrilineal descent (AlZubi, 1999: 9). This study, however, deals with the growing derivative social meaning of Badu in Kuwait in the context of “country as opposed to city or primitive as opposed to civilized and the category to which it is purported to apply” (Longva, 2006: 171).

Why study these groups?

After the oil boom and consequent modernization Kuwait’s built environment and people changed forever. Today, most Hadhar trace back their origins to Badu tribes throughout the Arabian Peninsula. They once roamed the deserts of Arabia but when famine struck their lands they immigrated to Kuwait to find better opportunities. Kuwait gradually became a trading hub and its town flourished in the crossroads between maritime trade from Asia and the caravans taking goods to Syria and Iraq. Thus, the Hadhar Kuwaitis were exposed to many cultures in their travels and trade, which in turn made them more tolerant and open to other cultures compared to their ancestors who still lived in the heartland of Arabia.

Hadhar who used to live in mud brick courtyard houses now live in modern villas. Bedouins also no longer need to live in tents and move around; so they may in fact be considered as Hadhar. They all live in the city and share similar lifestyles. After long transitional processes, all Badu have now been settled and “all Kuwaitis are now urbanized, and Hadhar and Badu therefore do not exist as distinct, ontological entities” (Al-Nakib, 2014: 6). Therefore, in an increasingly globalized world the Hadhar and Badu settlement groups are no more. They have all merged into the larger Kuwaiti society. Nonetheless, the Hadhar-Badu dichotomy still exists in Kuwait as a popular discourse in today’s social culture with the Badu being the largest group in Kuwait’s population. Each group has a unique and distinct cultural and ethnic personality that is derived from their past identities. They still carry with them their own traditions, traits, dialects, and behaviors. It is in these differences that this study intends to highlight and understand how socio-cultural qualities evolved into lifestyle practices specifically in the contemporary Kuwaiti house.

These two groups account for the majority of Kuwait’s past and present population, yet no existing studies have examined the differences and similarities of these significant cultural groups in the context of their domestic built environment. While significant research has been conducted on the relationship between tribalism and nationalism in the Gulf, no attempt has been made to investigate how the Hadhar-Badu dichotomy influenced the built environment, especially their contemporary dwelling spaces. Furthermore, no in-depth research has been conducted to understand how modernity has impacted their lifestyles in relation to their homes. Therefore, this study intends to contribute to and understand new perspectives of Kuwait’s transformation and subsequent modernization, thereby providing another layer of
meaning and information to further enrich the discussion of the modernity versus tradition paradigm.

BACKGROUND

Impact of Globalization

The “thrust of modernity” or globalization has had a great impact in the world, transforming people’s way of life. Although, this study explores the effects on Kuwait's built environment, the phenomenon is universal. Anthony Giddens (1990) sees globalization as the inherent “thrust of modernity” that works for a greater interconnectedness global-wide. He defines globalization as, “the intensification of world-wide social relations which link distant localities in such a way that local happenings are shaped by events occurring many miles away and vice versa” (Giddens, 1990: 64).

For some it is a force of economic prosperity while for others it has and continues to have a negative socio-cultural and environmental impact on sustainable development. Culturally, some are concerned that “globalization will impose conformity and homogeneity and that their familiar, personal neighbourhood coffeehouses and indigenous religious communities will be replaced by impersonal global identities” (ECSSR, 2008: 19). Mahgoub asserts, “Globalization is viewed by some as a new form of colonialism and occupation...Economic superiority, allowing two-thirds of the world's wealth to go to only one-third of the world's population while one-third of the world's wealth is going to two-thirds of the world's population, is increasing the ‘gap’ between poor and rich countries” (Mahgoub, 2004: 507).

Modernization via globalization also affected social relationships, as Beck claims, “these changes have also generated new forms of individualisation. They affect patterns of interaction dependent upon housing and living arrangements .... Thus traditional forms of community beyond the family are beginning to disappear.” (Beck, 1992: 97). Beck argues that the solution to the “negative consequences of modernity is not the rejection of modernity itself, but its radicalization” (Ibid). As a result, necessary are critical reflections on “modern impacts and their ecological, urban, and social conditions of existence, and hence potentially to seek approaches to change them” (Ibid).

Therefore, the challenge is to work within globalization yet recognize and confront its side effects by being “active participants instead of passive recipients of globalization” (Mahgoub, 2004: 518). Satler remarks, “Today feelings about globalization are more sophisticated. Globalization may bring within each regions of cultural difference, but it also threatens those regions with sameness. No global culture can absorb everything. A coexistence of diverse philosophies is not only possible but necessary” (Satler, 2000: 22).

Moreover, this paradigm is also argued by ElSheshtawy asserting that cities that witnessed rapid growth within the last decades are moving towards a model that attempts to balance forces of modernization and change while trying to preserve traditional elements within society (ElSheshtawy, 2000). Furthermore, Liangyong states, “that globalization and regionalization are like two sides of a coin and that they are inseparable” (Liangyong, 2000: 12). There seems to be a consensus that globalization is an inevitable reality and one needs to recognize its far-reaching effects all over the world, “sometimes even painful, changes in their accustomed ways of doing things. But if the challenges are great, so also are the opportunities” (Madison, 1998: 20).
Culture, House Form and Identity

The environmental side effects of globalization have led many advocates for sustainable development and to re-examine culture and the vernacular. Culture is a key dimension in sustainability (Duxbury & Gillette, 2007) and it is important to recognize its impact in providing local solutions to global challenges. Moreover, the value in linking cultural and ecological sustainability provides for a better foundation to implement successful sustainable development (Throsby, 2008). Continuity of culture and its survival must be inspired by past traditions (Kenney, 1994). Furthermore, Hawkes explains how it is through society’s values that everything is built and is an expression of its culture. Therefore, the ‘application of culture’ is integral for new paradigms that emphasis sustainability and well being (Hawkes, 2001).

Social symbolism of house form has been examined by many researchers. Rapoport understands house form and culture as primarily “a socio-cultural determinism of architectural form” (Rapoport, 1969: 10). He explains that the act of building a house is a “cultural phenomenon” and the socio-cultural forces are considered primary in shaping house form, whereas climate, construction materials, methods, and technologies are secondary. Rapoport sees “the content of spaces, their size and correlation, the level of understanding and connection between the built and the natural environment, private vs. public space organization, view of appropriate distance etc., directly influence architecture both in form and type” (Ibid: p.9, 47).

Despite Rapoport giving primacy to socio-cultural factors he does not exclude other aspects. In vernacular architecture, cultural and environmental factors are seen to merge as one, manifested in traditional vernacular elements. For example, in the Middle East the courtyard meets the culture’s need for privacy and is also a direct response for the harsh desert climate. The skin covering the Arabian tent is breathable providing a cooling effect in the hot desert. Similarly, the verandahs and large windows in the Australian house is a translation of people’s desire to ‘connect with nature’ as well as an environmental solution for ventilation. It is true that socio-cultural aspects are important, however, the final house form is influenced by both culture and the environment equally. Nonetheless, for this study although the researchers acknowledge the importance of the environmental factors influencing house design it will focus mainly in the socio-cultural factors within Kuwait’s domestic built environment.

Appleyard sees the home as a symbol that conveys and expresses identity, and buildings are seen to "carry social messages...for their creators, owners and neighbors, about who they are" (Appleyard, 1979: 4). While social symbolism has been referred to, the reasons behind symbolic use of architectural elements have not been clarified. Tognoli (1987) highlights that the research direction is towards a more socio-cultural understanding of the house. He suggests that the home environment is more than just physical place, "in fact research on home shows a de-emphasis on the physical and special, and a reliance on social, cognitive, cultural, and behavioural issues that emphasize home as a security, comfort, and symbol of a place of departure and return" (Tognoli, 1987: 655).

Culture has also been very much associated with identity. The concept of identity expresses who people are and how they see themselves. In UNESCO’S declaration of cultural rights they state, “[C]ultural identity applies to all cultural references through which individuals or groups define or express themselves and by which they wish to be recognised; cultural
identity embraces the liberties inherent to human dignity and brings together, in a permanent process, cultural diversity, the particular and the universal, memory and aspiration” (UNESCO, 1996).

Cultural identity is therefore an expression of who people are, and it is by recognizing these differences that one may embrace the diversity of humanity. Many have recognized the value of identity in architecture. Identity can be rooted in an interpretation of a culture and its self-expression, it can also give a sense of meaning for a place. “Architecture of identity” rivals “architecture as space” and “architecture as language” as one of the principle themes in architectural discourse (Abel, 2000: 141).

There are many examples in which people seek to explore identity in their dwellings. Rapaport argues for, “open-ended” design in housing to enable homeowners to take an effective part in designing their living spaces (Rapaport, 1968). Similarly, John Turner asserts that self-built housing provides opportunities for expressions of personal and social identity (Turner, 1976). Norberg-Schulz understands the relation of man to place is more than simply a matter of being able to orientate oneself to one's surroundings but has to do with a much deeper process of identification (Norberg-Schulz, 1980).

When a cultural identity is disconnected from its past it starts to search for a new form of self-expression. However, prior research demonstrated that in fact culture is never really disconnected from a society: it morphs into a new version where socio-cultural traits resist change. This study intends to further explore these issues. Its journey towards a new understanding of ‘the self’ may be understood through the constant changing of architectural landscapes. Perhaps in finding a new expression for a culture’s identity it may use meanings from it’s past to address future concerns.

KUWAIT’S DOMESTIC BUILT ENVIRONMENT

Traditional Courtyard House

The courtyard house was one of the most important elements of old Kuwait City. In order to understand this one needs to ask what factors catalysed its emergence in Kuwait. The country’s harsh desert environment and strict adherence to religious values encouraged the development of innovative architectural concepts that created comfortable living spaces. The courtyard house emerged in order to maintain a delicate balance between culture and sustainable living, reflecting an awareness and sensitivity of the natural world. Kuwaiti courtyard houses are distinguished by several features or elements: the Hosh or courtyard itself; the Liwan or covered walkway; the traditional wooden doors; the Diwaniya (men's reception area); the Bagdir (wind catch); the Jelleb or well; the Merzam (gutter); the Bircha (water collection tank); its mud brick; its flat roofs; and usually, a one story structure (AlHaroun, 2015). Although similar to other regional vernaculars, the people, materials, craftsmanship, and overall sociocultural and economic dynamics that shaped the Kuwaiti courtyard house made it a unique local creation.

(Fig. 1) Bait AlKhalid is one of a few renovated traditional courtyard houses that still remain in Kuwait. The courtyard was a multipurpose open space where the entire family would gather and socialize. Some courtyards had a tree or shrubs, and most would have a Jelleb. The Liwan, or covered walkway, separated the edge of the courtyard from some rooms while the rest of the house spaces would directly overlook the courtyard. Some houses had more than
one courtyard, with each serving a different purpose. The most common examples would have a Diwaniya, although some would have a Haram (female court). The houses were built of mud brick or adobe, which was very effective against Kuwait’s harsh climactic conditions (Ibid).

Figure 1. Bait AlKhalid or AlKhalid House in Kuwait City. The image to the upper left is the house overlooking the street and upper right image is the courtyard space (Source: Authors Archives, 2018).

The Arabian Tent

The Badu were a nomadic people. Their houses or dwellings were a typical Arabian tent called bait es-shaar, meaning the booth or house of hair made from a wool combination of sheep, camel and goat hair, making it blackish in colour. It was supported by round wooden poles (Fig. 2). The back-strip, functioning as a wall, was flexible and movable according to the wind direction and the users’ needs. Sometimes they moved it several times in one day to block the harsh, cold, or sandy winds. The size of the tent varied according to the family’s social status and wealth; a typical small family lived in a tent of one pole. As the family increased in size, status, or wealth, the number of supporting poles increased accordingly.

Figure 2. Badu tent (Source: Rapoport, 1968).

The nomad’s tent was easily divided into two major spaces: one for the family and one for the diwaniya; a reception area reserved for the male members of the family and their male
guests. Charles Doughty, who visited and lived in these houses during the 1880s, described how they were built, “When the tent-cloth is stretched upon the stakes, to this roof they hang the tent-curtains, often one long skirt-cloth which becomes the walling of the nomad booth: the selvedges are broached together with wooden skewers. The booth front is commonly left open, to the half at least we have seen, for the mukaad or men’s sitting-room: the other which is the women’s and household side, is sometimes seen closed” (Doughty & Lawrence, 1921: 267).

**The Modern Villa**

With the oil boom came the emergence of new suburbs sprawling beyond the new city and so too came new houses. The built environment in Kuwait has been clearly impacted by the various economic, political, social and technological changes experienced by the city and nation. In fact, the transformation of the city through its master plans literally forced a new house design on Kuwait and its people – the Hadhar and Badu. People were forced to move to completely new neighborhoods and adapt to a new way of life. The speed of change gave no time to reflect on the far-reaching consequences that would reshape the city’s urban fabric.

In his observations of Kuwaiti development, Saba Shiber writes, “the modern house or villa plunked on a uniform and non-descript plot which, with several hundred similar plots constitute the inorganic and uneconomic new neighbourhoods of Kuwait …The house sits clumsily in its plot exposed on all four sides to the elements, with a garden that is no garden at all for it consists of the corridor set backs from every boundary of the lot” (Shiber, 1964, 287).

In examining the country’s transformation, AlBahar states that, “Kuwait's residential building environment portrayed the most identifiable impressions of this accelerated phenomenon of cultural change” (AlBahar, 1990: 24). Post-oil houses differ radically from pre-oil houses. Rapid economic, political, social, and technological changes significantly altered people's perception of architecture. This resulted in a “plethora of eclectic” and a “carnival show, an architectural history showroom of copied styles and motifs” (Ibid, p.133).
The designs range from Neo-Islamic, Neo-Classical, Spanish, Cubist, Japanese, and many others. During the 1980s and later, highlighted after the first Gulf War, people searched for a Kuwaiti architectural identity, and so emerged Neo-Islamic designs alongside variations on traditional forms. (Fig. 3) clearly depicts the multitude of house styles and forms in Kuwait’s contemporary residential landscape. What has led Kuwaitis to design houses that were completely foreign and away from their traditions and vernacular? Many researchers studied this phenomenon. It is apparent that Kuwaitis in their attempt to modernize felt they wanted...
to catch up with the rest of the developed world. They demolished old Kuwait town and went looking for a new identity in their built environment. In their journey, from vernacular, to modern, and beyond, Kuwait’s architecture lost the human connection to nature and community relationships. New grids and houses changed how people lived and connected. The introduction of the automobile and highways took away the sense of community, which once people had when they walked to work, the mosque, or marketplace. Although modernity brought with it hope for a better future and technological advancement such as air-conditioning, in a way it also brought a sense of isolation and coldness. The buildings were concrete, steel, and glass with no reference to local culture. Many outside designers started to add balconies that were never used and Masbrabiyas (sun screens) that gathered dust. Moreover, no consideration was given to Kuwait’s hot desert climate. Kuwait became a place of experimentation and hybrid building development.

Despite these overwhelming changes, current research notes that, although the house form changed, Kuwaitis still maintained certain socio-cultural spaces and traditional practices. AlHaroun’s thesis (2015) demonstrated how Kuwaitis dealt with and adapted to the collision between traditional concepts and modernity; for example, how the courtyard has been replaced by the family living room, and how people’s misunderstanding of the courtyard may in fact show how they valued outside spaces (AlHaroun, 2015). Similarly, AlJassar (2009) highlighted the persistence of the diwaniya as an important part of Kuwait’s socio-culture (AlJassar, 2009). This research intends to further these understandings by shedding light in to what extent modernity affected Kuwait’s household spatial arrangements.

The Evolution of the Hadhar and Badu Houses

Although both Hadhar and Badu now live in modern villas each group has different requirements and internal spatial configurations for their house designs. These differences have been discussed in this section and will be further highlighted and explored in the main empirical part of this study. (Fig. 4) below is a comparative plan analysis between the Hadhar and Badu house before and after the discovery of oil. It clearly depicts how social spaces in Kuwait’s contemporary houses have a direct link to their traditional counterpart. The courtyard was the heart of the traditional Hadhar house as seen in (Fig. 4-A). It was an exclusive space used by the entire family. However, after the 1950s and subsequent oil boom, the modern villa in (Fig. 4-C) introduced a new house typology to Kuwait. The courtyard has been replaced with the guest or family living room. In contrast with the Badu, the Hadhar in both house types always shared the same entrance for males and females. The only strictly male space that survived the transformation was the diwaniya. The importance of the diwaniya spaces is tightly linked to Kuwaitis’ social and cultural habits.

The Badu used to live in Arabian tents (Figure 4-B) before settling in Kuwait. There is a clear gender-based separation in a typical Arabian tent in which the distinction between male and female spaces is clearly defined by a dividing screen wall called a ‘qata’. As a patriarchal society, one would expect that the majority of space would be devoted to the man’s domain; however, the women’s side actually occupies two-thirds of the tent space while only one-third is left for the men. Interpreting their daily activities would explain the spatial divisions of the tent. While men spent most of their time outside the tent herding their camels, hunting, or raiding other tribes, women used to do most of the physical work of “pitching the tents, cooking, carrying water, spinning and weaving and looking after the flocks” (Faegre, 1979: 24). Although both domains share the same frontage where they can be approached by relatives and guests, the men’s entrance is “generally offered less privacy” than the women’s
domain which is considered a “forbidden territory to all others, while the women may watch the men through a small viewing hole in the Qata” (Ibid, p.24).

Figure 4. Comparative plan analysis between the Hadhar and Badu houses before and after the discovery of oil. (The above diagram was constructed by the authors (2018) however, the plans have been collected from the following sources: A: The National Council for Culture, Arts, and Letters: 2009, B: Torvald Faegre: Tents: Architecture of the Nomads: 1979, C/D: Collected from various architectural offices in Kuwait).

The Badu’s contemporary houses (Fig. 4-D) have distinctly similar socio-cultural spaces rooted in the traditional Arabian tent. For example, the diwaniya and magalat spaces, which is a male social space where men typically sit on the floor, is directly linked to the men’s section of the tent. Additionally, the Badu house, like the tent, continues to evidence strong gender segregation in the separate entrances and female living areas.

METHODOLOGY

Cognitive Maps

The term ‘cognitive’ means a “conscious intellectual activity such as thinking, reasoning, remembering, imagining, or learning words” (Merriam-Webster Dictionary, 2012), which are all elements of perception. Therefore, cognition is a person’s perceptual and sensory
translation of the real world; a person’s personality and experiences are revealed through his or her cognitive expressions. One such expression, and a significant tool in environmental cognition research, is the ‘cognitive map’. The concept of drawing a space or place reflects various individual interpretations and provides a platform for researchers to discover and analyze emerging perceptions and understandings of the built environment.

Cognitive mapping “is a process composed of a series of psychological transformations by which an individual acquires, stores, recalls, and decodes information about the relative locations and attributes of the phenomena in his everyday spatial environment” (Downs and Stea, 1973: 7). Similarly, cognitive maps suspend impressions, thoughts, feelings and ideas until, consciously or unconsciously, the mind solicits, changes, and often distorts or manipulates its contents for some immediate purpose. In this way cognitive maps (images) allow us to bridge time, by using past experiences to understand present and future situations (Downing, 1992: 442).

Today, research in cognitive spatial mapping and perception traces its origins to Edward Tolman's work from 1948 and Kevin Lynch's notable study from 1960, introduced in his book *The Image of The City*. His book was the first to study “the mental image of a city” as it was, “a first word not a last word, an attempt to capture ideas and to suggest how they might be developed and tested” (Lynch,1960: 3). Lynch continues to define the city image and its elements as physical forms and classifies them as: paths, edges, districts, nodes and landmarks. Since then, there have been many studies of cognition and perception that have used sketch maps. Cognitive approaches to the study of human environments gained momentum and were used to study people's perceptions of spaces around the world.

In Kuwait, the first use of the ‘cognitive expression’ started after the demolition of old Kuwait City, from the mid-1950s to the mid-1960s. In an attempt to save past imagery, Kuwaiti artists such as the renowned Ayoub Hussein AlAyoub painted scenes from his memories of old Kuwait City. Born in 1932 in Kuwait, AlAyoub painted over 600 works representing life in Kuwait's past (AlGhunaim, 2008). In parallel, a few historians and researchers used sketch maps to locate houses from old neighborhoods; however, their research was not usually focused on the built environment.

In 2014, AlHaroun presented the first known study of Kuwait City and the Kuwaiti House that used cognitive maps as a research method (AlHaroun, 2014). It highlighted current understandings of Kuwait's built environment by exploring perceptions of its city and home spaces. In 2015, AlHaroun continued to use cognitive maps as a research tool on contemporary attitudes to vernacular elements in Kuwait's domestic building environment (AlHaroun, 2015). This study continues to use cognitive maps by investigating the differences and similarities between the two major cultural groups in Kuwait; the Hadhar and the Badu. The use of cognitive maps is intended to provide deeper knowledge of how people were affected by the transformation of Kuwait City.

**Data Collection**

Data has been first collected via a pilot sample obtained from students from the College of Architecture at Kuwait University. This group provided an interesting first glimpse of the differences and similarities between the Hadhar and Badu houses. However, it was not enough to gauge diverse understandings from each socio-cultural group. In addition, there was not an equal response from the Hadhar and Badu groups. The Badu group was
significantly underrepresented. Therefore, to obtain a more diverse sample the researchers used a snowball sampling strategy that originated from their prospective socio-cultural group, which included the researcher's family, friends, and diwaniya guests. The data collected was from various locations in the university, houses, and diwaniyas. Each participant was asked to complete a questionnaire; the first part asked for demographics such as age, gender, nationality, socio-cultural group, educational level, occupation, type of housing, and area of residence. While the second part asked for one question which was “to draw your house or apartment floor plan”. There were no time limitations to complete the survey, however most participants completed the drawings within ten minutes.

Some participants in the pilot study drew their house as elevation instead of a floor plan, which made it more challenging to analyze and understand the spaces. This may be due to them not understanding the question or that they do not know how to draw floor plans. To avoid the language barrier, the questionnaire has been written in both Arabic and English and the researchers rewrote the question to ask the participants to specifically draw floor plans. Despite this, there were still participants who drew elevations. Any participant who did not mention their socio-cultural group was eliminated. Any unclear or blank sketch was also disqualified. The final participant count was 120 with an even distribution between the two groups; 60 Hadhar and 60 Badu.

Data Analysis

This study’s findings further reflect the value of cognitive maps in research through the participant’s perceptions and mental representation of their homes. The maps, “are not just a set of spatial mental structures denoting relative position, they contain attributive values and meanings” (Kitchin, 1994: 2). Furthermore, “the knowledge of space (cognitive maps) is critical to attitudes toward, decision making about and behaviour within places” (MacEachern, 1992: 245). Therefore, the data analysis used was a form of content analysis using open coding, which was used to analyze the cognitive maps. Instead of only looking at words within texts, the strategy was to look specifically for design elements within the sketch. The cognitive maps have been carefully examined and general observations have been made regarding the sketches. The second step was to analyze the data from all the participants, ranking the most identified house element in their current house. Every house element drawn or written about by the participants has been recognized and identified as an element in the data analysis. The data collected was the number of participants who identified a specific element in their sketches. The house elements became the categories, contrasts, similarities, and emerging patterns have been observed from the data, providing the themes used to structure the discussion presented below.

FINDINGS

(Table 1) below presents the study’s participant demographics. Of the 120 participants who drew their houses, 60 were Hadhar and 60 were Badu. The majority of the participants were young women that lived in houses with their families. (Table 2) shows the data extracted from the cognitive maps of the two socio-cultural groups. It ranks the most identified element in both the Hadhar and Badu houses.
Table 1. Hadhar and Badu participant profiles (Source: Authors, 2018).

<table>
<thead>
<tr>
<th>HADHAR</th>
<th>#</th>
<th>BADU</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>14</td>
<td>Male</td>
<td>20</td>
</tr>
<tr>
<td>Female</td>
<td>46</td>
<td>Female</td>
<td>40</td>
</tr>
<tr>
<td>Below 35</td>
<td>40</td>
<td>Below 35</td>
<td>28</td>
</tr>
<tr>
<td>Above 35</td>
<td>6</td>
<td>Above 35</td>
<td>12</td>
</tr>
<tr>
<td>Apt.</td>
<td>12</td>
<td>Apt.</td>
<td>10</td>
</tr>
<tr>
<td>House</td>
<td>43</td>
<td>House</td>
<td>35</td>
</tr>
</tbody>
</table>

Table 2. Comparative data table of sketches of contemporary Hadhar and Badu houses. Total participant’s sketches: 120: Hadhar: 60, Badu: 60 (Source: Authors, 2018).

<table>
<thead>
<tr>
<th>RA NK</th>
<th>NAME OF HOUSE ELEMENT</th>
<th>NUMBER OF PARTICIPANTS IDENTIFYING ELEMENTS (FREQUENCY)</th>
<th>% OF MAPS IN WHICH ELEMENT APPEARS</th>
<th>RA NK</th>
<th>NAME OF HOUSE ELEMENT</th>
<th>NUMBER OF PARTICIPANTS IDENTIFYING ELEMENTS (FREQUENCY)</th>
<th>% OF MAPS IN WHICH ELEMENT APPEARS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DOOR/ENTRY</td>
<td>49</td>
<td>81.6%</td>
<td>1</td>
<td>DOOR/ENTRY</td>
<td>41</td>
<td>68.3%</td>
</tr>
<tr>
<td>2</td>
<td>BATHROOMS</td>
<td>39</td>
<td>65.0%</td>
<td>2</td>
<td>FAMILY LIVING</td>
<td>39</td>
<td>65.0%</td>
</tr>
<tr>
<td>3</td>
<td>GUEST LIVING</td>
<td>38</td>
<td>63.3%</td>
<td>3</td>
<td>BATHROOMS</td>
<td>32</td>
<td>53.3%</td>
</tr>
<tr>
<td>4</td>
<td>KITCHEN</td>
<td>38</td>
<td>63.3%</td>
<td>4</td>
<td>KITCHENS</td>
<td>28</td>
<td>46.6%</td>
</tr>
<tr>
<td>5</td>
<td>BEDROOMS</td>
<td>31</td>
<td>51.6%</td>
<td>5</td>
<td>BEDROOMS</td>
<td>23</td>
<td>38.3%</td>
</tr>
<tr>
<td>6</td>
<td>STAIRS</td>
<td>30</td>
<td>50.0%</td>
<td>6</td>
<td>STAIRS</td>
<td>20</td>
<td>33.3%</td>
</tr>
<tr>
<td>7</td>
<td>WINDOWS</td>
<td>21</td>
<td>35.0%</td>
<td>7</td>
<td>DIWANIYA</td>
<td>20</td>
<td>33.3%</td>
</tr>
<tr>
<td>8</td>
<td>FAMILY LIVING</td>
<td>18</td>
<td>30.0%</td>
<td>8</td>
<td>WINDOWS</td>
<td>17</td>
<td>28.3%</td>
</tr>
<tr>
<td>9</td>
<td>MASTER BEDROOM SERVICE ZONE</td>
<td>15</td>
<td>25.0%</td>
<td>9</td>
<td>MULTI-FLOORS</td>
<td>16</td>
<td>26.6%</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>12</td>
<td>20.0%</td>
<td>10</td>
<td>COURTYARD</td>
<td>12</td>
<td>20.0%</td>
</tr>
<tr>
<td>11</td>
<td>MULTI-FLOORS ELEVATOR</td>
<td>9</td>
<td>15.0%</td>
<td>11</td>
<td>CORRIDOR</td>
<td>7</td>
<td>11.6%</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>9</td>
<td>15.0%</td>
<td>12</td>
<td>MAGALAT</td>
<td>6</td>
<td>10.0%</td>
</tr>
<tr>
<td>13</td>
<td>STORAGE</td>
<td>9</td>
<td>15.0%</td>
<td>13</td>
<td>DINING ROOM</td>
<td>6</td>
<td>10.0%</td>
</tr>
<tr>
<td>14</td>
<td>DINING ROOM</td>
<td>9</td>
<td>15.0%</td>
<td>14</td>
<td>MAID ROOM</td>
<td>6</td>
<td>10.0%</td>
</tr>
<tr>
<td>15</td>
<td>DIWANIYA</td>
<td>7</td>
<td>11.6%</td>
<td>15</td>
<td>FEMALE ENTRANCE</td>
<td>5</td>
<td>8.33%</td>
</tr>
<tr>
<td>16</td>
<td>FRONT ENTRANCE STEPS CORRIDOR</td>
<td>5</td>
<td>8.30%</td>
<td>16</td>
<td>GUEST LIVING</td>
<td>5</td>
<td>8.33%</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>5</td>
<td>8.30%</td>
<td>17</td>
<td>OUTSIDE KITCHEN LAUNDRY</td>
<td>5</td>
<td>8.33%</td>
</tr>
<tr>
<td>18</td>
<td>DRESSING ROOM</td>
<td>5</td>
<td>8.30%</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>COURTYARD</td>
<td>3</td>
<td>5.0%</td>
<td>19</td>
<td>STORAGE</td>
<td>4</td>
<td>6.66%</td>
</tr>
<tr>
<td>20</td>
<td>OFFICE</td>
<td>3</td>
<td>5.0%</td>
<td>20</td>
<td>DRIVER ROOM</td>
<td>4</td>
<td>6.66%</td>
</tr>
</tbody>
</table>
DISCUSSION OF FINDINGS

Our study identified 20 design elements within the respondents’ sketches. Most of these elements are found in both Hadher and Badu houses. The magalat and female entrance has exclusively been identified in the sketches of the Badu group. On the other hand, (Table 2) shows that there are three space elements in Hadhar houses that could not be found in Badu houses: the elevator, dressing room, and office. Moreover, the Hadhar participants’ sketched the service zone, which included the maid or driver room, whereas the Badu participants specifically named each room. Besides the above observations the following themes have been inferred from the findings.

The Diwaniya

In our survey, the most salient distinction between the two groups was the ‘Diwaniya’, a gathering place inside Kuwaiti houses where men congregated and spent time together discussing various issues from business and politics to everyday life. The analysis of the survey shows that the diwaniya is a significant space in Badu houses. In their sketches, 33% of Badu respondents visibly identified the diwaniya, while only 12% of Hadhar respondents identified that space. The diwaniya is seemingly an important space for both groups but even more so for the Badu. Why has it been identified more in the Badu sketches?

One explanation may be obtained by understanding the history of the diwaniya. Aljassar (2009) acknowledged “for a patriarchal society such as Kuwait, the diwaniya plays a vital role in the everyday activities of Kuwaiti society.” He explained that for Kuwaiti men, “it is a place of social interaction, a place for conducting business and closing deals, a place for cultural exchange, and a place of political power and lobbying” (AlJassar, 2009: 192). The history of the diwaniya could be traced back to the central Arabian tribal social system from which most prominent Kuwaiti families originate. One of their main traditions is the gathering of tribal men in the sheik’s tent or house to discuss relevant matters. Such a place used to be called majlis, the seating place. By the time these tribes settled in Kuwait in the early 17th century, majlis evolved into the diwaniya located in the traditional Kuwaiti house.

However, for the Hadhar not every house had a diwaniya. There would usually be one diwaniya for a ‘family name’ (an extended family), many of whom represented the ruling family, merchants, and other prominent members of society. The Hadhar group may use the diwaniya once or more per week. This concept has been passed to modern Kuwait. However, for the Badu group, it is a place where most of the males spend a large amount of time and it consequently can be found in a majority of their houses today. This may be understood as how the gendered separation of living spaces in the Arabian tent manifested itself in the form of the diwaniya and magalat for the males and the guest reception room for the females in the contemporary Badu house.

Therefore, the diwaniya is a more significant space for males in the Badu group than the Hadhar as it relates to daily gatherings. The study argues that house spatial organization is tightly coupled with the family’s socio-cultural traditions and values based on their historic place of living. Thus, found that there are major spatial distinctions between the houses of Hadhar and Badu. These differences are not only apparent in the diwaniya but also in the house main spaces such as living hall and main entrances.
The Magalat

The *magalat* is the only space that is specific to the *Badu* group with 6 of the participants identifying it in their sketches. The *magalat* is a small space that is often attached to the *diwaniya*. It has no specific or clear format; sometimes it could serve as a reception area to the *diwaniya* with no defined enclosed space, or it could be a small ‘*diwaniya*’ placed right on the edge of the house directly next to the main entry door for daily use by young men as a casual *diwaniya*. (Figure 5) shows four *Badu* houses that both have a *diwaniya* and a *magalat*. They are very much connected. The only difference is that the *magalat* is a place where people usually sit on the floor, and on many occasions even food is served on the floor. This specific spatial arrangement and behavior has also been found in Arabian tents. Therefore, one may conclude that the *magalat* may have evolved from the *Badu*’s historic living space. However, its contemporary reinterpretation in the modern *Badu* house is an indoor air-conditioned space where males sit on the floor. This finding may also reveal how the *Badu* group adapted to the effects of modernity. It seems that there are some socio-cultural architectural spaces such as the *diwaniya* and *magalat* that appear to be resilient forms, which persisted in Kuwait’s contemporary built environment.

Figure 5. Sketches of four *Badu* houses highlighting the strong relationship between the *diwaniya* and the *magalat* (Source: Study Participants, 2018).

Gender-segregated Living Spaces and Entrances

Kuwait’s religion is Islam and Kuwaitis both *Hadhar* and *Badu* are still in a predominantly conservative Muslim society. Due to its history as a regional trade hub, Kuwaitis, especially *Hadhar* were exposed to many different people and cultures. The *Badu* on the other hand were people of the desert and although nomadic, they did not interact much with the outside world. Therefore, despite both groups being Muslim, the place they lived whether it was in the town or desert, and their daily lifestyle had a direct influence on their socio-cultural relationships with the built environment.
The findings indicate that there is a distinct gender separation of spaces within the Badu participants’ homes. (5) participants’ from the Badu group identified a separate female entrance for their houses, whereas none of the Hadhar group did. Similarly, (5) from the Badu group identified guest living room. The sketches reveal that this female entrance usually leads to the guest living room, which suggests it is a female majlis or social gathering space. This indicates that for the Badu household, the men usually congregate either the diwaniya or in the magalat, and women in the guest living room.

![Figure 6. Comparative house sketch between the Hadhar on the left and the Badu on the right. Notice the clear difference between the two houses. The Hadhar house has one main entrance, a diwaniya for men and guest living for both genders. The Badu house has multiple entrances that would indicate clear gender segregation of the entrance and living spaces (Source: Study Participants, 2018).](image)

In the Hadhar group of participants, (63%) overwhelmingly identified the guest living room as their main social gathering space followed by the family living room (30%) and the diwaniya (around 12%). However, 65% of the Badu participants’ identified the family living room as the main social gathering space, followed by the diwaniya (33%), the magalat (10%) and the guest living room (8%). (Table 3) clearly shows this difference.

The data suggests that the two groups have different lifestyles and, accordingly, different uses for different spaces. The majority of Hadhar participants identified the guest living room as the most recognized space in their homes. This group usually use the guest living room for both genders, the family living room for the family only, and the diwaniya only for men. Whereas the Badu participants mostly identified the family living room for both genders and men would use either the diwaniya or magalat. Likewise in the Badu household, it seems that the guest reception room is very much related and identified as the female quarters or living space. This further reinforces the idea that both Hadhar and Badu have different uses for social spaces and that the Hadhar household is less segregated than the Badu household.
Table 3. Shows the difference between the Hadhar and Badu living spaces (Source: Authors, 2018).

<table>
<thead>
<tr>
<th>HADHAR HOUSE</th>
<th>NUMBER OF PARTICIPANTS IDENTIFYING ELEMENTS (FREQUENCY)</th>
<th>% OF MAPS IN WHICH ELEMENT APPEARS</th>
<th>BADU HOUSE</th>
<th>NUMBER OF PARTICIPANTS IDENTIFYING ELEMENTS (FREQUENCY)</th>
<th>% OF MAPS IN WHICH ELEMENT APPEARS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Guest Living Room (Male &amp; Female)</td>
<td>38</td>
<td>63.3%</td>
<td>1. Family Living Room (Male &amp; Female)</td>
<td>39</td>
<td>65.0%</td>
</tr>
<tr>
<td>2. Family Living Room (Male &amp; Female)</td>
<td>18</td>
<td>30.0%</td>
<td>2. Diwaniya (Male)</td>
<td>20</td>
<td>33.0%</td>
</tr>
<tr>
<td>3. Diwaniya (Male)</td>
<td>7</td>
<td>11.6%</td>
<td>3. Magalat (Male)</td>
<td>6</td>
<td>10.0%</td>
</tr>
<tr>
<td>4. Guest Living Room (Female)</td>
<td>5</td>
<td>8.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CONCLUSION

Research Significance

The significance of the findings was not that Hadhar and Badu have different house spatial arrangements but in fact that difference has been a natural progression from their traditional dwellings. This means that despite the impact of globalization and consequent effects of modernity, certain aspects of Kuwaitis culture survived and adapted in their house form and spaces. This morphology has also been discussed in prior research. AlJassar highlighted how the diwaniya survived Kuwait’s modern transformation (AlJassar, 2009) while AlHaroun discussed contemporary understandings of the courtyard (AlHaroun, 2015). Recent research in ArchNet-IJAR also discussed culture and architecture in a different context. Zejinilovic presented the evolution of the built environment in Sarajevo, which highlighted the persistence of culture despite shifting political affiliations from the Ottomans to the Austro-Hungarian Empire and then socialist Yugoslavia. The various cultural groups and ideologies had different residential typologies, space configuration and visual expression (Zejnilovic, 2015; 2018).

Resistance to change has been evident throughout history. In the last centuries many cultures and civilizations endured the effects of colonialism. Today, among the concerns, especially from the ‘Global South’ is that “the impact of globalization on the culture of the ‘developing’ ‘post-colonial’ countries is pervasive and endemic” (Dandekar, 1998: 6). Some in the Arab world view globalization as “another term for capitalism and imperialism” and that “all Arabs and Muslims need to consider it an imminent danger that is endangering the political, social, cultural and economic stability” ( Za’za’, 2002: 1). Despite this, the findings of this study may suggest otherwise. It seems that culture always finds a way to adapt and survive in today’s globalized world.
This section will discuss the implications of this and other findings for research, practice, and society. For research, it enriches discussions from the literature review further highlighting the importance of culture. In fact, this research presents a case study in how resilient some socio-cultural architectural elements and spatial configurations are in the face of massive transformations of the built environment. In addition, culture is not necessarily expressed in form but is definitely witnessed in the spatial use of spaces such as the *diwaniya* and *magalat*. For example, in Kuwait a house may be modern from the outside but from the inside it is very much a reflection of culture and tradition.

For practice, this research provides architects and designers another level of understanding into Kuwait’s domestic built environment. It also solidifies spatial concepts and highlights the differences between the *Hadhars* and *Badus*. The study intends to enhance knowledge for designers to encourage future research, dialogue and collaboration. What does it mean to design for a *Hadharm*? Or a *Badu*? These inquiries are not meant to classify or stereotype any group; rather they intend to enrich understandings of culture and celebrate differences. Designers need to be aware of both localization and globalization and understand that culture becomes of paramount importance to promote sustainable development. There seems to be a gap between theory and practice. Knowledge gained from research has not always been used or applied in the real world. Therefore, this study recommends for practitioners in the field that they need to be aware of not only ‘what’ but ‘for whom’ they are designing. Unfortunately, client requirements and site has become more important than other factors. High real-estate prices and Kuwait’s housing crisis has led people to build mediocre block houses (AlHaroun, 2015). Also, in Kuwait, designers often neglect significant cultural and environmental considerations when designing a house. Thus, understanding their clients’ socio-cultural background becomes of great importance. It is the intention of this study to provide new understandings into the Kuwaiti house in order to direct designers to build more sustainable homes and better quality of spaces.

**Limitations**

The sketches provide great insights into contemporary social frameworks and lifestyles of the *Hadhars* and *Badus* as it relates to their domestic built environment. However, the study does have a few limitations. First, the collected cognitive maps may collect and infer certain types of information and several follow up questions become essential. For example, does socio-economic status influence the results? The researchers did not collect this type of information, and therefore, it is not clear whether income level would alter the spatial arrangement in people’s houses. However, logic dictates that the more affluent one is, the larger the land he/she may afford, and therefore, may demand different types of spaces such as swimming pools, larger gardens, etc. Yet despite adding new requirements to their houses, they may still follow the overall socio-cultural trend of their prospective group.

Second, for the *Hadhars* participants 14 were men and 46 were women, for the *Badus* participants 17 were men and 43 were women. Most of the participants were women. Although, they have identified the spaces that expressed a strong sense of segregation in the house, it is not clear whether an equal distribution of genders would have changed the results. To what extent does their gender effect their selection of male spaces such as the *diwaniya* or *magalat*. Would a more gender-balanced sample change the results? Would more male participants suggest more *Hadhars* would have selected the *diwaniya*? Therefore, it is the recommendation of the research team to conduct further research via in-depth
interviews of both Hadhar and Badu to gain further insights and socio-cultural understandings.

To conclude, the findings revealed significant differences between the Hadhar and Badu houses most highlighted by the diwaniya and magalat spaces and how gender is segregated via different living spaces and entrances. This paper argues that these differences are rooted historically in the Hadhar mud brick traditional courtyard houses and the Badu traditional Arabian tents. Both Hadhar and Badu have different uses for social spaces, and the Hadhar household is less segregated than the Badu household. Although the oil boom transformed Kuwait’s houses into modern villas, on the inside they are very much linked to each group’s traditional use of space. Therefore, further research is imperative to understand this phenomenon and contribute to the discussion of the modern versus tradition paradigm. In fact, the findings of this study may suggest that the effects of modernity are far less than what was revealed in prior research.

REFERENCES


TEMPORARY USES OF URBAN SPACES: HOW ARE THEY UNDERSTOOD AS ‘CREATIVE’?
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1673

Keywords
- temporary use; creativity; governance; urban planning; urban development.

Abstract
Analysis of the emergent theoretical, empirical, and planning policy studies of ‘temporary uses’ of derelict urban spaces in European cities illustrates three distinct realms where the concept of ‘creativity’ is defined and applied to urban management and redevelopment approaches: in terms of creative production, consumption of creativity, and creative governance. These concepts mesh together with a liberalization of urban planning and governance. Creative planning for temporary use suggests not just reducing the regulation of urban activity and built form, but transforming the aims and methods of planning itself to be more dynamic and more facilitative.

Q. Stevens
School of Architecture and Urban Design, RMIT University, Melbourne, Australia
email address: quentin.stevens@rmit.edu.au

ArchNet-IJAR is indexed and listed in several databases, including:
- Avery Index to Architectural Periodicals
- EBSCO-Current Abstracts-Art and Architecture
- CNKI: China National Knowledge Infrastructure
- DOAJ: Directory of Open Access Journals
- Pro-Quest
- Scopus-Elsevier
- Web of Science
INTRODUCTION

This paper examines how various definitions and applications of the concept of ‘creativity’ have been developed and deployed in the emergent theoretical, empirical and planning policy literature on ‘temporary uses’ of derelict urban spaces, in order to explore how these understandings of creativity and temporary use are influencing the purposes and methods of planning itself.

Temporary land uses have always existed in cities, ranging from circuses and squatting to materials storage and surface car parks. But until recently, such uses were not generally harnessed for the transformation of disinvested urban districts. They were epiphenomena that were never seen as part of urban development planning. Two European studies (Bürgin and Cabane, 1999; Urban Catalyst, 2001) initiated a new area of planning thinking and research by defining ‘temporary use’ in terms of economically-marginal activities that temporarily occupy and transform abandoned urban sites, and examining the potential importance of these uses for bringing new economic and social activity, jobs, and investment to cities. These studies appear to have introduced at least four new points of focus to planning thinking about temporary use. Firstly, temporary re-use is now seen to be an important economic and planning strategy for the redevelopment of former industrialised areas; one which takes place before, alongside, or instead of large-scale, long-term masterplans, and which contributes to long-term physical and economic development outcomes. Secondly, actors from the ‘creative industries’ are now understood as playing an important role in undertaking these temporary reuses and transformations. Thirdly, temporary uses of sites are acknowledged by city administrations as being important opportunities for attracting and nurturing creative industries. Fourthly, planning policy, which has traditionally focused on long-term visions and permanent rules, has begun looking at ways to support and promote particular short-term uses as a mechanism for driving urban change.

To explore the discourse of temporary use and the arguments around creativity that favour and legitimate it, this paper draws centrally on a qualitative, thematic content analysis of 43 of the earliest empirical and policy studies of temporary uses in Western European cities (see References). These publications were identified through exhaustive internet searching using the key term ‘temporary use’ and its German equivalents (Zwischennutzung, Temporäre / Vorläufige Nutzung), and snowball sampling of further material cited in the identified sources. The publications examine projects and policies in Germany and in several countries surrounding it (Switzerland, Austria, the Netherlands, Belgium), a region where economic conditions, governments and entrepreneurs fostered the earliest emergence of new temporary uses of under-utilised urban spaces. All translations from German-language sources are the author’s own. The literature covers the period from Bürgin and Cabane’s pioneering study (1999) up until 2012, when the first major survey and analysis was published of emergent temporary uses elsewhere, in the UK (Bishop and Williams, 2012). While the geographical and conceptual breath of research into temporary uses has continued to expand (Henneberry, 2017; Madanipour, 2017), the sample illustrates the initial concepts, projects and evaluations of temporary uses within the economic, political and cultural context of the German/Dutch-speaking world, which have subsequently had significant wider influence on theory and practice. These analytical insights are supplemented by further arguments and evidence drawn from more recent literature.
To pursue a grounded theory of temporary use as a new area of planning thought and practice, this paper uses a qualitative content analysis of the identified set of policy and research studies to explore the following key themes:

Table 1: Key themes in Temporary Use literature (Source: Author).

<table>
<thead>
<tr>
<th>Theme</th>
<th>Key sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>The definition of temporariness</td>
<td>Blumner, 2006</td>
</tr>
<tr>
<td></td>
<td>Böhme et al, 2006</td>
</tr>
<tr>
<td>The temporal, economic and institutional contexts for temporary uses</td>
<td>Urban Catalyst, 2001</td>
</tr>
<tr>
<td></td>
<td>SenStadt 2007</td>
</tr>
<tr>
<td>How temporary uses interact with other more permanent uses</td>
<td>Urban Catalyst, 2007</td>
</tr>
<tr>
<td></td>
<td>Schwarling and Overmeyer, 2008</td>
</tr>
<tr>
<td>The aims and perceived benefits of temporary uses</td>
<td>SenStadt, 2007</td>
</tr>
<tr>
<td></td>
<td>Brammer, 2008</td>
</tr>
<tr>
<td>The various types of actors who drive temporary uses</td>
<td>SenStadt 2007</td>
</tr>
<tr>
<td></td>
<td>Jorg, 2008</td>
</tr>
</tbody>
</table>

Inductive content analysis of the aims, perceived benefits and critiques of temporary uses led to the identification and analysis of two additional, more specific and critical themes that were raised in the literature:

Table 2: Key critiques expressed in Temporary Use literature (Source: Author).

<table>
<thead>
<tr>
<th>Theme</th>
<th>Key sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>How the idea of creativity is relevant to the development of temporary uses</td>
<td>Ebert and Kunzmann, 2007; Jorg, 2008; Angst et al, 2009; Colomb 2012a, 2012b</td>
</tr>
<tr>
<td>relationships between temporary uses, creativity, and neoliberal economics and theory</td>
<td>Kruse and Steglich, 2006; Lange, 2007, 2008; Colomb 2012a</td>
</tr>
</tbody>
</table>

This paper focuses on examining these latter two themes. The paper does not presuppose any authoritative definition of creativity (in German, Kreativität), or the purpose of creativity or innovation within urban economies and urban development (cf. Landry and Bianchini, 1995; Florida, 2002). Instead, it examines three distinct but interrelated contexts where the concept of creativity is defined and deployed within the academic and policy discourse about temporary use and the management and redevelopment of abandoned and underutilised sites. These are: creative production, consumption, and governance. Finally, the paper examines how these conceptions of creativity mesh together in planning thought with the liberalisation of urban development and urban governance.

**ANALYSIS**

**Creative Production**

Creative production is seen as an increasingly-important component of urban economies (Hall, 1998; Florida, 2002). In relation to the planning and management of urban built fabric, policy and theory also sees the creative industries to have a more specific role, as an
economically productive way to use vacant, derelict urban spaces temporarily. This is
understood as both convenient and strategic. Compared to other branches of industry,
creative enterprises are typically small, low-capital, and flexible about the spaces they
occupy. They are seen as a branch of industry that is uniquely willing and able to start
operating at short notice and relocate in a piecemeal fashion, and as able to rapidly adapt
their work practices to a wide variety and quality of existing sites, structures and
infrastructures when they become available, without major capital investment (Becker, 2010).
Today’s creative actors are frequently portrayed as ‘footloose’ or ‘nomadic’; their production
activities are not often fixed to physical and representational attributes of particular sites
(MA18, 2003; Urban Unlimited, 2004; Dienel and Schophaus, 2005). However, policy on
temporary use typically prioritises the development of new creative activities, rather than
relocating existing creative activities from elsewhere that may not engage creatively with the
new site. Temporary use is portrayed, for example, as “an attractive ‘first step’ for numerous
start-up ventures in the creative economy” (SenStadt, 2007:101). A major study of temporary
uses in Switzerland highlights that the percentage of creative workers engaged in temporary
businesses in Zurich’s former rail yards was four times the national average, and almost half
the companies on the site had been founded there (Angst et al, 2009).

Strategically, it is believed that creative actors such as artists and architects are particularly
well suited to utilizing disinvested, vacant spaces temporarily. They are able to perceive
distinctive aesthetic, historic, and functional characteristics within disinvested, vacant spaces,
and to efficiently activate these potentials, and thereby add high symbolic, social and
economic value to those sites (SenStadt, 2007; BMVBS/BBR, 2008). They are ‘pioneers’,
‘truffle pigs’ who unearth valuable, latent opportunities for the benefit of other investors who
follow them (SenStadt, 2007; Lange, 2007; fig. 1). Creative producers have “a feel for
unconventional and creative solutions”, including experimental uses of sites (Bürgin, 2010:8).

Figure 1. Photomontage emphasizing the role of ‘Creative Nomads’ (artists and musicians) in
temporary activation of unused urban sites, from Urban Pioneers: Temporary Use and Urban
Development in Berlin, the ‘manual’ based on the experiences of Berlin’s Department of Urban
An early summary by Kloos et al (2007) finds that the existing planning policy literature on temporary uses embraces both this pragmatic view of the creative industries’ capacities to make use of brownfields, as well as a more idealistic view of creative activities as having a positive influence on the wider development of local economy and urban form. More than just providing rent returns on devalorised properties, as would temporary warehousing activities or car parking, creative workers add significant symbolic and social capital to these disinvested sites, thereby accelerating their recuperation into the wider property market (Becker, 2010; Smith, 1996; Zukin, 1982). While there may be real, direct economic dividends in increased cultural production, policies often intend artistic and cultural permissiveness in such brownfield areas to be only temporary and transitional (Andres and Gresillon, 2013). In exchange for low rents, many creative workers invest a lot of their labour and expertise in modifying these spaces and bringing the public’s attention to them (Bishop and Williams, 2012). Because artistic projects often pursue goals beyond the purely economic, they will also often be driven forward even in the absence of profits (Becker, 2010).

Bürgin (2010:107) strikes a rare note of caution, pointing out that ‘impetuous’ creativity in temporary use can be disadvantageous for later users, if it brings adverse changes, damage or excessive wear to the building stock. Creative users may be wilful and unrealistic, making it difficult for landlords to manage properties and transfer them to new long-term tenants. Urban Catalyst (2001:86) notes that creative workers at the end of their temporary tenancy of Berlin’s Haus des Lehrers were “stubborn, explosive and radical”, and fought against relocation.

Inspiration in the creative use of vacant properties runs both ways. Original, creative activity is believed to be stimulated by vacated urban sites: their location, architecture, and former uses; the mixtures of new actors that are accommodated within the given configuration such sites; the dense communication networks and collaborations that often arise among these actors; and the new and temporary nature of site occupation. These conditions inspire new artists as well as established ones (Bürgin and Cabane, 1999; Angst et al, 2009; Bürgin, 2010). The large scale, openness, and specialized infrastructure of many former industrial sites, which can present impediments to their recuperation for other long-term uses, is often attractive for the production and display of creative works, whether plastic arts, performance, media, or architecture (Bürgin, 2010; Bishop and Williams, 2012).

Consumption of Creativity

A second component of creativity is the interesting consumption opportunities that new, temporary uses of urban spaces are believed to offer to residents and visitors. Whereas creative production emphasizes the tenants’ practices, the emphasis here is on innovations in the products of creativity, and in particular consumers’ experiences in and of the temporarily transformed urban spaces themselves.

Creative temporary uses are valued because they enhance the general cultural diversity and vitality of urban areas, by adding to the range of open space, social, cultural and commercial amenities (Bürgin, 2010), and enabling new combinations of such activities, as well as providing them in new and interesting locations where existing urban form, property values, government regulations and private management policies had previously precluded them. Under conditions of fiscal austerity following the latest global financial crisis, creative uses also have an ameliorative role. Their flexible labour and their limited financial resources are
being drawn upon to compensate for deficiencies in publicly-funded delivery of social and cultural amenities (Ferreri, 2015; Deslandes, 2013; Tonkiss, 2013; Urban Catalyst, 2001).

Temporary uses of urban sites are seen to be more experimental than permanent projects that require larger budgets and face larger risks. They can cater to smaller and more specialized audiences. Unconventional and controversial uses are more likely to be tolerated if they are only occupying marginal spaces that were previously out of use, and only of relatively short duration (Bishop and Williams, 2012; Havemann and Schild, 2007).

Temporary uses of industrial brownfields and other derelict land often centre on the physical redevelopment of those spaces for public access and use. Many temporary uses are publicly-accessible art or landscaping projects which have no intrinsic commercial function, although they may serve as attractions that stimulate spontaneous spending or long-term investment in their surroundings. This includes the provision of new kinds of informal, accessible spaces where the public can act, perform and interact: temporary places for relaxation, participative sports and games, commemoration, and protest (Bishop and Williams, 2012; Haydn and Temel, 2006). Among 43 pioneering temporary uses showcased in a government-sponsored study of Berlin (SenStadt, 2007), 30 were novel open spaces for public use: community gardens, accessible open spaces for people and animals; sports areas; and artificial beaches.

Creative public uses of formerly-vacant sites often engage with and enrich the particularity of space and local identity. Artistic engagement with a vacant sites sometimes engages directly and critically with the dynamics of the site’s development, seeking to explore, comment on and shape those wider processes (Till, 2011). For example, intensive, varied temporary uses of Berlin’s Palast der Republik prior to its demolition sought to critique and experiment with the history and future of the building and of the East German society that produced it, to encourage a broad political, cultural and practical re-evaluation of its legacy (Urban Catalyst, 2007; Colomb, 2007). Creative temporary uses are argued to be ‘identity-giving’ (identitätsstiftend) (Krauzick, 2007). In all these respects, the creativity of temporary uses is primarily seen in terms of its benefits to social development, rather than property development. Temporarily unused spaces provide physical and temporal windows of opportunity for public appropriation of real estate for alternative cultural needs that are not met by the open market. These temporary uses might not in themselves be profitable. The aim is often instead for the city and its citizens to benefit from privately-financed investments and services that enhance general quality of life.

Some innovative temporary consumption spaces indirectly serve aims for economic and property development. Berlin’s government has increasingly utilised entertainment- and leisure-oriented temporary uses as a form of city marketing, presenting such projects as “new playgrounds for artists, creatives, young travellers and tourists, thus shifting the focus (away) from the iconic sites of inner city redevelopment such as Potsdamer Platz” (Colomb, 2012a:243). Such offerings attract creative workers who seek a high degree of quality, variety and novelty in urban leisure offerings (Jorg, 2008). A report commissioned from Munich’s city department of employment and business puts this clearly:

Quality of life and a climate of openness and diversity are key criteria for the attractiveness of a location for highly skilled and creative workers… varied lifestyles create an inspiring and stimulating environment for creative working people… Arts and Culture are of particular importance for the quality of life of creative knowledge workers. Because the highly skilled especially demand art and culture in their spare
time, a comprehensive cultural offering in the city presents highly creative people with a source of inspiration for their own creative production… Whether high culture in opera, theatre and museums or the cultural scene in bars, in temporarily used army barracks, old factory buildings and brownfield sites, or temporary events in the summer such as Corso Leopold, the Streetlife Festival, and the ‘beach’ on the Cornelius Bridge of the Isar River [see fig. 2] - these are all appealing pastimes for creative knowledge workers. In addition, they help highly creative people with ideas for new products and services that are economically viable and that set new trends. (RAW München, 2007:22)

Similarly, in Berlin pioneering temporary use projects:

personify unusual but attractive urban lifestyles and hence cater to a demand that traditional urban structures fail to meet… The broad range of temporary use projects in Berlin has become a PR and economic factor for the city… a catalyst for the relocation of international companies (and) an attraction for tourists. (SenStadt, 2007:41)

In contrast to the theorizations of creative productivity outlined in the first section of this paper, which emphasise tangible material benefits through increased economic activity and reinvestment in the built environment, creative consumption activities on disinvested urban sites are believed to enrich the general quality of urban life, in both the short and long term. The example of sport and leisure activities illustrate that citizens can have a participatory role in such re-activations of spaces.
Creative Approaches to Urban Development

A third distinct aspect of creativity in the theorization of temporary use of brownfield sites links directly to urban planning practice. It is argued that governments, planners, property owners and temporary users all need to be more creative (here meaning innovative) in the rules, processes and investments they use to shape current activity on urban sites and future property development. This conforms to the broader historical case argued by Hall (1998), that in addition to cultural, intellectual, and artistic creativity, cities also thrive and develop through the technical and organisational creativity of city managers, particularly in terms of their engagements with local entrepreneurs (Jorg, 2008; fig. 3). In the context of temporary uses, urban planning is not merely a supportive conduit for creativity, but its target:

Here a fundamental distinction must be made... The first thing that can be observed is the creativity and innovation within temporary uses. This means that within temporary uses, innovative things may arise. Secondly, temporary uses can contribute to innovative urban planning. This occurs particularly through the experimental nature that temporary uses often exhibit, which through the resultant urban development can demonstrate alternative solutions for various problems. (Waldis, 2009, emphasis added)

Figure 3. Conceptual diagram of the relationships among the various actors that are creatively assembled to enable temporary use of a site. From left to right, and top to bottom: the trust that owns the site; a mutual fund that provides investment capital; the user cooperative Holzmarkt plus eG that developed and managed the site; tenants from small business, arts and culture; experts with ideas; local residents; and a community gardening association that maintains the open spaces.

Image courtesy of Urban Catalyst.
This latter conception of creativity as innovative planning centres on an expanded decision-making role for the users (i.e. tenants) of urban spaces, vis-à-vis their owners and regulators. In line with broader neoliberal thinking, this discourse rejects long-range, top-down strategic approaches to urban development in favour of freeing up and encouraging individual entrepreneurial initiative and capital. Creative governance generally means less regulation. Becker (2010:27) suggests that creative uses of space are hard to plan because they thrive on spontaneity and unexpected conditions and relations, and argues for “the removal of bureaucratic hurdles, the relaxation of public safety regulations, and the use of administrative discretion” – i.e., liberalization. Temporary users of sites are celebrated as ‘pioneers’ who lead and demand the attenuation or renegotiation of official planning strategies and controls and lease terms, and the opening up of both urban spaces and planning processes to a diversity of visions and inputs (SenStadt, 2007; Groth and Corijn, 2005). Some analysts go so far as to portray creativity as a general characteristic of temporary uses (Dransfeld and Lehmann, 2008).

With temporary uses, creative agents are able to demonstrate “not only the possibility, but the necessity to overrule conventions, guidelines and red tape and conquer the murky terrain of legal and social obligations” (Kreuzer, 2001:19). Rules and relationships are creatively negotiated across a broad scope of conditions including lease duration, uses, rent levels, guarantees, insurances, and utility costs. The public sector and site owners provide many kinds of direct and indirect financial and professional advice to attract and enable new users. New kinds of leases and permits are developed to suit tenant needs and capabilities (SenStadt, 2007). Creativity is employed by whichever actor is taking the initiative to encourage temporary use in a given location, according to three different scenarios: property owner seeks user, user seeks property owner, or urban developer seeks property owner and user (BMVBS/BBR, 2008).

Creativity on the part of property owners involves flexibility in how they seek to meet their short- and long-term financial goals. This means “engaging in ‘creative’ (sic) reactivation of brownfields and underused sites beyond the typical economic recovery patterns of property” (Kloos et al, 2007:6), and creativity in finding appropriate sets of tenants for large sites and buildings (Bürgin, 2010). “Creative rental concepts” may include short-term or even provisional leases, low rents supplemented by business profit-sharing, and cost-only rents to entice key cultural and artistic attractions to a location, to enhance the marketability of other properties (Rosic and Froessler, 2009). Such innovations require that landlords become more exposed to short-term market risks. The flexibility, creativity and spontaneity of actors from the creative industries often clash with the expectations and existing approaches of property owners and managers, requiring an openness to dialogue (Bürgin, 2010). On the positive side, temporary creative uses allow landlords to test out and demonstrate the feasibility of new uses, which also helps market sites to potential long-term users (Becker, 2010). Creativity is also applied to the place marketing process itself: temporary uses of derelict areas provide new techniques and new imagery to attract new groups of consumers and producers (Colomb, 2012a).

These various kinds of creativity in land marketing, planning and management processes may or may not involve tenants from the creative industries. One analysis, of the redevelopment of a former slaughterhouse for “research-oriented, innovative companies, creative business and cultural institutions” (Schwarting and Overmeyer, 2008:62), uses the German term kreatives Gewerbe (‘creative business’) rather than the usual sectoral term Kreativwirtschaft (‘creative economy’), and notes that less-financially-successful artists can no longer afford the rents at this site. A major German government guide to temporary uses
is careful to differentiate between the roles of ‘creative industries’ and innovative ‘entrepreneurs’, and uses the expression ‘artistic-creative temporary uses’ to clarify one case where both aspects are brought into play (BMVBS/BBR, 2008:92). These two aspects overlap most clearly in the environmental design disciplines (architecture, landscape architecture, urban design, interior design), whose core creative competency is the redevelopment of built form. These businesses are often strongly represented in the temporary use profiles of brownfield sites (Bürgin and Cabane, 1999). These actors are often forming small, new firms to pursue new kinds of projects, clients and funding. They can readily imagine, enhance, and capitalise on both the productive usefulness of individual properties, for their own business, and on the wider spatial and symbolic potential of the surrounding brownfield area and the redevelopment processes going on within it, when selling their services to other temporary and long-term users (Lange, 2008).

The dual aims of creatively utilising brownfield sites and facilitating the creative industries have also given rise to a new category of non-governmental, entrepreneurial mediating organizations whose role is as a conduit of information and negotiation between actors who need affordable space, the potentials of vacant buildings, and planning policies that regulate the development and use of those sites (Oswalt, 2002; Kruse and Steglich, 2006; Brammer, 2008; BMVBS/BBR, 2008; Angst et al, 2009). These organisations include ‘Urban Residue’, ‘Golfstromen’ and ‘Urban Resort’ in Amsterdam, ‘SpareSpace’ in Groningen, ‘Precare’ in Brussels (Jorg, 2008), ‘k.e.i.m.’ in Basle, and ‘Coopolis’ and ‘Stattbau’ in Berlin (SenStadt, 2007; Blumner, 2006).

For government planners, temporary uses of urban spaces by the creative industries can support the development of innovative planning strategies and policies in three distinct ways: as stimulus, delivery mechanism, or goal. As an inspiration or need for planning, temporary uses “can stimulate the creative process of urban design” (Bornmann et al, 2008:18), by suggesting new combinations of uses and end-user groups, and demonstrating alternative physical development potentials. Temporary uses also inspire a rethinking of planning processes through a creative understanding of how development happens, particularly in terms of the engagement of a wide variety of actors in decision-making and risk-sharing (Schwarting and Overmeyer, 2008). Because creative use projects on brownfield sites are often interdisciplinary, they require interdisciplinary action and policies from local governments (Becker, 2010). The complexity of creative temporary uses tends to necessitate the development of innovative forms of supervision, mediation or ‘brokering’ between and among government agencies, property owners and site users, and to inspire raised levels of citizen engagement in the planning and execution of projects (BMVBS/BBR, 2008; BBR, 2004).

The temporary use literature sees creative temporary uses as a conceptual inspiration for planning. The literature also sees planning harnessing temporary uses as a practical tool through which it can shape and test longer-term options for planning processes, regulations and physical development. Creative uses’ typical attributes - small scale, low capital investment, flexibility and orientation toward rapid, high-visibility outcomes – mean that they provide a relatively cheap, low-risk, constrained, but also extendable way of bringing innovations into urban planning. They present opportunities for cities to try out new policies and management approaches for urban development. Such ‘laboratories’ or ‘test phases’ develop the competence of various actors, including the government itself, and build trust between them (Becker, 2010; Bürgin, 2010; Waldis, 2009). In addition to being ‘truffle pigs’ for later investors (Lange, 2007:136), artists are thus also guinea pigs for planners.
The two drivers of planning innovation outlined above can be applied in pursuit of many different planning goals, and the promotion of many kinds of land use, whether temporary or long-lasting. Although existing literature seldom identifies tools and policies that are focused on facilitating temporary creative industry tenancies specifically, suitable instruments appear to include giving creative users advice, financial support, and preferential access to sites, and providing detailed databases of available sites (SenStadt, 2007; Böhme et al, 2006). Oft-mentioned is the desirability of user- and goal-oriented ‘one-stop-shops’ (Schwarting and Overmeyer, 2008) where potential temporary users - many of whom have little experience with the world of urban development and its regulation - can get advice and acquit the many necessary permissions; or of interdepartmental working groups to facilitate local government approvals for temporary projects (Schlegelmilch, 2009:498). As mentioned above, new non-governmental mediators have also sprung into existence to occupy this interface.

Healey (2004) notes that creative approaches to governance can help to foster a more creative society. But many analysts doubt the capacity of formal, ‘top-down’ planning and its tools to be creative and proactively supportive of creative temporary uses. Groth and Corijn (2005:521) note that the creative temporary uses of urban wastelands contrast with the lack of imagination and creativity shown by long-range, large-scale planning that has allowed such wastelands to arise in the first place: “creative environments do not spring into being as a result of top–down measures... they occur in the temporary lack of planning”. Similarly, Larsen et al (2011:88) suggest “a possible alternative to the conscious design for creativity[:... sometimes creative practices emerge in the spaces that only wait for future development... sometimes the temporarily empty spaces make room for surprising innovations that otherwise would not emerge”.

Bishop and Williams (2012) note that creative uses are difficult to create ‘top down’ because these uses are themselves intrinsically ‘bottom up’; the most important prerequisites are cheap rents, flexible spaces, and freedom from constraints. In keeping with Jacobs’ (1961) theorization of the role of old buildings in ensuring city diversity, it is the absence of commercial attention to urban spaces that allows new, creative actors, who have different, risky ideas and who are not purely motivated by profit, to inhabit and operate in run-down parts of the city, and thereby contribute to the processes of re-imagining, re-using and re-developing these areas. Becker (2010) suggests that the spontaneous, unplanned, short-term uniqueness of temporary creative uses is at odds with planning’s general focus on fixed long-term visions. He argues that the emphasis needs to be on processual aspects: local governments showing openness to experiment; setting a clear basic framework of roles that creative actors can play, to provide clarity and certainty to their efforts; and ‘creative support’, rather than control, through new, flexible “instruments of liberation and toleration” (Becker, 2010:81).

Hall’s (1998) emphasis on the importance of exchanges between cultural, intellectual, artistic and managerial creativity highlights that innovations in the practices of the various actors are connected: their interactions stimulate their creativity. But these interactions are not necessarily smooth and cooperative. In the case of Zurich’s railyards, creative temporary use was apparently inspired dialectically, through opposition to the interests of planners, government and the property industry: “the erstwhile forbidden nature of the former industrial zones and the illegal appropriation of many factories was part of the subculture that established itself [there] against speculation, discrimination and exploitation and in favour of alternative culture” (Angst et al. 2009:32). The way that the temporary users engaged with regulation and order in this case also lent itself to creativity and difference within the outcomes. Colomb (2012b) points to fundamental tensions between the increasing
profitability and marketability of successful temporary leisure uses of urban sites, government policies that rigidly prescribe the desirable range of creative temporary uses, and the great wealth of informal, experimental, often unconventional practices, not all of which can achieve political or economic traction.

Creativity Unleashed: Governing Temporary Uses

This closing section examines what implications the contemporary emphasis on creativity in the production, consumption and planning of temporary uses is seen to have for the role and form of planning in shaping urban redevelopment and local economic activity. In broad terms, the temporary use literature suggests the desirability of a liberalisation of both economic activity and strategic decision-making, by encouraging the participation of a wider range of small-scale private investors, producers, and consumers. More diverse inputs and less regulations imply the introduction of new ideas and approaches.

The emphasis within recent analyses of temporary uses in European cities such as Berlin, on the key role of pioneering, artistic individuals who revitalise urban spaces and define new leisure lifestyles for highly-mobile urban residents, has ample parallels to earlier waves of gentrification that have been documented in post-industrial New York and London (Colomb, 2012a; Zukin, 1982; Hamnett, 2003; Pratt, 2009). Creative actors are portrayed within the context of a ‘new frontier’ that demands self-sufficiency, initiative, and independent action (Ferreri, 2015; Smith, 1996). Both artists and the unused spaces they discover and transform are seen as among “the few remaining pools of untapped resources” that define this particular frontier (Colomb, 2012a:244). Successful exploitation of such opportunities rests on governments allowing and encouraging mobile, creative minds to rush to these new goldfields of symbolic capital. Temporary artistic uses of urban space fit well to neoliberal demands:

informal, spontaneous [temporary uses]… whose primary characteristic is the use of available urban, programmatic, economic open spaces… also have other features that make them perfectly compatible with the neo-liberal economy, from shifting risk to individuals to accelerating the use of space. (Pogoreutz, 2006:79)

Persons engaged in the cultural sector and temporary users coincide with the current principle of short, fast utilisation cycles… the frameworks of both temporary use and subculture activities demand the same characteristics as contemporary entrepreneurial thinking: flexibility, cost-consciousness, environmental friendliness, efficiency, innovation, contemporary thinking, connectedness and liberality. (Erismann, 2011:23)

Temporary artistic uses of derelict urban sites can be seen as a case of post-fordist production: exploiting the niche of these amortized property investments; accelerating their recommodification; optimising their economic potential by enhancing their variegation and cultivating new consumer groups; distributed networking of production; and minimal capital outlays on construction and infrastructure, focusing instead on ‘mediatisation’ of the product, which gives urban space the status of a service or an event (Ioannides and Debbage, 1997; Gale, 2009), or a piece of software that users can “populate and repurpose” (Bishop and Williams, 2012:188). This process of renewing exchange value is best achieved if there is a reduction of structural rigidities in the property and labour markets and in land use regulations (Haydn and Temel, 2006; Tonkiss, 2013). Urban Catalyst (2001) note that in
parallel to economic forces and technological development, two other significant causes of long-term vacancy on urban sites are the political and bureaucratic inertia of the planning system and misjudgement of the demand for particular uses. Economic liberalisation is thus seen to lie at the core of the phenomenon of creative temporary uses. This liberalisation also brings about more rapid and widespread availability of sites for temporary occupation, by accelerating the amortization of existing investments in land (Oswalt, 2001; MA18, 2003). The dynamics and diversity of disinvested urban spaces stimulates artistic creativity, which in turn serves consumers' rapacious desire for novel products (Bishop and Williams, 2012).

The creative governance approaches that the literature identifies as appropriate for entrepreneurial temporary uses cover a spectrum of levels of agency, from permissiveness through facilitation to direct participation. ‘Creative’ planning for temporary uses often appears to mean less planning, allowing more flexibility in land use, construction, and risk management. One proposed strategy is increased toleration (in German, Geduld) of temporary projects, even when they have no formal planning permission. Such a stance implies that a creative re-use is recognised as being somehow beneficial, even when it falls outside the framework of the local government’s and landlord’s understandings of their own objectives and interests, or when it is technically illegal (SenStadt, 2007; Ebert and Kunzmann, 2007; Dransfeld and Lehmann, 2008). Such judgments depend on careful distinctions and calibrations between short-term and long-term benefits and negative impacts, and the availability of alternative mechanisms to measure and control these. Prevention of temporary uses that are undoubtedly undesirable is acknowledged as an important tool in ensuring that sites remain available for other potential temporary uses that might offer more benefits (SenStadt, 2007). Cases have been documented where tolerated uses later receive sanction, and even eventually permanent permission (BMVBS/BBR, 2008). But a strategy of tolerance brings into question the relevance, predictability and consistency of the entire planning process.

Policies and studies identify a range of creative technical instruments that can be deployed to govern temporary uses, include specification of temporary uses for particular locations within local development, land-use and redevelopment plans, and permits for so called ‘flying buildings’ which, once approved, can be relocated repeatedly, with time restrictions on any given site. Several other tools remain rather new and untested in the German context: uses that are permitted ‘as of right’ without need for inspections and permits, the granting of time-limited and conditional planning permissions, and the revocation of existing permissions when a building is demolished or a longstanding use ceases, as a way of opening up spaces for other short-term use options (SenStadt, 2007). Many of these tools illustrate planning and its instruments themselves becoming more temporary, focused on fine-tuning of current, localised performance outcomes instead of defining general long-term certainties. Such creative approaches are potentially complex, resource-intensive, disruptive and imperfect, but as Healey (2004:98) notes, “risky, experimental governance requires some redundancy (short-term inefficiencies) and learns from failure as well as success”. As noted earlier, the understood justification for operational risks and potential failures is the potential capacity of creative uses to increase land value, enhance local quality of life, and reform planning approaches themselves. As also already noted, the limited temporal and spatial scope of these experiments also confines their risks.

The literature identifies a range of proactive roles that governments can play, include supporting, commissioning, financing, partnering, and marketing temporary uses. The creative potential of planning to facilitate temporary use includes “financial and creative enthusiasm for investment” (Kruse and Steglich, 2006:17). This suggests a characteristically
neoliberal coupling of subsidies and deregulation. Planning’s encouragement of temporary uses of urban spaces by creative actors fits the wider neoliberal shift from stable government-led urban service provision and regulation to flexible, facilitative governance, and increasing reliance upon entrepreneurial efforts and short-term, footloose private investments (Blumner, 2006; Groth and Corijn, 2005). In a time of reduced public spending, the vision of artists as “entrepreneurial self-starters” and “role models for a neo-liberal society” is not without its problems (Lange, 2007:142). These actors carry significant costs and risks; relatively few reap great rewards from success, and successful exploitation of an urban area forces out unsuccessful artists who cannot afford increasing rents. Ebert and Kunzmann (2012) suggest that policy may seek to improve the sustainability of certain clusters of creative industries in the face of gentrification, through careful policy choices such as controlling uses and rents, with particular attention to whether, which, and over what time frame such precincts might maintain a role in nurturing new, experimental practices and enterprises.

The academic and policy literature identifies a wide scope of roles and modes through which the public sector can shape temporary use projects so as to provide public benefits and minimise negative impacts; this extends well beyond traditional adversarial regulation. Governance of temporary uses is in numerous cases also enacted cooperatively by the public sector as one of many actors within a complex network. The public sector is also often landlord, manager, funder, guarantor, and/or provider of goods, services, staff and expertise for temporary uses, and therefore contractual agreements provide significant scope for steering or hindering the development and operation of those activities in the public interest. Creative planning does not inevitably mean not planning. Dransfeld and Lehmann (2008:72) suggest that creative production should not go unregulated. To prevent temporary creative uses from unexpectedly becoming permanent and displacing envisaged long-term uses, they argue that governments and landlords should develop ‘creative shackles’: contractual agreements between landlords, users and other stakeholders to consensually define targeted scopes and timeframes for temporary uses. Rather than just holding out carrots or sticks, planning can thus act creatively to govern temporary uses by wearing different hats, negotiating complex relationships, and developing new frameworks.

CONCLUSION

Recent calls to support creativity through planning also often advocate more creativity in planning, which means approaches that tolerate more varied land-use activities and that help to identify and support a wider range of goals for a greater range of actors. The kinds of urban development actors and interests identified in this paper were often undervalued or excluded by earlier planning practices. The key traits of creativity and temporariness point toward groups of actors - artists, ethnic minorities, young people - who typically have neither the political nor economic power to see their interests prevail in ordinary property markets or through standard urban development practices (Ferreri, 2015).

The discourse of creativity also tends to suggest an emphasis on use rather than on built form. The focus of attention has moved away from pre-defined physical visions, and towards the processes and impacts of urban development. One line of thinking about the role of creative temporary uses in urban planning suggests that such practices are not merely a new and powerful mechanism for urban development, but that creative, artistic practice can be a new way to stimulate public engagement and critical reflection on urban development and

Calls for planning to introduce new forms of control over new and untested temporary land uses are greatly exceeded by demands for more permissive planning tools that free up the unrealised potential of creative actors. The emergence and spread of temporary use thinking in the German-speaking world appears to not only reflect the decline of former urban industrial areas, but also to respond to the particular rigidities of German-style planning systems. The conceptual connection between temporary use and creative industries would appear to be twofold: artistic people are good at adapting how they work to new spaces that lack tenants, and they are good at enhancing those spaces. But conceptually conjoining creative enterprise and temporary tenancy implies that creativity is economically precarious and expendable (Tonkiss, 2013; Mould, 2014). Policy tools such as ‘creative shackles’ can potentially benefit these ostensibly precious creative workers by clarifying how particular temporary use arrangements align to their own long-term visions and needs.

ACKNOWLEDGEMENTS

This research was supported by a fellowship from the Alexander von Humboldt Foundation.

REFERENCES

Temporary Use literature analysed:


Other literature cited:


HISTORY MATTERS: THE ORIGINS OF BIOPHILIC DESIGN OF INNOVATIVE LEARNING SPACES IN TRADITIONAL ARCHITECTURE

DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1655

Mohamed S. Abdelaal, Veronica Soebarto

Keywords
university campus; Biophilia; innovation; bimaristan; metaphor; refuge; prospect

Abstract
Recent empirical studies have shown a positive correlation between nature, the built environment and creativity in the human brain. During the medieval Islamic Golden Era, higher education buildings of non-medical ‘madrasa’ and medical ‘bimaristan’ institutions applied specific techniques and strategies so that human intellectual curiosity could flourish through direct and indirect contact with nature. In contrast, the architecture of modern universities has lessened students’ multisensory focus and engagement with nature. Several studies have addressed these institutions’ failure to foster the innovation-generation process. This systematic review summarises and synthesises previous studies, elaborating the characteristics of those spaces that can host Innovation-Generation Processes (IGPs) based on psychological and neurological investigation. The study analyses research outcomes that support the stimulative impact of nature on people’s cognitive capacities. This demonstrates that the biophilic design approach utilises natural conditions and elements within the built environment to enhance the physical, social, intellectual and psychological status of innovators. The findings of this study demonstrate a strong interrelationship between IGPs and the built environment in traditional higher education institutions based on the premise of biophilic design. Hence, we can adopt some lessons from these ‘timeless’ buildings to support the evolution of innovative university campuses today.

M. S. Abdelaal* and V. Soebarto**

*Visiting Researcher, University of Adelaide, School of Architecture and Built Environment, Adelaide, Australia
**Professor, University of Adelaide, School of Architecture and Built Environment, Adelaide, Australia

*Corresponding Author’s email address: shokry.abdelaal@adelaide.edu.au

ArchNet-IJAR is indexed and listed in several databases, including:
• Avery Index to Architectural Periodicals
• EBSCO-Current Abstracts-Art and Architecture
• CNKI: China National Knowledge Infrastructure
• DOAJ: Directory of Open Access Journals
• Pro-Quest
• Scopus-Elsevier
• Web of Science

Copyright © 2018 | Copyrights are granted to author(s), Archnet-IJAR, and Archnet @ MIT under the terms of the ”CC-BY-NC-ND” License.
INTRODUCTION

For more than a thousand years, higher education institutions have profoundly contributed to social, cultural and economic enrichment in society. Historically, the relationship has been mutually supportive, thus university campuses today are still expected to act as incubators of innovative ideas that enable humans to thrive and prosper (Ransom, 2015). Accordingly, strategic and physical planners of present-day university campuses seek a more dynamic built environment and organisational setting in which to nurture the unpredictable characteristics of innovative learning (Turner, 1987). This study, therefore, poses a central research question: is innovation exclusively derived from technology, or is it generated by other catalyst agents, including the built environment, which can stimulate creativity in the human brain?

To answer this question, this research investigates the architectural configurations of the innovation-driven ‘timeless’ institutions of science and medicine during the medieval Islamic Golden Era, called ‘madrasa’ (Arabic for any educational institution). It is well documented that the buildings of madrasa witnessed miraculous evolution and ground-breaking innovation in several fields of knowledge and applied science, such as physics, chemistry, medicine and engineering, with limited technological advantages.

American biologist Edward Wilson (1984) proposed that the innate human need to affiliate with nature requires radical reform in modern society. The evolutionary approach of biophilia soon influenced several research domains including architecture and the built environment. The biophilic design concept has continued to develop over the past decade to employ the conditions and elements of nature, and has been implemented to promote physical, social, intellectual and psychological wellbeing.

An immense body of research has recently focused on investigating the correlation between human wellbeing and productivity and its connection to nature (Shibata & Suzuki, 2002). Early studies focused on measuring the impact of having visual access to nature on employees’ productivity, reducing the levels of harmful job stress and extending employment longevity. Further research continued to find correlations between the workplace and natural conditions. Most of these studies used historical examples for further insight (Kellert, 2005, 2008). This study will establish common ground between environmental psychology, neuroscience and phenomenological architecture through historical interpretation. The core aim of this study is to offer a more fine-grained, in-depth understanding of the correlation between design strategies and patterns of biophilic design in order to understand how to foster innovation in education spaces. Such a bond was revealed by the analysis of traditional madrasas, which spontaneously implemented these strategies in the absence of prior research. Also, this study attempts to overcome the negative tendencies of the hegemony of mere technological or visual features in designing learning spaces. This cannot be achieved without using historical case studies, which, by default, lack these features. Ultimately, this research is twofold. Firstly, the qualitative literature review investigates the premise of innovation-boosting spaces. In addition, the analysis includes the correlation between innovative space design and attributes of biophilic design. Secondly, it demonstrates a set of historical case studies of pioneering educational buildings in Islamic architecture to determine their relevance to the proposed attributes, patterns and elements of innovative biophilia-driven design.
METHOD: THE MULTISENSORY ARCHITECTURAL EXPERIENCE OF INNOVATION

This study proposes that the interrelation between biophilic design strategies and multisensory spaces can result in more innovation-driven learning spaces. This study looks at this correlation through an in-depth historical interpretation of the traditional academic schools or madrasa built between the eleventh and fourteenth centuries. This retrospective review will have a twofold impact. Firstly, it will significantly inform the design of today’s academic buildings to leverage the potential of creativity, productivity, self-esteem and wellbeing for knowledge seekers. Secondly, it will lower the negative ecological impact and increase the operational efficiency of a university campus regarding energy, resource consumption and waste control. The stronger the interrelation between these factors, the more likely it is that innovation will flourish and expand (see Figure 1).

THEORETICAL BACKGROUND: THE IMPACT OF NATURAL AND BUILT ENVIRONMENTS ON COGNITIVE CAPACITY

Today, the mission of architects and urban planners has become more complex as disciplines such as psychology, physiology, sociology and anthropology provide vital information about how people perceive space, behave within that space and develop preferences. Multidisciplinary studies have demonstrated the links between exposure to nature and improved performance of academic, intellectual and cognitive tasks in the workplace and other educational spaces (Benfield, Rainbolt, Bell, & Donovan, 2015; Han, 2010; Shibata & Suzuki, 2004; Tennessen & Cimprich, 1995). Other studies have found that active interaction with nature can restore attention (Lee, Williams, Sargent, Williams, & Johnson, 2015) and allow us to recover from stress and mental fatigue (D. Y. Li & Sullivan, 2016). However, few generic studies have explored the architectural characteristics and attributes of learning spaces that can foster collaboration and innovation based on scientific premises (Allen, 2007; Zundel, 2013). No single study has traced the common ground
between biophilia and innovation in higher education. Nevertheless, architects who wish to foster innovation seek to further understand the characteristics and stages of innovation generation as a process. Until then, such a process has no precise definition and a mysterious mechanism. However, social psychologists identify innovation as a mix of creativity and knowledge, which can spark the imagination, fuelled by data.

Nature and learning spaces: psychological and experimental findings

A long list of empirical and experimental studies has revealed the importance of the connection between humanity and nature (Biederman & Vessel, 2006; Joye, 2007; Masden & Salingaros, 2014; Ulrich, 1983, 1984). For example, Ulrich (1983) suggested in his psychoevolutionary theory that exposure to safe, natural areas is inherently restorative, because such settings were associated with survival during humanity’s long evolutionary history. This inherent human affinity with natural systems and processes is defined as biophilia (Wilson, 1984). A biophilic relation with nature is considered to be a fundamental biological need that influences people’s health, productivity, wellbeing and even existence (Kellert, 2005). The green design movement, which developed in the 1990s, established connections between improving environmental quality, work productivity, wellbeing and the built environment (Romm & Browning 1998; Ryan, Browning, Clancy, Andrews, & Kallianpurkar, 2014). These studies called for environmental building standards, such as the international building performance standard Living Building Challenge, which has incorporated biophilia into its rating system to promote buildings with a positive and generative environmental impact.

Further empirical studies proved that some natural elements act positively to support psychological, physical and emotional wellbeing for users of educational spaces to promote a more pleasant, efficient and effective innovation-generation environment. These elements include daylight (Wang, 2015), space proportions (Alexander, 1977), natural ventilation (Atchley, Strayer, & Atchley, 2012) and the presence of indoor plants (Shibata & Suzuki, 2004). From these findings, some studies explained the mechanism of innovation generation as the stimulation of the human senses by using some natural features, which may promote creative and paradoxical thinking. Some studies mentioned that paradoxical thinking is the core source of creative ideas, which leads to real innovation (Ingram, Lewis, Barton, & Gartner, 2016). Also, a recent US study at Stanford University suggested that walking in nature can positively affect the brain, which helps to curtail brooding or rumination: a likely precursor to depression (Bratman, Hamilton, Hahn, Daily, & Gross, 2015).

More recently, Li and Sullivan’s (2016) experimental study on school students revealed that exposure to nature directly impacts cognitive performance and promotes attention, restoration and recovery from stressful experiences. Nevertheless, there is a general gap in knowledge around the holistic impact of the built environment on human performance. To fill this gap, the conceptual and methodological complexity of real-world users’ experiences of built spaces must be addressed (Barrett, Zhang, Moffat, & Kobbacy, 2013).

The architectural settings of the Innovation-Generation Process (IGP)

Recent studies have diagnosed the Innovation-Generation Process (IGP) in business, higher education and research workplaces, and managed to break it down into multiple tasks and phases of teamwork missions (Coleman, Graham, & Mulhern, 2012). A pioneering study by Allen (2007) identified the characteristics of an innovative workplace and revealed that the creation of innovative products and processes requires certain moods and stages of innovation. Ness (2012) configured IGP from the perspective of socio-psychology. She
defined it as a six-stage sequential process in a teamwork setting. Based on Ness’s model of IGP, a study by Abdelaal (2018) described in detail the spatial arrangements needed to accomplish the mission of each stage, briefly listed in Table 1.

Table 1. Stages of the Innovation-Generation Process (IGP) and their associated architectural settings (Source: Authors).

<table>
<thead>
<tr>
<th>Innovation Stage</th>
<th>Mission</th>
<th>Architectural settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phrase a question</td>
<td>To provide more freedom of thinking and better socialising among the newly assembled team.</td>
<td>Out-of-office gathering space, preferably an outdoor area</td>
</tr>
<tr>
<td>Identify and break frames</td>
<td>Focusing on finding as many valuable ideas as possible (idea centred) within a disruptive model of innovation</td>
<td>Two types of space:</td>
</tr>
<tr>
<td>Ideas generation</td>
<td>To filter all available ideas and shortlist one to be transferred into a product</td>
<td>Social indoor and outdoor spaces, group members’ homes and collaborative workspaces are ideal locations for generating and modifying ideas for initial products</td>
</tr>
<tr>
<td>Incubation</td>
<td>Imagination, observation and analogy to generate an innovative prototype</td>
<td>Work in an ample space and private cell-type offices for executing individual tasks.</td>
</tr>
<tr>
<td>Melding</td>
<td>To merge the best ideas into a well-engineered product, moving forward from imagination to implementation</td>
<td>Two types of space:</td>
</tr>
<tr>
<td>Dissemination</td>
<td>To exhibit a crafted prototype and large-scale testing to be published</td>
<td>Convention halls, exhibitions, commercial streets, public plazas and parks</td>
</tr>
</tbody>
</table>

The listed typology of IGP spaces highlights that nature plays a vital role in consolidating the first four phases of the process: preparation, identification, idea generation and incubation (Plambech & Konijnendijk van den Bosch, 2015). Hence, immersion in nature, or a naturally stimulated built environment, influences the process of innovation and leads to more creative performance (Atchley et al., 2012).

**Biophilic design and innovation-based learning spaces**

As stated earlier, biophilic design can achieve a sort of retrospective reflection of nature based on the built environment to revive the genetic human affinity for nature. Neuroscience explains this biological phenomenon as ‘neurological nourishment’, which indicates that humans have an innate craving for a certain type of information related to the natural world. In addition, it is closely related to the brain’s centres of pleasure and pain (Biederman & Vessel, 2006). The more humans are exposed, interact with and even passively view nature,
the more nourishment occurs. This approach is an offspring of Attention Restoration Theory (ART) (Kaplan & Kaplan, 1989). According to ART, connection with the natural environment can facilitate the human senses of extension and fascination, which are crucial for cognitive restoration.

However, innovation generation is not limited to the human brain’s pleasure or restoration, as it is related more to intellectual skills. One of the earliest studies of outdoor learning by Mortlock (1994) confirmed that cognitive activities in nature may be regarded as an outdoor adventure, which symbolises a sense of adventure in the natural world, as exploring nature can be unpredictable and challenge people’s comfort zones. Wandering in nature involves physically demanding activities (e.g. trekking), risks (e.g. getting lost) as well as opportunities for uplifting experiences (e.g. viewing a beautiful sunrise from a mountain summit). According to Ee, Seng, and Kwang (2007), people need to be open to and embrace this sense of adventure. Similarly, innovative thinkers need to be open minded to generate creative ideas. Despite the limitation of bias samples in their study, Leong, Fischer, and McClure (2014) recent empirical investigation revealed that the more connected people are with nature, the more significant their preference for innovative and holistic thinking styles.

The unlinked patterns of biophilic design and innovation

Cramer (2008) and later Kellert (2015) suggested the first conceptual framework for biophilic design, which included three categories of human experience within spaces: direct experience of nature, indirect experience of nature, and experience of space and place. Recently, Ryan et al. (2014) derived from these categories a list of 14 nature-based design patterns further categorised within three types: nature in the space, natural analogues, and nature of the space (Browning, Ryan, & Clancy, 2014).

Although these design patterns are more tangible and have a wide range of applications, they do not redress the gap between theory and practice in designing specific types of buildings. Ryan et al. (2014) claimed that they intended their proposed patterns of biophilic design to serve any building type as a ‘multi-platform solution’ that is flexible enough to match any project’s needs based on its intentions. For this reason, from our point of view, many designers are still struggling with the embodiment of biophilic design features within their projects. Thus, our study focuses on integrating design patterns with the approach of IGP to be adapted in university campus architecture.

DISCUSSION: MADRASA AND BIMARISTAN COMPLEXES AS A BIOPHILIC AND MULTISENSORY EXPERIENCE

This section demonstrates the presence of the previously mentioned values, concepts and attributes of biophilic/multisensory design in the characteristics of the traditional ‘university campus’ in the Islamic era. The study is limited to secular academic institutions of applied sciences (i.e. madrasa and bimaristan) between the eleventh and fourteenth centuries in the capital cities of the Islamic world: Bagdad, Damascus, Aleppo and Cairo. Our research selected those temporal, typological and geographical limitations as those institutions witnessed endless innovation in various fields of knowledge.
Historical background: the roots of the madrasa and bimaristan prototype

From 787 A.D. Haroun Al-Rashid, the Abbasside Islamic Caliph, adapted the concept of attaching a school or madrasa to mosques and a hospital or bimaristan to a medical college from the Buddhist monastery or Sangharama (Pereira, 1994). In these schools, several advances in medical innovation functioned integrally within the hospitals of the Islamic world. It was evident that the early prototype of madrasa and bimaristan from the ninth century was influenced by other religions (e.g. via Christian Armenia and Buddhist Central Asia). By the twelfth century, the crusaders marvelled at the ‘new’ institutional type that had made its way to Europe (Pereira, 1994).

Early Islamic schools of medicine were influential centres of innovation that hosted Muslim, Christian, and Jewish scholars and pupils who shared the same enthusiasm to innovate, explore and generate new knowledge in science, medicine, chemistry, physics, mathematics and pharmaceuticals (Raḥmān, 1987).

Interestingly, Islamic academic institutions, both theological and medical, were distinguished by a set of standard features. These included: the original building form; the geometry of courtyards surrounded by four ‘iwans’; the impact of natural forces; and the use of water, shadow, daylight, colour and texture. The focus of this study will be the secular type of traditional madrasa (see Figure 2).

Figure 2. (Left) Madrasa, Qubbat &-Bimaristan al-Sultan Qalawun (1283 A.D.), ground floor plan.

1 An architectural unit that consists of an empty vaulted space enclosed on three sides and open to a courtyard or central space on the fourth (Peker, 1991)
Psycho-social interpretation of the madrasa complex: empirical findings

Researchers have investigated the madrasa, or traditional Islamic school complex, as an iconic prototype of a 'timeless' learning space. More recently, a study of the four ‘iwans’ of the Sultan Hassan Complex (1361 A.D.) examined the intellectual and cognitive impact of the building on its users. The study concluded that the use and experience of timeless buildings are ‘suggestive of relaxation’ after staying 30 minutes in the building (Essawy, Kamel, & Samir, 2014). Nonetheless, no empirical study has explored the secrets behind the success of these buildings as innovation hubs. However, it is well documented that these buildings are experienced as organic, alive, whole, comfortable, free, egoless, exact and mostly ‘timeless’. Hence, some architects and researchers attribute these qualities to spiritual sources while others focus on the builders’ broad and spontaneous expertise (Essawy et al., 2014). Our hypothesis supports the latter assumption.

Validating the biophilic patterns of traditional madrasa architecture

In contrast to the western conception of the building as a sculptural element in space, the traditional madrasa features well-arranged patterns on its exterior and within its interior spaces that harmoniously integrate and interplay with natural elements (Payette, 1988). These include: natural airflow, daylight, water elements, biomorphic ornamental forms and patterns; and clever manipulation of natural materials such as wood and stone (Akkach, 2005; Petruccioli & Pirani, 2013; Taheri, 2017). The abovementioned features are essential attributes of biophilic architecture. Hildebrand (2008) proposed five patterns in architecture that can be classified as advantageous to survival using biophilic design. Kellert (2015) later proposed 12 elements that could potentially influence the design of the built environment. Finally, Ryan et al. (2014) suggested the previously mentioned 14 complex patterns of biophilic principles, either directly, indirectly or metaphorically. The earlier proposed patterns by Hildebrand practically comprise Kellert’s 12 elements and, to a certain extent, Ryan et al.’s (2014) 14 patterns of biophilic design. However, the element of Kellert’s ‘change and metaphor’ and Ryan’s ‘biomorphic forms and patterns’ are considered subsections of Hildebrand’s original pattern of ‘order and complexity’, with further manipulation. Table 2 illustrates the similarities between the three approaches to the taxonomy of biophilic design in architecture.

Table 2. Combined patterns, elements and characteristics of biophilic design (Source: Authors).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex order</td>
<td>Ordered complexity</td>
<td>Complexity &amp; order</td>
</tr>
<tr>
<td>Prospect and</td>
<td>Change &amp; metaphor</td>
<td>Affection &amp; beauty</td>
</tr>
<tr>
<td>Refuge</td>
<td>Reverence &amp; spirituality</td>
<td>Reverence &amp; spirituality</td>
</tr>
<tr>
<td>Refuge (paired by Appleton, 1996)</td>
<td>Prospect &amp; refuge</td>
<td>Prospect</td>
</tr>
<tr>
<td>Enticement</td>
<td>Affection &amp; attachment</td>
<td>Visual connection with nature</td>
</tr>
<tr>
<td>Exploration &amp; discovery</td>
<td>Information &amp; cognition</td>
<td>Presence of water</td>
</tr>
<tr>
<td>Peril</td>
<td>Enticement &amp; curiosity</td>
<td>Mystery</td>
</tr>
<tr>
<td>Peril</td>
<td>Fear &amp; awe</td>
<td>Risk/peril</td>
</tr>
<tr>
<td>Peril</td>
<td>Mastery &amp; control</td>
<td>Presence of water</td>
</tr>
</tbody>
</table>
An earlier survey conducted by Movahed (2015) examined the impact of Ryan’s patterns in the historic Aqa-Bozorg Mosque (1875 A.D.). He used this building as a template to evaluate the recognition of these patterns by its visitors. The results of his survey listed the presence of water, material connection with nature, connection with the natural system, thermal and airflow variability, biomorphic forms and patterns, visual connection with nature and refuge as the most recognised patterns (in more than 140 responses). Accordingly, the proposed patterns in our study were chosen based on the intensity of their use in traditional madrasa architecture: order and complexity, change and metaphor of biomorphic forms, prospect and refuge, enticement, and risk and peril.

Order and complexity

Islamic architecture implemented complexity and order in various ways. Experimental studies have concluded that patterns found in Islamic architecture can achieve a cognitive balance between tedious and overwhelming (Browning et al., 2014), which enables one to make a comparison or choice (Kaplan & Kaplan, 1989). Also, this leads to positive health responses such as reducing stress, visual nourishment, and positive psychological and cognitive responses that foster innovation (Joye & van den Berg, 2011; Moon et al., 2014; Taylor, 2006). Those premises are essential for accomplishing the tasks of the second, third and fourth stages of IGP.

The pattern or ‘complex order’ (Kellert, 2008) uses various strategies such as fractal geometries with a scaling factor of 3, biogeometry (Shemesh et al., 2016), hierarchical symmetry (Salingaros, 2000), connective symmetries and universal scaling with a coherent spatial hierarchy around centres (Ramzy, 2015). The British mathematician Roger Penrose’s patterns, which are metaphoric geometric patterns of natural elements that do not contain arbitrarily large patches, can be found in many floors, walls and decorative roof ornaments, Muqarnas patterns, plants within the courtyard, windows and doors detail, trims and texture (see Figure 3).

Figure 3. (Top, left to right). Muqarnas dome, Erzurum Yakutia Madrasa, Turkey; Penrose pattern in arch geometry; snowflakes fractal (by Alexey Kljatov). (Bottom, left to right) Courtyard garden and Muqarnas entry, Bimaristan Al-Argoun, Aleppo, Syria; window ornament, Bimaristan Alnuri, Syria (Source: Adapted from @ http://premoderno.tumblr.com and archnet.org).
Change and metaphor of biomorphic forms

Stemming from order and complexity, biomorphic forms are symbolic representations of living and non-living elements in nature that are visually and perceptually pleasing, which to date has no scientific explanation. These patterns allow users of the built environment to feel connected to nature, which gives a sense of comfort, contemplation and absorption. This connection also reduces stress due to a shift in focus and enhances concentration (Joye, 2007).

For example, the golden angle (137 degrees) is the angle between successive florets in some flowers. Also, the Fibonacci series (0, 1, 1, 2, 3, 5, 8, 13, 21, 34 ...) is used to imitate the numeric sequence that occurs in many living things, especially plants. Phyllotaxian or dynamic symmetry features continuous movement and growth as in the sunflower (Hambidge, 1920). Finally, the golden section, which is the ratio of 1:1.618, is an ideal mimicry of the unfolding growth pattern of many living things (see Figure 4) (Ryan et al., 2014).

The mathematical proportions of madrasa and bimaristan plans accurately represent an array of squares and golden mean proportioned rectangles following the spatial hierarchy from domain to court to cell (Figure 5). These arrangements had their own philosophical symbols in traditional civilisations, primarily in the Islamic society, which was richly influenced by mystical and spiritual premises inspired from the Holy Quran and earlier theological approaches (Akkach, 2005).

Figure 4. Nature-based mathematical geometries: phyllotaxian or dynamic symmetry (Source: Joye, 2007).

Figure 5. Implementation of nature-based patterns and proportions in Bimaristan Al-Argoun, Aleppo, Syria (Source: Authors).
Prospect and refuge (meadow and cave)

Paired patterns such as prospect and refuge refer to inseparable dichotomies and powerful design settings that facilitate obtaining information about the environment while being protected within a shelter (Appleton, 1996), depicting for example the edge of a forest (Hildebrand, 1991). Such places seem to be genetically predisposed spatial preferences for humans in evolutionary psychology. The paired patterns are visual, aesthetic and spatial preferences combined with shading elements, terraces, water and calm grazing animals to provide a sense of safety, control and freedom (Browning et al., 2014). The health benefits of both settings (i.e. prospect and refuge) include reductions in stress, boredom, irritation, fatigue and perceived vulnerability.

Prospect is characterised as the ability to see from one space to another or the view from an elevated position; this setting is most effective within a building's interior (Kellert, 2005). Refuge represents the surveillance of vast open spaces from an enclosed 'private' space accompanied by reduced lighting from a small window set in a thick wall (Ramzy, 2015). These characteristics were acknowledged by Alexander (1977) as positive spaces, which provide the feeling of being backed into a smaller space while looking out to a large space.

Such an architectural setting was widely implemented in traditional madrasa by providing a well-proportioned courtyard (using the golden mean\(^2\)) which provides an average focal length (6–30 m) for a set of surrounding small study rooms or ‘kholwah’ with dimmed lighting (Figure 6).

![Figure 6](http://premoderno.tumblr.com)

Figure 6. (Top right) Refuge and prospect from a hillside cave into a valley. (Bottom, left to right) Examples of prospect and refuge patterns in an entrance hall, courtyard and small cell. Bimaristan, Al-Argoun, Aleppo, Syria (Source: Adapted from http://premoderno.tumblr.com and archnet.org).

\(^2\) The golden mean (or Golden Section, number, or ratio, or divine proportion, etc.) refers to half the diagonal of a rectangle with length 2 and width 1. It corresponds to the ‘irrational part’, \(\sqrt{5}/2=1.6180\).
Enticement, curiosity/mystery

The feeling of enticement reflects a more positive and pleasant meaning of exploration than mystery. However, both moods are required to provide a sense of being teased with a kind of denial and reward that tempts the user to investigate the space with curiosity (Browning et al., 2014).

Psychological engagement with such a sense of anticipation elicits a strong pleasure response, heightened curiosity, and increased interest in gaining more information. The sense of mystery provides the desire to move deeper into the space to explore, which supports stress reduction and cognitive restoration (S. Kaplan, 1995). The term ‘enticement’ represents viewing and moving to a place that is brighter than the one we occupy to reveal more features (Hildebrand, 2008). The architectural setting for both enticement and mystery are pathways and transitory spaces next to the entry point of the space. Enticement-driven patterns within the built environment foster social interaction and support within the innovative team that helps the development of the first three stages of IGP.

Techniques such as dramatic shade and shadow, winding paths, obscured subjects, auditory stimulation and translucent materials were densely applied in traditional madrasa architecture. Examples are the screen as a translucent element and the dark ‘majaz’ leading to a partially lit, winding corridor, leading to a broader courtyard immersed in light (Figure 7).

Risk and peril/fear and awe

Risk is an audacious experience that thrills the user and involves two paradoxical emotions – fear and pleasure – due to our genetic sensitivity to danger. Peril is characterised by observing a fully evident danger, while a controlled risk provides a thrilling sense of elation. However, it is vital to distinguish peril from anxiety, as anxiety can present in a case of lack of control, which might cause a sense of fear (Figure 8).

Controlled risk, peril or even fear and awe have a profound positive impact on raising awareness and curiosity, memory refreshment and problem-solving skills. Architecturally, the traditional madrasa builders used some tools to evoke low-level risk within these schools,
including the use of double height in shared spaces, balconies or catwalks, cantilevers and clever use of water sounds (Figure 8). This pattern is highly recommended to stimulate the generation and manipulation of ideas during the second and third stages of IGP.

Figure 8. (top right) A long bridge in the forest resembles a setting of peril: a controlled risk (Source: www.megapexil.com), (Bottom Left to right) Examples of risk and peril patterns. Flooding water fountain and entrance hall Bimaristan Al-Argoun, Aleppo, Syria, double height alcove ‘Iwan’ Bimaristan Alnouri, Damascus, Syria (Source: Adapted from @ http://premoderno.tumblr.com and archnet.org).

A proposed mechanism of interpretation

The previous examples reflect traditional builders’ recognition of human attachment to nature in different ways. Scientifically, the six stages of the Innovation-Generation Process (IGP) require specific design strategies to fulfil the physical, psychological and emotional needs of innovators in each stage. This study proposes that the IGP stages can be linked, as each stage requires certain moods and architectural configurations (see Table 1).

Table 3 summarises the proposed concepts of biophilic architecture found in madrasa architecture. It highlights the intellectual and psychological benefits of each approach and shows how they might be reflected in design, giving examples of their implementation in traditional madrasa architecture. Needless to say, such a typological configuration needs to be tested empirically and clinically to examine its validity for the innovation-generation learning space.
Table 3. Correlation between IGP stages and proposed biophilic design strategies and their innovation-generation benefits (Source: Authors).

<table>
<thead>
<tr>
<th>Stages of IGP</th>
<th>Shared strategies</th>
<th>Matching biophilic patterns &amp; suitable strategies</th>
<th>Architectural settings (from history)</th>
<th>Innovation-generation benefits</th>
</tr>
</thead>
</table>
| Stage (I)     | Phrase a question (Team form) | Biomorphic forms & patterns, presence of water, dynamic & diffused light, connection with natural systems | Patterned wholes, trees and column support, arches, dynamic balance, fractals, hierarchically organised scales, integrating parts to the whole, biomorphic Natural materials, botanical motifs | • Stress reduction (Grafetstatter et al., 2017; Ratcliffe, Gatersleben, & Sowden, 2013)  
• Decreased stress hormones (Q. Li et al., 2008)  
• Positive impact on concentration & memory restoration (Bowler, Buyung-Ali, Knight, & Pullin, 2010; Greenleaf, Bryant, & Pollock, 2013)  
• Education/learning opportunities (Clayton, 2007)  
• Facilitated social interaction (Kingsley & Townsend, 2006) |
| Stage (II)    | Identify and break frames (Team storm) | Material connection with nature, visual connection with nature, biomorphic forms & patterns, presence of water, dynamic & diffused light, connection with natural systems, risk/peril | Outside views and vistas, domes, arches, vaults, space as shape and form Courtyard, terrace, gallery and cells overlooking open space | • Positive impact on attitude & overall happiness (Barton & Pretty, 2010; Korpela, De Bloom, Sianojia, Pasanen, & Kinnunen, 2017)  
• Positive impact on concentration & shift in focus (Joye, 2007)  
• Positive affect on cognitive performance (Berman, Jonides, & Kaplan, 2008; Bringslimark, Hartig, & Patil, 2007; Koehler, 2011; MacNaughton et al., 2017; Ratcliffe, Gatersleben, & Sowden, 2016; Yin, Zhu, MacNaughton, Allen, & Spengler, 2018)  
• Reduced anger/frustration (Grafetstatter et al., 2017; Kuo & Sullivan, 2001)  
• Increased self-esteem (Pretty, Peacock, Sellens, & Griffin, 2005) |
| Stage (III)   | Ideas generation (Team norm) | Complex order, material connection with nature, visual connection with nature, dynamic & diffused light, non-rhythmic sensory stimuli, risk/peril | The universe and cosmic context by using fractal, dynamic symmetry and Penrose patterns, spatial harmony by using golden mean and Fibonacci series generative patterns, filtered and diffused light Multisensory contact, habitats and ecosystem & information richness, plants, animals and living organisms Sensory variability, transitional spaces, reflected light | • Improved mental engagement/ attentiveness (Biederman & Vessel, 2006; Han, 2010; Jeon, Yeon, & Shin, 2018)  
• Enhanced creative capacity (Korpela et al., 2017)  
• Increased inspiration (Fredrickson & Anderson, 1999)  
• Improved creative performance (Lichtenfeld, Elliot, Maier, & Pekrun, 2012; Steidle & Werth, 2013)  
• Foster imagination (Glaveanu, Gillespie, & Valsiner, 2014)  
• Reduced headaches (Hansmann, Hug, & Seeland, 2007) |
CONCLUSION: ANTICIPATING THE FUTURE OF INNOVATIVE HIGHER EDUCATION FROM HISTORY’S LESSONS

This paper has summarised a literature review on the interrelation between nature, the built environment and innovation. The literature revealed that implementing the principals of biophilic design can have a positive impact on innovative learners and producers in higher education (students, staff and faculty). Hence, the reconfiguration of higher education environments, so they are more integrated with natural features (explicitly, implicitly and metaphorically), can profoundly enhance physical, psychological, cognitive and intellectual performance and foster the Innovation-Generation Process (IGP).

The review of earlier studies about biophilic design revealed that current approaches cannot offer a precise mechanism for implementation to assist designers today, as they lack consistency and inclusiveness. Possibly, the reason behind such a delay in mapping the architectural features of biophilia is due to the scarcity of examples or deliberately constructed case studies that could serve as a template. A key outcome of this research is that history matters. Historical examples of innovative learning spaces can serve as excellent precedents for future studies and design. This research brings to light the importance of reviewing the history of architecture by using different lenses.

The results of our historical interpretation inform architects and planners of tomorrow’s university campuses that other aspects of design, in addition to technological aspects, deserve more manipulation to achieve an innovative working and learning environment. Although the mechanisms of the operation and stimulation of the human brain and its biochemical interactions are common variables, it is necessary for those who are seeking to build innovative learning spaces to provide the proper spatial and environmental settings for the various tasks and stages of the Innovation-Generation Process (IGP). These results support Ramzy’s (2015) and Movahed’s (2015) research, which suggested that further studies and analysis are needed to investigate the embodied qualities of biophilic design in historic buildings, which can be used as a reference to evaluate the biophilic design features in today’s architecture.

Finally, the study selected five primary architectural settings for biophilic design to stimulate the human brain for better performance: complex order (including metaphoric patterns), prospect, refuge, enticement and mystery, and risk and peril. This paper further elaborates the linkages between these settings and the dynamism of the Innovation-Generation Process (IGP), especially the two early stages of IGP according to Plambach and Konijnendijk van den Bosch (2015). Some case studies of traditional educational buildings or madrasa from the Golden Age of Islamic civilisation have been discussed; however, further research may shed more light on the impact of geometrical patterns and metaphoric architectural forms on our neurological systems. Clinical studies should investigate how these patterns may...
influence our intellectual and cognitive capacities to inform the design of future innovative educational spaces.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the generous support of Effat University and the assistance of the School of Architecture and Built Environment at the University of Adelaide for hosting the researcher. Dr Peter Scriven deserves special mention for his valuable comments and suggestions.

REFERENCES


Zundel, B. (2013). *Explore, develop, innovate!: urban development for innovation economies*. (Masters), Kansas State University, Manhattan, Kansas, USA.
HEALING AND THERAPEUTIC LANDSCAPE DESIGN – EXAMPLES AND EXPERIENCE OF MEDICAL FACILITIES

DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1637

Ingrid Belčákova, Pavla Galbavá, Martina Majorošová

Keywords
landscape design; healing and therapeutic effects; exterior landscaping of hospitals

Abstract
Healing and therapeutic landscape design proposals are particularly suitable for medical facilities and, in general, facilities for people with health disorders, where they become a major support in difficult situations and can serve as a supplement to treatment. They do not replace medical help and different therapies, and neither do they exclude their need. However, their effects can improve and accelerate the recovery process in patients. In Slovakia, medical facilities do not often meet modern medical care requirements in terms of their technologies and equipment. For this reason, it is necessary to mainly transform hospital facilities and their exteriors in order to create the required natural foundation for patients in the form of healing and therapeutic landscape design. Using the example of the Philippe Pinel Psychiatric Hospital in Pezinok (Slovakia, Central Europe), we present a proposal for a green vegetation-scaping using the existing space, adding elements that highlight and support the therapeutic effect of the proposed space. The aim of the proposal is to create an environment that will bring positive changes for patients while serving as a relaxation space for employees.

I.Belčákova* , P. Galbavá & M. Majorošová

I. Belčákova, Faculty of Ecology and Environmental Sciences, Technical University in Zvolen, T.G.Masaryka 24, 960 53 Zvolen
P. Galbavá, ONY Landscape architecture studio, www.ony.sk
M.Majorošová, Faculty of Civil Engineering, Slovak University of Technology in Bratislava, Radlinského 11, 810 05 Bratislava, Slovakia

*Corresponding Author’s email address: belcakova@tuzvo.sk

ArchNet-IJAR is indexed and listed in several databases, including:
• Avery Index to Architectural Periodicals
• EBSCO-Current Abstracts-Art and Architecture
• CNKI: China National Knowledge Infrastructure
• DOAJ: Directory of Open Access Journals
• Pro-Quest
• Scopus-Elsevier
• Web of Science
INTRODUCTION

According to the World Health Organization (WHO), human health is defined as a state of complete physical, psychological and social well-being, and not only a state without any disease or physical disorder (Fredrickson, 2013). Talking about health, it is necessary to consider the interconnection of physical and mental factors that influence each other. On this principle, the natural environment or an environment with a predominance of natural elements can influence not only the physical but also the psychological state of a person as a positive factor in the creation of spaces.

Healing gardens or walks in nature can also serve as prevention against diseases. They are designed to promote human health in a comprehensive way, both physically and mentally. Designing and creating gardens is not just a matter of aesthetics, they have a much greater effect on humans (Jiang, 2014). Healing and therapeutic landscape design has been experiencing a boom in recent years, particularly in the USA, as well as Great Britain, Australia and the Scandinavian countries. A healing and therapeutic garden is primarily composed so as to fulfil its comforting purpose in particular, acting as anti-stress. In addition, it contains many other aspects with a positive effect on a person (Smidl et al., 2017). Nature is a natural place for relaxation, which can create some positive effects in humans. It can serve as a factor supporting a proper mental mood and internal functioning of the body and preventively reduce susceptibility to diseases (Sachs and Marcus, 2012).

Due to the effects on psyche and health, healing and therapeutic landscape design is primarily intended for various medical facilities, sanatoriums, healing spas or retirement homes (where the elderly suffer from various diseases). Of course, its application is not limited to these spaces in relation to its positive effects in general (Zeisel, 2007; Cooper-Marcus et al., 2009). The interest in the natural environment and health has again increased recently, though the creation of gardens for healing purposes goes back a much further than that. The use of gardens as spaces suitable for treatment has been observed in early Eastern, Greek and Roman cultures (Warner and Baron, 1993; Chen, 2004).

Gardens in hospitals and monasteries were used as a space for thought, as well as the cultivation of crops and herbs for medicinal purposes in the Late Middle Ages (Tyson, 1998). Gardens were also used for therapeutic purposes and therapy by working in a garden, especially in psychiatric facilities, at the turn of the 18th and 19th centuries (Epstein, 1998). Pavilion-style hospitals were built during this period. Many sanatoriums emerged in a natural environment during the 20th century. Gradually, however, natural elements as part of the treatment receded and high-rise multi-storey hospitals began to be built, the use of terraces and balconies disappeared, parking requirements increased.

We saw great advances in medical technology over the last decades (50-60 years). However, a concept of gardens with healing effects was neglected perhaps because of this trend, coupled with the economic pressure or the political situation of countries (Beal, 2004). A systematic study of the effects of natural spaces on health dates back to around 1980-90. Ulrich (1984) documented and demonstrated the relationship between the period of hospitalization, the use of pain medication and accessible view of external environment in surgical patients. Patients with a view of nature regenerated faster and required fewer pain medications.

Wilson (1986) and Kellert et al. (2008) presented a thesis entitled ‘Biophilia Hypothesis’, assuming that increasing contact with nature has healing effects on a disease. The
hypothesis draws attention to the existence of an instinctive connection between humans and other living systems. The design that reflects this thesis is based on 6 attributes: environmental elements, natural shapes and forms, light, space, local relationships, human-nature relationships conditioned by development.

ASLA (American Society of Landscape Architects) began sponsoring special meetings on the topic of healing gardens as part of an annual conference. An American botanical school in Chicago initiated the first postgraduate program in the USA in 2003 - Healthcare Garden Design for landscape architects who want to specialize in the field (Cooper Marcus, 2007).

A laboratory for research into the interaction of green vegetation with medicine and healing design called ‘Nature, Health & Design Laboratory’ was established in Copenhagen, Denmark in 2014. It is located in the Horsholm arboretum, the largest collection of trees and shrubs in Denmark. The laboratory team created the Nacadia therapeutic forest garden project to help people with mental illness and the Octovia healing forest project, which is used as disease prevention and promotes overall health (Stigsdotter, Randrup, 2008; Stigsdotter et al., 2014).

In Slovakia (Central Europe), treatment associated with relaxation in a natural environment was mainly used as part of the treatments in sanatoriums and healing spas in the last century. The sanatoriums established in the 19th and 20th centuries were primarily built as facilities for the treatment of tuberculosis and were built in a natural environment. Spas were built in a natural environment near springs, and spa parks were included as a supplemented treatment.

Today, sanatoriums located in nature are used to treat other diseases, addictions, or behavioural disorders and conduct rehabilitations. Some of them have changed their functions or are not used anymore. Spas and spa parks are still used for rehabilitation processes by different patients. The main component of a spa treatment in a spa are spa procedures, especially, contact with water from natural springs that contain healing substances. The specific treatment options depend on the type of spa.

The green vegetation of hospitals or other medical facilities in Slovakia is not specified in any Slovak legislation and there are no regulations that would support its fundamentals and use in practice. When looking at horticulture and urban planning, we can simplify the division of green vegetation based on its accessibility to the public as public, restricted, and private. Restricted green vegetation includes the green spaces of hospitals and sanatoriums, i.e. hospital gardens, green vegetation in the hospital and the surroundings of sanatoriums. In most cases, hospitals and other healthcare facilities in Slovakia do not have a well-adapted exterior space to help treat physical and mental illnesses. For this reason, it is necessary to transform hospital facilities and their exteriors in order to create the natural foundation required for patients in the form of healing and therapeutic landscape design. An example of such a facility is the Philippe Pinel Psychiatric Hospital in Pezinok (Slovakia), which we have considered as a pilot case study for the treatment and therapeutic design.

METHODOLOGY

The methodology of the interior and exterior revitalisation of the hospital is based on knowledge of the principles of healing and the design of therapeutic gardens and their positive influence on the psyche, perception and health of human beings. This methodology
relates to the connection between people and nature, the influence of the nature on the psychological perceptions of a person, the connection between nature and human health and, last but not least, the importance of green vegetation as a supplement to a treatment.

Our research included results from foreign studies, publications, and realizations based on the influence of therapeutic landscape design when used both passively and actively. In the next step, we focused mainly on the healthcare facilities and the effect of green vegetation on patients, visitors and employees of facilities abroad as well as in Slovakia. The economic aspects, the appropriate methodology for the evaluation of therapeutic designs, and the value of their treatment character are part of our research.

We have applied our research on the design of revitalisation based on the principles of treatment and therapeutic design mentioned below, an analysis of the facility, consultations with several stakeholders, and the results of questionnaires with employees and patients. The design works with existing space, and there are added elements that highlight and support the treatment effect of the proposed space. The aim of the design is to create a space that will bring positive changes for patients and it will offer a relaxing space for employees.

Study area description

The Philippe Pinel Psychiatric Hospital is located on the outskirts of Pezinok town which is close to the Little Carpathians Mountain Range, in a peaceful natural environment on the edge of an urbanized landscape that is characterized by low building constructions. It is accessible from a II. class road (No. 503) called Malacká cesta. There are bus stop and a car park in front of the complex.

Pezinok is located at an altitude of 156 m above sea level, with its highest point known as Čertov kopec (752 m above sea level). The town is located 18 km northeast of Bratislava (the capital) and is surrounded by the districts of Senec, Bratislava, Malacky and Trnava. The average summer temperature is from 16 to 20 ° C; in winter it is -2 to -4 ° C. The annual precipitation reaches about 700-740 mm for approximately 90-95 precipitation days. The town and its surroundings are considered to be an important wine-growing region.

The forests around the town are predominantly Fagus-Quercus and are a part of the protected landscape of the Little Carpathians Mountain Range. Apart from Fagus and Quercus, the main species that occur in this are Fraxinus, Acer and Tilia and the non-native Castanea. In herbaceous communities spring Adonis vernalis, Chrysopogon gryllus, Pulsatila grandis and Dianthus lumnitzi can be found. The species that only occur on this mountain range are: Ruscus hypoglossum, Coronilla eremus and Rhamnus saxatilis. There is a wide range of animals too. The mountain range has a specific development of crystalline, and overall it is characterized by the following rocks: granitoid rocks, limestone, slate, phyllites, amphibolites, etc.

The character of the hospital is mostly pavilion-like and is supported by green vegetation with aspects of forest park or spa park, spacious lawns and aesthetically developed trees. The buildings and facades of the buildings are built in various architectural styles, depending on their construction and additional modifications. The tallest building in the area has 5 floors.

The main entrance to the area is located on its east side and it is accessible also for the cars of employees, who can park near the main buildings. Another entrance for vehicles is also
located on the eastern side; it is closer to the southeast, and the gate does not open. On the west side of the area, there is a free entrance for pedestrians through a little forest. Apart from the road communication, the complex is complemented by pedestrian communications, and the entire communication system connects the buildings and main relaxation areas and forms a good walking route. There is a parking lot and a bus stop in front of the entrance to the complex, and a bit further on there are two parking lots. At the entrance there is also an information desk and a buffet. This building is connected by a long ground floor corridor with a social hall and the patient entry building, along with ambulances and the Physiotherapy and Rehabilitation Departments. It also leads to the Women's Department via an overhead interconnecting corridor. Other buildings, i.e., the Male Department, Drug Addiction Clinic, food service, administration, St. Luke's Chapel, operational and technical buildings and unused buildings, are standalone. The area also features a bust of Philippe Pinel, several sculptures, a bell tower, non-functional water features within the smaller architectural works, as well as sports grounds for volleyball, basketball, tennis and football.

The green vegetation in the area is not specially designed for healing gardens, but it creates a naturally pleasant and natural healing environment for the hospital. The natural surface area is large in comparison to the reinforced surfaces. It can be said that green vegetation is one of the most attractive elements of the complex. It creates a peaceful atmosphere of the area and inspires calm. It does require some modifications, but overall it works very well. There are many tree species such as Pinus, Abies, Thuja, Tilia, Fraxinus, Acer Populus, Aesculus, Morus, Betula, Larix and Prunus (many of them are natural in the area, not all of them). Their care and maintenance are mainly handled by four exterior workers. The whole area offers visitors, patients and employees a beautiful view of the forested Little Carpathian mountains. At the same time, the site is part of an educational walkway due to its historical background.

The character of the green vegetation and its design differs in various typological areas:

- The entrance area in front of the complex – a maintained lawn in front of the entrance and part of the parking lot;
- Entrance garden - formed conifers and a smaller flowerbed with a rocky garden next to a fountain;
- The access part of the area – the lawn and conifers;
- Park type of hospital garden - free lawn areas and shady areas, groups of trees forming a forest park;
- Atrium of the Male Department - unused area, currently destroyed terrain, stone cubes and a lawn;
- Atrium of the Female Department- stone cubes and lawn, two high Betula trees and Taxus trees (Taxus is a poisonous plant, whether to let it remain is controversial). The space is simple and features no complicated gardening. The atrium is accessible;
- The atrium of the Rehabilitation Department, with a healing garden element, i.e., an atrium with a stone pavement and lawn, dominating conifers (among them is the poisonous Taxus again), young deciduous trees, a therapeutic walkway made from different materials, a pine cone cover bed between flowers (created as a part of patient activities), a fountain without water but pebble and fine vegetation decorations and flower pots. This atrium is maintained the best because the staff creates activities there and has works with patients recent years. It is accessible and used for the therapies. Atrium requires minor modifications in design;
• Space without any function - a large area in the northern part of the complex located behind the buildings, connected through the long corridor and it is not used, the spacious lawn is mowed by mowing tractors. The area is crossed by pavement proposed as a walking route but it is not used;
• Blatina creek – there is a creek in the area that is quite maintained, a short part is designed as an underground covered canal. Problems with wild vegetation; and
• Indoor vegetation - only located in some places in the hospital buildings, in halls, respectively in corridors some old flower pots with simple indoor plants.

The Philippe Pinel Psychiatric Hospital in Pezinok focuses on psychiatric illnesses and addictions to psychoactive substances as well as provides outpatient and constitutional healthcare. It consists of 6 clinics - a psychiatric clinic with a male ward, a psychiatric clinic with a female ward, a psychosomatic clinic, a drug addiction clinic, a gerontopsychiatric clinic, a neuropsychiatric clinic. The hospital includes a physiotherapy-rehabilitation unit and an outpatient department for the public. Currently, the capacity of the hospital is 480 beds, with around 340 employees.

**Philosophy of the healing and therapeutic landscape design**

The connection of humans and green vegetation has existed since time immemorial, and the number of studies focusing on the issue has increased recently. The presence of green vegetation promotes recovery by inducing positive changes, such as the improvement of blood pressure, cardiac activity, muscle activity and electrical activity in the brain. These findings are important not only for hospital complexes, which were primarily addressed in this work, but in general (Ulrich 1999). An improvement in behaviour, a better pulse, blood pressure and weight values were demonstrated in patients with Alzheimer’s disease thanks to the garden, but the nature of medicinal use has not changed (Westphal, 2000). We perceive certain differences in the character and effect of healing gardens according to their intended function with respect to the target group of persons and the degree of effect over time. There may be a difference between the effect of green vegetation on a patient after surgery and a patient with Alzheimer’s disease, and a difference between regular time spent in a natural environment and a short visit once in a while. A summary of recommendations for the creation of healing gardens, complemented with more recent findings is provided for the best effect possible. Green vegetation is perceived as an important tool for creating medical facilities people visit because of their current psychological or physical problem, while patients and staff are exposed to a stressful environment (Cooper Marcus, 2007; Shackell & Walter, 2012; Ulrich, 2002). Based on the research, it is stated that a person goes through the following three or four stages in terms of psychology, when the person decides to visit green spaces (e.g. gardens or park areas) or to a natural environment to feel good (Cooper Marcus, 1997):

• a journey - a change of place or flight from the place where stress has occurred, the healing garden serves as a sanctuary;
• sensory awaking - awakening of the senses, sensory experience based on new phenomena, sounds, scents, etc.;
• personal centering - concentration on internal processes, finding inner strength, changing the view of problems; and
• a deeper perception of a human’s connection to the environment, perception of the whole, relief.
Ulrich’s theory of the so-called restorative design is based on the theory and research of behavioural science and science in areas related to health. It suggests that green vegetation in medical facilities is an important comforting means for both patients and staff because it provides the following in humans (Ulrich, 1999):

- sociality;
- sense of control (person loses control in a hospital, led by the conditions and staff of medical facility);
- physical movement;
- access and bond to nature; and
- general, various positive distractions.

The theme of therapeutic design and healing gardens has been dealt with by several experts from different fields over the past 30 years, and a number of studies on the effect of green vegetation/ the natural environment on humans, whether within a view or within a given environment, have been carried out. The terms ‘healing gardens’, ‘therapeutic gardens’, ‘restorative gardens’, ‘restorative garden design’, ‘healing landscape design’, etc. and their definitions have been gradually used. These terms generally represent the creation of gardens with a healing and therapeutic effect, i.e. with a positive effect on human health; they should help and accelerate treatment. On the basis of certain views and opinions, any natural garden or park could be considered as healing, but such a garden is specified in more detail for the highest efficiency in the use of its healing and therapeutic effects. Some authors distinguish the terms ‘healing garden’ and ‘therapeutic garden’ in particular (Eckerling, 1996; Mitrione and Larson, 2007; Cooper Marcus and Barnes, 1999).

The term healing garden can be considered instead as a concept for a garden with an applied design to recover from a disease, focusing more on mental health and overall wellbeing. It approximates the methods of psychoneuroimmunology focusing on the correlation between stress and health. Eckerling described a healing garden as a healing environment garden, the influence of which makes a person feel better (Eckerling, 1996). The term therapeutic garden can refer to a garden that produces a certain effect and a measurable outcome in the disease process, related to the particular aspect of a disease or healing process (Mitrione and Larson, 2007). It is less focused on mental health and related more to allopathic medical systems defined by treatment based on the biological action of medicine, using medicine that induces a state opposite or incompatible with the course of a disease (garden elements and activities in the case of a garden). Cooper Marcus and Barnes (1999) described therapeutic gardens as gardens to improve overall patient and employee moods that can induce stress relief and alleviate physical symptoms.

The Centre for Health Design (CHD) presents the following types of therapeutic gardens (Westphal, 2000; Smith, 2007):

- healing garden (physical, psychological and mental healing effect, induction of overall feeling of well-being);
- enabling garden (based on psychological effects, aiding physical recovery, improving physical condition based on possible activities, mental growth based on meaningful activities);
- meditative garden (supports the inner thought process);
- rehabilitative garden (primarily based on rehabilitation in the environment); and
- restorative garden (regeneration after stressful situations).
Bengtsson and Grahn (2014) summed up, compared and considered the results of various studies and the principles of designing healing gardens based on them in their research in 2014 (including, for example, the works by Grahn et al. (2010), Cooper Marcus (1997), Bengtsson and Carlsson (2013), Rodiek (2008). They selected 6 important qualities of the environment in medical facilities that enhance comfort: proximity and easy access, entry and fencing, safety, familiarity, easy orientation, and various possibilities in different weather conditions. They also selected 13 environmental qualities that support the relationship between humans and nature as well as access to it: joyful and meaningful activities, contact with the surrounding life, social possibilities, culture and connection with the past, symbolism and reflection, outlook, open space, species richness, nature’s influence on the senses, changes in nature according to the seasons, peace, nature life, and sanctuary.

In the late 1990s, three publications on the exteriors in nursing homes and hospitals were published in English (Cooper Marcus and Barnes, 1999; Gerlach-Spriggs et al., 1998; Tyson, 1998), as well as other books on transforming a garden at home into a healing space (for example, McDowell, 1998; Mintner, 1993; Cooper Marcus, 2007). The philosophy of healing and therapeutic landscape design is the design of gardens supporting health. This design combines garden and landscape architecture with psychology and medicine (see Figure 1). It is based on the theory that nature, green vegetation and a garden have a positive effect on the human psyche, senses and health. The presence of a healing garden can serve as an additional part of a treatment.

![Mental map of healing garden philosophy](Source: Authors)
The methodology of the solution/design of the healing and therapeutic gardens relies on the exterior typology in medical facilities and the current recommendations for designing such spaces. Well-known and published methodological guides (Cooper Marcus and Sachs, 2014; Sachs and Shepley, 2014) were applied in the example of the Philippe Pinel Psychiatric Hospital in Pezinok (Slovakia).

According to Cooper Marcus (2007) the exterior spaces of medical facilities are classified in terms of their character and location to the premises and buildings as follows:

- park-style of hospital garden;
- access part of the campus;
- entry space in front of the campus;
- entry garden;
- garden inside;
- square;
- roof garden;
- roof terrace;
- healing garden;
- meditation garden;
- vistas garden;
- atrium garden;
- vistas/walking garden;
- semi hidden garden;
- borrowed landscape; and
- education paths and protected nature.

The principles of creating healing and therapeutic gardens as well as their positive effect on the human psyche, perception and health are an important part of designing healing and therapeutic gardens. When designing the outer hospital space, we can follow several groups of principles. Ulrich (2002) outlined the possibilities for physical movement, selection options, socialization-supporting elements as well as access to nature and positive distractions as four main aspects of a medical facility garden. Kaplan and Kaplan (1989) distinguished four principles that a garden can include as a natural environment: cohesiveness/coherence, readability - as factors of understanding; and mystery, complexity - as factors of discovery.

Cooper Marcus (2007) defined a successful garden using the following principles: variation of spaces, the abundance and predominance of green vegetation, movement support, positive distractions, minimizing interference, minimizing ambiguous elements that can have different meanings for healthy and ill people.

McDowell and Clark-McDowell (1998) recommended 7 elements of the healing garden design: a special entrance that welcomes and takes hold of a visitor to the garden; a water feature for their physical, psychological and mental effects; the creative use of colours and light that induces emotions and comfort; an emphasis on natural elements; the integration of art; elements that attract animals to create animal diversity.

Kellert (2005) presented 9 basic environmental values on which the attraction of a person to nature depends: aesthetics, dominance, humanity, morality, naturality, negativism, science and scientific knowledge, symbolism and utility.
RESULTS

The proposed design is based on the principles of the creation of healing gardens and on the requirements of the staff who work in the facility. It should be adjusted to the target group of people, i.e., the patients of the facility and their health problems. The design of the healing garden with a therapeutic influence is intended to support the treatment of patients, increase the value of the facility, and create a harmonious environment. It is essential to have gardens and natural elements that represent positive values and that these areas are managed in harmony with human needs to support and bring about relaxation, a sense of calm, and psychical and physical energy. There should also be the possibility for physical activities, selection possibilities, elements supporting socialisation, access to a nature, etc.

Study area analysis

The hospital area has great potential for all prepared therapeutic design proposals. When comparing the present state of the architecture and greenery of the study area, the architectural elements represent a major problem. The present state of the buildings and unused spaces and elements is very negative. A substantial number of buildings in the area are not utilised nor do they have any function. Furthermore, they are in very bad condition in terms of safety. Refurbishment must also be undertaken on the garages, water supply station and transfer station. A majority of the buildings need refurbishment of the facades, windows, doors, and balconies. Behind the hospital, on its northern side, we can see a great deal of potential in the unutilised mowed area (see Figure 2).

Figure 2. Study area analysis (Source: Authors).
A great positive and essential element of the healing character of the complex is its natural character and its integration into the environment of the Little Carpathians. There are trees and shrubs, or herbs, many of which have healing properties (*Allium ursinum* and others) and can have a positive effect because of their specific scents. The singing of birds is very pleasant. There is a nice ornamental flower bed at the great fountain. A stream flows through the complex, with its open visible part being not only aesthetic, but also having a pleasant sound of flowing water in nature. Furthermore, the entire premises and its continuity to the forest offer the possibility of healthy walks. Environments suitable for walks, sports areas and outdoor seating options support socializing. There are plenty of sunny and shady areas within the premises, as well as a simply developed network of paths that allow a person to choose the environment and how it suits them (see Figure 3). The choice, one’s own decision, a sense of control are also promoted by the diversity of sports grounds where one can choose between football, basketball, volleyball or tennis. In addition to the above-mentioned features and elements, the positive distractions are enhanced by the presence of simple art.

![Figure 3. Scheme of basic natural elements (Source: Authors).](image-url)
According to the categorization of the outdoor areas of medical facilities, the following typological areas are located in the design area: an entrance area in front of the complex, an entrance garden, the entrance area of the complex, a park-type hospital garden, one unoccupied atrium garden, two atrium gardens with the possibility of an entrance (one of them with a therapeutic garden element), a space without a designated function and without use, a space for sports areas, an economic and technical space, a leased landscape and, at the same time, protected nature and an educational trail leading through the premises (see Figure 4).

The art is in the form of sculptures depicting humans and animals. A symbolic sculpture of the premises is the bust of Philippe Pinel near the entrances to the complex. Other sculptures show open arms with doves, birds of prey with caught fish, mythology and symbolism. A distinctive artistic element is also the facade of the drug addiction ward, the bell tower, fountains and the composition of wooden blocks. There is a new therapeutic path for the development of senses, especially touch and sensorimotor function, in the atrium of the rehabilitation department.

Figure 4. Scheme of therapeutic garden characteristic elements (Source: Authors).
Questionnaire survey results

77 persons took part in the questionnaire survey out of which 41 persons were hospital employees, 18 were patients staying at the hospital, 1 was a patient completing a one-time medical control and 17 were visitors. They responded to the questionnaire points as follows:

I am:
(mark one option)

- Employee of the hospital: 53%
- Patient who is hospitalized in the hospital: 22%
- Patient who came for a one-time medical examination: 24%
- Visitor: 1%

Would you welcome a simple revitalisation of the green vegetation in the area?

- Yes: 73%
- Rather yes: 23%
- Rather no: 0%
- No: 1%
- I do not know: 3%
What do you like the most in the complex?
(you can mark more than one option)

- Trees, shrubs, plants, natural character of the area: 74 responses
- Open lawn area: 36 responses
- Seating areas: 25 responses
- Art and sculptures: 23 responses
- Walking route, pavements: 11 responses
- Sport areas: 32 responses
- Buildings: 10 responses
- Outdoor activities: 0 responses
- Exterior activities: 13 responses
- Other:
  - gym
What would you recommend improving in the area? (you can mark more than one option)

<table>
<thead>
<tr>
<th>Suggestion</th>
<th>No. of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trees, shrubs, plants: add more species</td>
<td>18</td>
</tr>
<tr>
<td>Trees, shrubs, plants: add flowering species</td>
<td>35</td>
</tr>
<tr>
<td>Trees, shrubs, plants: add more flowerbeds</td>
<td>38</td>
</tr>
<tr>
<td>Trees, shrubs, plants: nicer arrangement, composition, aesthetic environment</td>
<td>25</td>
</tr>
<tr>
<td>Trees, shrubs, plants: better maintenance</td>
<td>24</td>
</tr>
<tr>
<td>Open lawn areas: seeding plants</td>
<td>13</td>
</tr>
<tr>
<td>Open lawn areas: different use of areas</td>
<td>8</td>
</tr>
<tr>
<td>Increase the number of seating areas</td>
<td>52</td>
</tr>
<tr>
<td>Design of the seating areas</td>
<td>23</td>
</tr>
<tr>
<td>Bins</td>
<td>27</td>
</tr>
<tr>
<td>Signs, information tables</td>
<td>24</td>
</tr>
<tr>
<td>Railings</td>
<td>9</td>
</tr>
<tr>
<td>Art, sculptures: modification of existing elements</td>
<td>24</td>
</tr>
<tr>
<td>Art, sculptures: adding new elements</td>
<td>18</td>
</tr>
<tr>
<td>Water elements: decorating of the fountains with flowers (or other decoration without)</td>
<td>26</td>
</tr>
<tr>
<td>Water elements: review the function of the fountains (modification by using water)</td>
<td>47</td>
</tr>
<tr>
<td>Walking route, pavements: adding new pavements</td>
<td>19</td>
</tr>
<tr>
<td>Walking route, pavements: modification of the existing pavements</td>
<td>25</td>
</tr>
<tr>
<td>Facades of the buildings</td>
<td>47</td>
</tr>
<tr>
<td>Barrier-free elements, modification for using a wheelchair etc.</td>
<td>27</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>gym, fitness</td>
<td></td>
</tr>
</tbody>
</table>
Would you like to have small areas set apart for planting herbs, fruits and vegetables?

![Pie chart showing responses to the question.]

Would you welcome simple revitalisation through the use of interior plants in the buildings?

![Pie chart showing responses to the question.]

How do you perceive the natural environment of the area? (peace, anxiety, anger, motivation, activity, courage, nervousness, other...)

Notes and comments

- **peace**: 65
- **enjoyment**: 18
- **harmony**: 2
- **symbiosis between man and nature**: 1
- **motivation**: 6
- **activity**: 4
- **courage**: 2
- **relax**: 5
- **efforts to improve what we have now**: 1
- **comfort**: 4
- **calm**: 2
- **positive emotions**: 3
- **ok**: 1
- **pleasure**: 1
- **dulcification**: 2
- **vacancy**: 5
- **freedom**: 2
- **energy**: 3
- **feelings of beauty**: 2
- **satisfaction**: 1
- **good mood**: 1
- **nice atmosphere**: 1
- **nervousness**: 1
- **anger**: 2
- **rather sadness**: 2
- **sadness**: 1
- **anxiety**: 1
- **fear**: 1

No. of responses
Design proposals

Taking into account the large hospital area, we have firstly divided the revitalisation proposals into units or categories (from the point of view of both landscape architecture and building architecture). After a detailed analysis of the hospital premises, the adjustments of unused buildings, small architecture, paths, roads, building facades, entrances and interiors were proposed in terms of architectural elements in an effort for wheelchair accessibility and a reflection of the questionnaire survey results (see Figure 5).

As already mentioned, a lot of buildings in the area do not have any use and/or function and they are in very bad condition. They could potentially have a bad impact on patients walking along or observing them from a greater distance. They are perceived as a damage of current
landscape scenery, and at the same time, they can result in negative emotions when thinking about the hospital management. The patient may feel that when area management is so poor the patient management may also be very bad. We have proposed a detailed analysis of the unused buildings, the evaluation of their present state and, accordingly, we have created a detailed proposal for the whole hospital area.

The previous architectural and landscaping designs are aimed at improving the healing and therapeutic character of the environment. The complex currently has a great potential for implementing nature therapy. They partially meet almost all the major aspects of healing gardens that only need to be taken to a higher level to provide the desired effect.

The landscape adjustment design focused on the adjustment of atriums and unused areas, completing the environment with natural elements and management measures for exterior areas (see Figure 6).

The main therapeutic elements that should be added to the exterior of the hospital are:

- the possibility of working in the garden in the form of growing plants - horticultural therapy, and the possibility of growing medicinal herbs and edible plants;
- completing the environment in the spirit of a sensory garden, that is, with elements that engage touch, smell, sight, taste, hearing;
- adding harmonic colours in the form of plants, water features, flower beds, plants with interesting textures, nesting boxes;
- singing birds (their introduction to the premises of the hospital in question is currently planned in the foreseeable future), edible plants; the smells of plants are of great importance;
- wheelchair accessibility, universal design; and
- therapeutic exterior elements according to the character of patient treatment requirements, elements supporting movement, motor skills, concentration, thinking, etc.

In relation to the healing gardens, we propose a reconstruction of the building with green houses. Its function should be renewed. In the past, the green house had everything that one could need for herb growing. It could also be utilised during winter time. After renovation, patients can cultivate healthy fruits and vegetables suitable for nutrition there. Fig trees or citrus plants can also be cultivated along with different kinds of herbs having a variety of smells and tastes (for example basil, horsemint, bee balm, basil thyme, chive, or meadow sage). While growing herbs, the patients can improve their management and responsibility skills and also their interest in the natural environment. These activities can also result in better social skills and communication in a team. Additionally, such activity makes patients less stressed during their therapy, and they can feel themselves to be more efficient and successful.

Several unused fountains are in the hospital area. Their renovation is financially very difficult, so the hospital management does not plan to repair them. However, we have proposed to improve their aesthetic function. The hospital has already started the repair of the stone mosaics that are part of the fountains. We have also proposed some reconstructions that include vegetation that can bring “vital material” to the fountains (for example *Bacopa speciosa*, *Campanula betulifolia*, *Fragaria vesca*, *Tulipa gregii* etc.). At the same time, we recommend a reconstruction that will not have a negative effect on future fountain utilisation.
The hospital area is very large and old and requires a number of serious renovations (step by step based on hospital resources). From landscape point of view, the area is very valuable, having the potential for therapeutic landscape design. In principle, one just needs to add several vegetation types as well as elements supporting therapy. The management of the greenery that is already on site is also very important. For renovation purposes we propose to organise volunteer garden activities involving patients and using available financial grants.

In our proposal, we have mostly focused on the hospital atriums. There are three of them: one is not utilised, one is half utilised and one is utilised for therapeutic purposes. As a part of a building, an atrium can serve as a nice enclosed space while also serving as a natural...
vista for hospital rooms and a space for relaxing. The already utilised atrium has a so called “touch path and touch fountain” made from cones and other materials. A lot of greenery can be observed there. The atrium was brought to life and managed with a minimum of financial sources. On the other hand, the non-utilised atrium is a space where patients throw garbage out of windows. The atrium where only ruderal vegetation can be observed is perceived by patients as a “non efficient space suitable only for damaging activities”. That is why hospital management has started their renovation activities right there. That space is suitable for patients unable to walk. Based on the needs of patients we have recommended the renovation of the sport field areas. One such space has already been reconstructed.

Throughout the whole hospital area, we have recommended focusing on green area management and adding some isolated greenery, ornamental flowers, greenery having an impact on human senses (Lavandula, Geranium, Sedum, etc). For outdoor activities – drawing, music, working with wood and others – natural materials can be very positive. The renovation of interior spaces using vegetation elements is also very important. They can eliminate harmful substances from furniture, walls and air. At the same time, they can serve as an aesthetic design element resembling nature. For that purpose, interior vegetation elements are very useful (Chlorophytum comosum, Spathiphyllum, Sansevieria trifasciata, Zamioculcas, Aspidistra elatior, Philodendron scandens, Hedera helix, Ficus elastica, Nephrolepis exaltata, etc…). From the time we began the preparation of our study for the hospital, several renovations have already taken place (both outdoor and indoor).

**CONCLUSION**

The topic of healing and therapeutic landscape design is extensive, but it is built on simple principles. It is important to be aware of the effects of green vegetation and the associated therapies on the mental and physical state of persons. In Slovakia, this issue is currently of interest and has a great potential for further development. In recent decades, there has been no interest in investing in healing gardens and no funds have been expended on this issue. Medical centres are often just centres designed in the old functional style of socialist medicine, regardless of the unpleasant or depressing perception of visiting them from the point of view of a patient.

The proposed design is based on the principles of the creation of healing gardens and on the requirements of the staff who work in the facility. It should be adjusted to the target group of people, i.e., the patients of the facility and their health problems. The proposed design with a therapeutic influence is intended to support the treatment of patients, increase the value of the facility, and create a harmonious environment.

The case study on the premises of the Philippe Pinel Psychiatric Hospital in Pezinok, together with questionnaires, demonstrates the positive effect of green vegetation on people, the need for green vegetation and its re-cultivation. It also points to the advantages and disadvantages of the complex and suggests a solution. The hospital complex in Pezinok is extensive, with potential for nature treatment, and would be a wonderful therapeutic area for patients, visitors and employees if adjusted.

Nowadays, based on the design schemes presented, the individual works are being done in the interior and exterior of the hospital with the help of the patients. The patients are doing such activities as a part of their therapy, which is under the supervision of the healthcare personnel and volunteers. Landscape therapeutic design provides some considerable
financial costs, but according to surveys, the creation of healing gardens in medical facilities reduces healthcare expenses.

The economic aspect of healing gardens should be considered from the beginning of their design. Resources for creating a therapeutic garden should be used reasonably. For example, Sedum creates an area covered by green vegetation and reduces the use of lawns, i.e. lawn care costs (reducing regular mowing, etc.). Using plants with less need for water and houseplants easier to grow in a given environment will facilitate care and reduce expenses. Solar lights and water features that use recycled rainwater can also help financial efficiency and sustainability.

The purpose of the low-budget design of the interior hall was to transform the space through simple changes that require a minimum of expenditures and bring about a positive effect. The design is based on the hospital's requirements and ideas. The proposed design for Philippe Pinel Hospital can be presented as a positive example for other healthcare facilities in Slovakia.

ACKNOWLEDGEMENTS
This research was supported by the Scientific grant Agency of the Ministry of Education, Science and Sport of the Slovak Republic (VEGA 1/0096/16).

REFERENCES


SENSORY SPACES: SENSORY LEARNING – AN EXPERIMENTAL APPROACH TO EDUCATING FUTURE DESIGNERS TO DESIGN AUTISM SCHOOLS
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1704

Joan Love

Keywords
autism schools; sensory environment; design education; interior architecture; student experience

Abstract
Universities and design schools have a responsibility to ensure that the education of future designers enables design for special populations, in this case specifically children with autism. This paper presents a case study of an autism defined experimental teaching-led design project, within a first-year university Interior Architecture course, on which the author is a tutor. It draws on the author’s extensive working knowledge of autism issues, incorporating mediation between SEN schools and design students, and employing research informed teaching. The project involves a new local free school for autism, at a temporary site. The experiment is designed to challenge students, emphasising the importance of understanding how primary research, accessed directly from the end users, informs progressive design thinking. It attempts to influence their design work in subsequent years at university and in practice, and facilitate bridging the gap between academic research and real-life application. This paper seeks to identify how an autism defined project, focussed on student-centred learning and encompassing choosing sessions with children with ASD, can be taught in the first year of undergraduate study. Further, it aims to analyse how the teaching styles and content of a partially ‘live’ community design project impact on the participants. This is achieved by describing the details and challenges of the project together with the interactions between the students and the school. It concludes that the project adds value to the student experience, builds student confidence and eliminates pre-conceived ideas surrounding autism. It shows that design can be an interactive process between university and special schools. Equally, the pitfalls of a live project of this nature are highlighted, as is the need for modification before similar projects are reproducible as viable educational models.

Joan Love
School of Art, Architecture + Design, Leeds Beckett University, Leeds LS2 9EN, United Kingdom.

Corresponding author’s email address: j.love@leedsbeckett.ac.uk
INTRODUCTION

The government has published design guidelines encompassing the environment within schools (A&BB, 1992, 1999, 2001, 2008, 2015) for those with autism (also known as Autistic Spectrum Disorder or ASD). However, particularly in respect of earlier versions, these have been challenged as inadequate, and alternative approaches have been proposed or endorsed by the NAS (National Autistic Society) and by architects Vogel (2008), Scott (2009: 36-51), McAllister & Maguire (2012:103–112), Mostafa (2008: 189-211, 2014: 143-158). The latest version (A&BB, 2015) recognises the needs for alternative spaces for autism to some extent, but is still limited in its advice for designing autism environments, concentrating on provision for general special needs and net areas of buildings. This paper does not seek to augment these developing approaches. Rather, it explores and champions an experimental teaching-led design project which discourages any preconceived ideas on autism and transfers knowledge to design students who have an important role in the future of designing for people with autism.

The first year of study provides educators with the primary opportunity to mould and stimulate creativity (Saxton, 1981) and for early intervention in design thinking (Temple, 2010) as part of the design process. Inspirational teaching from day one is essential to hold interest and set a pace, allowing core skills and the design process to feed subsequent years. In the project described, first year university design students learn about pedagogy informing the design of space which, in turn, enriches shifting sensory environments through their proposals. This project responds to the call for a ‘trans-critical’ pedagogy in design education, applying knowledge found through real social issues (Salama, 2015). Centrally recognised is that ‘reliable and unbiased knowledge about client requirements, along with user needs and behaviour, are also important in improving design quality and performance. A structured process (i.e. a research process) is most effective in gaining this knowledge’ (Collins, 2014:3). The need for integrated evidence-based live projects is discussed by many (Kolb, 1984; Harriss & Widder, 2014) but more complex problems within our marginalised contemporary societies (Salama, 2015) demand further investigation.

The primary goal is to enable the students to explore different types of design thinking by investigating all options and reconsidering possibilities regarding the way schools for autism are designed. This exposes them to a deeper understanding of a design brief as well as forming a real connection and sensitivity towards inclusive design (Scott et al, 2018:9-22) and the end users. The research places a greater emphasis on the individual (Williams, 1996) in our growing autism society (NAS, 2018), with the aim of helping these children to access learning more effectively, having their voices heard and eventually improving integration with the world around them (WRD, 2011). The requirement for community engagement to establish a two-way collaboration (Sara & Jones, 2018; Bernardi & Kowaltowski, 2010) is paramount if we want to understand the true needs of users. This subsequently communicates to students the importance of re-evaluating any preconceived design histories, enabling students to unlock first-hand information.

This paper describes a case study of an experimental teaching-led design project, evaluating its methodology and the challenges it presents. A future paper will review how those challenges were addressed in four subsequent projects based on the design of an autism school together with the design outcomes of all five projects.
Orchestration

The paper is split into four key sections:

**Part One:** Scope of project.

**Part Two:** Direct participation, working alongside children with autism undertaking “choosing” sessions.

**Part Three:** Presentation of the design outcomes to the children and SEN (Special Educational Needs) teachers. A critique of this educational model through feedback.

**Part Four:** Teaching reflections, recommendations and conclusion.

**PART ONE: SCOPE OF PROJECT**

The vehicle and evidence for this research is a studio-based project to design a small school for autism, for children aged 11-19, attempting to integrate adaptable sensory spaces. The part ‘live’, part ‘hypothetical’ project nurtures creative thinking and targeted research, under the close supervision of an art-school trained design tutor, who has a working knowledge of autism, and a tutor who has experience of school design within architecture.

Designing spaces appropriately for people with autism has many challenges. This paper takes the teaching stance that students of art and design are recommended to adopt a flexibility of thinking in their design proposals and consider them as fluid, ‘work in progress’ rather than as a fixed definition or destination. This reflects the early stages of professional design practice and the ever-changing knowledge base (NAS, 2018) of this highly complex, forever diverse condition.

The main springboard for the student design projects has been ASD children, the knowledge of people with autism, primarily Grandin (2008), Lawson (1998), Blackburn (2004), and the valuable knowledge of SEN teachers. The focus is on sensory processing issues (Bogdashina, 2003), (Biel and Peske, 2005), and how designers can be responsive to these disorders through exploring and interpreting the design of spaces. This encompasses the balance of knowledge-based concepts with an open-ended creative approach to process, expressed primarily through drawings and three-dimensional model making.

**Teaching methodology: a design project as a case study**

The part live project sidesteps the ‘traditional approach to studio teaching’ (Salama, 2015:75). It demands a focussed, deep level of critical thinking, research and understanding of a complex social issue, exposure to users, prioritising real human needs, ‘learning through discovery’ (MacDermott et al, 2012:77), and merging knowledge with application, to avoid possible contradiction between theory and practice. The students see first-hand that the design process shifts and changes owing to external factors, some of which are controllable, some not.

Various constraints determined how the project could be implemented. It was to be a teaching led research project with a real focus, and with design students visiting autism schools, without causing sensory overload or disturbance to the children. To be manageable, only a small group of students could be assigned to this particular brief, but equally it had to fit in with the staffing, number of tutorials, module outcomes and supporting lecture series in the existing course. To achieve this, an overarching brief used the same building and the
same time span, but was divided into 8 main briefs, 4-6 students per group, one of these groups being carefully selected students to undertake the design for autism brief.

**Selection of students to undertake the project**

Four design students from 40 were selected for the autism project, to be run in Semester 2 of first year, their suitability having been assessed in Semester 1, when fundamental design skills were being established. Their strengths, weaknesses, and ‘fit’ could be ascertained from the presentation of the students’ second design project which used an existing building. The autism project requires a high level of commitment, a strong work ethic and a desire to be challenged. Its success is founded on students not falling at the first fence, but there is limited time to evaluate their track record. Two of the four students proved to be very strong and this was enough to enable the project to flourish.

**Effective ways of knowledge transfer to the students:**

1. **Briefing.** From day one, it is critical to undertake a full and detailed briefing to kick start the design process including an introduction to autism. Although given autonomy, students were encouraged to focus on the areas of hypo and hyper sensitivity, i.e. acoustics, light, touch, proprioception, vestibular, and transitioning between spaces. This fast track approach is required to accelerate student understanding in a complex project requiring major tutorial support and no time to waste.

2. **Using film to engage.** Temple Grandin’s film ‘Thinking in Pictures’ was issued in advance of the briefing to assist in giving the students a grounding prior to the start of the project. Understanding how a narrative relates to travelling through interior space is a vital part of the course, and this film is an ideal example of how environments affect how people feel and can help to inspire a design approach.

3. **Accessing research.** Varied research recommendations were issued, to respond to different learning styles; for instance, in addition to books authored by people with autism such as Grandin (2008) and sensory expert Bogdashina (2003), online resources were suggested, which can be more accessible to visual learners. These include Lawson’s website (2018) and Bogdashina’s online PowerPoint (2014), both of which provide clearly defined information. A key breakthrough was introducing the YouTube clip with Amanda Baggs’ ‘In my own words’ (2007), communicating an understanding that non-verbal does not necessarily mean at the low-functioning end of the spectrum. The clip also illustrates that the most informed research is from those with autism, and how, as designers, students need to try to understand the world from their viewpoint.

4. **Peer to peer learning.** This is critical, as the subject area of autism is too large to cover in a short time. Students focus within specialisms and bring acquired knowledge to tutorials for discussion and feedforward, followed by fortnightly studio group pin ups for formative feedback. Sharing the information with the group also enhances an appreciation of diversity in the ASD children.

5. **Online working group.** This enables sharing of ideas, design precedent images, references, trouble shooting, and general communication. Subject specific reading
and research material is targeted at individual design students, and 24/7 access assisted with the time limitations.

The site

The chosen (hypothetical) project building is sited adjacent to Leeds Bridge, where, in 1888, Louis Le Prince is believed to have filmed the first moving image using his single-lens camera. The overarching brief was inspired by film and, to link site with brief, each design student was given a film to research, each of a different genre. The only difference with the autism group’s project was that they were given the focus for their brief. This autism brief had already been extensively researched by their tutor; if the students were going to tackle a more complex design project than the other students in the year, then they required extra help in return.

A design research report

Students were required to produce a detailed illustrated Design Report covering: individual brief, site and building analysis, film research, re-evaluating the design of spaces for autistic individuals, case study, precedent studies, conclusion, and proposing a way forward. They were asked to look at The Government Building Bulletin for Designing for disabled children and children with special educational needs (A&BB, 2008), but to question this throughout. A key driver is the desire to question the “one size fits all” approach (Williams, 1996) within the design for autism in schools.

Specific design requirements

The individually negotiated student briefs evolved and developed as the research emerged. Nonetheless, all spaces within the project were to include:

1 Clarity of purpose (no mixed functions, so as to avoid any confusion of use). In a conference discussion with Ros Blackburn, an adult with autism who is an international speaker, Blackburn noted that the key improvement to be made in the design of interior spaces is increased clarity of purpose (Personal conversation, 13 July 2012). For Blackburn, entering a space with both a bed and a computer could prove perplexing; should she go to sleep or work? To her, ‘the outside world is a confusing mass of sights and sounds. It is totally baffling and incomprehensible’ (Blackburn cited by Bogdashina, 2014). Likewise, Blackburn argues that spaces should clearly communicate the direction people with autism should be walking, in order to prevent collision with walls, using the example of a hospital designed for wheelchair users, with straight corridors and red lines on the floor.

2 A low arousal environment. Blackburn also picked up on visuals in the conference lecture theatre, which appeared insignificant to the neurotypical observer: how light created rainbows on chairs, a pink jumper on the back of a chair, and the specific arrangement of three coffee cups. Therefore, environments which may appear at first sight low arousal, and therefore non-distracting in an educational setting, can actually be distracting to people with autism. Similar views on environments have been corroborated by many in the field of autism (Mostafa, 2008).
Community engagement and collaborative learning: the school

The local school, which became part of this project, was in temporary accommodation, sharing some spaces with a local college, in a far from ideal situation. It is a Free SEN School, initially started with just 5 children, but with a plan in place to increase in size to 50 pupils, over 5 years, and to move to purpose-converted accommodation within 2 years. Their initial small class size worked out well with the project, as 1:1 sessions with each child were easily facilitated.

The project required a sensitive approach, working with children ranging from non-verbal and severely affected, to verbal and high functioning. The head teacher assisted with Project Ethics and an internal code for the names of the students was implemented to avoid any breaches in confidentiality. All of the “choosing” sessions were approved in advance by SEN staff for appropriate content. Use of the term ‘autism’ was avoided in the presence of the children, as the Head advised many of them do not know that they have this condition and they could find the term confusing. The teachers provided a short profile on each of the children and their sensory needs, to help in understanding them individually, and to help pre-empt any behavioural triggers.

The design students met with the Chair of Governors for a briefing on the plans to move to their new building, giving an insight into the context and complexity of a design project, and a connection to the real world. The Chair had just returned from a visit to Forest Way, Leicester, a new build, mixed special needs school with 30% ASD children. On her recommendation, the students visited this building later in the project, to understand the preferred approach for the new school.

PART TWO: INFORMATION GATHERING - A SERIES OF INTERACTIVE SESSIONS BETWEEN THE SCHOOL CHILDREN AND THE DESIGN STUDENTS

Ice-breaker

This involved all of the children, staff and design students, held in the main classroom. It commenced with the students showing a stop frame animation which they had produced in response to the Temple Grandin film, primarily describing crossing over thresholds and journeys between a series of spaces. The students then showed pictures of their pets, which opened up communication between the whole group in a more successful and personal way than purely speaking about the animation.

The children then served tea and cake in their temporary dining room, as part of developing social skills but also an ideal opportunity for the students to be introduced to the children and to help gain their trust. A natural pairing occurred; certain students engaged more readily with certain children and vice versa.

Linking learning

In the interim, the main class teacher started to link the sessions with some of her school sessions, as part of discussing the move with the children to a new school. She provided us with the following information, which went on to inform the first “choosing” session:

Classroom design requirements suggested by the class of children and gathered by the class teacher: ‘Chairs – red, fabric, soft, Reclining chairs, Small round windows, Thick
carpet – blue, Not like a classroom, Small, coffee type table, TV/music centre, Brick - grey walls (they had breezeblock for walls in their temporary classroom), Spot lights – dimmer switch, Fish tank, No camera zone, Nothing on the walls, Projector to do pictures.’ (Personal note from teacher). The most interesting comment was ‘Not like a classroom’.

Design requirements for a classroom by one of the children who was not available for the above session, but compiled this brief himself:

‘I would like a big classroom because I feel claustrophobic. I don’t want a small classroom with lots of people in it. It makes me feel frustrated and angry and I feel like I want to run out the room to get away. I would like a big play area to play basketball. It would be nice to have a quiet area in the playground with a few benches to sit on to talk and relax. I would like a separate room for play and activities like playing Lego or reading a book. It would need to be a quiet room with bean bags or comfy seats with soft material like cotton or fake leather. The classrooms could be painted green and blue because they are my favourite colours.’ (Personal note from child).

Based on an understanding that a high proportion of ASD children are visual learners and learn more effectively through direct participation (Scott, 2011), a series of hands-on “choosing” sessions with the design students were arranged. These centred on choice, by the children, of one two-dimensional image in favour over a second. To help source images, the students were introduced to the following information: children’s likes and dislikes; issues within their current building; selected writings by people with autism; and the film Temple Grandin’s ‘Thinking in Pictures’. The tutors and design students then debated the strengths and weaknesses of the images. It became evident that the staff needed control of the final choice of images as the students were finding it difficult to undertake both this and their design reports.

Child to design student learning, and vice versa, via a choosing session in the classroom

The students were each paired with a child, working on visual choices, led by teachers and teaching assistants, primarily using the Applied Behaviour Analysis (ABA) reward-based teaching method. This was useful for the students, as they could learn how the two temporary classrooms functioned on a 1:1 basis; workstations were utilised for choosing and a quiet corner for individual reward activities, such as listening to favourite music on headphones. The session highlighted many of the problems within non-purpose-built classrooms, which the students analysed in their extended design report, in an attempt to identify key design issues.

Two-dimensional image choice

For each child, a pack was prepared of an extensive series of A4 colour, photographic images describing internal spaces, with obvious, differing qualities. The groups were split into two, one of higher ability than the other. One group coped with longer sessions and less frequent breaks, the other shorter sessions with more frequent breaks. The images were presented as a contrasting pair, always with the choice between two images, and then the child decided which of the two images they preferred. The students asked ‘Do you like this, OR this?’ The children with speech sometimes gave a reason for a particular selection. Key spatial options included:

- Looking out of a space into a landscape or looking into a space: designed by Carlo Scarpa;
• A dark corridor with a light at the end and vice versa: spaces designed by James Turrell and John Pawson;
• A straight corridor with or without a door at the end: spaces designed by Claudio Silvestrin;
• Soft spaces, designed by Ernesto Neto or hard spaces, designed by Richard Serra;
• Simple off-white grounded spaces, designed by Hiroshi Sugimoto or complex suspended spaces, designed by Cristine Iglesias;
• Contained curved or contained linear spaces: Dan Graham’s sculptural optical installations;
• Warmly lit interior or cool lit interior: designed by Maria Nordman;
• Spaces constructed from textured timber or those constructed from hard stone materials: designed by Peter Zumthor.

The children who could concentrate for longer periods were shown further image choices, which grew in detail depending on their earlier selected preferences. This process means that the design students have to think on their feet, to reflect design in action (Schon, 1987), pulling out more paired images depending on each child’s feedback.

The process encourages two-way learning as the design students are introduced to exemplar precedent, by architects and designers, potentially inspiring their design work. The sessions also helped the students to make the connection that ‘any object or built environment embodies human choices and preferences’ (Salama, 2015:268).

Outcomes: In hindsight, the simple shapes and forms which were presented as choices - large circles and angular lines - were actually too simple and came across as abstract, rather than purposeful, confusing the children. Better were photographs of spaces which were deliberately uncluttered, so as to be clear in their intentions, with images of real spaces being more easily interpreted by the children. There was no significant preference for any particular space across the group, although the exercise did encourage conversations about likes and dislikes. One boy started to draw plan layouts of very ordered linear, desks, chairs and circulation routes set up within a grid (Figure 1).

Another child was particularly interested in stairs and balconies and would draw pictures which included many stairs and viewing points from above. When asked why he liked stairs so much, he responded that he enjoyed looking at them and the motion of walking up and down, information utilised in the student’s project.
Two-dimensional colour choice

This was a choice between a series of contrasting plain, flat, bright and soft versions of the same colour, and neutral light and dark versions of a colour, printed onto A4 paper. 10 combinations in total.

Outcomes: There was no discernible pattern of selection of colour; the children liked different colours and each child made different choices. Some children gave reasoning for their choice, particularly if they could relate it to something they knew. In one instance, red was interpreted as fire and burning, so this was not selected. Blue spaces were interpreted as water by two children, yellow as sand by one child, so these options were selected. Green space was associated with a jungle, while another connected it to the grass outside, again the selection being made.

Three-dimensional texture choice

For one child, with complex needs, use was made of a sensory box incorporating a series of interior material samples, instead of 2D images. The session was as interactive as possible; the teacher sat opposite the child and gained eye contact while presenting the choices verbally, lifting up the samples so that the child could touch and experience the texture.

Outcomes: In this box of textures was a grey composite tile which the child touched regularly. This was a new texture to her, so generating a particularly interesting sensation. There was not enough textural difference between the two smooth timbers presented, one dark and one light, to make a choice. Two materials were touched extensively: textured ribbed paper (orange) and heavily textured light stone. The teacher commented that this was a very successful session with the child concentrating for good periods of time. Utilising alternative methods of extracting information is a key design skill, as recognised by the ‘tactile maps’ produced for the participation of the visually impaired (Bernardi & Kowaltowski, 2010).

When presenting the A4 plain coloured sheets, it was much harder to ascertain a definite choice as the child was looking to the left each time and was not as engaged with the feeling of the flat smooth paper.

Spatial choosing session in the dark room/photography space

This room was selected on a pre-visit to the school as an ideal ‘control’ location to insert a series of spaces; acoustically and visually quiet, in an undisturbed location, it also had many variations of artificial lighting. A series of 4 environments were installed as options, which came in the form of pop up tents of varying size and shape (Figure 2). Additional options included a weighted blanket, a Pilates ball to sit and possibly rock on, and a static bean bag. Again, choices were always between two items, and the options offered were varied depending on the ability of the child. Once the optimum learning environment was established, a learning activity was undertaken, set on a light box (choice of ‘on’ or ‘off’) with options of coloured Irlen overlays (Figure 3), which can minimize or eliminate glare (Lawson, 1998). A light box was selected, as glowing with upward light has been identified as beneficial for some people with autism (Bogdashina, 2013).
Figure 2. (Top) Four low tech, alternative pop up environments with options for how to sit, set within a photographic studio. (Source: Author).

Figure 3. (Bottom) Light table options with Irlen overlay choices (Lawson, 1998): image choices, text choices and hand drawing choices. (Source: Author).

**Ambient lighting to room choices:**

These options were presented to each child: Full fluorescent ceiling lights on or off; Half fluorescent ceiling lights on or off and/or Up light full on; Up light half on, Up light low on? The general lighting options varied per child, with a variety of combinations, including totally off for both ceiling and Up light in one instance. The chosen light intensity was then used throughout the exercise.

**Space/Positioning Choices:**

These options were presented to each child:

1. (White Cube Tent): to sit in the open space outside the cube, or inside the cube and to sit on cushions, the floor or a bean bag:
   - 4 out of 5 children preferred to be inside the white cube tent.
   - 3 of the children preferred to be on the beanbag, rather than on the cushions or the floor.
   - 3 of the children preferred to recline rather than sit.
2. To be in the Cube with seating of choice or in the White Suspended canopy/enclosed in sheer fabric with seating of choice:
   • 3 of the children did not want to sit under the sheet canopy. The others did not take part in this option. One child commented that it reminded him of a wedding dress and the other of a hammock at his grands.

3. Coloured tepee (child sat on the floor - with cushion) or Dinosaur tent (child lying on the floor - with cushions):
   • Of the 3 children who took part, all 3 liked the dinosaur tent over the tepee, which was rather small.

Overall preferences: 1 liked sitting in the white cube and 2 liked to lie down in the dinosaur tent.

**Touch/pressure/hug:**

Choices: In the favourite setting, with or without the weighted blanket providing gentle, deep pressure, possibly useful for sensory-integration. Analogous to Grandin’s hug machine, this illustrated to the students an alternative way of addressing sensory pressure.
   • out of 5 children, 3 preferred the weighted blanket over their knees. 1 preferred to lie on it.

**Proprioception and Vestibular: Balance/Movement:**

Choices: Pilates ball: kneeling on the floor and leaning over the ball OR sitting and gently rocking on top of the ball. The ball was selected as some autistic people think better when they are moving (Grandin, 2008).

2 of the 3 children liked to sit on the ball and move slightly. The 3rd found that it had too much movement and from then on stopped the exercise, he was at his limit. He had a strong reaction to feeling unbalanced and unstable. The Pilates ball was too unstable, and something which only offers slight movement might be a preferred option.

**Light box on or off?**

There was a preference (4 out of 5) for the light table to be switched on whilst looking at the images. A choice out of up to 10 Irlen overlays were presented, two at a time in contrasting coloured pairs. Once the most favoured of the 10 overlays was selected, the overlay was placed over a picture of the same interior space selected in the previous exercise (a Corridor with or without view, depending on preference). A text-based choice, with different coloured overlays, was also presented, aimed at selecting the clearer image. Additionally, an opportunity to freehand draw was given, followed by looking at the drawing with the Irlen overlay demonstrating how it readily changes the whole colour palette of their work.

**Outcomes:** There was one clear outcome: all the children made different choices, each with their own individual views and sensory needs.

It was evident that the children did like to be given a choice of tent, to sit or lie in, and many liked the option of a weighted blanket to sit on or under. They appreciated to be able to choose lighting from up lighting, to a general over light, to light from a light box, with light from below. They responded well to selecting their own immediate environments and
focused on task when the fit was correct. One child loved to draw, so this session went on for a longer period of time, as he communicated fluently through his drawings. Another child was so relaxed that he expressed a desire to have a nap. This highlighted the need for learning spaces to be adaptable and responsive to the individual.

This collaborative research study, although limited in nature and not meant to be of scientific importance, provided useful knowledge to inform the student design projects. However, the research needed to be backed up with a visit to a fully functioning SEN school, so that the students could gain an overall picture of how a whole school operates.

In the design brief, the students were asked to consider integrating sensory spaces within their whole project building, to support learning activities, and not just within ‘calm rooms’, so that a more holistic environment is explored to maximise learning and reduce the opportunity for sensory overload in every space.

PART THREE: AN OPPORTUNITY FOR THE STUDENTS TO PRESENT THEIR INDIVIDUAL DESIGN PROJECTS

Preparation

As part of the design process, the children came to hear the students present their work in the University studio. In advance, to assist the children cope with the visit, a series of photographs were provided of the journey from their school, to the exterior of the building, and then the interior route to the studio (a working studio, a section of which was screened-off to provide a non-distracting area with any potentially hazardous materials removed). A detailed risk assessment included options available for the students (e.g. lift or stair), and an adjacent room was cleared as a calm breakout environment.

Delivery

In an informal manner, the four design students presented their design ideas one at a time, placing the work in the centre of the table, with the children and teachers sitting around the table for an interactive approach. 1:50 scale figures were added to the models to help show the children how the spaces could work with the human form, which the children found engaging (Figure 4).

![Figure 4. A visual and tactile experience: Photographs of the students presenting their work to the children, at the University, incorporating their ideas for an ASD school through drawings and 3D models. (Source: Author).](image-url)
The students made a few key points and showed the children their drawings of the spaces, models of their ideas and of the building. The children touched the models and passed them around and many asked questions; this worked well and encouraged sharing and turn taking.

The presentations were deliberately short, visual, highly structured, and with reduced language, to reflect their school lessons. The students went onto present their work again to the tutors as a full and complete design project for assessment utilising multi-sensory learning styles (Flemming, 1987).

The children who were able to cope with further environmental stimulus were shown around the working interior studio to broaden their knowledge of university life and to raise their aspirations.

A critique of this educational model

Feedback from expert autism teachers and the external examiner

The senior autism teacher at the School was supportive of the collaborative project, saying that students had helped improve the social experiences for their children, while the children provided clues on how they would like their sensory spaces to be designed in their new school. The teacher thought that the process generated ideas and approaches which they could choose to take forward in their new school and it also gave them an opportunity to explain to their children some of the changes involved with moving into a new building. It would have been of further value to have presented the design ideas to the teachers on a separate occasion, for more targeted design feedback.

The project also received support from the external examiner, who stated ‘Design projects across all 3 years are stretching, innovative, and often deliver startlingly interesting results. The live projects and partnerships with Specialist Schools, is to be commended.’

Student feedback

Speaking about the project, a first-year design student said: ‘It was a great and exciting experience and I learnt so much about the thinking process which then goes through to design for specific individuals. This is a lesson I would have probably never have learnt otherwise.’ The student group believed that one of the most helpful stages was their first case study visit, as it made sense of the needs of the children. In particular, they stipulated that they would definitely benefit from their tutor being present at the case study visit, so that the tutor could ask all the right questions of the autism teachers, which would allow for a deeper connection to the project.

PART FOUR: TEACHING REFLECTIONS AND RECOMMENDATIONS

Realistic goals and clear instructions

Various challenges were presented by the project such as communicating with a temporary school whose headmaster left half way through the project, working with children whose autism spanned a wide spectrum, and gauging how much to expect from the first-year
university design students on a research led project. A balance was required between feeding information on autism to the students to accelerate the design process and leaving space for students to develop alternative approaches for themselves, so their ability to create their own design ideas in response to this information could be tested and assessed.

A key realisation between tutors and design students was that, as a first attempt at this project, there was an element of “breaking in” which comes with its own challenges and rewards. The importance of simplifying individual briefs became apparent, rather than tackling the design of a whole school, as did the need to take control of the planning of content and direction of the choosing sessions. Being in their first year, the students required careful management with clear guidelines. Encouraging them to latch onto one strong research idea, inspired initially by the work with children, and then follow it through by creating one or two strong spatial design responses, became the most effective teaching approach.

**Time and organisational management**

The small group tutorials were held at the end of a studio day, allowing extendable time not only to advise on the individual projects, but also to set up subsequent choosing sessions. The project ran for 12 weeks, including 5 weeks of research and 7 weeks of hands-on design. Small group tutorials of 4 students, twice a week for around 1.5 to 2 hour sessions, were required to make sense of the moving target, and to give clear responsive direction. Regular deadlines were essential, incorporating flexible minor deadlines to respond to the reality of a live situation.

Owing to tight schedules and availability of teaching staff within the school, a limited number of face-to-face sessions had to be fitted in at short notice. This included: one introductory meet, to assess if the project was viable; a fact-finding meeting for all; a getting to know the children session, broken into two parts; one choosing session, broken into three small parts; and one presentation and feedback session.

**Makers**

It would be beneficial if a ‘Professional Maker’ is available in the research team, to collaborate and help construct 1:1 aspects of the student’s design ideas for testing. However, to encompass this, the project would probably need to be run over a longer timeframe. One option would be if the Interior Architecture students could team up with some Furniture or Product Design students.

**CONCLUSION**

Running a student led design project in a live and professional project setting, collaborating directly with a local school, is an effective way of priming students for real world design and maximising the student experience. Not only does it inform the students about autism and the users, but also helps instil a sense of social responsibility.

A collateral benefit is to the autistic children involved - they are shown university life, which in some instances could raise future aspirations, they have opportunities to develop life and communication skills (turn taking, giving opinions, choosing, coping with different
environments) and, in this case, the process assisted the impact of the transition of moving to a new school.

The conclusion reached, though, was that this approach was not sustainable and an alternative way of running the project had to be found in future. Issues included:

1. The disproportionate amount of time attempting to organise when the two groups meet, partially owing to the inflexible university module structure: 3 in Semester 1, and 3 in Semester 2, in parallel to the school’s fixed daily timetable.

2. Co-ordinating University assessment deadlines with the availability of the school children and staff for feedback. For transparency, some universities require module deadlines to be published at the start of Semester 1.

3. Communication between university tutor and school teacher can be difficult as the teachers are understandably uncontactable during classroom hours and have very full long days supporting school work.

4. The demands of managing a part ‘live’ project which is a moving target, is all consuming, if it is to be undertaken effectively, particularly with the larger proportion of the year also to teach in parallel.

5. There is no real time to stand back and reflect on a short project, as tutors need to be reactive to the situation. Running the project for a second year would help to address some issues, but this can be problematic; in this case, the school moved to a second temporary location and was under different leadership.

6. All sessions with the school must be deliverable on a realistic basis with no additional budget for staffing or materials, unless these are attainable.

7. Working alongside children with special educational needs is an emotionally demanding undertaking, but it is also highly rewarding. There is a strong desire to provide the children with the best experience possible, to show that designers care.

8. It has been evidenced that having a tutor on the project who has a working knowledge of autism is of real value. This enables the effective transfer of up-to-date, specific knowledge to students as and when relevant information is accessed, such as at conferences and speaking to experts and contacts at autism schools in the local community. A working knowledge in autism also helps to reassure SEN teachers that the project is going to be run with understanding and sensitivity to their children.

9. The adoption of ‘concrete material experiences’ (Temple, 2010), in this case through autism research, and ‘abstract learning’ through concept development, has been successful in engaging the students with a complex brief, more complex than their immediate contemporaries on the course.

The process adds value to the student experience, builds confidence by meeting professionals and clients and eliminates pre-conceived ideas surrounding autism. It shows that design can be an interactive process between university and special schools. However, this paper highlights the pitfalls of a live project of this nature, to be of use for current educators. Essentially, the project needs to be contained and more accessible, to reproduce
as an educational model. This is to be explored in a future paper, by reference to case studies of subsequent autism specific projects.

‘Industry needs creative workers that can collaborate, communicate and integrate activities and projects.’ (Furniss, 2015:5). ‘An awareness and understanding of perceived and real environmental effects is critical for students both as users and as future designers and architects.’ (Salama, 2015:270). The university module structure can be constraining for ‘live’ projects, and in order to overcome this, educators need to be innovative with our delivery.

The Spatial Civic Agency model addresses the issue of live projects being criticised ‘as working for rather than working with community groups’ (Sara & Jones, 2018:330). A target resolution advanced by this model involves a cross-community approach and consensus. However, when autism is involved, a different perspective and language are required; it is about the autism community as a whole, but more importantly, it is about the individual with ASD. It is almost impossible to find a shared language, as suggested in non-autism specific populations, and maybe this is one reason why limited progress, in the form of design for autism, has presented itself. As learnt in the experiences of a special needs role play model (Bernardi & Kowaltowski, 2010), such a model is no substitute for live research. The taught transferable skill is that each and every community has to be researched in detail to understand their individual identities and actual needs.

To share and collectively create knowledge, as opposed to the knowledge purely being disseminated (Sara & Jones, 2018), is fundamental to teaching if our students are to be prepared and credible for a successful future in design practice.

ACKNOWLEDGEMENTS

Thank you to Amanda Wanner, senior lecturer and colleague, who supported me with this first autism driven project with the students, and David Littlefield, external examiner, for his encouragement. The research would not have been possible without the agreement of the former head master, Tim Gleave, of The Lighthouse school, Yorkshire’s first special free school, and in particular a key SEN teacher, Tracy Obrien, and of course the children and staff of the school.

REFERENCES


NAS (3), Autism Profiles and Diagnostic Criteria. NAS Website. from https://www.autism.org.uk/about/diagnosis/criteria-changes.aspx


DESIGN FRAMEWORK FOR URBAN MOSQUE IN THE CITY OF KUALA LUMPUR: A QUALITATIVE APPROACH
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1586

Nayeem Asif, Nangkula Utaberta, Arman Sarram, Sumarni Ismail

Keywords
urban mosque; compact cities; Kuala Lumpur; design framework

Abstract
Thousands of years after the establishment of mosque as a place of worship, issues and problems regarding its continuous development, especially those stemming from complexity of modern living have created the need for urban planners and architects to reconsider its planning and design in regard with limited land availability, shortage of resources, accessibility and appropriate architectural expression. Thus the aim of this research is to find a proper definition for urban mosques in compact cities and point out the key considerations for the design of urban mosques. This research is conducted qualitatively through reporting on available design guidelines related to the current topic followed by a discussion on three mosques within the Malay Archipelago as the secondary data source. Consequently, three mosques within Kuala Lumpur, Malaysia were studied as a primary data source. The outcome of this research establishes a framework for possible design approach of urban mosque development as a basis for future mosques design in compact cities. The result can be utilized as a source of information for reference purpose as well as a possible guide on the effectiveness of urban mosque concepts, possible challenges in a compact city setting, vertical expansion, and sustainable development.
INTRODUCTION

The Mosque is a significant symbol to Muslims; it is interpreted to recreate divine presence on earth yet it is not built according to any divine pattern. The Qur'an in its divinity does not provide explicit rules as to what a mosque should look like, but major Islamic theological discourse outlines the vital elements of a mosque. Muslims in the past and even today have made use of local artisans and architects to create beautiful, magnificent mosques (Baharudin & Ismail, 2014).

There has been ample documentation on the historical evolution of mosque design throughout the history of Islam. The contextual differences regarding regional location, technological availability, cultural influence as well as political perspectives put a significant impact on the design of mosque (Hillenbrand, 2004; Ismail, 2008; Khan, 1990; M Rasdi & Utaberta, 2010; Elkhateeb et al., 2018; Tarabieh et al., 2018). However, compared to the references available on design documentation for early mosques until the 20th century, a guideline on mosque design for contemporary times are limited regarding available texts and research. Prominent works among this sector are design criteria for mosques and Islamic centers by Kahera (2017); design of mosque as community development center by Rasdi (1998); mosque architecture and formulation of design criteria by Imam (2000); design standard for mosque in various facilities by Mokhtar (2009); as well as some small handbooks for mosque design standards focusing on specific contexts (Department of Town and Country Planning, 2011; Imam, 2000; A. Kahera, Abdulmalik, & Anz, 2017; Mokhtar, 2009; Rasdi, 1998).

The rapid changes in contemporary societies call for fundamentally new spatial arrangements in every sphere of urban life. The growth of the modern cities as defined by the needs of the industrial period in their establishment period requires to be reformed in innovative ways resonating with the current way of life in urban areas (Seifert, 2009).

Malaysia as a Muslim majority nation has a diverse cultural and architectural style of mosque all over the country. The structure plan for Kuala Lumpur 2020 illustrates the future requirements for building new facilities among which there are 309 mosques and surau (DBKL, 2015). While the land constraints remain for the city of Kuala Lumpur, the need of the growing population cannot be overlooked. Current practice for planning and designing mosque in the compact urban settings, in particular within Kuala Lumpur, shows a tendency for horizontal progression of layout despite the issue of land insufficiency (Ahmad et al., 2015). Hence, for the context of designing an urban mosque, consideration should be given to the nature of the structure, the relationship between communities in compact cities and the institution of a mosque to ensure a structure that can accommodate the needs of the population. This study, therefore, attempts to evaluate modern urban mosque architecture in compact city setting to assess on the sensibility of its designs as well as address critical issues relative to its purpose and improvements for further optimal use.

LITERATURE REVIEW

Emerging challenges in designing urban mosque in compact cities

By modern times, the definition of a compact city is aimed at a sustainable society based on three principles- urban forms, spatial characteristics, and social functions. According to a more recent report of Organization for Economic Co-operation and Development on compact
city assessment, a compact city is defined based on three distinct characteristics which are: (1) dense and proximate development patterns; (2) urban areas linked by public transport systems; and (3) accessibility to local services and jobs (Compact City Policies, 2012).

The emergence of mosques in dense urban settings and the appropriate design approach for these mosques is a relatively new discussion. Ismail Kahera pointed out that mosque can be found in compact settings during the early days of American cities on the east coast (A. I. Kahera, 2010). The term compact in his statement was referring to the densely populated neighborhood with houses arranged horizontally. Meanwhile, today's compact cities are equipped with high-rise residential blocks with population density much higher than that of the traditional neighborhoods. Moreover, the vertical development also brings change in road network, accessibility, and land use pattern. All of these makes the scenario for today's urban mosque unique in manner. Current guidelines for planning and designing mosque lack adequate information on vertical development for mosque. Vertical development is not just merely stacking the functions on above another linked by stairways; instead, this is a sophisticated process which requires a carefully formulated framework (Abel, 2003).

A framework is a basic order underlying a system, concept, or text (Merriam-Webster, 2004) and in the context of this research, a design framework for urban mosque refers to the outline, or skeleton, of predefined factors affecting the design and serves as a guide for designing mosque in compact urban settings.

Table 1: Prominent literature on mosque design with indications of research gap concerning the current study (Source: Authors).

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Title</th>
<th>Area of discussion</th>
<th>Identified gap related to the current study</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Design Criteria for Mosques and Islamic Centers (2017)</td>
<td>Guideline for urban mosque in Western context</td>
<td>The typology of urban mosque discussed does not consider a situation such as dense urban area, limited land, and vertical development</td>
</tr>
<tr>
<td>2</td>
<td>Guideline for the design of Mosques and Surau, Department of Town and Country Planning (2011)</td>
<td>Guideline for mosque in the Malaysian context</td>
<td>Generalized instruction which lacks specific discussion on an urban mosque in compact settings</td>
</tr>
<tr>
<td>3</td>
<td>Design standards for Muslim prayer facilities within public buildings (2009)</td>
<td>Focuses on special prayer facility</td>
<td>Prayer facilities within buildings are different in the genre than entire mosque building on a particular site.</td>
</tr>
<tr>
<td>4</td>
<td>Architectural Graphic Standards (2007)</td>
<td>Guideline for mosques in Western countries</td>
<td>Focuses on space requirements for mosques in Western context only</td>
</tr>
<tr>
<td>5</td>
<td>Neufert Architects' Data (2003)</td>
<td>Design criteria for mosque from historical perspective</td>
<td>Contemporary issues on mosque design are unavailable</td>
</tr>
</tbody>
</table>

This research attempts to bridge the gap on design framework for urban mosques. Previous studies which are closely related to the scope of this research have pointed out several factors to be considered for the analysis such as land use and vertical planning (Ahmad et al., 2015), contextual design (Al-Hathloul, 2004; Mohd Rasdi & Utaberta, 2007), and diversified activities and related facilities (Asif et al., 2015; Rasdi, 1998, 2010). In short, the factors to be observed primarily are context (in this case compact cities), capacity, facilities, and activities. The diagram below visually represents the factors to be considered in evaluating urban mosques.
METHODOLOGY

This study is qualitative describing the practices and lifeworld regarding the institution of a mosque in compact urban settings. The research is based on two levels of data: a) Secondary data and b) Primary data. The researcher conducted a descriptive analysis of secondary data collected from available written sources on three mosques outside Malaysia though within the Malay Archipelago which are presented in the case studies section.

Primary data are collected from three mosques within the city of Kuala Lumpur, Malaysia. Selection criteria are discussed in the sampling section. Semi-structured interviews and observations were adopted as the data collection method. Findings from the semi-structured interview are analyzed through content analysis supported by observational findings wherever needed. The overall process is illustrated in figure 2.

Sampling

Case selection for the study was based on the following characteristics: Type and size of the mosque; type of zone; the population density of the region; functionalities; spatial topology; and architectural features/designs. Kuala Lumpur, the federal capital for the government of Malaysia, has the largest population among Malaysian cities according to the population census of 2010 (“MALAYSIA: Administrative Division,” 2010). For the ease of governance, the area is divided into 6 zones, and each zone has one masjid as Pusat Pejabat to observe the affairs of other mosques under them. The most densely populated zone in Kuala Lumpur
is Zone 3 or City Center (135 people/hectare). Based on this characteristic, this study focuses only on zone 3 out of all 6 zones. According to the list of MAIWP, there are ten mosques and nine surau jumat within this zone (DBKL, 2015)

Out of these ten mosques, three mosques have been shortlisted for this particular research. Among the remaining seven mosques, respondents for semi-structured interview were not available, one of the mosques was under construction, and the rest is a special type of mosque with a historical value having single storied building blocks. Therefore, based on the surroundings, limitation of land and vertical approach of design Masjid Al-Imam Asy-Shafie, Masjid Jamek Kg. Baru and Masjid Jamek Pakistan have been selected.

Case studies

This section will present a brief discussion on selected mosques outside of Malaysia. As this research will focus on developing a framework for mosque in Malaysian context primarily, the selection of foreign mosques follows several criteria:

1. Mosque in similar context, regions close to Malaysia is chosen (i.e., Indonesia, Hong Kong, Singapore);
2. Among the selected regions, cities with high density of population are selected to ensure that the selected mosques are situated in compact urban settings;
3. Type and size of mosque and functionalities, spatial topology and architectural features/designs are considered to select cases.

Based on these criteria the selected mosques are (1) Istiqlal Mosque, Jakarta, (2) Kowloon Mosque & Islamic Centre, Hong Kong and (3) Masjid Al Islah Punggol, Singapore. It is to be noted that the scale of these mosques vary as well as their capacity, while the evaluation criteria focus primarily on the context, activities, facilities and land use. A brief introduction of the cases is presented below in table form.
Table 2: Comparative table for study cases (Source: Authors).

<table>
<thead>
<tr>
<th>Name of the Mosque</th>
<th>Location</th>
<th>Capacity per Land Area* (Person/Sqm)</th>
<th>Facilities</th>
</tr>
</thead>
</table>
| Istiqlal Mosque (1978)             | Jakarta, Indonesia   | (200000/90000) 2.22                 | • Main prayer hall  
• Classrooms  
• Resting areas  
• Plaza (multipurpose space)  
• Landscape garden  
• Office  
• Madrasa |
| Kowloon Mosque & Islamic Centre (1984) | Hong Kong            | (3500/25200) 0.14                    | • Main prayer hall  
• Clinic  
• Day-care center  
• Community Centre  
• A/V room  
• Market and food stall  
• Guest room  
• Staff dormitory  
• Kindergarten  
• Classroom  
• Library  
• Exhibition  
• Office |
| Masjid Al Islah (2015)             | Punggol, Singapore   | (4500/3700) 1.21                     | • Main prayer hall  
• Education center  
• Administrative center  
• Plaza  
• Classrooms |

Discussion on the design consideration for study cases

Considering the design characteristics, Istiqlal mosque and Al-Islah mosque have more contemporary design style, and Kowloon mosque blends traditional elements with contemporary styles (Crossette, 1987; Ward, 2017). On the other hand, the Kowloon mosque, designed by architect I.M. Kadri, represents the unique identity of the Muslim community in Hong Kong. Among all these three cases, Al-Islah mosque has the most distinct design characteristics.

Apart from the religious programs and additional communal activities, the cases have one thing in common: all three mosques are used by the community as recreation parks with adequately designed landscape features.

One of the significant aspects noted from the discussion is the use of vertical spaces within these mosques. Unlike the traditional style of horizontal or spread out design, these mosques tend to be developed vertically to accommodate its functions within the settings of the compact neighborhood.
Several aspects found to be unique for urban mosques in a compact setting compared to that of the traditional mosque and traditional design approach. They are noted below.

a) A mosque can be designed with more elaborate facilities despite having a lower capacity to accommodate people (Haroon, 1995).

b) While modern style mosques have better provision for effective functional arrangements, in the case of Kowloon mosque, it has blended traditional elements with contemporary style and yet has the most elaborate functional spaces (Ward, 2017).

c) The design language of mosque is required to be accepted by the community people. As for the case of Al-Islah mosque, the community people consider this mosque as a reflection of Islamic aspiration of Singapore (Asif & Utaberta, 2016; Peterson, 2016).

d) Open or semi-open spaces are recommended for mosques in high-density areas. These spaces can be either an adjacent public park (Istiqlal and Kowloon mosque) or plaza area at ground level or elevated plaza (Al-Islah Mosque) with adequate greenery (Peterson, 2016).
Vertical stacking of functions is present in all three cases. Instead of providing a large prayer hall with a high ceiling, the vertical space is used for accommodating the functions within the limited available land.

**COMPARATIVE DISCUSSION BETWEEN PRIMARY AND SECONDARY DATA**

This section will briefly analyze the findings collected for the three chosen samples and at the same time inference will be made with the outcome of early case studies.

**Outlining a standard definition and design framework for an urban mosque in compact cities**

The study gave information on the mosque’s evolution, the rapidly growing challenges they face and how these mosques have so far addressed such issues. The role of the Mosque is composed of thoroughly institutionalized multiple functions and roles when Muslim society norms have undergone a few drastic changes to adapt to the modern age. Responsibilities of various nature such as socio-political, socio-economic, educational and religious are now intertwined, and mosque as an integral part of society is also responsible for its development, guidance, and administration.

In the compact city setting, Masjid Jamek Kg Baru’s design and planning address the needs and requirement of urban communities living in dense areas as is evident in the interviewee’s response. It presents the similar situation with Al-Islah mosque in Singapore mentioned in the previous section. Al-Islah mosque’s design is also welcomed by the community as it fulfills their expectation from their mosque. Both Masjid Jamek Kg. Baru and Masjid Al-Islah are designed in a way that is different from the traditional symmetrical layout of mosque, and the design proves to be well accepted among the users according to the findings (refer to the figure below).
The renovation strategy for Masjid Jamek Kg. Baru is successful in a way that it increases the capacity of the mosque as well as added facilities to the mosque complex to serve the needs of the community. Meanwhile, the planning of Masjid Jamek Pakistan is not integrated with the requirements of the neighborhood, which causes an overflow of people on the street during Fridays and other occasions. This situation is certainly not expected for a compact city where the overflow of users on streets is a usual phenomenon. In contrast, the traditional horizontal design of Masjid Al Imam Asy-Syafei has the much lower capacity to accommodate people while having the largest land area. Moreover, the recorded activities are also fewer than the other two mosques in Masjid Al Imam Asy-Syafei.

Therefore, it can be concluded that the most efficient mosque regarding capacity, facilities, and land utilization is Masjid Jamek Kg. Baru while Masjid Jamek Pakistan and Masjid Al Imam Asy-Syafei hold the latter positions respectively.

Considering the above, urban mosque in compact cities can be defined as: an urban mosque within the settings of a compact city is the mosque which has maximized the land use by arranging adequate facilities serving the surrounding communities with required activities and programs, and fulfills the capacity requirement within its limited available land area.

Apart from the definition of an urban mosque, factors needed to be considered for urban mosque as derived from the study above are summarized below:

a) Standardization of facilities designed for urban mosques is crucial to ensure community involvement by providing different activity spaces;
b) Vertical stacking of the functional spaces and creating a visual link among them;
c) Use of design elements such as a ramp or lift to make the facility accessible to the elderly and disabled people;
d) Flexibility in design and multiple uses of a single space to ensure maximization of the use of available facilities;
e) Providing a plaza area as a setback for the mosque building, which could offer open space feelings within a dense urban setting. The plaza could be at road level like that of Masjid Jamek Kg. Baru or elevated like Al-Islah mosque at Singapore.
f) If residential facilities are required for an urban mosque (like Masjid Jamek Pakistan) they are advised to be planned in the early stage of design to avoid making horizontal development.

Figure 7. Vertical spaces with physical access and visual connection (Upper: Al-Islah mosque, Lower: Masjid Kg. Baru) (Source: https://www.archdaily.com/773123; Authors, 2016).

CONCLUSION

The results of this research have provided insights into the evolution of mosque and how it can be further improved to address modern challenges. Based on the evaluated mosques in this study, urban mosques are built and made to serve the fundamental purpose of mosque, however, because of the other essential needs of the community it also serves other purposes which demonstrates the flexibility of mosque in serving the community socially, economically and even politically. It shows the relevance of urban mosque where space constraint is an on-going issue. Furthermore, the examples of mosques both modern and old were able to demonstrate and retain functionality and aesthetic presentation while maximizing its space allotment.
Addressing the fact that Kuala Lumpur Structure Plan 2020 proposes to build more than 300 mosques within the city, this study is highly significant to provide a guideline for developing urban mosques in the compact city of Kuala Lumpur. If the new mosques are appropriately planned considering all the key requirements of an urban mosque, it will ensure a better and more liveable environment for Kuala Lumpur as well as within the region of Malay Archipelago in the years to come.

**ACKNOWLEDGMENT**

This study is conducted with the aid of FRGS 2017 [Vote no: 9553400], FRGS 2016 [Vote No: 5524799] granted by Ministry of Higher Education, Malaysia (MoHE) and Geran Putra - Inisiatif Putra Siswazah (IPS) [Vote No: 9617600] granted by Universiti Putra Malaysia. Authors also acknowledge the support WARIS Research Group, Faculty of Design and Architecture and Halal Product Research Institute, Universiti Putra Malaysia.
REFERENCES


Haroon, H. (1995). *Transformation of Kowloon mosque and Islamic centre*. The University of Hong Kong, Pokfulam Road, Hong Kong SAR. https://doi.org/10.5353/th_b3198239


https://www.citypopulation.de/php/malaysia-admin.php


FINDING HARMONY IN CHAOS: THE ROLE OF THE GOLDEN RECTANGLE IN DECONSTRUCTIVE ARCHITECTURE

DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1696

Luai Aljubori and Chaham Alalouch*

Keywords

decorivist architecture; golden ratio; golden rectangle; proportional systems; architectural design; geometry

Abstract

It is generally accepted that compositions in deconstructive architecture are irrational, fragmented, and do not follow proportional systems or principles of architecture, such as harmony, continuity, and unity. These compositions are understood as the result of compilations of random geometries that are often non-rectilinear, distorted, and displaced. In spite of this, deconstructive architecture is widely accepted and practiced in the last couple of decades. On the other hand, geometrical proportions have long been considered as a self-guided method of aesthetically proven designs. This paper examines the hypothesis that the golden rectangle as a proportional system is manifested, to a varying degree, in deconstructive architecture. Methodologically, the hypothesis was tested using two inter-related methods. First, Tension Points of three famous examples of deconstructivist architecture were identified using the Delphi method by a panel of experts. Second, a matrix of displaced golden rectangles was used to test the degree of correspondence between the tension points of the case studies and the golden rectangle. It was found that deconstructive architecture is not a type of “free-form” architecture; and that conventional proportional systems and aesthetics laws, such as the golden ratio, are partially manifested in its compositions and forms, thus confirming the hypothesis. This paper argues that since architects are trained to capture proportional systems and design according to certain organizational and proportional principles, this would inevitably be consciously or unconsciously reflected on their designs.

L. Aljubori
Assistant Professor and Head of Department, Architecture and Interior Design, College of Engineering and Architecture, Nizwa University, Nizwa, Oman.

C. Alalouch
Assistant Professor in Architectural Engineering, Sultan Qaboos University, College of Engineering, Department of Civil and Architectural Engineering, Muscat, Oman, B.O.Box. 33, PC. 123

*Corresponding Author’s email address: c.alalouch@squ.edu.om
INTRODUCTION

The effect of new ways of thinking and innovative philosophical ideas on architectural design is unavoidable and can be easily traced back through the history of architecture. This is particularly notable in the twentieth and twenty-first centuries. This influence is not restricted to the design process, but expands to impose a changing power on the final product itself as illustrated in the visual appearance of forms and compositions (Weston, 2011). One of the most notable and recent philosophical trends that have had a significant influence on contemporary architecture is the Deconstruction Theory (Wong, 2010).

This paper does not discuss the deconstructivist architecture’s focus on human experience of space, which has been a subject of a wider debate in the last decade. It attempts to draw attention to the outer form of deconstructive buildings and how these random-looking compositions are governed by concealed proportional systems. Such systems are causing them to inherit beauty that might justify the wide acceptance and spread of this movement. Forms in deconstructive architecture are known for being a compilation of random geometries that are often non-rectilinear, distorted, and displaced. It is generally accepted that the resultant compositions in this architectural style are usually irrational, fragmented, and more importantly, do not follow proportional systems nor principles of architecture, such as harmony, continuity, and unity (Jodidio, 2011). The movement itself rejects the purity of forms and attempts to create ‘new sensibility’ by creating buildings that disturb the common understanding of forms (Johnson & Wigley, 1988). Some authors described the movement as an “assault on such familiar norms as horizontal floor planes, vertical walls, and regular structural grid” (Weston, 2011, p. 199).

On the other hand, geometrical proportions have long been considered as a self-guided method of aesthetically proven designs (Dabbour, 2012; Nabavi & Ahmed, 2016). In particular, the golden ratio is arguably known as THE indicator of aesthetic quality of buildings, which respect laws of proportion of nature. Le Corbusier stated in reference to the golden ratio, “Behind the wall, the gods play; they play with numbers of which the universe is made up,” emphasizing the divine property of the golden ratio (Kappraff, 2004, p. 288). Architectural designs that rely on the golden ratio as an organizational and proportional framework are considered as the exemplars of architectural aesthetics and order throughout the history of art and architecture.

The assumption underpinning this study is that since proportional systems and aesthetics laws – e.g., the golden ratio- inherently exist in natural and artificial environments alike, and since architects are trained to capture these systems and designs according to certain organizational and proportional principles, then, these laws and proportional systems should be partially manifested in the deconstructive architecture, consciously or unconsciously. Hence, this study has attempted to provide evidence that forms and compositions in deconstructivist architecture are not as random, distorted, displaced, and fragmented as they are assumed to be. It argues that deconstructive architectural designs are governed, to a certain degree, by proportional systems and laws of aesthetics. Thus, this paper examines the following hypothesis:

1. The golden ratio as a proportional system is manifested, to a varying degree, in the two-dimensional generative elements of deconstructive compositions; and that a systematic representation of a matrix of golden rectangles is needed to unveil the proportional principles inherent in deconstructive projects.
To address these hypotheses, this paper employs two interrelated methods. Firstly, a matrix of golden rectangles, that are displaced and have variety of scales, was used to examine famous examples of deconstructive architecture in order to demonstrate the extent to which the generative elements of the forms manifested proportional systems. Generative elements in this context are understood as the two-dimensional elements from which the three-dimensional components of the elevations of the form were extruded. This method can also be used as a framework to guide new designs in a way that respects proportional laws and harmony. Secondly, the Delphi Method was used to identify the tension points of three famous examples of deconstructive architecture. Next, the proposed method was applied on these case studies to test the degree of correspondence between the compositions of each case study and the golden ratio. Tension points are related to the concept of visual tension in art and design, and are understood in this study as the points of the generative two-dimensional elements of the form at which the composition of a building starts to deform, distort, or fragment to create visual tension, interest, and imbalance.

**Deconstructivism**

During the 1960s, Jacques Derrida and Paul De Man set out the outlines of the deconstruction movement in critical studies of literature and grammatology. Their notion and forward thinking have inspired other fields, such as art, fashion, and architecture. In particular, Derrida’s philosophy and thinking became the foundations upon which revolutionary architects of the 18th century refuted the two main prevailing facets of architectural styles of their time, namely, Modernism and Post-modernism.

Consequently, the architectural style known as Deconstructivism was embraced by a group of architects known as the “deconstructivists”, who understood architecture as a kind of communication language. Based on this understanding, contradicting ideas and binary distinctions, such as presence and absence, solid and void, regularity and irregularity, harmony and chaos, are believed to occur in architecture just as they occur in linguistics philosophy. The traditional understanding believes that one concept in each binary distinction possesses a governing power, whereas the other is a subsequence of the first and is significantly less important. However, deconstructivism argues that the less advantaged concept, or the subjugated one, is just as important and necessary as the explicit meaning and expression of the first concept. It is argued that creativity and uniqueness lies in the way between the two concepts (Weston, 2011). In architecture, this way of thinking has created new opportunities to re-read the traditional architectural styles and opened possibilities to re-evaluate their values and concepts (Durmus & Gur, 2011). This, in turn, suggests that since buildings can be designed and constructed using the conventional laws of architecture, the non-conventional methods, such as deconstruction, could also be used to design functionally and structurally stable buildings.

When translating this philosophical understanding into architectural language and forms, architects tend to reject the conventional rectilinear geometries of the common architecture and transfer them into non-rectilinear shapes by manipulating the outer shell and external non-structural surfaces of the building. Unlike conventional architecture, the simple geometric forms are allowed to distort each other and the composition does not necessarily follow compositional rules that ensure stability and form purity (Johnson & Wigley, 1988). Hong and Hwang (2006) had summarized four general compositional methods in deconstructionism,
namely, decentering, disjunction, decomposition, and discontinuity, as well as the denial of history.

The resultant composition is often characterized by the absence of fundamental architectural principles, such as proportional systems, harmony, unity, continuity, and coherence. It also focuses on radical formalism with complete rejection of constraining notions, such as “purity of form” and “form follows function” of the modernism. This tendency among deconstructive architects to liberate form from the rigidity of historical, scientific, and technological rationalities has resulted in the use of opposing geometries and distorted grid (Wong, 2010). According to Jodido (2011), this random-looking and sometimes conflicting geometry is used by deconstructivist architects as a metaphor to reflect the competing forces in contemporary cities that would often lead to fragmented and unstable societies.

This movement was crystalized by the famous 1988 New York exhibition, “Deconstructivist Architecture”, organized by Philip Johnson and Mark Wigley. Frank Gehry, Daniel Libeskind, Rem Koolhaas, Peter Eisenman, Zaha Hadid, Coop Himmelblau, and Bernard Tschumi were the avant-garde architects featured in this exhibition. Perhaps, the simplest and clearest description of this movement can be found in the exhibition’s Fact Sheet, which stated: “Deconstructivist architecture focuses on seven international architects whose recent work marks the emergence of a new sensibility in architecture. The architects recognize the imperfectability of the modern world and seek to address, in Johnson’s words [Philip Johnson], the "pleasures of unease." Obsessed with diagonals, arcs, and warped planes, they intentionally violate the cubes and right angles of modernism. The traditional virtues of harmony, unity, and clarity are displaced by disharmony, fracturing, and mystery.” (MoMA, 1988, p. 1).

Arguably, deconstruction architecture pays a great deal of attention to people’s experience of space, which is quite similar to the Soviet Constructivists that formed the base for the deconstruction architecture in the west (Valon, 2009). However, in a recent study, Mohtashami (2016) argued that the deconstruction movement has influenced architectural designs in semantic, physical, and technical aspects. He analyzed 23 buildings and found that deconstruction criteria are mostly realized in the physical characteristics of buildings, rather than in the semantic or technical characteristics. In fact, forms and compositions of buildings seems to be the primary focus of the movement since its inception.

In this century, the rapid development of computer-aided designing and drafting systems, coupled with the technological advancement in construction systems and materials, have greatly facilitated deconstructivism to flourish in architecture. This growth is supported by the unprecedented desire among contemporary architects to produce buildings that are surprising, impressive, eye-catching, and aesthetically sound. Designers are now able to create unexpected and complex shapes and compositions that would have been impossible otherwise. In addition, CAD systems offer the facility to simulate the post-construction effect of buildings, in terms of their environmental impact, energy use, and structural stability, which in turn support and provide justification for the deconstructivism movement. These advancements have allowed architects to create forms that are able to “disturb our thinking about form” making them deconstructive (Johnson & Wigley, 1988, p. 10).

This movement has received strong criticisms from several architectural critiques and philosophers, such as being detached from the context, holds little social significance, and embraces capitalism (Frampton, 2007), and undermines the historical reading of the site
(Weston, 2011). Nonetheless, this movement has managed to find its notable place within the world’s architectural scene, declares itself as a leader and trend-maker in architecture, and incites more public interest and reception (Durmus & Gur, 2011).

Producing a generalized definition of deconstructive architecture has been difficult because heterogeneous and un-repetitive forms are among the principal characteristics of the movement (Valon, 2009). However, nowadays, the architectural community accepts that forms and compositions in deconstructivist architecture may appear distorted, dislocated, fragmented, and consisting of discordant pieces, with the final product being unpredictable, not following proportional systems, and showing controlled chaos. These characteristics are arguably common among almost all deconstructive projects.

In spite of the irrationality and nonsense in form formation and the disregard for the laws of aesthetics and organizational order, deconstructive projects are well accepted and widely spread around the globe. It has also become a leading trend in design, which has raised several questions: since the human brain is prone to seek order and reasoning, why is deconstructive architecture publicly accepted and celebrated? Does deconstructive architecture conceal, either intentionally or unintentionally, some sort of proportional systems in its unexpected and surprising forms and compositions? Therefore, it is necessary to examine the role of the proportional systems in deconstructive architecture.

Proportional Systems and the Golden Ratio

Throughout the centuries, human beings are prone to surround themselves with beauty. The ancient Greeks had developed the science of aesthetics as a way to understand and analyze this mysterious, but fascinating, concept. In their attempt to answer the question ‘what makes something beautiful?’ they were inspired by the language of the natural world, where harmony and rhythm are manifested in the form of geometrical proportions. They believed that harmony is the key to beauty and that geometrical proportion is the key to harmony.

Plato (360 BC), in one of his dialogues, Timaeus, wrote about the proportional systems and considered them as a key to the physics of the cosmos. Marchant (2013a, p. 34) beautifully highlighted why understanding and capturing proportions matters in our life when he stated, “The universal language of proportion may be seen as the outward reflection of an inner beauty. It is found in the underlying structure of nature, from the smallest to the largest levels of scale, and connects all things of the world to the cosmic order of the universe.” Hence, he argued, shapes designed to harmonious proportions are the most aesthetically pleasing shapes.

The relationship between proportions and architecture is as old as the era of Vitruvius (1st century BC), who described the proportions of the human body and noted that these proportions should have a relation to architecture. In architecture and pattern design, the importance of geometrical proportions is amplified because architecture uses shapes and geometries, and seeks to compile them in the most aesthetically pleasing way. Dabbour (2012, p. 381) stated, “Geometric proportions in architectural patterns represent a design language, as words do in a spoken language. They determine the frameworks within which elements may be arranged into a pattern, a relation between one element and another, and a proportional relation within one element. They address and reflect the natural laws that govern the basic harmonies of nature, being describable by means of mathematics and geometry.” In addition, the use of proportional system in architecture guarantees that each
and every part of the design is correlated (Frings, 2002). This, in turn, results in aesthetically pleasing and workable designs.

In their search for a formula for beauty, the Greek discovered the golden ratio and considered it as a pre-requisite to harmony and beauty. The golden ratio is often denoted by the Greek letter, \( \phi \) (Phi), which is an irrational mathematical constant that can be written algebraically as, \( \frac{\sqrt{5}+1}{2} \), or approximately 1.6180339887. Zeising (1845) claimed that the beauty of numerous works of art is the result of their components being in the golden ratio. This claim is supported by Fechner’s series of psychological experiments on aesthetics (Fechner, 1865, 1876; Fechner & Höge, 1997).

The golden ratio is manifested in the natural world, in human proportion, and in the growth patterns of many living flora and fauna (Elam, 2011) as well as in the universe (Kapusta, 2004). Arguably, the golden ratio is the most pleasing proportion to the human eye (Akhtaruzzaman, et al., 2011). Green (1995), in his review of the historical and contemporary issues related to the alleged aesthetic properties of the golden ratio, found that there are real psychological effects associated with the golden ratio.

Architects in their quest for beauty have been fascinated with the concept of the golden ratio since the ancient times. It was first applied at the Parthenon by Greek sculptor and mathematician, Phidias (and hence the ratio got the initials “Phi” of his name) (Huntley, 1970). It also exists in the design of the Pyramids, which indicates that the Egyptians were also aware of the ratio (Meisner, 2016a). In a literature review on the golden ratio, Shekhawat (2015) found that many key architects in history, such as Palladio, Le Corbusier, Pacioli, and Leonardo DaVinci, favoured the use of the golden ratio in their designs. He summarized several studies showing that many buildings in ancient and contemporary times have been built based on the golden ratio, and that the golden ratio has occurred at different moments in the history of architecture.

However, some authors questioned the relationships associated with the golden ratio and described them as coincidences and exaggerations (Kissinger, 2012; Gailiunas, 2015). Others went even further to provide evidence on what they call “misleading” claims of the existence of the golden ratio in famous examples in nature, art, and architecture (Markowsky, 1992). Many of the criticisms were however refuted (Meisner, 2016b). In addition, some psychologists questioned whether the golden ratio is actually associated with people’s preference and choice for aesthetics (Phillips, Norman, & Beers, 2010).

Throughout history, other proportional systems were also used and recommended by architects, philosophers, and mathematicians. Plato, for example, placed great importance on two geometrical ratios: the two times progression of 1:2:4:8; and the three times progression of 1:3:9:27, which are used in musical proportions. In architecture, Palladio used these ratios in the room plans that he advocated (Marchant, 2013a). During the early Renaissance, Pacioli (1447–1517), the Italian mathematician, wrote “Tractato de l’architectura”, which was a part of the 3-part book, “The Divine Proportion”. He recommended – along with the golden ratio – that architects should use simple ratios of integral numbers, such as 1:2, 1:3, 3/4, and 2/3 (Frings, 2002). Root two (1:2), root three (1:3), and root five (1:5) have been also used in art and architecture. Plato described root two and root three equilateral triangles as the most beautiful triangles that are underlying the structures of the universe (Marchant, 2013b). These proportional systems can also be found in the art and design of Islamic architecture (Dabbour, 2012). Marchant (2013a) showed that
φ, \sqrt{2}, \sqrt{3}, \text{ and } \sqrt{5} \text{ were the underlying geometrical proportions for the designs in Islamic patterns, while } \phi, \sqrt{2}, \sqrt{3}, \text{ were used in the design of Taj Mahal in Agra, India. These proportional systems, the golden ratio included, were clearly manifested in notable buildings in the history of Islamic architecture, such as the Great Umayyad mosque in Damascus (709-715), Ibn Tulun mosque in Cairo (876-879), Sultan Qaytbay Funerary Complex in Cairo (1472-74), Bu Inaniyya madrasa in Fes (1350-55), and the 19th-century extension of Cordoba mosque (Marchant, 2013a). Although the golden ratio is not the only proportional system that was used, experimented with, and recommended throughout the history of art and architecture, it is indeed the most widespread criterion of beauty that permeates the world of art and architecture (Stakhov & Sluchenkova, 2003).

The use of the golden rectangle by many key architects throughout history is not only driven by cultural and aesthetics reasons, but also by functional needs. Shekhawat (2015) provided mathematical evidences that the golden ratio achieves a great level of connectivity and creates the best-connected rectangular arrangement. Despite criticisms, the golden ratio provides an effective means upon which aesthetics in architecture can be analyzed, evaluated, and compared in a quantitative way.

**Tension Points**

In art and design, Visual Tension is the source of visual interest and vital energy that shape the connection between the art (a building’s form in this study) and the observer (Fennel, 2009). This term is generally defined as “a balance maintained in an artistic work between opposing forces or elements: a controlled dramatic or dynamic quality” (Editors of Encyclopaedia Britannica, 2011). Visual tension is understood in this study as the interplay of conflicting forms that creates a balance between the conflicting visual and physical forces that provoke feelings of uneasiness or suspense. With this understanding, Tension Points are defined as the points of the generative two-dimensional elements of the form at which the composition of a building starts to deform, distort, or fragment to create visual tension, interest, and imbalance. Based on the aforementioned literature and understanding, this paper uses a matrix of multi golden rectangles that are displaced and have variety of scales to explore the degree of correspondence between tension points of famous examples of deconstructive architecture and the golden ratio.

**METHODOLOGY**

**The case studies**

Three famous deconstructive building designs were selected as the case studies for this study. The selection was based on the following criteria:

- The significance of the design in the history of the deconstruction movement;
- The architect should be known for his/her deconstructive approach in design;
- The design is already constructed, occupied, and functioning;
- The popularity of the building among the architecture community;
- The availability of literature, including 2D drawings and 3D models.

Consequently, three building were selected, namely, the 41 Cooper Square, the Cincinnati Contemporary Arts Centre, and the Perot Museum, as shown in Figure 1. The availability of data and drawings had played a major role in the selection process.
Method Development

The golden ratio itself is a property of a one-dimensional (x, y, or z) line segment. A line is thought to achieve the golden ratio when it is divided into two segments in a way that the ratio between the longer segment and the shorter segment equals the ratio between the length of the whole line and the longer segment, as shown in Figure 2. This ratio is always equals to $\varphi$ (1.6180339887 approx.). The point at which the line is divided to achieve this property is called the golden section, i.e. $1/\varphi$.

$$\varphi = \frac{AC}{CB} = \frac{AB}{AC} = 1.618033987 \text{ approx.}.$$  

A line segment, AB, is divided to form a golden ratio at the golden section, i.e. point C.

When expanding the golden ratio into two-dimensional representations (xy, xz, or yz), we get the golden rectangle. A rectangle is said to be a golden rectangle if the ratio between its long side and its short one equals $\varphi$ (Stakhov & Sluchenkova, 2003). A series of golden rectangles that correspond to Fibonacci numbers can be constructed, as shown in Figure 3 (the golden rectangles in Figure 3 are AFED, BCEF, and GHCE), where $AF/FE = BC/CE = HG/GE = \varphi$. The process shown in the figure can continue infinitely to create smaller and smaller golden rectangles.

$$\varphi = \frac{AC}{CB} = \frac{AB}{AC} = 1.618033987 \text{ approx.}.$$  

1) Start with a square.  
2) Find $M$ (mid-point of DC) and draw the arch $BE$ (reduce=MB).  
3) Offset $BF$ to create a square (offset distance=$BF$).  
4) Offset $GE$ to create a square. Repeat the process.

Figure 2. One-dimensional representation of the Golden Ratio (Source: Authors)  

Figure 3. Steps of constructing a two-dimensional representation of the golden ratio i.e. the Golden Rectangle (Source: Authors).
The two-dimensional golden rectangle has repeatedly appeared in studies that offer analyses of proportions in building designs. Searching the phrase, ‘golden rectangle in architecture’ on Google could yield hundreds of thousands of results. In this type of analysis, the golden rectangle is usually superimposed on plans, sections, or elevations of buildings to show that the exterior dimensions or the arrangements of some architectural elements in buildings correspond to $\phi$, as shown in Figure 4. This method was applied in the visual analysis of the Pantheon in Rome (Doczi, 2005), the Palazzo della Signoria in Florence (Bartoli, 2004), The Great Umayyad mosque in Damascus (Marchant, 2013a), and other traditional and contemporary examples of architecture, art, fashion, and nature.

In spite of the fact that architectural forms are naturally three-dimensional products, to the authors’ best knowledge, the golden rectangle has never been used to analyse the generative two-dimensional elements of the three-dimensional forms of buildings. Almost all analyses in this area were focused on the overall dimensions of the elevation or the arrangements of the two-dimensional elements, while neglecting the third dimension. This has developed a perception that the golden rectangle is restricted to the design of regular and grid-based plans and elevations, and could not be used as a tool to create forms and compositions. Therefore, this study presents a matrix of displaced golden rectangles superimposed on the generative two-dimensional elements of the form that can be used to analyze architectural forms in terms of the degree to which the formation of the composition corresponds to the golden rectangle. The focus is on the analysis of famous examples of deconstruction architecture as previously explained.

![The Pantheon in Rome (Doczi, 2005)](image1)
![Palazzo della Signoria in Florence (Bartoli, 2004)](image2)
![The Great Umayyad mosque in Damascus (Marchant, 2013a)](image3)

Figure 4. Examples of the conventional way of using the golden rectangle to analyze architectural elevations and plans.

Our starting point was a simple 3D cuboid, with the dimensions of $1:1:1:\phi$, corresponding to the golden rectangle, as shown in Figure 5a. A golden rectangle can be superimposed on any of the elevations creating an extrusion grid as shown in Figure 5b. The designer can opt to use more than one golden rectangle and displace, rotate or rescale them to create a more...
complex grid. Then the designer can select any parts of the golden grid and subject them to extrusion procedures in a way that corresponds to the functional requirements of the building, as shown in the example in figures 5c. The extrusion values could also correspond to the golden ratio and can be done either positively (addition) or negatively (subtraction), figures 5d. The resultant form can then be scrutinised against functional, environmental, and structural requirements. The process can be repeated until a satisfactory composition is developed. The final composition should then be subjected to further development and refinement to achieve workable internal spaces. Therefore, this method could help designers to create unlimited aesthetically pleasing novel forms from simple shapes, which in turn allows the designer to explore a whole range of possible compositions that the variability of the initial form allows.

Figure 5. The process of producing compositions that conform to the golden ratio (Source: Authors). a) Start with a simple cuboid, b) superimpose one or more golden rectangles on any of the elevations, c) select areas on the grid for extrusion, and d) extrude these areas.
In this case, the golden rectangle provided a design framework and a systematic method to produce innovative, novel, and unusual compositions that could achieve the aesthetic criteria of the golden ratio. Figure 6 shows a perspective of the resultant form.

Figure 6. A perspective of the resultant form (Source: Authors).

Architects have the choice to select the number, scale, and location of the golden rectangles from which the two-dimensional shapes would be extruded to create the composition. The selection of the golden rectangles and the extrusion procedures should correspond to a design goal, e.g., functional, environmental, contextual, or structural. In addition, the designer might use the golden ratio to guide the extrusion values in order to produce compositions that are fully conforming to the golden ratio. However, this might be challenging in some cases due to functional or structural constrains. Although this process seems to impose restraints on the design, it actually provides a structure within which unlimited aesthetically pleasing compositions could be created. Then, the designer can select the form that he/she accepts as the most appropriate, and would satisfy the balance between aesthetical, functional, and structural requirements. Figure 7 demonstrates the possibility of producing an unlimited number of compositions that conform to the golden ratio using the method described before.

Similarly, the same method can be used to analyze existing designs by superimposing a displaced matrix of golden rectangles on the elevations of the form of an existing design. The number, scale and position of the different golden rectangles can be modified in an iterative manner to find the best fit between the golden matrix and the tension points of the composition. This assessment method was used in the current study to test the degree of correspondence between the tension points of the selected case studies and the golden rectangle. By doing so, the degree of the composition’s correspondence to the golden ratio can be measured. Subsequently, different compositions can be compared in terms of aesthetics and harmony.
Figure 7. Compositions conform to the golden ration generated using the method presented in this study (Source: Authors).

**Tension point identification (Delphi Method)**

To identify the tension points for each building form, the Delphi method was used. This method was designed to capture the opinions of a selected group of experts in the subject of discussion through a series of structured data-gathering rounds (Kahn, 2006). Typically, participants are anonymous to each other and they are physically isolated. In the first round, each participant is asked to answer a question or a set of questions based on their experience and knowledge. The facilitator would collect, summarize, and present the data as a collective response that combines the answers of all participants. In round two, the participants are presented with the collective answer of the whole group and are given the opportunity to revisit their original answer. This process can be repeated until a consensus is reached. The Delphi method is widely used in researches and practices when a consensus among experts is needed (Abdulrahman, 2010).

In this study, a two-round Delphi survey was conducted with four experienced architects to identify the tension points for each case study. We followed the typical protocol of the method. Each participant was presented separately with 2D and 3D drawings of the three case studies and they were asked to highlight, on the drawings, what they think is a major tension point. It was clarified for them that tension points in this context means “The points of
the generative two-dimensional elements of the form at which the composition starts to
deform, distort, or fragment creating visual tension, interest, and imbalance”. Since the
deformation and fragmentation of the form is better observed in the three-dimensional space,
participants were given the freedom to use the two-dimensional, three-dimensional or both
types of drawings to fully understand the buildings and identify the tension points in a more
accurate and comprehensive manner. The data was then summarized by the researchers
and presented anonymously for each building. Next, the participants were asked to revisit
their answers upon considering the collective answers of all participants. The revised data
were then collected and sent to the participants for a final feedback.

This exercise was limited to two adjacent elevations for each case study due to practicality.
Including more elevations would have resulted in a large number of judgments that
participants should make, which is likely to compromise the quality of the outputs. In addition,
the Delphi method requires the participants to revise their answers in light of the collective
response of the whole group. Including more elevations would have created confusion and
uncertainty in the revised answers. This is an exploratory study that aims to provide initial
evidence that proportional systems are manifested to a varying degree in deconstructive
architecture. Thus, it was concluded that two elevations for each case study would be
sufficient to fulfil the aim of this study.

The degree of correspondence between tension points and the golden rectangle

To quantify the degree of correspondence between the tension points of the forms of the
case studies and the golden rectangle, Equation 1 was used:

\[ r = \frac{\sum_{i=1}^{n} \frac{x_i}{t_i}}{n} \]  

………..  Equation 1

where \( r \) is the overall degree of correspondence between the form’s tension points and the
golden rectangle, \( n \) is the total number of elevations considered, \( x \) is the number of tension
points on the elevation that conform to the golden rectangle, and \( t \) is the total number of
tension points of the elevation. Upon completing the development of the method, it was
applied to assess the degree to which three famous examples of deconstructive architecture
 correspond to the golden rectangle.

RESULTS

Tension Points

As previously explained, tension points identified by a panel of experts were collected using
the Delphi method. Table 1 shows the number of tension points that all participants in the
Delphi method had agreed upon for each building, while Figure 8 maps these tension points
on two adjacent facades of each case study.
Table 1. Number of tension points identified by the Delphi panel in each case study (Source: Authors).

<table>
<thead>
<tr>
<th>Case Study</th>
<th>No. of tension points</th>
<th>Total no. of tension points</th>
</tr>
</thead>
<tbody>
<tr>
<td>41 Cooper Square</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Front view</td>
<td>23</td>
<td>43</td>
</tr>
<tr>
<td>Side view</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Cincinnati Contemporary Arts Centre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Front view</td>
<td>24</td>
<td>52</td>
</tr>
<tr>
<td>Side view</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Perot Museum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Front view</td>
<td>17</td>
<td>33</td>
</tr>
<tr>
<td>Side view</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

The table shows that the Cincinnati Contemporary Arts Center has the highest number of tension points with 52 points, followed by the 41 Cooper Square with 43 points, whereas the Perot Museum has the least number of tension points with 33 points. Discussions with the panel of experts have indicated that the form of the Cincinnati Contemporary Arts Center looks and feels more complex and dramatic compared with the other two projects. This could be due to the clear displacement of the elements of the elevations that had resulted in a stronger definition of the forming geometries. Another reason could be that this form consists of a large number of basic geometries that are connected and composed in an unexpected manner, as opposed to the other two projects, where fewer, but more distorted and skewed geometries were used. In addition, the variation in the colours of the Cincinnati Contemporary Arts Centre creates stronger contrasts between the geometrical shapes, resulting in a robust visual tension.

Once the tension points of the form of each case study have been determined, the previously described method was applied to analyze the extent to which the tension points correspond to a selected matrix of displaced golden rectangles. This step allowed the researchers to test the hypothesis underpinning this study; the golden ratio, as a proportional system, is manifested to a varying degree in deconstruction architecture.

**Degree of correspondence**

Several golden rectangles, with variations in scale, location, and orientation, were tested on two elevations of each case study. Due to the aim of the study, this process was iterative and exploratory in nature. The researchers attempted to test as many golden rectangles as possible to ensure a proper and comprehensive coverage of each elevation. Golden rectangles that overlapped with the tension points were then retained. Figure 9 illustrates the process of applying the matrices of the golden rectangles to the Cincinnati Contemporary Arts Centre.
Figure 8. Tension points of the case studies as identified by the Delphi panel of experts (Source: Authors).
Figure 9. Example of applying the proportional matrix to test the correspondence between tension points and the golden rectangle, Cincinnati Contemporary Arts Centre (Source: Authors).

The results of this exercise are shown in Figure 10, which illustrates the tension points in each project, as identified by the panel of experts, and the corresponding golden rectangles. For each elevation, three golden rectangles were found as “the best fit” for the tension points. The data from this figure were extracted to calculate the degree of correspondence ($r$) using Equation 1, as shown in Table 2.

The results support the hypotheses of this study and show that in all the projects considered for this study, a high degree of correspondence was found between the tension points and the golden rectangles. The highest degree of correspondence was found in the Perot Museum, followed by the 41 Cooper Square, with negligible difference (approx. 0.02%). The Cincinnati Contemporary Arts Centre had shown the lowest degree of correspondence, with a value of 0.56%. A careful examination of Figure 10 shows that the Cincinnati Contemporary Arts Centre has the highest number of tension points that conformed to multiple golden rectangles. This project also had the highest number of total tension points, as shown in Table 1. These two factors have contributed to lower the degree of correspondence of this project.

In conclusion, the results showed that the golden rectangle, as a proportional system, was found to be manifested, to a varying degree, in the three chosen case studies. This observation supports the hypothesis underpinning this study and suggest that the tow-dimensional generative elements of the elevations that, when extruded, cause the form to deform, fragment or distort are govern to varying degree by the golden rectangle. Table 3 shows the number of tension points in each case study that conform to multiple golden rectangles. Higher number of these points indicates stronger presence of proportional systems in the case study. The Cincinnati Contemporary Arts Centre has the highest number of tension points that conformed to multiple golden rectangles, indicating a stronger presence of the golden ration.
Table 2. Degree of correspondence between tension points and golden rectangles for each case study, calculated using Equation 1 (Source: Authors).

<table>
<thead>
<tr>
<th>Case study</th>
<th>Elevation</th>
<th>Total number of tension points (n)</th>
<th>Number of unique corresponding tension points**</th>
<th>Total number of corresponding tension points (x)</th>
<th>Degree of correspondence of the elevation (x/t)</th>
<th>Overall Degree of correspondence (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooper Square</td>
<td>Front Elevation</td>
<td>23</td>
<td>Red 7</td>
<td>17</td>
<td>0.74</td>
<td>0.77</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Blue 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Green 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side Elevation</td>
<td>20</td>
<td>Red 6</td>
<td>16</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Blue 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Green 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cincinnati Contemporary Arts Centre</td>
<td>Front Elevation</td>
<td>24</td>
<td>Red 8</td>
<td>15</td>
<td>0.63</td>
<td>0.56</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Blue 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Green 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side Elevation</td>
<td>28</td>
<td>Red 10</td>
<td>15</td>
<td>0.54</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Blue 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Green 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perot Museum</td>
<td>Front Elevation</td>
<td>17</td>
<td>Red 7</td>
<td>12</td>
<td>0.71</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Blue 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Green 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side Elevation</td>
<td>16</td>
<td>Red 5</td>
<td>14</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Blue 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Green 6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* n is the total number of elevations considered. For all case studies, n = 2.
** If a tension point is overlapped with more than one golden rectangle, it is only counted once.

Table 3. Number of tension points that conformed to multiple golden rectangles in each case study (Source: Authors).

<table>
<thead>
<tr>
<th>Case study</th>
<th>Elevation</th>
<th>Number of tension points that conformed to multiple golden rectangles</th>
</tr>
</thead>
<tbody>
<tr>
<td>41 Cooper Square</td>
<td>Front Elevation</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Side Elevation</td>
<td>0</td>
</tr>
<tr>
<td>Cincinnati Contemporary Arts Centre</td>
<td>Front Elevation</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Side Elevation</td>
<td>1</td>
</tr>
<tr>
<td>Perot Museum</td>
<td>Front Elevation</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Side Elevation</td>
<td>1</td>
</tr>
</tbody>
</table>
Figure 10. The overlapping matrices of the golden rectangle and tension points. The letters A, B, and C depict the tension points that conform to the red, blue, and yellow golden rectangles, respectively (Source: Authors).
DISCUSSION AND CONCLUSIONS

This study challenges the general understanding among the architectural community, which promotes the idea that deconstructive architecture is based on random compilations of unrelated, displaced, and distorted geometries, resulting in compositions that do not follow traditional design principles, such as proportional systems and harmony. In particular, this study has examined the extent to which forms and compositions in deconstructive architecture are “random”. This focus was motivated by the hypothesis that since seeking patterns and order is an ingrained tendency in human beings, and since architects are trained to capture and apply proportional systems in their designs, then, proportional systems, such as the golden rectangle, are likely to be manifested in the deconstructive designs to varying degrees, whether consciously or unconsciously.

To test this hypothesis, two interrelated methods were used. First, a matrix of displaced golden rectangles was developed to test existing forms for the extent to which they conform to the golden rectangle. This method can also be used as a design tool to develop forms that achieve the golden ratio in their generative elements. Second, a two-round Delphi method was used to identify the tension points of three famous deconstructive projects, namely, the 41 Cooper Square, the Cincinnati Contemporary Arts Centre, and the Perot Museum. The idea of tension points was borrowed from the Visual Tension concept, which is well known in art, and is defined in this study as the points of the generative two-dimensional elements of the form at which the composition of a building starts to deform, distort, or fragment to create visual tension, interest, and imbalance. Then, the tension points were examined to check the degree of correspondence between their locations and selected golden rectangles.

It was found that the tension points of the three case studies conformed, to a varying degree, to the golden rectangles, thus, confirming the hypothesis. This suggest that some of the main generative two-dimensional elements on the examined elevations that, when extruded, caused the form to deform, fragment, or distort correspond to the golden ratio to certain degrees. The highest degree of correspondence was found in the Perot Museum, with 0.79 of the tension points conformed to the golden rectangle. Similar results were found in the 41 Cooper Square, with 0.77 of the tension points conformed to the golden rectangle. The lowest degree of correspondence was found in the Cincinnati Contemporary Arts Centre, with a ratio of 0.56%. However, this particular project has the highest number of tension points that conformed to more than one golden rectangle at the same time, indicating a strong presence of the golden ratio.

This paper uses the concept of tension points to examine the extent to which the forms in deconstructive architecture conform to the golden rectangle as a measure of aesthetics and order. Although tension points have been used in art at a two-dimension level, to the authors' best knowledge, its use in the context of assessing the two-dimensional generative elements of the three-dimensional forms of deconstructive architecture is rather original. For example, in his search for the golden ratio in art work, Kappraff (2004) believed that it is likely that artists have unconsciously built points of tension in their art in ways that correspond to the golden ratio that would result in “the natural state of tension” needed by the human brain to recognize an art work as pleasing. He added, “I, myself, have created a template from which I can measure certain points of tension and focus in many classic paintings and invariably found them to conform to the golden section”. In fact, our findings from analyzing and studying deconstructive architectural forms are aligned with his findings from analyzing paintings.
This study has provided evidence that deconstructive architecture is not as random as it looks to the naked eye, and that it is governed by varying levels of proportional systems. It has shown that deconstructive architecture is not a type of “free-form” architecture, as classified by Wong (2010). The scope of this study did not include determining whether the search for regularities through proportional systems in architecture is a sort of Apophenia, i.e., human tendency to seek patterns in unrelated data or things, or not, and whether researches in this area are “misfits” or informative. The debate in this topic is long-lasting and seems to be endless. Nevertheless, the role of proportional systems, such as the golden ratio, in architectural designs is almost undeniable. In fact, the role of proportional systems in architecture is deeply rooted in human history and in the theory of architecture, as previously explained. This is may be best summarized by Frings (2002), who provided evidence of the value of proportional systems from the ancient work of Vitruvius, who believed that an educated architect has to know arithmetic, geometry, and proportion of the human body; to Leon Battista Alberti in the Renaissance era, who recommended simple numerical proportions to architects; to Serlio, Vignola, and Palladio’s use of simple and commensurable ratios, and to the work of Luca Pacioli, who was a great admirer of the golden ratio in the 19th century, to Adolf Zeising, who arguably discovered the golden ratio for architecture; to Neufert and Le Corbusier’s work on the golden ratio in the 20th century. Our findings extend these works by providing more evidence that proportional systems are manifested in contemporary movements, namely, deconstructive architecture, in the field of architectural design.

Although the design process in architecture is complicated and difficult to understand as it involves some mix of rationalization, intuition, and preference (Alalouch, Aspinall, & Smith, 2015), this study shows that proportional systems, such as the golden ratio, are unavoidably manifested in architectural forms and compositions that are generally accepted and seen as pleasing to the mind. This manifestation could be explicit or implicit, conscious or unconscious.

This paper also contributes to the body of knowledge by introducing a design and analysis method that can be used to develop forms that conform to the golden rectangle. Such a method would increase the freedom of the design, without imposing unnecessary restraints on the process. It could also be used to establish a design language that systematically embraces beauty rather than excludes it. This method can also be used to assess existing forms to determine the extent to which they embrace proportional systems, as shown in this study.

Due to its simplicity and ability to provide variation of forms that conform to the golden ratio, the method can be used in design education as an active-learning mechanism contributing to the knowledge-integrating theory of design education (Salama, 2015). Unconventional and systematic method are not very common in design studio teaching. An exception of this is the method introduced by Alalouch (2018) which uses simple model-making tasks to introduce parametric thinking to novice design students. Similarly, the method could be used as an active- and experiential-learning tool in theory courses that address the proportional systems as part of its syllabus. This aligns with the work of Salama and MacLean (2017) who called for the integration of active and experiential learning into theory courses in architectural education.
One limitation in this study can be associated with the availability of data and drawings of deconstructive projects. Future researches should expand the work presented in this paper to include a larger sample of deconstructive architects, and explore the existence of other proportional systems along with the golden ratio. This work should be combined with subjective observations and data related to the design process that deconstructive architects use in a day-to-day basis. In other words, future researches should explore the design process behind deconstructive architecture in addition to the finished product. This will most likely open a window into how deconstructive architects think, and the role of their education and experience in the manifestation of proportional systems in their designs. In addition, the examination in this study was limited to applying a matrix of displaced golden rectangles on two elevations of each selected project to examine whether the generative two-dimensional elements of the composition conform to the golden ratio. Future work should pursue the development of a three-dimensional presentation of the golden rectangle to better capture the degree of correspondence between the three dimensions of the form and the golden ratio.

Equally important, the design and assessment method presented in this study should be tested in an educational context and examined in terms of process and product. This method should be tested with undergraduate design students to produce simple proportion-friendly forms. The feasibility of this proposed method and its impact on learning domains should be observed and examined.

All things considered, this study has shown that deconstructive architects have applied Aristotle’s statement, beauty is to “maintain the just measure” (Lawlor, 1989, p. 3), which might provide justification to the wide acceptance of the movement. This paper does not aim, however, to glorify the golden ratio nor to examine its accuracy in architecture. It aims to show that designers, whether consciously or unconsciously, do implement some sort of proportion systems in their designs, even in the most extreme architectural style as the deconstructive architecture.

**REFERENCES**


INFLUENCE OF PARAMETRIC TOOLS ON THE COMPLEXITY OF ARCHITECTURAL DESIGN IN EVERYDAY WORK OF SME’S

DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1665

Adeline Stals; Sylvie Jancart; Catherine Elsen

Keywords
architectural design; parametric modeling; complexity; SME’s

Abstract
Digital design tools and notably parametric ones have generated profound modifications of the architectural practice. In line with this evolution, technological and formal changes at the scale of architectural artifacts are underway, leading to a shift especially in regard of how architects deal on an everyday basis with CAD and morphological complexities. Big offices, thanks to their human and financial resources, have faced these difficulties and pushed the limits of their architectural projects. Little is known, however, about how smaller offices, accounting for the largest part of the European market, did adapt to these profound evolutions. Going through the results of a large-scale online survey, this paper analyzes the Belgian case regrouping mostly small and medium offices. The contribution discusses the meaning of parametric design for architects and reflects particularly on how architects do or do not implement these new digital tools in their everyday workflows. The results eventually shed light on the fact that parametric tools have the potential to free the creativity of SME’s and moreover unveil how these tools might overcome some of the current complexities of the daily architectural practice.
INTRODUCTION

Digital design tools are no longer a substitute for hand-drawing tools. Beyond the possibility of innovating in terms of architectural morphology, those tools actually induce a cultural change. This change takes place technically and humanly, as both the ways of practicing architecture and its disciplinary definition have changed in recent decades (Picon & Razavi, 2011).

The evolution of technologies on various levels (design, calculation, manufacturing) has certainly allowed the emergence of new profitable constructive possibilities, but has also paved the way for renewed levels of complexities inside the architectural workplaces. A research by Chase and Murty (2000) mentions in that regard two notions of complexity. They name the first one, the design complexity, relating to the appearance of the designed object, also discussed by Oxman and Gu (2015, p. 477) under the term morphological complexity: “among its forms of influence, parametric design has affected the topological and formal characteristics of designs produced in diverse design fields such as architecture, industrial design and fashion design.” The second complexity, CAD complexity, is actually what Chase and Murty develop in their paper. They define CAD complexity in an architectural context, relating to the use of CAD functions applied to both organization and production of the completed model. This opens discussions about the evolution of morphological and tools’ complexity, and how they are actually perceived by the day-to-day practitioners.

These evolutions, and notably these emerging forms of complexity, have been faced by big offices thanks to their resources and large teams of software engineers, enabling them to train their teams to these renewed workflows. Research studies have been generally performed within these large offices whose parametric practices are recognized, setting aside the experimental applications of parametric tools inside small and medium architectural firms (SME’s)¹. Yet, SMEs represent 77.7% of the Belgian offices in 2016 and moreover an estimate of 99% in Europe in 2014 (Architects’ Council of Europe, 2015). Questioning their day-to-day digital practices is therefore crucial, considering the representativeness of offices of these sizes. We therefore wonder: have parametric tools influenced the complexity of SME’s everyday architectural design? And if yes, in which way?

The goal of this paper is to discuss how designers have experienced these technological and formal changes. In order to do so, we collected empirical data through a large-scale online survey that structured knowledge about Belgian architects’ and architectural engineers’ everyday practice.

The paper first goes through a review of complexity and its evolution through history of architecture. This evolution contextualizes the emergence of parametric modeling and highlights our research gap. We go further with technical details and the methodology used to design and distribute the online survey. The summary of the main results is later divided in three parts: firstly we review the state of digital and parametric tools’ uses in everyday practices, then these results are completed by an analysis of Belgian designers’ interest in

¹ In a report written by the Walloon Region (Direction générale de l’Economie et de l’Emploi, General Direction of Economy and Employment) defining the term SMEs in the European sense, a society of less than 10 employees is called micro entreprise. Taking into account the particularity of the architectural market compared to the economic market in general, we refer to these small offices as SMEs in this research.
and understanding of parametric tools. We eventually dig deeper into the impact of digital and parametric tools on architectural practices. A discussion about the results addresses the perception of digital tools and the understanding of parametric ones. We also discuss where the complexity in the daily work lies in SME’s.

THEORETICAL EVOLUTION OF MORPHOLOGICAL COMPLEXITY THROUGH HISTORY OF ARCHITECTURE

This section deepens the notion of complexity in architecture in light of three consecutive eras of architectural history: first when the physical experimentation was considered the primary tool for dealing with such complexity, second at the very beginning of digital architecture and, third, in regard of the current use of digital design tools. We close this section by clarifying some confusion that may persist in the field of parametric design, especially when it comes to the multiple definitions of the concept itself and the categorization of well-known commercial software in each of its sub-categories.

Morphogenesis through experimentation

In the past, understanding and controlling morphogenesis of structures, often inspired by nature, usually relied on empirical, trial/error methodologies requiring complex physical prototyping and experimental settings. Architects and engineers such as Antonio Gaudi, Heinz Isler or Frei Otto conducted such studies in order to progressively refine their funicular, shell or lightweight tensile and membrane structures (Stals, Elsen, Jancart, Delvaux, 2015). One can admit that these architectures expressed a certain kind of simplicity both on an aesthetic and structural level, given the intrinsic coherency of their formation process. However those experimental processes still generated complexity in terms of mathematical description of the shape, not yet mastered at that time. Moreover, those mechanically constrained generated shapes, chosen because they ensured some structural coherence, also limited the architects in the diversity of exploitable morphologies.

First step into the digital era

In the late eighties, computer aided design machines speeded up the drafting and modifying process, leaving the rest of design steps mostly unchanged. CAD, first intended as a medium for production, was perceived as difficult to use in the early stages of the design process where the priority should remain creativity rather than precision (Guidera, 2011). The increasing complexity of architecture nevertheless pushed architects to find tools adapted to express their ideas. Some architects focused their research on how to model their ideas, others have been interested in how to communicate them notably through immersive virtual environments (Abu Alatta & Freewan, 2017).

In the early 21st century, a new generation of tools (such as parametric software) started to emerge and more deeply impacted the design process. Generative design approaches, among them, resulted from the need for renewed strategies to facilitate the exploration of alternative solutions in design, considering computers as an opportunity to achieve unexpected but viable solutions, rather than a thread. Kolarevic (2003) used the term “digital morphogenesis” to refer to design processes in which digital media is not used for representation but as a generative tool for the derivation of form and its transformation.
However, the inventory of projects designed at that time indicates that the complexity of these shapes did put some distance between the ideas on screen and their feasibility. Most of the software used at those early times, initially supposed to simplify the design process, rather generated multiple levels of complexity. Based on what Picon appointed as disruptions (2010), we sum up these renewed complexity levels in three main categories, partly explaining from our point of view why lots of these complex shapes remained at a virtual stage (Stals, Elsen, Jancart, 2016). One complexity takes place between morphology and structure, the digital approach rather encouraging morphological audacity at the expense of structural coherency and rationality. Another complexity appears at the interface of multidisciplinary skills and knowledge of the design process, tarnishing the already intricate collaborative process by multiple confusions and misunderstandings. The last identified complexity operates at a scale and tectonic level of the project. The evolution of digital manufacturing tools has enabled the development of new building materials and especially to personalized prefabrication, sometimes confusing the distinction between primary and secondary elements of buildings, for instance. All these complexities, we argue, lead to tensions between architectural desires and practical, technological feasibility.

Digital architecture today

Lately, more and more of these complex shapes have been built. Projects such as the Pompidou Center by Shigeru Ban, or the Louis Vuitton Foundation by Frank Gehry have indeed been erected, demonstrating that larger companies (generally taking advantage of generous budgets) have found ways to work around those levels of complexity. The attitudes of architects are consequently slowly evolving, some of them realizing that the introduction of digital tools into the design process might enable more than simply representing and processing information. Those architects, depending on their capacity of action, are therefore ready to explore how these tools might contribute to the development of innovative morphologies, better adapted to their expectations and creativity (Terzidis, 2004). By doing so, they still have to address the above-mentioned complexities, and to do so they tend to develop specific protocols and strategies. These protocols and strategies have been firstly studied in the context of large, internationally recognized architectural offices. Shelden (2002) for instance has questioned the representation and constructability of Gehry’s Architecture with respect to parametric use. Specifically on parametric tools, we can mention the research of de Boissieu (2013), again conducted in large offices whose practices are recognized, showing what characterizes the architects’ cognitive operations when using parametric tools.

While large architectural firms have thus developed their own research and development teams, and even their own proprietary software, little is known about the strategies developed by small and medium architectural firms. This gap is even more relevant when looking at parametric design in architecture. Following up existing literature on this topic, the only study paving the way on how small agencies deal with digital tools was indeed carried out in Austria and England but could not be concluded due to lack of architect’s participation (Dokonal & Knight, 2008). More specifically in Belgium, the last study about the use of design tools by architects was conducted in 2008 (Weytjens, Verbeeck, & Verdonck, 2009). The goal of this survey, mainly addressed to the North part of the country, was to assess the impact of different type of design support tools (DSTs) through the decision making process. This research was thus not specifically focusing on the role of parametric tools in architectural practices, nor did it tackle the confusion that might occur between the various interpretations of the terms in this field. It rather classified six types of design tools according
to the role they played all along the design process: based tools, communication tools, modeling tools, presentation tools, structuring tools and evaluation & analysis tools.

In parallel, some studies investigated parametric through experimentations in an academic environment. For example, Guidera (2011) analyzed parametric as an exploratory design medium for novice students, shedding light on the fact that formal exploration is more frequent than expected. Some studies, on the other hand, develop some interest for parametric processes in architectural practices but do not identify their field study. Peters and Whitehead (2008) for instance evoke in particular the interest of parametric to link parameters and therefore to give more coherency to the project, but without supporting these affirmations by concrete field research. Table 1 sums up this panel of previous researches and highlights (in the grey column) the little interest for SME’s practices in general, and for the use of parametric tools in particular.

Table 1. A look into researches done about digital and parametric practices. In regard of each column (i.e. each category of observed participants) the minus (-) and plus (+) indicate how familiar those participants are with the technology, according to the respective authors (Source: Authors, 2018).

<table>
<thead>
<tr>
<th>Authors</th>
<th>Years</th>
<th>Topic</th>
<th>Country of the research</th>
<th>Students</th>
<th>SMEs</th>
<th>Large offices</th>
<th>Offices with no specific size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chien, Yeh</td>
<td>2012</td>
<td>Creative design process in parametric design</td>
<td>Unspecified (country of authors : Taiwan)</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td>de Boissieu</td>
<td>2013</td>
<td>Parametric modeling in architectural design: characterization of cognitive operations</td>
<td>France</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dilys, Burry</td>
<td>2010</td>
<td>State-of-the-art of parametric modeling and analysis of degree of software openness</td>
<td>Australia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dokonal, Knight</td>
<td>2008</td>
<td>State of digital architectural design</td>
<td>UK, Austria</td>
<td>x</td>
<td></td>
<td>Irrelevant</td>
<td></td>
</tr>
<tr>
<td>Guidera</td>
<td>2011</td>
<td>Conceptual design, exploration using parametric computing</td>
<td>USA</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peters, Whitehead</td>
<td>2008</td>
<td>Discussion on geometry, shape, complexity with an algorithmic approach</td>
<td>UK</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Shelden</td>
<td>2002</td>
<td>Digital surface representation and the constructability of Gehry’s Architecture</td>
<td>USA</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>
In addition to this scarce quantity of research conducted in SME’s, we observed during some focus groups that architects were still confused about terminology related in particular to BIM and parametric fields (Stals, Jancart, & Elsen, 2018). The following section summarizes the results and clarifies certain terms.

The various understanding of “parametric design”

Confusions actually exist in regard of what can be called “parametric design” and how one can distinguish between the various commercial software offered to architects. We will therefore first define what this paper refers to as parametric design and confront it with the notion of Building Information Modeling (BIM). We will then go deeper into the explanation of parametric modeling.

To understand the fundamental meaning of parametric design ((a) – see Figure 1 below), we should go back to its very first steps and more specifically to the formal research carried out by Antonio Gaudi, especially for the generation of funicular curvature vaults of the Sagrada Familia. Parametric design was once analog and this research can effectively be considered as part of the very first reflections that led to the current digital parametric design. Considering this seminal work, parametric design can therefore be defined as a design methodology that enables, among other things, to generate forms from the exploitation and manipulation of a large amount of environmental, acoustic, structural, social or urban data taken over as ‘parameters’.

This early version of a definition can be completed by the following statement of Oxman and Gu (2015, p.479): “the interest of the practice is a passage from drawing of a singular object to the construction of a design process. In the parametric design process, once the rules are implemented, an unlimited number of design alternatives can be generated in parallel.” From basic parametric design there is consequently a shift towards parametric design process, characterized by three principles according to Woodbury (2010):

1. Designers develop rules and define their logical relationships while creating 3D visualization models;
2. Designers can modify their model at any time;
3. Design alternatives can be developed in parallel at any stage of the process.

Recent developments in computer science have seen the emergence of two modeling processes, both of which have gained recognition while sometimes inducing certain forms of confusion (Figure 1): parametric modeling (b) on one hand, and BIM (Building Information Modeling) (c) on the other hand. These two terms, commonly used, overlap and are sometimes misused. Indeed, these two modeling logics share the same goal of integrating various data into the architectural project. While in the BIM process, data integration rhymes with adding an additional layer of information to some geometric model, confining the data to
Complementary static elements, the case of parametric modeling directly integrates the data in a process of morphogenesis, and can therefore be referred to as computational design.

Looking now at these computational design processes, two additional types of modeling emerge. They distinguish mainly in terms of selected modelers. In the context of parametric modeling software (e) such as Rhinoceros® or Digital Project®, the designer has to link parameters and dimensions to pre-programmed geometric constraints. For example, to create a circle in Rhinoceros®, the consumer sets up the preprogrammed “circle” function and provides it with parameters (center position and radius). On the other hand, in algorithmic modeling software (f), such as GenerativeComponents® or Grasshopper®, the designer is invited to manipulate a textual or visual programming language (similar to a computer programming code) that enables him/her to go beyond the limits of the user interface (Leach, 2014). In the remainder of this article, although the term "parametric" is retained because of its common use in architectural research, we will focus only on algorithmic modeling software and more specifically on those with a visual programming interface. Indeed, looking into the small community of early adopters, this mode of visual programming seems preferred by the architects, propelling Grasshopper® to the rank of the most widely used parametric software in general (Cichocka, Browne, & Rodriguez, 2017) and also in Belgium, proportionally speaking (Stals, Elsen, Jancart, 2017).

Consequently, and in order to summarize what we mean by parametric modeling in this paper, we rely on the words of Turrin and his colleagues (Turrin et al., 2015, p. 5):

“Parametric modelling allows representing geometric entities having editable attributes, and relationships by means of associations. Attributes can be expressed by independent values, which act as input to the model; their eventual variations generate different solutions of the model. Associations allow for processing the data across the related geometric entities; this means the different solutions of the model are generated while respecting the consistency of pre-established relations among geometric entities”.

Figure 1. Relation between terms in the field of parametric design and focus on “algorithmic modeling” referred to as “parametric modeling” in the remainder of this paper (Source: Authors, 2018).
To complete this semantic review, one has to acknowledge the fact that some parametric modeling software (a) moreover support BIM processes (c), just as efficiently as they support parametric modeling (b) (see Figure 2). To differentiate between these two modeling logics, we therefore refer to the writings and examples provided by Janssen and his colleague (Janssen, 2016; Janssen & Stouffs, 2015). These authors categorize these two types of parametric modeling according to the type of iteration each software supports. To start with, they refer the term “associative modeling” to BIM systems such as Graphisoft ArchiCAD© and Autodesk Revit©. This type of modeling is characterized by the simplest type of iteration: single-operation, which applies the same operation simultaneously over multiple geometric entities, limiting the ability to automate the model-building process. For instance, if the input of an ‘extrude’ operation consists of a list of polygons, then the node may iterate over the list and extrude each polygon in turn. In contrast, the authors associate “data flow and procedural modeling” to parametric modeling, used for software such as McNeel Grasshopper© or Autodesk Dynamo© for instance. In this case, the software rely on implicit multi-operation iteration which is the most powerful. Working with data structures, it therefore performs more complex types of data matching. For example, if the extrusion distances are also provided as a list, the operation may iterate over different lists. The procedural modeling is therefore defined as “supporting explicit multi-operation iteration”. Authors eventually close the subject by listing “object modeling”, which refers to software supporting no kind of iteration, such as SketchUp©. This type of software does not generate confusion with other classifications because they are generally not seen as parametric modeling software by architects.

Figure 2. Types of parametric modeling software, on basis of Janssen and his colleagues’ work (2016) (Source: Authors, 2018).
RESEARCH GAP

The need to clarify these multiple definitions and categories is related to the fact that no consensus has been reached, neither among the community of practitioners nor among the scientific community. Yet, digital tools, and specifically parametric ones, are nowadays recognized for their potential to lead to new complex, non-standard pieces of architecture. Lots of researchers have focused on large offices’ strategies, but little is known about how small and medium architectural offices do deal with such digital tools.

Considering this current state of knowledge, this paper will therefore address three main research questions:

- How is the parametric modeling perceived? Do architects express interest for new software such as parametric ones?
- Considering the use of digital tools nowadays, how do architects specifically use parametric tools?
- What influence do parametric tools have on the design process? Where does the day-to-day complexity hide in regard of those parametric tools?

In line with these questions, the next section reports findings collected from a large-scale survey identifying (i) the current situation of Belgian offices and more specifically the challenges small and medium offices face in dealing with digital tools during their design processes, and (ii) their perception of complexity all along these processes.

PRACTICAL LOOK INTO BELGIAN PRACTICES

Methodology

To question the digital tools architects use and their parametric knowledge, we decided to interview the Belgian community and its large proportion of small and medium architectural offices. To do so, we contacted about 13,000 architects or architectural engineers registered in the three different regional Architects Associations, out of the 14,482 members registered in 2016 (Ordre des Architectes, 2016). Regarding the large amount of people to reach, we used an online-based survey strategy in order to explore the previous research questions. The following sections aim at describing the methodology to rigorously build and analyze this survey.

The questionnaire was built around three main sections: demographic data, digital tools, and parametric practice. The first part aimed at collecting the participants’ demographic data in order to contextualize each profile. Ten questions were formulated (1 open-ended question, 7 semi-open questions and 2 closed-ended questions) and mainly related to the participants’ gender, age, background, expertise, main day-to-day tasks and size of firm. The second section questioned designers’ digital culture, the digital tools they used on a daily basis, their feelings about those digital tools and the impact those digital tools have on the architectural design process, from their point of view. This section contained 26 questions with 6 open-ended questions, 10 semi-open questions and 10 closed-ended questions. In this paper, the analysis of this section will solely focus on the participants’ knowledge and use of parametric tools. Other results specifically focusing on the role of digital tools in regard of multidisciplinary work for instance have been published elsewhere (Stals, Jancart, Elsen, 2016). The concluding section investigated parametric design and tools, whose results will
be the chore of this paper. This section was structured around 9 questions (1 open-ended question, 1 semi-open question and 7 closed-ended questions), discussing the understanding of the concept and the impact on practice. This section asked, for example, to “rank according to your priority the difficulties encountered when using parametric tools.” It also investigated whether designers felt concerned by the arrival of new parametric design tools or in what time period they planned to train themselves to parametric tools use. The whole survey is available on demand (please contact authors).

The questionnaire was tested with a first round of three architects, which enabled us to clarify the meaning of some statements, to adapt some fixed-alternatives answers and to test the time needed to complete the questionnaire rigorously.

After this test-survey, we concluded that if a completed survey fulfilled one of the following criteria, it was considered unusable and therefore was not included in the next steps of our research:

- The survey was completed far too quickly and therefore could not have been taken seriously. The test-survey round demonstrated that the 15 minutes boundary was the right limit;
- Only the first section of the survey was completed (the other two completely ignored), and therefore offered no data about neither digital nor parametric design/tools. This means that some surveys, where only a few questions have been dismissed, are still considered as valuable (in that case, a “no answer” or NA notation appears in regard to the few dismissed questions);
- Regarding the size of the firm, we put aside participants working in structures of more than 100 people. These people, the “background” and “main tasks” sections reveal, are mostly architects working as academics only or included in larger, contractor structures, which are out of the scope of our research.

The analysis of the data mostly concentrates on quantitative results treated in order to delineate general trends, supported by specific statistical tests and qualitative data to look more closely at some of these trends.

**Sample description**

For this study, over 700 responses were collected and 572 answers were eventually selected for analysis after cleaning the data. This amount represents 4.1% of the architects registered in the three different regional Architects Associations. The female-male observed ratio is close to the one collected through another survey conducted in 2014 by the Architects’ Council of Europe (73.0% of male architects at that time)(Architects’ Council of Europe, 2015). In our case, 72.9% of the surveys were answered by men and 26.8% by women (while 2 people did prefer not to answer), indicating that the current sample is sufficiently representative of the Belgian community. Our survey displays 49.3% of the participants under 40 years old, confirming the relative youth of the population as already observed by the 2014 survey. In regard of expertise, 32.9% of the respondents are practicing their main occupation for less than 10 years, 27.3% are practicing it for 10 to 20 years and 38.3% for more than 20 years (Figure 3 – 1.5% did not answer). Regarding their professional situation, 52.6% of the respondents are isolated, independent architects (working on their behalf), 22.0% are independent architects working for some collaborator, 5.5% are employees, while 3.9% are architectural engineers and 2.6% are teachers (other participants distribute among other occupations). Throughout this paper, we will refer to the participants as “designers”.
The 2014 European survey moreover showed that the amount of medium-sized offices was continuously decreasing, in favor of smaller structures: at the time being, already 74% of European offices counted only 1 person. Table 2 demonstrates the relevance of our Belgian case in that regard, since 42.7% of the respondents are indeed working in a firm of only one or two people. Furthermore, almost 80% of the participants are working in a structure smaller than 10 people (see shaded cells in Table 2). This trend also justifies why the paper intensively focuses on understanding the daily routines of small and medium architectural offices, not deeply studied by researchers and yet constituting the larger part of the professional practice.

Table 2. Size distribution of firms in Belgium, according to our survey (Source: Authors, 2018).

<table>
<thead>
<tr>
<th>Size of firms (number of people)</th>
<th>1 to 2</th>
<th>3 to 5</th>
<th>6 to 10</th>
<th>10 to 20</th>
<th>20 to 50</th>
<th>50 to 100</th>
<th>NA</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>42.7%</td>
<td>22.6%</td>
<td>12.4%</td>
<td>11.9%</td>
<td>5.2%</td>
<td>3.7%</td>
<td>1.6%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Results

Study of digital and parametric tools in architectural design

We organize the results of the survey under three major topics, enabling comparisons between digital and parametric tools. We begin by describing the use of digital tools in general compared to the practice and use of parametric tools. We go further by detailing the meaning of the word “parametric”, as understood by the Belgian designers, in order to delineate the complexity hidden behind this type of digital tools (in terms of multiple definitions; of existing confusions between various commercial packages). We eventually contrast the different impacts digital tools and parametric tools have on architectural practice, and notably concerning the diversity of shapes designed. This comparison highlights the generated complexities induced or mastered by each kind of tool.
State of digital and parametric practices

To complete the current state of knowledge about digital and parametric practices (Shelden, 2002; Woodbury, 2010; de Boissieu, 2013), we report in this section the results of current Belgian practice. Our results first show that 76.9% of the participants indeed use digital tools during the design phase. This percentage confirms that our research meets the current day-to-day working realities. We still have to underline that the use of digital technologies decreases as the age increases, 17.8% of the designers aged 55 and more indeed declaring not using any digital tool, while only 5.9% younger than 55 years old stating not using digital tools.

Additionally, designers were questioned about digital tools they use: “In what way do you use 2D, 3D or parametric software listed below? (Please specify if it is 2D or 3D use when you use them. Multiple choices possible)”. Figure 4, in that regard, shows that designers using design tools just for 2D drawing mainly use AutoCAD© (56.2%), followed by Vectorworks© (19.6%) and ArchiCAD© (14.8%). ArchiCAD© is also used as a 3D support tool (22.8%) but Sketchup© remains the reference for 3D modeling in architectural design, at least for 52.3% of the users. Parametric software such as Grasshopper©, Generative Component©, Vasari© or Digital Project©, as Figure 4 demonstrates, are either totally or largely unknown by the Belgian sample.

Yet, 12.5% of the participants state using parametric tools on a regular basis. Out of these participants, those who do engineering calculations are the most frequent users of parametric software (Fig. 5), followed by those who practice 3D modeling (18.6%) and those who do designs of public buildings (17.8%), i.e. larger projects. The design of residential projects comes in last (11.9%), although this type of project still represents 37.4% of the tasks generally undertaken by the Belgian architects interviewed. These figures validate the fact that designers carrying out residential projects (generally corresponding to small to medium-sized buildings) do not feel concerned by the arrival of parametric design tools, leaving them to larger, more complex projects. The following quotes about architects...
supposedly using parametric tools, according to some participants, confirm the results mentioned above: “Zaha Hadid and all the star architects”, “this type of architecture is confined to projects “headlights” and very amply funded”.

Interest and understanding of parametric tools

First of all, resulting from the following question “What evokes for you the term “parametric modeling” in architecture?” our study shows that more than half of all the respondents (51.5%, N=369) have never heard of the term “parametric modeling”. Concerning the evocation of this term, there is a slight growing tendency to better understand parametric modeling with the office growing in size. The same tendency is observed in Figure 6 in regard of the interest rate for parametric tools. To validate these trends, we have tested whether “yes” and “no” answers were equally distributed by size of offices. To do so, we used the Mann-Whitney U statistical test which rejects, in a highly significant way, the assumption that “yes” and “no” are equally distributed regardless of the size of the firms (p-value = 7.293/10000). Therefore, we can state that, at least at the time being, the smaller the offices, the less interest they have in digital tools such as parametric ones. Our results moreover underline that globally speaking only 14.4% of the respondents state “being concerned” about the arrival of these parametric tools on the market, leaving 38.6% of non-concerned participants and 47% who have no opinion.

When it comes to the perception of the term “parametric tool” (understood here as software with a visual programming interface), among the 87.5% of the respondents declaring not using parametric tools (in regard to the question : “Do you use parametric tools?”), 57.5% of them refrain from suggesting a definition of parametric modeling (according to their point of view) while 2.1% designers prefer to skip the question. 40.1% of these “non-users”, on the other hand, try to give a definition. Out of this group, 18.8% associate it with BIM process in regard of the definitions they provide, for instance “drawing software such as BIM”, “BIM or the ability to extract data from the project model”. Another 53.6% provide an incorrect definition. Answers such as “ability to output 3D, 2D and cuts generated by the model”, “complexity of shapes”, “whim of the 2000s” are indeed considered as poorly representative of what parametric modeling really is. As for the remaining 27.6%, the provided definitions
are more adequate although not complete, e.g.: “encoding of rules that will result in one or more forms, changes of parameters to change the shape”, “a huge power of shape parametrization”.

Globally speaking, one can observe that some designers are able to explain the methodology but do not grasp the added-value parametric tools might have for their own practice. Others associate some strong mathematical notions to the term, generating a perception of complexity (one of the respondent for instance quotes: “A modeling of complex shapes using mathematical formulas.”). Moreover, the parametric modeling is obviously associated by some of the non-users to larger architectural projects: “an advantage for large projects”, “bad, ugly and uninteresting architecture like NOX and Zaha Hadid or very generic architecture”, “something that has nothing to do with the job I do today ... Like any technology, its value depends on how it is used”. The Belgian architects surveyed indeed generally associate the term “parametric” to three well-known architects and their offices: Zaha Hadid, Frank Gehry and Foster & Partners. This misunderstanding of the term is also observed when looking at numbers: 82% of ArchiCAD® users indeed think it does not rank among the parametric software; yet this software can be considered as belonging to the BIM category given its library of parametric objects.

Conversely, 83% of those who have taken the plunge of parametric software (as we understand it), and who do use a plug-in such as Grasshopper® are aware of doing parametric design. In that regard, 95.7% of the architects actively using parametric tools have given an explanation of what this term means to them. 3.3% of them provide what can be considered as a wrong answer with no regard to the real added-value, e.g. “image created on basis of points defined on the X and Y axis”. Another 2.8% associate the parametric term only to the BIM process and 93.9% of those who use parametric tools give a complete definition, such as: “Design by using certain parameters (see i.e. Grasshopper). The term is mostly associated with the flamboyant forms of architects like Zaha Hadid or Frank Gehry but the technique could also be used for less extravagant designs, i.e. to design a façade system, vegetation scheme in a landscape plan...”. It therefore seems that the more parametric tools one uses, the more coherent the definition of the term is.
Impact of digital and parametric tools on architectural practice

Looking at how digital tools have impacted the architectural practice (specifically in regard of the satisfaction of use and the complexity generated), our results show that 83.5% of the respondents are satisfied with the digital tools they use, leaving 16.5% of surveyed designers unsatisfied. While 58 people (13.5%) did not answer, 27.4% find that digital tools have made their work more complex in general. Among the satisfied designers, 75.9% of designers are not only satisfied but consider that the digital tools do not make their work more complex (Fig. 7). Listing the top factors complicating architectural practice nowadays (in response to the question “List 5 factors that complicate your architectural practice nowadays? (Rank them in order of complexity)”), digital tools are among the top six factors, side by side with administrative formalities (stated 285 times); regulations (and more specifically planning regulations - 230 occurrences), “PEB” certification (Belgian building energy efficiency certification – 134 occurrences), evolving building techniques (111 occurrences) and customer requests (107 occurrences).

Figure 7. Designers and their digital tools: perception of satisfaction and complexity (Source: Authors, 2018).

If we go deeper into the analysis of complexity in the design process, Figure 8 shows that the perception of complexity in architecture in regard of digital tools globally increases with age. A generation effect is nevertheless observed for the age group 41-45. 67.1% of that age group indeed find that digital tools do not make their work more complex: the main reason being that digital tools have allowed them to save time in particular thanks to 3D visualizations and easier collaboration with stakeholders. We can expose some representative quotes such as: “No more India ink, razor blades and layers ...”, “speed of design, assisted design, fast changes, data exchange”, “It's a huge step forward in the visual presentation of the files. The client immerses himself directly in the project and understands it directly. 3D can also improve your creations.”, “improved coordination across disciplines”. We also have to notice that architects between 41-45 are less prone to find that digital tools have complicated their work, the proportion being close to the corresponding one in the “under 30 years” category. This may partially mitigate the observed global generation effect.
The survey moreover asks the participants to evaluate how design tools impact several factors of their architectural practice (Fig. 9). Most of them agree that digital tools have strongly increased the execution speed of projects, strongly facilitated exchanges with stakeholders and the implementation of projects, but they state digital tools have not at all promoted diversity of the shapes produced. Excerpts of free-field answers such as “complex shapes are difficult to represent” (e.g., curves) and “non-standard element is complex”, generating “less creativity” bring qualitative support to this result.

To fully understand the influence of the digital factor, we add here some results looking at how digital tools modify the architects’ roles, from their point of view. Designers seem first divided when it comes to the designer’s intent, and how it might have been impacted by the
digital era (38.3% totally agree – 25.0% slightly agree – 27.6% not at all agree – 9.0% no opinion). They rather agree (52.8% agree - 23.5% slightly agree) that digital tools have modified their control over the implementation of the project (15.6% not at all agree, 8.0% no opinion), and at the same time are not sure about the impact on control of building costs (30.9% for improvement – 22.4% slightly agree – 35.2% not at all agree – 11.5% no opinion).

Considering the perceived effects of digital tools, we then question more specifically the impact of parametric tools on the design process under the question: “According to you, parametric tools...”. Figure 10 lists several potential impacts parametric tools might have on the design process (as documented by Oxman & Gu, 2015), and presents how our survey’s participants evaluate these impacts (from “it facilitates” to “it complexifies” through “I do not know”). The proportion of “I do not know” answers reflects the lack of information about the role of parametric tools described in the previous section. Indeed, between 54.1 and 71.4% of participating designers do not know the value of parametric tools, confirming the analysis that 51.5% of participants have never even heard of "parametric modeling". However, when giving their opinion, architects appreciate the interest of using parametric tools. We refer to remarks like the following one: “The use of a set of parameters and various functions defining one or more geometries and one or more interactions between them, in order to create a final "shape" that is evolutionary, variable, and easily adaptable according to the variation of the basic parameters, unlike a direct Sketchup model, which is more laborious to modify later, and not "implementable"'.

The comparison of the impacts of digital tools on Figure 9 and the effects of parametric software on Figure 10 brings out another comment about promoting the diversity and complexity of shapes. Even though Figure 9 shows that a large part of the interviewed designers agree that digital tools have not at all promoted the diversity of shapes produced, Figure 10 indeed shows that parametric tools, on the other hand, do facilitate the generation of complex geometry shapes. Black sticks on Figure 10 indicate when participants believe parametric tools make much easier the generation of shapes with complex geometry, while generating a coherent numerical model that keeps and coordinates changes all along the process. Generally speaking, participants moreover recognize that parametric tools facilitate
different aspects of the design process (taking into account more parameters, exchanges between stakeholders, consistency of form and structure). To go deeper into the understanding of parametric tools’ impact on complex geometry, the following chart (Figure 11) details this trend by partitioning participants that do use vs. that do not use parametric tools. To ensure that these data could be compared, we used the Mann-Whitney statistical test. The hypothesis that the use has no effect on the perception of the use of parametric tools can be rejected in a highly significant way (p-value < 0.01). Looking at data this way, it seems that designers using parametric tools do much more agree (proportionally speaking) with the fact that parametric tools facilitate the generation of complex geometry, while non-users more largely think tools make this generation more complex (or either say they do not know).

FIGURE 11. Effect of parametric tools on the generation of complex geometry shapes depending on the use of parametric tools (Source: Author, 2018).

This last graph shows that parametric tools can somehow bridge the gap generated by the adoption of traditional digital tools in regard of the diversity of shapes, by providing a way for willing architects to (at least) facilitate the generation of more complex shapes.

DISCUSSION

Our study focuses on the role and impact digital tools, and parametric ones in particular, have on the architectural practice taking place in the large proportion of Belgian small and medium architectural firms. The Belgian case, with its representative firms’ size distribution (table 2), indeed confirms the need to devote a larger part of research to small offices’ day-to-day work. Our research therefore closes the gap between studies about parametric practice conducted in large offices, and general studies about digital practice conducted in smaller structures.

In small offices, the first difficulty lies in the understanding of the term “parametric” itself, and in the understanding of which software are considered as such. The term “parametric tool” oversees two subclasses which definitions depend on how the software manage iterations. Associative modeling tools (supporting BIM processes), on the one hand, are more and more
popular and even used in the workplace while dataflow and procedural modeling (referring to visual programming), on the other hand, still remain underdeveloped. Thanks to the data collected through our online survey, we can observe that the misunderstanding of the parametric concept itself may in part explain the tools’ limited use, at least inside the Belgian landscape of small and medium architectural firms.

Globally speaking, one can observe that designers are generally able to explain the methodology specific to parametric tools but do not grasp the added-value parametric tools could have for their own practice. Moreover, they associate to the term some strong mathematical notions that might generate an impression of complexity and fear of use.

Considering the use of digital tools nowadays, we see that more than 75% of designers use digital tools, but only 12.5% use parametric tools according to their purpose. Only 14.4% of the participants state “being concerned” about the arrival of the parametric tools, and 51.5% have never heard of the term itself. There is thus a real lack of interest for parametric tools compared to other types of more traditional software such as the ones supporting BIM processes. This difference is notably due to the fact that designers associate this practice to “larger and more complex projects” as well as larger offices. Indeed, we observe that the evocation of the term “parametric modeling”, the understanding of it, as well as the fact of feeling concerned about it, are following a slight growing tendency with the office increasing in size. In practice, parametric tools are also more used for engineering calculation, leaving aside their potential for the Belgian architects’ main mission (in regard of typologies of projects undertaken), that is the design of residential projects.

Concerning the perceived complexity hidden in their day-to-day work, and although our results show that 83.8% of the respondents claim to be satisfied with the software they use, digital tools remain among the top six factors considered as source of complexity in the architectural practice nowadays. The architects also seem to be more impacted by the use of digital tools as their age increases. Beyond this aspect, architects state that digital tools have promoted some aspects of their design processes such as the speed of execution of projects or the exchanges between stakeholders. The diversity of shapes produced is however differently perceived, as 42.7% of the designers consider that digital tools have not at all promoted such diversity. Comments such as the following one underlines this paradox: “not managing a 3D program perfectly can limit the design process for fear of not being able to model something”.

When looking at how parametric tools in particular have impacted the daily architectural practice, our first observation is that there is an obvious lack of knowledge about the potential effects of parametric tools. As illustrated on Figure 10, between 54.1 and 71.4% of participating designers do not know the value parametric tools might have for the design process. Yet, we also notice that architects more regularly using parametric tools particularly appreciate the support in terms of generation of complex geometric shapes and the flexibility to manage those shapes: “innovative approach that allows to generate shapes with complex geometry from the exploitation of a large amount of data”.

It seems that the positive influences of parametric tools, as perceived and experienced by architects, may partly overcome the complexities listed over time. Formerly, as discussed in the Morphogenesis through experimentation section, the experimental processes generated complexity in terms of mathematical description of the shape, at that time not yet mastered. This complexity is nowadays overcome thanks to the parametric modeling process allowing both modeling control and flexibility. Digital tools in general provide a wider number of shape
possibilities, although at first creating tensions between ideas and technical feasibility. With time, practice and expertise, it seems that parametric tools help taking into account from the start several parameters (Fig. 10), such as materiality and structure, this way bridging the gap towards an historic complexity generated by the integration in architecture of the first digital design tools, as developed in the section First step into the digital era.

CONCLUSION

The goal of this paper is to shed light on the influence parametric tools have on the day-to-day practice of small and medium architectural firms, as well as on the complexity of architectural design as perceived by these SME’s. To this goal, we sent a survey to 13,000 Belgian architects and architectural engineers. We collected 700 answers, out of which 572 have been considered valid and treated. The online survey is built in three main sections gathering firstly some demographic data about the participants, secondly data about digital practice and culture and thirdly data about parametric practice and knowledge.

In order to reveal which tools create the complexity of the daily work, we have analyzed the data from different angles. First, we can state that the very limited use, lack of interest and general misunderstanding observed when referring to parametric tools is understandable (given its relatively recent introduction into practice), but still necessary to overcome in architectural SME’s. Statistically significant results support the observation that the size of the office stands by far as the main factor influencing the level of understanding and of interest when it comes to parametric tools. A sharp increase in knowledge of these tools is indeed observed as offices grow in size. From our point of view, the global misunderstanding occurring in smaller structures might partly explain why they generally delay, or even reject, their possible use. Another factor influencing the use of parametric tools is mostly related to the nature of the task to achieve: engineering calculations, compared to design of residential projects, more easily engage designers in using parametric tools, although residential projects constitutes the larger part of architectural SME’s day-to-day missions.

Second, our results show how designers, globally speaking, state feeling limited in achieving the design of a diversity of shapes with traditional digital tools. In regard of the research conducted by Chase and Murty (2000), it seems that two types of complexity might explain this sense of limitation: the design complexity and the CAD complexity. The first one relates to the appearance of the designed object whereas the second one is about the CAD functions used to make a model. Our results address both these levels of complexity and show that SME’s are currently still facing the second complexity while big offices seem to be progressively dealing with the first one.

Considering these observations, we investigate parametric tools as a potential solution to this lack of current digital support when it comes to morphological audacity. Looking especially at the diversity and complexity of forms, we argue that parametric tools, once they will have penetrated SME’s architectural habitus, will carry the necessary potential to free SME’s creativity.

REFERENCES


LOCATION BASED DATA REPRESENTATION THROUGH AUGMENTED REALITY IN ARCHITECTURAL DESIGN

Faruk Can Ünal*, Yüksel Demir

Keywords

location based data; augmented reality; architectural design

Abstract

Architects conduct site visits prior to a design activity to understand existing conditions. If the architect's position and orientation are known on site, and augmented reality system has access to a location based content database of the site, then augmented reality system can display the content in 3D directly upon the architect's view. Generally, architects use augmented reality as a visualization tool for presentation. It is also possible to collect data of a site and represent it in situ for architectural design. This paper is a survey of location based data representation in augmented reality systems to use in early stages of architectural design related to site. Initially, it describes the field of augmented reality including the characteristics and requirements. Then it surveys the state of the art by reviewing featured applications of location based augmented reality technology. Developments to the recent conditions from the first implementations have been revealed with components. At the same time, this paper aims to find common links between these featured applications and architectural site survey. Thus, it discusses opportunities of augmented reality to provide the needs of an architect as a site visit. However, it suggests which augmented reality components are more suitable in recent conditions for use in architectural design related to site. As a survey paper, it focuses on how location based augmented reality can be used in architectural design instead of presenting a model or an application.

F.C. Ünal*
Department of Architecture, Gebze Technical University, Kocaeli, Turkey

Y. Demir
Department of Architecture, Istanbul Technical University, Istanbul, Turkey

*Corresponding Author's email address: fcunal@gtu.edu.tr

ArchNet-IJAR is indexed and listed in several databases, including:

- Avery Index to Architectural Periodicals
- EBSCO-Current Abstracts-Art and Architecture
- CNKI: China National Knowledge Infrastructure
- DOAJ: Directory of Open Access Journals
- Pro-Quest
- Scopus-Elsevier
- Web of Science

Copyright © 2018 | Copyrights are granted to author(s), Archnet-IJAR, and Archnet @ MIT under the terms of the "CC-BY-NC-ND" License.
INTRODUCTION

Architects conduct site visits prior to a design activity to understand existing conditions. They also need typical activities that includes data gathering, managing complexity, mapping and analysing site. These activities are the main tasks to start an architectural design from first site visit to analysis (Anderson, 2011). There is a fundamental need for an architect to visit the site where the project will be located. The site will suggest a series of characteristics that affect the architectural design (Farrelly, 2007). The natural composition of a site contributes to make it a distinct place through topography, landscape, natural resources and climate. Overlaid on its natural composition, cultural context also influences the way that people use the site and gives its character. Cultural context includes all human-made factors like religion, art, history, settlement, infrastructure, surrounding buildings, use of materials, etc. (LaGro, 2008). These natural and cultural characteristics of site need to be sought and gathered by the architect who designs there. However, it is necessary to manage the complexity of data from different parameters and sources. The condition of any site as a record of natural and cultural data can be mapped for organized complexity. The mapping provides to have read the site, and thoroughly understand it via spatial relations in architectural design. Architects correlate data which is spatially represented in a map to properly analyse a site and put it to use in their own project. At this point, architectural design needs to take advantage of information technologies for location based data.

Over the last years, location based augmented reality came into prominence with the rise of the mobile devices, the increasing availability of location based data and the accessibility of mobile networks (Nóbrega et al., 2017). Location based computing makes it possible to link data to actual physical locations, thereby augmenting the real world with a layer of virtual information (Khan & Loke, 2017). Location based augmented reality systems can provide information about the contents of a place as the architect walks around the site. Therefore, an extensive study is carried out from augmented reality characteristics and requirements to featured applications of location based augmented reality. Firstly, augmented reality characteristics and requirements are investigated to use in detailed analysis of applications. Additionally, these featured applications are evaluated with components, significance in location based augmented reality and potential contribution to architectural design. This paper aims to find common links between these featured applications and architectural site survey. At the same time, it suggests which augmented reality components are more suitable in recent conditions for use in architectural design related to site.

AUGMENTED REALITY CHARACTERISTICS & REQUIREMENTS

Beginning in the 1960’s, augmented reality has progressed from first augmented reality prototypes (Sutherland, 1968), to coin as augmented reality (Caudell & Mizell, 1992), and the developments continues with enabling technologies. Augmented reality supplements the real environment with computer generated content that creates a seamlessly coexisting spatiality. The goal of augmented reality is to enrich a user’s perception and interaction with the real environment (Arnaldi et al., 2018). Combining real and virtual, interaction in real time and registration in 3D are characteristic properties of augmented reality systems (Azuma et al., 2001). These fundamental characteristic properties also demonstrate the technical requirements of the augmented reality system. An augmented reality system has to have a display that can combine real and virtual content, an interface that can provide interaction on a computer system and a tracking system that can find the position of user’s viewpoint and virtual contents (Billinghurst et al., 2015).
Combining Real and Virtual: Display Techniques & Types

In order to combine real and virtual content, some kind of display technology is needed. Depending on the display techniques and the position of the display, augmented reality display technologies are classified in two different approaches (Krevelen & Poelman, 2010). Table 1 shows display techniques, display types and display devices that emerged from the intersection of display techniques and types. Basically, there are three display techniques to visually present an augmented reality: video see-through, optic see-through and projection-based display (Verlinden, 2012).

Table 1: Display techniques and displays for augmented reality (Source: Verlinden, 2012).

<table>
<thead>
<tr>
<th>Display techniques / Display types</th>
<th>Video see-through</th>
<th>Optical see-through</th>
<th>Projection-based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head-attached</td>
<td></td>
<td>Head-mounted display (HMD)</td>
<td></td>
</tr>
<tr>
<td>Hand-held</td>
<td>Hand-held devices</td>
<td>See-through</td>
<td>Spatial projection-based</td>
</tr>
<tr>
<td>Spatial</td>
<td>Embedded display</td>
<td>boards</td>
<td></td>
</tr>
</tbody>
</table>

In video see-through display technique, computer graphics are combined with captured video frames in real time. This type of technique digitizes the real environment scene using a video camera system, so that the image of the real environment can be composites the rendered image of the virtual content which using digital image processing (Carmigniani et al., 2011). Video see-through display is the most widely used technique in augmented reality systems due to the ease of accessing the display devices. A wide range of devices, from smartphones to tablets, include a camera that can be used to capture video for augmented reality.

Another technique is optical see-through display that provides the virtual content with a direct view of the real environment. This technique uses an optical combiner to superimpose a computer-generated scene onto the real scene (Hua et al., 2011). With leaving the perception of real environment alone, optical see-through displays do not suffer from limitations in resolution, lens distortion, eye displacement, or time delay. It’s important for safety demanding applications that require a direct view of the real environment, such as medical or military application.

The third technique is projection-based display that projects the virtual content overlay onto real environment. While other techniques combine the real and virtual world view at the display’s image plane, projection-based displays overlay virtual content directly on the surface of the physical object of interest (Sand et al., 2016). While projection-based display could have an advantage of not requiring the user to wear anything, this could limit the display to be tied with certain locations. It requires a physical surface where the virtual content can be projected onto. Other limitations of projection-based display include being more sensitive to lighting conditions, and suffering from shadows created by other physical objects.

While augmented reality displays use different techniques to combine the real and virtual environment, they can also be categorized based on where the display is placed between the user’s eye and the physical object to be augmented (Bimber & Raskar, 2005). Displays can be arranged in three different types: head-attached, hand-held and spatial display (Peddie, 2017). Figure 1 shows where the displays are located with respect to the observer and the physical object with example of displays.
Head-attached displays refer to head-mounted displays (HMD), which can apply either of the three display techniques. Users mount this type of display on their heads, providing virtual content in front of their eyes. No other physical objects come between the eyes and the virtual content from the display, which supplies the virtual content not getting blocked by other physical objects (Aukstakalnis, 2016). The main advantage of head-attached display is its hands-free nature. These displays provide a high mobility and visually immersive experience.

Hand-held display describes augmented reality systems which can be hold by the user. With advances in mobile device technology, hand-held displays became powerful enough to process augmented reality visualization. From smartphones to tablets, a variety of devices have been used as augmented reality displays (Yusof et al., 2016). Hand-held displays are considered to be mobile and personal, besides sharable with others as needed. They are also more socially accepted compared to head-attached displays.

Projecting the virtual content directly onto the surface of physical object is common approach used for implementing spatial display (Marner et al., 2011). Compared to head-attached and hand-held displays, spatial displays are limited in mobility and are usually installed at a fixed location. As spatial displays tend to provide a larger image in many cases, they are more applicable as public displays which multiple users see. Spatial displays detach most of the technology from the user and integrate it into the environment.

**Interaction in Real Time: Interface**

One of the most important aspects of augmented reality is to create appropriate techniques for intuitive interaction between the user and the virtual content of augmented reality applications in real time. Depending on the interaction of augmented reality applications, different interfaces have emerged over time. There are five main ways of interaction in augmented reality applications. Figure 2 shows augmented reality interfaces: information browsers, 3D user interfaces, tangible user interfaces, natural user interfaces and multimodal interfaces (Billinghurst et al., 2015).

Information browsers are one of the representative types of augmented reality interfaces. In this interface, augmented reality displays are considered as a window into an information space, and the main task of the user is to manipulate this window to browse the information. Other types of interactivity common to information browsers includes choosing different information to view, filtering information shown, navigating into details of the information provided, and changing visualization style, etc. Most of these interactions can be
accomplished using traditional 2D graphical user interfaces and screen input (Langlotz et al., 2013). The interaction method provided is simple and easy to learn as the users can use their knowledge of traditional mobile user interfaces.

3D user interfaces adopt 3D interaction techniques to manipulate virtual objects through controllers (Kulshreshth & LaViola Jr, 2018). 3D user interfaces can provide good interactivity in augmented reality applications for entertainment, design, and training. Users can interact with 3D virtual objects everywhere in space in a natural and familiar way.

Tangible user interfaces use physical objects for representing virtual entities and information, and to bridge between the physical and digital worlds. While tangible user interfaces provide natural and intuitive interaction with digital information through manipulating physical objects, they can have limitations with display capabilities, either showing very limited information with different status of physical objects (Shaer & Hornecker, 2009).

Natural user interfaces provide the interaction of natural body motions and gestures. Sensors are used for tracking and recognizing body movements. With advance in computer vision technology, augmented reality systems became capable of recognizing user's body motion and gesture in real time without requiring the user to wear any sensors (Kaushik & Jain, 2014).

Multimodal interfaces are used to provide richer interactivity in augmented reality applications. Main goal of multimodal interfaces is to combine different modalities of input. Among different combination of input modalities, speech and gesture recognition combined is one of the most widely and actively researched combinations (Lee et al., 2013). This type of interface offers a relatively robust, efficient, expressive, and highly mobile form of interaction that represent the users’ preferred interaction style for future augmented reality application.
Registration in 3D: Tracking

The registration in augmented reality is a process which properly aligns the objects in the real and virtual environments to each other. As users move their viewpoints, virtual contents must remain aligned with the observed 3D positions and orientations of real objects. The registration depends on accurately tracking the viewing pose, relative to either the environment or the annotated objects. Tracking is defined as the measurement of object position and orientation in a scene coordinate system (Yi-bo et al., 2008). Each type of tracking device has different level of accuracy that depends greatly on the type of system being developed. Tracking technology of augmented reality can be classified into three kinds: sensor based tracking, vision based tracking, and hybrid tracking techniques (Zhou et al., 2008).

Sensor based tracking techniques are based on sensors such as magnetic, acoustic, inertial, GPS, optical or mechanical sensors. They all have their individual advantages and disadvantages. For example, magnetic sensors have a high update rate and are light, but they can be distorted by any nearby metallic substance that disturbs the magnetic field (Pagani et al., 2016). GPS and inertial sensors are the most preferred types due to the ubiquity of mobile devices such as smart phones and tablets. These sensors are essential for detection of position and orientation in a location based application.

Vision based tracking techniques can use image processing methods to calculate the camera pose relative to real world objects. Objects are localized based on their pixel information including changes in brightness, intensity, and other local features. The advantage of vision based tracking is its high adaptability to unprepared environments. For example, a point cloud based system is able to build multiple 3D maps for an unknown environment online and the markerless tracking schemes can perform 3D registration based on image visual cues extracted from camera frames (Yu et al., 2016).

Hybrid is the most common type of tracking for augmented reality systems by combining a few complimentary tracking techniques to comprise the advantages of both and support the disadvantages of the other. Hybrid tracking systems gain data from multiple sensors to add additional degrees of freedom, enhance the accuracy of the individual sensors, or overcome weaknesses of certain tracking methods. For example, GPS tracking systems are often combined with inertial sensors and vision based tracking in order to obtain pose estimation due to their low accuracy and only providing positional information (Singh & Mantri, 2015).

LOCATION BASED DATA REPRESENTATION IN AUGMENTED REALITY SYSTEMS AND ITS POTENTIAL CONTRIBUTION TO ARCHITECTURAL DESIGN

Augmented reality allows for an on-site representation of information that is registered to the physical environment. As computers increase in power and decrease in size, new wearable and mobile computing applications became feasible, promising users access to online resources always and everywhere. Significant improvement has been obtained by new generation smartphones and tablets, which are equipped with GPS, inertial sensors, and fast network connections (Shatte et al., 2014). With these opportunities, at the same time representation of spatial data sets has become important via location based services. The ability to supply location based data to users is a key aspect to make augmented reality more practicable (Pierdicca et al., 2016). The merge of location based services and augmented reality provides a valuable addition towards the presentation of data in the real world at the
location of interest (Santana et al., 2017). Location based augmented reality facilitates a greater awareness and better understanding of the environment (Riera et al., 2014; Pereira et al., 2018).

In architectural design, site visit is a fundamental need for an architect to understand existing conditions. Site visits provide clues about how to produce a design response. Architects spend time at the project site and make visits to experience the site’s context. The architect’s main efforts on the site focus on data gathering and absorbing the sense of place. However, it is necessary to manage the complexity of data from different parameters and sources. For this reason, the condition of any site can be mapped to have read the site, and thoroughly understand it via spatial relations in architectural design. Architects correlate data which is spatially represented in a map to properly analyse a site and put it to use in their own project (Figure 3). At this point, location based augmented reality can be used to map a site, and investigate it.

Figure 3. An example of site analysis through mapping (Source: Site analysis, 2017).

The use of location based augmented reality has become common with different applications in architectural design field (Freitas & Ruschel, 2013; Sato et al., 2016; Miyake et al., 2017). It makes possible a new class of applications that exploit surrounding contents of a place as the architect walks around the site. Thus, developments from the first implementations to the recent conditions have been revealed in location based augmented reality with featured applications. The sample applications included in this survey were selected based on their outstanding characteristics and the improvements they have made. Potential contributions of these applications to architectural design are reviewed, whilst also providing an insight into attitudes towards utilising these technologies within the architectural site survey.
MARS

MARS project, acronym of “Mobile Augmented Reality System”, was one of the first outdoor projects. Feiner et al. (1997) combined wearable computers with GPS tracking to produce a number of location based augmented reality interfaces for showing information in place in the real world. The touring machine was an early prototype of an outdoor MARS that presents 3D graphical tour guide information to campus visitors. The touring machine allows users to walk around the university campus and access information via a tracked see-through display and hand-held display. The main theme of their work was presenting contextual information of the university visually connected to the physical world by combining multiple display and interaction technologies. The user is tracked through a combination of satellite-based, differential GPS position tracking and magnetometer/inclinometer orientation tracking. As the user looks around the campus, the see-through head-attached display overlays textual labels on campus buildings. When selected, each of them sends a URL to a web browser running on the hand-held computer. The browser then presents information about the campus, the user's current location, a list of departments, and a list of buildings, respectively. Besides GPS, two additional means of determining position are often employed in MARS, mostly as part of hybrid tracking systems: inertial sensors and vision based approaches. With developing researches in MARS, 3D model of a building that once occupied Columbia University campus, was overlaid on its former site. This application also presents a situated documentary of the history in Columbia campus via showing the model of a historical building at its original location (Höllerer et al., 1999).

Figure 4. MARS project as an augmented reality information guide (Source: Höllerer & Feiner, 2004).

Figure 4 shows a more recent version of the MARS, annotating restaurants in the Columbia University neighbourhood. This prototype of MARS provides an interface to a database of the restaurants in New York City. Information about restaurants is provided either via an overview 3D map, so that the user can be guided to a specific place of own choices, or as direct annotations of the actual restaurant locations themselves. Having selected an establishment, the user can bring up a popup window with further information on it: a brief description, an image of the interior, restaurant’s menu and reviews (Höllerer & Feiner, 2004).
Archeoguide

Archeoguide offers personalized augmented reality tours of archaeological sites. It uses outdoor tracking, mobile computing, 3D visualization, and augmented reality techniques to enhance information presentation, reconstruct ruined sites, and simulate ancient life. Archeoguide project aims to develop new interactive methods for accessing cultural heritage information. Site information servers administer a multimedia object database storing 2D images, 3D models, audio and video clips, and text objects on the archaeological site. These objects are organized in a hierarchical tree structure, enabling grouping according to the information they represent. Mobile units provide all information stored in the central database to the touring users and incorporate a hybrid system that contains GPS, inertial and vision based tracking for identifying the user’s view. The system filters the information through user’s position and orientation. The system automatically personalizes the tour according to its user’s profile, entered prior to the tour’s start. Based on parameters like age, interests, education, and archaeological knowledge, the system draws up a basic tour and enriches it with corresponding information. Moreover, the proposed interface allows choosing between several themes and media. Archeoguide especially provides an opportunity to visualize the 3D reconstructed damaged site (Vlahakis et al., 2002), see Figure 5.

VIDENTE

With the advent of augmented reality applications running on hand-held computing devices, VIDENTE project aims to develop a mobile augmented reality solution to visualize subsurface characteristics. Unlike conventional solutions, augmented reality provides a more intuitive interface to access complex underground utility network data in the field. Users no longer have to transform map space into the real world since they obtain an integrated view of both at a time. From user’s localization, it is possible to visualize in real time 3D representation of networks of cables and pipes hidden underground. Figure 6 shows the hidden pipelines superimposed as a computer graphics overlay on the road surface in front of the user. The rendered augmented reality scenes are adjusted continuously as the user moves around. The platform comprises a GPS module and an inertial measurement unit for respective position and orientation tracking. Geospatial objects originating from an operational location based database are delivered to the client application in offline or online.
mode. The application converts the delivered geospatial data into a corresponding three-dimensional computer graphics data structure. Scenes are assembled as a video see-through at the hand-held device in real time by merging continuously streamed video footage with location based computer graphics considering the client’s currently tracked position and orientation. By means of this application, users are enabled to visualize both hidden underground objects such as cables, pipes and joins and abstract information such as legal boundaries or safety buffers (Junghanns et al., 2009).

![Figure 6. Presentation of the subsurface infrastructure via VIDENTE project (Source: Junghanns et al., 2009).](image)

**CityViewAR**

CityViewAR is a mobile outdoor augmented reality application for providing AR information visualization on a city scale. As an information browser, the main function of the CityViewAR application is to allow the user to efficiently access geo-located information. The application takes advantage of built-in sensors on smart phones (e.g., GPS, electronic compass and accelerometer) to provide information based on the user’s current location. To meet different needs of the users, CityViewAR shows information using different visualization methods, including AR, interactive digital map, and list views. These three views are used as the main interfaces with which user could browse through the content and information provided (Figure 7).

The application is designed to start with the Map view which is more accessible independently from the user’s location. Map view gives enough spatial context, and provides a familiar starting point. The users can easily switch into the other browsing views using icons located at the bottom right screen corner, and then access various content including historical information, images and panorama pictures (Lee et al., 2012). In the AR view mode, the application shows virtual information overlaid on a live video camera background, making the virtual content appear in the real world. This type of application shows information on point of interest (POI) in the real world. In most cases, geographical information is shown as virtual bubbles with text and images of the related POI. In addition to providing historical information about buildings, the CityViewAR application is also designed to provide onsite AR visualization of the buildings, allowing users to see a virtual 3D model of the building on the real site where it once was. This application shows that making such information easily accessible to the public in a number of formats could help people to have richer experience about cities.
Alongside development of smart mobile devices, numerous concepts, techniques, and prototypes have been introduced, focusing on basic implementation issues of augmented reality mobile applications. Geiger et al. (2014) focus on the efficient implementation of a robust mobile augmented reality engine, which provides location-based functionality. They denote this engine as AREA (Augmented Reality Engine Application). Their work deals with the development of a generic mobile application, which enables location-based mobile augmented reality for realizing applications. In order to enrich the image captured by the smart mobile device’s camera with virtual information about POIs in the surrounding, basic concepts enabling location-based calculations are developed. Figure 8.a shows the algorithm realizing the location view.

AREA has been integrated with several mobile applications such as LiveGuide. LiveGuide can be used to provide residents and tourists of a German city with the opportunity to explore their surrounding by displaying points of interests stored for that city (e.g., public buildings, parks, places of events, or companies). When realizing such mobile applications on top of AREA, it turned out that their implementation benefits from the modular design and extensibility of AREA. In particular, when developing the LiveGuide application type, only the following two steps were required: First, the appearance of the POIs was adapted to meet the user interface requirements of the respective applications. Second, the data model of AREA was adapted to an already existing one. Figure 8.b shows user interface elements in the context of the LiveGuide application and originally implemented for AREA.
BIM based AR

An advanced form of documentation is building information models (BIM), which may contain spatial information, construction schedule, and lifecycle analysis etc. Architects still have to rely on their spatial awareness to map the 2D drawings or 3D projections into the context of real 3D space, e.g. to use that information during the construction of 3D buildings on the construction site. Researchers tried to facilitate the process of mapping 2D design documentation to 3D real-world construction reality by mixing virtual information with the real environment. Meza et al. (2014), focused on how to use the BIM information and feed it into augmented reality systems. They implemented a BIM based AR system that consists of four activities: creating building information model, creating schedule, creating augmented reality model, and using augmented reality model on site (Figure 9).

Figure 8. (a) Algorithm of AREA for presenting location view (Source: Geiger et al., 2014); (b) an adapted user interface from AREA core engine to LiveGuide (Source: Geiger et al., 2014).

Figure 9. Presentation of BIM based AR system (Source: Meza et al., 2014).
Table 2: Evaluation of featured location based augmented reality applications (Source: Authors).

<table>
<thead>
<tr>
<th>Location Based Augmented Reality Applications</th>
<th>Display Technique / Display Type</th>
<th>Interaction Type</th>
<th>Tracking Type</th>
<th>Significance</th>
<th>Contribution to Architectural Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARS</td>
<td>Optical see-through display / Head-attached + Hand-held display</td>
<td>Information Browsers</td>
<td>Hybrid Tracking (GPS+DGPS+ Magnetometer+ Inclinometer+ Vision based tracking)</td>
<td>First use of augmented reality for the exploration of urban features</td>
<td>Representation of site information</td>
</tr>
<tr>
<td>Archeoguide</td>
<td>Optical see-through display / Head-attached + Hand-held display (Pen-tablet+ Palmtop)</td>
<td>Information Browsers</td>
<td>Hybrid Tracking (GPS+DGPS+ Inertial Sensors+ Vision based tracking)</td>
<td>Use of different data representations and enhanced database structure</td>
<td>Visualization and simulation of former condition</td>
</tr>
<tr>
<td>VIDENTE</td>
<td>Video see-through display / Hand-held display</td>
<td>Information Browsers</td>
<td>Hybrid Tracking (GPS+Inertial Sensors)</td>
<td>Direct up to date data about the subsurface utilities</td>
<td>Presentation of hidden underground objects &amp; legal boundaries</td>
</tr>
<tr>
<td>CityViewAR</td>
<td>Video see-through display / Hand-held display</td>
<td>Information Browsers</td>
<td>Hybrid Tracking (GPS+Inertial Sensors)</td>
<td>Information visualization on urban scale</td>
<td>Presentation of data on a city scale</td>
</tr>
<tr>
<td>AREA</td>
<td>Video see-through display / Hand-held display</td>
<td>Information Browsers</td>
<td>Hybrid Tracking (GPS+Inertial Sensors)</td>
<td>Engine application for location based augmented reality applications</td>
<td>Editable application layout for architectural applications</td>
</tr>
<tr>
<td>BIM based AR</td>
<td>Video see-through display / Hand-held display</td>
<td>Information Browsers</td>
<td>Hybrid Tracking (GPS+Inertial Sensors)</td>
<td>Building information modelling and augmented reality system integration</td>
<td>Visualization and simulation of 4D content (Information with a time component)</td>
</tr>
</tbody>
</table>

These featured applications included in this survey were evaluated on their augmented reality components, significance in location based augmented reality and potential contribution to architectural design (Table 2). It shows that some of the components seem more appropriate to location based augmented reality systems. Hand-held displays that use video see-through display technique are mostly preferred type of display. It depends on widespread access to hand-held displays instead of head-mounted displays. On the other hand, head-mounted displays can be preferred as a natural platform with hands-free working environment in the future. This survey showed that information browsers are the most suitable representative types of augmented reality interfaces. These interfaces are designed for basic interaction tasks to view the visualized location based augmented reality scene and browse the information provided. Hybrid is the most suitable type of tracking systems to use in location based augmented reality. Reviewed applications showed that hybrid tracking based on GPS and inertial sensors is sufficient with the development of tracking technology. Furthermore, hybrid tracking can be enhanced with vision based tracking. For systems to be successful in architectural design, developers need to take into account that augmented reality components need to be compatible, widely used, natural to interact with and precisely detectible.
MARS is the first use of augmented reality with location based data for the exploration of urban features. It makes it possible to collect data of a site and represent it in real place for architectural design. This kind of application promises to make easier the design process by bringing the architect into more direct contact with the building site. They can enable architects to not only interact with surrounding contents throughout site visit, but carry out design analyses while on site.

Archeoguide introduces innovative approaches to organize multimedia objects in database for different data representations. In addition to that it can show historical information on archaeological site by use of 2D images, 3D models, audio and video clips, and text objects. It can make contribution to architectural design about visualization and simulation of former condition on site, such as older versions of buildings in view, or pictures of past events. It can also inform an architect to protect the archaeological areas on site.

VIDENTE converts location based data to three-dimensional computer graphics on a hand-held device. It provides direct up to date data about subsurface utilities. By means of this application, architects are enabled to visualize both hidden underground objects such as infrastructures and abstract information such as legal boundaries. It may allow architects to gain an immediate check of a site’s surroundings for finding the best place for architectural design.

CityviewAR is an essential application for the demonstration of information visualization on urban scale through smartphones. The main function of this kind of applications is to allow the user to efficiently access location base data in a city. It can enable a greater appreciation of a site’s context for architectural design. Most of the information needed to understand a site’s constraints and assess its merit can be provided to architect.

AREA is an engine application developed to enable location based augmented reality applications to be easily developed on smartphones. It can present information registered directly to places with point of interests (POIs). Information of POIs comes in a variety of forms, such as text, image, video, audio, or 3D model. It provides editable application layout for architectural applications.

BIM based AR focus on how to use the BIM information and feed it into augmented reality systems. The most familiar use of these applications is to overlay a real site with an intended virtual design at full scale. It can be used to present information with a time component via visualization or simulation of 4D content. This kind of application encourages architects to consider and evaluate their project site across a range of timeframes, and from multiple viewpoints. Given the data rich nature of BIM, it can be possible to perform site analysis in-situ at full scale.

Location based augmented reality systems require that the user actually be at the place where the task is to take place. Being at the place is essential in architectural site survey. In a site visit, architects do not see these locations with comprehensive information. They have to collect site data from different sources and mediums. Then all collected data needs to be managed on maps that analyze the site. It is a long process that takes time and work-force. Use of location based augmented reality systems can provide data presentation of locations as they are current condition. If a database of the environment is available, an augmented reality application can track data representations. With the use of augmented reality, an architect looks at project site and sees data directly overlaid on the site. Architects walking around the site with augmented reality systems would gain a much better understanding of
the site. The power of augmented reality systems lies in their ability to visualize normally hidden or abstract features, such as infrastructures and boundaries. In addition to that augmented reality systems can show historical information of site. By providing information in a BIM format, location based augmented reality systems provide significant contributions to site analysis in scale with surroundings.

CONCLUSION

In this paper, we have surveyed how location based augmented reality can be used in an architectural site visit. To understand the importance of location based data in architectural design, this survey is an extensive study from augmented reality characteristics and requirements to some featured applications of location based augmented reality. As can be seen, the main idea under the research is supporting architects with opportunities of location based augmented reality. Location based augmented reality has become increasingly popular in recent times due to the minimal hardware requirements, improved computational power of consumer devices, and the ubiquity of mobile devices. From this study, we have seen that hand-held devices are mostly preferred type of display with hybrid tracking. Information browsers are the most representative types of location based augmented reality interfaces. These display, interaction and tracking types can be used to design a location based augmented reality system for architectural design.

MARS, Archeoguide, VIDENTE, CityViewAR, AREA and BIM based AR projects are surveyed as a state of the art by reviewing features. We have tried to find common links between these featured applications and architectural site survey. Therefore, this paper is intended to be a first step towards establishing a model which supports architects in a site visit. An architectural design study conducted using such a location based augmented reality system shows favourable response because the users think it is easy to understand a project site than a usual visit. On the other hand, the use of location based augmented reality can make a decisive contribution to surveying project site. Location based augmented reality provides a platform to enable novel types of architectural design applications.

ACKNOWLEDGEMENTS

We acknowledge The Scientific and Technological Research Council of Turkey (TUBITAK), The Department of Science Fellowships and Grant Programs for financially supporting.

REFERENCES


AN EDUCATIONAL APPLICATION BASED ON VIRTUAL REALITY TECHNOLOGY FOR LEARNING ARCHITECTURAL DETAILS: CHALLENGES AND BENEFITS

DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1719

Sayyed Amir Hossain Maghool, Seyed Hossein (Iradj) Moeini, Yasaman Arefazar

Keywords
- virtual reality; architectural educational; immersive environment; problem based learning; flipped learning; experiential learning; learning styles

Abstract
Architectural learning is intensely multifaceted and faces many challenges. Educational theories such as Problem Based Learning, Flipped Learning, Learning Styles theory, and Experiential Learning theory are researchers’ responses to those challenges. In fact, many of these theories need proper means in order to be effectively applied in architectural education. Moreover, the possibilities provided by Virtual Reality (VR) Technology, combined with the complex intrinsic properties of architectural pedagogy, place this technology under architecture researchers’ constant watch. With its experiential nature, VR technology can improve architectural students’ learning. Although the study of VR applications for educational purposes is not new, this is rarely studied in the light of emerging learning theories in architectural education. In response, an educational application called LADUVR (“Learning Architectural Details Using Virtual Reality Technology”) has been designed by the authors to show how VR would address the current shortcomings of architecture learning systems. The present paper discusses the benefits and challenges of developing these kinds of applications, and shows how by using LADUVR users can experience being on a construction site, investigate the architectural details closely, and test what they have learned in an interactive and immersive environment. To continue, the paper examines the feedback from the implementation of LADUVR; with the results indicating that LADUVR would indeed enhance the learning of architectural detailing in most aspects. The paper concludes with a comparison between the use of this application and conventional learning methods.
INTRODUCTION

Even though humankind has been familiar with the concept of Virtual Reality since the 1930s (as introduced in Stanley G. Weinbaum’s 1935 book *Pygmalion’s Spectacles*), the concept has faced challenges to realize. CAVEs (Cave Automatic Virtual Environment) and HMDs (Head-mounted Display) like the “Sword of Damocles”, “Sensorama”, “Sega VR”, etc. are technologies that have been developed since that time to realize immersive virtual environments. The decrease in the cost of providing tools for experiencing virtual environments in an immersive and interactive fashion, in addition to the tremendous amount of software and other hardware development in the recent years, leads to the availability of VR for public users. At present, HMDs are the most convenient tools for delivering a virtual reality experience with a high degree of immersion.

Nowadays, investment in the VR market is raising expeditiously. It is anticipated that the total revenue of VR and Augmented Reality (AR) market would reach $120 billion in 2020 (Augmented/Virtual Reality Report, 2016). On the other hand, the e-learning market has an intense influence on the education market. A report expects the growth of e-learning market from $165.21 billion in 2015 to $275 billion in 2022 (Costello, 2017). Undoubtedly, the emergence of virtual reality would be a substantial contributor to the flourishing market of e-learning.

Alongside investments in this area, the increase in research on the applications of VR is remarkable. If we search the word “Virtual Reality” in the Science-Direct database (https://www.sciencedirect.com), the growth in the number of articles about VR from 1087 in 1999 to 4800 in 2016, claims that the virtual reality phenomenon is an increasingly interesting topic for researchers. The above data indicates the crucial role of VR in the future human transactions. Confirming this, Michael Heim (1994) describes VR as ‘a technology that can be applied to every human activity and can be used to mediate in every human transaction’. One of the many possible implications of this revolutionary technology would be developing educational applications especially for architectural purposes.

Many educational theories and models introduced by pioneers in the field acknowledge flaws in traditional learning and teaching. For example, educational theorists such as David A. Kolb (1976), Richard M. Felder (1988), Isabel Briggs Myers (1985), and Fleming & Mills (1992) believe that learners’ preferences differ from each other. Architecture pedagogy faces such challenges no less than other disciplines (Banerjee, 1996; Nabih, 2010; Danaci, 2015). For instance, a challenge more specifically confronted by architecture students is how to convert the knowledge into practice (Banerjee, 1996).

In response to architectural education’s challenges, LADUVR (“Learning Architectural Details Using Virtual Reality Technology”) is designed to take advantage of potential benefits of VR technology. With its immersive virtual environment and interactive interface, LADUVR is designed to help architecture students with learning contents of architectural detailing in their curriculum. LADUVR’s approach to learning is in harmony with problem based learning, experiential learning and flipped learning theories.

RESEARCH QUESTION AND METHODOLOGY

The main questions addressed in this paper are ‘how virtual reality technology fills the gaps in architectural pedagogy?’ and ‘what are the characteristics of a virtual reality educational
application in this field regarding emerging theories in architectural education? ’ To answer, a design science research (Creswell, 2009; Peffers et al., 2007) approach is adopted. The objective of this approach is to design, develop and evaluate an educational application based on virtual reality technology for learning architectural details regarding new theories in architectural pedagogy.

Starting with a review of some well-known challenges of architectural education and emerging learning theories that argue challenges in current architectural pedagogy, the paper then moves on to clarify the importance of the problem by conducting a survey among architectural students. This paper discusses virtual reality technology as an established tool for educational purposes. Moreover, this paper seeks to extract characteristics of an effective educational application based on virtual reality for a theoretical course in architecture (architectural detailing aka construction). A report on these stages of the research is then followed by the introduction of an educational application designed and developed by the authors based on VR technology named LADUVR. Finally, the implementation of LADUVR is scrutinized. In order to understand the effectiveness of this application, semi-structured interviews were conducted among eight students who have taken construction detailing courses within the last year.

LITERATURE REVIEW

Architectural Education Challenges

Architectural learning is intensely multifaceted and challenging (Banerjee, 1996). Students need to deal with structural questions on one hand, review historical periods of ancient cities for history courses on the other, and also involve design studios and their complicated image production challenges. Such challenges in teaching architecture and related disciplines have been observed by the likes of Vincent Canizaro (2012) and Greig Crysler (2013).

In addition to all these difficulties in architectural pedagogy, incompetency in transferring knowledge into practice is one of the major issues (Banerjee, 1996; Nabih, 2010). Hacer Danaci (2015) suggests that the final purpose of architectural education is to make students...
capable of implementing theories into the design and also mentions that the knowledge that comes from memorizing will be forgotten soon and even repetition of that process would not help.

Architecture comprises diverse and sometimes disjointed, discipline areas within a unified framework (Nabih, 2010) and it makes architectural education an immense challenge. Some architects split architecture education into two areas: primary architectural lessons like learning to design; and para-architecture lessons namely structural and mechanical courses (Nadimi, 2017). Some others categorize architectural courses into three sub-categories of knowledge, skill, and design. The extent of architectural related fields in addition to the increasing pace of science development affirm that catching up with the latest knowledge in architecture is certainly a challenge for students, however, Ujwala Chakradeo (2010) believes that new technologies will evolve the learning of knowledge and skills in the near future and students and instructors can easily use them worldwide. Although new technologies can be beneficial in every aspect of architectural pedagogy, and that these technologies can offer effective ways of learning, the focus of this article is just on knowledge-based courses in the curriculum.

Moreover, theories about learning in architecture have been discussed in many studies to address the challenges mentioned before. The explanation of some of these theories and their relation with virtual reality technology is discussed in the following sections. There is an anticipation by the authors that with the help of principles and features mentioned in those theories, we could create an effective VR application for architectural education.

It is noteworthy to mention that there are other learning theories in architectural education that can utilize new technologies and enhance learning, which is beyond the scope of this paper. For instance, the SOLE model developed by Mohd Zairul (2018) that is a student-centered learning (SCL, aka Self-Directed Learning introduced by Knowles (1975)), theory inspired by self-determination theory of Deci & Ryan (2008) and the Rich Environments for Active Learning (REAL) model (Grabinger & Dunlap, 1995). These theories need interactive, student-centered learning environments which rely on intentional learning.

**Problem Based Learning**

One of the emerging theories in architectural pedagogy is Problem Based Learning (PBL). PBL is an innovative educational theory that was introduced at McMaster University in Canada at the end of the 1960s (Camp, 1966). Many studies have been done on the implementation of PBL in architectural courses (Bridges, 2007). With the PBL method, the learning process is initiated by a problem and students identify the information required to solve the problem (Bibbings, Bieluga & Mills, 2018). Being problem based rather than subject based means that students critically question and draw their own conclusions about what they have experienced. Alongside that, the student’s learning is not fragmented into different specialties or teaching sessions. They reflect upon prior learning, analyses and synthesize the contextual information, acquire further knowledge and assimilate into their existing knowledge base (Wong & Lam, 2007).

**Flipped Learning**

Despite the benefits of e-learning and remote education, researchers claim that fully online learning is not what students are seeking. Instead, learners prefer a blended learning
approach (Rovai & Jordan, 2004; Garrison & Vaughan, 2011; Allen & Seaman, 2013). The flipped classroom is based on a blended learning approach, which means “there is an integration of both face-to-face and remote delivery methods” (Partridge et al., 2011). The flipped classroom is not a new topic in educational research studies, however, this concept has become popular due to the recent advancement and availability of technology (Davies et al., 2013).

**Experiential Learning**

Pioneer theorists of education emphasize a kind of teaching that comes from experience. Kolb (1984) posits that learning is a process that involves making knowledge through a transformation of experiences. This approach conforms to the theory of Constructivism: a theory of gaining information, which suggests humans obtain knowledge by learning from their experiences. Experiential learning has long been a part of architecture and engineering education (Harrisberger, 1976). For instance, Kerry Mulligan et al. (2018) discuss how experiencing a situation could affect the way we think about an architectural problem and suggest that experiential learning should be embedded in architectural education.

HAASE (as cited in Salama, 2006) argues that by incorporating experiential learning theory in architectural education it is possible to fill the gaps between education and the act of building. Also, it would better equip students to critically understand and overcome challenges they might face in their future. Salama also emphasizes on the importance of experiential learning in architectural education by stating that although there is a tremendous diversity of approaches and methods in architectural education, experiential learning seems to be a common key issue discussed in the studies about architectural education. He pushes forth the idea by mentioning that education theorists including Benjamin Bloom, David Kolb, Jean Piaget, John Dewey, and Paulo Freire believe that experiential learning should be an integral part of any pedagogical system.

**Learning Styles**

Students learn in different ways. Richard M. Felder (1988), one of the theorists of education, discusses these differences in his paper about education in engineering classrooms. He suggests that some people prefer to acquire knowledge visually, however many others are inclined to auditory sources of knowledge. Some people learn better by doing, while some others are more efficient by contemplating a problem. He also states that not only learners are different from each other, but also the methods of teaching are diverse.

Educational models classify learners into various types regarding their learning preferences. Felder (1988), Kolb (1976), Fleming (1992), and other researchers have grouped learners according to their characteristics in separate categories and suggested corresponding learning styles. Importantly, as soon as teachers understand these differences they might find themselves obliged to devise different teaching methods for every learning style. Felder (1988) states that ‘how much a given student learns in a class is governed in part by that student’s native ability and prior preparation but also by the compatibility of his or her learning style and the instructor’s teaching style’. His study strongly suggests that existing mismatches between teaching and learning in the present engineering education reduce educational efficiency.
Felder divides learners into five major groups: 1. Sensing and Intuitive Learners, 2. Visual and Auditory Learners 3. Inductive and Deductive Learners 4. Active and Reflective Learners, 5. Sequential and Global Learners. Although this categorization has similarities with those of Jung (1971) and Kolb (1984), the concentration of Felder’s studies on engineering education makes it appropriate for further research in architectural education. The following list of the characteristics of learners provides guidelines as to how an educational approach should provide assistance particularly for the hitherto neglected types:

**Sensing and Intuitive Learners**

According to Jung (1971 as cited in Felder, 1988), people would prefer to understand their surrounding area in two different ways; some people are inclined to contemplate and speculate about their environments, others are more comfortable to utilize their senses to understand their world. Felder also states that a considerable proportion of engineering students are sensory learners and that is in contrast with the fact that most engineering courses except for laboratories emphasize on principles and theories.

**Visual and Auditory Learners**

According to Felder (1988), humans differ not only in how they understand their surrounding world but also in the ways they obtain information. Visual, Auditory and Kinesthetic are the three styles he introduces in his model, but he intentionally ignores the third category. A possible explanation for this decision is that he was unable to find a feasible solution to convey kinesthetic information. However, in the present time, new technologies have solved this problem at least in the laboratory. Researchers have developed technologies to transfer and simulate the senses of smelling and touching that could be used in the near future for presenting kinesthetic data in classrooms. These new technologies are part of VR’s hardware to enhance the immersion degree. Richardson (1984 as cited in Felder, 1988) argues that majority of college students are visual learners while most college teaching styles are auditory or a visual representation of auditory data.

**Inductive and Deductive Learners**

Philosophers divide reasoning into two groups: Inductive and Deductive reasoning. In Inductive reasoning, humans use evidence and observations to build principles and general rules. Through Deductive reasoning on the other hand, individuals are able to explain a phenomenon by using principles. Samir Okasha (2002) argues that although the Deductive reasoning is more trustworthy than Inductive reasoning, humans use the latter constantly in their lives.

Felder also believes people are Inductive or Deductive learners based on their learning preferences. At least half of the teachers in engineering classrooms are Deductive teachers. Having said that, Hilda Taba (1966 as cited in Felder, 1988) and McConnell (1934 as cited in Felder, 1988) argue that inductive teaching approach improves learning and would bring in academic achievement.
Active and Reflective Learners

Felder (1988) classifies learners into two types based on how they transfer obtained information to the knowledge: Active and Reflective learners. He puts forth the theory by stating that, Reflective learners are in fact introspective people, however, Active learners prefer to do active experiments. It seems that there are some similarities between experiential learning’s principles, PBL and Active learners’ characteristics (Salama, 2015).

Sequential and Global Learners

The final factor for grouping the learners is whether they understand the provided information immediately or after spending a considerable amount of time. Linda Kreger Silverman (1987 as cited in Felder, 1988) discerns between these learners by calling them Sequential and Global Learners. Felder (1988) states that most curricula, course syllabi, textbooks, and teachings styles are sequential.

Learning Styles of Architecture Students

To examine Felder’s claims in addition to a study conducted by Magda Mostafa and Hoda Mostafa (2010), and to highlight the importance of paying attention to every 32 distinct types of learners, a survey based on the “Index of Learning Styles” (Felder & Soloman, 1993) including 44 questions—originally developed by Barbara A. Soloman and R. Felder—was conducted among 82 architecture students at the Faculty of Architecture and Urban Planning, Shahid Beheshti University (SBU), Tehran. Of the study population, 60 respondents completed and returned the questionnaire. There are similarities between the results of this survey and those described by Felder. For instance, Table 1 and Figure 2 show the distribution of different types of learning preferences. Also, if we accept Felder’s claims about inadequacies of teaching styles in engineering classes, around half of the students do not receive a proper education due to their characteristics. Therefore, finding a solution to fill this gap seems necessary. The survey showed that 33 percent of architecture students at SBU are sensory learners. However, most teachers use intuitive teaching methods. This gap becomes deeper when it comes to visual learners. According to the survey, 82 percent of the students who participated in the survey were visual learners whereas most engineering courses are based on the auditory material.

Table 1: Number of students in every learning style (Source: Authors).

<table>
<thead>
<tr>
<th></th>
<th>Sensing</th>
<th>Sensing</th>
<th>Intuitive</th>
<th>Intuitive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Active</td>
<td>Reflective</td>
<td>Active</td>
<td>Reflective</td>
</tr>
<tr>
<td>Visual</td>
<td>5</td>
<td>2</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Visual</td>
<td>4</td>
<td>3</td>
<td>13</td>
<td>8</td>
</tr>
<tr>
<td>Auditory</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Auditory</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Despite the significant proportion of learners who have been left out in the current system, there is hardly any alternative for them on offer. For example, sequential learners that could not catch up with the pace of lectures, inevitably use notes and textbooks. However, these sources are not ideal ways to convey architectural concepts and data to students. A sensible
approach to tackle this is using new technologies like VR as a supplemental tool for architectural education.

<table>
<thead>
<tr>
<th>Learning Style</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing / Intuitive</td>
<td>33%</td>
</tr>
<tr>
<td>Visual / Auditory</td>
<td>82%</td>
</tr>
<tr>
<td>Active / Reflective</td>
<td>62%</td>
</tr>
<tr>
<td>Global / Sequential</td>
<td>55%</td>
</tr>
</tbody>
</table>

Figure 2. Learning styles percentage bar chart for the participants (Source: Authors).

**VR Technology and Architectural Education**

Virtual Reality can be defined as the human endeavor to remove barriers between the real world and virtual world, and it encompasses technologies that provide tools for users to interact with the simulated virtual environments. Collins dictionary defines Virtual Reality as: "an environment which is produced by a computer and seems very like reality to the person experiencing it". Regenbrecht and Donath (1997 as cited in Portman et al., 2015) have described VR as a means of communication that takes place in a virtual space and embeds users as an integral part of that. Most of VR definitions emphasize on experiential and sensory aspects of virtual reality, and those attributes actually are the key factors that make VR a unique way of communication and learning.

Researchers have found a tremendous amount of VR applications. For instance, using VR to design cars’ interiors (Zimmermann, 2008) or remote surgeries (Marescaux & Rubino, 2005) and even training firefighters (Bailie et al., 2016). Among its numerous applications, using VR for educational purposes is a prevailing approach. Moreover, researchers believe that the compatibility of VR and educational goals provides an excellent opportunity for students and teachers. Zhigeng Pan, et al. (2006) envisions a flourishing future for global learning market due to the application of VR and Augmented Reality in e-learning.

In spite of research studies conducted for finding VR role in education, the share of architecture is not sufficient. J. Dvořák et al. (2005) state that currently VR tools are widely implemented in mechanical engineering. However, architects do not take advantage of this technology frequently in their career, and that is happening while architectural pedagogy can benefit the most from VR. One advantage of VR implementation in architectural pedagogy could be an enhancement of three-dimensional perception for students. They also confirm the educational role of VR technology in architectural education by mentioning that VR would facilitate thinking in a 3D way and by using VR students can see directly in 3D.

Some researchers suggest using VR in theoretical architectural courses. For instance, Jeff Rickel (2001) envisions a classroom scenario: ‘History students can learn about ancient Greece by walking in its streets, visiting its buildings, and interacting with its people'. In a virtual environment, humans can communicate and transfer knowledge without time and space limitations that exist in the real world while saving time and money and minimizing health risk.
Loukas Kalisperis et al. (2002) argue that using VR in design studios would boost architectural design education for students at the beginning of their professional career. They also mention that with the help VR students will be able to participate in classrooms, which is an important shift from only observing the 3D contents. This participation is not individual, in fact, by using multi-user applications and developing network features for VR application, multiple users can experience a virtual environment at the same time and also communicate and cooperate with each other while designing, presenting, and learning.

Although some engineering schools and architects have accommodated VR labs for research purposes (Portman et al., 2015), few of them use this technology as an educational apparatus. One example of VR implementation in architectural pedagogy is the one in Ball State University (Angulo, 2015). They have used a virtual simulation environment called “CAP VR Environment” in their university since 2011. Design students at Ball State University use CAP VR to analyze their design projects in terms of functionality and appearance. Antonieta Angulo states that their virtual environment with the capability of free navigation in that environment is useful for architecture students to design “signature spaces”.

In their studies, Alcinia Zita Sampaio et al. (Sampio et al., 2009; Sampio et al., 2010) introduce some applications that have been developed to be used by civil engineering students. In these applications (titled: “Didactic VR Models”, “VR Model of the Incremental Launching Method of Bridge Construction”, and “The Virtual Model of Lighting Management”) the user gets familiar with structural details and how to maintain lighting component in a house. They claim that with the options provided in those applications, the user would be able to interact with the virtual environment. For instance, in “VR Model of the Incremental Launching Method of Bridge Construction” the user has control over the process of building a bridge and can forward or rewind that process.

Another study at the University of New South Wales, Australia (Wang et al., 2015) investigates the effects of a VR application called “Situation Engine” on learning preferences of construction and architecture students. Situation Engine is designed to introduce construction to students via virtual reality technology. Wang’s survey on 245 architecture and construction students suggests that the long-held sense about positive effects of VR technology on students’ learning capability is proved in practice and long exposure to educational VR application promotes movement towards an inclination for active experimentation.

A review of previous studies indicates that although VR has been introduced or used for educational purposes, their relations with emerging theories in architectural education are not well established and their evaluations are to some extent limited. The deficiency in the previous evaluations was due to lack of objectives for the design of the educational applications and the limits in hardware and software used.

**VR Technology as a Response to Learning Theories**

To extract the characteristics of an effective educational application based on virtual reality technology, the capabilities of VR to facilitate implementation of emerging theories in architectural education is reviewed in the following sections:
Problem Based Learning (PBL) and VR

Virtual reality is a new tool that can enrich high quality-PBL and engage architectural students in deeper ways. Virtual reality can give architectural students an immersive experience to observe and take notes. Coupled with focused, inquiry-based questions, students can deepen their research. Moreover, an interactive virtual reality experience can help students become more deeply and personally engaged in topics (Gyldendahl Jensen, 2017). When choosing a question to explore for project-based learning, taking the time to experience materials related to that topic can encourage students to think more critically about their driving questions. Nabih (2010) states that a PBL approach in architectural education should be ‘motivating’, ‘intellectually challenging’, and ‘include puzzling’.

Flipped learning (FL) and VR

Flipped learning requires flexible environments where students can choose when, where, what and how to study and learn. Therefore, virtual reality with its immersive and interactive nature could be used as a learning tool that could be used anywhere and anytime. To put it in the whole, VR can be used for achieving flipped learning’s goals and benefits. Wei-Kai Liou et al. (2016) have discussed that virtual reality and augmented reality can be blended in the formal classroom settings to promote active learning, which results in enhancing knowledge, comprehension and application skills of the learners.

Experiential learning (EL) and VR

The basis of experiential learning theory is in harmony with the capabilities of VR. William Winn (1993) acknowledges this by stating that the characteristics of immersive VR and the axioms of constructivist learning theory are entirely compatible. He also claims that constructivist theory provides a valid basis for a theory of learning in virtual environments. He puts forth the idea by saying that first-person experience in VR and the notion of immersion are the key contributors to the compatibility of VR with constructivism. Moreover, Zhang and Liu (2011) mention that humans learn from their surrounding environment not only by observing it but also by interacting with that.

Learning styles (LS) and VR

As Felder (1988) points out in his model, in every classification there is at least one group of learners that the current educational system fails to provide any growth opportunity for. For instance, sensory learners (at least one-third of architecture students) need sensory tools to learn, but it is challenging to find any sensory teaching methods or utensils in universities’ classrooms. VR technology, nevertheless, can provide sensory learning solutions for learners who prefer to utilize their senses to understand. The result of matching VR capacities to neglected learning styles is presented in Table 2. In this table, benefits and advantages of VR technology for architectural education are mentioned.
### Table 2: Capacities of VR to be a response to different learning styles (Source: Authors).

<table>
<thead>
<tr>
<th>Classification</th>
<th>Sensing and Intuitive Learners</th>
<th>Visual and Auditory Learners</th>
<th>Inductive and Deductive Learners</th>
<th>Active and Reflective Learners</th>
<th>Sequential and Global Learners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Style</td>
<td>Sensing</td>
<td>Visual</td>
<td>Auditory</td>
<td>Deductive</td>
<td>Active</td>
</tr>
<tr>
<td>How much current engineering education cares about them? (As noted by Felder)</td>
<td>Very Low</td>
<td>Low</td>
<td>High</td>
<td>average</td>
<td>Not determined (low*)</td>
</tr>
<tr>
<td>Characteristics</td>
<td>Prefer to experience and learning by sensing</td>
<td>Prefer visual data</td>
<td>Prefer auditory data</td>
<td>Use observations to build principles</td>
<td>Prefer to do active experiments</td>
</tr>
<tr>
<td>VR capacities to respond to the learning style</td>
<td>Simulating sensory data and providing the sense of presence</td>
<td>Providing a huge amount of reach and immersive visual data</td>
<td>Providing a huge amount of reach and immersive auditory data</td>
<td>Simulating realistic environment with accurate real-time physics and light simulation</td>
<td>Providing an interactive virtual environment</td>
</tr>
</tbody>
</table>

*although it is not directly stated by Felder, our informal surveys suggest that teachers do not include active experiments in architecture classrooms.

### CHARACTERISTICS OF A VR APPLICATION FOR ARCHITECTURAL EDUCATION

Studies clearly confirm the possibilities that VR provide for enhancing learning and realizing pioneer theories of learning in architectural education. The characteristics of an ideal VR educational application are listed below. Arguably, the inclusion of all those features in a VR educational application, would enhance the learning process.

Regarding PBL, the application should be fun and motivating. VR technology is arguably fun by its nature. However, through increasing levels of immersion, adding visual effects, adding game-like tasks, and making the application more interactive, it is possible to make the system more engaging. Moreover, by simulating real events (e.g. simulating a construction site process), the system can provide an environment for learners to freely draw their own conclusions about what they have experienced. Regarding the experiential learning theory, the system should also be interactive and immersive to bring the opportunity for the learners to learn from experience. Salama (2015) acknowledges that by stating learning through experience involves not merely observing the phenomenon being studied but also doing something with it. The study of learners’ style (Table 2) also implies that the system should be interactive, immersive, flexible, and realistically simulating events. Besides, some learners prefer to decide when and where to learn new concepts and be exposed periodically to advanced concepts, hence the system should be flexible in regards to these needs.
As asserted in the literature review, some VR educational applications have been developed by researchers, but the level of interaction and immersion were limited in those cases. Alongside that, the assessment component was neglected in the previous implementation of VR in architecture and construction education. Therefore, LADUVR is trying to address those flaws.

A VR application should be flexible to become an effective learning tool considering the flipped learning theory. Although the optimum level of flexibility is not clearly investigated in any studies so far (Wanner & Palmer, 2015), studies show the flexibility would increase students’ engagement in learning (Bergmann et al., 2012; Hao, 2014; Zappe et al., 2009). Flexibility in VR education could be interpreted as learners’ decision on what type of learning materials they prefer to use and when they decide to learn. In fact, by including different learning sources such as audio, text, image, video, and 3d models the application would be flexible. Alongside that, as mentioned before, a flipped learning tool should have an assessment component. That is also possible to be included in the system due to the interactive nature of VR technology.

**LADUVR APPLICATION**

LADUVR is an educational VR application (developed by the authors) that presents educational material about construction and architectural detailing to users based on the characteristics extracted from learning theories mentioned in previous sections. Although similar applications have previously been developed, LADUVR arguably has advantages over them in terms of the level of interaction and content.

**The Structure of LADUVR**

LADUVR is comprised of three main sections: one for a step-by-step simulator for a house building process, one for facilitating an in-depth observation of architectural details, and one for practicing and learning. Below are brief descriptions of each section:
A Step-by-step Simulator for the House Building Process

In many architecture schools (including SBU), site visits are arranged for construction courses. The idea behind this section is to simulate the sense of being on a construction site using a virtual environment and VR technology as far as possible and thereby facilitate the teaching of the building process to students. Due to the real-time simulation of light, realistic materials, and detailed 3D model of the building, users can actually experience a sense of being on a construction site. Moreover, in this section users can investigate the house building process from different views and also control that process easily just by pressing some buttons on the controllers. The controllers also provide additional information about every step of the building process in the form of imagery or audio via buttons and screen on them. For instance, by clicking on a button of the controllers a sound clip about the current step of the building process will be played.

By using this section, students are expected to understand construction stages more in-depth in an experiential fashion and also learn the time sequencing of the building process. Alongside that, this experience is completely safe and saves money and time compared with the actual construction site visit.

In-depth Observation of Architectural Details

Learning by investigating a 3D model rather than looking at a 2D representation of an architectural detail (the traditional way of presenting educational materials to the students in classrooms or books) is the obvious advantage of using VR technology. The purpose of this section is to facilitate learning of architectural details by providing an experiential learning opportunity for students using capabilities of VR technology. In this section, the user experiences the sense of being in a small virtual house and would be able to freely and virtually walk in the house. Users can interact with the virtual environment in this section; for example, to observe the details of a specific part of the building, they can click on some highlighted points, and a menu will guide them to activate some section planes. These cutting planes provide an opportunity for users to see through parts of the building and understand the architectural detailing for the corresponding section. To gain more
information users may click on “In-Depth Exploration” buttons and they would go to another level. In this level, users see an extracted part of the building including the selected detail. In this level, there are options that could help the user through the process of understanding that particular detail. For instance, the user can point at every component of the 3D model and the software plays a sound clip with additional information about that component.

Figure 5. A screenshot from “A Step-by-step Simulator for the House Building Process” section (Source: Authors).

To increase the amount of immersion, the user can activate a flashlight that can be used to light up the dark spots of the 3D model.

Figure 6. A screenshot from “In-depth Observation of Architectural Details” section (Source: Authors).
The third section is dissimilar to other sections in the sense that in this one, users practice what they have learned in the other two sections. In fact, this section is the assessment component of LADUVR. In this level, which includes some real-time simulations (lights and physics simulation), users build architectural details from the components provided in that virtual environment. These tasks would internalize their understanding and skills to work with materials. This is in line with Stice’s (1987) view that learners retain 90 percent of what has been presented to them when they struggle with that materials in action.
In 12 booths designed in circular form for this section, users build virtually 12 most fundamental architectural details (adopted from Construction-1 and Construction-2 courses in SBU curriculum). In every booth, users confront a sample of specific detail, an incomplete detail, and a table with some architectural components on that (bricks, steel profiles, insulation materials, etc.). The users are expected to use those components to finish the incomplete detail. If everything goes correctly, a message notifies users that the task has been accomplished; otherwise, they should correct their mistakes. Alongside the samples that exist in every booth, users carry a screen on their controller that shows additional information about the particular detail presented in the test. The most interactive section of LADUVR is “Practice and Learn” therefore a considerable amount of coding was required to accomplish this section’s aim.

Challenges and Stages of the Work

In this section challenges in the process of developing any educational application like LADUVR are reported. This interdisciplinary project demands a wide variety of skills. To elaborate on this, three different types of tasks have been done by the authors to develop LADUVR. These tasks can be categorized as “Designing and Providing Contents”, “Designing the Interface” and “Coding and Programming”.

Designing and Providing Contents

The most challenging section for developing any educational application is providing appropriate contents. To accomplish this, numerous studies have been conducted to select valid and suitable architectural details for presenting to architecture students. All contents of LADUVR are chosen with reference to two courses (Construction-1 and Construction-2) at SBU. They are both undergraduate courses, and play a key role in teaching construction and architectural detailing. Some of the contents are also chosen with reference to the book “Understanding Architectural Details” by Emma Walshaw (2015).
The next step was to convert all the chosen materials to VR optimized 3D models. This step was the most time-consuming part of the project and in this process a lot of modeling, texturing, and 3D model optimization was carried out to ensure that the final application would run smoothly and would not cause any problem including motion sickness for users. All 3D modeling on the computer was carried out using Sketchup Pro for Windows. After modeling all the contents, 3D models have been imported to the Unreal Engine. Not until we have the fully detailed 3D models of architectural details were we able to develop a VR application, because in this kind of media, the user would inspect 3D models in a virtual environment from almost every possible view and even a single minor error in the 3D model could ruin the learning process and would cause distraction and even motion sickness.

Figure 10. The house modeled to represent architectural detailing contents in LADUVR (Source: Authors).

Coding and Programming

There are major issues with this stage, as programming is not the normal practice among architects and their teachers (in this case coding for a VR application). To overcome this...
problem, effective and relatively easy-to-use tools have been introduced in the game production industry: The Game Engines. Game Engines are powerful tools for developing any kind of application because they provide a wide variety of features for the developers including accurate light simulators, physics simulators, some templates and pre-coded assets for producing VR application. Alongside those tools, Visual programming language (VPL) is contrived in some of those game engines. VPL is a programming language that uses graphical elements and figures to develop a program. The user-friendly interface of VPLs makes it a useful tool for people who are not familiar with the traditional way of coding and want to develop educational applications. Unreal Engine is one of the most powerful free game engines available for developing VR applications and also includes its own node-based visual programming language called Blueprints.

![Figure 11. A sample of VPL coding done for LADUVR that controls the visibility of components of Test no.1 in “Practice and Learn” section (Source: Authors).](image)

To finalize the production of LADUVR, significant amounts of optimization and bug fixing were found necessary. In fact, to make a VR application, it is crucial to make every part of the application so efficient that it would run at least in 60 frames per seconds to reduce the chance of motion sickness occurrence. In case of not being able to fulfill that requirement, the VR experience would fail. Some tricks and optimizations for VR applications that have been used in LADUVR are discussed in a study by Hii Jun Chung (2007).

**Designing the Interface**

An interface is an essential part of any application, and when it comes to VR, it becomes more crucial to design an interface compatible with the capabilities of VR and expectations of the users. LADUVR’s interface (like the other components) has been designed with much trial and error to make sure that the users would be comfortable while using this application.

In LADUVR, the user can interact with the interface of the application using two physical motion controllers. By pointing at specified parts of the virtual environment and clicking on the keys of motion controllers, the user could interact with the application. The same menu also provides information about how to use application and additional information in every section.
IMPLEMENTATION AND EVALUATION

The next step after the feasibility study and introduction of LADUVR was the implementation and evaluation. The evaluation was performed in the Architecture department, Faculty of Architecture and Urban Planning, Shahid Beheshti University, through a pilot study carried out to measure the effectiveness of LADUVR on a small group of architecture students.

The equipment and facilities needed for this study included a virtual reality head-mounted display (HTC VIVE), a room with minimum of 3 meters by 2.5 meters of free space (The recommended minimum space for using HTC VIVE is 2 meters by 1.5 meters, however, interacting with LADUVR's interface in that amount of space is challenging.), and a personal computer with a high performance graphic processor. Due to satisfactory levels of immersion that HTC VIVE provides and its reasonable price, LADUVR is specially designed to work with this specific HMD. However, LADUVR is modifiable to work with other HMDs.

After providing all the requirements, students who had completed Construction 2 or Construction 3 courses within the last year were called to participate through an announcement. Eight students were randomly selected from volunteers for the meeting session and the interview. Importantly, half of the interviewees had significant experience of being in a real construction site. At the scheduled meeting time, instructions were given to users to feel comfortable with the application’s interface. Each participant experienced LADUVR in a fixed amount of time (about 15 minutes). At the end of the experience, all were interviewed. Greg Guest et al. (2006) suggest that considering the concept of “Saturation”, within the first six interviews basic patterns in the result would be exposed and after 12 interviews enough saturation could be reached. It was found safe to assert in this case that eight interviewees would suffice.

Moreover, participants were interviewed by asking 11 questions to compare their experience of LADUVR with what they have seen in the current construction course in the university. Finally, a question about ‘How well do you remember what you have learned in your experience with LADUVR?’ sent to participants and they sent back their answers. The results of this preliminary study suggest that students believe LADUVR could help them to understand architectural detailing better in a flexible, interactive, and immersive environment. As a matter of fact, LADUVR was found to be effective, efficient and attractive for most students. Detailed results of this evaluation are as follows:
Level of Flexibility

We asked participants ‘do you think that the level of flexibility that is provided in LADUVR is more than actual construction courses? or not? And do you think it would enhance your learning progress?’. Almost all the participants implied that this application is far more flexible compared to traditional classes at the university because they have an opportunity to decide when, where, and what to learn. They also asserted that shifting from one source of learning (e.g. a 3D model of a construction detail) to another source (e.g. recorded videos of a construction task) is really easy and it really makes the application engaging. Moreover, about half of the participants asserted that they think this level of flexibility would help them to proceed their learning process more effectively, however, the other half claimed that they prefer to have a guideline or a teacher beside them while using LADUVR to guide them what to watch first and what to do next. One of the interviewees also stated that she cannot follow the learning process without having a linear learning path. It is possible that the diversity in the reactions to the level of flexibility in LADUVR is related to the learning styles of the participants.

The Assessment Component

Participants were asked to tell their opinion about the assessment section of LADUVR (Practice and Learn section). Most of the interviewees were satisfied with this section in terms of the level of engagement, however, five participants claimed that they prefer more types of assessments tasks and it is a good idea to add options to access previous results of the tests from the internet and compare that to other students. Although the authors of this article are aware of the limitations and deficiencies of this section (e.g. not providing personalized test according to the users' learning styles due to the challenging nature of coding), the general opinion about the idea of testing learners' knowledge through a series of game-like tasks was very positive.

Clarity of the Learning

To find out the quality of information that LADUVR offers, we asked the participants how they evaluate the clarity of data presented in this application. There was a clear consensus on the higher clarity of the data that is transferred through LADUVR compared to actual construction courses due to a real 3D presentation and real scale of objects presented there. Participants declared that in the first section of LADUVR (A Step-by-step Simulator for the House Building Process) there were some missed steps in the process of building and they suggested that by increasing the number of steps they would understand the whole process more precise. In addition, all the participants evaluated the clarity of data for the two next sections excellent. Participant also said that lack of perceiving texture and weight for detail components put this application a level below a real construction site experience.

The Quantity of Information Conveyed

The interviewees agreed that the amount of information perceived during this event (regarding the exposure time) is higher than what teachers offer during construction classes. However, some interviewees believe that in some sections of LADUVR there is more information than their capacity to learn in one session.
Transferring Knowledge to Others

A good measure to understand how well a topic is learned is to examine the ability to transfer that data to other people. So, all the interviewees were asked about this issue. Almost all of them believed that due to the higher level of clarity in data presentation compared to traditional construction courses, they would be more successful to transfer data to classmates and colleagues in a linguistic way. It is noteworthy to mention that a portion of participants in the interview was concerned about being able to draw 2D presentations from what they had learned in LADUVR.

Ability to Transfer Knowledge into Practice

Considering the fact that the presented data were clearer compared to those of traditional learning, interviewees declared that it would be easier to use that information in a real scenario. However, they stated that there are some skills (e.g. how to implement a brick wall completely vertical) that users cannot learn in applications like LADUVR. Some interviewees believe that LADUVR is more efficient for getting a grasp of construction. In contrast, some stated that gaining experience through working in real construction sites is a better way for learning tips and tricks.

Reviewing Learned Materials

Participants in the interview mentioned that they have to acquire VR hardware to use LADUVR at home or school for relearning purposes. In fact, the present costs of equipment needed for realizing virtual reality is an obstacle to implementing VR technology in architecture schools. Moreover, users prefer to use notes and books for relearning and reviewing educational materials.

Attractive or Boring

We asked the participants’ opinion about how much they found LADUVR an interesting way of learning. All the participants described the experience as far more attractive than the traditional alternative. Most interviewees also stated that they were surprised how fast the testing time passed. They found the whole experience enjoyable because of the possibility to interact with materials. however, a small number of applicants doubted whether the experience remains as attractive as the first time on the next occasion.

Replacement for Teachers

Although a small portion of interviewees stated that this application could replace traditional education, most of them believed that this application is a supplement for traditional education.

Remembering After a Week

After a week we sent the participants a question about how much they remember what have learned in their experience with LADUVR. Almost all the participants stated that they remember what they have learned in their first session. Moreover, they added that they have
maintained a visual model from presented materials in LADUVR since the testing time. However, some interviewees stated that they remember the overall concept better than minute details. One of the interviewees also added that during the testing of the third section of LADUVR, he spent more time on getting comfortable with learning interface rather than spending time to learn architectural detailing.

Advantages of LADUVR

Some advantages of using LADUVR in architecture pedagogy over the traditional way of learning architectural details from the perspective of the participants are listed below:

- **3D Instead of 2D:** Perceiving information similar to when people look at real objects (including all information about dimension and scale) is possible in LADUVR. Representation of architectural details in papers and regular monitors are two-dimensional while by using VR technology, learners perceive the real scale of architectural components in a three-dimensional environment.

- **Interactive:** The most important factor that distinguishes this application from other traditional presentations of educational materials and even other VR applications that were mentioned in previous paragraphs, is the level of interaction that is provided in LADUVR.

- **Immersive:** The sense of presence in a virtual world could facilitate the mind to focus on learning instead of imagining. The realistic environment of LADUVR with its real-time reflection and lighting calculations provides a high degree of immersion.

- **Control over Time:** It is in actual life experiences that people learn from natural phenomenon. In most cases, the process of natural phenomenon cannot be controlled or rewound, however, in virtual environment users have control over time. For instance, in “A Step-by-step Simulator for the House Building Process” users can rewind or forward the building process.

- **Additional Multimedia Information:** Options for presenting extra audio, video, and pictures while inspecting the 3D model of the details is a notable feature of LADUVR. For example, in this application, a sound clip would be played to guide how to implement a metal deck just by clicking on the metal deck's 3D component.

- **Cost Less Time and Money:** In spite of the initial investments for developing the application, cost of implementing LADUVR compared to preparing similar real-life situations, for example, a real construction site visit, is less.

- **No Health Risk:** Being on a real construction site presents a safety risk to the attendees; however, the virtual environment eliminates this risk.

CONCLUSION

Undoubtedly, VR technology will play a crucial role in the future of e-learning and the way humans will think about education. Alongside other sub-fields of architecture, teaching construction and architectural detailing could benefit most from this new technology. Furthermore, there are many challenges in architectural education that can be addressed through VR. For instance, according to a survey conducted in this study about half of the architecture students do not receive the education in the way they are better at receiving. In response, an educational application based on VR technology called LADUVR has been
designed and developed, an interactive and immersive experience which is fun, flexible, and has an assessment component. The grounds for this application are based on new theories of education in architecture such as PBL, EL, FL and learning styles theory. To elaborate on this, an educational VR application should be flexible, interactive, immersive and comprise an assessment component to: 1) put an end to the neglect of some learning styles, 2) to be a tools for realizing blended learning and 3) promoting problems based learning, as well as 4) being a tool for providing experiential learning opportunity in classrooms.

Through developing LADUVR, challenges and advantages were identified. The first challenge bear to implement VR technology for educational purposes would be preparing contents that meet requirements for VR. Moreover, like a video game, a VR application without enough interaction would be a one-way media and could not motivate learners to use this flexible source of learning. The third challenge is translating all the plans and contents to computer language. Although this would require the knowledge of coding, new tools for developing applications like VPL could help researchers that are not expert at coding.

Finally, the implementation of LADUVR was put to test as part of this work. A pilot study of LADUVR was conducted with the results indicating that learning construction through virtual reality has notable benefits: 1. Facilitating blended learning and problem based learning's goals by being a flexible learning tool, 2. learning knowledge more efficiently, 3. improving recalling the information for a longer period of time, 4. providing an experiential learning tool that could facilitate transferring perceived knowledge into practice, 5. providing assessment component by being interactive, and 6. facilitating conveying data to classmates and colleagues are potential advantages of LADUVR.

However, interviewees believe providing equipment for using VR application in architectural classrooms is a serious challenge. Alongside that, participants in the pilot study declared that there is less probability for LADUVR to replace teachers and classes in the near future. In fact, it is better to use LADUVR as a supplemental tool for education.

OPEN POSSIBILITIES

VR world is just at the beginning of its era; many hardware and software that would enhance VR experience are introduced every day. But the interdisciplinary nature of developing VR applications is an immense challenge in the way of using maximum capabilities of this new technology in education and e-learning, and how to implement that in architectural pedagogy could be subject to future research studies. From the authors’ point of view, the following topics could be open possibilities for further studies.

- More research is required to determine the efficacy of these kinds of applications and how to implement them in actual classrooms.
- Further studies can be done on the relationship of other educational models with VR technology.
- Designing and evaluating VR educational application that have adaptive features for different users with different learning preferences. An adaptive and intelligent educational systems which provide an alternative to the traditional “one-size-fits-all” approach in education (Eissa & Lee, 2008).
- Design VR/AR educational application that helps students connect learning with their life-world experiences.
REFERENCES


Bergmann, J., & Sams, A. (2012). Flip your classroom: reach every student in every class every day. International Society for Technology in Education.


THE GREEN ROOF THERMAL PERFORMANCE EVALUATION IN COMPARISON TO ASBESTOS CEMENT TILES APPLIED TO LIGHT STEEL FRAME BRAZILIAN BUILDINGS

DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1709

Angélica Felicidade Guião Marcato Costa; João Alexandre Paschoalin Filho; Tatiana Tucunduva Philipi Cortese; Brenda Chaves Coelho Leite

Keywords
thermal comfort; sustainable constructions; green roof

Abstract
This research aimed at comparing the thermal performance provided in experimental modules, one of which was performed with conventional cover, made of asbestos cement tiles; another with green cover. The structure of the studied modules was executed using Light Steel Frame technique. As an experimental research, modules were built in a wide place, without the interference of shading. Instruments were installed in the inner part of the modules to measure the following data: air temperature, relative humidity. From the collected data, representative episodes have been chosen for the studies that aimed to compare the comfort provided by both modules, built with different roofs. As result, it was verified that the module with green roof had better performance than the module covered with asbestos cement tile in all selected episodes. The module covered with green roof maintained lower internal temperature variation throughout the days, indicating that the green roof has characteristic thermal insulation, reducing the heat flow from the roof.
INTRODUCTION

Discussions about sustainability have been taken great relevance. In this context, the urbanization and civil construction industry are the main players responsible by environmental impacts. There are many effects caused by the modern urbanization model in last decades, such as hygrothermal discomfort and heat islands. The thermal discomfort inside the buildings increases considerably in the face of this phenomenon. In this situation, Mascaro and Mascaro (2009), comment that vegetation has an important role to improve the urban ambience. Tan et. al (2017) highlights the phenomenon of Urban Heat Island (UHI) as one of the most significant impacts of urbanization, which is defined as the observation of significantly higher air temperature in densely built environments to their surrounding rural areas. Tam et. al (2017) comment that many studies have observed temperatures increases up to 4°C arising from UHI in many cities all over the world. To Tan et. al (2010), Urban Heat Island has negative consequences on human health, human outdoor comfort and energy consumption for regulating indoor temperatures inside the buildings.

As stated by Squier and Davidson (2016), the urbanization of past century led to destruction increasing of natural environmental and great areas of waterproof cover. According to the authors, many ecosystems were destroyed and natural cycles were altered. Within this context, green roofs or vegetated roofs are often used by their ability to provide quasi-natural surfaces. Green roofs can help regulate thermal process, leading to reductions in building cooling and heating loads and decreases urban heat island phenomenon. Silva et. al (2011) comment that the hygrothermal discomfort generated by the cities could be softened with natural resources. In this way, green roofs became an important agent in urban microclimate transformation. According to Mahdavi and Orehoungi (2008) new buildings must embodied intelligent design to adapt on local climatic conditions and social functions. To Cubukcu and Diktas (2013) only a limited number of studies considered the effect indoor environmental features, and physical characteristics such as complexity, roof type, window size, and amount of open space of a building. As specified by Shafique et. al (2018), green roofs built at the building rooftop are old techniques. At ancient time, people constructed green roofs on the rooftops as gardens to thermal insulating and to reduce the adverse effects of urbanization. According to the authors, one of the most famous ancient green roofs was the Hanging Gardens of Babylon, built around 500 before Christ. The modern green roofs started from Germany in the 1960s to reduce energy consumption in the building during the energy crisis. Nowadays Germany is known as the world leader of green roofs, because green roofs on the large scale are being developed, designed and implemented on commercial and residential buildings (Shafique et. al, 2018).

According to Dias (2013, p.1), “...among the components of a building, the roof is the most important considering the indoor heat increase”. To Righi et. al (2016) the green roof can influence on violet rays harmful effects, providing better thermal inner conditions in the buildings. Genko and Henkes (2013) comment that the green roofs can reduce heat island phenomena in the cities keeping a pleasant microclimate and helping carbon sequestration. According to Loiola et. al (2018) the green roof, or rooftop garden, consists of a vegetative layer grown on a rooftop, and since 1990s, installing green roofs has become an usual practice, especially in the urban areas of many cities in developed countries. Shafique et. al (2018) report that green roofs are also referred as vegetated roofs, cool roofs, eco roofs, and roof garden or living roofs. As stated by the authors, green roofs are designed to encourage the vegetation on the top of the buildings aiming to get environmental benefits, better thermal comfort and storm water retention. To Li and Yeung (2014), green roofs increase green spaces and the sense of wellness. According to Feng and Hewage (2014); Santamouris
(2014) and Loiola et al. (2018), green roofs reduce the heat island effect on big cities, improve buildings thermal performance cooling internal environmental during summer, as well as promoting insulation during winter, providing energy savings and better management.

**GREEN ROOFS: TECHNICAL ASPECTS**

As stated by Speak et al. (2013), there are many technical aspects to be considered during green roof projects and installation, divided in three categories by planting density, vegetation type and roof structural capacity. These categories are: Extensive – characterized by low structural load capacity and low implantation costs, since it requires little fertilization and irrigation; Semi-Intensive – used for structures with higher load capacity and medium maintenance costs; Intensive – usually used for structures with higher load capacity (Shafique, et al., 2018). This category requires constant fertilizing and irrigation. Silva Junior et al. (2012) comment the extensive green roofs are conceived of as being almost self-sustaining, that is, they need the minimum maintenance. However, green roofs require a reasonable depth of soil according to vegetation that will be used. According to Vacilikio and Fleishfreesser (2011), the intensive green roof requires soils with a thickness of more than 20 cm. According to the authors, the extensive green roofs are cheaper, formed by creeper species and can be installed on sloping surfaces. Rangel et al. (2015) highlight that each kind of green roof will demand a specific vegetation type.

Speak et al. (2013) and Shafique et al. (2018) carried out researches on the hydrological properties of green roofs that revealed a range of average rainwater retention efficiencies. According to De Nardo et al. (2005), Mentens et al. (2006) and Moran et al. (2003), for extensive green roofs there is a range between 45 to 60% of cumulative water retention. Mentens et al. (2006) states the direct relationship between green roof substrate depth and higher water volumes retention.

Nicks et al. (2016) consider that green roofs are able to provide a layer of vegetation and soil to offset the original loss of landscape in the cities. As specified by them, many green roof systems support shallow substrates, making possible to use green roofs on many pre-existing buildings with little or no additional structural support needed. Speak et al. (2013) recommend the use of rustic vegetation species, such as native plant and well adapted to local environmental conditions. According to Lopes (2007), the choice of plant species should take into account certain criteria, such as resistance to high solar radiation level, and regeneration capacity after prolonged droughts and torrential rains; horizontal root development; reduced growth time; adaptation to narrow substrates and with few nutrients; large leaf surface and do not loose many leaves. From the authors’ considerations, it is observed that grasses are considered the most suitable plant species for extensive green coverings.

Vacilikio and Fleishfreesser (2011) carried out a study where they compared the inner air temperatures of two experimental buildings. One building was covered by green roof, and asbestos cement tiles covered the other. According to the authors, the obtained data showed a significant reduction on thermal amplitude inside the building covered by green roof. The green roof reduced the temperatures along the day and kept the inner environment warm by night. Such behaviour was also identified in the work conducted by Lima et al. (2009), which obtained a reduction in the thermal amplitude around 5º C, comparing a module constructed with green roof, with another one endowed with waterproofed slab. According to Rosseti et al. (2013), this phenomenon occurs because green roofs increase thermal insulation layers.
that reduces the heat flux through the roof. Therefore, lower thermal energy is transferred from the exterior to the interior of the building. Carneiro et al. (2015) performed an experiment by a period of 70 days in the city of Recife, Brazil. The researchers built experimental models covered by four different kinds of roofs, such as: asbestos cement tile with 6mm thickness, recycled tile with 6mm thickness, green roof with Zoysia japônica grass and other green roof, however covered by Arachis repens grass. The authors concluded that the roofs covered by vegetation demonstrated better thermal performance comparing with the other kinds of roofs. Squier and Davidson (2016) carried out the study of the thermal properties of a green roof using field data gathered from an extensive 0.56 ha green roof in Syracuse, NY. Sensors were installed at five stations across the roof aiming to measure temperature at four depths within the roof layers. Data have been gathered from September 2013 to September 2015. Heat fluxes ranges from -5.75W/m² to 9.46 W/m² were observed. Negative (downward) heat flux is found during summer and early fall, and positive (upward) heat flux dominates during heating season. According to the authors, solar radiation can heat upper layers of the roof significantly above ambient air temperature during the summer. Barmparesos et al. (2018) studied six classrooms located under concrete roofs during warm and cold periods of school year.

The Experimental monitoring took place in a typical school building in Athens/Greek. The results show that, during summer, the green roof reduces indoor temperature of classrooms by about 2.8oC in comparison with the respective classroom covered under concrete roof. However, during cold season, the classrooms underneath green roof cover demonstrated higher values of indoor temperatures (19.7oC) than the classrooms under concrete roof (16.4oC). The author also report that the absolute air humidity showed a relatively stable for both classrooms during all of the experimental period. He et al. (2017) studied the effects of two important parameters on a green roof thermal performance; the thickness of soil layer and leaf area index of plant layer. The author simulated 18 cases with different combinations of soil thickness and leaf area index. The results show that the soil thickness has a significant effect on long term thermal performance of green roof in both summer and winter, while the effect of leaf area index is only significant in summer. Study carried out by Olivieri et al. (2013) in a Mediterranean climate show that the density of green roof plants affected the energy consumption of the studied building by up to 60% depending on specific conditions. Lee and Jim (2018) performed measurements using a wide range of precision sensors in order to study the thermal-cooling performance of an intensive green roof (0.5m of substrate thickness) in a building localized in Hong Kong. The green roof data were compared to a bare roof also monitored. The authors concluded that the green roof registered significant surface and air-cooling on sunny days. The vegetation served as an interceptor and filter of incoming solar radiation. However, the authors report that the solar irradiance imposed notable influence on surface temperature on the bare roof.

As stated by Khan and Assif (2017), beyond thermal performance increasing, the green roof also provides energy saving for the buildings. According to then, green roofs are a passive strategy that can be a useful solution in different climates in order to reduce building's energy consumption. Green roofs provide energy saving and reduction in greenhouse gas emissions. Masseroni and Cislaghi (2016), using extensive and detailed green roof parameters, concluded that green roof attenuates flood events that can produce overflows in the large urban areas. However, the authors highlight that the green roofs effective can be influenced by their initial conditions in terms of volumetric water content of the substrate. Under field capacity of saturation, the effects of floods attenuation and water volume retention drastically decrease.
The use of Light Steel Frame as construction methodology

According to the Brazilian Association of Technical Standards – ABNT: NBR 15.575/2013, the construction materials used in civil construction can influence the inner comfort conditions of a building, specially the roof. In this way, civil construction industry has been developing technologies in order to reduce the environmental impacts caused due its activities and improve the thermal comfort of new buildings. According to Lee et a. (2017) the use of light steel frame (LSF) in rapid constructions has grown significantly, especially concerning low and medium-rise buildings. Light steel frame can be considered a dry construction method.

Angelo and Serra (2014), Gorgolewski (2007) and Lawson et. al (2009) report that, in recent years, lightweight walls have become more used in Europe because of its advantages such as quick execution time, the integration of systems in walls thickness, the reduction and recyclability of wastes during the construction phase, the reduction of structural loads and low water consumption. However, according to Angelis and Serra (2014), the thermal characteristics of light steel frame materials are more heterogeneous than traditional wall, made with bricks and mortar. In fact, the thermal conductivity of insulation layer of these materials is about 0.04 W/mK while steel frames are about 1000-1500 times higher.

According to Gomes et. al (2013), LSF is new to Brazil, having been introduced in the late 1990s aiming construction of residential houses. Thus, LSF design practices needs some adjustments considering Brazilian climate conditions. As stated by Gomes et. al (2013), it occurs because LSF system was imported from United States and, therefore, implicitly includes assumptions about climate that may not apply to Brazilian conditions. In addition, according to the authors, steel structural systems have been recently considered by designers and construction contractors seeking innovative construction technologies. However, despite the great interest by designers and construction contractors, there are few academic researches about this issue yet.

RESEARCH GOALS

In this context, two experimental modules were built using LSF constructive technique in the city of São Paulo/Brazil. It can be said that LSF may be considered a sustainable constructive system because it generates low amounts of wastes and improve thermal conditions of the buildings. One of the modules was built with green roof, and the other with asbestos cement tile. Therefore, the main goal of this research is evaluate the thermal performance of each module built using LSF technique. As stated by Lundholm and Williams (2015), it is very important to carry out researches that focuses on quantifying thermal behaviour of green roofs. To Shafique et. al (2018), many researches are aiming to the performance of green roofs in different regions around the world. According to the authors of the research on the green roofs, there are numerous social, environmental and economic benefits. Significant evidence shows that green roofs can give different kind of benefits, such as storm water management, reduced urban heat island, enhance the air and water quality, decrease of water and energy consumption, decreased noise pollution and other benefits more.
MATERIAL AND METHODS

Execution modules site

The modules were built in an area located in the Campus Vergueiro parking lot of Nove de Julho University, in the city of Sao Paulo/Brazil. The geographic coordinates of the chosen area are: 23.56°S 46.64°W and 745m of altitude. According to Sao Paulo municipality (2017), the climate of the city is characterized as tropical altitude, with average annual temperatures between 19º C and 27º C. In summer, it is common to present rains in the late afternoon, which relieves the heat and in the winter usually presents dry and sunny days. Spring is hot and dry, and in autumn the temperature is mild.

For the adoption of climatological data used in this research, government agencies and monitoring institutes were consulted, with meteorological stations located near the area where the modules were built. In this way, the meteorological station closest to the area of the modules was Sé Meteorological Station, administered by the Center of Management of Emergencies (CGE).

The modules were built in a wide area with no shading incidence or any kind of interference, caused by other buildings or vegetation. According to Nicks et al. (2016), the spatial heterogeneity where the green roofs are built may influence its behavior in thermal conditions. For the authors, shaded areas promote small heat fluxes through the roof and reduce storm water retention. The modules were positioned with the same solar orientation, arranged side by side, at a distance of 2.0m from each other, with the doors directed towards the south orientation and the windows directed towards the east orientation, as shown in Figure 1.

Figure 1. Modules positioning – no Scale (Source: Authors).

Modules characterization

Light Steel Frame technique has been used in modules execution. These were supported on sill plate foundation with 15cm thickness. The modules have identical characteristics, except for the kind of the roof. One module was covered by green roof (1) and the other one was covered by asbestos cement roof (2). Both modules have the following inner dimensions: 1.90 x 2.35m and 2.55m of ceiling high, as show in Figures 2 and 3.
For each module was installed a window in white color with the dimensions of 1.20 x 1.0m, and also a wood door with the dimensions of 0.72 x 2.10m painted in white. For green roof waterproofing, was installed flexible bicomponent made with thermoplastics materials and cements with additives and incorporation of synthetic fibers (polypropylene). The module’s 1 draining layer was composed by recycled civil construction aggregate. To enable the rainwater flow, a drainage PVC tube was installed (Ø 2”). The green roof used was the extensive type with substrate of 15cm thickness. Figure 4 shows the details.
The vegetal species chosen to the green roof was “emerald grass” (Zoysia japônica). According to Lopes (2007), this kind of grass presents great resistance to weather and is appropriate to green roofs. The module 2 was covered with asbestos cement tiles with 6mm thickness and dimensions of 1.10 x 1.83m. This kind of tile was used in module 2 because it is very commonly used in Brazil. Figures 5 and 6 show the modules 1 and 2.

Data Collection

For the evaluation of the internal thermal comfort of the modules, these individually counted on a system for measuring the environmental variables, composed of a thermal stress measurement instrument with a globe thermometer to measure the variables: radiant temperature, air temperature, relative humidity and air velocity. The measuring instruments were fixed on a metal tripod, positioned at the center of each module. The fixing height is based on the recommendations of Fundacentro - Jorge Duprat Figueiredo Foundation of Labour Safety and Medicine (2002). Fundacentro (2012) recommends that the instruments have to be fixed 1.10m height. This value corresponds to the level of the thorax of a seated person.

To measure the inner environmental conditions of each module, the following equipment had been used: Thermal stress meter, globe thermometer and a data logger model HMTGD-1800 – Highmed. The obtained data were stored by means of continuous monitoring, with records every ten minutes. It was performed a total of 144 measurements per day.
The CGE (Emergency Management Center) made available meteorological data from the Sé Meteorological Station. The measurement period occurred between March 2017 and February 2018. Table 1 presents the days that were performed the measurements.

![Table 1. Data measurements dates (Source: Authors).](image)

**FINDINGS**

**Representative episodes**

For the characterization and thermal performance analysis of the modules 1 and 2, in front of the data of the Sé Meteorological Station, a representative episode was selected in each of the nine analysed periods. The episodes were selected considering the thermal peaks of the periods, being peaks of high or low air temperature, as shown on Figure 7.
Table 2 presents the representative elected episodes; limiting date and schedule in order to make possible the individual analysis of each episode.

Table 2. Selected representative episodes (Source: Authors).

<table>
<thead>
<tr>
<th>Period-Episode</th>
<th>Air temperature</th>
<th>Since</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Maximum temperature</td>
<td>03/24/2017</td>
<td>03/24/2017</td>
</tr>
<tr>
<td>2</td>
<td>Minimum temperature</td>
<td>04/11/2017</td>
<td>04/11/2017</td>
</tr>
<tr>
<td>3</td>
<td>Minimum temperature</td>
<td>05/13/2017</td>
<td>05/13/2017</td>
</tr>
<tr>
<td>4</td>
<td>Minimum temperature</td>
<td>09/25/2017</td>
<td>06/26/2017</td>
</tr>
<tr>
<td>5</td>
<td>Minimum temperature</td>
<td>10/21/2017</td>
<td>10/24/2017</td>
</tr>
<tr>
<td>6</td>
<td>Minimum temperature</td>
<td>11/13/2017</td>
<td>11/14/2017</td>
</tr>
<tr>
<td>7</td>
<td>Maximum temperature</td>
<td>12/17/2017</td>
<td>12/18/2017</td>
</tr>
<tr>
<td>8</td>
<td>Maximum temperature</td>
<td>01/24/2018</td>
<td>01/25/2018</td>
</tr>
<tr>
<td>9</td>
<td>Maximum temperature</td>
<td>02/09/2018</td>
<td>02/10/2018</td>
</tr>
</tbody>
</table>

The nine episodes selected were isolated and generated graphs that demonstrate the variation of the air temperature. These graphs also compare the data obtained for both modules and Meteorological Station, as shown below (Graphics 1 to 9).
Graphic 1. Episode 1 – Air Temperature

Graphic 2. Episode 2 – Air Temperature
Graphic 3. Episode 3 – Air Temperature

Episode 3 - Air temperature

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature (°C)</th>
<th>Module 1</th>
<th>Module 2</th>
<th>Sé Meteorological Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00 AM</td>
<td>15.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08:20 AM</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08:40 AM</td>
<td>14.55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09:00 AM</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09:20 AM</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09:40 AM</td>
<td>17.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:00 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:20 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:40 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:00 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:20 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:40 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:00 PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:20 PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:40 PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01:00 PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01:20 PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01:40 PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02:00 PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02:20 PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02:40 PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03:00 PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

13-May-17

Graphic 4. Episode 4 – Air Temperature

Episode 4 - Air temperature

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature (°C)</th>
<th>Module 1</th>
<th>Module 2</th>
<th>Sé Meteorological Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>03:00 PM</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04:00 PM</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05:00 PM</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06:00 PM</td>
<td>15.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07:00 PM</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08:00 PM</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09:00 PM</td>
<td>18.70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:00 PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:00 PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:00 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01:00 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02:00 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03:00 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04:00 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05:00 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06:00 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

25-Sep-18  26-Sep-17
Graphic 5. Episode 5 – Air Temperature

Module 1 | Module 2 | Sé Meteorological Station

23-Oct-17 | 24-Oct-17

6:00 AM | 6:50 AM | 7:40 AM | 8:30 AM | 9:20 AM | 10:10 AM | 11:00 AM | 11:50 AM | 12:40 PM | 1:30 PM | 2:20 PM | 3:10 PM | 4:00 PM | 4:50 PM | 5:40 PM | 6:30 PM | 7:20 PM | 8:10 PM | 9:00 PM | 9:50 PM | 10:40 PM | 11:30 PM | 12:20 AM | 1:10 AM | 2:00 AM | 2:50 AM | 3:40 AM | 4:30 AM | 5:20 AM | 6:10 AM | 7:00 AM | 7:50 AM | 8:40 AM | 9:30 AM | 10:20 AM | 11:10 AM | 12:00 PM | 12:50 PM | 1:40 PM | 2:30 PM

17.40
17.0
13.87

25-Oct-17

6:00 AM | 6:50 AM | 7:40 AM | 8:30 AM | 9:20 AM | 10:10 AM | 11:00 AM | 11:50 AM | 12:40 PM | 1:30 PM | 2:20 PM | 3:10 PM | 4:00 PM | 4:50 PM | 5:40 PM | 6:30 PM | 7:20 PM | 8:10 PM | 9:00 PM | 9:50 PM | 10:40 PM | 11:30 PM | 12:20 AM | 1:10 AM | 2:00 AM | 2:50 AM | 3:40 AM | 4:30 AM | 5:20 AM | 6:10 AM | 7:00 AM | 7:50 AM | 8:40 AM | 9:30 AM | 10:20 AM | 11:10 AM | 12:00 PM | 12:50 PM | 1:40 PM | 2:30 PM

17

13-Nov-18 | 14-Nov-18

4:00 PM | 4:40 PM | 5:20 PM | 6:00 PM | 6:40 PM | 7:20 PM | 8:00 PM | 8:40 PM | 9:20 PM | 10:00 PM | 10:40 PM | 11:20 PM | 12:00 AM | 12:40 AM | 1:20 AM | 2:00 AM | 2:40 AM | 3:20 AM | 4:00 AM | 4:40 AM | 5:20 AM | 6:00 AM | 6:40 AM | 7:20 AM | 8:00 AM | 8:40 AM | 9:20 AM | 10:00 AM | 10:40 AM | 11:20 AM | 12:00 PM | 12:40 PM | 1:20 PM | 2:00 PM | 2:40 PM | 3:20 PM | 4:00 PM

17.7
14.44

Graphic 6 – Episode 6 – Air Temperature
Graphic 7. Episode 7 – Air Temperature

Graphic 8. Episode 8 – Air Temperature
From the results, the initial, peak and final temperature measurements of module 1, module 2 and the Meteorological Station are shown in Table 3.

Table 3. Air Temperature – Episode measurements – Initial/Peak/Final (Source: Authors).

<table>
<thead>
<tr>
<th>Episode</th>
<th>Date</th>
<th>Schedule</th>
<th>Temperature (°C)</th>
<th></th>
<th>Temperature (°C)</th>
<th></th>
<th>Temperature (°C)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial</td>
<td>Peak</td>
<td>Final</td>
<td></td>
<td>Initial</td>
<td>Peak</td>
<td>Final</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M1</td>
<td>M2</td>
<td>EM</td>
<td>M1</td>
<td>M2</td>
<td>EM</td>
<td>M1</td>
<td>M2</td>
</tr>
<tr>
<td>1</td>
<td>05/24/2017</td>
<td>1:00 AM</td>
<td>24.0 24.1 24.15</td>
<td></td>
<td>26.1 27.8 29.06</td>
<td></td>
<td>03/24/2017</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>04/11/2017</td>
<td>1:00 AM</td>
<td>24.1 24.1 24.32</td>
<td></td>
<td>27.8 29.5 30.97</td>
<td></td>
<td>04/11/2017</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>05/13/2017</td>
<td>8:00 AM</td>
<td>27.6 27.4 27.6</td>
<td></td>
<td>31.2 32.0 33.72</td>
<td></td>
<td>05/13/2017</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>09/25/2017</td>
<td>3:00 PM</td>
<td>23.7 25.3 23.97</td>
<td></td>
<td>28.6 30.6 33.5</td>
<td></td>
<td>09/26/2017</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>10/23/2017</td>
<td>6:00 AM</td>
<td>26.7 28.9 26.7</td>
<td></td>
<td>31.2 33.5 35.8</td>
<td></td>
<td>10/24/2017</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>11/13/2017</td>
<td>4:00 PM</td>
<td>23.6 25.7 26.6</td>
<td></td>
<td>28.6 30.6 33.5</td>
<td></td>
<td>11/14/2017</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>12/17/2017</td>
<td>7:00 AM</td>
<td>22.7 22.7 22.9</td>
<td></td>
<td>26.6 28.6 31.2</td>
<td></td>
<td>12/18/2017</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>01/24/2018</td>
<td>6:00 AM</td>
<td>22.7 23.0 20.92</td>
<td></td>
<td>27.7 30.6 33.5</td>
<td></td>
<td>01/25/2018</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>02/09/2018</td>
<td>7:00 AM</td>
<td>22.2 21.7 21.1</td>
<td></td>
<td>29.1 32.0 33.72</td>
<td></td>
<td>02/10/2018</td>
<td></td>
</tr>
</tbody>
</table>

In Table 3 it is possible to visualize the temperature variations between the episodes. In order to compare the thermal comfort between the modules, it was necessary to group the episodes of minimum and maximum peaks separately. Table 4 presents the data of Episodes 1, 2, 7, 8 and 9, which corresponds to the maximum peaks of temperature, and
Table 5 presents the data of Episodes 3, 4, 5 and 6, which corresponds to the minimum temperature peaks.

Table 4. Air temperature variation – Initial/maximum peak /Final (Source: Authors).

<table>
<thead>
<tr>
<th>Episode</th>
<th>Module 1 (M1)</th>
<th>Module 2 (M2)</th>
<th>Meteorological Station (MS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial (°C)</td>
<td>Variation (°C)</td>
<td>Peak (°C)</td>
</tr>
<tr>
<td>1</td>
<td>24.0</td>
<td>+2.1</td>
<td>26.1</td>
</tr>
<tr>
<td>2</td>
<td>24.1</td>
<td>+2.9</td>
<td>27.0</td>
</tr>
<tr>
<td>7</td>
<td>22.7</td>
<td>+5.9</td>
<td>28.6</td>
</tr>
<tr>
<td>8</td>
<td>22.7</td>
<td>+5.0</td>
<td>27.7</td>
</tr>
<tr>
<td>9</td>
<td>22.2</td>
<td>+6.9</td>
<td>29.1</td>
</tr>
</tbody>
</table>

Based on the collected data, it was found that module 1, compared to module 2, presented lower air temperature fluctuation in all episodes. Module 1 presented, lower peaks temperature than the module 2, in the order of 1.7 °C to 2.9 °C, proving the reduction of the heat flux of the green roof, which leads to the improvement of the thermal performance provided by the surveyed coverage system.

The results were demonstrated as already observed by Getter et.al (2011) and Barmparesos et. al (2018). According to the authors, reduction of surface temperature and thermal comfort are two important functions of green roofs. Green roof vegetation and substrate absorbs fewer solar radiations than other type of roofs or any kind of tile. Yan (2011) carried out a research in Japan and the data revealed that the green roof reduced the surface temperature in order of 3oC comparing it to another kind of roof. Bevilacqua et. al (2016) show an experimental analysis of an extensive green roof installed on a building of University of Calabria. The analyses showed that the green roof was able to reduce the temperature at the interface with the structural roof, on average, by 12oC with respect to a black bituminous roof in summer and to maintain, on average, a value that is 4oC higher in winter.
In Singapore, Quin et. al (2012) measured the surface temperature from green roof and bare roof. When the results were compared with other, the green roof showed results in decreasing the surface temperature as compared do the bare roof. The author highlights that green roofs have the ability to decrease the surface temperature and hence improving the internal environment of a building.

To Jim and Tsang (2011), the selection of vegetation influences the rates of evapotranspiration and the albedo of the roof, but also contributes of solar gain relative to a traditional roof due to vegetative surface shading. The greater thermal mass of a green roof aids in stabilizing temperatures throughout the year.

CONCLUSIONS

In the present work, the thermal behaviour of two modules was constructed, analysed and compared, being one with green roof and the other with conventional cover asbestos tile, denominated module 1 and module 2, respectively. Light steel frame methodology was chosen for its sustainable characteristics.

The module 1, covered with green roof, presented better thermal performance than module 2, covered with asbestos tile in all selected episodes. Module 1 also demonstrated less inner air temperature variation when compared to module 2. However, considering the lower air temperature peaks (Episodes 3, 4, 5 and 6) it was found that the lower the external temperature, the lower the temperature difference between both modules.

Considering higher temperatures peaks, which were Episodes 1, 2, 7, 8 and 9, the module 1 has lower temperatures than that of module 2, in the order of 2.0°C in average. This fact proves that the module covered by green roof provides the heat flow leading to the inner part of the module. Also, it can be affirmed that thermal performance of modules 1 and 2 met the expected behaviour, even both modules built with LFS construction method.

Thus, the usage of green roof and the light steel frame system (LSF) in building construction can be considered to reach the concept of sustainable architecture, because they represent a passive bioclimatic construction technique, once adopt technology that optimize the building performance and minimize harmful impacts to the environment. The LSF has aroused great interest in the market, being used in various types of housing, both small and large, as well as in apartment buildings (four floors), commercial buildings, schools, hospitals and retrofit of existing buildings.

Therefore, it can be concluded that the module equipped with green roof and executed by means of LSF technique consists of an environmentally efficient construction, since it provides interior thermal comfort, presents potential to improve the climatic conditions of the cities and is constructed using dry executive method with low demand for natural materials, high dimensional accuracy, low energy consumption and minimization of waste generation.

REFERENCES


DESIGNING FOR AUTISM: AN ASPECTSS™ POST-OCCUPANCY EVALUATION OF LEARNING ENVIRONMENTS
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1589

Magda Mostafa

Keywords
autism; school design; post-occupancy evaluation

Abstract
The objective of this paper is to demonstrate the application of the Autism ASPECTSS™ Design Index in the Post-Occupancy Evaluation of existing learning environments for children along the autism spectrum. First published in 2014, this index outlines 7 design criteria that have been hypothesized to support environments conducive of learning for children with autism spectrum disorder (ASD). Using the index as a framework, this paper outlines a case study of a Post-Occupancy Evaluation (POE) of an existing pre-K-8th grade public charter purpose-built school for children on the autism spectrum. The tools used for the evaluation were: the ASPECTSS scoring of the school through a survey of teachers and administrators; on-site behavioral in-class observation; and focus groups of parents, teachers, staff and administrators. The results informed a design retro-fit proposal that strived to assess any ASPECTSS compliance issues and implement the index across the learning spaces, therapy spaces, support services and outdoor learning environments of the school. This paper will outline the application of the index and the resultant design from this process. The results will strive to present a scalable and replicable methodology and prototype for improving existing built environments for learners with ASD.

M. Mostafa
Associate Professor of Design and Associate Chair of Architecture at the American University in Cairo (AUC), Cairo, Egypt.

*Corresponding Author’s email address: m_most@aucegypt.edu
INTRODUCTION

Autism has been classically defined using a triad of characteristics (Wing, 1997) namely social challenges, communication challenges and repetitive behaviours. A revision of this original behaviour-centric definition has recently been developed to include the underlying factors leading to this behavioural triad, namely “visual as opposed to linguistic processing, impaired abstraction, and lack of theory of mind” (Cashin, A., Sci, D. A. and Barker, P., 2009).

First proposed as a spectrum by Wing, the more encompassing term Autism Spectrum Disorder has become more commonly used to describe the large range of behaviours and challenges faced by individuals with autism. The sensory theory of autism poses that these behaviours and challenges may be related to the range of sensitivities that an individual on the spectrum may have towards the five senses of hearing, sight, touch, smell and taste. First posed by Rimland in 1964 and later expanded by Delacato and Lovaaas, this theory presents the intersection where the built environment can influence those behaviours and challenges. In accordance to this theory (Rimland, 1964; Delacato, 1974; Lovaaas et al 1971), it can be hypothesized that, as the primary source and controller of the majority of sensory inputs, the built environment can potentially play a tremendous role in exacerbating or alleviating the challenges faced by those along the spectrum of autism. In its relation to the built environment, this paper therefore further poses that autism is a different but equally valid way of perceiving the sensory environment afforded by the physical world around us. This concept was presented in 2008 as the Sensory Design Theory as related to ASD (Author, 2008). Inspired by the “Catalyst for Discussion” tool of the UK’s DfEE (DfEE, 2001), the theory is manifested in the Sensory Design Matrix which intersects Francis Ching’s (Ching, 1996) categorization of architectural form, space and order, against the perceptual senses- sight, touch, hearing, smell, taste and proprioception to catalyse, hypothesize and generate design guidelines for testing.

The Autism ASPECTSSTM Index is the result of such testing and was developed as an application of this theory (Mostafa, 2008, 2014). It is a set of criteria developed specifically for the design and assessment of built environments for individuals along the spectrum of autism. First published in 2014 the Index, like the autism it supports, is itself a spectrum and provides a framework for design thinking as opposed to a prescriptive set of recommendations (Mostafa, 2014). It is comprised of seven design concepts outlined in the excerpt below, which should be considered when designing for autism (adapted and updated with permission from Architecture for Autism: Autism ASPECTSTM in School Design, 2014).

**Acoustics**

This criterion proposes that the acoustical environment be controlled to minimize background noise, echo and reverberation within spaces used by individuals with ASD. The level of such acoustical control should vary according to the level of focus required in the activity at hand within the space, as well as the skill level and consequently severity of the autism of its users. For example, activities of higher focus, or according to Sensory Design Theory, those taking place in “low stimulus zones”, should be allowed a higher level of acoustical control to keep background noise, echo and reverberation to a minimum. Also provisions should be made for different levels of acoustical control in various rooms, so students can “graduate” from one level of acoustical control to the next, slowly moving towards a typical environment in order to avoid the “greenhouse” effect, where skills are demonstrated in a perfectly sensory mitigated room but not generalized elsewhere (Mostafa, 2008).
Spatial Sequencing

This criterion is based on the concept of capitalizing on the affinity of individuals with autism to routine and predictability. Similar to what was later identified by Suskind as Affinity Therapy (Suskind, 2016), this principle applies to individuals with ASD’s specific affinity to routine and predictability as a spatial manifestation. Coupled with the criterion of Sensory Zoning, which will be discussed shortly, Spatial Sequencing requires that areas be organized in a logical order, based on the typical scheduled use of such spaces. Spaces should flow as seamlessly as possible from one activity to the next through one-way circulation whenever possible, with minimal disruption and distraction, using Transition Zones which are discussed below.

Escape Spaces

The objective of such spaces is to provide respite for the users with autism from the over-stimulation found in their environment. Empirical research has shown the positive effect of such spaces, particularly in learning environments (Mostafa, 2008). Such spaces may include a small partitioned area or crawl space in a quiet section of a room, or throughout a building in the form of quiet corners. These spaces should provide a neutral sensory environment with minimal stimulation that can be customized by the user to provide the necessary sensory input.

Compartmentalization

The philosophy behind this criterion is to define and limit the sensory environment of each activity, organizing a classroom or even an entire building into compartments. Each compartment should include a single and clearly defined function and consequent sensory quality. The separation between these compartments need not be harsh, but can be through furniture arrangement, difference in floor covering, difference in level or even through variances in lighting. The sensory qualities of each space should be used to define its function and separate it from its neighbouring compartment. This will help promote conditioned responses and provide sensory cues as to what is expected of the user in each space, with minimal ambiguity, mitigating adjustment time and getting users on task with increase efficacy.

Transition Zones

Working to facilitate both Spatial Sequencing and Sensory Zoning, the presence of transition zones helps the user recalibrate their senses as they move from one level of stimulus to the next. Such zones can take on a variety of forms and may be anything from a distinct node that indicates a shift in circulation to a full sensory room that allows the user to re-calibrate their sensory stimulation level before transitioning from an area of high-stimulus to one of low-stimulus. More recent anecdotal evidence using acoustical pods as transition zones has also begun to show a larger scope of use for such spaces than originally anticipated. These include the use of the space as a positive reinforcement tool as well as a safe space to initiate social interactions with peers and school community members. More research is needed to quantify and verify this use, but preliminary findings of ongoing research are promising.
Sensory Zoning

This criterion, based on the concepts of Sensory Design, proposes that when designing for autism, spaces should be organized in accordance to their sensory quality, rather than the typical architectural approach of functional zoning. Grouping spaces according to their allowable stimulus level, spaces are organized into zones of “high-stimulus” and “low stimulus”. The former could include areas requiring high alertness and physical activity such as physical therapy and gross motor skill building spaces. The latter could include spaces for speech therapy, computer skills and libraries. Transition zones are used to shift from one zone to the next.

Safety

A point never to be overlooked when designing learning environments, safety is even more of a concern for children with autism who may have an altered sense of their environment. Research has shown that injury and mortality are significantly increased in individuals with autism as compared to the general population (Lee et al, 2008; Svend, 2013). Specifying robust materials, safety fittings to protect from hot water, detailing fixtures to avoid small removable parts or hanging strings and an avoidance of sharp edges and corners are examples of some of the considerations that may reduce these risks. (Adapted with permission from Mostafa, 2014b)

Research has shown the applicability of these criteria to the design of various environments such as residential (Mostafa, 2014a) and learning (Mostafa, 2014b) as well as an assessment tool (Mostafa, 2014c). In this paper the ASPECTSS Index is used as a framework for a Post-Occupancy Evaluation of a purpose-built school for students on the autism spectrum. This evaluation was commissioned by the board of directors of the Foundation that constructed the school building on a 26-acre campus where the school is located, with the objective of proposing retrofit design interventions to better align the school's learning environment with ASPECTSS principles.

The school under assessment, a public charter school for students with ASD, which includes Pre-K to 8th grade, served approximately 114 students at the time of assessment, ranging in age between 3-14 years. This school is the first phase of a multi-phase campus, and is part of a larger building which houses the foundation and its services. The Foundation runs programs that are open to families worldwide. Both the charter school and Foundation utilize the campus facilities to offer services including early intervention, speech, occupational therapy, behavioural therapy, mental health counselling, music, art, fitness, golf, yoga, vocational training, cooking and life skills, and global educational outreach and training. This demonstrates efficient and creative use of space and the services they provide both functionally and operationally, capitalizing on the available resources to maximize their benefit to the largest community possible, both locally and globally.

A further scope of re-design proposals for a second public charter school also housed on the same campus that serves students 14-21 years old was commissioned as part of the POE, but is not the scope of this paper. As of the writing of this paper, the second school building was complete and running its first academic year of instruction in its new location. Prior to this point the second public charter school had been running successfully for over 15 years in a different premises.
Academically the school bases its curriculum and interventions on evidence-based practices and primarily adopts applied behaviour analysis (ABA) as the foundation of all instructional intervention. Its students are organized across 8 grades as well as pre-kindergarten and kindergarten, distributed primarily by age but also by skill and ability. The typical class size was 6-8 students with one class teacher and 1-2 teacher aids, in addition to shadow teachers of some specific students. The school is also staffed with specialist staff in the areas of Speech and Language therapy (SLP), Behavior, Occupational Therapy, Physical Education, music therapy, and art instruction.

Spatially the building has 20 classrooms, distributed along two wings of a U-shaped plan across a single storey, 14 of which were in use as regular classrooms during the assessment. The remaining spaces were used for storage, fitness/PE, foundation classrooms and aftercare programming. The main base of the form houses the main entrance, administration spaces, services such as bathrooms, and therapy and specialist spaces and offices and specialty learning labs. These include a life skills lab, music room, art room, library and computer lab, as well as individual therapy rooms with adjacent observation rooms. Each flank of the U-shape opens directly to outdoor spaces. The campus itself is accessed via a security perimeter by car (Fig. 1). The design of the building included many positive spatial, material and operational features that were purpose-built for provision of an appropriate built environment for its users. These features included:

- Smartboards;
- concealed cabinetry for clutter control;
- wide hallways and high ceilings for the creation of a sense of open space;
- calming neutral colors throughout;
- bathrooms in the classrooms to reduce transitions with the option for public bathroom in the older side to teach proper bathroom use;
- uses of Acoustiblok in the walls to reduce permeation of noise between rooms;
- LED lighting throughout;
- cameras throughout that record audio and video for professional development and research;
- specialty furniture and specialty playground equipment for universal design compliance and maximum accessibility;
- placement of windows in rooms to reduce distraction;
- observation rooms in 18 of the 20 classrooms;
- specialty labs;
- golf course.

METHODOLOGY

The evaluation itself was carried out in two stages: remotely through an online ASPECTSS Survey of parents, teachers and administrators to score the environment’s compliance, as well as an on-site stage. The on-site stage of the evaluation consisted of behavioral in-class observation and focus groups of parents, teachers, staff and administrators of the school. The retrofit design interventions proposed were at the whole school, classroom and outdoor space levels. Given the existing nature of the school these interventions were limited and excluded any reconstruction or major physical alterations to the school layout.
The ASPECTSS survey completed online was composed of 21 questions, 12 of which surveyed the compliance of the environment to the 7 ASPECTSS criteria across a 5-point Likert scale. 6 introductory questions gathered general data about the surveyed and the school, including one question measuring the “autism-friendliness” of the school across a 5 point Likert scale. The remaining 3 questions were open-ended solicitations of general observations about design features that were conducive or disruptive, as the case may be.

Six behavioural observations of the general classrooms were conducted over three days utilizing the observation rooms available for that purpose. These rooms were centrally located and each overlooked 2 classrooms using one-way mirrors and a sound-system. This allowed for minimal disruption of classroom activity and minimized the influence of the observation itself on the data collected. Observations included all functional activities typically conducted in the classrooms, including group work, push-in one-one instruction, small-group simultaneous sub-groups, specialist instruction and snack time. Classrooms were also visited when students were not present to observe detailed furniture arrangement, resource organization practices and layout opportunities and challenges. The focus of the observation was to map user-space relationships, identify target areas for re-design and generally assess the ASPECTSS compliance of the classroom.

Focus groups were also conducted over three days with the following groups: foundation staff, school administrators, PreK-8th grade school teachers, 14-22yr school teachers located off campus in another location, PreK-8th grade school parents, 14-22yr school parents, and Board of Trustee members. Interviews were conducted with members of the Foundation staff, the PreK-8 public charter school and 14-22 yr public charter school including: the Foundation Project Manager, Construction; Foundation Program Director; Foundation Assistant Director for Clinical Services; Foundation Recreation and Services Coordinator, Adult Services Coordinator, and PreK-8 School Principal and 14-22 yr School Principal. The following questions provided a framework of the discussions in the focus groups and interviews:

- The Autism ASPECTSS Design Index and its criteria are based on the premise that the architectural environment provides the vast majority of man-made sensory input to the autistic user, and that as a result can have a huge impact on how the user perceives and consequently behaves within the space, depending on his or her sensitivities. Do you agree with this premise?
- How would you rank the importance of the following- acoustics, tactility, visual environment, smell, taste and proprioception?
- Do you think the physical setup of this school is conducive of learning for its autistic users? If yes, in what ways? And if no, what issues are problematic?
- How about the non-autistic population? What works and what doesn’t?
- Have you made adjustments to your own environments (home, class, office, therapy space) to make it more effective for the autistic user? What problem were you addressing and how did you resolve it? Was it successful? How so?
- How do you manage your spaces with such a diverse spectrum as the sensory needs of autistic students? For example one student may enjoy tactile environments while another does not.
- Therapy: pull-out vs. push-in? Is the decision for either or a result of the spaces that the therapy spaces are currently housed?
- How often are observation spaces used?
• I’ve observed different furniture layouts throughout the Lower School. What are your criteria for those layouts, and what has worked for you? Are they activity/skill/age dependent?
• Are the embedded teacher desk spaces in classrooms ever a distraction for the kids? For those of you who have it slightly partitioned off- does that work better?
• Escape: the index calls for the provision of escape spaces. What are your thoughts on their usefulness and location? Would that be a tool that you would like to see introduced? It could be on several levels- preventative before an over-stimulation happens, as opposed to reactive after it does.
• The ASPECTSS Index calls for 7 criteria to be put in place to make built environments more effective, have you applied any to your spaces?
• Have you visited places where you felt the physical setup was ideal for autism? Can you describe it? What problem/s did it seem to address?
• If you could make improvements to your classroom/workspace, what would they be? How about the school as a whole?
• Are you familiar with the future plans for the schools upper school? Do you have any suggestions, thoughts, concerns?
• If there were something you would like me to communicate to your other counterparts anonymously related to the design of the school and its future phases, what would it be?

RESULTS

The survey was provided to Foundation staff, PreK-8 school staff (both teachers and specialist staff) as well as parents. The response profile of the ASPECTSS survey was 7 teachers out of a total of 12, 4 specialists and therapists, 21 administrators and support staff and 13 parents. The ASPECTSS scores indicated a well-designed school with a provision of an appropriate sensory, spatial and functional environment for the needs of the students. The average score received by the school from the total number of applicants was 44.37 points out of a possible 60. This is slightly below previously assessed purpose-built autism schools which showed strong alignment between perceived design excellence and ASPECTSS score, which averaged 52.32 with a range of 46.4 to 57 points out of a total possible 60 (Mostafa, 2014c).

The ASPECTSS assessment of the school, as ascertained by classroom observations, interviews, focus groups and site assessments are summarized as follows:

1. **Acoustics**

   1.1. Assessment:

   1.1.1. The acoustics of the school building were assessed with respect to the following space categorizations:

   • Classrooms:
     • The classroom spaces in general performed well acoustically when they were fully furnished and occupied. Despite the high ceilings there was manageable echo, partially due to the soft furnishings like carpets and cushions throughout the space. The more sparsely furnished rooms had more echo. The exception
to this acoustical performance was the doorways, which transmitted sound from the corridor spaces.

- Significant acoustical distraction was observed from the bathroom fans, particularly with those that were motion activated with the lights and turned on and off as the children entered and exited the bathrooms. This was distracting for the children working in the class, as well as occasionally frightening for some of the children using the bathrooms.

- Observation rooms:
  - The acoustical performance of these rooms was adequate.

- Circulation spaces:
  - Hallway spaces are typically areas of concern acoustically. Their need for a generous spatial dimensioning coupled with their linear configurations often present acoustical challenges. The main hallways here also demonstrated significant echo, particularly when a number of students were moving from one class to another, a common occurrence throughout the day. Of particular concern was the central node immediately after the reception area as you enter the school proper past the double doors (fig. 1, room 1025). The combination of the elevated ceiling and the intersection of three corridors create a sound trap that amplifies the echo and reverberation in the vicinity. This is of particular concern when the circulation spaces are operating at peak times, such as the beginning of the school day, the end of the school day, and between classes, when large numbers of students and teachers are moving through the school. Given that this space is the first to meet the children as they begin their day, the sensory overload possibly created by this acoustical condition is not the optimum spatial experience. It may not be the most conducive of transition from their arrival to school to the beginning of the school day, or vice versa from their school day to their departure from school. This observation was very much shared by the administration and staff of the school, who prioritized this space as a priority issue.

The same could be said for visitors of the school who are met by this acoustical amplification when they first enter the school. Albeit subconscious, this may give a more chaotic first impression than necessary to these visitors - and very undeservedly so - given the overall order, organization and flow of the rest of the school. Mitigating this problem would therefore have several levels of benefit for students, staff and visitors.

1.2. Recommendation:

1.2.1. Soundproofing may be installed in the doorways.
1.2.2. Higher efficiency fans with quieter performance could be installed, with switches operated manually to avoid sudden activation.
1.2.3. It is suggested that acoustical panelling be installed along the lengths of the walls of the corridors. This should be kept neutral in colour and avoid any sharp edging, small parts or detailing that may result in injury. It will serve a triple purpose of mitigating echo, providing an opportunity to personalize the school space and allow for encouraging display of student's work which will reward and raise self-esteem, as well as assist with way-finding when coordinated with the proposed colour scheme.
1.2.4. It was suggested that the echo and “sound trap” condition of the central node 1025 be addressed. This may be through installing acoustical wall panelling similar to that proposed in the corridors, in addition to a non-visually disturbing ceiling treatment. Ceiling treatments could be colour coded and arranged to follow the scheme proposed as part of the way finding and navigation solutions proposed later in the report. Installation pattern was to be kept regular and minimally distracting.

2. **Spatial Sequencing**

2.1. Assessment:

2.1.1. The spatial sequencing internally within the school proper, and between the spatial zones, generally follows the best practices advised by the ASPECTSS™ Index. Administration, General classrooms, Specialist Spaces and Outdoor Areas (formal playgrounds and courtyard) are organized in a logical and routine aligned sequence. Classes are also organized by age, flowing sequentially from younger to older. The benefit of this sequencing however is not fully realized as a result of less than desirable transitioning between major shifts in these zones, particularly from outdoors to indoors and vice versa, as well as from corridors to classrooms. This will be discussed in more depth in 5. Transition Spaces. Furthermore the strict symmetry of the school does not allow for one-way progression of this sequencing, although this is not expected to be an issue of concern given the pattern of use of the school.

2.1.2. Spatial sequencing internally within classrooms varied greatly throughout the school as observed during the post-occupancy evaluation observations. The majority of the classrooms sequenced activity stations in a manner that flowed logically with the activities at hand. These included stations for group work, one to one, individual work, escape spaces, resource storage and teacher planning space. A few classrooms however did not have clear and ordered definitions for these stations, which will be discussed in 4. Compartmentalization. A documentation of the observed classroom patterns of use, their consequent furniture layouts, and proposed standardized patterns that would accommodate the apparent needs of the teachers and students will be outlined in the Behavioral Mapping section of this report.

2.2. Recommendation:

2.2.1. Teachers were encouraged to draw from the proposed classroom patterns and furniture layouts proposed as modular templates to help sequence their classrooms more efficiently (fig. 2). This was to be considered in alignment with the typical daily routine and schedule of the class and its students as closely as possible. A pattern that provides the most flexibility was to be used to avoid constant changes in classroom arrangement. Such constant change is not only time and energy consuming for the teachers, but creates an environment of unpredictability that does not capitalize on the students’ skill in adhering to routine and order. This is particularly the case in the younger classes who may have a stronger need for such predictability.

2.2.2. Older classes may have more flexible and changing layouts, to allow the students to transition to the possibly less-ordered environments of the Upper
School classrooms or mainstream junior high or high schools that they may be transitioning to. Figures 2 illustrates this flexibility.

3. **Escape Spaces**

3.1. Assessment:

3.1.1. At the time of assessment the lower school had two levels of escape space provision throughout. The first was found in the majority of the classrooms, in the form of a carpeted area with soft furnishings such as cushions and/or beanbags, typically located in the corner of the room opposite the wet area sink counter along the exterior wall. In no more than 3 cases the escape space was improvised in another space in the room, but this commentary relates to the intended location of the escape space, which is the former. These spaces were used for sensory breaks and quiet time for students within the classroom. The location and configuration of these escape spaces at the time of assessment was not ideal for various reasons. They were large, day lit, open to the classroom and adjacent to an exterior wall. Although the latter may not be an issue at this stage of the lifetime of the school, when later stages are complete and the courtyard is in more regular use, there may be an issue of external noise transmission. An alternative smaller configuration, that limits the environment a student has to process during escape, was seen perhaps to be preferable.

A second level of escape, although not originally intended for this purpose, was located at two key points in the school at the ends of the east and west wing corridors in rooms 1117 and 1052. Although originally intended for small group informal activities- such as board games, reading or listening to music- for which it is better suited- they evolved into calming areas, perhaps indicating a need for such a space. This space however was found not to be ideal for calming purposes, understandably as it was not designed with this function in mind. The space is large, with high ceilings, promoting echoes and reverberation, which may be encouraging of loud behaviors in some students, reinforcing as opposed to de-escalating the issue at hand. The large space also expanded the scale of the sensory environment that the student was required to process and handle during de-escalation. These spaces were also located at the extreme ends of the school making their accessibility limited, particularly from classrooms further away. For safety the doors of these spaces needed to be left open during de-escalation, which provided visual access from the corridors, which could also have reinforced behaviors.

3.2. Recommendation:

3.2.1. It was suggested that efforts be made on four levels: improving the in-class escape space configuration; improving the de-escalation space configuration; providing a third intermediate level of escape space opportunity spatially woven throughout the school for de-escalation; and reducing the frequency of sensory overload while mitigating the need for escape in the first place throughout the school. It was expected that the latter be achieved through the application of the collective recommendations of the Post-Occupancy Evaluation. The remaining levels were to be addressed as follows:
Suggested escape space configurations are illustrated in the proposed templates and prototypes (fig. 2). In general however this re-configuration was suggested to include making the in-class escape spaces smaller, providing opportunity for tighter tactile stimulation, by creating corners and surfaces for students to curl up against and between safely. This could be achieved through anything from a customized cushioned built in crawl spaces to a simple arrangement of cushions in a corner. Generally the escape space was to be kept neutral in colour, texture and other forms of stimulation, as well as be located in the quietest part of the room whenever possible.

The proposed space was also to be at least partially separated from the remainder of the classroom. This helps reinforce the perception of separation from the over-stimulation that leads to the need for escape in the first place. This was proposed to varying degrees, ranging from almost complete visual and physical partitioning using bookcases or other low partitioning, to minimal gestural partitioning that can be as subtle as coloured masking tape marking off the area, or placement of an area rug. This will depend on the level of the students in the class and their need for isolation during escape. Individualized sensory kits to be made available for the different students for use during escape were also suggested. These could include tactile stimulation props like safe bristle brushes, bouncing ball-seats, swinging/rocking seats, visual stimulation toys such as fibre optic lights or cool temperature lava lamps. It was seen as essential however that any partitioning always allows the teacher and any other supervisors to be able to see the student using the escape space at all times.

In general this level of control in the escape space should be gradually changed in accordance to the skill level and age of the children to avoid a reliance on its presence, and difficulty in transitioning to more neuro-typical spaces- in other words to avoid the “greenhouse effect”. It should be noted however, that it is the position of the ASPECTSS™ practices, that provision of escape for individuals with autism is perhaps, along with transition spaces, the easiest and most effective spatial support that should be required of any space that individuals with autism will use- whether it is a future school, residence or job placement.

4. Compartementalization

4.1. Assessment:

4.1.1. The general classroom layouts and patterns used throughout the school all demonstrated some level of compartmentalization. In the majority of the classrooms different teaching activities were located in discrete spaces, spatially separated from one another. Some classes achieved this distinction and clarity better than others, with the most successful arrangements utilizing the furniture in as close as possible an alignment to their original intended arrangements (fig. 1). Other classes improvised for their needs using the available furnishings, an indication of a need to re-assess the furniture arrangements and their best fit for purpose in the activities carried out in the classrooms.

4.1.2. An exception to this, and of particular interest was the different ways teachers used the desk space allocated to them. The original furniture layout provided a
large linear desk space, parallel to the built-in storage closet, configured back to back with a set of computers for students use. The teacher’s desk gave its back to the classroom space, an arrangement that seemed counter-intuitive to many, judging by the number of teachers who abandoned the original configuration. Many made adjustments to make better use of the space, relocating their computer to a smaller drawer unit on wheels, making it movable around the classroom, or even relocated their computers to a shelf inside the storage cupboard so it could be tuck away. One well-managed classroom had the teacher’s desk completely removed.

In focus groups and interviews with teachers, the majority noted that they did not use the desk as originally intended. They felt that the visual and physical accessibility of teaching material on the desk was distracting to many students, and caused some to go off task, once they saw another activity on the teacher’s desk that they preferred to work on. They also rarely used the desks for lesson planning or other work, given its accessibility to the classroom space.

4.2. Recommendation:

4.2.1. An assessment of the existing vs. the intended use of classroom space, and their consequent furniture layouts, is illustrated in Behavioral Mapping. Proposed templates for the behavioral geometries and activity prototypes observed in the post-occupancy assessment are also proposed in that section. These templates will help summarize the recommendations proposed addressing classroom arrangement.

4.2.2. It was generally recommended that alternative teacher desk configurations be used to make better use of the available space.

4.2.3. It was recommended that activity stations should be clear in their spatial territory, defining the activity to be carried out in each. This activity/space pairing was to be kept as consistent as possible, particularly in younger classes, to capitalize on a certain level of predictability. Consistency in this may help students get on task more quickly. Flexibility in these arrangements may be introduced gradually as the grades progress to prepare for more flexible upper school configuration, typical classroom arrangements in a mainstream school placement should that occur, and general adaptation to less reliability on space/activity pairing in typical environments outside of the classroom.

5. Transition Spaces

5.1. Assessment:

5.1.1. In general transition spaces were not discretely defined throughout the school. Movement between different sensory zones was generally direct, using typical vestibule and hallway arrangements. Sensory zone transition requiring attention included; car drop-off to entry vestibule (1002 & 1005); entry vestibule to main hallway (1025); playgrounds to hallways (1135 & 1137); hallways to classrooms (1134 & 1068); hallways to specialist spaces (1144, 1087, 1077); and school to courtyard (1116, 1053, 1085).
5.2. Recommendation:

5.2.1. It was suggested that generally these spaces should provide a certain opportunity for transition between high stimulation to low stimulation, and provide the sensory environment to support that. The entry vestibule 1025 is a prime example, and was discussed under Acoustics. Proposed provisions could be in the form of lowered acoustical ceiling treatments and a calming colour scheme within a geometrically framed space.

5.2.2. Car drop-off to entry vestibule (1002) was also suggested to be reconfigured, to provide for better transition at the beginning and the end of the day, as well as help with the functionality of how drop off and pick-up are currently being conducted. It is proposed that the covered drop-off area (1002) be fenced off with a low safe fencing system to allow students to sit and await pick up outside with supervision. It was suggested that gates be installed to allow entrance and exit to and from the paved walkways, as well as to and from the car drop off, which must also be supervised. Appropriate, comfortable seating should also be made available to make transition more comfortable.

5.2.3. Hallways to classrooms (1134 & 1068): This transition is perhaps one of the most essential as it moves the child into his or her core functioning space. It was proposed that acoustical seating pods be made available in some of the setback spaces off the hallways at the entrance of each classroom/observation room unit. These pods will create a quiet oasis space that will allow students a moment to adjust at the return from one sensory stimulation level of experience to that of the classroom. This can be in the form of comfortable seating that may allow for some tactile enclosure and acoustical separation. Fig 3 shows an example of such seating, which could be customized in scale to provide a more intimate enclosure for younger children, as well as possibly provide an upper space for storage of cluttering objects like school bags and coats, similar to hallway lockers in typical school arrangements.

5.2.4. Hallways to specialist spaces (1144, 1087, 1077): These spaces needed to provide perhaps the biggest sensory adjustment, as they mark the entrance to spaces such as music, art, life skills, occupational therapy and sensory integration, which are considered high stimulation zones. In the case of 1077, the space marked the entry to a low-stimulus zone of the computer lab and library. It was suggested that an acoustical pod may be made available, particularly in the OT, SI transition vestibule, to allow for children to remove and store their shoes before entering the SI room. Some geometric framing and colour coding was suggested a transition for 1077 leading to the library and computer lab.

5.2.5. School to courtyard (1116, 1053, 1085): As the more granular use and operation of the courtyard evolved with different phases of the school’s completion, it was suggested that these covered areas may evolve more clearly as transitions, with seating and more enclosure introduced.

6. Sensory Zoning

6.1. Assessment:

6.1.1. Generally the main sensory zones of the school were well organized and clearly defined. These included: parking drop/off (high stimulus); entry hall/admin (low stimulus and transition); specialist spaces (high stimulus);
library/computer (low stimulus); classrooms (low stimulus); playgrounds (high stimulus), courtyard (possible future natural sensory transition space). There was minimal sensory ambiguity amongst these zones, although transition may be better managed, as discussed above.

6.2. Recommendation:

6.2.1. There were no additional recommendations for the sensory zoning arrangement of the school, other than how it relates to other criteria such as Transition Spaces.

7. Safety

7.1. Assessment:

7.1.1. Safety was clearly of a very high priority to the school, particularly with regards to accessibility to and from the campus. Much thought was put into the levels of security put in place for access to the public areas of the auditorium and foundation from the outside, with an additional layer of security for access to the lower school premises. Safety measures were also put in place for the exit of students from the premises to avoid eloping and wandering.

7.1.2. Physical safety of students was also carefully considered throughout the school. Furniture, fittings and equipment were generally selected and installed with safety in mind.

7.2. Recommendation:

7.2.1. It was recommended that intercoms be placed on the exterior wall at key-card access doors leading to the outdoor playground and courtyard spaces. If for any reason a teacher or staff member was locked outside, they have no way to get back into the school. Also, should a child be injured, a teacher may not be able to leave them to go get help, and will need an immediate means to summon assistance.

ADDITIONAL OBSERVATIONS AND RECOMMENDATIONS

Other framing considerations provided in the evaluation were:

(1) Independence-drive design: A framing concept of the ASPECTSS™ Design Index is to support learning and skill development with the ultimate objective of as much independence as the student is capable of achieving. This should be considered for independence within the lower school premises, the upper school premises and as the students interact with typical environments either if and when they are placed in a mainstream school or place of employment, or in their daily lives with their families outside of school.

(2) Avoidance of “green-house” effect: As an extension of independence-driven design, the ASPECTSS™ Index advocates against the use of completely customized and ideal environments throughout a child’s education. In the earlier stages these supports, such as those outlined in this paper, are key to providing a window of learning opportunity for the child to develop the necessary skills to communicate, interact and learn. Once these skills begin developing, and are more established,
typically as the child grows and progresses, such supports should be gradually reduced, and spatial tactics that are more aligned with typical environments should be gradually introduced.

(3) An example of this would be the gradual migration of classroom layout towards a more typical setup as the grades progress in the lower school, whether for preparation to move to the upper school, or to a mainstream inclusion program, as the case may be. Opportunities for different levels of graduating architectural accommodations to allow for ease of transition to typical environments should be created.

(4) Managing artificial light: The use of LED lights throughout the school is the ideal artificial lighting source for users with autism. The return on the investment put into these systems in the form of a more comfortable, calm environment for the students, is clear throughout the school. It is suggested however that dimmer switches be introduced in some of the spaces, particularly 1117 and 1052, where a more controlled management of light may be useful for the proposed function of the room. Some of the specialist spaces, such as Sensory Integration (SI) as well as the younger classes may also benefit from such control systems.

(5) Way finding and Navigation: Way-finding and navigation throughout the school, despite its clear layout, was found to occasionally be confusing, even for typical users. Data collected from the interviews, focus groups and surveys of parents, teachers and staff supported this observation. The Post-Occupancy Evaluation observational data seems to indicate that this is a result of: the symmetry of the building; the lack of distinguishable external visual navigational indicators partially as a result of that symmetry, and the use of a neutral consistent color palette throughout the school. The former issue cannot be changed with any retrofit solutions, being part of the structure and layout of the school, however the other issues can be addressed.

(6) In addition, the spatial sequencing along the main corridor running through 1025, was ambiguous and did not provide sufficient visual-spatial cues to distinguish entrances to main hallways (1134 and 1068), specialist space vestibules (1144, 1087 and 1077) bathrooms (1073) and courtyard exit hall (1086). The following was therefore recommended:

i. Creation of identifiable external visual indicators, to distinguish the east playground, west playground and two northern courtyard exits. Examples of such visual indicators would be identifiably different landscape features such as differently coloured and configured playground equipment or distinctly different soft landscape choices. A simple solution could also relate to color coding the interior walls framing the doors to follow the east and west colour coding system. In addition a safely mounted, easily distinguishable flag could be installed along the line of site of the hallways looking towards the playgrounds, to help distinguish east from west and support better orientation.

ii. Color-coded Navigation: Use of subtle, neutral colors to help support navigation is highly recommended. This will be particularly useful to help distinguish between symmetrically identical hallways. A sparing use of color is proposed, in the hallway nodes, the vestibules, the internal walls framing the exit doors and the acoustic fabric panelling in the main halls. Fig. 4 shows the color palette proposed.
DISCUSSION

The application of the Autism ASPECTSS Design Index as a framework for autism design performance generally and specifically as a basis for Post-Occupancy Evaluation is outlined through this paper. The resultant recommendations, when mapped against the index's criteria, provide a range of interventions that can scaled up, replicated and customized in other learning environments for users on the spectrum. The specific examples illustrate the application of the index to real-life design scenarios and provide a catalyst for thought for future projects.

Given that the Lower School Building was only the first phase of the project, lessons learnt from this assessment provided guidance for other buildings across the campus to be completed in subsequent phases. These include the Upper School building that houses a public charter school for grades 9-12 and up to the age of 22 years, a Gymnasium and Cafeteria building and Cultural Arts Pavilion, a Medical and Research Facility as well as an Adult Services Building. The application of such lessons to such a range of diverse building types shows the replicability of design interventions resultant from ASPECTSS criteria assessment.

Further investigation is planned to study the performance of the school post-implementation of these recommendations, and measure the real-time actual impact of the interventions outlined in this paper on the performance of students, the functioning of the school and the general autism friendliness of its design after application of the recommendations outlined here. It is hoped that this will further verify the efficacy of this tool as an important framework for conducive design for autism.
ILLUSTRATIONS

Figure 1. General Plan of the school (Source: Author).

Figure 2. Modular classroom templates proposed (Source: Author).
REFERENCES


BOOK REVIEW: MAKING DYSTOPIA — THE STRANGE RISE AND SURVIVAL OF ARCHITECTURAL BARBARISM, BY JAMES STEVENS CURL, OXFORD UNIVERSITY PRESS. 2018.
DOI: http://dx.doi.org/10.26687/archnet-ijar.v12i3.1828

Nikos Salingaros

Keywords
architecture; modernism; Bauhaus; history of 20th century architecture

Abstract
This is a review of the scholarly book “Making Dystopia — The Strange Rise and Survival of Architectural Barbarism”, by Professor James Stevens Curl. The book is severely critical of the Modernist movement in architecture, holding it responsible for the loss of historical, traditional, and vernacular building cultures. It goes further to associate the loss of other valuable aspects of culture with the erasing influence of modernist thought. The obvious transformation of the built environment influenced people subconsciously away from older compassionate, humane design practices, and towards a cold, inhuman industrialism. Today’s unsustainable Industrial-Modernism is not the inevitable consequence of a natural process of architectural evolution, while the Bauhaus was not an enlightened architecture school. Professor Stevens Curl’s work is an invaluable resource for academia, the public, and professional practitioners. It could help to trigger a massive re-orientation of the building industry, helped by forward-thinking legislators. An enlightened and interested public has to come to grips with what happened, and try and fix it for a better society in the future.

N. Salingaros, Professor of Mathematics at the University of Texas at San Antonio

Dr. Nikos A. Salingaros, Ph.D. (Physics), is Professor of Mathematics at the University of Texas at San Antonio, and author of ten books and over one hundred papers on Architecture and Urbanism (in addition to his purely scientific publications). He shared the 2018 Clem Labine Award for Architecture, and is the recipient of the 2019 Stockholm Cultural Award for Architecture. Salingaros is a Member and on the Committee of Honour of the International Network for Traditional Building, Architecture & Urbanism, member of the Scientific Committee of the Institute for Advanced Architecture of Catalonía, member of the World Architecture Community, and member of the Environmental Structure Research Group. Dr. Salingaros directs Masters’ and PhD theses on Architecture and Urbanism at Universities throughout the world.

*Corresponding Author’s email address: salingar@gmail.com
This scholarly book makes several startling claims: 1. Today’s unsustainable Industrial-Modernism is not the inevitable consequence of a natural process of architectural evolution, but rather the result of dishonesty, greed, and manipulation by special interests. 2. Cult movements and mass psychology defied human physiology and commandeered cultural and economic forces to define our contemporary built environment. 3. What architecture schools teach students bears no relation to what actual users (as opposed to real-estate speculators) want in their buildings. 4. The history of architecture in the Twentieth Century has been falsified to promote this goal.

A prospective reader might too hastily surmise that this is a strictly polemical book, interesting if one dislikes modernist and contemporary architecture (although there are many people in this category). Is it conceivable at this late date to reject the dominant building and design styles we have inherited? Wouldn’t that discredit the founding principles of modernity? Yes, it indeed condemns its cult aspects and differentiates those from real technological progress. The controversial points above are strongly substantiated, and even a sceptic will find the extremely detailed supporting arguments fascinating.

Professor James Stevens Curl’s admirable new book details the origins of modernism and its controlling influence on world architecture. Meticulously researched, it presents the key events and driving ideas that resulted in modernist typologies substituting for traditional ones. The account includes uncomfortable information normally concealed from public knowledge. Enjoyably enough, whenever a skeleton in the architectural closet is revealed, that unpleasant fact is presented with inimitable British understatement and wry humour rather than with indignation.

Professor Stevens Curl argues that established architecture continues to promote something that has manifestly failed humanity. Building typologies such as flat roofs, transparent/reflective glass curtain walls, cantilevers (overhanging, often menacing structures), houses raised on *pilotis* (columns that look too thin to support weight), featureless, plain, smooth white walls, polished metal façades, and long horizontal strip windows are revealed as deliberately non-adaptive stylistic devices. This contradicts what every architecture student has been taught for decades: that these are absolutely necessary features for the architecture of the 20th and 21st Centuries. Well, they certainly became dominant features, but the polemical arguments used to promote them are without any architectural foundation.
I have already reviewed this iconoclastic book for *Traditional Building Magazine*. I discussed how the wave of modernism devastated adaptive, traditional architecture, leading to the worldwide collapse of local supporting industries after World War II. Here, I focus on the religious cult aspects of the modernist movement. Professor Stevens Curl develops my thesis presented in *Anti-Architecture and Deconstruction* (for which he wrote the Foreword) that twentieth-century architecture is a cult. The cult implemented social engineering to substitute our biological senses of health and beauty with modernism’s peculiar visual constructs.

Although the discussion of cults comes late in the book (p. 311), it offers an explanatory framework for otherwise inexplicable phenomena: how people were seduced to abandon emotional comfort and healing environments for cold, sterile ones that create anxiety and might even make them sick. Some frightening deceits are responsible for architectural dystopia: “It is therefore important to grasp the simple fact that the *tabula rasa* demanded by modernism has close links with manipulation, a programme of destruction, a fanatically held belief in a cult, and a burning desire to change the world” (p. 315).

A writer of fantasy novels, Paul Scheerbart, was commissioned by the German glass industry to dream up messianic, evangelical slogans touting the spiritual advantages of building with glass walls. Those phrases were publicized in Bruno Taut’s 1914 ‘Glass Pavilion’ in Cologne, an iconic building of architectural modernism (p. 88). Architecture schools teach those slogans today as unquestioned truths, and contemporary Starchitects repeat them whenever they propose a giant glass building. However, “The universal application of glass could hardly be described as ‘functional’, ‘rational’, or ‘scientific’: it was just packaging, an illusion of ‘Modernity’” (p. 372).

This book is essential reading because it helps us to understand what happened to erode the world’s rich cultural inheritance. Professor Stevens Curl correlates the loss of art, culture, music, and even the sacred, with the dominance of architectural modernism. Its implications therefore go far beyond what buildings look like. He explains how cult allegiance to the modernist movement drove intelligent people (who had written otherwise excellent scholarly essays and books) to become transmogrified into propagandists. Their extremely biased and highly selective texts advocate industrial modernism as the only acceptable architectural expression for our times. Those authorities convinced generations of people of a misleading ‘inevitability’ for modernist architecture and urbanism.

Well-loved architectural pioneers such as C.R. Mackintosh, L.H. Sullivan, C.F.A. Voysey, O. Wagner, and F.L. Wright disliked what was to become the *International Style* and wanted nothing to do with it (p. 69). This background story has not stopped architectural historians with an agenda from (falsely) including those names among the founders of the modernist movement. The second revelation is that the abolition of ornament was merely the imposition of a stylistic *Diktat*. The widely and uncritically accepted narrative about ethics — used to condition students psychologically to reject ornamentation — simply falls apart.

Professor Stevens Curl traces the complicated story of architectural style in Europe as it became more and more influenced by industrial production. Long before arriving at the *International Style*, this change towards austere *Bauhaus* modernism resulted in the stripped
classicism that became the official architecture of both the Third Reich and the Stalinist Soviet Union. Another shock, then, is to discover this long-suppressed and uncomfortable parentage.

The book documents a very disturbing, altogether different history of the German Bauhaus school (1919-1933). The Bauhaus teachers come across more as charlatans than enlightened pioneers of a new way of teaching and thinking about design. Their unsavoury crossover into National Socialism (“Gropius wrote to Goebbels in 1934 claiming that the new Modern architecture was Germanic”, p. 181), as well as unhealthy connections with weird quasi-religious cults, skipped over in official histories, leaves one with a bad taste. It cannot be sufficiently emphasized that our building styles and educational system for architects are descended directly from this source.

“The claim of Walter Gropius, for example, to have been influenced by Ruskin’s writings, would have surprised, even shocked, the Englishman himself” (p. 20). And the story that the Nazis closed down the Bauhaus because they were against true innovation is simply not true. Hannes Meyer, the Bauhaus’s director prior to Ludwig Mies van der Rohe, turned the school into an institution for teaching Marxism-Leninism, which naturally alarmed the government. But it was Mies who actually decided to close the school, and then tried to ingratiate himself (unsuccessfully, as it turned out) with the Nazi regime.

The sad fate of Erich Mendelsohn casts a damning light on some modernist heroes. Gropius and other members of the Bauhaus were nasty to him, most probably out of anti-Semitism. The same could be claimed of Philip Johnson, the impresario who established the International Style (and later, Deconstructivism) in the United States, and who promoted almost every one of the European modernist immigrants, except Mendelsohn. Thus the extremely talented Mendelsohn saw his international career dwindle to designing three Synagogues in the US.

Le Corbusier comes in for a thorough castigation for his personal failings (he was absolutist and totalitarian), but also especially for his architectural and urban ideas. Contrary to what gullible students are universally taught, his design schemes are almost all faulty, and not only by a little bit. Using numerous explicit examples, Professor Stevens Curl exposes Le Corbusier’s principles of design to be odd and impractical dogmatic assertions. He asks, “Why Corbusier is still ‘rammed down’ the ‘throats’ of architectural students today?” (p. 204).

The history of architecture is quintessentially political; however, this book is decoupled from any imagined partisan slant. People sympathetic to Marxism automatically accept a modernist architectural ‘look’ as superior because it rejects the past. This association has long kept architectural modernism dominant, as belief in the modernist cult replaced traditional religions. Fashionable but uncomfortable architectural expressions are shielded by branding criticism of them as ‘reactionary’, thus loading the question politically and preventing debate. This book exposes manipulation by special interests of both Left and Right in promoting an agenda that ignores the health and lives of common citizens.

Forces hidden from public notice continue to shape our built environment. The story of entrenched power mixes up architecture, government planning, the US CIA’s covert
manipulation of Art and Architecture to undermine that of the Soviets, the Museum of Modern Art (MoMA) acting as a front for CIA operations, General Motors sponsoring its ‘Futurama’ exhibit to gut urban downtowns and promote car sales and suburban sprawl, and oil and rubber companies gearing up into immense production to supply the new motorized city. These ‘Extractive Global Imperialist’ forces found modernist design schemes wonderful.

Professor Stevens Curl rails against the powerful minority segment in society that has profited from implementing this type of inhuman environment. Those forces destroyed perfectly sound urban fabric, housing stock, historic city centres, and irreplaceable monuments. In the UK, “There was hardly a squeak of objection from a populace cowed and browbeaten by Modernist rhetoric” (p. 254). Big money (never too concerned with ethics) allied itself with criminal elements in the government to produce dystopia. Among the very few who actually went to jail were architect John Poulson and government bureaucrat T. Dan Smith (named ‘Man of the Year for 1960’ by The Architects’ Journal) (p. 278). But not before they had enriched themselves having wrought immense devastation across the UK.

This book shows how, by becoming expert in manipulation, power games, and propaganda, the modernist cult cornered all the major architecture prizes and took over the journals. Architects who did not wish to join were made into ‘non-persons’. Thus the building sector rejected human nature and what the market previously craved — comfortable, healing environments — in order to impose the peculiar desires of a small cohort of architects. Real-estate speculators were pleased. But many people were also caught up in utopian promises, ready to sacrifice their inherited humanity for ‘progress’.

Society turned away from several generations of architects who knew how to build commercial and domestic structures having long-established life-giving qualities (incidentally, destroying their careers) to adopt instead an alien aesthetic disliked by much of the population. Despite criticisms from a large number of people, architectural culture never turned again to humane buildings. Architects who create adaptive, sensitive buildings today have to buck the mainstream, regardless of where they are located.

As one of Britain’s foremost architectural historians, Professor Stevens Curl naturally goes into great detail on British architecture during the modernist period, and rehabilitates important British architects who were shamefully marginalized by cult propagandists. The cowed architectural establishment stood by and allowed the profession to marginalize those members. “A great language capable of infinite variety of expression, a mighty and expansive vocabulary, a vast resource based on two and a half millennia or more of civilization, was superseded by a series of monosyllabic grunts, foisted on the populace with a totalitarian disregard for the opinions of those who had not been drilled to conform” (p. 370).

Some commercial developers nowadays try to satisfy popular taste by badly copying older typologies. Unfortunately, that turns out poor quality design, since the profession lost the knowledge of how to properly implement traditional compositional rules. Our cult-dominated schools resolutely refuse to teach young architects the craft of building healing, humane living environments. Generations of instructors don’t know those techniques, which re-use adaptive solutions discovered in pre-modernist eras. Adaptive design contradicts, hence
threatens, modernist abstraction. We consistently find hostility towards designs that generate human comfort, despite research showing the health benefits of experiencing them.

“Students’ ‘projects’, produced in ‘studios’, were largely graded on the basis of how closely they resembled whatever ‘architecture’ illustrated in the magazines was currently fashionable (p. 366) … ‘Architectural education’ for far too long has been hermetically sealed from reality, a form of navel-gazing, irrelevant to the real world outside” (p. 372). After this book gains a wide, well-deserved readership, the current practice of imposing modernist ideology on architecture schools as a condition for accreditation will have to be discontinued and a more sane, humane, and reasonable approach to architecture and town planning adopted.

An incredibly high level of scholarship distinguishes Making Dystopia, so that its critics will have a hard time shrugging off its message. This makes Professor Stevens Curl’s work an invaluable resource for academia, the public, and professional practitioners. It could help to trigger a massive re-orientation of the building industry, helped by forward-thinking legislators. An enlightened and interested public has to come to grips with what happened, and try and fix it for a better society in the future.

REFERENCES