ARCHITECTURE OF COMPLEXITY
DESIGN SYSTEMS SOCIETY AND ENVIRONMENT
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Option #1

1. Enter https://onboard.utah.edu in the address bar and follow the instructions.
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Architecture is contextually contingent. Once the social, economic, and environmental networks and systems that presuppose architecture become a fundamental context for design, then the capability and culpabilities of architecture and its systems become newly, and more intensely, important. Ulrich Beck suggests that we are in a new phase of modernity in which architects’ operations can be characterized by the development and implementation of contextual systems of increasing hazard. Our belief that society can control the dangers that itself produces is self-defeating. Ulrich suggests that we wrestle today with the side effects of yesterday’s successes. How can we ensure a tomorrow that does not suffer from the same fate?

Systems thinking focuses on large-scale dynamic networks, rather than linear cause-and-effect relationships. In building, thinking systemically requires an equifinality approach: recognition that there are multiple ways to answer the problem of building, which lead in turn to different ways to organize design practice. Further, systems thinking uses multi-finality: recognition that similar initial conditions of cost, scale, and scope can yield widely different building results. This demands a broader understanding of what constitutes architecture. It demands a more systemic and holistic approach to the built environment.

Complicatedness is unforgiving in building, and the call for holistic thinking risks being inflated to an obtuse level where the system becomes an unmanageable mess of parts and relationships that become too untraceable to mean much of anything. As such, systems thinking in building practice requires defining the extent of the system – framing the inquiry to determine the specific parts, linkages, and networks. This makes architecture of complicatedness into an architecture of complexity. While complicatedness is confusing, alienating, and inefficient; complexity is rigorous, rich, layered, and meaningful.

The conference theme is the architecture of complexity. It seeks for the creation, clarification, codification and communication of research knowledge on architecture as design, systems, society and environmental networks. This call is for papers that span the modalities and domains of research, scholarship and creative work in architecture: history, theory, criticism, quantitative, qualitative, technical, applied, classroom, and practice. This is also a call for allied disciplines in planning, design, engineering and business, as well as the physical and social sciences to ask questions and begin to answer why, what, and how of complexity in the built environment.

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Day 1 Keynote Address:  
Jason F. McLennan  

Jason F. McLennan is considered one of the most influential individuals in the green building movement today and the recipient of the prestigious Buckminster Fuller Prize. Jason F. McLennan’s work has made a pivotal impact on the shape and direction of green building in the United States and Canada and he is a much sought after presenter and consultant on a wide variety of green building and sustainability topics around the world. McLennan previously served as the CEO of the International Living Future Institute – a leading NGO that focuses on the transformation to a world that is socially just, culturally rich and ecologically restorative. An Ashoka Fellow, Jason is the founder and creator of the Living Building Challenge, widely considered the world’s most progressive and stringent green building program. He is the author of five books: The Philosophy of Sustainable Design, The Dumb Architect’s Guide to Glazing Selection, The Ecological Engineer, Zugunruhe and Transformational Thought.

Day 3 Keynote Address:  
Steven A. Moore  
University of Texas at Austin  

Steven A. Moore is Bartlett Cocke Regents Professor of Architecture and Planning at the University of Texas at Austin where he teaches design and interdisciplinary courses related to the philosophy, history, and application of sustainable technology. Before completing his Ph.D. in 1996, Moore was the Design Principal of Moore/Weinrich Architects in Maine (1970–91). At UT, he served as Director of the Graduate Program in Sustainable Design (2000–2016), founded the Graduate Portfolio Program in Sustainability (2005), and is Co-founder of the University of Texas Center for Sustainable Development (2003). Moore is a Fellow of the National Endowment for the Arts, a Loeb Fellow of the Harvard Graduate School of Design, the recipient of an Individual Scholar Award from the National Science Foundation. He is the author of many articles, twenty-five book chapters and seven books on the topic of sustainable architecture and urbanism. Moore’s most recent book, the second Edition of Pragmatic Sustainability: Dispositions for Critical Adaptation, appeared in July 2016.
WEDNESDAY, JUNE 14

REGISTRATION 1:00 PM - 5:00 PM
Bailey Gallery, Architecture Building

KEYNOTE ADDRESS: JASON F. MCLENNAN 5:00 PM - 6:00 PM
Room 127, Architecture Building

RECEPTION 6:00 PM - 7:00 PM
Bailey Gallery, Architecture Building

DINNER: ON YOUR OWN 7:00 PM
Refer to Page 47, “Out and About in Salt Lake City” for recommendations

THURSDAY, JUNE 15

BREAKFAST 8:00 AM - 8:30 AM
At Hotel

REGISTRATION 8:30 AM - 9:00 AM
Bailey Gallery, Architecture Building

OPENING PLENARY 9:00 AM - 10:00 AM
Room 127, Architecture Building

9:00 AM INTRODUCTORY REMARKS
Co-Organizers And Chairs

9:10 AM VIDEO
Systems Thinking - Russ Ackoff

9:25 AM THINKING IN BUILDING/ENVIRONMENT SYSTEMS
Brook Muller

9:30 AM CONNECTING DOTS, VALUING VALUES + CONSIDERING DESIGN: HOLISM, SYSTEMS AND THE SEARCH FOR PROGRESS
Dr. Brian Robert Sinclair

9:35 AM CRITICAL INQUIRY TOWARDS SYSTEMS THINKING OF RUSS ACKOFF: INTERPRETATIONS FOR ALTERNATIVE URBAN DESIGN METHODOLOGIES DURING SOCIAL CRISIS AND URBAN FLUX
Ezgi Balkanny

9:40 AM PANEL DISCUSSION
Moderator: Ryan E. Smith

SCHEDULE
SESSION 1A: SYSTEMS THINKING IN ARCHITECTURE
Room 228, Architecture Building

10:00 AM HUMANNESS AND ARCHITECTURE:
LATENT VALUE SYSTEMS IN ARCHITECTURAL THEORY
Philip D. Plowright

10:20 AM INTERSECTIONALITY, OPPRESSION, AND OPPORTUNITY IN
ARCHITECTURE: CLAIMING THE SOCIAL COMPLEX
Leonard Bachman, Christine Bachman

10:40 AM AUGMENTED INTELLIGENCE:
INTERSECTIONS BETWEEN COMPUTER SCIENCE AND
ARCHITECTURAL DESIGN
Ming Hu

11:00 AM APPLYING PERFORMATIVE TOOLS IN THE ACADEMIC DESIGN
STUDIO: A SYSTEMIC PEDAGOGICAL APPROACH
Rahman Azari, Ph.D., Ian Caine

11:20 AM DEVELOPING DATA-DRIVEN APPROACH FOR OCCUPANTS-
BASED ENVIRONMENTAL CONTROL
Chen Zhong, Joon-Ho Choi, Marc Schiler

11:40 AM PANEL DISCUSSION
Moderator: Prescott Muir

SESSION 1B: DESIGN CULTURE, SOCIETY, HEALTH, ECONOMIC, AND
ENVIRONMENTAL NETWORKS
Room 229, Architecture Building

10:00 AM ALIGNING THE DESIGN INTENT WITH THE ACTUAL USE OF A
HEALING GARDEN IN A PEDIATRIC HOSPITAL
Kalina Vander Poel, Corey Griffin

10:20 AM CONSIDERING COMPLEXITY, CONTEXT AND CULTURE IN
CONTEMPORARY TOKYO: URBAN SYSTEMS \ URBAN TYPOLOGIES \ URBAN DESIGN
Dr. Brian R. Sinclair

10:40 AM INDIA'S WATER HUSBANDRY: DESIGN FOR CHANGE
Carey Clouse

11:00 AM PHOTOGRAPHY IN THE URBAN RENEWAL TOOLKIT:
The CASE OF PRUITT-IGOE
Mike Christenson

11:20 AM PLACE-BOUND RELATIONSHIP:
THE MISSING COMPONENTS IN THE NEW SOCIALIST COUNTRYSIDE
Wei Zhao

11:40 AM PANEL DISCUSSION
Moderator: Shundana Yusaf
THURSDAY, JUNE 15 (CONTINUED)

SESSION 1C: ECOLOGY OF THE BUILT ENVIRONMENT
Room 128, Architecture Building

10:00 AM ANALYSIS OF A NEURAL NETWORK MODEL FOR BUILDING ENERGY HYBRID CONTROLS FOR IN-BETWEEN SEASON
Jonghoon Ahn, Soolyeon Cho

10:20 AM SHAPED BY LIGHT: INTEGRATED DAYLIGHTING AT THE REID BUILDING AT THE GLASGOW SCHOOL OF ART
Mary Guzowski

10:40 AM PERFORMANCE NICHE: AN ECOLOGICAL SYSTEMS FRAMEWORK FOR TECHNOLOGY AND DESIGN
Michelle Laboy

11:00 AM FEASIBILITY OF RAINWATER HARVESTING IN US
J. Kim, William Laughner

11:20 AM VISUAL QUALITIES AND PERCEIVED THERMAL COMFORT: RESULTS OF SURVEY STUDIES IN A LEED PLATINUM OFFICE BUILDING
Amir H. Zarrabi, Mona Azarbayjani, Julia Day, Elizabeth Thariyan, Elizabeth Stearns, Brentrup Dale

11:40 AM PANEL DISCUSSION
Moderator: Jorg Rugemer

LUNCH Bailey Gallery, Architecture Building
12:00 PM - 1:00 PM

PRESENTATION OF THE HAECER AWARD

PAPER SESSIONS 1:00 PM - 3:00 PM

SESSION 2A: SYSTEMS THINKING IN ARCHITECTURE
Room 228, Architecture Building

1:00 PM DEMOCRATIZING ACCESS AND IDENTIFYING INEQUALITIES: GENDER, TECHNOLOGY, ARCHITECTURE
Shelby Doyle, AIA, Nick Senske

1:20 PM THE FORMS OF BUREAUCRACY AT CENTRE BEAUBOURG
Ewan Branda

1:40 PM PARASITICAL ANALYSIS IN THE BUILT ENVIRONMENT: SCALES OF COMPLEXITY
Mike Christenson

2:00 PM A DIGITAL DÉRIVE: EXPLORING THE POTENTIAL OF A CROWDSOURCED SITE ANALYSIS
Jennifer A. E. Shields

2:20 PM THE POWER OF WORDS: GROUNDED THEORY RESEARCH METHODS IN ARCHITECTURE & DESIGN
Christian Bollo, Thomas Collins

2:40 PM PANEL DISCUSSION
Moderator: Leonard Bachman
THURSDAY, JUNE 15 (CONTINUED)

SESSION 2B: DESIGN CULTURE, SOCIETY, HEALTH, ECONOMIC, AND ENVIRONMENTAL NETWORKS
Room 229, Architecture Building

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<tr>
<th>Time</th>
<th>Title</th>
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<tbody>
<tr>
<td>1:00 PM</td>
<td>EXPANDING INCLUSIVENESS-INTEGRATING STUDENTS WITH ASD</td>
<td>Ulrike Altenmüller-Lewis, Dr.-Ing., AIA</td>
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<tr>
<td>1:20 PM</td>
<td>CONTINGENT CONTEXTS IN THE GERMAN COUNTRY SCHOOLS OF GILLESPIE COUNTY, TEXAS</td>
<td>Ben K. Shackle lette, AIA</td>
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<tr>
<td>1:40 PM</td>
<td>HEALTH IMPACTS OF MICROENVIRONMENTS IN THE SUMMER</td>
<td>Pravin Bhiwapurkar</td>
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<tr>
<td>2:00 PM</td>
<td>CULTURAL LANDSCAPES OF RELIGIOUS PLURALISM: NETWORKS OF DIFFERENCE AND THE COMMON GOOD</td>
<td>Timothy Kent Parker, Margaret Grubiak</td>
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<tr>
<td>2:20 PM</td>
<td>EXPLORING ALTERNATIVES FOR CRITICAL ACCESS HOSPITALS: RESEARCH-BASED DESIGN FOR RURAL HOSPITALS</td>
<td>Hai Cai, Kent Spreckelmeyer, Frank Zilm, Mario Medina, Hugo Shereard, Paola Sanguinetti</td>
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<td>2:40 PM</td>
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PH.D. SESSION

1:00 PM - 3:00 PM
Conference Room, Architecture Building

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<td>1:00 PM</td>
<td>CLASSROOMS INDOOR ENVIRONMENT QUALITY AND STUDENT HEALTH AND LEARNING IN SOUTHERN CHILE</td>
<td>Maria Isabel Rivera</td>
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<tr>
<td>2:00 PM</td>
<td>INDOOR ENVIRONMENTAL QUALITY ECONOMICS</td>
<td>Mahsa Minaei</td>
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BREAK

3:00 PM - 3:30 PM
Bailey Gallery, Architecture Building

PAPER SESSIONS

3:30 PM - 5:30 PM
Room 228, Architecture Building

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<tr>
<th>Time</th>
<th>Title</th>
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<tbody>
<tr>
<td>3:30 PM</td>
<td>THE CASE FOR A THEORY OF INTERACTIVE ARCHITECTURE</td>
<td>Eric Sauda</td>
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<tr>
<td>3:50 PM</td>
<td>WEATHER REPORT: STRUCTURING DATA EXPERIENCE IN THE BUILT ENVIRONMENT</td>
<td>Marc SaudeKamer, Andrea J. Johnson, Daniel Keefe, Seth Johnson, Ross Altheimer, Aaron Wittkamper</td>
</tr>
<tr>
<td>4:10 PM</td>
<td>BUILT ENVIRONMENT EPISTEMOLOGY: KNOWLEDGE EXCHANGE THROUGH UNIVERSITY-INDUSTRY COMMUNITIES OF PRACTICE</td>
<td>Ryan E. Smith, Robert Hairstans</td>
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<tr>
<td>4:30 PM</td>
<td>QUESTIONING SUSTAINABILITY: A TRANSFORMATIVE APPROACH TO HUMAN RESETTLEMENT</td>
<td>James Miller</td>
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<tr>
<td>4:50 PM</td>
<td>PANEL DISCUSSION</td>
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SCHEDULE
THURSDAY, JUNE 15 (CONTINUED)

SESSION 3B: ECOLOGY OF THE BUILT ENVIRONMENT
Room 229, Architecture Building

3:30 PM  FORM-FINDING OF AN ECOLOGICAL “GREEN” WALL USING BENDING-ACTIVE BIOTENSEGRITY STRUCTURE
Rui Liu, Diane Davis-Sikora

3:50 PM  HYDRO-LOGICAL ARCHITECTURE
Brook Muller

4:10 PM  BUILDING PERFORMANCE ESTIMATION: FACADE VISUAL INFORMATION-DRIVEN BENCHMARK MODEL
Bingyu Wang, Joon-Ho Choi, Douglas Noble, Marc Schiler, Bharat Patel

4:30 PM  THERMAL PERFORMANCE USING RADIANT BARRIER AND PHASE CHANGE MATERIALS IN ROOFS
Haider I. Alyasari, Jae D. Chang

4:50 PM  DEVELOPMENT OF STUDENT SATISFACTION SURVEY TOOL TO EVALUATE LIVING-LEARNING RESIDENCE HALL
Sharmin Kader

5:10 PM  PANEL DISCUSSION
Moderator: Hazem Rashed-Ali

PH.D. SESSION
Conference Room, Architecture Building

1:00 PM - 3:00 PM

3:30 PM  EMBRACING TRADITIONS + CONSTRUCTING FUTURES: RECONCILING WESTERN ARCHITECTURE AND ISLAMIC CULTURE WITHIN THE URBANITY OF DUBAI
Sabeen bin Zayyad

4:30 PM  WETWARE: A MANUAL FOR URBAN SCALE AI
Alexander Webb

POSTER RECEPTION
Bailey Gallery, Architecture Building

5:30 PM - 7:00 PM

DINNER: ON YOUR OWN
7:00 PM

Refer to Page 47, “Out and About in Salt Lake City” for recommendations
FRIDAY, JUNE 16

BREAKFAST  8:00 AM - 8:30 AM  
At Hotel

ARCC ANNUAL MEETING  8:30 AM - 10:00 AM  
Room 127, Architecture Building

PAPER SESSIONS  10:00 AM - 12:00 PM  

SESSION 4A: PEOPLE AND PROCESS IN ARCHITECTURAL PRACTICE  
Room 228, Architecture Building

10:00 AM  THE CAPTURE AND SYNTHESIS OF QUALITATIVE INFORMATION IN ARCHITECTURAL PROGRAMMING  
Dustin Schipper, Andrea J. Johnson, Adam Wilbrecht

10:20 AM  VALUE BY DESIGN - SYSTEMATIC DESIGN DECISION MAKING IN THE ARCHITECTURAL DESIGN PROCESS  
Madlen Simon, Ming Hu

10:40 AM  ARCHITECTURE (DISAMBIGUATION): MAPPING A RESOURCE-BASED DESIGN PROCESS SYSTEM  
Ahmed K. Ali

11:00 AM  IN SEARCH OF HEALTHY COMMUNITIES: A CONCEPTUAL FRAMEWORK FOR ENGAGING DEVELOPERS  
Traci Rose Rider, Ph.D., J. Aaron Hipp, Ph.D., Margaret Van Bakergem, MPH

11:20 AM  PANEL DISCUSSION  
Moderator: Erin Carraher

SESSION 4B: ARCHITECTURE MATERIAL AND KNOWLEDGE FLOWS AND MANAGEMENT  
Room 229, Architecture Building

10:00 AM  NEXT GENERATION BUILDING TECHNOLOGIES: A DIFFERENT PATH TOWARDS COMMERCIALIZATION  
Matthew Gindlesparger, Jefferson Ellinger

10:20 AM  DEVELOPMENT OF A SIMPLE HOT BOX TO DETERMINE THE THERMAL CHARACTERISTICS OF A THREE-DIMENSIONAL PRINTED BRICKS  
Brian Peters, Adil Sharag-Eldin, Brigid Callaghan

10:40 AM  CONCRETE LATTICE UNITIZED ARCHITECTURE OF ASSEMBLY  
Ryan Goold, Daniel Fengere, Tsz Yim Ng, Wes McGee

11:00 AM  TACTILE EXPERIMENTAL PARAMETRICS  
Mark J. Clayton, Xing Kai, Han Yunsong

11:20 AM  INVESTIGATION OF THE RELATIONSHIP OF THE THERMAL COMFORT PERCEPTION BETWEEN THE LOCAL AND WHOLE BODY SEGMENTS IN A WORKPLACE ENVIRONMENT  
Qi Wang, Joon-Ho Choi, Marc Schiler, Douglas Noble

11:40 AM  PANEL DISCUSSION  
Moderator: Rima Ajlouni

SCHEDULE
FRIDAY, JUNE 16 (CONTINUED)

SESSION 4C: ECOLOGY OF THE BUILT ENVIRONMENT
Room 128, Architecture Building

10:00 AM  IMPROVING ENERGY MODELING TECHNIQUES FOR HISTORIC BUILDINGS USING PRELIMINARY VERIFICATION METHODS
Daniel Chung

10:20 AM  THE ENERGY EFFICIENCY PRIZE: SIMPLE DESIGN TO OVERCOME COMPLEX BARRIERS
Malini Srivastava, Christopher Nelson

10:40 AM  HOW CAN DEEP-CULTURAL PATTERNS AID IN RESETTLEMENT? A CASE STUDY OF THREE MARSHALLESE COMMUNITIES
James P. Miller

11:00 AM  NATURAL VENTILATION I HISTORIC BUILDINGS: THE KALTEYER HOUSE IN SAN ANTONIO, TEXAS. ANALYSIS AND SIMULATIONS OF NATURAL VENTILATION
Eleonora Laurini, Angela Lombardi, Hazem Rashed-Ali, Simonetta Cirrana, John Murphy, Michael Carroll

Meredith Sattler

11:40 AM  PANEL DISCUSSION
Moderator: Chris Jarrett

LUNCH  12:00 PM - 1:00 PM
Bailey Gallery, Architecture Building

PRESENTATION OF THE NEW RESEARCHER AWARD, PH.D. DISSERTATION AWARD, AND POSTER SESSION AWARD

PAPER SESSIONS  1:00 PM - 3:00 PM
Room 228, Architecture Building

SESSION 5A: PEOPLE AND PROCESS IN ARCHITECTURAL PRACTICE

1:00 PM  ON THE MARGIN OF CITIES
Arief Setiawan, Ph.D.

1:20 PM  DOCKING STATE OFFICE BUILDING: REVISITING THE ENERGY PERFORMANCE OF THE MODERN GLASS TOWER
Michael D. Gibson

1:40 PM  FREE AGENCY: STRATEGIC (SUB) OPTIMIZATION IN TRANS-SCALAR DESIGN
Jacob Mans

2:00 PM  REPRESENTING PERFORMANCE AND TRADE-OFFS WITH MARCEL BREUER’S VASSAR RESIDENCE HALL
Clifton Fordham

2:20 PM  PANEL DISCUSSION
Moderator: Robert Young
FRIDAY, JUNE 16 (CONTINUED)

SESSION 5B: ARCHITECTURE MATERIAL AND KNOWLEDGE FLOWS AND MANAGEMENT
Room 229, Architecture Building

1:00 PM  QUESTIONNAIRE SURVEY ON FACTORS INFLUENCING OCCUPANTS’ OVERALL SATISFACTION ON DIFFERENT OFFICE LAYOUT IN A MIXED-HUMID CLIMATE
Armin Amirazar, Mona Azarbayjani, Julia Day, Elizabeth Thariyan, Elizabeth Stearns, Dale Brentrup

1:20 PM  ENERGY PERFORMANCE OF DIFFERENT TYPES OF DOUBLE SKIN FACADES IN VARIOUS CLIMATES
Ajla Aksamija, Ph.D., LEED AP BD+C, CDT

1:40 PM  MODELING THE EFFECTIVENESS OF FLUSH-OUT PROCEDURES IN REDUCING FORMALDEHYDE IN NEW BUILDING CONSTRUCTION
Daniel Chung

2:00 PM  LIVING-RAMMED-EARTHEN-ENCLOSURE: REHEARSING SYSTEMIC DESIGN PROCESSES
Meredith Sattler

2:20 PM  LANGUAGE OF ARCHITECTURAL WOOD: WASTE TO ECOLOGICAL ABUNDANCE
Leonard Yui

2:40 PM  PANEL DISCUSSION
Moderator: Rima Ajlouni

SESSION 5C: DESIGN CULTURE, SOCIETY, HEALTH, ECONOMIC, AND ENVIRONMENTAL NETWORKS
Room 128, Architecture Building

1:00 PM  ISSUES OF HEALTH IN ARCHITECTURAL EDUCATION: COMPLEXITY, INTERDISCIPLINARITY, AND FRAMEWORKS
Traci Rose Rider, Ph.D.

1:20 PM  USING IMMERSIVE ENVIRONMENTS TO EVALUATE MULTI-SENSORY RESPONSIVE SURFACES
Matthew Wagner, Ivica Ico Bukvic, Dane Webster

1:40 PM  RESILIENT DESIGN FOR HUMAN CAPITAL/HUMAN DEVELOPMENT-BASED BUILDINGS
Joseph Bilello, Ph.D., FAIA

2:00 PM  MUNICIPAL ANNEXATION AS A MECHANISM FOR SUBURBAN EXPANSION IN SAN ANTONIO, TEXAS 1939-2014
Ian Caune, Jerry Gonzalez, Rebecca Walter

2:20 PM  R.A.W.: SOCIAL AND ECONOMIC COMPLEXITY IN WILMORE, NC
Chris Jarrett, Peter Wong

2:40 PM  PANEL DISCUSSION
Moderator: Keith Diaz Moore

SCHEDULE
FRIDAY, JUNE 16 (CONTINUED)

BREAK
Bailey Gallery, Architecture Building
3:00 PM - 3:30 PM

RESEARCH ROUNDTABLE PLENARY SESSION
Speaker: Kendall Nicholson, ACSA
Moderator: Ryan E. Smith
Bailey Gallery, Architecture Building
3:30 PM - 4:30 PM

DINNER AND KEYNOTE ADDRESS: STEVEN MOORE
Cucina Toscana, Downtown Salt Lake City
5:30 PM - 8:00 PM
Refer to Page 46, for Address and Public Transit Directions.
PAPER ABSTRACTS

*LISTED ALPHABETICALLY BY AUTHOR
In residential and commercial buildings, programmable thermostats have been practically used to provide appropriate heating and cooling energy to satisfy the thermal conditions. With the help of rapid development of computing technology, recent controllers are able to adopt advanced algorithms such as Fuzzy Inference System (FIS) and Artificial Neural Network (ANN). Several studies for the algorithms were tested to improve the performance of conventional controllers through the large scaled databases associated with hidden interactions between parameters. However, most models focused on the optimization of fuel use for boilers or motor speed for fans, which have some disadvantages to provide sensitive control signals responding to thermal demands in zone scale level.

The advanced FIS and ANN controllers, which deal with simultaneous control of supply air mass and temperature, are tested to optimize supply air conditions for in-between seasons that require both moderate heating and cooling. The controllers are compared with a thermostat on/off model by means of the total control errors and thermal energy consumption. To verify the effectiveness of the controllers, the measures of Integral of Absolute Errors (IAE) and energy consumption results are compared with conventional thermostat on/off controller. The IAE describes the difference between desired and measured room temperature reflects control accuracy, and hourly thermal gain from the system reflects energy efficiency. The ANN mass and temperature simultaneous control algorithm indicates high efficiency for control errors by 5.59% and effectively mitigates energy increase by 3.95% in comparison with thermostat on/off controller. Even though the ANN model can effectively reduce control errors for thermal comfort, it consumes quite less energy than FIS model, and similar amount of energy for thermostat on/off controller. Under building's conditions requiring more sensitive controls and consuming large amount of energy, the ANN controller can be used to effectively optimize the supply air conditions.

### ENERGY PERFORMANCE OF DIFFERENT TYPES OF DOUBLE SKIN FACADES IN VARIOUS CLIMATES

AJLA AKSAMJUA, PH.D., LEED AP BD+C, CDT
DEPARTMENT OF ARCHITECTURE, UNIVERSITY OF MASSACHUSETTS AMHERST, AMHERST, MASSACHUSETTS

This paper explores thermal and energy performance of double skin facades (DSFs) in different climate types, specifically focusing on three typologies: box window, corridor type and multistory DSFs. These systems were investigated and analyzed to answer the question of how the different DSFs perform in comparison to each other, as well as a typical curtain wall (single skin facade used as a baseline), in a multitude of climate applications. The utilized research methods included two-dimensional heat transfer analysis (finite element analysis) and energy modeling. Heat transfer analysis was used to determine heat transfer coefficients (U-values) of all analyzed facade types. Results indicate that there is little variation in thermal performance of the different DSF types, but that all DSF facades would have significantly improved thermal performance compared to the baseline single skin facade. Energy modeling was conducted for an office space, which would be enclosed by the analyzed facade types. Individual energy models were developed for each facade type and for 15 different climates, representing various climate zones and subzones. The results were analyzed to compare energy performance of DSFs and baseline single skin facade, as well performanced of DSFs in various climate types. The results included significant differences between the DSFs and single skin facade, but less variations between the different typologies of investigated DSFs. Moreover, the results show what would be the effect of DSFs in different climate types on energy performance, heating, cooling and lighting loads.

### ARCHITECTURE (DISAMBIGUATION): MAPPING A RESOURCE-BASED DESIGN PROCESS SYSTEM

AHMED K. ALI
TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS

The process of designing and developing a building from conception to realization is indeed a sequence of creative and rigorous activities that combine the art of architecture with its scientific, engineering and financial aspects. Like other creative activities, the design process charts a path that is not always straightforward and, in fact, is likely to include multiple investigative sub-design procedures. Previous attempts to define the architectural design process have been vague and confusing to those in other disciplines. In this paper, we introduce a novel method of integrating system thinking into architectural design by mapping its processes in a standard modeling language. We present a decision-support framework using process mapping in order to incorporate sustainable building materials and resource reuse decisions into architectural design practice. We turned to other disciplines' knowledge bases, such as Business Information Technology (BIT),
to develop a workflow system for the Design-Bid-Build (DBB) process. Mapping both current and the proposed design processes, including their activities, workflow, processes and decision nodes, was critical in defining roles, processes, and subsequent decisions. A literature review suggests that there are five types of design processes, which are somehow defined as linear, divisional, centralized, cyclical and investigative. However, no attempts have been made to map their processes using a systematic methodology. In this study, we utilized a qualitative methodology to capture the required knowledge from industry experts in resource-based design and then integrated our findings into a set of process maps to support the materials decisions of the architectural design team.

EXPANDING INCLUSIVENESS — INTEGRATING STUDENTS WITH ASD

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A significant increase of children diagnosed with autism means that as a society we must better understand and appropriately consider the needs of people with ASD. Autism spectrum disorder (ASD) is characterized by a range of disorders and a group of multifaceted developmental disabilities. As a result, the needs of affected people may vary widely. A broadening of the requirements and attributes of inclusive design is necessary. This paper is an introduction to the problematic of designing learning environments for school-aged children with ASD. While people at every age suffer from autism, supporting children on the spectrum and helping them to develop to their best potential should be of priority for our society. This paper outlines recommendations for educational environments that consider the needs of students with autism. It briefly explains some of the key markers and symptoms of the disorder and the perception or the experience of space by people on the autism spectrum as documented by various research studies. Lastly, a set of preliminary design criteria and recommendations will provide guidance for designers and educators to help them design and/or adjust educational environments for school and daycare spaces that help better integrate children on the spectrum into the learning environment.

THERMAL PERFORMANCE USING RADIANT BARRIER AND PHASE CHANGE MATERIAL IN ROOFS

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Buildings are large consumers of energy worldwide, responsible for roughly 40% of the world’s primary energy consumption. This paper analyzes the thermal performance of two passive roof construction technologies as a means of improving the indoor thermal conditions under summer conditions. Three identical Test Cell Structures (TCS) were constructed in eastern Kansas. All the TCSs were calibrated and two types of roofing technologies, Radiant Barrier (RB) and Phase Change Material (PCM) were individually applied to a TCS and their performance in terms of indoor air temperature reduction was compared. A one-way analysis of variance (ANOVA) was calculated for the study. The experimental results show that the thermal performance of RB obtained the best thermal improvement. TCS equipped with RB registered indoor air temperature 1.6 °C (2.9 °F) lower than the control test structure.

QUESTIONNAIRE SURVEY ON FACTORS INFLUENCING OCCUPANTS’ OVERALL SATISFACTION ON DIFFERENT OFFICE LAYOUT IN A MIXED-HUMID CLIMATE

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Open-plan offices seem to be more common these days in comparison with enclosed private configurations. This layout is commonly assumed to ease communication, teamwork and interaction between co-workers and increase workspace satisfaction while enabling airflow and passive design strategies. However, there has been little attempt at quantifying pros and cons in terms of occupant satisfaction in open-plan office layouts. The research seeks to identify overall satisfaction/dissatisfaction of occupants in different office layouts, and to determine the differences between occupants’ reported office layout and other reported factors. These factors include gender, age, view, working hours, visual comfort, and thermal comfort. The survey study was sent to occupants in office buildings (n=1,026) that are located in mixed-humid climates. The results show that the highest satisfaction ratings were reported by occupants in enclosed offices and open-offices with low partitions. The results also show that the open-office spaces with high partitions had lower satisfaction appraisals in comparison with lower partitions across 7 IEQ factors except ‘view’. In addition, between open-plan offices, satisfaction with ‘quality of light’ and
‘thermal condition’ slightly increased as the height of partitions decreased. These findings enhance our understanding of occupant satisfaction by indicating that increasing partition height contributes to higher dissatisfaction among office workers.

**APPLYING PERFORMATIVE TOOLS IN THE ACADEMIC DESIGN STUDIO: A SYSTEMIC PEDAGOGICAL APPROACH**

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This paper describes a third- and fourth-year pilot design studio at the University of Texas at San Antonio (UTSA). Two instructors—one with expertise in building performance and the other in architectural design—implemented a systems-based approach to teaching undergraduate design studio that allowed students to explore the oft-misunderstood relationship between architectural performance and form. The instructors integrated advanced performance modeling into the design curriculum, restructuring the studio around 10 parallel and interactive lab sequences: 5 covering topics specifically related to building performance and 5 covering general design topics. The reconfigured studio required participants to pursue issues of sustainability and design in parallel, allowing students to leverage building performance as a form generator, not a technical overlay. Both iterations of the studio produced a winning entry in the American Institute of Architects (AIA) Committee on Technology and the Environment (COTE) Top Ten for Students Competition, which recognizes ten winners annually from a national pool of entries.

**INTERSECTIONALITY, OPPRESSION, AND OPPORTUNITY IN ARCHITECTURE: CLAIMING THE SOCIAL COMPLEX**

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We review three dimensions of architecture’s complicity in institutionalized social oppression and offer a transdisciplinary lens for transformative opportunities. Equity deals with the history of elite classes dominating the common populace, and rulers in marble palaces and servants in dirt floor homes. Social justice is then a contemporary residual of class discrimination and a force of emancipation toward equal access to public resources, aspirational prosperity, and well-being. Finally, sustainability attends to underlying damages that accrued in previous eras of short-term thinking, unfair commodification of resources, and institutionalized greed.

This paper is not, however, an exercise in political, legal, planning, or technical solutions. Instead, we frame the relation of architecture and institutionalized oppression within the concept of intersectionality (i.e., the complex social dynamic that compounds those multidimensional problems). To balance architecture’s naïve and negligent guilt, we conclude with emerging opportunities in architecture towards promoting broad welfare, social justice, and class equity. Three such opportunities are discussed: social activism, stakeholder engagement, and sustainability.

**HEALTH IMPACTS OF MICROENVIRONMENTS IN THE SUMMER**

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Economically deprived communities in urban areas face disproportionately significant health risks; children and the elderly are particularly affected. While socioeconomic factors are commonly associated with health disparities, the role of the outdoor environment, especially during extreme heat events, has been less frequently studied. This research investigates the heat stress index (HSI) and ultrafine particle (UFP) exposure in 24 microenvironments. The data were recorded during an extreme heat event in 2016; the goal was to better understand how residents experience environmental exposure as a part of their daily routine when the boundaries between microenvironments are repeatedly crossed. Additionally, a statistical analysis of such exposure along both spatial and temporal scales is presented here, in order to assess the dual roles of development patterns and overlapping loci of social interactions within these microenvironments. The results of this study shows that HSI and UFP exposure varies in space and time. The HSI in 54% of the microenvironments tested was within the danger zone identified by the National Weather Service (104°F to 124°F), while the remaining 46% of the microenvironments fell within the extreme caution zone (91°F to 103°F). The average five minute walk among these microenvironments indicated that 70% of the time, residents would be subjected to a danger zone, and the remaining 30% of the time they would fall within extreme caution conditions. The average UFP exposure varied from 7,633 to 34,751 particles/cm³. Microenvironments with a high percentage of sealant surfaces and lack of vegetation showed increased HSI values; close proximity to traffic and the freeway further elevated HSI and UFP exposure. These results are useful in understanding the health outcomes previously recorded by a community health survey in which heat and respiratory
illnesses were substantial. The evidences presented here provide crucial context-specific information for re/designing urban communities to minimize health disparities.

**RESILIENT DESIGN FOR HUMAN CAPITAL/HUMAN DEVELOPMENT-BASED BUILDINGS**

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From case studies of architect and non-architect–designed buildings confronted by natural and man-made disasters of the recent past, where human capital restoration was a greater determinant in courses of design action rather than financial capital, this paper extracts exemplary cases of mitigation, adaption, and transformation design responses to disaster instances in first and third world sites at building and town scales. Testing the relevance of resilience attributes from biology and complexity theories (Zolli and Healy 2012), cases prepared with graduate students in courses on resilience and research methods, studied these tenets of resilience that readily mapped onto architecture (i.e., simple cores/complex edges, modularity, etc.). Further, the case method pedagogy challenged students to make architectural decisions before, during and after disasters. Selected disaster mitigation strategies for (a) post-earthquake school design in Port au Prince, Haiti, (b) future disaster adaptation designs in New Orleans 9th Ward housing post-Hurricane Katrina, and (c) post-tornado transformative building designs that changed the identity of small town Greensburg, Kansas, are abbreviated. In contrast to well-understood roles before and after disasters, architects roles during disasters are absent from the literature and mainstream practice of architecture. Efforts to better ascertain critical roles for architects during relatively predictable disaster events (i.e. hurricanes, flood, wildfire, storm surge, sea level rise, etc.) are explored and a precedent illuminated.

**THE POWER OF WORDS: GROUNDED THEORY RESEARCH METHODS IN ARCHITECTURE & DESIGN**

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Grounded Theory (GT) is a systematic methodology used to reveal patterns in qualitative data and to develop theoretical positions or frameworks from these patterns—the theory is “grounded” in the words. Since its inception in the late 1960s, GT has emerged as a preeminent qualitative research methodology and is widely used in diverse disciplines such as nursing, education, and the social sciences where researchers look to better understand the why and how questions related to human decision making and action—questions that frequently interest architects and designers.

Grounded Theory is a robust and intuitive approach and set of procedures suitable for a wide variety of architectural research objectives that should be considered and used more often. It can be used as a stand-alone qualitative method or in conjunction with quantitative methods as part of a mixed methods approach. This paper includes an elegant plan of action for researchers who are not content to let the richness of interviews and observations go to waste. The process for beginning a Grounded Theory analysis is laid out simply with key references highlighted. GT is equally powerful in analyzing existing data, resulting in new answers and unexpected questions.

**THE FORMS OF BUREAUCRACY AT CENTRE BEAUBOURG**

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The 1970 international competition for the Centre Beaubourg (later renamed the Centre Georges Pompidou) proposed a new cultural institution for the information age: a museum and library conceived as a giant computer. The competition brief represented this enormous cultural information processing system through a program comprising meticulously tabulated requirements, diagrams of spatial relationships, and specifications for all technical aspects of the building’s performance. At Beaubourg, rational programming was applied for the first time to an elite cultural building. This paper examines the visual and notational languages of programming used at Beaubourg to control the performance of this information machine and to model the complex exchanges upon which the new institution’s metabolic processes were based. Borrowing the conceptual frameworks, rhetoric, and notational conventions from the new discipline of systems engineering, the programming team created novel graphs, topological diagrams, and flow diagrams that formed a new zone for architectural creativity, and in so doing challenges the possibility of a clean bifurcation in the early 1970s between the formal avant garde and an emerging positivist technocracy.
This paper reports a series of research and design activities that explore an innovative model of healthcare delivery in rural areas. In spring 2016, a group of researchers in the School of Architecture, Design, and Urban Planning and School of Engineering at the University of Kansas organized a think tank titled "Innovations in Rural Healthcare Environments." The symposium brought together more than 100 healthcare providers, policy makers, and designers to outline specific research issues about how innovative design solutions can improve the efficiency and effectiveness of rural healthcare systems. Several major themes emerged from the panel discussions: 1. Rural healthcare facilities will need to adapt to changing practice models and constrained economic conditions by blending themselves into the fabric of the surrounding communities they serve and partner with local communities; 2. "Community Outpatient Hospitals" (COH), a new type of facilities that concentrate on primary and outpatient services, community-based health maintenance programs, and information technology rather than bricks and mortar will replace the obsolete “Critical Access Hospitals” (CAH) model; 3. Future rural healthcare designs should recognize the root causes of community health issues and also address individual uniqueness; 4. One size doesn’t fit all.

These key themes were used in a research-based design in the Health and Wellness graduate capstone studio. Students explored a range of design options that addressed the ways that traditional rural inpatient hospitals could be repurposed and refocused using Philips and Harper counties in Kansas as examples. In addition to in-depth analysis of socio-economic status, community health, and physical infrastructures of these two typical rural communities, students also conducted onsite observations, workflow mapping using spaghetti diagrams, and focus group interviews to inform innovative prototypical solutions for rural hospitals. The inter-disciplinary evidence-based design approach has been proven to be effective for student engagement and deeper understanding of rural conditions.

MUNICIPAL ANNEXATION AS A MECHANISM FOR SUBURBAN EXPANSION IN SAN ANTONIO, TEXAS 1939-2014

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This paper examines the history of municipal annexation as a mechanism for suburban expansion in San Antonio, Texas between 1939 and 2014. Annexation, which permits municipalities to enlarge jurisdictional boundaries by absorbing adjacent, unincorporated areas, emerged as a powerful governmental apparatus to grow Sunbelt cities across the postwar United States. Political elites in San Antonio began leveraging annexation with remarkable efficiency after World War II and continue the practice today. During the period under study, the city council executed 461 annexations and boundary adjustments, adding 497 square miles to the metropolitan footprint. The same time frame saw San Antonio grow to become the seventh most populous city in the United States, adding 430,000 people in the last decade alone, with another 1.1 million expected by 2040. The continued use of municipal annexation as a way to grow the city has generated a wide array of responses among citizenry, ranging from strong support by 2040. The continued use of municipal annexation as a way to grow the city has generated a wide array of responses among citizenry, ranging from strong support to opposition from development communities eager to access emerging markets, to opposition from historically disenfranchised neighborhoods where people contend that annexation further consolidates resources in middle- and upper-income areas of the city. This paper examines the historical roots of such positions in an attempt to clarify today's contentious discourse on annexation in San Antonio.

PARASITICAL ANALYSIS IN THE BUILT ENVIRONMENT: SCALES OF COMPLEXITY

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The built environment is a complex physical record created by people over time, and as such, it necessarily embodies contradictions and competing agendas. As part of the larger project of architectural epistemology, this research seeks to bring new technologies to bear on the built environment, as unique means of generating, structuring, exchanging, and activating architectural knowledge. To this end, the research describes and tests the method of parasitical analysis of digitally modeled built environments. As an analytical method, it is fundamentally comparative, effectively constituting a means of “reading” a digital model by indirect means. In order to illustrate the method, I consider a chronologically organized digital model of the Pruitt-Igoe housing project in St. Louis, Missouri. Pruitt-Igoe. Due to its chronological organization, the model contains geometry representing two distinct conditions, i.e., “before” and “after” the demolition of historic structures and construction of the Pruitt-Igoe housing project. Each of these conditions is
subjected to parasitical analysis and the results compared. While parasitical analysis does not promise to resolve the multidimensional questions and contradictions embodied by Pruitt-Igoe, it nevertheless holds promise as a unique analytical method.

**PHOTOGRAPHY IN THE URBAN RENEWAL TOOLKIT: THE CASE OF PRUITT-IGOE**

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In this paper, I consider two approaches to the analysis of photographic practices carried out as part of the federally-funded Urban Renewal program. Using the case study of the Pruitt-Igoe housing project in St. Louis, Missouri, I map photographers’ points of view and fields of view into a digital model to produce representations of the space of photography, and I map photographic fragments into a digital model to highlight photographers’ biases and omissions. The work discussed here is characteristic of ways in which photographic practices were used in other cities engaged in the Urban Renewal program.

**IMPROVING ENERGY MODELING TECHNIQUES FOR HISTORIC BUILDINGS USING PRELIMINARY VERIFICATION METHODS**

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Often for historic buildings air infiltration and thermal resistance values for the envelope are not well known and can significantly influence accuracy of building energy simulations as well as the actual energy performance of a building. This paper will detail some of the methods used in a funded research project to improve energy modeling for historic buildings using low cost preliminary verification methods. By using in-situ non-destructive testing methods to measure heat flux and surface temperatures more accurate thermal resistance values were determined for two buildings. By using door blower pressurization tests the air tightness of both buildings were measured allowing for a more accurate understanding of air infiltration rates. By using these field derived parameters building energy simulations with calibrated input parameters were created and compared with baselines (using standard assumptions for materials and air infiltration) to study the significance of preliminary verification methods on the predictive nature and accuracy of building energy simulations for historic buildings. Using this method of modeling coupled with field testing should improve confidence and accuracy in future building energy simulations for historic buildings and ultimately help provide more meaningful energy data in the decision-making process for owners and operators of historic buildings.

**MODELING THE EFFECTIVENESS OF FLUSH-OUT PROCEDURES IN REDUCING FORMALDEHYDE IN NEW BUILDING CONSTRUCTION**

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New building construction is often a source of indoor air pollution due to the large amount of volatile organic compounds that are emitted from newly manufactured building materials as well as field applied coatings, sealants and adhesives. One major concern has been the release of formaldehyde (HCHO). High levels of HCHO exposure has been linked to negative health effects such as irritation of the skin, eyes, nose and throat, neurological effects, increased risk of asthma and possibly the development of cancer. The United States Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) rating system attempts to encourage through voluntary action sustainable building design and construction practices. LEED recommends a whole building flush-out procedure and indoor air quality assessment to occur for all new construction to help reduce indoor air pollutant concentrations. The LEED version 4 rating system procedure requires that 4267 m3 of outside air to be supplied to the interior for every square meter of floor area. This research explores the effectiveness of the flush-out procedure and the inferred limits to the amount of off-gassing materials that can be included in new construction. The project used a first order emission decay model to iteratively determine the maximum allowable source emitting areas that could be present at the start of the flush-out procedure and still meet recommended concentration limits for formaldehyde from two engineered wood products. Modeling included residential, school and office scenarios to determine a range of allowable source areas (0.25 m2 to 1.60 m2 per unit of floor area). These results varied with changes in air exchange rates, material emissions characteristics and ceiling heights. In most cases the modeled indoor air concentration of formaldehyde was calculated to be below the recommended limit when using typically expected source areas in each of the three scenarios.
TACTILE EXPERIMENTAL PARAMETRICS

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Parametric modeling and assembly of curved surfaces can be difficult for students to grasp due to complex computational workflows that rely upon higher mathematics. Using readily available materials and 3D printed components, a kit for parametric curved surfaces can initiate students into this field of contemporary design using a tactile approach. Software templates then enable the students to create a digital model of their initial physical model. The paper presents an example kit for Tactile Experimental Parametrics. It describes the concept, the parametric models of the fittings, the printing process and tools, the parametric modeling of the assemblies, and example designs produced by the students. The software tool for modeling was Autodesk Revit, and the 3D printing was done with an XYZ Print desktop printer. Workshops were conducted at Harbin Institute of Technology with students in the upper levels of the architecture program.

INDIA’S WATER HUSBANDRY: DESIGN FOR CHANGE

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Changing weather patterns, combined with population growth and demographic shifts, have begun to impact the shape and structure of India’s traditional water landscapes. Water scarcity as well as superabundance can be linked to natural weather events such as cloudbursts, glacial lake outburst floods (GLOFs), and drought, as well as to human causes such as development pressures. Considering as a backdrop the intertwined issues of urban development and climate change, this paper establishes a taxonomy of water management systems found in India and charts each system’s capacity for change. Both traditional and current systems are identified, in an effort to better understand the varied tools and techniques used for harnessing, regulating, and conserving water in South Asia. Water management systems featured in this paper include the talaab, the ghat, the canal, bunds and tanks, the stepwell, the artificial glacier, the ice stupa and the snow barrier band. This research draws upon a combination of field study and archival document studies, conducted in India from 2012-2016. As a survey of water management strategies, this paper makes a connection between design practice and water husbandry, acknowledging the need for reference material that could support adaptive design thinking in the face of environmental change.

DEMOCRATIZING ACCESS AND IDENTIFYING INEQUALITIES: GENDER, TECHNOLOGY, ARCHITECTURE

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While technology has rapidly become more accessible to more people, its benefits are not always evenly shared. This paper searches for methods of identifying and defining gender inequality in architecture as it relates to digital technology and computation. The authors begin by documenting and then questioning existing metrics for measuring women’s participation in architecture, then look outside the field to STEM disciplines, educational research, and economic theory as means of framing this research agenda. By examining and critiquing current patterns of technological distribution and academic culture, the authors seek to foster greater equality in education, architecture, and, consequently, the built environment.

REPRESENTING PERFORMANCE AND TRADE-OFFS WITH MARCEL BREUER’S VASSAR RESIDENCE HALL

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Donald Schon coined the notion of wicked problems that are too complex to be broken down into their component parts prior to offering solutions. He noted that wicked problems faced by large organizations and social structures have increased in light of technical advancements, and have been challenged by expertise in which knowledge is distributed among disparate individuals and institutions (Schon, 1987)

Architects utilize intuition and creative leaps fostering a notion of architect as genius, and a model in which architects provide leadership and orchestrate specialist consultants. Owner initiated pressures on budget and schedule, increased systems performance expectations has challenged this model while internationally recognized firms have come to rely on collaborations with engineering firms such as ARUP to provide sophisticated integrated designs. A gulf has formed between firms that can forge, afford, and manage these relationships, and those that cannot.
In the face of performance goals warranted by environmental and social needs, can architects as a group achieve emergent designs without relying on collaborations with elite engineering consultancies? If so, how can intuition be complemented increasing efficacy and performance? Opportunities for optimal solar and daylighting performance increase when performance factors are considered and buildings correspondingly shaped early in the design process but architects have limited time to validate design decisions before committing to actions.

Considering the importance of knowledge, a paucity of studies exist that validate how form has impacted the performance of modern architecture. More importantly, existing studies fail to acknowledge relationships and tradeoffs between different factors where value is added in design. This paper utilizes results from a study of a Marcel Breuer design for a college residential hall where tradeoffs between solar performance and composition are considered. The analysis expands on methods of analyzing seminal buildings that have been traditionally available, but do not provide sufficient perspective on building performance.

**DOCKING STATE OFFICE BUILDING: REVISITING THE ENERGY PERFORMANCE OF THE MODERN GLASS TOWER**

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The Docking State Office Building, a 12-story state office building immediately adjacent to the historic capitol building in Topeka, Kansas, was completed in 1957 as one of the region’s earliest examples of tall, curtain wall glazed modern architecture. The Docking’s glass curtain wall was innovative for its time, and the design exhibits an elegant composition of stone planes and glazed skin.

In recent years, the Docking Building has been thrust into limbo, with competing plans to demolish, renovate, or sell the building semisold in government gridlock. Problems with the buildings systems and glass facades have been cited in arguments to demolish the building. This paper examines the building’s current and potential energy performance on a typical tower floor, analyzing the original curtain wall’s thermal resistance and ability to use daylight. While it is believed that the building needs gutted and re-skinned to be saved, the paper asserts that the original environmental hypothesis of the building is sound.

**NEXT GENERATION BUILDING TECHNOLOGIES: A DIFFERENT PATH TOWARDS COMMERCIALIZATION**

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As the global human population expands, so do the bounds of the built environment. Advances in building technology are reactionary to the myriad of negative impacts buildings have on our global ecology: poor indoor air quality, inefficient envelope assemblies, and an unsustainable paradigm of energy use are just some of the numerous examples. There are many technological advancements that have the potential to be disruptive in the building industry, but the path towards commercialization of these technologies is often unclear and interrupted by the slow pace of product development and deployment in the construction industry. Sole source entities will not be able to develop and deploy these disruptive technologies without transdisciplinary collaboration and clear pathways for commercialization. This paper looks at an example of a next generation building technology moving to commercialization, beginning as an interdisciplinary collaboration in the academy within departments of architecture, science, and engineering. The project has become a reality by advancing the production of the system by working explicitly with architecture firms, manufacturers, and clients on real building installation projects. The technology is a modular plant wall system that improves indoor air quality (IAQ) in buildings by utilizing plants as a biomechanical filtration system that interconnects to a building’s HVAC system. The potential benefits include reduced energy consumption, HVAC equipment requirements and the improved well-being and productivity of building occupants. This project could only be completed with full collaboration of industry and the academy. The proof of concept could only be developed where multiplicities of expertise can be found – biologists, designers, engineers, horticulturalists, etc. The proof of operation could only be tested in a full building scale integration where architects, contractors, manufacturers, regulatory agencies, etc. can be fully integrated into the execution and hold agency over the outcomes.
Concrete Lattice seeks to challenge our normative association with concrete building construction by developing a lattice system of prefabricated units using Glass-Fiber Reinforced Concrete (GFRC) as the primary material. Lattice systems are porous, lightweight, and deployable; terms that are not typically associated with concrete structures. The design of parametric units rather than linear components, typical of lattice systems, highlights issues of assembly in precast building systems using integrated components. While design workflows and CNC fabrication aided in efficiently manufacturing the units, the assembly is post-tensioned during the construction process to limit the amount of scaffolding necessary. Our goal was to address the gap between design and production by exploring the development of complex lattice systems and using digital design tools to streamline the production of units to be deployed on site. The design of our Concrete Lattice through prototyping and fabrication highlights the value of design research for design studio learning.

The complexity demonstrated through this project argues for the use of computational design in both informing design decisions and managing the myriad contingencies involved in the production of a novel structure. Complexity in this respect addresses not only formal and experiential concerns, but also structural and manufacturing processes. Our Concrete Lattice makes explicit the role digital technology plays in the integration of design, engineering, and fabrication. While this discourse is not new, our design aims to take full advantage of lessons from precedents and offer a unique project uncharacteristic of what we have come to expect from concrete as a material.

This paper explores an integrated approach to daylighting design in the Reid Building at the Glasgow School of Art (GSA) by Steven Holl Architect (SHA). It considers how SHA has skillfully and creatively bridged the poetic and practical potentials and complexity of daylighting to artfully reconcile the physical and measurable attributes of site, climate, program, and ecological performance with the intangible qualities of atmosphere, aesthetics, and human experience. Daylight studies using Velux Daylight Visualizer explored how the daylight supports design intentions, program, and performance. SHA’s Reid Building provides insight into an integrated approach to daylighting design strategies and methods to inform contemporary architectural practice and design education.

In the 1960s, the “design pattern” developed by Christopher Alexander provided a promising starting point for reflection on architecture that is increasingly produced by digital and generative systems. Alexander’s theory left a limited mark on the architectural design process, but it was radically adopted by computer science. Fifty years later, design algorithms and parametrics are a new field situated directly at the crossroads between computer science and architecture. We are in an era when digital intelligence can not only solve complex mathematical problems on the level of software, but also augment human intellect by generating architectural meaning. This paper compares computer science and architectural design, analyzing the fundamental differences and identifying the point of convergence.

Like many American cities, Charlotte, NC is undergoing a flood of in-town apartment construction that saturates the market with repetitive, single-use housing stock. This phenomenon is exacerbated as emerging professionals seek metropolitan living in the city center only to move out of the city once lifestyles mature, expanding suburbanization. Based on historical research of urban renewal in Charlotte and studies in recent demographic changes and current housing trends, locally and nationally, this paper...
presents R.A.W. or Residents at Work, a complex model of mixed-use, mixed-income and income-generating urban housing that responds as an antidote to the rampant quantities of large-scale, single-use, monolithic housing construction recently built in Charlotte, North Carolina.

**DEVELOPMENT OF STUDENT SATISFACTION SURVEY TOOL TO EVALUATE LIVING-LEARNING RESIDENCE HALL**

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Post-occupancy evaluation (POE) is becoming increasingly significant for continuous improvement in designing and operating any building facilities. As user’s satisfaction is a significant indicator (Zimring, 1990), development of a valid and reliable data collection instrument is one of the important actions for a successful POE (Federal Facilities Council, 2001). Today’s trend of building residence hall incorporating living-learning programs is increasing to achieve better student success in social and academic life. These new concepts are resulting in the creation of innovative design ideas and new space requirements (e.g., maker’s space, innovation lab). To assess the residents’ satisfaction about their college housing environment, various authors had focused on various objectives and parameters (Davis & Roizen, 1970; Foubert et al., 1998; Kaya & Erkip, 2001; Amole, 2005; Hassanain, 2008; Amole, 2009; Dhalan et al., 2009; Khozaei et al., 2010; Najib et al., 2011; and the EBI survey tool). Among all, Najib et al. (2011) in Malaysia focused on physical and social variables combining some parameters mentioned by other authors, but the tool needs more modification to accommodate today’s living-learning residence hall design in the United States. The EBI tool mostly focuses on student affair program, not architectural design. The need to develop a new student survey tool is evident, considering the environmental dimensions and architectural determinants. This study followed several methods while developing this survey tool. First, analyzed previously developed tools and scales for student housing to obtain the initial pool of questionnaire items. Second, reviewing several newly constructed projects’ Program of Requirements to modify this list. Third, conducted a post-occupancy evaluation in a 648 beds living-learning center considering the initial questionnaire items. Fourth, the instrument was further modified (based on the feedback from the POE). This tool has developed for the undergraduate student residence hall and it carries a great significance to the architects and to the university housing professionals.

**FEASIBILITY OF RAINWATER HARVESTING IN US**

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This paper assesses the climatic feasibility of water self-sufficiency of buildings that employ rainwater harvesting. The feasibilities of standard single-family residential buildings that employ rainwater harvesting in thirteen cities that represent a range of climatic regions across the continental U.S. were assessed. Using the water consumption data published by the United States Geological Survey (USGS) and the American Water Works Association (AWWA), the quantities of current water consumption in typical American households with the average population of 2.58 residents were analyzed. Using the NOAA 30-year average precipitation data, the volumes of rainwater that can be harvested from the rooftop catchment areas of standard two-story single-family homes in the test-bed cities were estimated. Comparing the volumes of water consumption and harvested rainwater, the water self-sufficiencies of the test homes were analyzed. Our analyses revealed that, with the current level of water consumption, rainwater harvesting can supply up to 33% of the total water demand of typical homes in the Southeast subtropical region. In the arid Southwest, rainwater harvesting can meet less than 5% the domestic water demand even in rainy months. However, when rainwater is used for indoor uses only, rainwater harvesting can supply a higher fraction of residential water demands. Supplemented by rainwater harvesting, conservation through the incorporation of water efficient technology and change in resident behaviors is instrumental for enhancing buildings’ water self-sufficiency.

**PERFORMANCE NICHE: AN ECOLOGICAL SYSTEMS FRAMEWORK FOR TECHNOLOGY AND DESIGN**

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Current paradigms of sustainability move the design and construction industry to pursue a comforting “independence” in function; the pursuit of net zero goals. If an “interconnected” paradigm of ecological design superseded the “independence” paradigm of sustainable design, alternative measures could look to define what particular performance niche a building must occupy or construct in an ecosystem. In evolutionary ecology, early definitions of niche refer to a location, independent of the organism occupying it, while more functional definitions refer to the role an organism assumes in
sustaining ecosystem functions or constructing an environment. In architecture this may translate to site and performance, respectively. Recent translations in the architecture discourse explored principles of evolutionary ecology, including the notion of niche as site. This paper explores the notion of niche as ecological function, a view of performance with the potential to push design considerations beyond the system boundary of a site, and to understand how to best leverage technology and site construction, beyond site response, to perform in a larger ecosystem boundary. Thinking of buildings not only as consumers but also providers of ecological services, involves defining a niche, understood as the performance void or “recess” in a specific ecosystem to be occupied or replaced by the introduction of a building into an environment. The use of ecology as a metaphor in the design disciplines may be a productive catalyst for new collaborative ways of conceptualizing the relationship of architecture to the environment. However, the meaning of ecological has been stretched into countless definitions, modifiers and applications. This paper returns to the original science of ecology to examine how the concept of niche can trigger renewed thinking about the ecological performance of buildings. Real and speculative examples from practice and academia are presented to illustrate the concept.

**NATURAL VENTILATION IN HISTORIC BUILDINGS: THE KALTEYER HOUSE IN SAN ANTONIO, TEXAS. ANALYSIS AND SIMULATIONS OF NATURAL VENTILATION**

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Approximately one-fifth of the planet’s geographical area is characterized by hot-humid climates, while being inhabited by one-third of the total world population. The majority of continental areas have weather conditions outside the thermal comfort zone. This has resulted in considerable and consistent increases in the use of HVAC mechanical systems, with its associated energy costs and environmental impacts, which potentially nullify the benefits otherwise achieved by the energy conservation policies implemented by many industrialized countries.

Much can be learned from the study of historical buildings where sensitive design approaches were implemented with respect to natural ventilation strategies. An excellent example of a passive stack effect design employing skylights to take advantage of convective air flow is found in the Kalteyer House located in San Antonio, Texas. San Antonio is situated in Climate Zone 2A, hot-humid. The house under analysis is a three-story plus basement, single-family brick residence, designed at the end of the nineteenth century in Richardsonian Romanesque style by the architect James Riely Gordon (1863-1937). Here, the difference in temperature and pressure between two different zones of the house, enhanced by the presence of the skylight, creates naturally occurring convection air flows without the aid of mechanical systems. Natural ventilation can be an incredible resource for implementing passive cooling of buildings.

This paper aims to investigate how to maximize the potential offered by these passive design strategies by developing an understanding of how they have been historically implemented, specifically in the Kalteyer House, and then exploring their potential as a valid alternative for achieving thermal comfort in newly-designed residential buildings. The effectiveness of this passive-cooling strategy is determined through an in-depth case study analysis and critical understanding of the passive system designed by James Riely Gordon, evaluated through CFD software simulations to determine how to maximize the potential of stack ventilation, which is currently underutilized due to the advent of mechanical-cooling systems. The goal of the analysis is to achieve the best performance in terms of thermal comfort with the minimum amount of energy consumption, thus reducing the resulting environmental impact.

**FORM-FINDING OF AN ECOLOGICAL “GREEN” WALL USING BENDING-ACTIVE BIOTENSEGRITY STRUCTURE**

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Interaction between form and force defines the inseparable relationship between architecture and structural design. Many new architectural forms with complex curved geometries can be generated by active elastic bending and pre-stresses introduced by materials with large elasticity and inner stress state. In addition, these structural systems with reversible elastic deformations are shape adaptable. Three case studies were completed in this study, which include a static bending-active Textile Hybrid M1 at La Tour de l’Architecte designed by ICD/ITKE, a bending-activated tensegrity structure designed by Technische Universität München, and a bending active tensile membrane hybrid tower designed by CITA and KET. Based on the findings, principles for a new type of bending-active structure with biotensegrity logics are formulated through systems thinking to address its function, architectural form-finding, and structural stability. A
pre-stressed and self-stabilized ecological “green” wall prototype was designed and built using elastically bent glass fiber reinforced plastic (GFRP) rods in combination with flexible and expandable connections. The new adaptive and dynamic structural form, coupling bending-active systems with biotensegrity logics, explores the opportunities of elasticity, resiliency, and strength within a self-supporting structure. This study presents the design, material selection and iterative form-finding of the wall prototype. The GFRP bending rods play an important role in the structural system, and need to be carefully arranged and connected to carry the loads transferred from the plants, and to enhance the rigidity and stability of the structure.

FREE AGENCY:
STRATEGIC (SUB) OPTIMIZATION IN TRANS-SCALAR DESIGN
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This inquiry explores the architectural habits that a priory prioritize building-scaled efficiency over effectiveness at alternative scales to define a building's performance. These habits, while good intentioned, undermine the architect's agency to act on the non-linear, non-isolated networks that shape our design contexts. When operating on complex adaptive systems one cannot assume that by making an individual processes more efficient the effect on the larger system will be increased efficiency. In fact, often when a process is made more efficient in isolation, the net effect on the system, as a whole, is an increased inefficiency. Performance dictated by the energy efficiency of an individual building-scale is ineffective when optimizing performance within the realities of non-isolated systems. The shortsightedness of architects focused myopically on building efficiency has yielded a serious performance defect when considering buildings in aggregate.

As an alternative to the isolating influence of efficiency this inquiry explores the design of strategic (sub) optimizations; architectures that yield agency and energy efficiency to reinforce critical moments of feedback that optimize the system at an alternative, and often much larger, scale. The concept of “free agency” in architecture refers to a practice allowed to operate outside a building's envelope; on that intends to prioritize the “building” as (sub) component within larger, trans-scalar, design interventions. In this context, the architect manages and synthesizes an increasing amount of expert knowledge of which they are not expert. The architect, as non-expert, is ideally suited to make associations between dissimilar forms of expertise that represent potential design interventions that transcend spatial and temporal scales. These concepts are explored through a set of (sub) optimized design inventions focused on ecologic and energetic feedback loops between forested management practices, wood processing, and wood construction in North-Central Minnesota.

HOW CAN DEEP-CULTURAL PATTERNS AID IN RESETTLEMENT?
A CASE STUDY OF THREE MARSHALLESE COMMUNITIES
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The projected impact of global climate change on community resilience places a significant proportion of the world's population in a precarious position. The increase in storm surges and sea inundation events create a poor outlook for small island nations in the South Pacific, decreasing habitability. Forced displacement and relocation is a likely future that many communities face in Small Island developing states, such as the Republic of the Marshall Islands. The impending landlessness faced by the Republic of the Marshall Islands calls to question the viability of the Marshallese culture and whether or not it can survive resettlement within another nation. As a freely associated state of the United States, there is a high probability that resettlement will follow the current chain migration of Marshallese into the United States.

This paper addresses the complexity of resettlement programs with cultural resilience in mind as we approach the design, development and planning of climate resettlement schemes. The study analyzes the cultural patterns imbued in the dialectic between culture and the built-environment of the Marshall Islands by employing a multi-sited ethnography across three communities in the Marshall Islands. Primarily qualitative analysis is employed to uncover deep-time cultural patterns that persist across time and space. These methods have led to a deeper understanding of cultural resilience in relation to the built environment in the Marshall Islands within a complex systems approach.

The goal of the research is to not only develop a language for building cultural resilience in resettlement programs, but also expand the development discourse to consider the agency of the built-environment in providing for more inclusive environments and the need for transformative action to be truly inclusive. Based on the positive attributes of deep-cultural patterns, they demonstrate a phenomenon that must be considered in any development project.
QUESTIONING SUSTAINABILITY: A TRANSFORMATIVE APPROACH TO HUMAN RESETTLEMENT

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Within the discourse of sustainability, two worlds collide. When translated cross culturally, sustainability does not hold the same meaning within different epistemologies, as demonstrated by anthropologist, Peter Rudiak-Gould in the Marshall Islands. Additionally, the use of terminology such as ‘sustainable development’, has a marginalizing effect – us versus them. Even within the context of urban renewal projects in the United States, development holds connotations of ‘minoritization’ (Laguerre), gentrification, and white-washing. Furthermore, the use of sustainability does not capture the complexity that is inherent in creating sustainable development. Ulrich Beck implements the term ‘reflexive modernity’ in his description of the ‘risk society’; perhaps if development is thought in terms of the inherent risks associated with ‘progress’, then we can achieve more regenerative processes. What does sustainability actually mean in practice? Through a literature review on the implications of sustainable development in alternate epistemologies this paper builds a critique of the current practice. The view of sustainable development as a neocolonial agenda is carried forward into the case study of a series of sustainable development projects on Namdrik atoll, Republic of the Marshall Islands, which earned the ‘Equator Prize’ in 2012. The rising issue of human resettlement as the next embodiment of sustainable development is brought to light and the implication for the future resettlement of low lying atoll nations, such as the Marshall Islands, is discussed. Resilience is brought into the discussion in order to propose a way toward mitigating neocolonial agendas in development programs and leading toward the sustained role of social justice in policies and practice.

HYDRO-LOGICAL ARCHITECTURE

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Water serves as a medium through which to explore architectures of complexity and ecological responsiveness. I offer an encapsulation of the multiple water crises facing cities in the American West, in part a function of the reality that we dwell in what environmental historian Donald Worster, borrowing from Karl Wittfogel, labels a hydraulic society. Acknowledging the health, environmental and economic consequences of the ways we currently appropriate water resources, I advocate for the value of decentralized, site scale water systems in urban environments that integrate harvesting, storage, treatment, recycling and ecosystem recharge. In a time of the population growth and climate change, the ‘big move’ in a next generation of thinking about water and the built environment is counter-intuitively a focus on the urban site, the very location to put into meaningful relation pressing matters of supply with those of downstream effects.

Building from this larger contextual understanding, this paper offers the beginnings of a hydrological design approach, that is to say, a systems-oriented, water centric manner of conceptualizing and making architecture, one that involves:

- Tracing the journey of water through a site as a way to begin to internalize impacts that have historically been external to architectural design
- Identifying synergies amongst water system elements
- (Re)Defining the system as a coupling of architecture and environment
- Narrating the steps in the architecture-environment system

Two interrelated motivations guide this undertaking: (1) a growing realization of the exciting and important design implications that follow from foregrounding water concerns in architecture, and (2) an interest in the ways such a focus allows for the identification of important and often neglected systems interconnections, not the least of which are the many functional synergies to be derived between sustainable architectures and ecologically functional urban landscapes.

DEVELOPMENT OF A SIMPLE HOT BOX TO DETERMINE THE THERMAL CHARACTERISTICS OF A THREE-DIMENSIONAL PRINTED BRICKS

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With the rapid advancement in the application of innovative computational tools, in particular, parametric design, algorithmically-driven built forms have shown promise in the building industry as evidenced by the exponential growth of three-dimensional printing of building components over the past several years. With the promise to simplify construction, lower cost, increase speed and responsible use of natural resources, encourage recycled material use, and increase design flexibility, parametrized 3D printing represents a credible alternative to current construction practices. To date, the focus of research has been on printing techniques, materials, and structural performance, but many of the promised benefits and opportunities have remained largely unrealized. One of the
topics that have received little attention is the study of the thermal performance of the 3D printed walls and envelope components. This paper describes the design and application of a small Hot Box Apparatus developed specifically to test the thermal performance of small and highly detailed samples produced in our labs. Based on several initial experiments, authors discuss in detail the testing procedures, the instrumentation, and the conditions of the tests. The discussion includes errors encountered and elaborates on their sources and how we addressed them in the two experiments that are the basis of this paper. The results revealed that the obtained values from the hotbox were within the acceptable margin of error found in similar laboratory tests. Data collected from testing a rigid polystyrene board of known thermal characteristics were used to estimate parameters used in the determination of the thermal resistivity (R-value) of the ceramic wall. Initial results the R-value of ceramic assembly were promising because of the ability to embed different shapes and sizes of air pockets in the wall. Recommendations include improving the performance of the Hotbox and instrumentation to increase the accuracy of the measurements.

HUMANNESS AND ARCHITECTURE: LATENT VALUE SYSTEMS IN ARCHITECTURAL THEORY

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Complexity of information in architectural design methods requires an understanding of the underlying process frameworks as a point of access to the structure of information and priorities, encouraging both greater success and more relevance to the outcomes (Plowright 2014). However, in addition to designer selected priorities and disciplinary requirements (environmental forces, social interaction, cultural projection), there are embedded values which are used to make many judgements within the system but are not recognized. This paper explores an aspect of this issue through the application of Conceptual Metaphor Theory (CMT) to a corpus of architectural theory.

CMT and conceptual metaphor analysis is one of the strongest tools to examine knowledge sources as it is based on the transfer of knowledge across domains. The paper uses a corpus of contemporary architectural theory and criticism texts to analyze the source domains, conceptual metaphors, primary metaphors and image schema used in architectural cognition through Cognitive Linguistic and Discourse Analysis methodology. The analysis highlights a fundamental way architects operate in pursuing their discipline is through the projection of being human – both as an act of formal design as well as in interpretation of our environment. Source domains of human actions, human interactions, human motion and other types of actions and motions dominate discussions when talking about buildings, building elements and architectural ideas. These are organized through larger, more complex gestalts of human agency and personification. The interesting point of this analysis is that while the current research utilizes textual analysis, it should be highly relevant to other modalities of production within architectural design. This is due to what is known as the cognitive commitment, a theory that positions the human mind as a single system and fundamental in any discussion of embodied cognition. As such, the content of criticism and discourse would be indivisible from issues of design generation and span multiple modes of communication and interpretation. This paper examines the notion of projected humanness in more detail, addressing nuances in situatedness as present in architectural discourse.

ALIGNING THE DESIGN INTENT WITH THE ACTUAL USE OF A HEALING GARDEN IN A PEDIATRIC HOSPITAL

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The combination of an increased value placed on quality of life and hospital satisfaction with the known health benefits of nature have fostered healing gardens to become a standard programmatic element in hospital design. Given the complex relationships between health and habitation, program and occupancy, healing gardens would benefit from greater study and research. This research observed use patterns of a healing garden located adjacent to the third-floor oncology unit of a pediatric hospital in Portland, OR. Use patterns recorded through observation and behavior mapping include user group, length of stay, and activity. Additionally, weather data taken on site was correlated with use patterns to better understand the impact of temperature, relative humidity and light levels. Some findings in terms of healing garden use are concurrent with past research from literature reviews while other findings are not. While this particular healing garden is successfully used for longer durations than those found in the literature review (despite only being accessible from an upper floor), many aspects of this healing garden are not used as envisioned by the design team for a variety of reasons outlined in this paper. This research serves as an initial set of data to inform design decisions to improve the quality of life for patients, providers, and visitors.
ISSUES OF HEALTH IN ARCHITECTURAL EDUCATION: COMPLEXITY, INTERDISCIPLINARITY, AND FRAMEWORKS

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Increasing interest is seen at the intersection of architecture and health. The built environment has become associated with health outcomes including obesity, cancers, and diabetes (Sallis, J. F., et al. 2012). Engaging our students in these inquiries surrounding health is important in preparing them for future practice, regardless of the specific building type on which they ultimately focus. This paper reviews the implementation of one such course focusing on the well-being and overall health of the occupant, using the frameworks of the WELL Building Standard and the Living Building Challenge (LBC). The reviewed course engages interdisciplinary teams composed of students from the School of Architecture, the College of Engineering, and the College of Natural Resources, with private practice. Through these partnerships, students focus on real-world projects as case studies to conceptually assess health and well-being implementation strategies, lending prominence to wider sociocultural influences surrounding the topic of health in the built environment (Kahu 2013). The course, rooted in the theoretical perspective of Constructionism, puts forth an effort to break out of the conventional assumptions and meanings commonly associated with an object (Crotty 1998), such as the built environment’s neutral impact on health. The course has been specifically designed to: (1) establish a framework for common content relating to health in the built environment across disciplinary boundaries; (2) build meaningful partnerships between a variety of student focus areas through intentional exercises; and (3) establish a common vocabulary between architectural education and aligned disciplines regarding health and the built environment. The course structure, activities, and assessments are reviewed, proposing a solid template for including integrated design and themes of health in architectural education, and providing methods for sharing the value of the architectural education process across campus.

IN SEARCH OF HEALTHY COMMUNITIES: A CONCEPTUAL FRAMEWORK FOR ENGAGING DEVELOPERS

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As the U.S. continues to see rapid growth in urban areas, multifamily developers are providing rental units to house this population surge. Given that critical health outcomes including obesity, cardiovascular disease, diabetes, and cancers have been linked to the built environment, and provided the influence of home on community health and healthy behaviors, multifamily real estate must be an active participant in the health conversation. While connections between housing and health have long been recognized, empirical evidence is needed to inform decision-making within the real estate industry to encourage their active engagement in developing healthy communities. Potential benefits regarding the real estate industry’s influence on community health are beginning to draw attention, including work by the Urban Land Institute (ULI), the Green Health Partnership, and the recent 2016 Health and Well-Being Module from Global Real Estate Sustainability Benchmark (GRESB). Regardless, a large gap in peer-reviewed research still remains. This paper outlines the early stages of a research initiative exploring considerations for building a business case for private developer investment in projects engaging community health. This proposed framework suggests methods for integrating resources and expertise to create a holistic, mixed-methods business case to understand motivations, processes, and implementation mechanisms needed to develop practical strategies and create identifiable value based on health and well-being within multifamily developments. Items to be addressed include: (1) how and why developers might address health; (2) criteria for decision-making processes; (3) favored health strategies within projects; (4) economic factors, including discussions with financial lenders; and (5) considerations between different project types and locations based on local infrastructure and relevant housing and health policies. The resulting business cases would be able to inform municipal policies to encourage multifamily development projects that support creating a culture of health in communities, as well as incentivize or make the case to developers to incorporate health in their projects.


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This paper examines relationships between conceptual and spatial boundary conditions as they produced knowledge, processes, communication, and frontiers at Biosphere 2 [B2]. B2 created a novel architecture, one that simultaneously addressed symbolic and molecular criteria. The architectural-apparatus of B2 was constructed as a laboratory to house a
microcosm of Earth's ecosystem service provisioning processes for eight people, over two year intervals. Over 3,600 species were intentionally and unintentionally entangled within a 'Human Experiment' designed to test eco-technical applications for long-duration outer space colonization. Boundaries were essential to the project's design, construction, and enclosure experiment. They both facilitated and undermined the experiment’s success architecturally, scientifically, and culturally while creating inherent tensions through the delineation of edges driven by conceptual boundary conditions, often determined utilizing Ecological Systems Theory and diagramming practices. In the case of B2, the primary boundary manifest as the physical bathtub-space frame building envelope which facilitated unprecedented potential for quantification and categorization of molecules in the gas phase. For B2, this boundary was considered necessary for scientific inquiry during “The Human Experiment” and produced intense design, construction, and maintenance challenges. Once complete and sealed inside, an edited and enhanced Earth, shrunk 30 trillion times, began to evolve. Through the demarcation and analysis of B2's boundary conditions and their dynamic qualities, which frequently demanded redefinition, this research unpacks relationships between architectural envelope conditions, transitional spaces, scientific theory, body/organism skins, and biogeochemical processes to reveal findings related to the entangled anthropocentric condition architectural occupies today.

**THE CASE FOR A THEORY OF INTERACTIVE ARCHITECTURE**

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Historically, architecture's cultural role has changed in sometimes radical ways. A theory of contemporary architecture must deal with the proliferation of information and communication technologies, seeking a transformed role for the physical setting in a digital age. This paper reviews perspectives from computational disciplines, proposes the outline of a theory of interactive architecture, and presents a preliminary exploration of heuristic methods as a tool for the design of interactive architecture.

Computation began agnostic about physical setting, focusing on symbolic systems. But in diverse disciplines, theorists and researchers are questioning the validity of abstraction without an understanding of physical and cultural settings. Ecological psychology investigates how perception must be based on the physical setting rather than only interior mental processes. Actor Network Theory proposes that humans and physical artifacts are interchangeable within a network of meaningful activity. Embodied interaction demands that the meaning of human behavior arises from the physical and behavioral setting. Physical cognition studies how we reduce cognitive load by storing information in both physical settings and symbolic systems. Based on this understanding of the role of the physical in meaningful settings, a case is made for a theory of interactive architecture. This theory is aligned with the activity model of interaction design, privileging the experience of users of space in mixed settings containing both physical forms and media. This paper will explore these approaches with a specific question: does the physical setting influence in important ways the manner in which we understand and use information? Using both a modification of Nielsen’s heuristics and the use of a design science experiment focused on a taxonomic understanding of design possibilities, this paper speculates on a set of interactive architectural heuristics.

**THE CAPTURE AND SYNTHESIS OF QUALITATIVE INFORMATION IN ARCHITECTURAL PROGRAMMING**

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Digital workflows able to accommodate qualitative information are key to addressing issues of rigor, clarity and continuity in architectural programming. Technological advances have progressively improved the role that data can play throughout the design process, but current use of such technology relies almost exclusively on numerically defined quantitative information. This research investigates the relatively unexplored potential that current technologies offer for harnessing qualitative information throughout the design process, and lays a groundwork for new practices in architectural programming based on emerging human and environmental metrics coupled with digital capabilities. In this paper, programming and the flow of qualitative information is reviewed through literature, a series of interviews, and a case study of programming documents on one project. An analysis of these studies frames a proposal for a database-driven strategy to improve the handling of program information throughout a project’s lifecycle. A discussion of the strategy’s impact makes a case for better architectural information management practices, and sets the stage for future research and development at the intersection of programming, qualitative information, and building information modeling.
ON THE MARGIN OF CITIES

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The United Nations indicates that more than half of the world population now lives in the urban area. In urban environment outside of North America and Western Europe, one of their prominent characteristics is the prevalence of the informal settlements. They are a manifestation in the built-environment of experiences of modernity, which have shifted from the transitions from traditional into modern societies into integration into the globalized, post-industrial world, which included impacts of the economic, political, and cultural forces of late capitalism. This phenomenon possesses a multitude of social, economic, political, and environmental issues, in particular, in relationship to the presence of the urban underprivileged. The latter informs a particular way of constructing and ordering of space and form of cities. This paper reports the design research that the author and students have been performing in slums in Addis Ababa, Mexico City, Manila, and Mumbai. The research documents and analyzes first hand experiences in slums architecturally, then seeks the relationship to the local socio-cultural contexts. The design research aims to ask the question of how to interrogate contemporary spatial and formal practices in this context? How can we theorize these practices within the context of theory of modernity in architecture? It intends not only to offer the understanding of slums in descriptive or prescriptive fashions, but also to seek generative design principles that possess potentials as social catalysts.

CONTINGENT CONTEXTS IN THE GERMAN COUNTRY SCHOOLS OF GILLESPIE COUNTY, TEXAS

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This paper investigates the origins and the cultural development of the 19th century German country schools of Gillespie County, Texas focusing on three selected school sites which have been preserved and maintained to the present day by the descendants of the original builders and students. By 1900, there were over forty rural schools thriving in close-knit rural communities which eventually would close through consolidation in the 1950s. Today, less than twenty remain standing preserved through private support as cultural heritage centers concurrently maintained to accommodate a wide variety of community activities. This study begins with an overview of rural education in Gillespie county followed by the analysis of three surviving schools evidenced by archival materials, oral histories, and on-site field documentation. The central thesis of this paper is the architectural qualities, functional purposes, and building technologies found in the rural schools of Gillespie County represents a contextual cultural response to social and physical needs, and delineates a syncretic method for merging embedded social traditions from the German source regions of the original colonists with the cultural and environmental conditions of the Texas Hill Country region. The sustainability of the schools as historical sites and active community centers is highly dependent upon the physical support of the living descendants of the families who attended the schools, and as their numbers diminish the future of the schools is uncertain.

A DIGITAL DÉRIVE: EXPLORING THE POTENTIAL OF A CROWDSOURCED SITE ANALYSIS

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The 20th c. French theorist Guy Debord devised a method for investigating the subjective qualities of an urban environment. He termed this method a dérive, which he defined as “…a technique of rapid passage through varied ambiences.” This method, a psychogeographic survey, would privilege experiential characteristics over objective, geometrically measurable ones. A reinterpretation of the dérive retains the subjectivity of Debord's concept but capitalizes on the strengths of contemporary mapping technology, namely the aggregation and filtering of many data points and sets. This new method serves as a strategy for crowdsourcing the location of a temporary intervention in an introductory environmental design course offered to 150 students including architecture, landscape architecture, and city planning majors. This project, for which the digital dérive is phase one, suggests that in order to design for the built environment, we must be aware of the many complex elements and systems that compose it. A two-phase exploration gives students the opportunity to reflect on their immediate and surrounding environment, and to develop skills in mapping, cataloguing, representing, and abstracting those conditions. This paper describes the history, significance, and contemporary understanding of psychogeography and its cartographic representations, a specific methodology for (and outcomes of) a digital dérive, and the role of these cartographies in the design and transformation of the built environment.
VALUE BY DESIGN - SYSTEMATIC DESIGN DECISION MAKING IN THE ARCHITECTURAL DESIGN PROCESS

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UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND

The authors survey design decision making in architecture and related design professions, setting forth normative practices and identifying important proposals for innovative methods to navigate the complex constraints of design problems. First the authors set forth conventional decision making methodology in the engineering and architecture design process. Then the authors survey typical decision making processes in related design fields such as industrial design, engineering design, and product design and identity their different approaches. The paper compares decision making strategies in engineering and architecture design. The authors conclude by analyzing strengths and gaps of systematic decision making methods in the context of architectural design. This literature review will lay the theoretical foundation for researchers in the area of architectural decision-making and evaluation. The authors will apply these findings to their study that proposes and tests an innovative design decision-making methodology that systematizes a process for evaluating early design proposals against client criteria.

CONSIDERING COMPLEXITY, CONTEXT AND CULTURE IN CONTEMPORARY TOKYO: URBAN SYSTEMS | URBAN TYPOLOGIES | URBAN DESIGN

DR. BRIAN R. SINCLAIR

Tokyo is one of the planet's largest, most complex and most successful cities. With a population exceeding that of Canada, the Tokyo Metropolitan Region embraces a rich array of features key to a well-crafted, well-designed and highly-functioning city. Consistently Tokyo ranks among the world's top cities, based on a wide array of metrics/ measures. From a world-class multi-modal transportation system and vibrant mixed-use neighborhoods to walkable streets and planning innovations, Tokyo demonstrates how an urban centre can be colossal and complex while proving demonstrably dynamic, accessible and livable. For those looking from outside Tokyo proves a paradox – massive in size, and incomprehensible in scope while functioning at high levels, running smoothly and being relatively free from serious problems. Amenity is high, crime is low, efficiency is unprecedented, design is pervasive and a sense of community is ubiquitous. Tokyo's success is worth critical examination, not only to cull out reasons for achievement but also to better grasp facets of the city than contribute to its Gestalt. An approach overarching the research critically considers the vehicle of 'urban typology'. Using typology as a lens for investigation, the work imaginatively identifies/delineates unique typologies that define, shape and characterize Tokyo's rich fabric. Case studies embrace conventional awareness of typology while charting new ground in conceiving exceptionally Japanese types. Creative typologies include: Gate-Threshold; Spiritual Spark; Arcade Street; Optimize Leftovers; Extreme Parking; Koban; Palimpsest Remnants; Folded + Compressed; Thin Landscapes; Vending Ethos; and Love Zones. The approach taken to Tokyo Typologies is original, bold and in keeping with the pulse, energy and uniqueness of this leading global city. The author invokes an existing holistic framework for design + planning to better illuminate compelling reasons for Tokyo's ongoing progress despite intense pressures on economic, environmental, social, cultural & spiritual fronts. Application of findings, beyond Tokyo, is postulated.

BUILT ENVIRONMENT EPISTEMOLOGY:
KNOWLEDGE EXCHANGE THROUGH UNIVERSITY-INDUSTRY COMMUNITIES OF PRACTICE

RYAN E. SMITH, AND ROBERT HAIRSTANS
UNIVERSITY OF UTAH, SALT LAKE CITY, UTAH
EDINBURGH NAPIER UNIVERSITY, EDINBURGH, UK

This paper explores the nature of knowledge through a history of knowledge production in society. It emphasizes the modes of knowledge including explicit and tacit and argues for knowledge management and knowledge transfer as strategies to both codify explicit knowledge and extract and transfer tacit knowledge. One method that has been identified to encourage tacit knowledge transfer is communities of practice (CoPs). Further, the paper argues for ways in which the university as an institution and network of institutions may serve as a CoP knowledge hub in specific regions to foster new modes of knowledge transfer beyond traditional scientific means. The paper concludes with a preliminary proposal for this type of CoP in the Built Environment Exchange (beX) as a model for international university – industry knowledge transfer in the construction sector.
THE ENERGY EFFICIENCY PRIZE: SIMPLE DESIGN TO OVERCOME COMPLEX BARRIERS

MALINI SRIVASTAVA1, CHISTOFER NELSON1
‘CARNEGIE MELLON UNIVERSITY, PITTSBURGH, PENNSYLVANIA’
‘NORTH DAKOTA STATE UNIVERSITY, FARGO, NORTH DAKOTA’
‘GEORGETOWN UNIVERSITY, WASHINGTON, DC’

Due to the almost 40% share they have of all energy produced and 70% of all electricity produced and 38% share of all greenhouse gas emissions, the existing building stock needs immediate attention. Several studies identify the complexity and variability of conditions that cause the behavioral, financial and informational barriers preventing owners and occupants from adopting one-size-fits-all energy efficiency approaches despite the fact that these measures have cost-saving potential. Hirst and Brown coined the term “energy efficiency gap” and noted the failure of households, businesses, manufacturers and government agencies to take full advantage of cost-effective energy-conserving opportunities.

The Georgetown University Energy Prize (GUEP) was launched in 2014 and challenged cities and counties of populations ranging from 5,000 to 250,000 to reduce their energy use during a two-year competition period (2015-2016). The focus of the competition is on the reduction of municipal and residential building energy use by increasing energy efficiency. This makes it one of the largest national efforts to focus attention on closing the energy efficiency gap. The design strength of the competition is that it allows communities to create the approaches that best fit their needs in order to address one or more of these barriers.

This paper surveys public sources of information to identify the efforts that have been undertaken by the 50 semi-finalist cities. It further categorizes these efforts into three major typologies and several sub-typologies of energy-efficiency efforts. These typologies are sorted according to the hierarchy of rankings based on the GUEP dashboard providing a cluster visualization of impactful efforts.

The paper concludes with a discussion of typology combinations that appear to have the greatest utility in this preliminary study and outlines further research directions based on future data submitted by the actively participating cities.

WEATHER REPORT: STRUCTURING DATA EXPERIENCE IN THE BUILT ENVIRONMENT

MARC SWACKHAMER1, ANDREA J. JOHNSON1, DANIEL KEEFE1, SETH JOHNSON1, ROSS ALTHEIMER3, AARON WITTKAMPER4
‘SCHOOL OF ARCHITECTURE, UNIVERSITY OF MINNESOTA, MINNEAPOLIS, MINNESOTA’
‘DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING, UNIVERSITY OF MINNESOTA, MINNEAPOLIS, MINNESOTA’
‘Ten x Ten, Minneapolis, Minnesota’
‘Wittkamper / Reiff, Minneapolis, Minnesota’

With the influx of data into the everyday, users demand an interactivity that is localized and immediate, connected to and informed by exhaustive information across space, time, and discipline. As the data cloud burgeons through a plethora of types of inputs, designers grapple with frameworks for analysis and visualization, and the experience of interacting with information remains visually strapped to surfaces of digital display or pre-set as largely static objects. As the Internet of Things develops and the built environment becomes sensing and automated, the ability for all people to engage with, understand, and have a role in the complexity of data input and output requires a new paradigm for building, one in which data is an intelligible component of an environment that is continual, receptive, and communicative. This paper analyzes Weather Report, a constructed environment driven by user-informed data collaboratively designed by an interdisciplinary group of architects, landscape architects, and computer scientists. The aim of this paper is to discuss the assets and liabilities of a spatial data experience posed by the project, framed through questions of design agency related to data input, user interaction, and a plurality of design voices, and the implications of this innovative approach on broader practices. It suggests that a field we term “spatio-data design” might be an emergent area of study, where the built environment is as informed by the management and choreography of data as it is by the traditional assembly of physical materials and components.

USING IMMERSIVE ENVIRONMENTS TO EVALUATE MULTI-SENSORY RESPONSIVE SURFACES

MATTHEW WAGNER1, IVICA ICO BUKVIC1, DANE WEBSTER1
‘VIRGINIA TECH, BLACKSBURG, VIRGINIA’

Our research identifies purposeful uses for multi-sensory responsive surfaces. The premise of our research explores spatial typologies which we believe would benefit from
such surfaces. Digital fabrication tools and technology, as well as material characteristics and mechanisms, provide a strategic means for navigating the multitude of forces at play.

Serving as the activating link between material research and design innovation, the relationship between the designed object and the forces surrounding that object are always present, perceivable, and tactile. Both Programmatic as well as physical complexities guide the methodology of our design process, which progresses through a series of focused strategies. Through a specific disposition, we evaluate each responsive surface for performance potentials.

Our goal is to study the effects on how human behavior positively changes as a result of our multi-sensory responsive surfaces. Our responsive surfaces seek to reduce fatigue and distraction in both office environments (daylighting) as well as educational multi-use spaces (noise).

For interior performance and comfort in office environments, our responsive surface optimizes interior lighting levels by constant actuation. Each individual module is set with parameters controlling a mechanical curl ratio mandated by true material allowance uncovered through performative weather data and real-time lighting metrics. For educational multi-use spaces, our responsive surface optimizes interior environments by adapting to the changing reverberation rhythms of voices and footsteps. It can also be parametrically calibrated to a desired acoustic setting, which allows for increasing or decreasing acoustic dampening depending on the needs of the interior space and its occupants.

Additionally, our research is testing the capabilities of an augmented reality design tool, for real-time, immersive data visualization experiences within a virtual space. Through an immersive digital environment, we are able to view a digital prototype in a space at full size. The information visualized and collected assists in the design refinement of our digital prototype. The virtual environment provides a strategic understanding of how the responsive surface responds to multi-sensory input (proximity, light, and sound), as well as how it performs in various spaces.

**BUILDING PERFORMANCE ESTIMATION: FACADE VISUAL INFORMATION-DRIVEN BENCHMARK MODEL**

BINGYU WANG, JOON-HO CHOI, DOUGLAS NOBLE, MARC SCHILER, BHARAT PATEL

UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES, CALIFORNIA

The goal of this paper is to investigate and determine the significant impact of building facade information (i.e., basic facade features), as well as climatic impact, on building energy performance. Compared with these easily accessible facade features, parameters including envelope thermal properties, internal systems, and operating schedules are regulated by building codes and regulations, based on different building functionalities. Such facade parameters are variables that have large potential for affecting building energy performance. These attributes were extracted to conduct a data mining process to establish a correlation between building energy consumption and relevant physics information. Stepwise regression, and artificial neural network (ANN) are techniques used in this research. A facade visual information-driven benchmark model was developed as a building energy use intensity estimation baseline. Considering its comprehensive interpretation of variable variance and better predictive ability, it was proved that it is capable and feasible to use the facade visual information as the building key performance indicator, for estimating the building energy use, which is a fast and straightforward way to predict the energy use at urban scale. Traditional energy predictions, as a very complicated and time-consuming process, require multiple details and information about a building when preparing for energy modeling. Incorporating a transformative building energy performance estimation approach may enable stakeholders to easily assess their existing building energy consumption as well as establish a viable integrated energy master plan.

**INVESTIGATION OF THE RELATIONSHIP OF THE THERMAL COMFORT PERCEPTION BETWEEN THE LOCAL AND WHOLE BODY SEGMENTS IN A WORKPLACE ENVIRONMENT**

QI WANG, JOON-HO CHOI, MARC SCHILER, DOUGLAS NOBLE

UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES, CALIFORNIA

Traditional air-conditioning methods maintain temperatures in a whole room at a constant level, and much work has been done to assess and improve the thermal comfort and sensations of people in a workplace environment. This study endeavors to identify the relationship of the thermal comfort perception between the local and whole body segments in a workplace environment. A total of 20 human subjects were tested in the University of Southern California’s climate chamber to determine their physiological parameters and subjective perceptions of environment. Ambient temperature was documented during the tests, while the human subjects were exposed to a warm, cool, or neutral environment. Based on these tests, correlation and stepwise analysis are applied to identify the relative thermally sensitive skin areas, their contribution rate to the overall
thermal sensation, and potential skin area combinations that have high correlation with overall thermal sensation. Results show that local thermal sensations are high correlated with the overall thermal sensation, the thermal sensation of arm is particularly strongly correlated with the overall thermal sensation with the reference to the Pearson R value of 0.918. Besides, with different genders and BMIs, there exists a sensation difference even in the same environment temperature. The study also identifies the different impacts of local thermal sensation while predicting the overall thermal sensation by applying data driven model.

**LANGUAGE OF ARCHITECTURAL WOOD: WASTE TO ECOLOGICAL ABUNDANCE**

LEONARD YUI

The sustainable paradigm in architecture emphasizes concepts of conservation like limitation and efficiency, yet the ecological processes reveals a world founded upon abundance and functional complexities. Why are materials like urban wood waste treated so differently from those in the forest? This paper investigates the terms and narratives that have come to shape the language of wood used by the architectural profession (architectural wood) and forest scientists (ecological wood) and proposes a synthesis based on the concept that ecological benefits depend on an abundance of materials. The two perspectives about wood arise from distinct but related historical and contextual variables that reveal an opposition to one another. This raises questions about whether a designer can realize deeper ecological solutions while maintaining current constructs of architecture. The research in architectural wood looks to contemporary construction methods as well as the historical evolution from the forest to human product. The investigation shows how architectural thinking favors the structural language of “strength” and “efficiency,” as well as the avoidance of key ecological functions prevalent through terms such as “pests” and “decay.” Materials are favored for their linear and human functions, and once exhausted, are discarded and removed from the architectural process. Ecological wood is defined by forest science research in coarse woody debris. The research in ecological wood revealed concepts of redundancy and terms associated with decomposition, disturbance and legacies. These processes are favored by a multitude of species for their complex latent properties and serve various ecological roles simultaneously. The fundamental differences in language reveals deep barriers that may discourage ecological collaborations. The conclusion proposes to elevate the concept of ecological abundance by responding to architectural design gaps revealed through ecological research. The response aims to construct and prepare a more collaborative design language between designers and scientists.

**VISUAL QUALITIES AND PERCEIVED THERMAL COMFORT-RESULTS OF SURVEY STUDIES IN A LEED PLATINUM OFFICE BUILDING**

AMIR H ZARRABI, MONA AZARBAYJANI, JULIA DAY, ELIZABETH THARIYAN, ELIZABETH STEARNS, BRENT RUP DALE

UNIVERSITY OF NORTH CAROLINA, CHARLOTTE, NORTH CAROLINA

KANSAS STATE UNIVERSITY, MANHATTAN, KANSAS

This contribution was solely written by students and/or doctoral candidates.

Occupants are exposed to various interlinked environmental factors in office spaces. Office spaces have visual qualities, spatial characteristics, and building features that can have a significant impact on their overall perceived comfort and perceived thermal comfort. The analysis used subjective responses from 500 occupants collected from an energy efficient LEED platinum building in Charlotte, North Carolina. The survey addressed visual qualities of IEQ factors (View satisfaction, Natural daylighting, Quality of lighting, and. Based on the occupant survey, empirical analyses have examined the effects and interactions of Indoor Environmental factors (such as thermal, visual and the ability of control) on occupant perceptions. This evaluation was executed in different personal attributions, spatial locations, and configurations (classified by different floors, office layouts, distance to windows and cardinal directions) of their workspace. The results indicated that the pleasant visual qualities could positively impact the perception of thermal comfort, even when other measured visual or thermal comfort problems existed. Enhancing visual comfort (lighting and view) can improve occupants’ perception of thermal satisfaction indirectly and may provide better indoor conditions in office buildings. The study implies that occupant surveys can offer a systematic measure for evaluating office spaces to enhance the perceived comfort.
PLACE-BOUND RELATIONSHIP: THE MISSING COMPONENTS IN THE NEW SOCIALIST COUNTRYSIDE

WEI ZHAO
UNIVERSITY OF UTAH, SALT LAKE CITY, UT

In 2006, China’s central authority released a new policy calling for “Building a New Socialist Countryside.” This policy embraces a set of ideas that aim to boost modern agriculture, increase rural affluence, advance infrastructure construction, and improve public services and democracy. The local practice, however, turns this broad concept into a ground up rebuilding of a new countryside where rows of identical apartment buildings rapidly emerge in rural China. Meanwhile, rural residents are relocated to new settlements and historical and vernacular houses are demolished. Using Yanxia village in Zhejiang Province as a case study, this paper examines the local deployment of this policy. Drawing upon archival research and ethnographic fieldwork, this paper argues that the newly constructed settlement fails to provide a satisfactory home environment for the local residents because of its detachment from the existing cultural landscape. This detachment fundamentally breaches the place-bound relationship between the residents and the vernacular settlement, which is essential in constructing the meaning of home for residents of Yanxia.

DEVELOPING DATA-DRIVEN APPROACH FOR OCCUPANTS-BASED ENVIRONMENTAL CONTROL

CHEN ZHONG, JOON-HO CHOI, MARC SCHILER
UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES, CALIFORNIA

The design and operation of building systems frequently face a conflict goals between providing acceptable thermal comfort conditions and reducing building system’s relevant energy consumption. Integrating individually different occupants’ thermal comfort preferences into the building thermal environment control strategy has high potential to contribute to overcoming this conflict issue. Therefore, the goal of this study was to develop an intelligent control algorithm to maximize energy conservation efficiency while enhancing the occupants’ thermal comfort and satisfactions. Considering individual occupants’ different thermal preferences, two occupancy conditions were selected in this study: single-occupancy condition (SOC) and multi-occupancy condition (MOC). The control logic is different between SOC and MOC, but the control for SOC can be adopted as the fundamental principle of the multi-occupancy condition. The SOC experiments were conducted to survey subjects’ thermal preference pattern while the thermal environmental conditions changed from 18 ºC to 30 ºC in the climate chamber. Meanwhile, subjects’ physical parameters were collected by heart rate sensors and survey forms to confirm the correlation between the indoor thermal condition and subjects’ individual features. With the consideration of real-time environment conditions and human individual features (such as gender, BMI, and heart rate), subject’s individual thermal preference pattern were captured and learned by machine learning algorithm. The occupants’ thermal comfort preference under different environmental condition can be predicted by the developed machine learning algorithm. Based on individuals’ thermal preference pattern, Overall Thermal Dissatisfied (OTD) index was developed to determine the optimal set point temperature for minimizing the overall thermal dissatisfactions. The study result revealed the energy conservation potential up to 42% savings while significantly increased occupants’ thermal comfort in a workplace environment.
DEAN'S WELCOME

It is my pleasure to welcome you to the University of Utah’s College of Architecture + Planning where we are leading innovation in how we educate students in the rapidly changing professions of architecture, design and planning. Whether it be our Multi-disciplinary Design students designing medical carts that reduce medical errors, or Architecture students designing and building sustainable cabins for the Girl Scouts, or City and Metropolitan Planning students leading campus sustainability efforts, our graduates emerge with a sense that they must be creative, critical and caring in all that they do. We do so rooted in four commitments:

Responsibility: A responsibility to past, present and future generations for the sustainability of our creative expressions that reallocate natural resources
Resilience: A systemic understanding that polycultures and diversity nurture greater ecological and community resilience
Respect: A respect for the health and culture of all places
Response: The demand to respond to the grand challenges of our time through innovative and collaborative modes of practice that demonstrate our commitment to excellence and quality

These four commitments are game-changers that suggest that care is the ethical imperative of our professions demanding new modes of thinking and doing to transform the world into a better place. We believe in the inspirational quality of both evidence and empathy; we believe in creative play rooted in curiosity; we believe in the necessity of symphony, the power of story and the criticality of meaning. Quite simply, this is a special place at a special time where there is a convergence of faculty, students and professional communities that seek positive, transformative change. We are a community that lives by the saying "be the change you wish to see." This is the Utah School and we sincerely hope you come and join us...to make a difference.

Sincerely,
Keith Diaz Moore, Dean
College of Architecture + Planning

OUR MISSION

The mission of the College of Architecture + Planning is to nurture a culture of discovery, design and innovation in our designed world rooted in an ethic of care, community and commitment. Our efforts will be the spark for positive transformation in our designed world to promote the health and well-being of our society and environment through research, community engagement and educational experiences shaped to nurture the agile, inventive minds necessary to address global challenges that are yet unknown.

OUR COMMUNITY

The College of Architecture + Planning at the University of Utah is a community of award-winning and highly recognized set of faculty, entrepreneurial students and supportive staff which together create a creative community unlike any other. Structurally, the College is made up of the School of Architecture, the Department of City and Metropolitan Planning and the fledgling Multi-disciplinary Design program. We are also home to three research centers: the Ecological Planning Center, the Integrated Technology in Architecture Center, and the Metropolitan Research Center. I hope you will explore our College and see how you might join us...to make a difference.
KIOSK PARKING PAY LOT
Patrolled Monday-Friday 7am-10pm
$2.00 per hour; $20.00 daily maximum
• The Business Pay Lot features kiosks that function as the point of contact for purchasing and validating parking.
• Customers purchase their desired time through the kiosk using their vehicle’s license plate and credit card.
• Kiosks work similar to a parking meter. Payment or a validation must be made to initiate a parking session, not when leaving the pay lot.
• Vehicles parked in a pay lot with no valid form of payment will be ticketed.
• The kiosk system allows you to be notified when parking is going to expire and give you the option to add time from your mobile device.

ENTRANCE TICKET PAY LOT
Patrolled Monday-Friday 7am-10pm
0-15 minutes - Free
16-30 minutes - $1.00
31-60 minutes - additional $2.00
Each additional half hour - $1.00
$20 daily maximum
The Bookstore pay lot dispenses a ticket upon entry, which you will pay at booth upon exit. Cash and credit cards are accepted.

PAY-BY-PHONE METERS
Patrolled from 8am-8pm
$2.00 per hour
https://paybyphone.com/how-it-works
1. Download the App, visit the mobile site, or call the number posted on signage.
   Phone numbers, website information, and a QR code for Pay-By-Phone meters are displayed on parking meters and signs.
2. Respond to the prompts.
   Existing users will be prompted to enter the 5 digit location number, stall number, and parking time. New users will be guided through a registration process.
3. Wait to confirm parking time started.
   Once you have received confirmation your parking has started you may leave your vehicle.
4. Extend parking anytime.
   Extension is possible at any time. Simply pull up the App, website, or call the number you initially dialed. Your account or number will be recognized and you can extend parking time from your meeting or classroom.

A service charge of $.25 or $.35 will be charged in addition to the parking rate.
CUCINA TOSCANA - DINNER DOWNTOWN (282 SOUTH 300 WEST)

The Trax Line is the best route to get to Cucina Toscana from campus. Get on the 703-Red Line Train (Heading West) at the University South Campus Station (see map above). Exit at the Courthouse Station and transfer to the 701-Blue Line Train (Heading North). Exit at the Planetarium Station. Walk South on 400 W. Turn left on Pierpont Ave. Turn right on 300 West. Cucina Toscana is located on the west side of the street.

TRAX STATION MAP

WALKING PATH FROM PLANETARIUM STATION
## SALT LAKE CITY

A few of our favorite establishments in Salt Lake City and the best ways to get there.

### COFFEE & PASTRIES

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
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<tbody>
<tr>
<td>Publik</td>
<td>975 S. West Temple, 502 Third Avenue</td>
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<tr>
<td>Tullie Bakery</td>
<td>863 East 700 South</td>
</tr>
<tr>
<td>The Rose Establishment</td>
<td>235 South 400 West</td>
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<tr>
<td>Three Pines</td>
<td>163 Main Street</td>
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<tr>
<td>La Barba</td>
<td>327 West 200 South</td>
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<tr>
<td>Blue Copper Coffee Room</td>
<td>179 West 900 South</td>
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<td>Les Madeleines</td>
<td>216 East 500 South</td>
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### BEER & COCKTAILS

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<td>Under Current Bar</td>
<td>279 South 300 East</td>
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<td>Water Witch</td>
<td>163 West 900 South</td>
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<tr>
<td>Bar X</td>
<td>155 East 200 South</td>
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<td>Beer Bar</td>
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<td>Copper Common</td>
<td>111 East Broadway</td>
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<tr>
<td>Proper Brewing Co.</td>
<td>857 South Main Street</td>
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<tr>
<td>Fisher Brewing Co.</td>
<td>320 West 800 South</td>
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### RESTAURANTS

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<tr>
<td>Copper Onion</td>
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<td>Em’s</td>
<td>271 North Center Street</td>
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<td>La Bag Kitchen</td>
<td>912 Jefferson Street</td>
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<td>Liberty Tap House</td>
<td>850 East 900 South</td>
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<td>Manoli’s</td>
<td>401 East 900 South</td>
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<td>Mazza</td>
<td>1515 South 1500 East</td>
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<tr>
<td>Pago</td>
<td>878 South 900 East</td>
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<tr>
<td>Pizza Nono</td>
<td>925 East 900 South</td>
</tr>
<tr>
<td>Proper Burger Co.</td>
<td>865 South Main Street</td>
</tr>
<tr>
<td>Trestle Tavern</td>
<td>1513 South 1500 East</td>
</tr>
</tbody>
</table>

### TRANSPORTATION

The city is easily accessible via the light-rail system TRAX, bus, Lyft, or Uber.

### GALLERIES & MUSEUMS

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
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<tbody>
<tr>
<td>Natural History Museum of Utah</td>
<td>301 Wakara Way</td>
</tr>
<tr>
<td>Utah Museum of Contemporary Art</td>
<td>20 South West Temple</td>
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<tr>
<td>CUAC</td>
<td>175 East 200 South</td>
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<tr>
<td>The Leonardo</td>
<td>209 East 500 South</td>
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<td>Gilgal Gardens</td>
<td>749 East 500 South</td>
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