MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ARCHITECTURE

GRADUATE SEMINARS BS501 - BS601

2023-2024 FALL SEMESTER
JANUARY 17, 2024 | 08.40 - 12.40 | @KUBBEALTI

Coordinators: Mehmet Koray Pekeriçli

Meeting ID: 264 922 592 023
Passcode: znbim6

(Microsoft Teams will be used.)

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January 17, 2024 8:40-12:40

Kubbealtı

Online Live Broadcast on MS Teams

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Meeting URL: CLICK HERE

January 17, 2023 Wednesday
BS 501 SEMINAR IN BUILDING SCIENCE

Coordinator: Mehmet Koray Pekeriçli

8:40 – 9:00

Aslıhan Şener — Comparative Energy Performance Analysis of Electrochromic and Conventional Glazing Types by Varied Facade Orientations of Office Buildings in Different Climates

Supervisor: Ayşem Berrin Çakmaklı
Jury: Mehmet Koray Pekeriçli, Sevil Funda Ataylar

In light of the energy crisis, population growth, urbanization, and environmental pollution, the demand for rational energy use has become crucial. Buildings, particularly office buildings with their extensive use of glass facades, consume a significant portion of the world's energy sources. This is largely due to their envelopes, where the choice of glazing plays a critical role. Therefore, optimizing building facades, especially in office buildings is vital in achieving energy efficiency and improving indoor comfort. Conventional glazing types, while standard, often fall short in dynamically responding to changing environmental conditions, leading to increased energy demands. In contrast, electrochromic (EC) window systems have emerged as innovative solutions, offering the ability to dynamically adjust their optical properties based on sunlight and cloud conditions. These systems meet the needs of solar control, thermal insulation, and natural lighting according to weather conditions while also ensuring thermal and visual comfort.

This study aims to evaluate and compare the energy performance of electrochromic windows on different facade orientations of an office building with various conventional glass types in different climatic zones. It focuses on heating, cooling, and lighting loads, along with the energy consumption of the electrochromic glass, aiming to identify the most energy-efficient solution for each orientation. The findings will be used to make decisions related to the selection of glazing systems for different orientations in different climatic zones, considering the specific energy performance, visual comfort, and daylight utilization requirements of an office building.

Keywords: Electrochromic Glazing, Glazing Performance, Comperative Building Energy Analysis, Energy Efficiency in Office Buildings, Solar Control

9:00 – 9:20

Parisa Jafaripourbaghali — Beyond Roads and Buildings: Adapting Automotive Strategies to Construction

Supervisor: Mehmet Koray Pekeriçli
Jury: Arzu Gönenç Sorguç, Ayşem Berrin Çakmaklı

The construction sector holds significant economic importance, but it faces challenges related to inefficiencies and low productivity. Despite considerable technological advancements across various industries, particularly in the automotive sector, the construction industry often prefers traditional approaches over mass production and prefabrication by new technologies. Examining the success of the automotive industry in mass production and prefabrication, this study seeks innovative solutions to construction challenges related to prefabrication.

The research addresses the limited understanding of integrating modern technologies from industries like automotive into construction practices. With the slow adoption of prefabrication and modularization in construction, the study aims to uncover hindrances and apply lessons from the automotive sector. Objectives involve identifying key success factors in the automotive industry's use of prefabrication and modularization and assessing the current state of adoption and challenges in construction. Utilizing a mixed-methods approach, the research encompasses a thorough literature review, industry reports, and primary data collection through surveys and interviews with construction professionals. Ultimately, the anticipated findings aim to provide solutions for obstacles and support the widespread integration of prefabrication and modularization in construction.

Keywords: Construction Industry, Mass Production, Automation, Prefabrication, Modularization.

9:20 – 9:40

Özge Demirci — Mycelium Composite Materials: Fabrication and Applicability in the Built Environment

Supervisor: Ali Murat Tanyer
Jury: Ayşe Duman, Arzu Gönenç Sorguç

Environmental issues due to excessive resource usage and discarding the materials at their end-of-life phases have moved sectors to implement closed-loop strategies and look for alternative sources. The constructed environment has a notable share in this resource and energy usage. Therefore, the construction industry is experiencing a paradigm shift towards bio-fabrication and bio-materials that promise biodegradability, biological growth, sustainability, and low cost. Being one of the alternative biological sources, mycelium has gained more importance over the years. Mycelium composites have various applications in buildings, such as insulation panels, acoustic foams, and floorings. The individual studies related to mechanical properties and usages of mycelium composites have different experimental approaches which makes standard production in industrial scale and applicability difficult. For this reason, despite their wide range of applications, their fabrication and applicability still require further research before incorporating them into our lives. This study aims to propose an alternative solution to these problems with a novel fabrication process, selection of substrates and mycelium species with an investigation of their applicability in the construction industry. Guided by the exploration motivation across

disciplines, the study plans to provide fabrication and application possibilities from bioengineering, material engineering, digital fabrication, and architectural perspectives.

Keywords: Mycelium, Mycelium Composites, Digital Fabrication, Bio-Materials, Bio-Fabrication

9:40 – 10:00

Begüm Şener – Timber Construction Hands-on Training supported by Virtual Reality

Supervisor: Ayşe Duman
Jury: Özlem Karakul Türk, Refik Toksöz

The main target is to provide an active and experiential learning medium for training timber construction masters and designers by benefitting from the constructivist approach. That can be achieved by interactive virtual learning. Adapting such innovative approaches to training and learning in technical and vocational education and training (TVET) can be a promising step in rehabilitating the weaknesses in the professional education and professional competence of technicians, masters, and designers. The study is shaped to discover the potentials and limitations of an interactive virtual learning medium targeting the combined use of active and experiential learning media with a constructivist approach in training timber construction masters and designers. The other target is the performance assessment in the virtual environment of that virtual learning tool developed in the study. The data obtained during the testing periods of all stages of virtual learning medium development and assessment will establish the feedback and background knowledge. Their joint interpretation is expected to be guiding in enhancing innovative training approaches. the advance in professional competence particularly in timber construction mastership and design, has vital importance to provide the survival of traditional timber framed housing technology and sustain the timber construction technological culture developed in Anatolia.

Keywords: Interactive virtual learning, Technical and vocational education and training, Traditional timber construction, Virtual reality, Cultural heritage

10:00 – 10:20

Alp Giray Köse — Wind Allocation between the Urban Environment and Buildings to Increase Air Quality and Regulate Environmental Temperature with Kinetic Facades

Supervisor: Mehmet Koray Pekeriçli
Jury: Ayşem Berrin Çakmaklı, Zühre Sü Gül

Air quality and environmental temperature are crucial for human health and productivity. For this reason, people try to control these parameters in their living environment. Although there are multiple systems as a solution for controlling these parameters indoors, these solutions can cause other problems that adversely affect the urban layout, such as the increased urban heat island effect. This is also valid for urban solutions to air pollution and the urban heat island effect. For example, vegetating a street decreases the UHI effect but negatively affects air quality.

There might be a better mutualistic solution for solving problems for both urban and indoor scales. Increased wind flow can solve both indoor and outdoor air pollution and overheating problems. With the help of new technologies, data can be collected, and the kinetic built environment can be shaped according to the needs of the built environment. That is where smart cities and buildings started to emerge, but today, there is little to no communication between them. Wind allocation with kinetic facades can be the link to combine these two concepts to achieve better air quality and environmental temperature. The kinetic facade can control the wind flow, decide where the wind is needed to increase the air quality and arrange the environmental temperature from both scales.

Keywords: Air Quality, Environmental Temperature, Kinetic Facades, Wind Allocation, Urban Design, Smart Building, Smart Cities

10:20 – 10:40

Bade Eloğlu — Enhancing Pedestrian Mobility in Built Environments: Improving Pedestrian Footbridge Design Frameworks Via Machine Learning

Supervisor: Arzu Gönenç Sorguç
Jury: Mehmet Koray Pekeriçli, Müge Kruşa Yemişçioğlu

Constant changes in built environments result in new urban demands to emerge. In the face of the changes, it is the architects' responsibility to respond to the new demands. However, it is challenging to fulfill this aim, particularly in cases where the built environment's infrastructure is insufficient. This challenge is manifested within built environments by the proliferation of ad hoc solutions, mainly at the urban furniture scale. Pedestrian footbridges are one of the most encountered ad hoc solutions in this context. The harmonic integrity of pedestrian footbridges built with this approach within their environments fails, leading pedestrians to not fully embrace the structures.

This research aims to improve pedestrian footbridges' design frameworks and prevent them from transforming into psychological and physical barriers for pedestrians using machine learning models. It intends to use machine learning tools to assist architects by defining a generative design process.

To achieve the research goals, the features to be improved in pedestrian footbridges are identified based on structure examples and literature reviews. Later, a three-stage machine learning process is applied to the dataset created from pedestrian footbridge images. In the first stage, the data set is divided into "satisfactory" and "unsatisfactory" samples, depending on the presence of desired features, using object detection tools. Later, the groups are given to a CNN model as inputs to enhance accuracy in image classification. Then, the CNN output is used as input data for a GAN model that generates design proposals and high-quality pedestrian footbridge images.

Keywords: Pedestrian Footbridge, Pedestrian Mobility, Changing Built Environments, Ad Hoc Architectural Solutions, Generative Design

10:40 – 11:00

Gülşah Doğan Karaman — A Systematic Literature Review on Biomimetic Water Harvesting in the Discipline of Architecture: State of the Art and Future Perspectives

Supervisor: Arzu Gönenç Sorguç
Jury: Müge Kruşa Yemişçioğlu, Semra Selçuk Arslan

The primary definition of biomimicry as a scientific discipline is the application of natural elements, systems, and models to solve design issues. The biomimicry approach has led to the development of fresh and innovative solutions for challenges in the architectural field. Nature is employed as a variety of data sources in the design that are based on this approach, and these data are then transferred to different materials, structures, functions, and processes. This work aims to investigate the evolution of biomimicry as an architectural methodology accompanied by a bibliometric analysis of studies concerning biomimicry and water harvesting. This study aims to highlight the significance of biomimicry in architecture. The publications from 2002 to 2023 that were published in the Web of Science (WOS) database were analyzed in the study. The software programs SankeyMATIC and VOSviewer were utilized to graph the analysis results. By examining ten sources from the field of architecture identified in the data, a framework for water harvesting and biomimicry was created with BIOGEN methodology, and pinnacles were examined. If there are architectural structures within these examples, they are examined. This work can be used as a guide for upcoming research to apply nature as a server to architecture to address the issue of water harvesting in the built environment.

Keywords: Water Harvesting; Biomimicry; Bibliometric Analysis; Architecture

11:00 – 11:20

Emire Nur Solmaz — Close–Packed Masonry Wall Generation via Deep Reinforcement Learning and Robotics

Supervisor: Arzu Gönenç Sorguç
Jury: Mehmet Koray Pekeriçli, Müge Kruşa Yemişçioğlu

Generating a form of a structure is one of the fundamental problems. The structure can be composed of different types of units. The properties of those elements may also differ. The system of the structure should follow a pattern. This pattern needs a certain rule in order to have a consistent result for each time. A masonry wall of close-packed elements will be investigated in this study. The aim is to reduce the gap and combine irregular elements in the most feasible way. Concerning this, an algorithm that arranges pieces according to their edge lengths will be proposed. Moreover, robotics is a developing field that supports humans in a variety of areas. Construction is among these areas. Thus, the construction of the close-packed pattern will be produced through robotics. Transferring the information to the robot is a crucial subject. Deep reinforcement learning is generally used for this task. Apart from that simulation environments are used for performing the experiments beforehand in order to adjust lacking parts. Grasping is an important feature for this task since it is based on a pick-and-place situation. Robots should be able to differentiate each object and place them accordingly. It is possible to have a close-packed masonry wall by using deep reinforcement learning and robotics with a pattern-generating system based on irregular shapes.

Keywords: Robotics, Deep Reinforcement Learning, Irregular Object Stacking, Close Packed Structures, Masonry Wall Pattern

11:20 – 11:40

Dilara Ayşegül Köse — Assessing Optimal Design Scenarios in Floating Architecture for Turkey: Mitigating the Impacts of Climate Change and Natural Disasters

Supervisor: Ayşem Berrin Çakmaklı
Jury: Soofia Tahira Elias Özkan, Funda Baş Bütüner

As the world's population continues to grow, the destruction of green areas is increasing, aggravating the effects of climate change. Climate change impacts human systems and ecosystems, including extreme weather events, floods, droughts, glacier retreats, loss of species, ocean acidification, and more. Among these impacts, rising sea levels are one of the most devastating effects of climate change. Sea levels will rise to unacceptably high levels between 2040 and 2050. The rise in sea level poses various challenges for countries, including land submergence, displacement of maritime borders, potential economic losses, and millions of people being at risk of becoming climate refugees. Therefore, to adapt to rising sea levels and climate change, we must consider cities built on the sea as an innovative solution.

Floating architecture is considered a new and sustainable solution for rising sea levels. The concept of floating architecture was created in 1960 by Kenzo Tange. Constructing on water bodies also provides various benefits, such as more green space on land and a potential solution for natural disasters such as earthquakes. Floating architecture considers multiple subheadings such as urban design approaches, functions, energy sources, platform and connection types, materials, agriculture possibilities, desalination ways, transportation, and expansion possibilities. This study will examine the design consideration subheadings of floating architecture and determine the most sustainable design scenario for Turkey's marine boundaries.

Keywords: Floating Architecture, Climate Change, Sustainable Design, Floating Cities, Design Guidelines

11:40 – 12:00

Çağatay Toprak — Mobile Architecture: As a Viable Alternative to Student Housing

Supervisor: Soofia Tahira Elias Özkan

Jury: Ayşem Berrin Çakmaklı, Ayşegül Tereci

The accessibility to housing is an attention-deserving issue as of today, the problem can be observed to be widespread across the globe as the rate of house ownership is decreasing. This issue is also relevant in student housing, especially in Turkey after the 2020 Covid-19 outbreak, with the a lot of student dormitories had to be utilized for quarantine purposes and even in the aftermath of the virus, in various regions of the country, many students struggle to find dormitories simply due to lack of sufficient quantity in student housing. This study aims to provide a viable alternative of mobile architecture in the form of container housing to the shortage of student accommodation. As Mobile/Tiny houses offer adaptability, de-mountability and ease of installation, they can provide the flexibility to accommodate the needs of particular groups and locations. Within this study, the shortcomings of both traditional student housing and mobile architecture will be analysed through user-reviews to get an insight into the lacking components in such cases. The research aims to provide a system of units that can answer the demand by also bringing design solutions to issues of internal comfort and privacy, which are some of the more important concerns with such cases of architectural design. The study is ultimately aimed to be a guideline, a framework for settlement and infrastructure, not a design by itself in order to answer for the lack of quantity in the field.

Keywords: Mobile Architecture, Container, Student Housing, Housing Infrastructure, Framework

12:00 – 12:20

Bengi Bayar — Architectural and Engineering Considerations in Lunar Habitats

Supervisor: Soofia Tahira Elias Özkan

Jury: Bekir Özer Ay, Ayşegül Tereci

This study attempts to form a guideline for the design of extraterrestrial habitats for designers and engineers. The study aims to work on the habitat necessities brought about by the extreme conditions on other celestial bodies.

It is clear that the next step in humanity’s exploration through space is to set foot on other planets and the interest for space colonization is growing among people. However, due to the nascent nature of the subject, limited research exists on what these habitats should provide as a shelter for humans and in what amount. To continue the study by proposing a solution to these problems, the environmental conditions of other bodies will be investigated, and an elaborate guideline will be created to help designers and engineers working on extraterrestrial habitats make decisions. In this way, it is planned to provide a clearer pathway for future researchers working on the design of extraterrestrial habitats and facilitate future research by providing a solid basis and making the exploration and development of extraterrestrial habitats more accessible.

Keywords: Space Architecture, Habitat Design, Lunar Habitat, Mars Habitat, Space Settlement, Space Structures

12:20 – 12:40

Ceren Gül Sungun — Kitchen Shaft Orientation Prioritizing Natural Ventilation in High-Rise Residential Apartments

Supervisor: Soofia Tahira Elias Özkan

Jury: Ayşem Berrin Çakmaklı, Nastaran Deljavan

Apartment shafts take advantage of the principle of natural convection of fluids, where the rising warm air plays a role.In winter, polluted air is transported through vertical shafts in high-rise residential buildings by buoyancy forces. Different stories that are connected with a singular vertical shaft in a multiple-story building are affected by different levels of buoyant forces. Varied buoyant forces lead to infiltration on lower floors and exfiltration on upper floors. In high-rise residential buildings, ventilation of polluted air -smoke, heat, vapor, or contaminants, from lower floors through vertical shafts results in the transport of air pollutants to upper flats above the neutral plane.

The subject of this research is inter-floor transportation of polluted air in kitchens of high-rise residential buildings. It aims to investigate using horizontal ventilation shafts instead of vertical ones to prevent inter-floor air transportation and planning these shafts regarding the prevailing wind direction, thereby reducing the necessity for mechanical ventilation.

Within the scope of this study, the investigation focused on studying the airflow orientation and employing Computational Fluid Dynamics (CFD) simulation programs. The data obtained is hoped to contribute to an effective kitchen ventilation design that prioritizes natural ventilation without causing side effects on other floors in the high-rise apartment building.

Keywords: Apartment Ventilation, Stack Effect, Wind-Induced Ventilation, Residential Kitchen, CFD Simulation