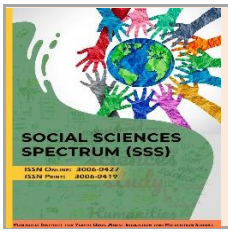


Social Sciences Spectrum

A Double-Blind, Peer-Reviewed, HEC recognized Y-category Research Journal

E-ISSN: 3006-0427 **P-ISSN:** 3006-0419
Volume 04, **Issue** 03, 2025
Web link:https://sss.org.pk/index.php/sss

Modular Outdoor Seating for Public Well-being: A Design-Led Approach to Sustainable and Flexible Urban Furniture

Mona Gulzar
Assistant Professor, Department of Product and Industrial Design, University of Engineering and Technology, Lahore, Punjab, Pakistan
Correspondence Author: mona.gulzar@uet.edu.pk

Iqra Muqadas
Sr. CG Artist, Department of Product and Industrial Design, University of Engineering and Technology, Lahore, Punjab, Pakistan

Nimra Amjad
User Experience Designer, Department of Product and Industrial Design, University of Engineering and Technology, Lahore, Punjab, Pakistan

Article Information [YY-MM-DD]

Received 2025-05-08 **Accepted** 2025-07-22

Citation (APA):

Gulzar, M., Muqadas, I & Amjad, N. (2025). Modular outdoor seating for public well-being: A design-led approach to sustainable and flexible urban furniture. *Social Sciences Spectrum*, *4*(3), 34-51. https://doi.org/10.71085/sss.04.03.316

Abstract

Keeping in mind, the fast pace urbanizations and environmental challenges, need of sustainability in public furniture must be addressed while enhancing social and emotional well-being. This paper is designed to address the approach to prioritize sustainability, flexibility, and emotional durability. Grounded in universal design principles (Carmona, 2010), landscape integration (Gehl, 2010), and emotional durability (Chapman, Emotionally Durable Design, 2015), the study proposes a methodology for creating adaptable, inclusive, and environmentally responsible urban furniture.

The design accommodates diverse demographics through multi-height modules, intuitive configurations, and aesthetic adaptability (Zhang, 2024), contributing to both functional and therapeutic outcomes in public environments (Gardner, 2018).

Keywords: Modular Design, Outdoor Seating, Public Well-Being, Sustainable Urban Furniture, Flexible Systems, Universal Design, Emotional Durability, Geopolymer Material, Ergonomic Design, Landscape Integration.

Introduction

Urbanization has driven the urgent need for well-designed public spaces that foster community interaction and emotional restoration (Oihane Gómez-Carmona, 2019). Parks, plazas, and recreational areas are vital elements of urban life, improving both individual health and collective well-being (AlWaer, 2021). However, the absence of flexible, user-centric furniture in many urban environments has limited the effectiveness of these spaces (Mulyono, 2017). This research of Modular seating solutions, inspired by universal design standards (Gehl, 2010), have emerged as a dynamic tool to support a diversity of activities, ranging from resting and socializing to digital engagement (Tovar E., 2025). This research focuses on developing a modular outdoor seating system that responds to functional needs, promotes landscape integration (Radwan, 2017), and contributes to emotional resilience (Gao, 2022).

Literature Review

I. Urban Furniture & Emotional Durability:

Chapman's theory of emotionally durable (Gao, 2022) design emphasizes extending a product's meaningful lifespan to reduce consumption and environmental impact (Chapman, Emotionally Durable Design, 2015). This philosophy informs the development of seating units that users can emotionally connect with through visual familiarity, tactile comfort, and spatial flexibility (Urbaniture, 2024).

II. Modular Design Principles:

Modularity enables public seating to adapt to varying social, cultural, and contextual needs (Tovar E., 2025) (Sanches, 2010). Studies in Hong Kong have demonstrated that adaptive furniture enhances user engagement in urban settings, allowing spaces to evolve with minimal environmental impact (Zhang, 2024) (Main, 2010).

III. Landscape and Ergonomics:

Designing with landscape integration creates holistic experiences (Gehl, 2010). Furniture should complement natural environments while adhering to ergonomic standards (Appolloni L, 2020) that cater to a broad user base, including children, the elderly, and individuals with disabilities (Liu, 2022).

Research Methodology

This study is carried out on basses of a design-led qualitative methodology, merging principles from environmental psychology (Ackerman, 2018), sustainable design (Greenfield, 2023), and inclusive ergonomics (Council, 2000) (Harmon, 2025). The basis of the research lies in theory of emotional durability (Chapman, Emotionally Durable Design, 2015), ensures long-term emotional connections are more likely to be preserved and reused, thus reducing environmental degradation. Moreover, the study shows landscape design principles as stated by (Gehl, 2010), standing for spatial arrangements that support restorative and community-oriented experiences. The methodology was also informed by universal design frameworks (Carmona, 2010), which stress accessibility and inclusivity as central tenets of public infrastructure.

A multi-scalar process was adopted, beginning with contextual research on urban green spaces, followed by behavioral mapping of public seating usage in high-density zones (Ghassemi, 2016). Material experimentation played a significant role, particularly with geopolymer concrete derived from fly ash and eggshell waste, emphasizing the environmental sustainability aspect of the design. Participatory design strategies, including user interviews and expert consultations, were conducted

to ensure responsiveness to emotional and physical needs. Iterative prototyping allowed for continuous refinement, focusing on configurations that address varied anthropometric requirements. The process emphasized emotional resilience (Gao, 2022), user comfort (Carlos Mena, 2014), and aesthetic integration, positioning the final modular seating system as both a social and environmental asset in urban contexts.

Studying different conditions of open green spaces, multi-functionality and anthropometry to the targeted audience (Carlos Mena, 2014).” The design factors of the urban furniture include color, harmony with the environment, shape, form, ergonomics and its convenience, has had the highest impact on the citizens’ perceptive” (Ghassemi, 2016).

Formulating a solution to address the problems observed in the field through a design concept and applying it in the design alternatives. The module design must be formed together with the formulation of concept so that in the design process, the representation of design would become more distinct” (Kevin Norbert Otto, 2001).

Selecting the most appropriate design from the design alternatives according to the needs and the production process. The molding technique, volume and weight were calculated in order to create the flexibility of modular design. From that calculation, the design form was again adapted. A scaled mock-up was produced to form and test the modular system” (Abdul Munaf Shaik, 2015).

In the production process, the researchers explored the material mixture, as well as the molding and finishing techniques that could be used. Through the application of the selected module, feedbacks were drawn in order to evaluate its effectiveness in answering the design objectives and problems determined prior to the design process.

Design Objectives

The design objectives were framed to address both the functional and psychosocial dimensions of outdoor public seating. Central to this was the aim of creating a modular system that could adapt to a variety of outdoor environments and user demographics. The system was envisioned as one that would go beyond static functionality to encourage social interaction, comfort, and prolonged emotional engagement. Visual aesthetics were deliberately considered not only to ensure harmony with the surrounding landscape but also to foster psychological comfort through familiar forms and textures, aligning with findings by (Gao, 2022) and (urbanitureai, 2024) on spatial familiarity and emotional response.

Ergonomic considerations were informed by anthropometric research (Appolloni, 2020), ensuring that both children and older adults could comfortably use the furniture. The design sought to encourage emotional attachment through customizable modular arrangements that allow users to personalize their space—a key aspect of (Chapman, Emotionally Durable Design, 2015) durability theory. The incorporation of environmentally conscious materials such as lightweight geopolymer concrete contributed to long-term sustainability while also ensuring structural integrity in various climates. Thus, the design aimed not only to meet current functional demands but also to support the evolving needs of urban populations, particularly in high-stress environments where public well-being is a growing concern (carmona, 2019) (AlWear, 2021).

Case Studies:

Being more specific in qualitative research different platforms were used:

Encyclopaedia of Landscape Design

Initially, for knowing the scope area of product landscape design was studied (Design, 2017). It helped with planning and installation of foliage for the aesthetic and beneficial purposes. Planters design was incorporated in modular design on different parts with the usage of different types of plants.

Figure 1: *Layered Planting*

Sources: *Encyclopaedia of Landscape Design*

Award winning garden sitting projects

Different award winning garden sitting projects were studies (Gul onat, 2019) (Ely, 2016).

For existing literature different research papers on material research and flexibility design were kept in mind (Kin Wai Michael Siu, 2015). one of it is:

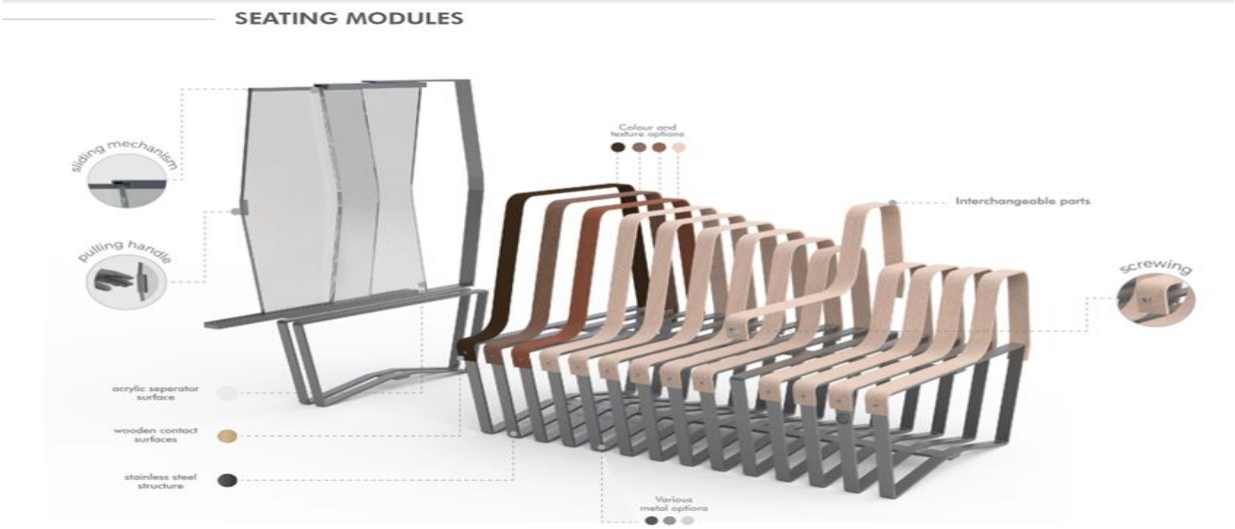
Coron - out

Well-designed project by Dilan Sari and Gul Onat was studies for the better understanding of universal and flexible design urban furniture. This project was mainly designed for public spaces and for the situation of Covid-19, where social distancing, privacy, design, features, and many other points were kept in mind. This was a modular designed furniture that allowed people to do activities of working socializing and allowing them to enjoy open are with hygiene.

1) Research:

Figure 2: *Background Reserch*

2) Modules:



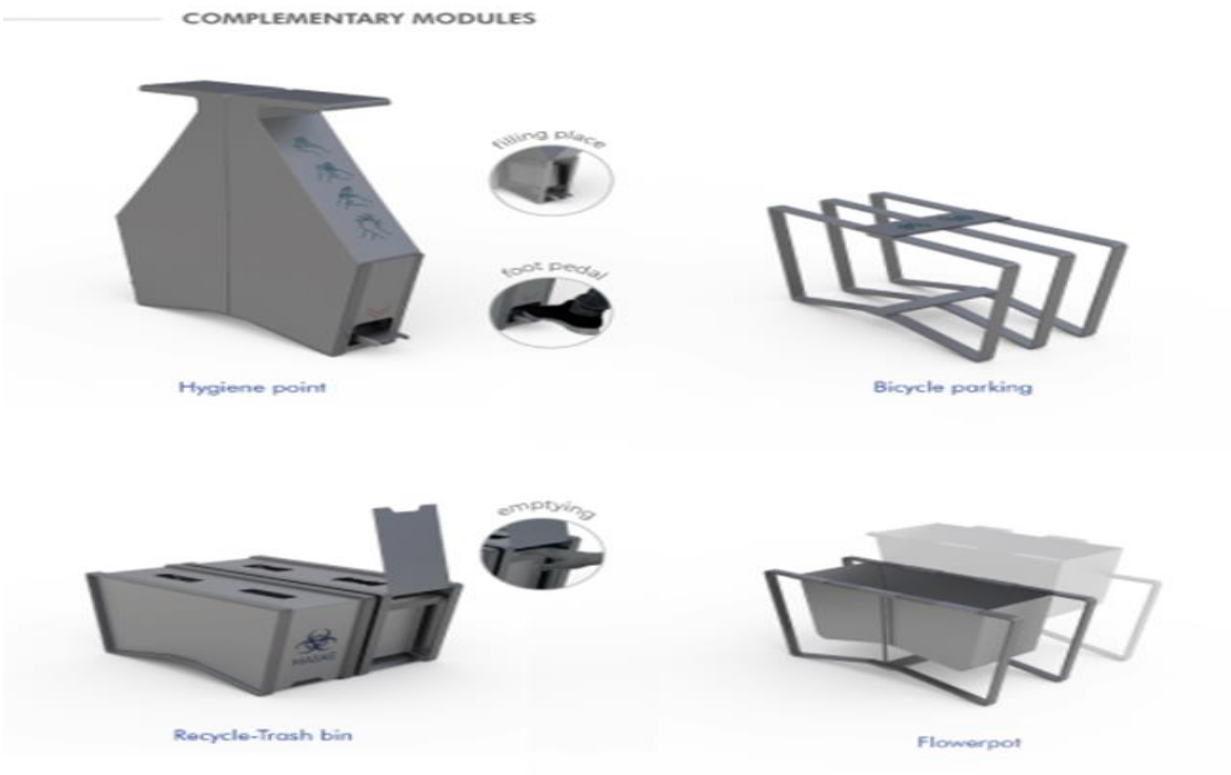


Figure 3: *Modules*

3) Usage scenario:

Three different scenarios were defined and designed. Modules can be assembling and rearranged in different requirements of space or need.

Figure 1: *Usage scenario 1*

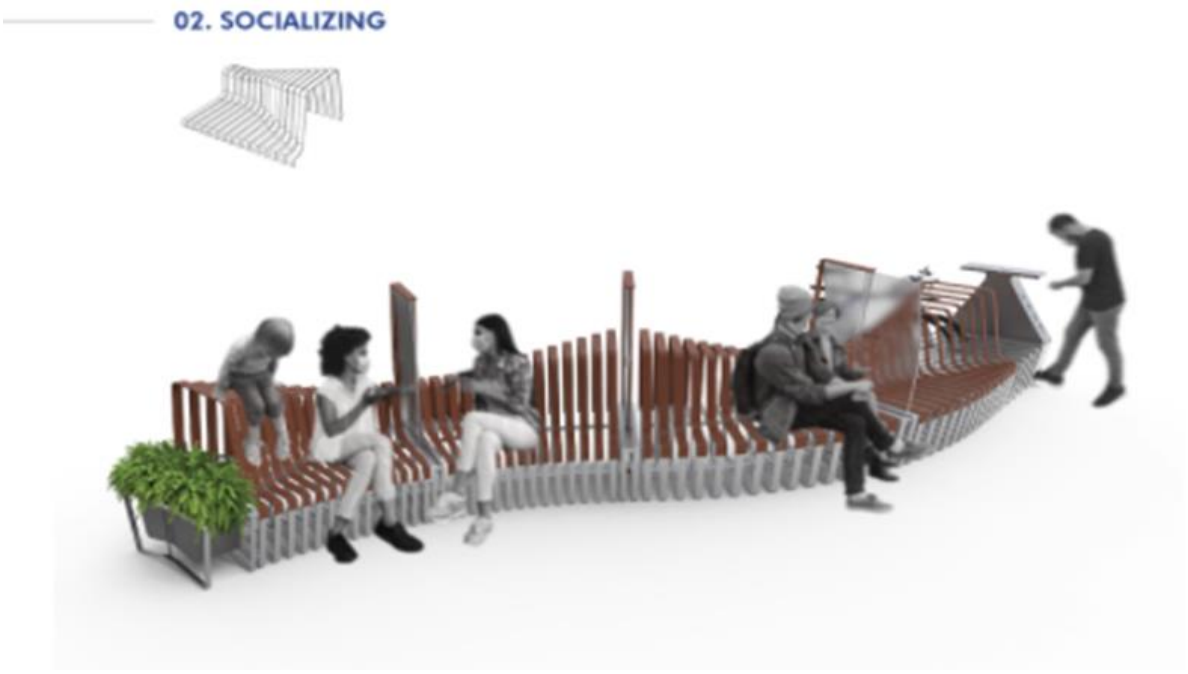


Figure 2: *Usage scenario 2*

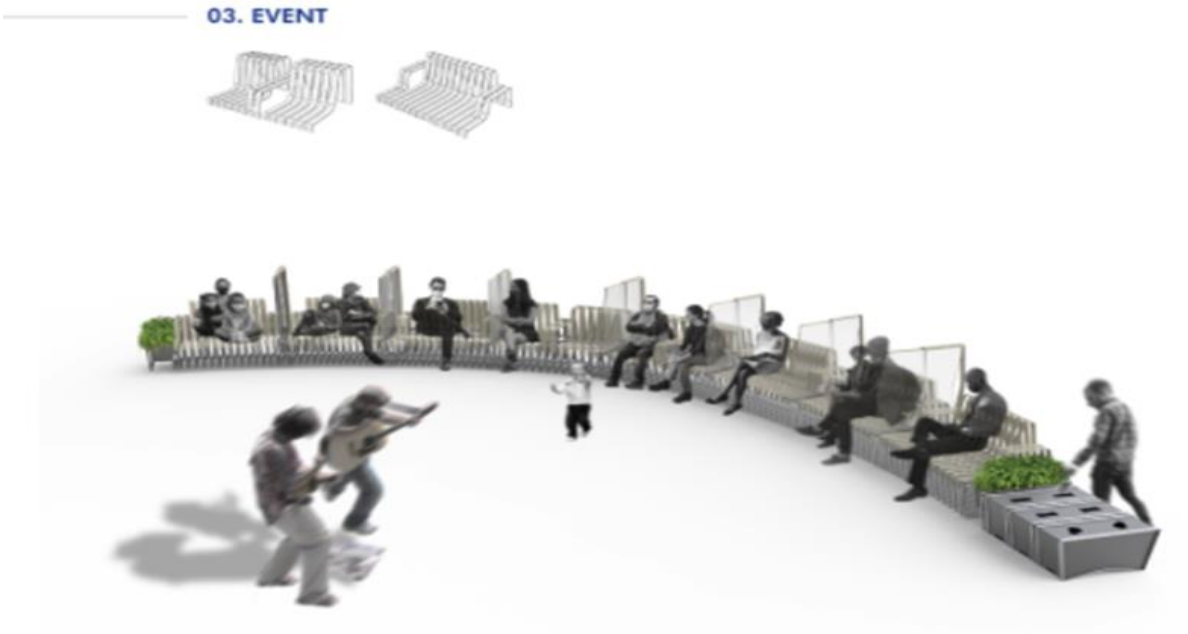


Figure 3: *Usage scenario 3*

Market surveys:

Two different market surveys were conducted to know about the existing materials and there use and dealing. Costing was also studied in these surveys. Ferozpur road, Lahore was visited for knowing out the terracotta and its uses. Shama stop ganda nala near ichra ferozpur road Yousaf gamla and decoration shop of pottery works was visited for knowing about the different planters. There are three reasons why these products are visited: It is high quality, It is easy to handle,

Another material used that has the lowest ecological footprint possible. The purpose of this case study at this shop was to take close look on designs and patterns made from this material.

This planter is made by clay on potter's wheel. Then for giving it aesthetics is given a specific texture by making its surface unclear.it consist of two separate parts of base and upper bowl. Bowl is used for planting purpose. Product will be used as an outdoor planter. It has a simple concave and bowl shape. Every item is in vertical curvy shape which is the appealing shape. It has grooves on the side.

Table 1: *Advantage vs. Disadvantages*

Advantages:	**Disadvantages:**
Made in terracotta	Can be cracked by knocking
Low co2 emitting material	No solution once cracked
Easy to handle	Difficult in direct coloring
Easy finishing	Heavy in weight
Easy polishing	

Dimensions:

Table 2: *Dimensions of Case Study planter are:*

Depth	**Width**	**Height**
24″	24″	48″

Other traditional available planters:

Figure 7: *Traditional designs*

Finishing:

Different Finishes applied on terracotta to give it a final look goes through some steps that are:

Glazing

Stamping

Cary coloring

Results:

Most of the products manufactured by TERRACOTTA accompany some other material. In potter's wheel is used and tough manufacturing have to face between different materials that results high cost and hard work. We need to work more on reduction of multiple material usages without compromising its strength. These case studies would be helpful going to a specific solution.

Market Research:

Initially, the outdoor seatings were studied in detail and different structures for them were modified. After a detailed analysis and working on the structure, it was decided to introduce different geometric angles and height variations in modules to give the structure a complete and interesting look for that observed terracotta, urban seating, and planter designs (Control, 201). The point of stability was checked through the prototype in later stages. The initial idea includes accommodating a large target audience by providing multiple functions in such a way that at the same time it serves as a landscape element as well as enhances the aesthetics of a site. For this purpose, a proper design catalog of different design variations was made for brainstorming:

Figure 8: *Available Designs*

Ideation:

For initial brainstorming, an inspiration was taken from an African bird "Hoopoes". The reason for its inspiration was its soothing voice, charming colors, and its nature to live in large open areas same as the characteristics of this product that will provide a relaxing experience, add beauty to the landscape, and will be placed in an open area (Grace Mulyono, 2017). After going through a defined process of brainstorming a rough design come up that still needed some work.

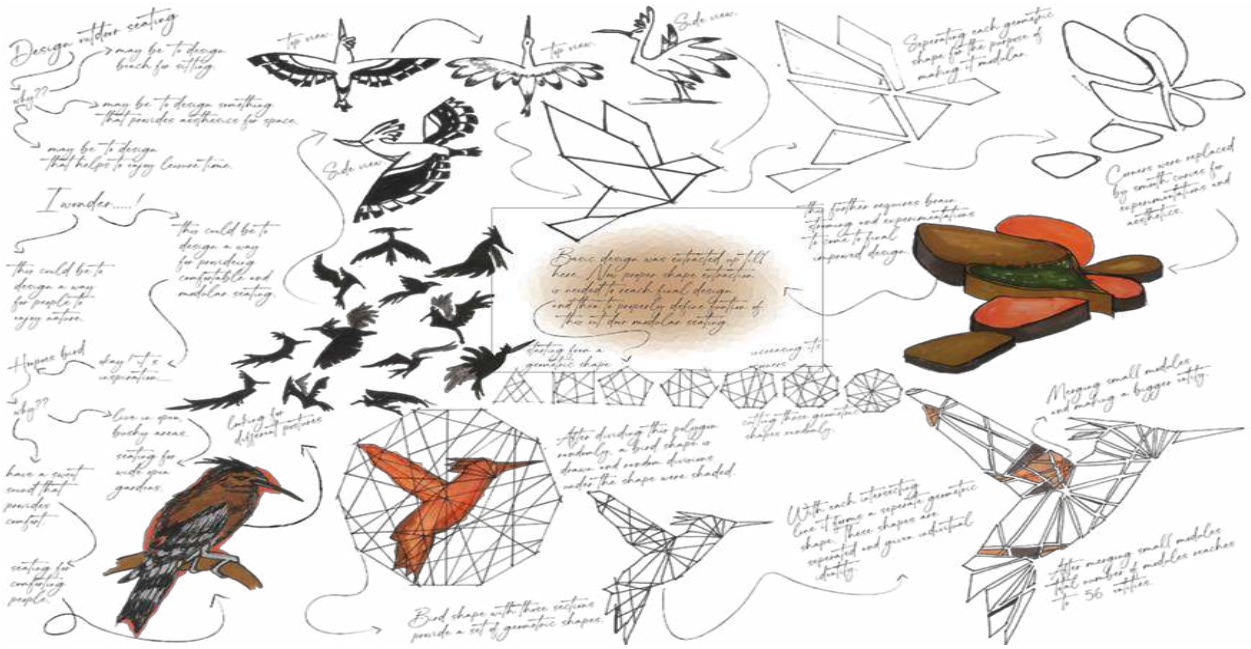


Figure 9: *Ideation*

After getting a modular shape of a bird for outdoor seating there was a need to work on the individual module. Design, height, function, and size are important to be specified at this level. Once its important elements are defined further working would be easy.

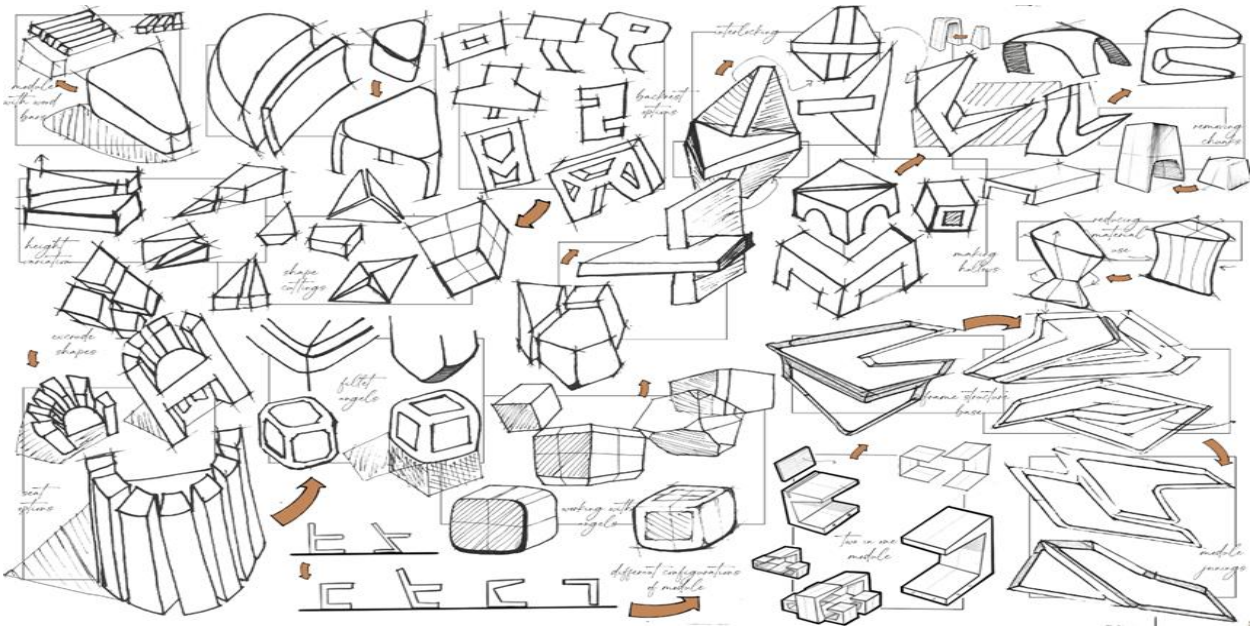


Figure 10: *Brainstorming*

CAD:

The 2Ds are generated with the help of AutoCAD software which shows all the elevations, plan, and bottom view (Levin, 2014). These elevations give the dimensions of the product and a better understanding of this design. Other technical details are also observed by these drawings.

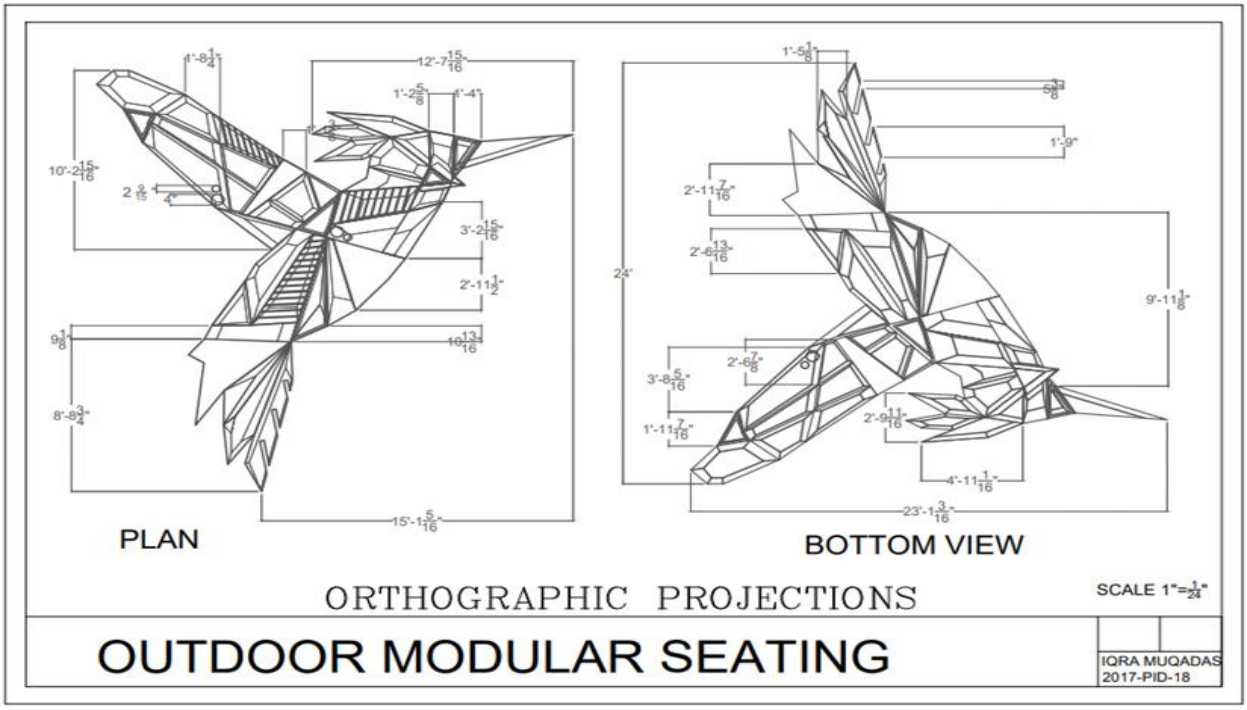


Figure 11: *Orthographic Projections*

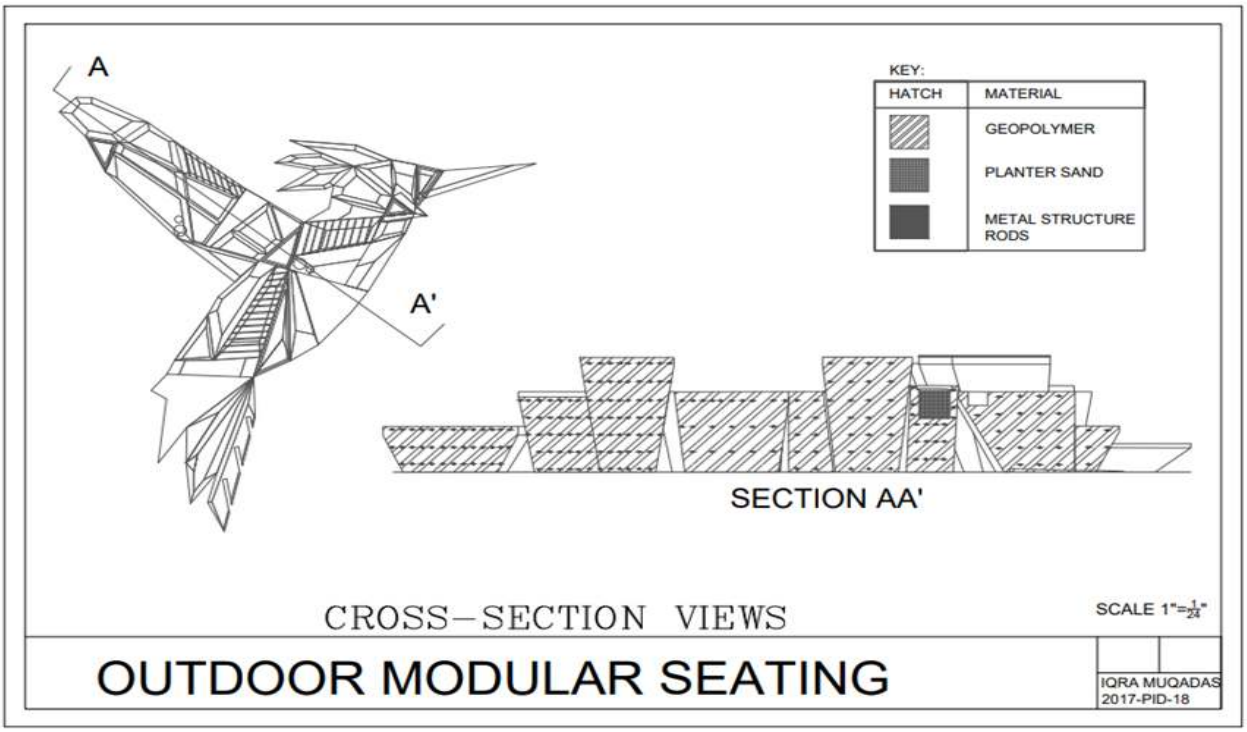


Figure 12: *Cross section*

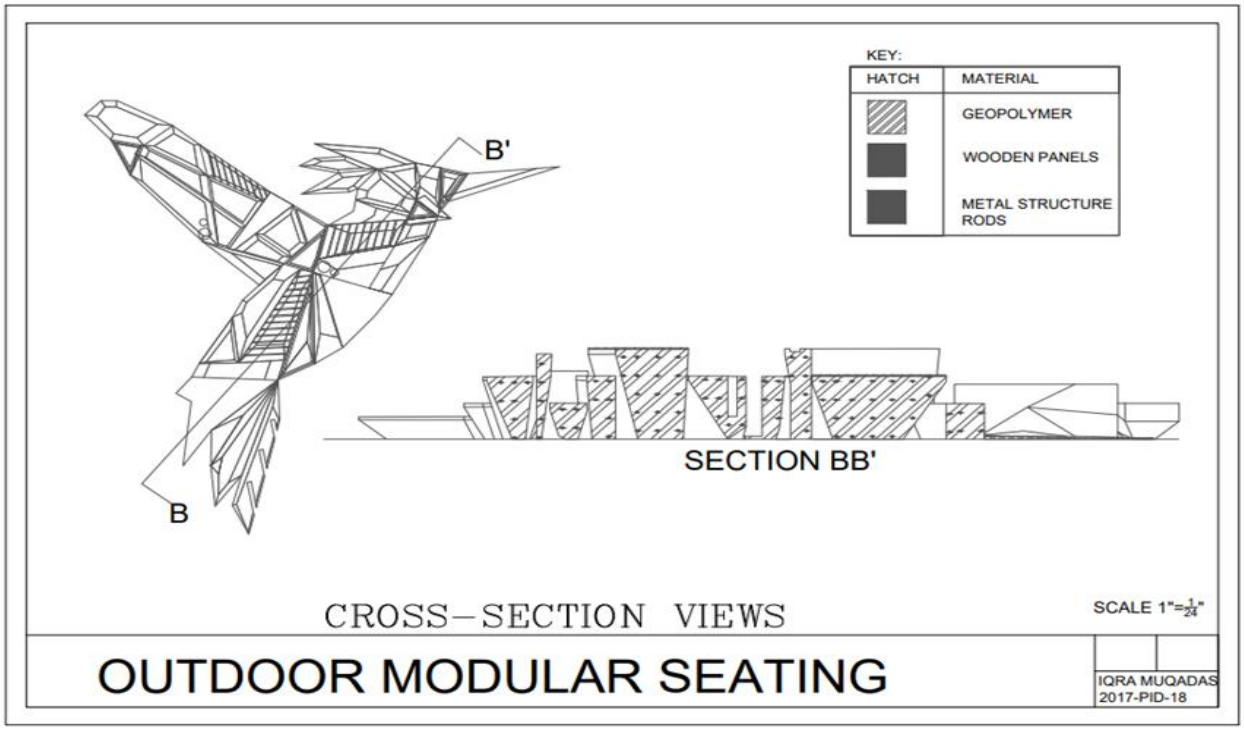


Figure 13: *Cross Section View*

3D Modeling:

After making initial sketches we move towards making 3d model on 3d max that takes us one step closer to understand the final design and knowing its aesthetic

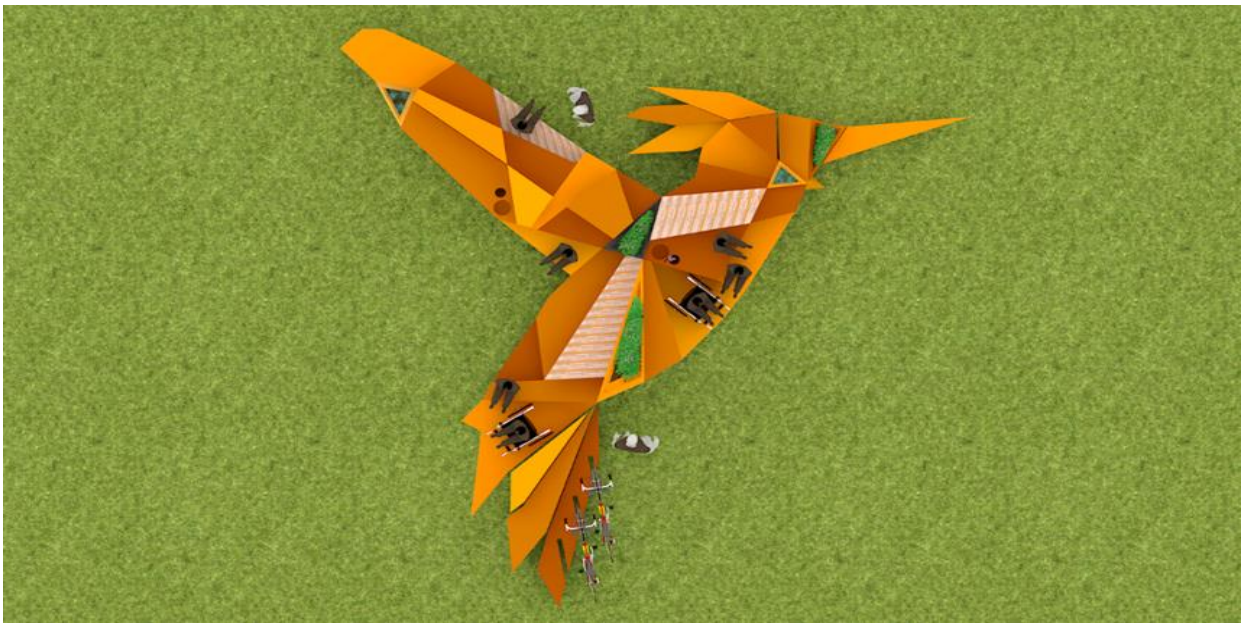


Figure 14: *Top View*

details. Aesthetics are aimed to achieve by using fresh colour pallet from bird inspiration and also by adding plants as a landscape element (Gehl, 2010).

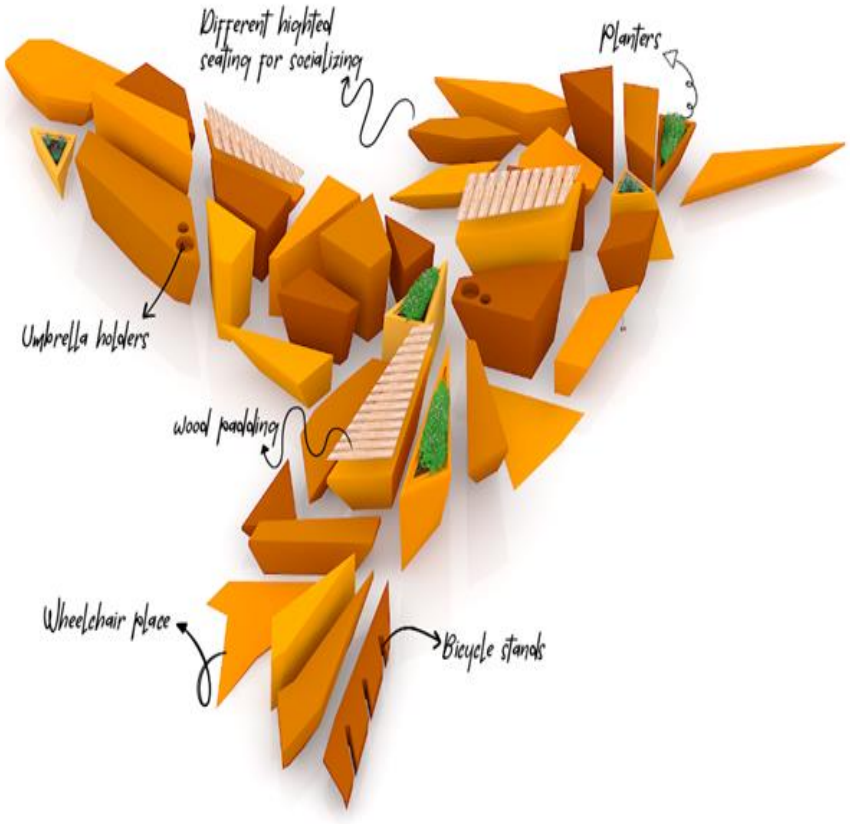


Figure 4: *Exploded View*

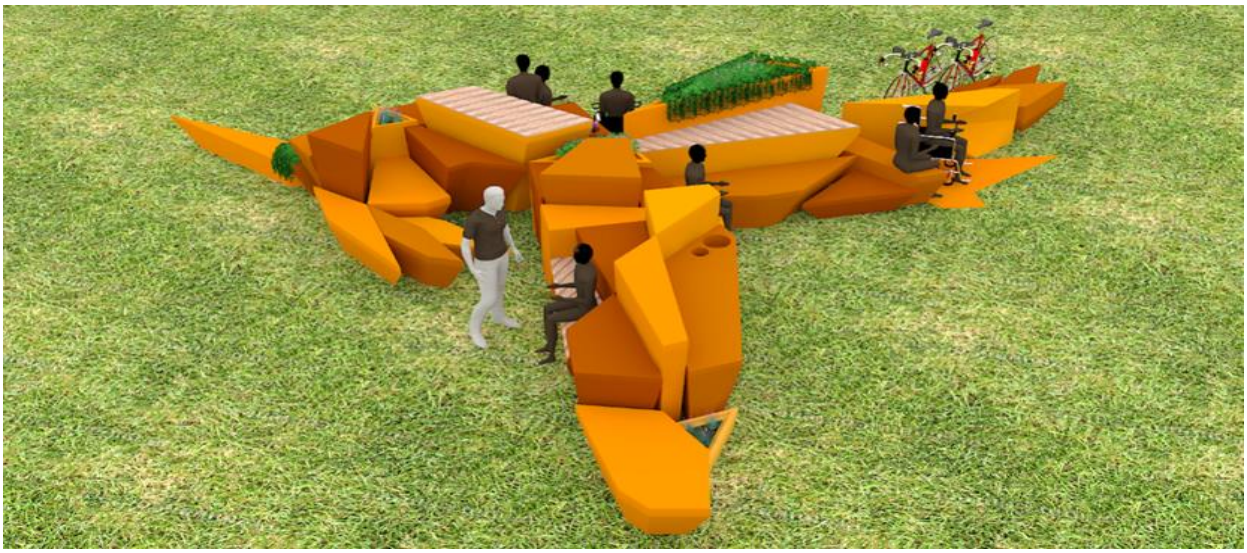


Figure 16: *Functionality*

Prototyping:

In the design process, making prototypes for better analysis and a deeper understanding of design and problems is preferred. The prototype was made in close-to-original material by scaling it down

by 10. Some modules were made by pouring mortar in mold and placing wire structures in between. While others were made by thermopile covered with cement. After buffing, coloring, and the final touch was given (Officials, 2011).

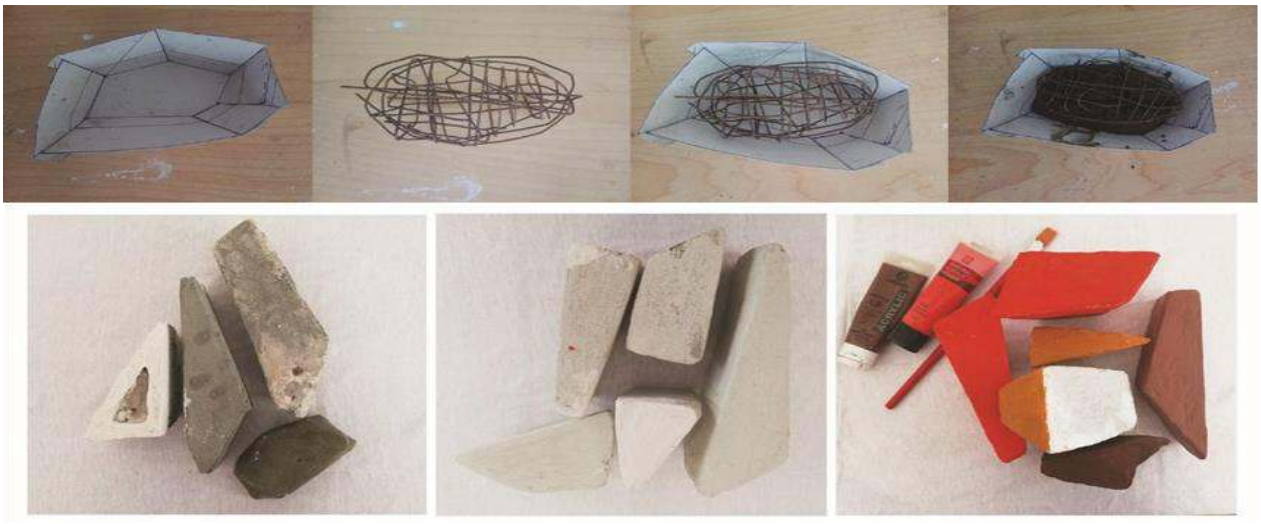


Figure 17: P*rototyping*

Design Features & Consideration

Modular Geometry

The design comprises individual modules of varying heights and profiles, derived from abstract shapes mainly triangles, extracted from abstract bird forms, and rectangular volumes, evoking natural harmony and playful curiosity (Tovar E., 2025) (Zhang, 2024).

Ergonomics

Each unit adheres to international standards for seat height, back support, and clearance (Mirrer, 2025), with additional considerations for footrests, arm support, and wheelchair access (Appolloni L, 2020) (Liu, 2022).

Functional Scenarios

The system supports multiple configurations including social clusters for group seating (Oihane Gómez-Carmona, 2019), multi height arrangements for interactions (Urbaniture, 2024), units for private rest or mindfulness (Gardner, 2018), Dual-purpose seating-planters for biophilic integration (Zhang, 2024) (Rinaldi, 2019).

Aesthetics & Emotional Engagement

A color palette of rust brown, ochre orange, and honey yellow reflects natural tones (Otto, 2003). Subtle textures enhance tactile experience and visual warmth, encouraging repeated engagement (Chapman, Emotionally Durable Design, 2015) (Dainoff, 2008).

Reflection

Informal user feedback and ergonomic assessments indicated:

Enhanced comfort and engagement due to varied heights and angles (Appolloni, 2020)

Preference for customizable layouts over fixed benches (Zhang, 2024)

Positive reception of abstract forms, particularly among disables, youngsters and the elderly (Liu, 2022)

The prototype demonstrates how a design-led process, rooted in empathy and systems thinking, can transform underutilized spaces into inclusive, aesthetic, and sustainable environments (Rinaldi, 2019).

Conclusion

This study presents a design leading to response to the growing need for sustainable, inclusive, and emotionally enriching public seating in the context of rapid urbanization and environmental strain (AlWaer, 2021) (Gardner, 2018). By grounding the research in universal design principles, emotional durability, and landscape integration, the project illustrates how modular outdoor furniture can transcend functional utility to become a therapeutic and socially connective element within urban environments (Carmona, 2010).

The proposed modular system, shaped by iterative prototyping, ergonomic considerations, and feedback from real-world observations—demonstrates that urban furniture can be both adaptable and emotionally resonant. The integration of geopolymer material addresses ecological concerns while the geometric abstraction and flexible arrangements promote multisensory engagement and inclusivity across age and ability groups.

Furthermore, this research reinforces the idea that urban design is not merely about space-making, but about human well-being, emphasizing that thoughtfully designed public furniture can act as a catalyst for restorative experiences, community interaction, and long-term behavioral benefits. In advancing this modular solution, the paper contributes to broader discourses on sustainable urbanism and mental health, urging city planners, designers, and policymakers to reimagine public infrastructure through a lens of empathy, adaptability, and environmental stewardship.

Conflict of Interest

The authors showed no conflict of interest.

Funding

The authors did not mention any funding for this research.

References

Abdul Munaf Shaik, V. V. (2015). Development of modular manufacturing systems. *The International Journal of Advanced Manufacturing Technology*, 789–802.

Ackerman, C. E. (2018). What is Environmental Psychology? *Journal of Environmental Psychology*.

AlWaer, H. S. (2021). Unhealthy neighbourhood syndrome. Mdpi.

AlWear, H. (2021). Unhealthy Neighbourhood "Syndrome": A Useful Label for Analysing and Providing Advice on Urban Design Decision-Making? *Suustainability*.

Appolloni L, A. G. (2020). Walkable urban environments: An ergonomic approach. Sustainability. https://doi.org/10.3390/su13116232

Appolloni, L. (2020). Walkable Urban Environments: An Ergonomic Approach of Evaluation. Research Gate.

Carlos Mena, E. F.-V. (2014). Role of access to parks and markets with anthropometric measurements, biological markers, and a healthy lifestyle. Nlh.

carmona, G. (2019). Transforming Ergonomics with Personalized Health and Intelligent Workplaces. Ios Press Ebooks.

Carmona, M. (2010). Public places urban spaces: The. *Elsevier*.

Chapman, J. (2015). Emotionally Durable Design. London: *Routledge*.

Chapman, J. (2015). Emotionally Durable Design. *Routledge*.

Control, B. C. (201). Healthy Built Environment Linkages Toolkit. Retrieved from un habitat: https://unhabitat-urbanhealth.org/download/healthy-built-environment-linkages-toolkit/

Council, I. E. (2000). The University of North California. Retrieved from Unc: https://ehs.unc.edu/topics/ergonomics/

Dainoff, M. J. (2008). Ergonomics and psychology: *Developments in theory and. Crc Press*.

Design, E. o. (2017). Encyclopedia of Landscape Design. *Dk*.

Ely, N. (2016). Mobilita. Retrieved from Behance: https://www.behance.net/gallery/41905815/Mobilita?tracking_source=search_projects_recommended%7Coutdoor%20%20modular%20furniture%20

Gao, T. T. (2022). Research on Urban Furniture Intervention to Foster Community Emotional Healing. *Springer*.

Gardner, J. M.-C. (2018). Gehl. Retrieved from Cities for people: https://www.gehlpeople.com/knowledge-hub/articles/

Gehl, J. (2010). Cities for people. Island Press.

Ghassemi, R. K. (2016). Urban Furniture and Leisure of Citizens (Case Study of Sabzevar. *Journal of Civil Engineering and Urbanism*.

Grace Mulyono, D. T. (2017). Development of Modular Outdoor Furniture Product Using Lightweight Concrete for Public Parks in Surabaya. IOP Conference Series: *Materials Science and Engineering*. Doi 10.1088/1757-899X/234/1/012022

Greenfield, D. E. (2023, Sep 3). Sustainable Design Strategies: A Complete Guide. Retrieved from Sigmaearth: https://sigmaearth.com/sustainable-design-strategies-a-complete-guide/

Gul onat, D. s. (2019). Coron-out. Retrieved from Behance: https://www.behance.net/gallery/114614205/Coron-Out?tracking_source=search_projects_recommended%7Coutdoor%20furniture%20product%20design

Harmon, T. (2025). Maximize Comfort with Ergonomic Outdoor Patio Furniture. Retrieved from Patio Production: https://www.patioproductions.com/blog/features/maximize-comfort-with-ergonomic-outdoor-patio-furniture/

Kevin Norbert Otto, K. L. (2001). Product Design: Techiniques in Reverse Engineering and New Product Development / K.N. Otto, K.L. Wood; pról. de Maurice F. Holmes. Researchgate.

Kin Wai Michael Siu, K. S. (2015). Flexible design principles: Street furniture design for transforming environments, diverse users, changing needs and dynamic interactions. Emerald. https://doi.org/10.1108/F-02-2014-0021

Levin, M. S. (2014). Modular System Design and Evaluation. *Springer*.

Liu, W. (2022). Inclusive urban renewal. *Isprs International Journal of Geo*.

Main, B. &. (2010). Site Furnishings: A Complete Guide to the Planning, Selection and Use of Landscape Furniture and Amenities. Wiley.

Mirrer, S. B. (2025). Using anthropometric data in the design of children's health care environments. Jstor.

Mulyono, G. T. (2017). Development of modular outdoor furniture using lightweight concrete. Iop.

Officials, A. A. (2011). Road Side guide (4th edition). Aashto.

Oihane Gómez-Carmona, J. S.-M. (2019). Enhancing street-level interactions in smart cities through interactive and modular furniture. *Journal of Ambient Intelligence and Humanized Computing*.

Otto, K. N. (2003). Product design: Techniques in reverse engineering. Pearson.

Radwan, A. H. (2017). The Importance of Integrating Street Furniture in The Visual Image of the City. Ijmer.

Rinaldi, A. (2019). Designing smart furniture for migrant integration. In. Iea Conference.

Sanches, M. G. (2010). Co-design in public spaces. *Design Research Society Conference*.

Tovar, E. (2025). Are modular seating systems redefining our perception of public? Arch Daily.

Tovar, E. (2025). Are Modular Seating Systems Redefining Our Perception of Public Spaces? Retrieved from ArchDaily: https://www.archdaily.com/1027386/are-modular-seating-systems-redefining-our-perception-of-public-spaces

Urbaniture. (2024). Urban furniture strategies: Redefining public spaces. Retrieved from Urbaniture: https://urbaniture.com/

urbanitureai. (2024). Urban Furniture Trends: Shaping the Future of Public Spaces. Retrieved from Urbaniture: https://urbaniture.com/urban-furniture-design/urban-furniture-trends-shaping-the-future-of-public-spaces/

Zhang, Z. S. (2024). Sustainable seating design in Shanghai communities. Mdpi.