

SUSTAINABLE PUBLIC SPACE FOR A LIVABLE CITY: A STUDY OF STEEL STRUCTURE DESIGN SOLUTION APPLIED IN DANANG CITY, VIETNAM

Dang Ngoc Thao Linh*, Cai Xuan Hieu, Le Dinh Huy, Le Nguyen Nguyen Luu,
Ngo Minh Quoc, Tran Thanh Hieu

The University of Danang - University of Science and Technology, Danang, Vietnam

*Corresponding author: dntlinh@dut.udn.vn

(Received: March 24, 2023; Revised: May 24, 2023; Accepted: May 25, 2023)

Abstract - Public space is essential for the sustainable growth of all types of cities. It significantly contributes to public mental health balance and brings a more vibrant and livable image of city life. A more invested in comprehensive design at the beginning of any master plan can result in huge potential. The research aim is to examine public space principal design and exploits with a case study method in Danang city, Vietnam. The result of the applied method proposes a public space design solution with a stainless steel structure, which is considered a flexible material for its aesthetic value in addition to economic and environmental considerations that can be used in public space design. This research delivers a potential design solution with secure public space rights, public use balancing traffic and pedestrians, and safety.

Key words - Sustainable public space; principal design; stainless steel structure; aesthetic value; environmental consideration.

1. Introduction

Public spaces have been recognized as an important role in the city development process since the beginning of human civilization, providing multiple advantages to individuals and society [1]. According to the United Nations, public spaces, which include parks and streets, are crucial for the well-being and productivity of cities and their populations [2]. In 2020, a study of 911 cities globally found that public spaces, on average, make up 16% of urban areas, with streets comprising three times more space than open areas like parks. A number of 30% of urban areas for streets and 10-15% for open spaces has been set out by the United Nations [3]. To achieve this goal, SDG 11, target 11.7, emphasizes the importance of green and public spaces in urban areas. It aims to increase the current allocation of approximately 4% to the targeted goal of 10-15% [2].

Public space can be recognized in various types, such as squares, streets, markets, parks, walkways, retail centres, community centres, playgrounds, schoolyards, and urban interiors. Although public space dates back to ancient times, some spaces with similar designs still exist today [4, 5]. However, urbanization and industrialization have significantly changed the character and functionality of public space. An effective management and good design quality of any public space could require a depth understanding and this process begins with comprehensive current state research [6].

Public spaces in urban areas in Vietnam have not been evaluated and developed correctly. In detail, public space itself has not been mentioned and highlighted for its importance, including green spaces, bodies of water, and urban relaxation spaces in any planning masterplan at a national or regional and municipal level. They mostly appear as empty spaces between buildings or areas without specific

planning or a fill-in as it needs. This situation typically happens as stakeholders are mainly concerned with economic benefits, creating as much commercial land and high-density products as possible to recover their investments quickly.

Specifically, public spaces in Danang need more quantity and more varied designs that do not reflect the city's cultural identity. Besides, local residents felt most unsatisfied as they could not be in the decision-making process. They are mostly absent from the processes of negotiation. "We are all unavoidably anthropocentric; the question is which anthropomorphic values and priorities we will apply to the natural and the social world around us", said Scott Campbell [7].

The authors' research helps the municipal government of Danang city to understand the meaning of having public spaces designed in the master plan, which significantly affects the identity of a city, the lives of its residents, the environment, and the urban planning network. At the same time, this research has selected a research area and proposed a design model solution for public space development.

2. Literature review

2.1. Public space

2.1.1. Definition and Roles of Public space

Famous 20th-century urban planners like Jane Jacobs and William Whyte have been working on urban sociology, which has profoundly impacted the importance of having public space research. This conception of public space is said to be the "gap" between buildings in a city, an attached open space of any community buildings, and a space for "outsiders" who are not part of the local community, such as tourists, visitors, and outcasts [8]. Public squares are beautiful, well-manicured spaces with lush green grass, trees, and other plants.

Public spaces vary in form, from "backyard" corners to grandiose public architecture. At a larger scale, formal public spaces improve the health of urban residents and the image of cities becoming vibrant and livable. It is a centre point for public life, events, and activities. On a smaller scale, these informal areas are stops to rest for pedestrians while providing open relaxation and socializing areas or leisure activities [9].

Furthermore, following Kevin Lynch's definition, urban open space refers to an area in the environment accessible for people's spontaneous and voluntary activities. Similarly, an open space is where individuals or groups gather to engage in physical and social activities, share information and knowledge, shape social structures,

and exchange ideas, as described in reference [10]. Public spaces allow people to carry out their daily and ceremonial practices and promote community bonding without being influenced by political or economic considerations, as explained in reference [11].

Public spaces are diverse and can include traditional squares, incidental urban spaces, and innovative areas that challenge traditional expectations. Thus, these spaces vary in appearance, social and physical function, and management [9].

2.1.2. *Function of Public space*

According to Haq, public spaces serve three primary purposes: environmental, economic, aesthetic, and social and psychological [12]. Rojas-Rueda et al. conducted a systematic review of longitudinal studies. They found that increasing the number of public spaces in residential areas reduces the risk of all-cause mortality [13]. They also recommended that future urban planning interventions consider the full range of benefits associated with public spaces rather than solely focusing on ecological benefits. James et al. identified evidence that green and public spaces could enhance health outcomes by encouraging physical activity, facilitating social interaction, and reducing stress levels [14]. Furthermore, public spaces represent a social indicator of a city's vitality, as they are accessible to all community members regardless of ethnicity, age, or gender. They serve as a democratic forum for citizens to interact with society, bringing people together and providing a venue for social relationships that may otherwise be absent in urban areas. Public spaces contribute to the cultural identity of an area and offer a sense of place to the local community [15].

During the COVID-19 pandemic, a survey was conducted in various European countries. The results showed that people missed outdoor exercise and socializing with others the most when it came to accessing public spaces [16]. This crisis provides an opportunity to rethink public space development from a comprehensive and nuanced public health perspective [17]. Furthermore, the failure of planners and urban designers to consider local everyday meanings and values can lead to residents' laziness "from each other and their own place" [18].

2.2. *Public space development*

2.2.1. *Planning for public space*

The improvement of public spaces is often initiated by planners, who play a crucial role in designing and shaping these areas. They do this in two distinct ways. Firstly, planners proactively identify the need and potential for new or revamped public spaces through site-based plans or policies. Secondly, they oversee the development of public spaces by determining whether to grant or withhold permission for development through regulatory procedures [9].

It is said that urban planners have to manage both of these roles to ensure that public spaces fully serve the public interest. Successful examples such as Barcelona have been highly praised [19]. Public space is significant considering that, on a global scale, it is often the private sector that designs and delivers new ones and is responsible

for their long-term stewardship. In this context, designing public space is the gateway through which municipalities deliver social justice. This factor is one of those essential ones where public space management is evaluated.

2.2.2. *Diverse public space*

Public spaces are distinguished from their surroundings by their physical shape, which creates a recognizable location. This is typically achieved through a sense of enclosure, where the buildings and landscape initially open up to create the space and then wrap around to contain it, creating a special place that is visually appealing [20].

The concept that cities and public spaces should be accessible to everyone has been a central topic in urban discussions, dating back to Henri Lefebvre's call for a "right to the city" in 1968 [21]. While it is important to acknowledge the need for certain unalienable rights to be guaranteed for all, it is also important to recognize that cities are inherently diverse and not everyone will have the same preferences or needs [22]. Therefore, it is not necessary for every public space to cater equally to every citizen or occasion, as some have suggested [23]. Research conducted in London has shown that public spaces take on different flavors due to the various interests and uses they accommodate, much like rooms in a house [9]. Instead, planners should recognize the legitimate diversity among urban populations and avoid imposing one-size-fits-all aspirations on public space projects [24, 25]. In this regard, public spaces can be strategically planned to cater to all community sections, with attention to ensuring safe, convenient, and inviting locations that avoid conflicts between different user groups. Although strategic planning for green spaces is common, planning for public spaces is generally rare. Therefore, planning for diverse provisions and avoiding a homogenized vision that can result in a one-size-fits-all design solution is crucial.

2.2.3. *Public space rights*

According to [26], discussions about public space rights typically involve the owner and manager of the space. Unfortunately, this can result in the privatization of public spaces, which can be detrimental to public life [26]. Instead, responsibility and rights related to public spaces should be based on the needs of the community and not just the owner or manager [27]. Ownership and management of public spaces can be complex, and it is important to determine whether they should be public or private. Additionally, all spaces have use restrictions to ensure that everyone has equal access to their amenities, regardless of ownership. Public spaces are crucial for promoting happiness in public life [28]. In reality, the ownership and management of public spaces have been subject to various complex arrangements, which often result in a need for more clarity regarding their public or private status. Additionally, all spaces are subject to usage restrictions, regardless of ownership, to ensure that the benefits of the space are distributed equitably among all types of users.

The general belief in literature when it comes to public spaces is that they should be open, unconstrained, and free for everyone to use without charge. To achieve this ideal, it's important to establish clear rights and obligations for

both users and owners during the creation or improvement of these spaces. However, this is not always achieved, and problems can arise when owners and managers abuse their privileges to exclude certain groups, limit access, or enforce rules that go beyond societal norms, such as banning photography. Carmona has established a standardized set of criteria known as the Charter for Public Space Rights and Responsibilities [9]. This applies to all public space efforts in policy or legislation (Table 1).

Table 1. Charter for Public Space Rights

The right of public space users	The responsibility of public space users	The responsibility of owners and managers of public space
<ul style="list-style-type: none"> - Rest and relax without any disturbances - Interacting with others and enjoying public spaces without unnecessary restrictions unless justified, such as regulations on drinking, smoking, safe cycling, skating, and dog walking - Engage in charitable activities, take photographs, trade (if they have a public license), campaign politically, and perform in non-residential areas 	<ul style="list-style-type: none"> - Respect the rights of others when using public spaces - Should not interfere with their activities - Act civilly and safely at all times - Should not litter or engage in any behaviour that may cause harm or disturbance to others. 	<ul style="list-style-type: none"> - Respect and protect the rights and privacy of all users - Ensure social justice among users while maintaining a safe and clean environment. - Public spaces should always be open and unrestricted unless regulatory stipulations exist

2.2.4. Designing public space

Although every public space differs, attempts to establish universally applicable principles for designing "good" public spaces are frequently based on conjecture and intuitive analysis, such as UN Habitat's 2013 report. However, extensive empirical research has identified several essential factors that are likely to be crucial in designing most public spaces, as reported by [29]. These factors include:

- How public places are clearly public in their use so that they feel and are available to the users.
- How to design an active place that is engaging environments for users.
- How historic and landscape features can make environments more meaningful.
- How justice delivers across users towards a positive social atmosphere in public space.
- How to secure and maintain public use with other vehicles and pedestrians.
- How places are made to feel comfortable by fostering safe and relaxed use.
- How to build a resilient public space due to their flexibility in the face of change while remaining distinct.

The following sections will discuss the seven factors and cite relevant research to support our findings. The authors will propose a public space design solution applied in a selected Danang, Viet Nam area.

2.3. Steel structure

As the construction industry continues to grow, the variety of building structures is expanding. This includes super high-rise buildings, long-span structures, UHV transmission towers, and other large buildings that require strong structural components to support their weight [30, 31]. Steel structure has become a popular solution for building structural applications because of its attractive appearance, easy maintenance, resistance to corrosion and fire, low life cycle costs with the good bearing capacity.

There are several types of steel, such as: Q345, A36, Q235, and SS400 having good mechanical properties, perform well at low temperatures, are flexible, and are easy to weld. They are commonly used in various applications, such as low-pressure vessels, oil tanks, vehicles, cranes, mining equipment, power plants, mechanical parts, and building structures [32]. Its products come in various shapes such as plates, sheets, strips, tubes, bars, cold-formed and hot-rolled structural sections, castings, fasteners, and fixes. Out of all these, cold-formed sections are the most commonly used for structural members. This is mainly because they are easily available, require less investment for production capabilities, and are suitable for light structural applications with high structural and material efficiency [33].

To conclude, steel structure is considered as a flexible material for its aesthetic value in addition to economic and environmental considerations which can be used in public space design. The following outcome of this research will propose a design solution for public space using this steel structure.

2.4. Current state of public space in Danang city

Danang is a city located in Vietnam and is bordered by Thuathienhue to the north, Quangnam to the west and south, and the East Sea to the east. The city center is 764 kilometers north of Hanoi, 964 kilometers south of Ho Chi Minh City, and 108 kilometers northwest of Hue. Due to its unique geography that includes high mountains, deep rivers, steep hills, and low mountains with narrow coastal plains, Danang is known as the "City of Five Elements".

In recent years, Danang has undergone a significant transformation. Beginning with the development of the infrastructure, particularly the transportation infrastructure, moving on to the beautifying of the city, and finally to the construction of a new environment in the broadest sense, laying the groundwork for new development.

Public space has always been a crucial controlling factor for the sustainable growth of all types of urban areas. It contributes both to the promotion of the health of city dwellers and the image of cities as vibrant and liveable [34]. However, public space management is considered a blind spot in the city master plan as there is a lack of official proposals found and it is said to be mainly referred to in critical articles or discussions in scientific journals or specialized conferences in Viet Nam. Any public space that is being constructed is normally reported as a remedy within a rapid development context.

Based on a survey, the authors have synthesized some typical models of public spaces in Danang city:

- Square



Figure 1. 2-9 Square: September 2 Street, Hai Chau District, Danang



Figure 2. Lien Chieu District Square: Nguyen Sinh Sac Street, Lien Chieu District, Danang

- Park



Figure 3. Apec Park: September 2 Street, Hai Chau District, Danang

- Sidewalk

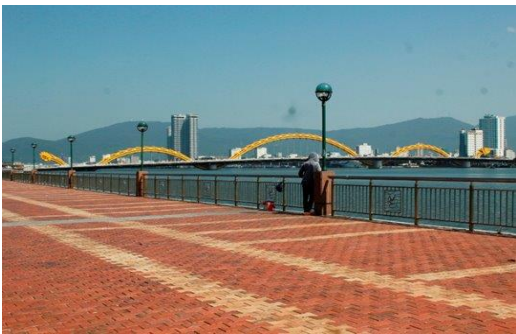


Figure 7. Bach Dang Sidewalk, Hai Chau District, Danang



Figure 8. Tran Hung Dao Sidewalk, Hai Chau District, Danang

3. Methodology

3.1. Methodology

In this study, a mixed-methods approach was used to better understand a research problem by collecting, integrating and analysing qualitative data. Both the strategy and the approach require a considerable amount of empirical data that can be retrieved from numerous sources. The first stage was identified to address the initial research question, which is to explore the benefits, functions, and significance of public space as well as principle for public space design. This can be found as archival data.

The second stage involves identifying the needs and desires of residents in the area for a public living space, as well as those of residents in other areas in search of space in the city of Danang. This provides the procedural justice by letting everyone into the decision-making stage in order to influence perceived fairness. This step also includes the use of observation methods, including delineation activities and sometimes marking activities in the study area over time during the day and day of the week. The author group conducted a direct survey for 100 different subjects living in the design area. The survey of Danang's waterfront was conducted in two parts. The first part was surveying the public demand on using and having a good quality of public space design. The data from the survey could help in answering questions related to the age range participating using public space? Why public using public space? Is public space an important factor which promotes human mental health? How far can public access to the nearest public space? What is the physical condition of the nearest available public space in their living area? The second part was surveying the design solutions that public expect to experience in public space. It is then answering questions related to what types of preferred activities in public space? What style of design that affected the availability or enhancement of city identity through public space? This approach worked as a framework which helped to deliver a comfortable area to encourage social engagement to public space.

The result of the survey delivers a concept design solution within its environmental and social context. Thus, the third stage involves identifying the design factors that must be considered and designing the space into a type based on the contribution of each component: identity, delineation in public use, public engagement, social justice, balanced public space between traffic and pedestrians, safety public use. Finally, a comprehensive proposed design plan will be presented.

3.2. Research Cases and Design Area

A new residential area which located on a new road along the waterfront named Thang Long is mainly for middle and high-income people. It has a growing number of villas on the outskirts of the city center. Except from residential housing, public infrastructure has been invested in to create spacious roads, but due to lack of maintenance and the failure to create attractive living spaces, the sidewalks along this road have been seriously downgraded. The road surface has become uneven, with broken and variable streetlights, making the area unfriendly and uninviting. Overgrown vegetation and trash, such as discarded furniture and waste which has made the area unsanitary and polluted, and have diminished its aesthetic value.



Figure 9. Current state of Thang Long road in Danang

- Infrastructure



Figure 10. Current state of Thang Long road's infrastructure in Danang

At night, the area lacks proper lighting, creating conditions for criminal activities and making it unsafe for pedestrians. This has led to a decrease in the number of people passing through the area. Furthermore, the high-speed traffic along the Thang Long road is difficult to control and can easily cause traffic accidents. The greenery in the area is also poorly maintained, and the overgrown grass has encroached on the sidewalks, making them unusable.

- Sanitation

The infrastructure in the area has been invested in with a planned drainage system running along the Thang Long road, which empties into the Cam Le River during the rainy season. This has reduced flooding in the area. In addition, the area has been renovated to create a green environment, with fresh air and open spaces.

- Security

The security system is almost nonexistent.

- Public space

Even public space sits opposite to residential housings, the level of social interaction and community activities among residents is low. It normally caught with only occasional gatherings of one or two groups in the evening under the bridge due to the lack of lighting and the potential for criminal activity.

3.3. Research Data

The authors issued 110 questionnaires and collected 100 responses to serve a survey on the needs and desires of residents living in this area regarding a public living space as well as housing in other areas in search of space in the city of Danang (Table 2).

Following to the table below, the data from the survey could help in answering questions related to:

- Question 1: Public at all ages are interested in participating in public space.

- Question 2: Most of public have noticed about the importance of public space in delivering and promoting human mental health.

Table 2. Questionnaire Analysis

No	Question and Answers	Result (%)
1	What is the age of you to participate in the survey?	
	10 – 20	19%
	20 - 35	33%
	35 - 50	28%
	> 50	20%
2	Is public space an important factor which promotes human mental health?	
	Yes	69%
	No	16%
	Have no idea	15%
3	Why do you use public space?	
	Club event	26%
	Personal relaxing place	26%
	Family relaxing palace	22%
	Meeting place	21%
	All	5%
4	How far is from your house to the nearest public space?	
	500m	59%
	> 1km	41%
5	Has public facilities along the Thang Long road currently serving the community's needs to your experience?	
	Yes	19%
	No	81%
6	What type of seating area that you want to have in public space?	
	Shady seating areas under trees	89%
	Open seating areas without trees	11%
7	Do you want to have a performance space in public space?	
	Yes	68%
	No	32%
8	Will exhibition space necessary to be in public space?	
	Yes	73%
	No	27%
9	What styles of design theme preferred in public space?	
	Straight line	36%
	Gentle curve	64%
10	Do you have any other opinions on proposing a better public space?	
	- It should be an airy and comfortable space	
	- It should have more trees	
	- It should have a playing area for children	
	- It should have available gym equipment	
	- It should be qualified for all types of users	
	- It should have food truck event	

- Question 3: Public expect using use public space as personal or family relaxing place, organizing club events as well as open meeting area.

- Question 4: As the selected area is a new development one so public can easily access to the public space within 1km.

- Question 5: Despite being a new urban area, public are disappointed as there nearest public space has not been treated with good design.

- Question 6, 7, 8: Public expect to have more shady seating

areas under trees for landscape features as well as performance and exhibition in a new public space design to encourage better social engagement and designing with active uses.

- Question 9: Public choose to have more gentle curve in design theme to demonstrate the identity of the coastal city which is known as having curves of ocean waves and it also creating clearly using pathway.

- Question 10: The public also ask for children playground, gym equipment as well as food truck events in order to raise economic benefits for municipal government.

4. Design

4.1. Design Process

Based on the survey above, it is recognized that a healthy and airy space for the people in the Thang Long area is essential. The authors have developed their idea from the primary function of public spaces, which reflects a city's vitality and life quality through the connection between people and between people and nature, combined with the reproduction of the famous Dragon Bridge image of Danang. It resulted in a stainless steel frame system model running along the Thang Long sidewalk to create a seamless and continuous public space.



Figure 11. Access to proposed design model on Thang Long sidewalk

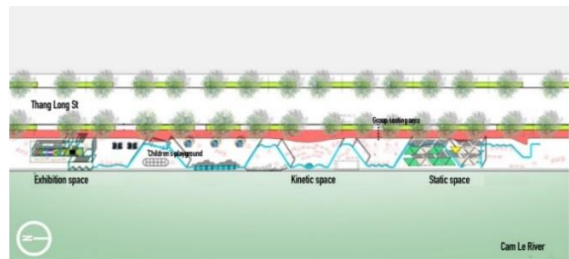


Figure 12. Master plan of proposed design model on Thang Long sidewalk

To cover social justice in public space, the authors propose to divide the steel frame system into three areas and connect them through smooth and gentle paths to make the area feel comfortable. They are known as "Static - Kinetic - Exhibition Spaces". This design solution is a proposed design module with a total length of 130 metres stainless steel frame, which can be installed along the entire length of the Thang Long sidewalk at any position as needed.

In addition, the authors propose to take inspiration from the blue colour of the sea, which has yet to be used in Danang. Blue is known for its language, such as creating

good communication and providing a calm and soothing feeling that helps bring relaxation.

4.1.1. Static space

The static space will focus on relaxation and resting for most middle-aged, elderly, and disabled people. In detail, this cluster of users only needs a place for personal leisure or playing chess and chatting. This space's shading is inspired by childhood kites made of thin fabric material connecting to hooks on the steel frame. It helps create a cosy and visually attractive space. At the same time, it can be easily replaced when there is damage, and its theme can also be switched according to festivals throughout the year.

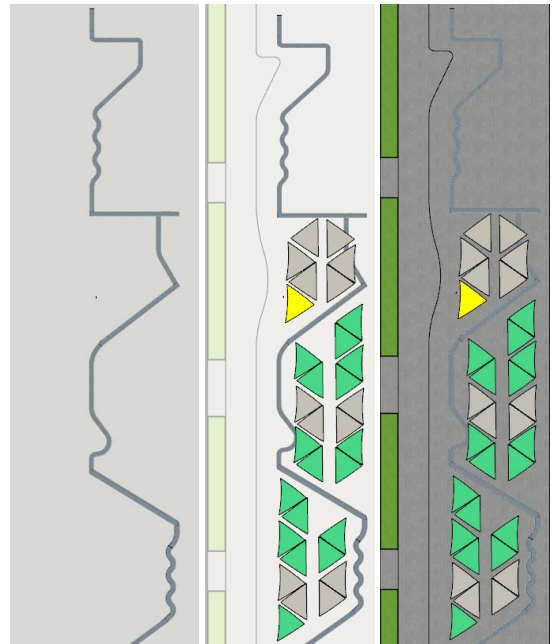


Figure 13. Master plan of "Static space" in proposed design model on Thang Long sidewalk



Figure 14. Perspective view of "Static space" in the proposed design model on Thang Long sidewalk

4.1.2. Kinetic space

The "Kinetic space" is a place focused on recreational activities for groups of teenagers and young adults. The steel frame imagery is also curved to create temporary partitions between different functional spaces on both sides of the wings, while the central space creates a promenade that connects the "Kinetic space" to other two areas (Figure 15).

Inside the kinetic space are commercial spaces, food truck events and group seating areas. The group seating area's design idea is inspired by beehives and circular arcs, symbolising a strong bond among people. There is a check-in space featuring a steel frame system that is curved to resemble famous images of Danang, leaving an impression

and attracting tourists to the site. Children's playground creates a more decadent environment sensibility with different activity equipment that is in curved shape for safety reasons. Additionally, there are open spaces for other forms of play, such as swings, seesaws, and traditional games.



Figure 15. Perspective view of "Kinetic space" in proposed design model on Thang Long sidewalk

4.1.3. Exhibition space

According to some surveys, the authors found that public spaces not only in Danang but also in Viet Nam are mostly designed to meet the needs of the public. However, social interaction needs to be distributed more as there is a lack of activities and facilities for disabled people. Therefore, to create a multi-functional space that serves the needs of all social groups, the authors propose an exhibition space with three different areas: a common connection space, a disabled people space and an exhibition space for everyone. The traffic flow is divided into two separate lanes to avoid confusion and difficulty for disabled people.

The common space contains seating made of steel frames to keep the promenade thorough from the Satic area to the end of its journey. The exhibition space for disabled people includes a two-colour plastic wall that can be rotated at the entrance to create an impressive and exciting effect. It allows them to feel connected and integrated into the space. Next, three notable 3D paintings are proudly made for disabled people by supporting their sensory and taste perception. The image of a fishing village inspires these paintings turned into basic geometric shapes; one is inspired by daily food items such as fruits, pizza, and cheesecakes; and the final painting depicts modern-day Danang with its high-rise buildings symbolizing the developing city.

The last one is exhibition space for everyone, and it can be rented for student academic exhibitions or picture displacement during significant city festivals. This space also contains a reception hall and a corridor leading to the exhibition area. The authors used the idea of ocean waves to create a canopy of fabric stretched over the roof to limit the sunshine as well as reflect the overall character design of this space.

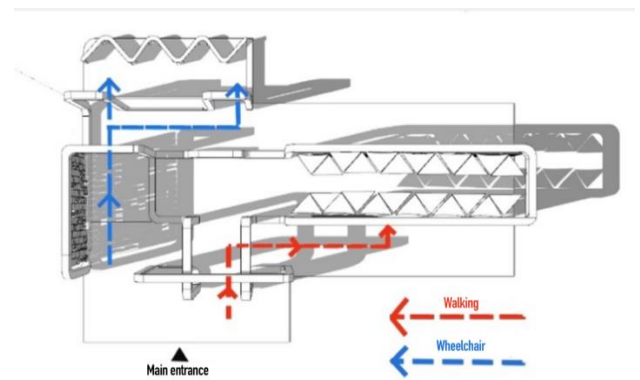


Figure 16. Master plan of "Exhibition space" in proposed design model on Thang Long sidewalk



Figure 17. Perspective view of "Exhibition space" in proposed design model on Thang Long sidewalk

4.1.4. Construction material

The authors have researched the construction materials of APEC Statue Park in Danang, which is a Q345 steel structure designed. The architectural highlight of the APEC Statue Park is the central area with a broad dome consisting of intertwined steel frames forming 3-dimensional curved square shapes. It has been created with CNC cutting to provide precise curved and winding lines.

Following the research, the authors propose the design solution using SS400 instead of Q345 steel frame because of the cost estimation. This SS400 steel frame will be processed and welded together according to the desired shape. After installation, it will be coated with Epoxy paint with a zinc-rich primer, and the structure will be cleaned using the sandblasting method to achieve a roughness of up to S.A2.5. Therefore, it will protect the steel layer well in

outdoor environments, even near the sea. For positions that are close to the ground, the frame system will also be galvanized or replaced with stainless steel to prevent rusting of the steel.



Figure 18. Construction image of stainless steel structure - curved dome from Ha Giang Phuoc Tuong Mechanical Joint Stock Company in Danang city

4.1.5. Landscape design

In the early 21st century, the rapid development of cities in terms of both height and width has led to a decline in recreational areas and rest spaces that incorporate natural landscapes within urban areas. Notably, the absence of public spaces or, if available, their tendency to fall into a state of spontaneous growth with wild vegetation exacerbates this situation. To create an appealing city landscape, it is important to maintain green spaces along both main roads and public areas. Natural landscapes provide a diverse and balanced living environment that improves air quality and enhances the attractiveness of public spaces [35].

According to Decision No. 3852/QĐ-UBND on the list of encouraged, restricted, and prohibited trees from being planted on streets in the city of Danang, the authors propose the following tree planting along the public space on Thang Long: Yellow Flamboyant. Yellow Flamboyant can grow and develop well in various conditions, withstanding heat and drought. This type of tree can grow well on sandy areas near the coast. In Danang, this species is quite common in the urban green system and is listed among the city's five main tree species.

The freshwater mangrove can be considered a modern urban landscaping tree, creating a soft and natural landscape, ensuring harmony in the urban environment. Pongamia is easy to grow and care for, has a long lifespan, and can survive in harsh climatic conditions. Its flowers bloom in bright pink. The disadvantage of Pongamia is that its fallen flowers and leaves can create a mess, so regular cleaning around the tree base is necessary.

4.2. Design Outcomes

Combining those design methods, the authors have simulated the solutions into sections and perspective drawings, producing a detailed design proposal for a public space along the Thang Long in Danang city. This selected solution is chosen based on cost-effectiveness calculations, their ethic of care to the local residents, and their potential to enhance the aesthetic value of the current sidewalk. The authors will submit this proposal for the municipal government's consideration and implementation to develop public spaces to serve the community.

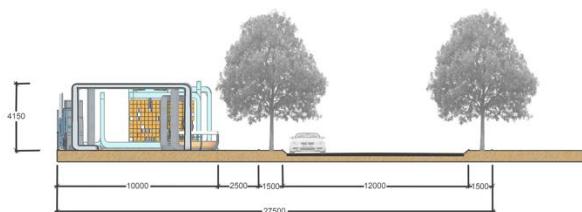


Figure 19. Section drawing of proposed design model on Thang Long sidewalk

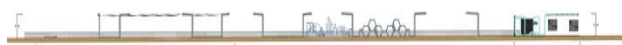


Figure 20. Vertical Section drawing of proposed design model on Thang Long sidewalk

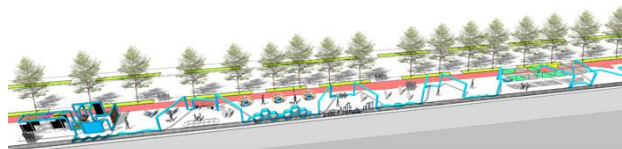


Figure 21. Perspective drawing of proposed design model on Thang Long side



Figure 22. Perspective view of proposed design model on Thang Long sidewalk

5. Conclusions

Based on the questionnaire results, it was found that there is a demand for a public open space that promotes social recognition. The goal is to create a space that benefits both residents and tourists and prioritizes human needs. This should be achieved through pro-social and life-enhancing activities rather than just passive recognition or interaction.

Regarding the idea, the authors took inspiration from the most distinctive features of Danang and filtered them

into an idea that gives a unique character to this area. A typical example is the Dragon Bridge or APEC Statue Park, which runs a continuous steel structure from one side to the other. Therefore, the authors proposed 3D steel structures that can withstand Danang's climate for this project, with the characteristic of a continuous line starting from a static area, transitioning to a kinetic space, and ending at an exhibition area. This modular design can also be copied anywhere that suits the dimension as well as the ethnographic character of the place in Danang city.

This proposed public design model can be used by not only residents as well as tourists in general. It offers a straightforward but connected zoning and tight organization, which is:

- Static space where a peaceful space is for those who prefer personal relaxation.
- Kinetic space that offers various types of outdoor activities for everyone, both daytime and night
- Exhibition space people is where students, artists, or anyone can display their work to the public. Also, a small exhibition space for disabled people is carefully provided. It is called the sensory polygon space, where they can move their senses, feel more comfortable, eliminate self-consciousness, and integrate into the community.
- In terms of parking, in addition to the available parking lot nearby, the team proposed the government draw lines and mark the road so that everyone can park and access the space as quickly as possible.

The proposed design solution addresses the issue of creating a harmonious environment between humans and nature; however, the rainy season or summer daytime may limit the usage of the area. The municipal government might require sustainable solutions for rain and sun protection for further sofiscation in the future.

REFERENCES

- [1] T. Banerjee, "The Future of Public Space: Beyond Invented Streets and Reinvented Places", *Journal of the American Planning Association*, vol. 67, no. 1, pp. 9-24, 2001.
- [2] UN U., *Sustainable Development Goals-17 goals to transform our world.*, United Nations, 2015.
- [3] UN. Secretary-General, *Progress towards the sustainable development goals: Report of the Secretary-General*, New York, 2017.
- [4] B. W. Stanley, B. L. Stark, K. L. Johnston, and M. E. Smith, "Urban Open Spaces in Historical Perspective: A Transdisciplinary Typology and Analysis", *Urban Geography*, vol. 33, no. 8, pp. 1089-1117, 2012.
- [5] M. Carmona, "Contemporary Public Space, Part Two: Classification", *Journal of Urban Design*, vol. 15, no. 2, pp. 157-173, 2010.
- [6] C. D. Magalhães and M. Carmona, "Innovations in the Management of Public Space: Reshaping and Refocusing Governance", *Planning Theory & Practice*, vol. 7, no. 3, pp. 289-303, 2006.
- [7] S. Campbell, "Green Cities, Growing Cities, Just Cities? Urban Planning and the Contradictions of Sustainable Development", *Proc. Int. Conf. on Name*, 62, no. 3, pp. 296-312, 1996.
- [8] L. A. Staeheli and D. Mitchell, "Locating the public in research and practice", *Progress in human geography*, 31, no. 6, pp. 792-811, 2007.
- [9] M. Carmona, "Principles for public space design, planning to do better", *URBAN DESIGN International*, vol. 24, pp. 47-59, 2019.
- [10] B. Plummer and D. Shewan, *City Gardens: An Open Spaces Survey in the City of London*, Belhaven Pr, 1992.
- [11] M. Hasan, "Influence of Rules on User Behavior in Public Open Space of Hong Kong", *Architecture Research*, 10, no. 4, 102-108, 2020.
- [12] S. M. A. Haq, "Urban green spaces and an integrative approach to sustainable environment", *Journal of environmental protection*, vol. 2, no. 5, pp. 601-608, 2011.
- [13] D. Rojas-Rueda, M. J. Nieuwenhuijsen, M. Gascon, D. Perez-Leon, and P. Mudu, "Green spaces and mortality: a systematic review and meta-analysis of cohort studies", *The Lancet Planetary Health*, vol. 3, no. 11, pp. 469-477, 2019.
- [14] P. James, R. F. Banay, J. E. Hart, and F. Laden, "A review of the health benefits of greenness", *Current epidemiology reports*, vol. 2, no. 2, pp. 131-142, 2015.
- [15] D. C. CABE, *The value of public space*, Design Council CABE (United Kingdom), 2014.
- [16] F. Ugolini, *et al.*, "Effects of the COVID-19 pandemic on the use and perceptions of urban green space: An international exploratory study", *Urban forestry & urban greening*, vol. 56, 126888, 2020.
- [17] Habitat U, *Cities and Pandemics: Towards a More Just, Green and Healthy Future*, UN Habitat, 2020.
- [18] C. Cartier and A. A. Lew, *Seductions of Place: Geographical Perspectives on Globalization and Touristed Landscapes*, Routledge, London, 2005.
- [19] F.-J. Monclús, "The Barcelona model: and an original formula? From 'reconstruction' to strategic urban projects (1979-2004)", *Planning Perspectives*, vol. 18, no. 4, pp. 399-421, 2003.
- [20] G. Cullen, *The concise townscape*, Routledge, London, 1995.
- [21] A. Vachet, "Henri Lefebvre, Le droit à la ville. Collection Société et Urbanisme. Paris, Anthropos, 1968, pp. viii, 166", *Canadian Journal of Political Science/Revue canadienne de science politique*, vol. 1, no. 4, pp. 472-474, 1968.
- [22] World Charter for the Right to the City, 2005. Website of UNESCO. Available: http://portal.unesco.org/shs/en/files/8218/112653091412005_-_World_Charter_Right_to_City_May_051.doc/2005++World+Charter+Right+to+City+May+051.doc. [Accessed: 14 February 2022].
- [23] K. Malone, "Street life: youth, culture and competing uses of public space" *Environment and Urbanization*, vol. 14, no. 2, pp. 157-168, 2002.
- [24] A. Light and J. M. Smith, *Philosophy and Geography II: The Production of Public Space*, Rowman & Littlefield Publishers, 1997.
- [25] R. Sennett, *The conscience of the eye: the design and social life of cities / Richard Sennett*, New York: Knopf: Distributed by Random House, 1990.
- [26] D. Mitchell, "The End of Public Space? People's Park, Definitions of the Public, and Democracy", *Annals of the Association of American Geographers*, vol. 85, no. 1, pp. 108-133, 1995.
- [27] M. Carmona, C. Magalhães and L. Hammond, *Public Space: The Management Dimension*, London: London: Routledge, 2008.
- [28] J. Nemeth, "Controlling the Commons How Public Is Public Space?", *Urban Affairs Review*, vol. 48, no. 6, pp. 811-835, 2012.
- [29] M. Carmona and F. Wunderlich, *Capital Spaces: The Multiple Complex Public Spaces of a Global City*, Routledge, 2013.
- [30] G. Shi, Z. Liu, H. Ban, Y. Zhang, Y. Shi and Y. Wang, "Tests and finite element analysis on the local buckling of 420 MPa steel equal angle columns under axial compression", *Steel & Composite structures*, vol. 12, no. 1, pp. 31-51, 2012.
- [31] H. Ban, G. Shi, Y. Shi and Y. Wang, "Overall buckling behavior of 460 MPa high strength steel columns: Experimental investigation and design method", *Journal of Constructional Steel Research*, vol. 74, pp. 140-150, 2012.
- [32] R S. Manufacturing, Q345 Steel | Equivalent Materials & Metal Specifications, 2020. Available: <https://redstonemanufacturing.com/q345-steel>. [Accessed: 14 February 2022].
- [33] L. Gardner, "The use of stainless steel in structures", *Structural Engineering and Materials*, vol. 7, no. 2, pp. 45-55, 2005.
- [34] T. V. T. Nguyen, H. Han, and N. Sahito, "Role of Urban Public Space and the Surrounding Environment in Promoting Sustainable Development from the Lens of Social Media", *Sustainability*, vol. 11, no. 21, 5967, 2019.
- [35] H. D. Anh, "Principles for forming urban green space systems", *Newspaper of Construction*, 2016. <https://baoxaydung.com.vn/cac-nguyen-tac-hinh-thanh-he-thong-khong-gian-xanh-do-thi-184767.html> [Accessed: 14 February 2022]