

The design and renovation for urban pocket park based on biophilic concept——A case of Larkin Street Park, Sydney, Australia

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Abstract. Urban parks are vital places for the protection of urban biodiversity and the environment, and their design and ethos are also relevant to the quality of life and human well-being in urban areas. With the development of cities and the improvement of the living standards of the people, some existing parks and open spaces have been unable to meet people's various needs for urban living environment, so the redesign and renovation of urban parks and open spaces has become a topical issue in the fields of architecture and urban planning. This study selected an urban pocket park in Sydney, Australia, as a case to explore a new approach to designing urban spaces – introducing biophilic concepts to address practical development needs. The case study also demonstrates the great potential and possibilities of biophilic concepts in improving the quality and appropriateness of urban spaces and environments. In addition, this study attempts to integrate the biophilic concept with the design and renovation of existing urban pocket parks and explore the characteristics and feasibility of the concept in terms of different functional areas and details. The significance of this study is not only to test the possibility of combining biophilic theory with urban spatial planning principles, but also to provide practical experience and suggestions for future construction and development of designs that are dominated or inspired by natural elements.

Keywords: Pocket park; biophilic design; urban and regional design; renovation design.

1. Introduction

Since the global large-scale urban construction and rapid urbanization process at the beginning of the 21st century, numerous cities have seen unprecedented scale and speed of development in terms of economy, industry, population and urban area, the urban appearance is changing with each passing day. At the same time, as an essential part of urban space and environment, the design of urban parks and open spaces are changing with the development and needs of the city in different stages [1]. Parks and open spaces play a critical role in the conservation of the urban environment and biodiversity, but also providing recreation and activities for urban residents. In terms of development trends, design strategies and future trends for small urban open spaces in many developed countries are moving in the direction of combining sustainable and nature-friendly concepts with practical functionality.

However, due to the influence of various local policies, planning strategies, construction budgets and other factors, some of the pocket parks that have been built have gradually failed to meet the rapid growth of the city and the diverse needs of local residents. There are problems including lack of design features, limited functions and lack of maintenance of infrastructure. Since these problems are becoming increasingly prominent, some scholars have carried out relevant research and analysis. Sadeghian and Vardanyan summaries and review the evolution, types and functions of urban parks [2]. Ibes and Sarhan et al. explore the potential and role of urban parks in terms of sustainability [3, 4]. However, these studies only discussed the future development trend and problems of urban parks from their perspectives, but did not specifically discuss the design and renewal of existed pocket parks. Therefore, in order to find effective solutions to this problem, a case was picked at Larkin Street Park located in Sydney, Australia, with the combination of biophilic concept, this study conducted an in-depth study on the design and renovation of urban pocket park.

In order to seek effective ways of working with nature and achieving sustainable urban development, this study will attempt to apply the biophilic concept to the design and renovation of

small urban open space, with the aim of creating a back-to-nature park experience in the city, and to explore the potential of biophilia to optimise the function of urban open spaces, enhance spatial design features and achieve sustainable development in the future. In addition, the study adapted the SOWT analysis to critically reflect on proposed renovation proposals and suggested future applications of the biophilic concept and planned development of urban spaces.

2. Biophilic concept and urban regional planning principle

2.1. Biophilic concept and applications

The biophilic concept originated from the research on psychology and human behavior in the 1960s, and was used to describe an instinctive human need to connect with nature or other life forms in the subconscious [5]. Subsequently, this concept was first proposed by Edward O. Wilson as the biophilia hypothesis, which holds that human beings have an instinct to seek contact with nature and other life [6]. In the field of architecture and design, biophilic design is an important approach to achieving sustainability and establishing a connection between humans and nature. It could not only meet people's needs to seek a connection with nature, but also have a positive impact on people's physical and mental health [7]. Furthermore, some related studies have proved that people will have additional advantages when they have a stronger connection with nature [8]. With the current development of the city and the improvement for the human's quality of living environment, this theory has been gradually applied to the contemporary design to improve the quality of urban buildings. The biophilic design is also considered to be a sustainable design strategy, based on which green buildings and nature-friendly spaces could have a positive impact on human health, as well as increasing productivity, creativity and clarity of thoughts [9, 10].

In recent research, Browning et al have proposed a theoretical framework for linking human bioscience and nature to the design of the built environment, based on an analysis of application examples of biophilic design over the years [11]. This framework consists of 14 biophilic design patterns and is used to specify design criteria and elements related to the biophilic concept (Fig. 1). Additionally, these 14 patterns can be divided into three categories, which are Nature in the Space Patterns, Natural Analogues Patterns and Nature of the Space Patterns. These categories cover nearly all the ways in which humans perceive nature, such as material, line, appearance, water, risk, vegetation, landscape, and more. From this theoretical framework, this study selected some forms suitable for the application in pocket parks, and integrated and innovated them with the new design and renovation methods of urban open space.

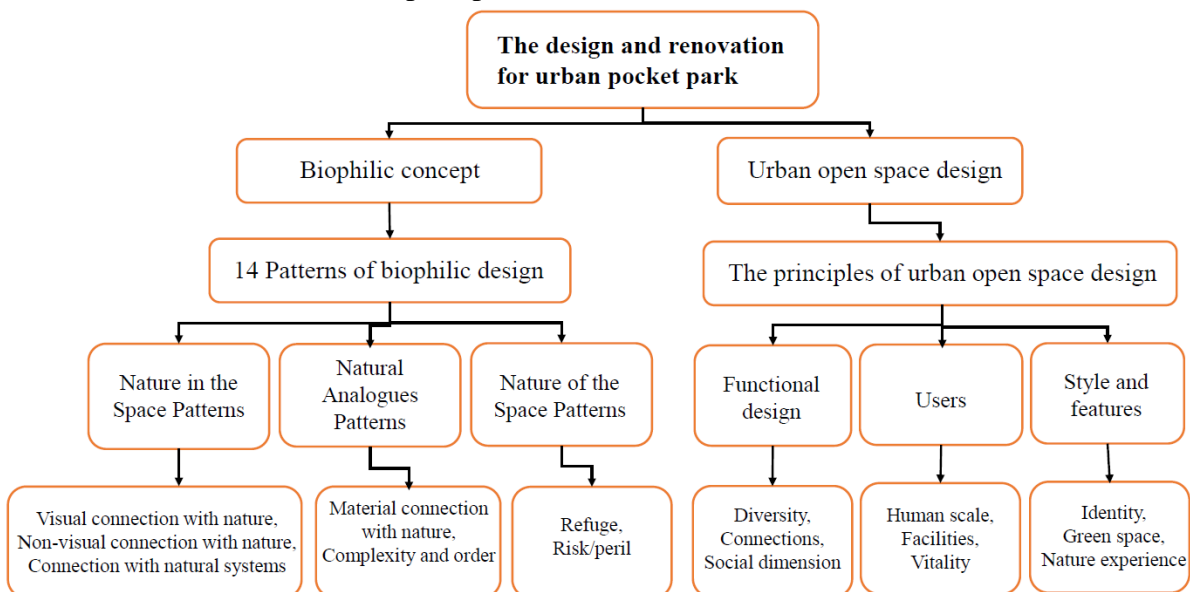


Fig. 1 The theoretical framework

2.2. Urban open space design principle

The design and theoretical development of urban open space entered a modern phase in the twentieth century, which was mainly focused on functional zoning and regional specialization [12]. Nevertheless, the twenty-first century has seen the emergence of urban open space design theories that focus on emerging concepts such as sustainability and human scale, rather than focused on specific purposes and functions [13]. Therefore, this study suggests that future trends for urban open space design will gradually integrate with the biophilia, and explore the potential of biophilic design in balancing the urban ecology and improving the quality of life for people. Additionally, the adoption of the biophilic concept as a design and renovation approach for urban park projects is novel, with few examples and no adequate theories and standards. In order to fill this gap in the field and demonstrate the effectiveness of biophilic concept, this study will introduce the existing basic principles of urban open space design and categorise them into functions, users and style and features for specific research [14]. Based on these classifications, some further specific elements are derived, which include different functional zoning, connectivity, social activities, human scale, amenities, etc. (Fig. 1).

2.3. Theoretical combination and innovation

For the purpose of incorporating biophilic concepts into the design and renovation of urban pocket parks, this study will focus on the application of these biophilic design patterns to the study area. For example, in the design of functional zoning, the form of Visual Connection with Nature can be expressed through the contours of areas and the form of paths. While curved and geometric lines are commonly used in the planning and design of urban open spaces, the introduction of biophilic concepts to optimise such designs creates a more intuitive visual and realistic experience of the natural environment.

Besides, one aspect that is easier to integrate and implement is the combination of the pattern of Material Connection with Nature with facilities. In the design methodology and results of this study, more public facilities and decorative materials for the interior of the pocket park were selected from existing materials in nature, such as wood, clay, and marble. The frequent use and shaping of these natural materials in this space can not only reflect the local ecology or geology, but also create a unique sense of locality [11].

3. The Pocket Park design and renovation

3.1. Design principles and case studies

3.1.1 Design principles and concepts

This research will combine biophilia theory of architecture and space design with the concept of urban open space to renew the existing urban pocket park and create a return to nature experience for the users. Firstly, this study will be based on the urban background and surrounding environment of the research site, so as to further determine the types and needs of users. Moreover, the site's internal functional zoning, spatial structure and vegetation layout were specifically planned and designed in accordance with existing urban planning policies and development requirements. In terms of design and intervention methods, this study will follow the 14 biophilic design forms proposed by Browning et al. [11]. Ultimately, the effect of the pocket park will be designed around the area divisions of relaxation, recreation and socialization.

3.1.2 Case studies of typical pocket parks

In order to achieve better design results for pocket parks, two representative cases were selected for analysis in this study, and their inspirations and approaches will be combined and innovated with the design and renovation of the study area.

The functional sculptural White House in Waiblingen, Germany is a project designed by the J. MAYER H. Architects' studio team in 2019 (Fig. 2) [15]. The design concept of the building reflects a contemporary understanding of a classic architectural house form that also communicates with its natural surroundings. The sculptural lines (folds and curves) are inspired by the saddle roof and the flowing objects of nature, thus echoing and reflecting the surrounding architecture and natural environment. In view of the special effect of this design approach, this study will attempt to adapt and enhance the design lines by using sources from nature and the surrounding architecture.



Fig. 2 White House, Waiblingen, Germany [15]

Located in Sydney, Australia, Balfour Street Pocket Park is a gathering space designed by Jane Irwin Landscape Architecture (JILA) and the local government for local resident (Fig. 3) [16]. While retaining the original design concept, JILA's renovation design further incorporates human scale and details related to nature and local characters. In addition, the project has achieved a better balance between simple spatial structure and fun, such as the multiple use of brick materials and special site planning. Overall, the project demonstrates that the design of a pocket park should not only consider its urban context, but also be studied through details, materials and functionality.

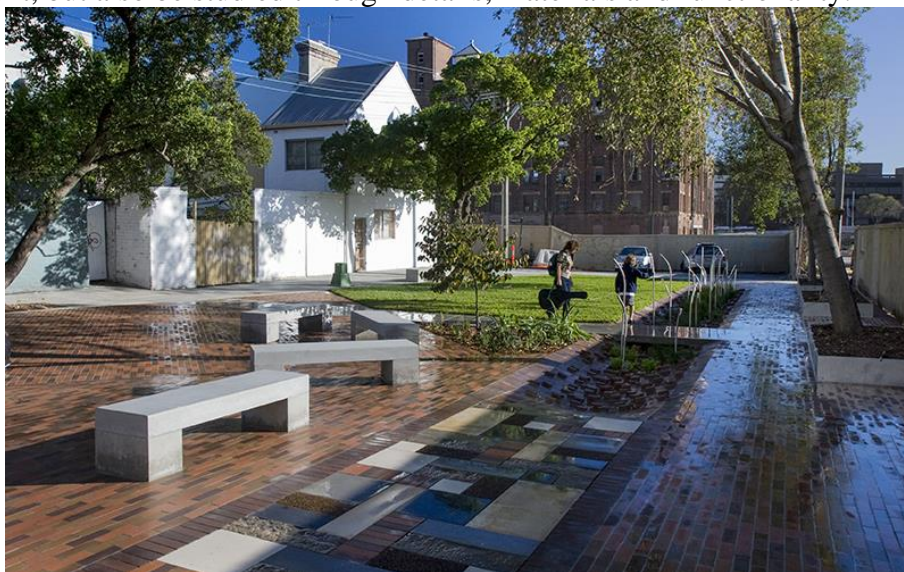


Fig. 3 Balfour Street Pocket Park, Sydney, Australia [16]

3.2. Site analysis and existing problems

To flesh out the design concept for this study, a community pocket park in Sydney, New South Wales (NSW), Australia was selected as the study area (red dotted area in Fig. 4). The park covers an area of approximately 1100 square metres and is located approximately 6km from the city centre, with the University of Sydney to the south and a commercial centre to the east. The land zoning map in Fig. 4 is drawn according to the land zoning plan of the NSW Government, which shows that the park is mainly surrounded by residential and mixed-use areas [17]. Regarding of further identify the types of users, the service area radius of the pocket park was set at 200m, which was increased based on Kounadi's criteria for park service studies [18]. Although Kounadi's research set the service radius of community parks and pocket parks to 150 metres, this study increased the service radius of pocket parks by 50 metres, taking into account the different study years and urban scale. As a result of that, within the scope of this service area, the main user groups are nearby residents, college students, teenagers and children.

The study also investigated and analyzed the conditions of the site and user feedback to ensure that the new design is distinct and applicable. According to Fig. 5, there are two open entrances to the area, located at sites 1 and 5, both of which are connected to the external footpath. The interior of this pocket park consists of a circular rest area, seating areas on either side of the road and a multi-seat social area, corresponding to site 2, 3 and 4 respectively (Fig. 5). Based on current user feedback and observational analysis, there are obvious problems with this pocket park: for example, there are no areas for young people and children to play and exercise, the overall design of the park lacks character and appeal, and the public facilities are outdated.

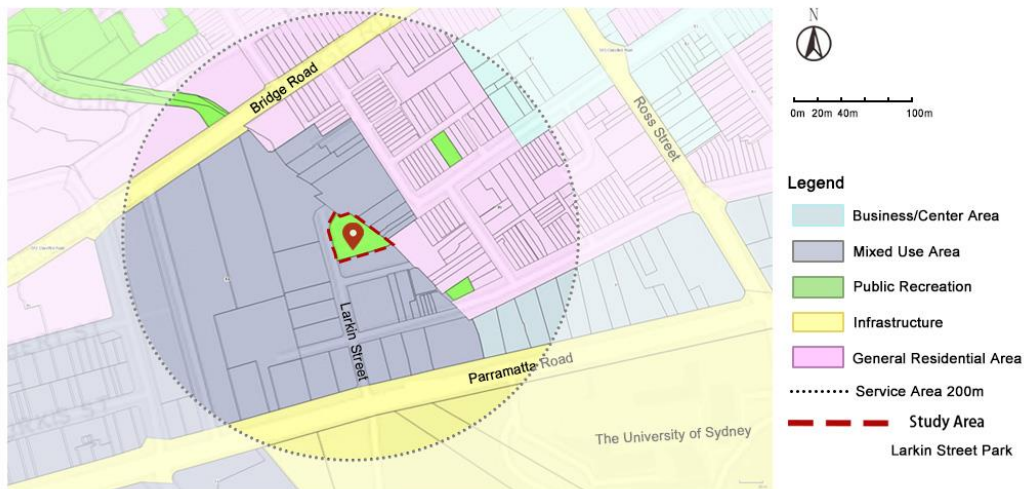


Fig. 4 Land zoning map and service area of Larkin Street Park

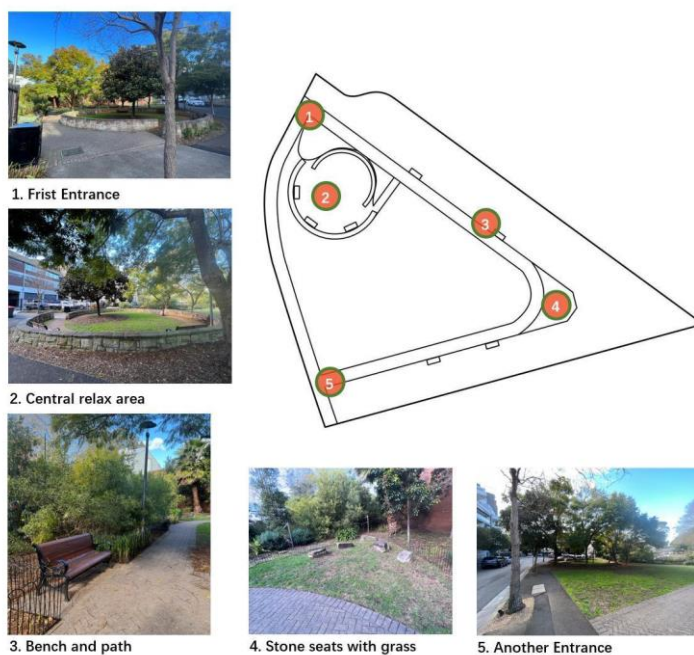


Fig. 5 Current floor plan and situation of Larkin Street Park

In addition, this research analyzed the current vegetation and landscape design of the park. Fig. 6 shows that although this park has a high green rate, there are still some problems: (i) Less diversity of plants, with only a few common types of arbores and shrubs; (ii) No flower plants, lack of other seasonal plants and canopy trees; (iii) Some ground surfaces are soil and concrete; (iv) Limited in layers and variation.



Fig. 6 Current vegetation of Larkin Street Park

3.3. Functional zoning and design inspirations

Based on these analytical results and existing problems, this study redesigned the functional area of the site. Fig. 7 illustrates a new functional zoning consisting of relaxation, activity, and social zones. In the following design, a consistent biophilic style will be adopted to provide renewal for different functional areas and build positive interactions between them.

As for design inspiration, the new design draws on biophilic concepts and some natural design theories for ideas and inspiration. The forms and structures of the space are mostly inspired by certain natural elements, such as water ripples, ocean waves, forest trees, and mountains. The lines and

feelings obtained from these natural elements will be used to create the different appearances of the whole park. Next, in terms of materials and details, the refuge of the forest and natural stone seating are selected as the main objects of inspiration, which usually bring a sense of security, comfort and calm [11]. Finally, special plants, such as climbers, are used to decorate the frames behind the benches, with the aim of making the space peaceful and fresh for the user.

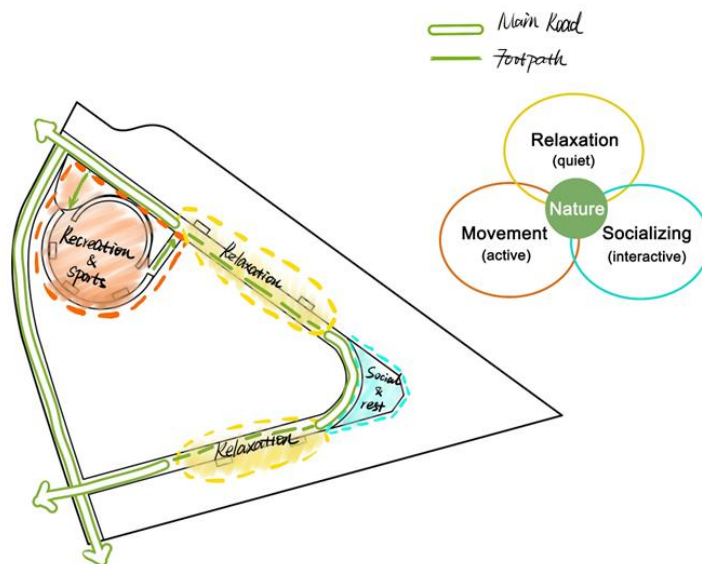


Fig. 7 The design of functional zoning

3.4. Design models and intended renovation results

3.4.1 The design and renovation of relaxation area

The Fig. 8 shows the final version of the design model (made by Rhino) and the intended effect results. The spirit of the previous layout and design of the relaxation area is preserved in the new plan and further enhanced by bringing in natural elements and details related to the human scale. In other words, the main rest seats are still set on both sides of the road, and the outer vegetation is appropriately separated with fencing. In terms of location and number, based on human-scale standards in urban open spaces [14], the road distance between benches was limited to 50 meters, and their number was increased to five to improve user accessibility and comfort (see map in Fig. 8 for specific locations).

In the design process, this study used hand-drawn sketches, mind maps, and Rhinoceros software modeling. The preliminary models based on hand-drawn sketches are shown in the gray-and-white images on the left of Fig. 8, with the remaining parts being the expected renovation effects. The final design has also taken reference from the design approach in the first case study (Fig. 2), using folds and curves to make the frame behind the bench into the shape of a mountain. And, to create a sense of refuge, the three frames have been rotated at an angle of 10-15 degrees to create a wraparound enclosure.

As for the fence, it was designed as an open fence made of multiple planks of varying heights, and an aesthetically pleasing curve was created by varying the height of these planks. Moreover, the hollow structure of the fence ensures functionality while adding interest to the user's view of nature from multiple perspectives. For example, facing the fence reduces the feeling of obstruction, while facing sideways provides an enveloping feeling. Finally, in terms of materials and decoration, common elements of nature such as wood, stone and climbing plants were chosen. These details complement each other and make the overall design more nature-friendly and lively. Overall, the new design not only demonstrates some of the patterns of biophilic design, but also greatly enhances the comfort and aesthetics of the environment. This design also results in a relaxing, comfortable and quiet space in the relaxation area.

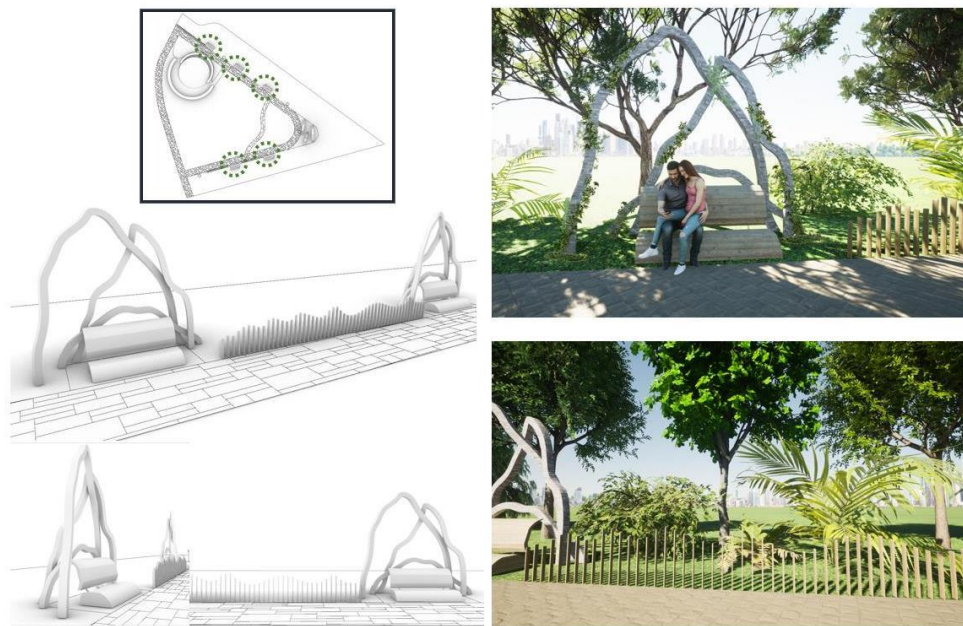


Fig. 8 The design of benches and fencing in relaxation area

To create a connection between the two relaxation areas and to enhance the user's experience of nature, a new path was added to the grassland in the middle of the park, which is similar in form to a winding river and is decorated with a stone surface (Fig. 9). Besides, flowers and plants have been added to the sides of the path, making it possible for users to experience nature from multiple senses as they walk. The original path surface was also redesigned with a light-colored stone surface to echo the natural design concept.

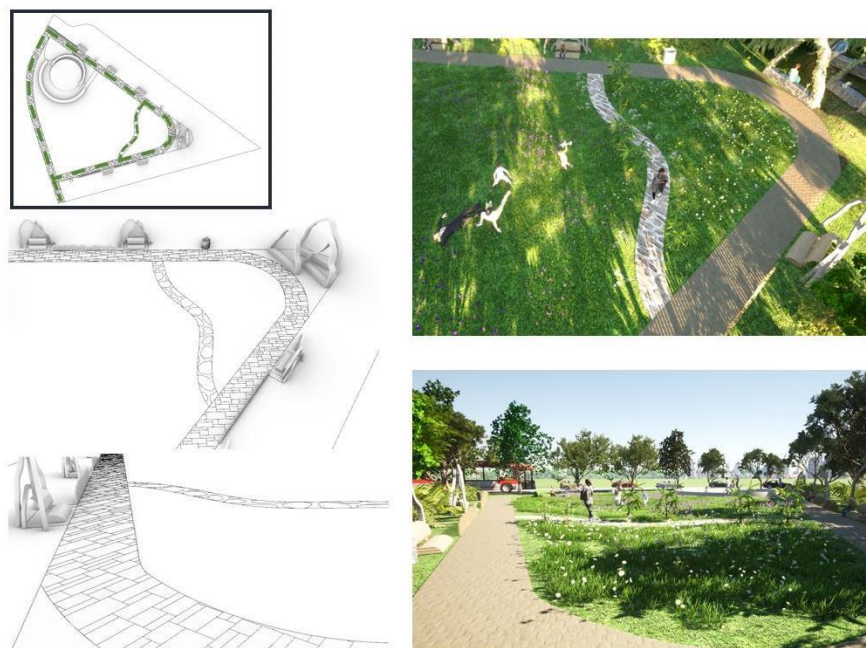


Fig. 9 The design of new path and paving patterns in relaxation area

The new design also focuses on the transformation of some of the facilities and details. In the central grass area, this design uses clay to create the shape of an outdoor sofa, with grass or shrubs laid on the surface (Fig. 10). As a result, it will shape the natural seating for people to relax and entertain. The redesigned bin combines its original shape with a type of wood material that contains an inner tube made of stone and an outer layer made of the same wood planks as the fence. To reveal the concepts of sustainability and natural vitality, the planks spiral in height in curves and incorporate some climbing plants. These facilities are designed to reflect the concepts of sustainability, renewable

energy and recyclability. Specifically, after effective classification and treatment of some organic wastes discarded by users, those organic wastes can become valuable fertilizer for agricultural soil and natural plants [19]. As a result, waste that is collected and used in a suitable way can become a new resource for nature and humans that was previously reflected in the current design. The study hopes to encourage people to think about their own behavior and the natural environment through such design details, which also respond to the central idea of the whole design: the friendly relationship between humans and nature.

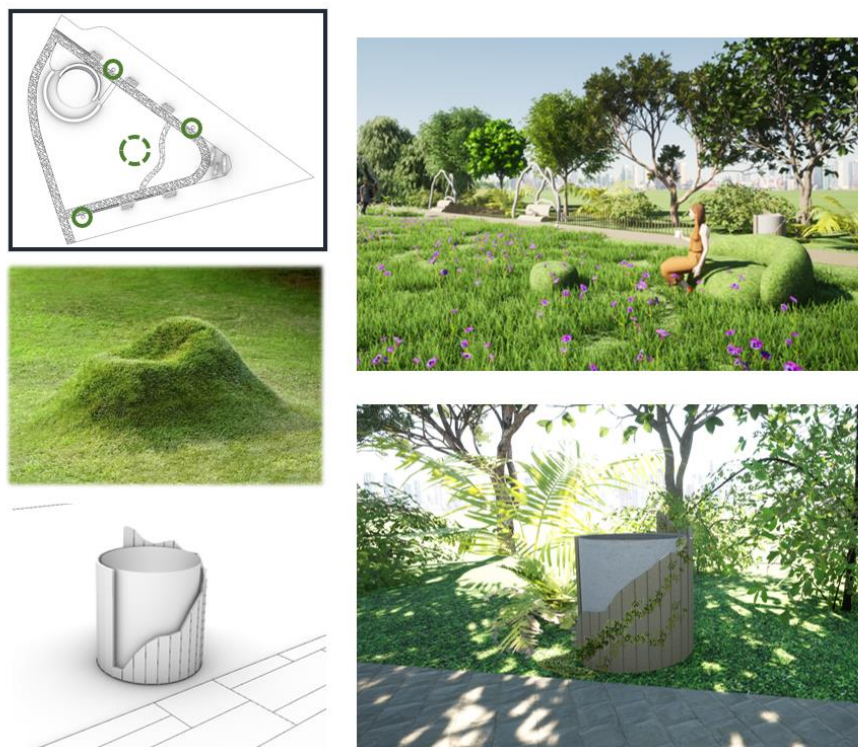


Fig. 10 The design and renovations of public facilities

3.4.2 The vegetation layout design

The final part of the relaxation area design is the vegetation layout and types. The vegetation not only completes the whole natural design of the park, but is also an essential foundation of the local ecosystem. According to Tree Advisory Board, the benefits of growing trees and plants are not limited to shading and beautifying the landscape, but also purify the air, insulate against noise and support the soil [20]. Therefore, this part has been given more attention in new design, and it is divided into categories, dynamic and hierarchical for design and intervention. In the vegetation layout map of Fig. 11, the new design reasonably adds some plant species and quantities to the original vegetation, such as deciduous trees and green shrubs. In terms of dynamics and hierarchy, Serwach & Joe and Browning et al both demonstrated that plants have numerous direct and indirect positive effects on people, so the current design also considers the characteristics of different plants [11, 21]. For example, additional floral plants that bloom and emit fragrance in certain seasons have been added to the grass in the middle of the park.

The new design addresses the problem of lacking hierarchy by adjusting the height and location of the plants. Three types of tall arbor trees are planned for the edges, while medium-height shrubs are placed closer to paths and seating areas. Furthermore, flowers and plants are designed in the middle of the grass to add layers and vibrancy to the landscape. As an example, the cross-section image at the bottom left of Fig. 11 shows the use of different plants in the area from point A to point B to create a sense of hierarchy and aesthetics. The height and density of plants are lower on the sides near the road, while the height and density of plants near the interior and edges of the site are adjusted according to the facilities and landscape. With the new vegetation design, the general appearance of the park will be closer to nature and more impressive.

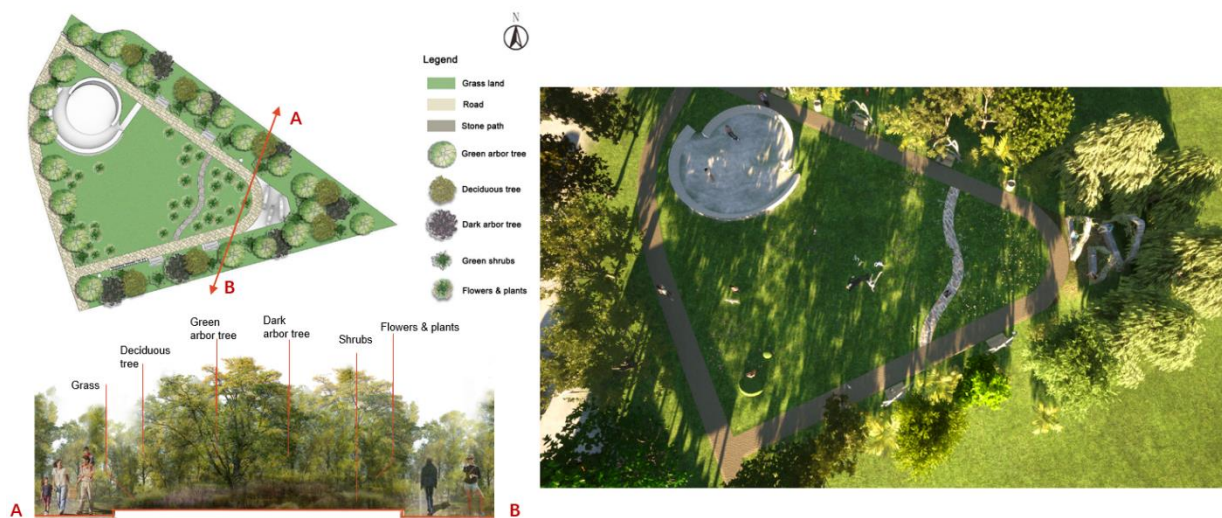


Fig. 11 The vegetation layout design

3.5. SWOT analysis and critical thinking

This section further analyses the future viability and applicability of the proposed design solution in the context of biophilic concepts, using the framework of SWOT analysis for critical reflection. In this framework, the internal and external influences on the design proposal are categorised as Strengths, Weaknesses, Opportunities, and Threats, and these results are helpful for the next step of decision making and the study of the future reconstruction plan [22]. Table 1 summarises the internal advantages and disadvantages of the design. Despite the lack of safety and drainage concerns, the plan shows many obvious strengths, such as high-quality design, a better natural environment, and integrated spaces for rest and recreation. According to the open space program investment plan issued by the NSW Government, further recent constructed and renovated open spaces are expected to be built for the use of the residents, which may bring more opportunities and possibilities for the redesign and renovation of the site [23]. Most of the constraints come from the budget and post-renovation maintenance costs of the new facility, as well as the location of the site.

In summary, although the new designs and plans presented in this study have some drawbacks and constraints, they still offer more benefits and sustainability than the current ones and have greater potential and possibilities for future research and development.

Table 1. The SOWT analysis of design application in Larkin Street Park

SWOT Analysis			
Strengths	Weakness	Opportunities	Threats
High quality design with sense of locality and nature Diverse vegetation and high greening rate Enrich the preceding layout and functions More space for relaxation and recreation Connect to communities and services Gathering space for local residents	Lacking further design for activity and social areas Not consider the safety and accessibility of new facilities Water drainage during the rainy season and urban flooding The difficulty of demolition and reconstruction	NSW Government open space program support Utilization value of the remaining space New design in old settings Possibility of water features and interactive landscapes in the future More attractive and competitive	Budget and loads of work for reconstruction Maintenance and management of public facilities Competing with nearby open spaces Adjacent street limits more connectivity Feasibility of new materials

4. Conclusion

This study innovatively combines the concept of biophilic with the design and renovation of urban pocket parks, and discovers the possibility of applying the concept in regional planning, landscape design and natural buildings. In the context of climate change and urban renewal trends, the time is ripe to integrate biophilic concepts into the design and renovation of urban areas. This is not only because biophilic design can improve environmental and architectural quality, but also has great potential for sustainable development of urban environments and human well-being. Reviewing the evolution and future trends in urban spatial planning and design, this study suggests that the biophilic concept can be applied to the improvement and enhancement of more urban environments than just pocket parks. The benefits of this design concept are obvious, and the renovation plan of the urban pocket park design in this study also confirms this view. After introducing the concept of biophilic, the original functions and space of park are preserved, and extra elements from nature are added, thus creating a green space that can balance the negative impact from city and high-level human happiness. In other words, it has the potential to provide residents who are surrounded by intense and fast-paced urban life with a quick break and a natural pleasure. Although the concept of biophilic design and the need for sustainability are rarely addressed in mainstream urban pocket park design, it seems imperative to incorporate and benefit from this concept into future urban design. Finally, this study believes that the effectiveness and feasibility of this combined approach can be verified by further practice and exploration in some small open spaces or sites.

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