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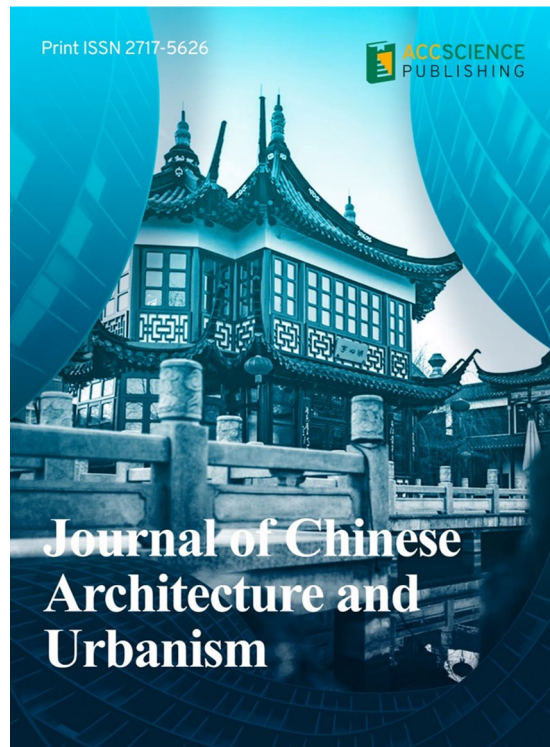
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A typical Chinese-styled building

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ORIGINAL ARTICLE

Constructing geographical and architectural
imaginations: The China-aided assembly
buildings in Africa, 1960s – 1970s

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Abstract

China's exports of architectural designs to numerous countries in Asia and Africa during the Mao era generated significant tensions regarding the necessary geographical knowledge. As many of these countries are situated in tropical regions, understanding and responding to the unique hot, humid or dry climate conditions was crucial for successful transnational architectural production. This article situates the practical knowledge generation process within a complex process of political, institutional, individual, and intellectual interactions, examining the role of Chinese architects and technocrats in constructing geographical and architectural imaginations for China-aided projects built in Africa. Specifically, in this article, two case studies of assembly buildings erected in Guinea (1967) and Sudan (1976) are presented to demonstrate Chinese efforts to address the climatic, cultural, and practical requirements of architectural aid. Through political negotiation, personal observation, onsite visits, media publication, and scholarly exchange, Chinese professionals constructed geographical and architectural imaginations in Africa, creating modernist architecture that retained a particular sense of place and time, thereby reflecting continuity and transformation of their domestic work. These subjective imaginations were shaped by the combination of economic rationality and technical expertise, manifested in the selection of appropriate site, climate responsive designs, materials, technologies, cultural articulations, and economic considerations. The aided buildings, as embodiment of the Chinese professionals' geographical and architectural imaginations not only displayed a critical process of knowledge production situated within the physical, material world in the tropics, but also served as China's political engagement with Guinea and Sudan that aimed to interrogate existing structure of international order.

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1. Introduction

Recent scholarship has increasingly focused on the emergence and exportation of China-built architecture in Asia and Africa during the 1960s and 1970s, as a form of material aid (Ding & Xue, 2015; Liu, 2022; Roskam, 2015; Song, 2022; Xue & Ding, 2022). However, a fundamental question that remains under-examined is the historical, geographical, diplomatic, and cultural contexts under which Chinese architects designed foreign-

aid buildings. During the Mao era (1949 – 1976), China's primary diplomatic targets were countries in Asia, Africa, and Latin America, yet the Chinese possessed limited geographic knowledge of foreign countries, and few individuals had the opportunity to travel or study abroad. This limited accumulation of geographical knowledge had a significant impact on foreign-aid architectural practice. Furthermore, given that many countries receiving Chinese aid are situated in tropical regions, how did Chinese architects recognize, understand, and interpret tropical architectural culture? Finally, how does this cognitive process and personal expression inspire contemporary overseas practice? By exploring these questions, this article seeks to shed light on the complexities of China's foreign-aid architectural practices during the Mao era, and their ongoing significance in contemporary global architectural discourse.

From the 1950s to the 1970s, the People's Republic of China delivered numerous industrial, institutional, and civic projects to less developed countries, in the form of gratuitous material assistance, and low-interest and interest-free loans. These constructions substantially contributed to the recipient nations' economic, political, social and cultural development and well-being (Ding & Xue, 2015). However, China's architectural aid to many Asian and African countries during the Mao era presented considerable challenges regarding the necessary geographical knowledge. Designing buildings in vastly different social, political, and cultural contexts posed significant difficulties for Chinese professionals, including architects and technocrats, as their geographical knowledge of the tropics was very limited. Nonetheless, the political and economic nature of China's architectural aid afforded Chinese professionals opportunities to engage critically with these challenges. Properly applying geographical knowledge was a crucial precondition for discovering other forms of knowledge, including architectural knowledge. In this sense, the provision of architectural aid enabled Chinese professionals to develop a more nuanced understanding of the complexities and specificities of the tropics and contributed to the advancement of architectural knowledge in China.

According to Marxist geographer Harvey (2005), the production of geographical knowledge is associated with a diverse range of factors, including states, nations and empires, supra-national institutions, non-governmental organizations, the institutions of civil society, commerce, industry and corporate interests, the media and entertainment industries, tourism and travel, and the institutions of education and research. In this context, China's architectural aid can be viewed as a process of

producing geographical knowledge, entangled with numerous critical sites of knowledge production, such as state-power, organizational and financial institutions, design institutes, civil diplomacy, transnational travel, media publication, academic research, and embedded architectural design practice. Through the lens of "geographical imagination," this article examines how Chinese professionals produced geographical knowledge of the tropical region and applied this knowledge to develop architectural imagination.

To investigate the Chinese professionals' process of understanding and expressing geographical conditions and cultural identities in China's architectural intervention in tropical Africa, this article focuses on the analysis of two assembly (*huitang*) buildings, namely, the People's Palace in Guinea (1967), and the Friendship Hall in Sudan (1976). It is important to note that the selection of assembly architecture does not undermine the significance of many other building types such as industrial factories and agricultural training centers, which formed the cornerstone and backbone of China's architectural aid, and represented China's emphasis on economic independence (Liu, 2022). However, the assembly buildings possess unique characters that are highly relevant to the discussion of formal and political issues. Among the limited number of assembly buildings built during the 1960s and 1970s, the two projects render three remarkable features.

Politically, both projects were significant edifices in their capital cities, playing an indispensable role in the political life and international exchanges of each country, and marking a symbol of national independence and new order in international relations. Esthetically, both buildings can be regarded as the representatives of the most formally articulated modernist projects for each architect and their affiliated design institutes, and therefore, represent remarkable material and spatial legacies of Chinese, Guinean, and Sudanese architectural cultures. Architect Wang Dingzeng once emphasized that the Sudan Friendship Hall was his most satisfying work (Lou & Tao, 2017). The Friendship Hall has recently been listed in the proposed *Docomomo Sudan Chapter*. Globally, both projects demonstrated Chinese architects' alignment with international practice in the tropical regions and manifested the tension of global power competition during the Cold War (Friedman, 2015).

However, what made the two projects different is that the People's Palace was a result of "imagination with presence," as the architects designed the building on site, deeply exposed to the Guinean architecture past and present, including vernacular buildings, colonial heritages and Western and Soviet practices. In contrast, the Friendship

Hall was a result of “imagination with absence,” as the architects were not permitted to travel to Sudan and lacked local architectural references while creating the building in a politically marginalized status. Whereas the design of the People’s Palace tended to follow established rules and norms, including the function and layout of domestic precedents, as well as forms and languages of international works, the creation of the Friendship Hall presented new possibilities of formal and spatial compositions. Both projects exemplify the two oppositional implications of “imagination,” with one pointing to the imitation and reproduction of the existing, while the other referring to the creation of something out of nothing (Zhang, 2021).

In this article, the author begins by examining the definition and theoretical framework of geographical imagination, and then explores how the Chinese building professionals developed their geographic knowledge of the tropical area through methods such as personal investigation during field trips, studying the works of domestic and international peers, and engaging in individual reflection and creative exploration. To illustrate the application of these methods, the paper presents two case studies: the People’s Palace in Guinea, and the Friendship Hall in Sudan. In these case studies, the author analyzes how architects understood the tropical climate, articulated local culture and responded to the building site. Finally, the article discusses the implications of the principle of adaptation to local conditions (*yindi zhiyi*) and the incorporation of formal-aesthetic, social, and political values of imagination in China’s transnational architectural practice.

By engaging with political negotiation, personal observation, onsite visits, media publication, and scholarly exchange, Chinese architects and technocrats constructed their geographical and architectural imaginations in the context of China-aided assembly projects in Africa. Through the creation of modernist architecture that retained a particular sense of place and time, these transnational architectural endeavors profoundly contributed to the formulation and expression of an alternative physical and social space that sought both bodily and political emancipation. While politics played a significant role in determining the dissemination and approach of China’s architectural aid, the implementation of these projects was shaped by economic rationality and technical expertise. This was evident in the planning, design, construction, and operation of the projects.

2. Geographical imaginations of the tropics

The concept of the geographical imagination serves as a valuable tool for analyzing the relationship between

individuals and larger social and spatial structures. David Harvey’s discourse on geographical imagination was inspired by C. Wright Mills’ concept of the sociological imagination, but Harvey sought to complement Mills’ ideas by focusing on issues of space, place, and territory. Harvey (1973) claimed that “spatial consciousness” or “geographical imagination” enables the individual to “recognize the role of space and place in his own biography, to relate to the spaces he sees around him, and to recognize how transactions between individuals and between organizations are affected by the space that separates them.” The geographical imagination, for Harvey, allows people to “fashion and use space creatively and to appreciate the meaning of the spatial forms created by others.” In addition to Harvey’s ideas, other scholars have developed and refined the concept of the geographical imagination from various perspectives. For example, geographer Derek Gregory re-defined it as the spatialized cultural and historical knowledge that characterizes social groups (Gieseking, 2017). Overall, the term geographical imagination can be understood as “a way of thinking about the world and considering the relative importance of places and the relationships between ‘our’ places and ‘other places’ (Gilley, 2010, p.1221).”

The term geographical imagination encompasses a wide range of meanings, including individual mental images and socially produced discourses about cultures, spaces, and differences. How people see the world is influenced by various factors, including social class, education, and personal and political philosophies. It helps people to better understand the other part of the world, which refers specifically to tropical Africa in this article. While recognizing the significance of geographical imagination in social theory, the author introduces the concept of architectural imagination, which refers to the ability to search for an alternative form, space, and experience in architectural practice. Key to this notion, by paraphrasing what landscape architect Corner (2014) called “landscape imagination,” is the centrality of the imagination in both understanding and projecting new forms of architecture, as well as the tools and techniques available for such a task. Architectural imagination might consist of some or all of the following envisions, formal, material (Mindrup, 2015), environmental (Hawkes, 2020), topographical, and experiential (Pallasmaa, 2014), among other aspects. While Harvey argues that the philosophy of social space could connect the geographical and sociological imaginations, the author proposes that space, whether physical or social, can link architectural imagination to geographical imagination. Both concepts share a common goal of promoting alternative spaces for social transformation and spatial justice.

Western colonial powers developed their understanding of the tropics through a combination of travel, exploration, scientific research, and conquer. The knowledge they produced through texts, drawings, and mappings significantly influenced European vision of the region (Driver & Martins, 2005). In contrast, the Chinese journalists, diplomats, and building professionals were among the first to develop an understanding of the tropical area. They did so through visits and the use of geographical and architectural imaginations, which were expressed through various media such as texts, drawings, and buildings. These imaginations of the tropics were interwoven with a range of cultural, social, and political knowledge.

2.1. The production of geographical knowledge of Africa

The emergence of geographical knowledge of Africa in the early period of the People's Republic of China was closely tied to political objectives and was a product of diplomatic engagement. China's participation in the 1955 Bandung Conference (Asian-African Conference) helped many Asian and African countries to establish a new understanding of the People's Republic of China. In the late 1950s and early 1960s, independence movements were surging in Africa, and China showed sympathy and support for countries resisting European colonial rule and U.S. imperialism. China's engagement with newly independent countries often included material and economic aid, opening up diplomatic relationships between China and a number of Asian and African countries.

For example, Guinea was the first sub-Saharan African country to establish diplomatic relations with China in October 1959, and received 15,000 tons of rice from China a few months later (Meng, 2020). Guinean President Ahmed Sékou Touré was the first African head of state to visit Beijing in September 1960, and he received a warm welcome from the Chinese government. During his visit, China's state-sponsored *Renmin ribao* (People's Daily) and *Renmin huabao* (People's Pictorial) devoted a significant amount of space to introduce Guinea's basic circumstances through rich illustrations (photographed by Xinhua journalists and photographers based in Conakry) and texts, marking the first comprehensive publication of the newly independent Guinea in China (Anonymity, 1960 September 11) (Figure 1).

In addition to the initial exchange of visits between high-level officials, non-governmental diplomacy between China and Africa also played a crucial role in deepening mutual understanding. In April 1960, for example, the Chinese delegation participated in the second Afro-Asian People's Solidarity Organization Conference (AAPSO)

held in Conakry, Guinea, contacted representatives of Asian and African countries, and actively promoted China's propositions and policies (Jin, 1960). During this period, the Chinese Acrobatic Art Troupe visited Guinea, and showcased the exquisite skills of Chinese artists to the Guinean people (Zhou, 1960). Several months later, in late 1960, the China Economic Construction Achievement Exhibition was opened in Guinea, exhibiting Chinese goods and urban and rural construction and attracting the attention of hundreds of thousands of Guineans (Jiang, 2007) (Figure 2).

From March to June 1961, the delegation of the China-African People's Friendship Association visited eight countries in West Africa (Feng, 1962). After returning, the delegation members contributed articles to *Shijie zhishi* (World Affairs) and *Renmin huabao*, introducing the customs, culture, arts, and social development of West African countries (Feng, 1961a) (Figure 3). For instance, Feng Zhidan, a member of the delegation, passionately described Guinea as a beautiful country with a superior geographical location, rich natural resources, political unity, and strong national pride (Feng, 1961b) (Figure 4). Feng's description that Guinea had built a large number



Figure 1. The eighth page of *Renmin ribao* devoted to introducing Guinean culture, environment, agriculture, and social conditions, September 11, 1960. Source: *Renmin ribao*.

of roads, bridges, schools, hospitals, and housing drew a prosperous picture of the newly-independent nation. These publications were among the earliest sources of geographical information accessible to Chinese readers and helped them to develop a preliminary understanding of West Africa.

The journalistic endeavors that focused on the general condition of West Africa were complemented by an initiative to translate and introduce Asian and African literature to Chinese audiences. For example, from 1958 to 1964, the

journal *Shijie wenxue* (World Literature, previously titled as *Translation*, or *Fanyi*), the only periodical publishing translated literature in the early 1950s, presented nearly 200 translated works from African literature, including poems, novels, dramas, folk tales, and other genres (Yuan & Zhang, 2020). The production of geographical knowledge (architecture, art, literature, and geography) through travel, observation, communication, and publication embodied China's intention to better understand the vast developing countries in the context of Western isolation. China and the African nations, to some extent, shared similar experiences of political independence, economic development, and cultural prosperity.

2.2. The experiences and lessons gained in aided projects in the tropical regions

In contrast to certain Western architects who relied on colonial networks to practice modernist architecture in tropical regions, Chinese architects developed their knowledge of these areas through continuous practice, and learning from experience gained in the foreign-aid projects (Zhu, 1964). But in the mid-1950s, the understanding of Chinese professionals of the tropics was limited. When designing factories in Vietnam, some Chinese architects relied on domestic experience, particularly the northern design specifications and norms influenced by Soviet expertise, to address local demands. As a result, many industrial buildings featured “fat” beams and columns



Figure 2. The planning of people's commune in Hebei Province, exhibited in Conakry, 1960. Source: *Shijie zhishi*, 1961, no. 24.



Figure 3. Chinese delegation visiting eight countries in West Africa. Source: *Renmin huabao*, 1961, no. 9.

(*Feiliang pangzhu*), a solid appearance, and small windows, which negatively impacted natural ventilation and lighting, and which resulted in high economic cost and material waste (Fangyi zhuan bianxiezhu, 2008).

In response to the hot and rainy climate in Vietnam, which required buildings to be protected from salt spray, damp heat, and mold, Fang Yi, China's head of aid to Vietnam in the 1950s, established a "task force team" to address these design flaws. The team collected local data on climate, wind direction, wind pressure, rainfall, and geological conditions, and compiled a special booklet *Yuanyue renyuan xuzhi* (Information for China Aid Personnel to Vietnam), which provided fundamental engineering knowledge and introduced local climatic, cultural, and socio-economic conditions to Chinese professionals.

Similar design mistakes and improvements were also observed in the China-aided factories in Cambodia during the early 1960s. Jin Oubo, the Head of the Beijing Industrial Architecture Design Institute (affiliated to the Ministry of Architectural Engineering), visited these projects in 1962, and identified several planning, design, construction, and operation problems. For instance, the factories were located far away from the urban area, resulting in insufficient market access. In addition, the scale of the factory was too large, and the scattered layout led to excessive infrastructure costs, while some buildings were constructed with excessively high standards. Jin reported these issues to senior officials, such as Fang Yi and Liu Xiufeng, Minister of the Architectural Engineering, who then brought them to the attention of Premier Zhou Enlai and Deputy Premiers Chen Yi and Li Fuchun.

Premier Zhou responded by instructing the State Administration of Foreign Economic Relations and Trade

to study and propose suggestions for improvement. Fang Yi took this task seriously and collaborated with design technicians and experts to find solutions. These design flaws were not unique to the Cambodian factories but were also evident in similar aided projects in other countries. As Li Fuchun emphasized, adjusting design measures to local conditions, prioritizing economic effects, and considering national conditions posed significant challenges for both foreign-aid projects and domestic constructions. Therefore, carefully discussing and summarizing experience were crucial. Indeed, these problems and solutions, experiences and lessons became a valuable reminder for designers and managers of aided-projects.

2.3. The observation and publication of tropical architecture

Chinese architects' perception about the tropics was largely associated with four main channels such as discourse, practice, visiting, and media publication. Between 1963 and 1964, the state-sponsored academic journal *Jianzhu xuebao* (Architectural Journal), run by the Architectural Society of China, introduced local vernacular residential houses and modern institutional and industrial projects in Indonesia, Myanmar (Yuan *et al.*, 1963a), Vietnam (Yuan *et al.*, 1963b), and Guinea (Ren, 1964) (Figure 5). These articles were accompanied by detailed information on ventilation, shading, layout, formal appearance, function, and basic construction conditions of local buildings, illustrated by rich photographs and hand drawings.

For example, in the article "Introduction to Indonesian Architecture," architect Dong (1963) presented the Hotel Indonesia, a strikingly Corbusierian building designed by architect, Abel Sorensen, and his wife, Wendy Becker, and inaugurated in 1962 by Indonesian President Sukarno in preparation for the 1962 Asian Games. This kind of large-scale modernist building with formal richness, tectonic articulation, and iconic tropical languages had never been seen in China at the time. The majority of these published modernist buildings were designed by Western architects and characterized with strong tropical formal languages. But the authors did not mention the name of the architects, partly due to the lack of relevant information, partly due to the then political climate, which weakened the role of individualism.

In addition to these carefully drafted articles, *Jianzhu xuebao* also published a large number of architectural images during the early 1960s. Each issue focused on a particular country, such as Ghana, Cuba, Mexico, North Korea, Hungary, and Albania. These publications on architecture in the so-called "Third World" represented a significant departure from the situation of the 1950s, when the presentation of foreign architecture in the



Figure 4. Feng Zhidan's visiting note on Guinea. Source: *Renmin huabao*, 1961, no. 7.

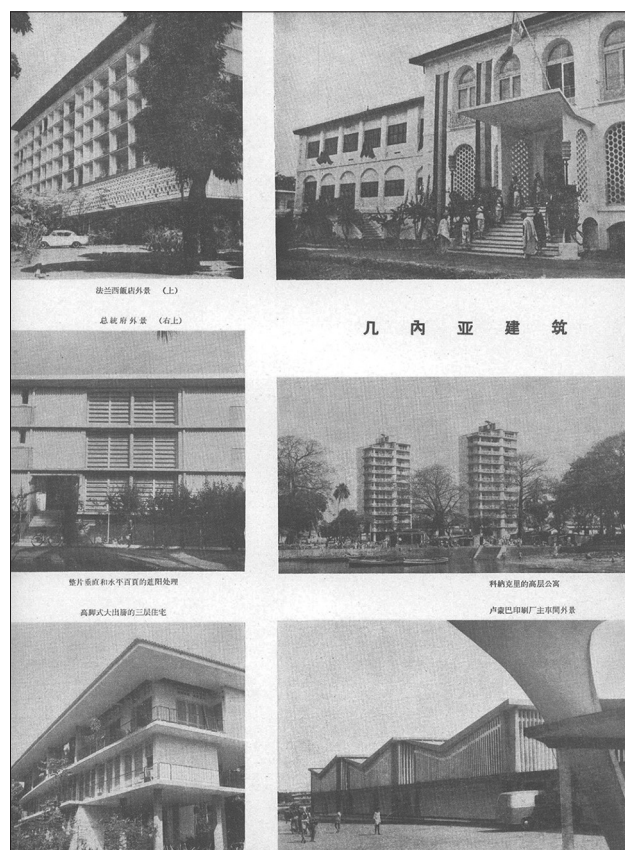


Figure 5. Guinean architecture survey published in *Jianzhu xuebao*. Source: *Jianzhu xuebao*, 1964, no. 8.

journal mainly came from the socialist bloc (Lu, 2017). The publications of the early 1960s were partly indicative of China's desire to break away from Soviet influence and engage more with developing countries in Asia and Africa. These introductions were also closely associated with China's architectural aid program, in which Chinese architectural professionals were sent to visit these countries for project surveys and investigations. On their return to China, their writings became an essential source for fellow architects seeking to understand tropical architecture.

While some Western architectural magazines, such as the *Architectural Review* and *Architectural Record*, were available in China's large design institutes and architecture schools, those interested in tropical climate design could turn to other specific monographs, such as Maxwell Fry and Jane Drew's *Tropical Architecture in the Humid Zone* of 1956 and the research report such as *Housing and Building in the Hot-Humid and Hot-Dry Climates* of 1952. Those works served as bibliographical resources for architect Chen (1962) in his article on tropical building design. These publications provided valuable knowledge about tropical architecture to Chinese audiences that would

otherwise be unavailable at the time. China's state-owned design institutes had their own ways of assembling and analyzing geographical and architectural information for their purpose of production (Xue & Ding, 2018). The result is the emergence of a specific in-house sector (*qingbao chu*) responsible for assembling national and international knowledge and the establishment of internal design group within institutional settings that focused specifically on foreign-aid projects.

3. The People's Palace, Guinea: Presence and imagination

Following Guinea's overwhelming vote for independence in 1958, the French promptly withdrew from the country, taking everything that was not bolted down and leaving a dilapidated economy. At the time, the capital city of Conakry exhibited a monotonous urban landscape characterized by a scarcity of modern constructions built by the French colonizers and primarily composed of lower-rise houses constructed by locals (Goerg, 2011). Guinea rapidly aligned itself with the Soviet Union and implemented socialist policies. By modeling on the contracts and agreements that governed intra-Bloc exchange, Guinea and the Soviet Union signed trade, financial, and technical agreements in 1959 and 1960, which encompassed the Soviet provision of blueprints, industrial plans, and equipment, as well as the dispatch of Soviet experts (Jersild, 2016).

The Soviet model of aid posed several challenges for Guinea, which had just gained independence and was reluctant to accept the Soviet "hegemonic" behavior and "unfair" protocol. Guinean President Touré was quickly disappointed with the Soviet Union and turned to the People's Republic of China for assistance. During Touré's visit to Beijing in September 1960, China and Guinea signed an economic and technical cooperation agreement. In 1961, the two countries discussed the first batch of China-aided projects, which included a match factory, a cigarette factory, a hydropower station, and a tea test station.

The match and cigarette united factory represented China's foray into Africa and its emerging international ambition (*daxiang feizhou diyipao*, or firing the first shot in Africa), and was the first project aided by China in Africa (Figure 6). It is not surprising, then, that the factory design received considerable attention from both Chinese central and local governmental leaders, including Premier Zhou, Fang Yi, and Guinean officials. By then, Fang Yi had left Vietnam for Beijing and was appointed as director of the newly established State Administration of Foreign Economic Relations. The Shanghai Light Industry Bureau, which had already gained extensive experience

in foreign-aid project delivery in Vietnam, was tasked with designing the project. This industrial project was completed by several design institutes, including Shanghai Light Industry Design Institute (responsible for equipment design), Shanghai Food Design Institute (process design), Beijing Industrial Architecture Design Institute (building design), and Shanghai Pudong Cigarette Machinery Equipment Factory (providing machinery equipment), all coordinated by the Shanghai Bureau (Wang, 1993).

Despite being considered a priority by political officials and design technicians, the implementation of the match and cigarette united factory encountered numerous challenges in terms of inappropriate design standards, logistical operation, management, coordination, and protocol negotiation. Nevertheless, with the intervention of Premier Zhou and Fang Yi, these difficulties were managed, and the project produced good economic performance (Rivière, 1977). During his visit to Guinea in 1964, Premier Zhou inspected the site, and praised the efforts of both Chinese and Guinean technicians and builders. He also pointed out some construction problems, including the cumbersome appearance of the factory building, which required a lot of materials, more investment, and longer construction time. Zhou suggested that some lightweight buildings should be used in Africa, and issues of ventilation and moisture-proof should be properly addressed. In response to Zhou's comments, Fang Yi immediately called a meeting of experts from the State Administration of Foreign Trade and Economic Cooperation and the Ministry of Architectural Engineering to study key technologies for

building tropical buildings and light steel structures. The aim was to improve the quality of foreign aid design and to promote domestic construction and manufacturing levels.

While celebrating the initial success of the match and cigarette united factory, during Zhou's visit, Guinean government requested to expand the existing aid program, including building a *huitang* (the People's Palace) in Conakry. The Beijing Industrial Architecture Design Institute was tasked with the project, and chief architect Chen Deng'ao was selected to design this project on the grounds of his achievements and good background (Lian, 2020). Chen Deng'ao was considered one of the most significant architects of his generation after completing the Di'anmen Military Dormitory buildings in the mid-1950s and the Beijing Railway Station (collaborating with Nanjing Institute of Technology) in 1959 (Figure 7). These two large-scale institutional projects demonstrated his prowess to deal with complex formal and functional problems in sensitive urban contexts. In the 1950s, Socialist Realism dominated the ideology of Beijing, and both projects maintained symmetrical layouts and a sense of monumentality. While the former was a pair of U-shaped linear buildings located on the two sides of Di'anmennei Street, part of the city's urban axis starting from Tiananmen to the Forbidden City to Jingshan Park to the Drum Tower, the latter was the city's state-of-the-art and largest transportation hub. Both projects reinforced the existing urban order and shared a similarity of Beaux-Arts style formal composition and eclectic articulation. To be more specific, the Dormitory buildings and Railway Station were characterized by a juxtaposition of modern concrete structures and traditional pitched roofs and decorations.

In 1961, Chen Deng'ao visited Guinea to conduct a design investigation, where he was impressed by Conakry's modernist architectural heritage, designed by architects from both colonial France and the Soviet bloc. During his visit, Chen meticulously observed and analyzed how local buildings in the area responded

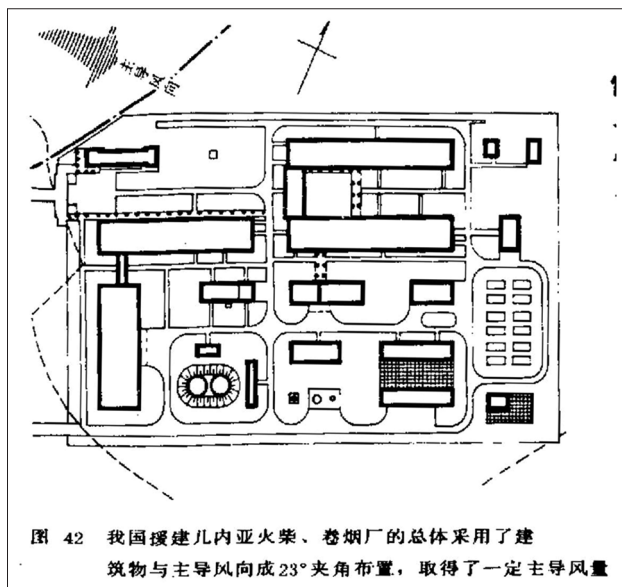


Figure 6. The layout of the match and cigarette united factory, Conakry. Source: *Redai jianzhu*, p. 29



Figure 7. Elevation of the Di'anmen Military Dormitory Buildings, Beijing, 1953. Source: *Jianzhu xuebao*, 1954, no. 2.

to ventilation, sun-shading, and heat insulation using specific architectural techniques (Figure 8). This visit and observation on Guinean architecture (local vernacular, colonial, and post-colonial buildings) enabled Chen to develop a comprehensive understanding of the relationship between architectural design and tropical climate and to maintain an intention to situate his design in this specific context. 4 years later, in 1965 Chen led a design group, comprising assistant architect Liu Dayuan, structural, mechanical engineers and a model maker from the Beijing Industrial Architecture Design Institute to revisit Conakry for 3 months. During this time, the team conducted a survey, developed proposals, and completed a whole set of schematic drawings, renderings, and models (Liu, 2015). Once the Guinean officials confirmed the scheme, the design team returned to Beijing. Architect Wang Rongshou led a project team within the design institute to carry out the construction drawings.

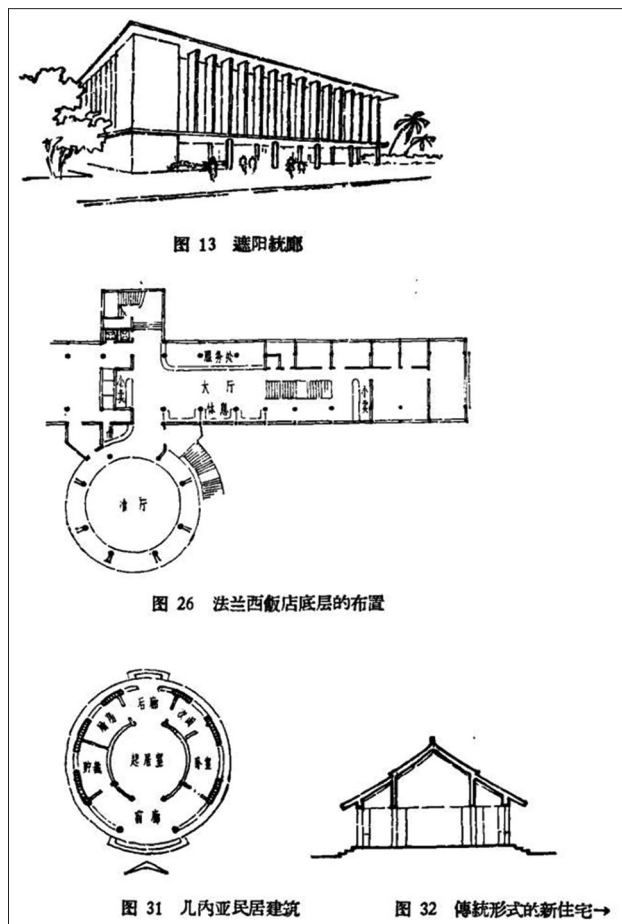


Figure 8. Illustrations in Chen's article on tropical architecture; modernist building with *brise-soleil* (up); the ground plan of the Grand Hotel de L'Indépendance (middle); plan and section of Guinean vernacular building (bottom). Source: *Jianzhu xuebao*, 1962, no. 10.

The proposed palace was situated on the narrowest point of the slender Kaloum Peninsula extending into the Atlantic Ocean. In an attempt to respond to the narrow and irregular site, the architects strategically positioned the 24,000 sqm People's Palace at one end of the site, leaving the other end for the plaza and parking lot. This intentional arrangement resulted in dynamic spatial consequences in the front plaza, visible to those walking or driving along the north road, where visitors could appreciate the building's main façade (Figure 9). The building's layout closely resembles that of the Great Hall of the People in Beijing, albeit on a smaller scale. The 1180-seat auditorium is situated in the center, flanked by the auxiliary functions in either side, and two landscaped inner courtyards in between (Figure 10). This layout recalls that of Beijing Railway Station, where the courtyards incorporate some native plants, and break the sense of closure of the super-large building plan.

The auditorium's impressive volume and strong centrality dominate the building's formal composition,



Figure 9. The People's Palace, Guinea, completed in 1967. Source: Courtesy of China Architecture Design and Research Group.

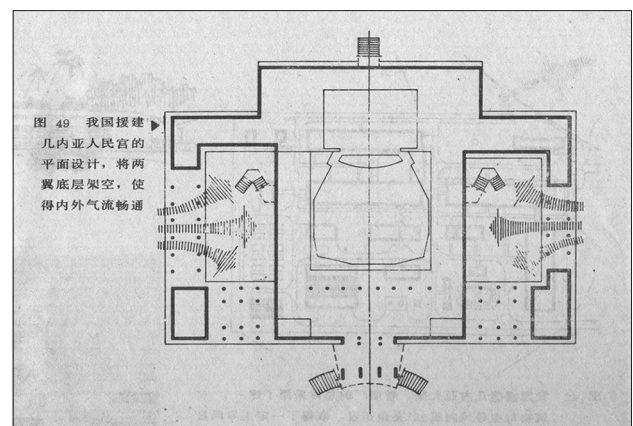


Figure 10. The natural ventilation diagram of the People's Palace. Source: Chen Deng'ao, *Redai jianzhu* (Tropical Architecture; Beijing: China Architecture and Building Press, 1989).

while the horizontal base conveys a sense of stability. The first floor of the base is raised and functions as public spaces, facilitating sea breezes to lower indoor and outdoor temperatures and enhances natural ventilation. Visitors access the second-floor lobby via large outdoor steps (Figure 11). The double-height lobby connects to bright lounges on both sides, which are linked to the courtyards through zigzag stairs outside (Figure 12). The building's interior maintains good natural lighting and ventilation conditions, creating a comfortable microclimate environment with the outdoor courtyards. Reflecting on the centralized layout years later, Chen (1987) recognized that different groups of people, such as bureau members, conference delegations, journalists, and the public, require distinct foyers and lounges. A single spacious and lavish hall may not be economical or intimate enough.

In addition to its monumental character, the building's tropical identity is best exemplified by the way in which the central volume is covered by down-to-floor prefabricated cement blocks, and the base volume is wrapped by dense

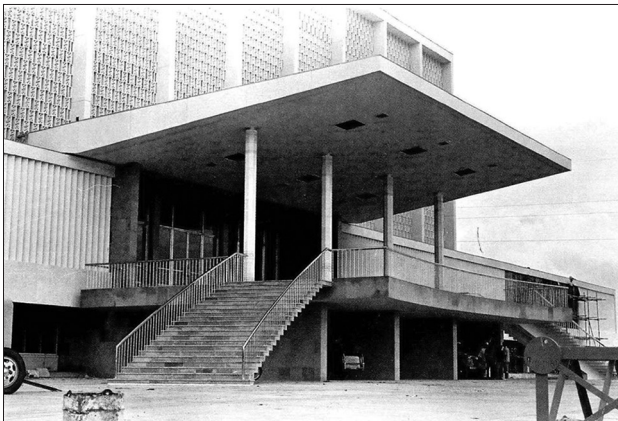


Figure 11. The main entrance of the palace. Source: Courtesy of China Architecture Design and Research Group.



Figure 12. The entrance lobby of the palace. Source: Courtesy of China Architecture Design and Research Group.

vertical concrete slabs. Importantly, this façade redefines the relationship between design and climate by presenting strong visual connections to tropical modernism, with the use of devices to block the heat of the sun or *brise-soleil*, a technique once characteristically used by Le Corbusier in the 1930s and later widely appropriated by international architects practicing in tropical regions.

During Chen's visit to Conakry in 1961, he was impressed by the deliberate design of modernist architecture in response to local hot and humid climate, exemplified by the Grand Hotel de L'Indépendance designed in 1953 by the French architects Atelier LWD, with contributions from Charlotte Perriand and Jean Prouvé for interior and furniture design. The hotel was composed of a long, seven-story slab building, supported by pillars, with a circular pavilion hosting the restaurant. A direct staircase links the elevated entrance to the lobby on the 2nd floor. Among his detailed documentation of local architectural heritage, the most noteworthy were the designs of facades for natural ventilation, such as the lobby enveloped by the *brise-soleil* and the restaurant facade created by Prouvé, consisting of screens that swing open to the sea.

In 1962, the Soviet architects E. V. Rybitsky and G. N. Tsytoich designed the Institut Polytechnique de Conakry (later renamed as Gamal Abdel Nasser University, Conakry) (Meuser & Dalbai, 2012). One notable feature of the project was the lecture hall, which was enveloped by prefabricated concrete blocks with a hollow pattern designed to facilitate natural ventilation (Figure 13). It



Figure 13. The Institut Polytechnique de Conakry. Source: Courtesy of Sputnik.

was possible that Chen (1989) had encountered with the university buildings during his 1965 trip, as he mentioned the campus building in his published notes. Nonetheless, Chen would also pay tribute to other Soviet architects such as Viktor Andreyev and Kaleriya Kislova, who had designed the Inya Lake Hotel for the government of Burma. The canopy of the Guinea People's Palace, with its subtle sectional change, was reminiscent of that of the hotel's design, which was published in *Jianzhu xuebao* in 1962, with photographs taken by Chen's colleagues.

It was within this dynamic international context of architectural practice that the palace building was created. Chen effectively synthesized a wide range of design references to produce a delicate wholeness that maintains a subtle balance in various dimensions. These include the equilibrium between formal lightness and volumetric heaviness, the interplay between the horizontality of the base and the verticality of the central assembly hall, and the coexistence between institutional monumentality and civic accessibility. This formal expression, adapted to local climatic conditions, to some extent, drew lessons from the construction of the match and cigarette united factory, whose bulky forms were amended.

Throughout the construction process, which began in early 1966, just several months before the outbreak of the Cultural Revolution, and completed in 1967, Chinese professionals encountered many difficulties, such as language barriers, climate inadaptability, large projects, and tight construction schedules (Xinhua News Agency Reporter, 1968, January 8). Despite these challenges, the project progressed smoothly, benefiting from both Guinea's political stability and Chinese and Guinean builders' collaboration and dedication. Since its completion, it has served as an important venue for national political conferences and international meetings, emerging as a symbol of Touré's regime. For example, in 1972, several African Heads of State and representatives of 25 other countries paid their respect to Ghana's former President Kwame Nkrumah, who lay in state at the People's Palace. This event marked a special moment in Guinea's leadership in fighting racial discrimination, segregation, and colonialism. In 2008, Chinese professionals renovated the palace in commemoration of Guinea's 50th anniversary of independence.

4. The Friendship Hall, Sudan: Absence and imagination

During the 1960s and 1970s, several Chinese architects were involved in designing assembly halls in developing countries. Although many influential figures, such as Chen Deng'ao and Dai Nianci from Beijing Industrial

Architecture Design Institute, were part of this movement, the design of the Friendship Hall in Khartoum, Sudan, by architect Wang Dingzeng and his collaborators from the Shanghai Civil Architecture Design Institute merits close attention. This project, although less well known, was even more elaborately engaged with its site. Not only did they introduce new ideas about the *huitang* architecture, but their approach to the site also paved the way for creative exploration and formal articulation.

On January 4, 1959, China and Sudan established diplomatic relations when Sudan formally recognized the sovereignty of the People's Republic of China. Beijing's non-interference diplomatic principle supported Sudan, even in the case of suppression of an attempted communist coupe which was opposed by the Soviet Union (Large, 2008). This laid the foundation of a positive relationship between the two countries, followed by economic grants and technical assistance from China throughout the 1970s. China's economic and aid relations with Sudan took the form of barter trade, concessionary loans, arms transfers and medical assistance as well as assorted infrastructure construction projects (Dijk & Pieter, 2009). The mutually beneficial relationship which started as early as the 1960s, included bilateral trade agreements for the export of long staple cotton to China, in exchange for manufactured and capital goods, and has continued to trend upward (Ali, 2006).

In August 1970, Sudanese President Jaafar Nimeiry traveled to China, and visited factories, people's communes, military and schools in Beijing and Shanghai. He was warmly welcomed by Chinese leaders and the people (Anonymity, 1970). During his visit, the two nations signed an Agreement in Economic and Technical Cooperation and a Cultural, Scientific, and Technical Protocol in Beijing. A year later, the United Nations General Assembly voted to admit the People's Republic of China, with the support of many developing countries, including Sudan. In appreciation of Sudan's firm political support of the One China policy, China decided to provide Sudan with a wide range of construction projects in the form of free-interest loans. Among these aided projects was the Friendship Hall initiated in response to a request from Sudan for a much-needed multipurpose conference hall.

When Chinese architects started designing the project in 1971, China was still embroiled into the Cultural Revolution and the design team faced double dilemmas. First, they had little knowledge of Sudan in general, and its architectural culture in particular. But they did know that Khartoum was an extremely hot city in the summer, as mentioned in a 1964 article published in *Shijie zhishi* (Chen, 1964). Earlier articles published in 1960 in the

same magazine, by Yan (1960), provided more detailed information about his travel to Sudan, including a visit to the Mahdi tomb in Khartoum, where he admired the bravery of the Mahdi against the British army officer Charles George Gordon. Gordon had participated in the suppression of the Taiping Rebellion in the Qing dynasty of China and later was killed by the Mahdi army in Khartoum. Yan Biao's condemnation of colonialism and imperialism helped to establish an emotional resonance with the Sudanese people. His travel notes became the limited geographical knowledge accessible to Chinese audiences at the time. Due to domestic political turmoil, principal architects in charge of the Friendship Hall project were not permitted to travel abroad, unlike the 1960s when architects were able to visit foreign-aid project sites. Together with the absence of published materials on Sudanese architecture, architects have little relevant information for reference.

Second, the design team at the Shanghai Civic Architecture Design Institute lacked the necessary experience to undertake such large-scale foreign-aid projects. Previously, such large-scale, high-proliferation foreign-aid projects were usually assigned to the Beijing Industrial Architecture Design Institute. However, due to the dissolution of the Beijing institute in the late 1960s, and the inability to immediately reorganize, the state authorities responsible for foreign aid assigned the task to the Shanghai institute.

At the schematic design phase, Wang Dingzeng, the former chief architect of Shanghai institute before the Cultural Revolution, was not permitted to participate in the project design by ultra-leftists who removed him from his leadership position. The design team produced several Beaux-Arts informed proposals and presented them to Fang Yi, the Minister of Foreign Economic Liaison Department in Beijing (Guo, 2017). However, these proposals were not approved. In the subsequent round, Wang was invited to contribute and presented a sketch characterized by an asymmetrical layout, showcasing his unconventional approach towards the project's complex functions (Figure 14). In 1972, Wang and his colleagues traveled to Beijing and presented the project to Chen Muhua, Deputy Minister of Foreign Economic Liaison Department. It was unclear how Wang's asymmetrical proposal, instead of the other three symmetrical layouts, was received by the Sudanese officials (Wang & Qi, 1996). When the asymmetrical scheme was ultimately selected and approved by both Beijing and Khartoum, Wang and his colleague Chen Zhi coordinated a group of talented architects within the design institute, including Guo Xiaoling, Li Yingqi and Zhang Zhimo, and spent 1 year in completing construction drawings (Figure 15).

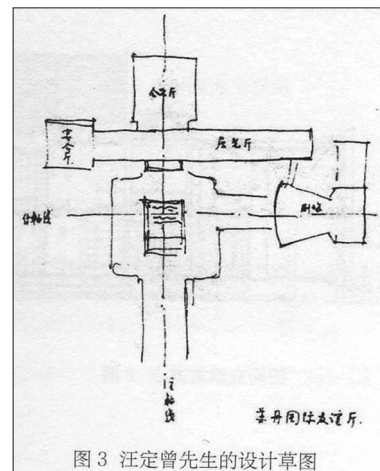


Figure 14. Wang's sketch for the Friendship Hall. Source: Shanghai Institute of Architecture Design and Research.



Figure 15. The model of the Friendship Hall. Source: Shanghai Institute of Architecture Design and Research.

Despite Wang Dingzeng's appointment as chief architect of the project, he was never able to visit Sudan for site surveys and project inspections. This was largely associated with the political climate at the time, in which the selection of professionals for overseas aid project was primarily based on political factors, such as loyalty, background examination, and health, rather than expertise. Wang's American educational background and potential personal connections with foreigners likely led to mistrust by the authorities. Despite the lack of local references, Wang and his collaborators were able to acquire certain knowledge on designing for a hot and dry climate through the works of fellow architects who had already practiced in tropical regions a decade earlier. In addition, the completion of the People's Great Hall in Beijing and the People's Palace, Guinea and the ongoing construction of the Bandaranaike Memorial International Conference Hall in Sri Lanka at the time likely provided valuable inspirations for Shanghai architects.

Wang's sketch for the Friendship Hall project reflected a cautious yet relaxed engagement with the site. The preference for asymmetrical composition was consistent with his previous work during the 1950s, such as the

residential community design project of Caoyang Village (Figure 16). In contrast to the then dominant Soviet planning principle in China, the Caoyang Village followed the existing river on the site and revealed Wang's intellectual debt to the neighborhood planning practices in the United States. Similarly, in his 1956 project for the Lu Xun Memorial Hall, Wang employed vernacular forms to create an asymmetrical layout, repudiating the conventional monumental building that tended to use traditional pitched roofs of imperial palaces. Wang's background in both civil engineering (Shanghai Jiaotong University, 1935) and architecture (The University of Illinois, 1937) helped him to consciously maintain subtle balance between arts and technology. The Caoyang Village, Lu Xun Memorial Hall and the Friendship Hall projects collectively exemplified Wang's repudiation of the Beaux-Arts principles that dominated China's state-led architectural practice.

Adjacent to the 2-story Sudan National Museum, the 24,700 sqm Friendship Hall was situated on a flat site near the confluence of the White Nile and the

Blue Nile in Khartoum (Shanghai Civic Architecture Design Institute, 1981). The architects' geographical and architectural imagination for the project were explicitly embodied in three aspects: response to the site, articulation of Islamic culture, and understanding of hot-dry climate.

To begin with, the Friendship Hall complex exhibits an overall asymmetrical layout with a free, Bauhaus style, which can be observed from a first glance (Figure 17). However, on closer examination, it becomes apparent that several building components, such as the cinema, the main conference hall and the banquet hall, maintain a sense of regularity. The outside plaza serves as the interaction of two axes that define the main hall and the cinema, respectively. During the initial sketching phase, Wang utilized main and secondary axial lines to measure asymmetries against the overall volume of the masterplan. It is noteworthy that few modern institutional buildings designed by Chinese architects maintained dynamic balance and asymmetry. A comparison with the Bandaranaike Memorial International Conference Hall in Colombo, Sri Lanka is interesting (Ding & Xue, 2022). The Colombo project consisted of an octagonal, main conference hall and a free-style auxiliary building hosting medium- and small-sized rooms, offices, and restaurants, which were connected by a corridor. This approach created a monumental order that satisfied the client's requirements in an economical manner. Otherwise, a number of rooms and spaces that were arranged for a ritual gesture would have been wasted or poorly functioning. In contrast, the architects of the Friendship Hall integrated varying functions, including conference, theater, cinema, banquet, office, and exhibition, into an organic complex (Figure 18). The interior of the main conference hall was particularly impressive, with warm wood finishes, fine furniture, and an overall solemn atmosphere (Figure 19).

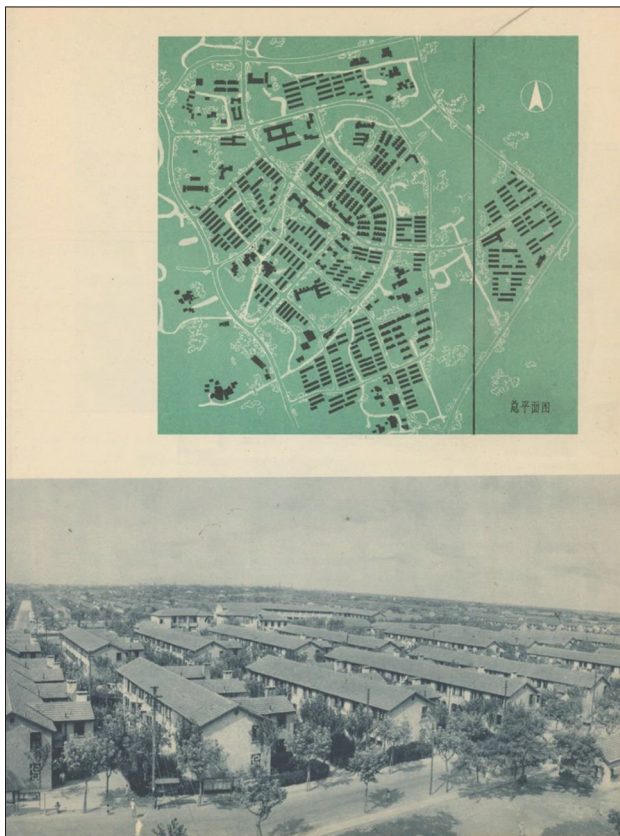


Figure 16. Caoyang Village, 1954. Source: Ministry of Architectural Engineering of the People's Republic of China, edited by the Architectural Society of China. *Jianzhu sheji shinian* (10 Years of Architectural Design; Beijing: Ministry of Architectural Engineering of the People's Republic of China, 1959).



Figure 17. The aerial view of the Friendship Hall. Source: Shanghai Institute of Architecture Design and Research.

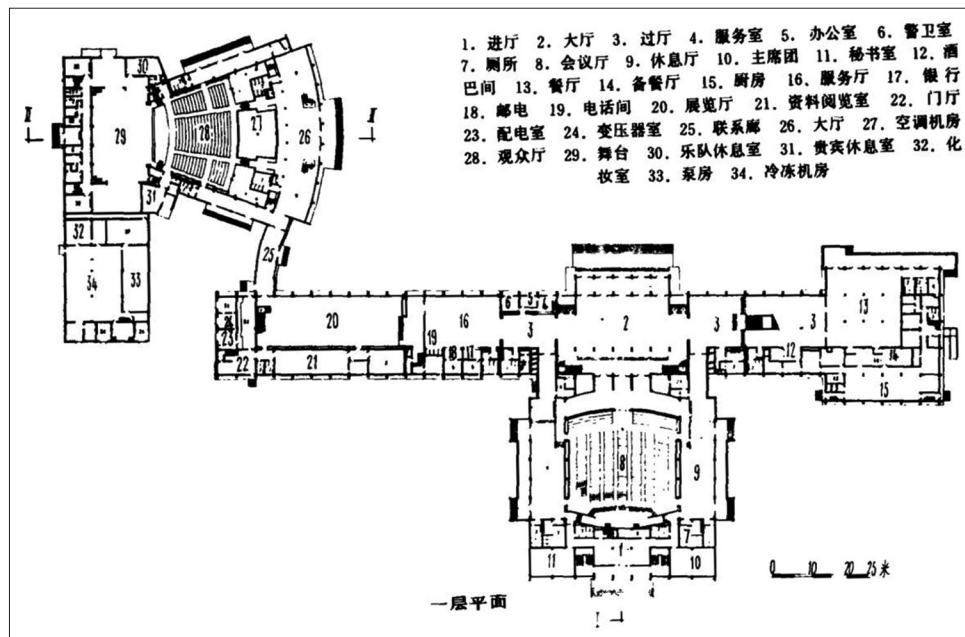


Figure 18. The first plan of the Friendship Hall. Source: Shanghai Institute of Architecture Design and Research.

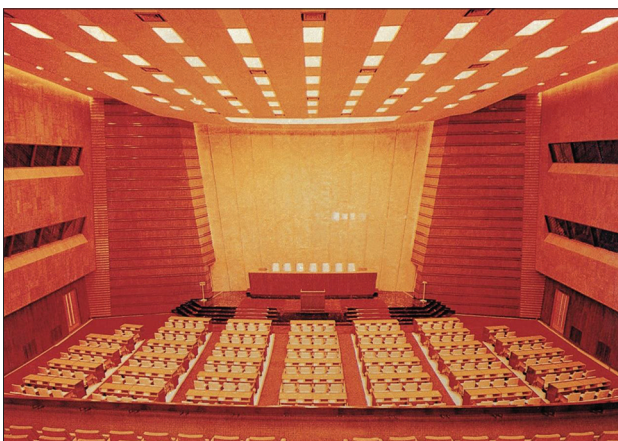


Figure 19. The interior of the conference hall. Source: Shanghai Institute of Architecture Design and Research.



Figure 20. The main volume of the Friendship Hall. Source: Shanghai Institute of Architecture Design and Research.

Second, the project's remarkable strength is attributable to one simple fact: the building reinterprets Islamic architectural tradition in an abstract way. The architects accomplished this feat by transforming the predominant pointed arches — characterized by two curving sides meeting at a relatively sharp angle at the top of the arch — into triangular forms with pure geometric languages. The canopy comprising continuously folded triangular plates creates a strong sense of rhythm, and indirectly implies its relation to the façade and local culture (Figure 20). What is notable is that the design team deliberately rejected the appropriation of iconic domes that were frequently employed in the context of Islamic

culture. This stands in contrast to the eclectic expressions found in the China Institute of Islamic Theology built in 1958 in Beijing (Zhao *et al.*, 1958). The Friendship Hall showcased an alternative, modernist understanding of Islamic architecture that was not a simple appropriation, but an innovative transformation of traditional forms. As such, it offers a benchmark for evaluating subsequent exported architecture to the Islamic cultural context. For instance, the China-aided People's Palace constructed in Djibouti City in 1985 utilized similar triangular arches to express Islamic cultural identity (Zheng, 1983).

Third, the architects' response to the local hot and dry climate was manifested in their approach to light control.

To regulate the amount of light and heat, the architects employed two types of sun-shading devices: vertical *brise-soleil* on the north façade of the conference hall and pre-fabricated cement blocks (*huage qiang* in Chinese architecture or *Jalis* in Islamic culture) that enveloped the façade of the horizontal platform and the cinema hall. Given that the complex's main façade faces the Blue Nile in the north, there are fewer windows on the east, west, and south façades, which effectively reduces solar radiation.

As one of the most remarkable edifices built in Khartoum, the Friendship Hall showcased the highest quality of Chinese design and construction, committed collaboration between Chinese technicians and Sudanese engineers and builders, and an international profile and political gesture of architecture. The project epitomized the consistent characteristics of Chinese-aided construction. During their collaboration with Sudanese Ministry of Construction and Public Works technicians, the Chinese professionals maintained a hard and simple spirit of sacrifice, disregarding personal gains or losses, and contributing their own strength to the country's foreign aid mission. On the project's completion in 1976, Sudanese scholar Ali (1976) provided a detailed account of the construction process:

When the hot summer months came, the technicians worked in the interior of the Hall and when the cooler weather approached, they shifted to work on the exterior of the building, thus saving energy and time. That is why the projects they undertake either finish on time or earlier than scheduled, but never after the target date... The Chinese normally prefer to be involved in the construction of the project in full collaboration, actually in real partnership, with Sudanese engineers and labors. While the Chinese receive a low wage, the Sudanese technicians are paid according to the prevailing wage rates. All the Chinese from the team leaders to the lowest technicians receive the same wage (LS. 30.7 per month in the case of the Friendship Hall). Moreover, the Chinese technicians mostly live in groups in a hostel-like setting and therefore do not create a problem of accommodation. The 200 Chinese technicians who participated in the erection of the Friendship Hall lived in three government houses (opening into each other), under the normal circumstances occupied by three Sudanese families who are in government service. Their dwelling was across the street from the project site and they did not require transport to and from their work.

On May 23, 1976, the Sudanese government held a grand ceremony in Khartoum to mark the opening of

Friendship Hall, a cultural center built with Chinese aid of loan (5.4 million U.S. dollars). The ceremony was attended by a Chinese delegation headed by Fang Yi, and was warmly received by the crowd and military band (Fangyi zhuan bianxiezhu & Zhongguo jingmao huabaoshe, 2005). President Nimeiry and Fang Yi were both adorned with large garlands for the occasion. As the third assembly building aided by China, the Friendship Hall once received unprecedented political attention internationally.

5. Imagining tropical modernism elsewhere

The People's Palace and the Sudan Friendship Hall not only serve as physical landmarks that defined the horizon of local urban landscape or cityscape, but also embody the vision of Chinese architects and technocrats during the 1960s and 1970s. These buildings form part of a large set of China-aided industrial, institutional, civil, and medical projects that aimed to transform the socio-economic and cultural wellbeing of the recipient African nations. While sharing certain geographical awareness and architectural sensibilities, these two buildings exhibit distinct approaches in producing alternative forms and spaces. The People's Palace features a centrally symmetrical layout and emphasizes a clear spatial sequence from the outdoor entrance steps to the lobby on the 2nd floor, evoking a traditional arrangement of the *piano nobile* in Western architecture. With little contextual references, the palace asserts its self-centered architectural order. The building's columns with decorative textures and lines and large-scale paintings in the interior spaces reproduce Guinea's traditional and political culture, which adds to its symbolic value.

On the other hand, the Sudan Friendship Hall presents an ingenious adaptation to the site environment. Its asymmetric layout subtly highlights the towering auditorium's dominant position, while lowering the traditional large-scale entrance steps to create a more intimate atmosphere. Unlike the People's Palace, the Friendship Hall does not employ obvious symbolic decoration. Instead, its light-colored materials and consistent formal languages produce a serene atmosphere that responds to the local dry and hot climatic conditions.

During the Mao era, foreign-aid projects presented important opportunities for Chinese architects to explore and experiment with modernist ideas, which showed both dramatic changes and certain continuities when compared with their domestic works. While architects such as Chen Deng'ao, Gong Deshun and Dai Nianci had completed several institutional buildings with political significance and Beaux-Arts expression in Beijing during the 1950s, they also designed modernist architecture in Guinea, Mongolia, and Sri Lanka, respectively, during the 1960s.

The coexistence of domestic eclecticism and overseas modernism in the work of individual architects reflected the complex interactions between aesthetic expression and socio-political, economic, and cultural dynamics. Architectural historian Zou (2001) remarked that the ideological context of foreign-aid practice, which was more relaxed than that of Socialist Realism in domestic projects, enabled architects to experiment with abstract formal languages that would have been otherwise impossible. However, a more nuanced reading of China's architectural aid reveals that such a complex and interdependent process was closely tied to knowledge exchange, socioeconomic condition, and subjective imagination.

To some extent, Chen's and Wang's modernist architectural imaginations in Guinea and Sudan were remarkable, but not created in isolation from broad intellectual context. In the 1950s, Cantonese architects such as Xia Changshi and others had already begun exploring the design practice of building ventilation, shading, and daylighting for the subtropical climate of Guangzhou. Their series of design works were published in the widely-circulated *Jianzhu xuebao* based in Beijing. For instance, Xia (1958) published an article in *Jianzhu xuebao*, which for the first time systematically introduced his approaches to climate-responsive design. Although Xia's creative exploration of concrete *brise-soleil* and roof ventilation solutions had limited influence on peers in Beijing and Shanghai, it nevertheless provided inspiration to fellow architects who practiced architectural aid in Southeast Asia and Africa, helping them to better understand the particularity of tropical and sub-tropical conditions.

Internationally, during the 1950 and 1960s, many European and Soviet architects practiced architecture in Southeast Asia, South Asia, and Africa, creating a form of tropical modernism characterized by the utilization of passive technology strategies, such as cross-ventilation, sun-shading, and insulation to enhance indoor bodily comfort (Le Roux, 2003; Jackson & Holland, 2014; Stanek, 2015). The earlier history of tropical architecture was deeply entangled with medical and racial discourses, biopolitics, and the political economy of colonialism (Chang, 2016). In contrast, China-aided buildings in tropical areas during the Mao period were designed with less emphasis on political and racial domination but more with economic rationality and political solidarity, displaying a preoccupation with techno-scientific expertise and political and economic engagement. Drawing on the tropical experience of international counterparts, Chen, Wang, and their colleagues challenged the colonial discourse of tropical modernism in their own unique way. They aimed to achieve bodily comfort in the China-built

assembly halls, factories, stadiums, schools, and hospitals, not for the benefit of the Chinese officials and professionals, but to improve the working conditions of locals.

Despite the deficiency of scholarship and knowledge about tropical regions at the levels of both top policymaking and techno-scientific understanding in the Mao era, the Chinese-designed modernist architecture demonstrated refined expressions of climatic response and cultural identity. In the 21st century, Chinese professionals have accumulated vast knowledge about the tropics, although sometimes incomplete or misleading. Yet, they still struggle to construct local identity and esthetic articulation. As Marri (2022) recently remarked, the Chinese-backed buildings and infrastructure in the context of the Belt and Road Initiative, present a kind of "eclectic and pragmatic" character. This observation becomes even more meaningful when we compare the "eclectic and pragmatic" expressions in the regions of Pakistan and Djibouti in the 2010s with the pure modernist forms created in the 1960s and 1970s in Africa. Perhaps, one would say that the historical significances, values, and implications of the two China-aided assembly buildings lie in the fact that architects and technocrats employed the guideline of appropriateness to construct a sense of place that was appropriate to local contexts.

6. Conclusion

In this article, the ways in which Chinese architects and technocrats conceptualized and articulated their geographical and architectural imaginations in Africa through building two site-specific assembly buildings in Guinea and Sudan are investigated. This knowledge production was shaped by various factors, including geopolitical power competition during the Cold War, institutional arrangement within the China-aid program, collective intervention of design institutes, individual onsite visits and surveys, scholarly publications, and knowledge dissemination. Understanding the geography of the tropics was a necessary prerequisite for the application and discovery of architectural knowledge, as transnational practices required architects to deal with complex requirements of climate, culture, function, and logistics. In response to these requirements, Chinese architects employed their architectural imagination to deal with climate, culture, context, function, materiality, and representation, ultimately striving to achieve the goal of geographical imagination — the realization of social change and the facilitation of spatial justice through architecture in specific contexts.

Through the design of the two *huitang* buildings, Chinese architects and technocrats envisioned alternative

physical and social spaces, creating a different assemblage of social relations in spaces of engagement with a different geometry of power, set of knowledge and politics of representation (Robertson, 2006). For one thing, they experimented with modernist ideas of flowing spaces and abstract formal languages, while highlighting the appropriateness of adapting to and articulating local specificities. The two assembly buildings, as instruments of diplomacy, not only served as China's exports of materials and expertise to recipient nations, but also embodied how Chinese professionals learned from local cultures and techniques. For another, these institutional spaces compensated for the lack of proper venues for national and international activities, symbolizing Guinean and Sudanese political independence. The People's Palace and Friendship Hall formulated alternative political identities, imaginations, and representations, standing in sharp contrast to the colonial period's conditions of racial discrimination and segregation. Both projects represented Chinese intervention into the international political order, imaging, and constructing the possibility of alternatives and conveying a sense of political emancipation.

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ORIGINAL ARTICLE

The extraordinary life and work of Arata Isozaki
(1931 – 2022): Seven decades of visionary
architecture

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ABSTRACT

In December 2022, the Pritzker Prize-winning Japanese architect, Arata Isozaki, passed away at his home in Okinawa, aged 91. Known as a theorist as well as a practitioner, Isozaki leaves behind a seven-decade career in architecture, with more than 300 designs and 100 built structures on five continents. This article analyzes the extraordinary life and work of the Japanese grandmaster and presents a portrait of his innovative urban design concepts and buildings. Despite its diversity, the author suggests that his oeuvre can be categorized into four distinctly different phases, exemplifying how Isozaki constantly reinvented and challenged himself. Isozaki combined Eastern and Western philosophies like no other architect before him and had a significant influence on Chinese architecture. He also practiced in China, where he had an office in Shanghai (since 2000) and realized a series of important buildings, including the Shenzhen Cultural Center and Library, the Museum of the Central Academy of Fine Arts in Beijing, and the Shanghai Symphony Hall. The author is a former collaborator and project partner of Isozaki during the 1990s, and draws from close knowledge, first-hand observations, and conversations to comment the most relevant projects and adds background information. Isozaki's work was concerned with formal and intellectual expressions; it is complex and highly personal in its interdisciplinary approach and absorption of a wide range of influences. For Isozaki, architecture was predominantly a cultural practice. Given that Isozaki has recently passed away and his oeuvre is now closed, the changed circumstances ask for a renewed focus and deeper interpretation of his remarkable, unusual legacy. He created original ideas, formal innovations, and versatile concepts for spaces that defy characterization as belonging to any single tendency or school of thought.

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1. Introduction

With over 100 built works and over 300 unbuilt designs, and a very productive career spanning seven decades, Arata Isozaki (born in 1931 in Oita; died in 2022 in Okinawa, Japan) created an unusually heterogeneous oeuvre that is diverse and original. Hence, writing about the Japanese architect is not an easy task. Isozaki was never tied to a specific style. However, with his recent passing, Isozaki's work is now due for a new look and deeper evaluation, shedding light on his enduring legacy.

Being a former close collaborator and project partner of Isozaki during the 1990s allows me to draw from background knowledge, first-hand observations, and personal conversations. In this article, I comment on the most relevant projects of the Japanese master and attempt to categorize the work in four different sections. I previously had worked as a young architect in the office of James Stirling and Michael Wilford in London, but left in 1990 to move to Japan to join Arata Isozaki in Tokyo. Originally, I planned to stay in Tokyo to experience working there for a maximum of 12 months, had not anticipated how much this change in workplace and culture would affect my future life, and thinking about architecture. Only later did I realize that the epicenter of world architecture had around this time relocated to Japan, and that Tokyo was “the place to be.” In the end, I stayed with Arata Isozaki for 3 years before moving to Berlin to open my own practice in 1993. My time in Japan gave me a good opportunity to closely observe and study the master’s oeuvre, conceptual thinking, and working methods.

My arrival in Japan, having come from Stirling’s office (which was at that time a relatively small firm with only 12 staff and a limited number of projects), could not have been a more change of pace: Isozaki Atelier, as the office was called, was a buzzing hub with a large number of interesting projects, constant activities, and a flow of information. The atelier was organized with Isozaki as the single master, heading up a group of around 30 – 40 dedicated architects. Nobody used computers while I was at Stirling’s office; in contrast, Isozaki Atelier embraced and represented the future of architecture. The digital revolution was happening (Mario Carpo dated the first digital turn in architecture in 1992).

I had encountered Isozaki’s work a few years earlier as a student when visiting an exhibition in Frankfurt displaying the 1984 competition proposals for the new Museum of Applied Arts; a project that was won by Richard Meier. Isozaki’s design proposal was so different from anything else there: He placed a giant cube in the middle of the parkland, thus minimizing the building’s footprint and impact to preserve most of the beautiful surrounding parkland and trees. I also admired the Museum of Contemporary Art (MOCA) in Los Angeles, which opened in 1986, and I was able to visit it. I had also seen photos of the Museum of Modern Art in Gunma (1974), a much-published earlier masterpiece. It was obvious to me that Isozaki was a refined master architect, working within his own universe and language.

I came to Tokyo when Isozaki was almost 60 years old and had just reached the peak of his career (with branch offices in New York and Barcelona), receiving a growing

number of invitations to participate in design competitions around the globe, including in Germany, Austria, and the UK. We collaborated on large-scale design competitions for prominent sites in Berlin (our competition success in 1992 resulted in two buildings at Potsdamer Platz, for which we subsequently formed a partnership), Munich, Stuttgart, and Vienna (where we won the first prize for the design of two unbuilt twin towers), and for the prestigious Tate Modern design competition in London.

The architectural critic Herbert Muschamp noted in 1993, “Arata Isozaki came of age in a country that was not only physically and economically in tatters but had also been torn from its cultural moorings” (Muschamp, 1993). However, from around the mid-1980s onward, Isozaki was building worldwide and became the first Japanese architect to work globally, while at the same time, being intensely busy in his home country: Japan’s post-war economy had been growing and booming continuously since 1960. It was a period of rapid economic growth, which came to an abrupt end with the “bursting of the Japanese economic bubble” in 1992.

Between 1960 and 1990, Japan emerged from the destruction of the Second World War and conquered global manufacturing, leading to an immense property boom (the Japanese call it the bubble era). By the mid-1980s, the joke was that the grounds of the imperial palace in Tokyo were worth the same as all of the state of California.

Following the Japanese asset price bubble from 1985 to 1991, when real estate and stock market prices were greatly inflated, in 1992, this bubble burst: the Tokyo stock market collapsed and property prices fell rapidly. Since then, Japan’s economy has been stagnant and it is yet to recover. The biggest economic challenge for Japan’s economy, the world’s third largest, is its aging population. Wingfield-Hayes notes “For 30 years, Japan has been struggling with a sluggish economy, held back by a deep resistance to change and a strong attachment to the past. Now, its population is both aging and shrinking. As a result, Japan has ended up with the world’s largest mountain of public debt. (...) A rigid hierarchy determines who holds the levers of power. A third of Japanese people are over 60 years old, making Japan home to the oldest population in the world. It is recording fewer births than ever before, and by 2050, it could lose a fifth of its current population” (Wingfield-Hayes, 2023).

However, during the boom years, people were taking charge of positive changes and young architects were given significant responsibilities. Isozaki was well-equipped to take advantage of this boom, getting his most extraordinary, and ambitious designs built. His Japanese projects were, however, rarely realized in central Tokyo.

Most of his buildings in Japan are to be found in smaller cities, such as Mito, Kyoto, Nara, Oita, Kitakyushu, and Fukuoka, or dotted around Tokyo's outskirts.

2. Education, early influences, and formative years

Arata Isozaki grew up in Oita where his father was a prominent businessperson who wrote haiku poetry. The Second World War had an important influence on his early vision of architecture. In 1945, when he was 14 years old, he witnessed the destruction of Hiroshima on the shore opposite his hometown. Three days later, southwest of Oita, the city of Nagasaki was bombed.

Isozaki studied architecture and engineering at the University of Tokyo, graduating in 1954 before completing a doctoral program at the same university in 1961. He maintained that his path to architecture was deeply influenced by the destruction he witnessed earlier in the nuclear bombings. "My first experience of architecture was the void of architecture, and I began to consider how people might rebuild their homes and cities," Isozaki said during his Pritzker Prize acceptance speech in 2019 (Isozaki, 2019). "Air bombardment had destroyed many of the cities, buildings had vanished, and there was only rubble on the ground," he wrote. "However, Japan had already assimilated Western modernization by that time. The only possible choice I had was to start from the ruins – the degree zero where nothing remained." Isozaki explained that due to the political and economic uncertainty of the period, he "could not dwell upon a single style." He noted, "As a result, change became constant. Paradoxically, this came to be my own style."

In his formative years to become an architect, in the 1950s, the ongoing austerity meant he had to be resourceful. After graduation, Isozaki went straight to apprentice with the eminent Kenzo Tange (1913 – 2005), the father of post-war Japanese modern architecture, before establishing his own firm in Tokyo, Isozaki Atelier (later: Arata Isozaki and Associates), in 1963. He continued to work for 9 years with his mentor, Tange, and even after leaving Tange's firm in 1963; he continued working with him throughout the 1970s, when he was invited to be the chief architect alongside Tange of Osaka's 1970 EXPO. While Tange still operated within the legacy of a modernity imported through foreign paradigms, Isozaki was the first Japanese architect to break free from these paradigms, to establish an independent, unique Japanese architecture with its own deviating principles (Bognar, 1985; Curtis, 1986; Frampton, 2007).

His early Japanese projects, such as "City in the Air" (1960 – 1961, unbuilt) and the Oita Prefectural Library

(1962 – 1966), bear strong influences from Le Corbusier, Louis I. Kahn, and Kenzo Tange. Isozaki belongs to the same generation of other Japanese architects, such as Fumihiko Maki (born 1928), Kisho Kurokawa (1934 – 2007), and Kiyonori Kikutake (1928 – 2011), as well as to the era of the Metabolism Movement. Japan's rapidly expanding cities needed further urban densification, and "Metabolist" ideas suggested that cellular biological growth provided a model for architecture. Nakagin Capsule Tower by Kisho Kurokawa became the icon of Metabolism, and its recent demolition (in 2022) is a symbol of the movement's apparent failures (Mack, 2022).

While he was sympathetic to the Metabolist ideas and theories for new forms of cities, Isozaki never joined the Metabolist group, preferring to follow his own avant-garde path. Isozaki positioned himself early as a member of an avant-garde that practiced outside architectural convention. He first captured international attention with "City in the Air," a theoretical proposal for tree-like megastructures branching like a forest canopy over Tokyo, cantilevering to the limits of practicable engineering. When "City in the Air" was proposed, Tokyo had limited the maximum height of construction to 31 m. Isozaki wrote about this in 1961: "Tokyo is hopeless... I am leaving everything below 30 meters to others. If they think they can unravel the mess in this city, let them try. I will think about architecture and the city above 30 meters. An empty lot of 10 square meters is all I need on the ground. I will erect a column there, and that column will be both a structural column and a channel for vertical circulation" (Figure 5).

It was the beginning of the maturation process of Japanese architecture, which would continue for several decades. Not only the widespread devastation of Japanese post-war cities brought an urgent need for new affordable housing but the economic boom also allowed for architectural experimentation and the realization of innovative and unrestricted ideas. As a result, Japanese architecture since 1960 has consistently produced some of the most influential and groundbreaking examples of modern design in the world. Throughout his long career, Isozaki always maintained an interest in visionary forms of cities and utopian concepts, especially in the radical urbanistic ideas between the 1920s and the 1930s. In 1960, he created an ironic photomontage with the title "Future City," in which he placed a Metabolist megastructure within a field of classical ruins of Rome. Regarding this montage, Schalk notes "the image pictures the city as the place where many life cycles of various cultures rise, overlap, and decline. In this juxtaposition of the already declined (Western classical architecture) with the visionary (Japanese Metabolist architecture) and its future (parts of the new scheme already collapsed), historical time appears

compressed” (Schalk, 2014, p. 281). In the end, very little of the visionary Metabolist theories crossed over into reality and, ironically, one of the few Metabolist projects ever built was Isozaki’s Prefectural Library in Oita (1966).

3. Architecture and thought leadership

3.1. A large and diverse oeuvre of buildings, from playful and inventive to monumental

Besides the destruction of the Second World War, what exactly were Arata Isozaki’s influences? His influences were plentiful. There were images of the destruction of Hiroshima and Nagasaki in August 1945, which Isozaki saw as a young man. Murphy notes, “The war never really left him. His theoretic concepts on urban design had impermanence as a central theme – the idea that cities rise and fall and are always in flux” (Murphy, 2022).

It helped that Isozaki had a deep understanding of architectural history, which allowed him to create direct links between his designs and the past. His interest and knowledge of Renaissance and Classical architects, such as Borromini or Schinkel, and his vast knowledge of architectural theory allowed him to use a variety of historical references without restraint. Isozaki drew on a dazzling range of influences (Taylor, 1976). His thoughts and approach to architecture were profoundly influenced by different key experiences, in which he had extensively commented on: first and foremost, Katsura Imperial Villa, the architectural masterpiece in Kyoto: the Emperor’s residence with an idealized circulation system around a series of garden spaces as eloquently described by Junichiro Tanizaki, Bruno Taut, and others (Tanizaki, 1977; Taut, 1934; Isozaki, 2005).

Another important artistic influence was the Japanese space/time concept of “Ma,” a concept Isozaki repeatedly aimed to express in his spaces: The merging of time and space. Isozaki was deeply versed in the significance of Japanese culture: its paradox, refinement, and notions of absence, emptiness, shadow, and darkness.

Ma describes the merging of space and time that exists as an in-between (intermediate) space, between the objects, as a moment of rest or suspension. Isozaki explained it like this: “In-between space, between sound and sound, there are silences apart, pauses. That’s called Ma. Space is important; however, in-between space is more important” (Futagawa, 1983). Isozaki told me that the first architectural book he ever read was Sigfried Giedion’s seminal book “Space, Time, and Architecture” (1941), which started his interest in the time-space connection. The Japanese concept of “Ma” influenced and affected everything Isozaki designed, including the way he thought about living in balance with nature and

the ecosystem. “Like the universe, architecture comes out of nothing, becomes something, and eventually becomes nothing again,” said Isozaki. “That lifecycle from birth to death is a process that I want to showcase.”

In the late 20th century, there was no other Japanese architect who combined the philosophies of East and West to the same extent as Isozaki. His provocative concepts were introduced to a wider audience in 1968 with the installation “Electric Labyrinth” exhibited at the XIV Triennale di Milano. In New York in 1976, he took part in the exhibition “MAN transFORMS,” which was curated by Hans Hollein; and in Paris 2 years later, he staged a legendary show that attempted to convey the concept of “Ma” to the European public. His traveling show, “Ma: Space/Time in Japan” was also on display at the Cooper Hewitt in New York in 1979. In 2003, he published “Japan-ness in Architecture,” calling attention to the simplicity, serenity, austerity, and humble attitude of Japan’s architectural traditions. Emphasizing “Japan-ness” inoculated him against accusations of Americanization, and the allegation that an internationalized Japanese architect had surrendered his cultural identity to the West, becoming foreign in his own country. This was a relevant aspect in Japanese society, which 150 years after it was forced to open its borders, is still fearful of the influences from the outside world.

In 1972, he married his third wife, Aiko Miyawaki (1929 – 2014), a prominent Japanese sculptor. She has been a strong support and critic to Isozaki; she also introduced him to an international group of radical artist friends, including Man Ray, whom she knew from the years she lived in Paris. Early on, he gravitated to jazz, Dadaism, and John Cage. Isozaki was influenced by Surrealism, Constantin Brancusi’s concept of the Infinite Column and the sculptural work of Isamu Noguchi, as well as the architectural work of Louis I. Kahn, especially Kahn’s use of the barrel vault at the Kimbell Art Museum and the design of the unbuilt City Tower project for Philadelphia (1957). Similar to the work of Kahn, Isozaki shared a preoccupation with monumental proportions and heavy building elements that did not hide their weight, materiality, and rough surfaces. Isozaki frequently referred to the Salk Institute in La Jolla (1959 – 1965), one of Kahn’s masterpieces, in which he composed a campus and courtyard overlooking the ocean and enclosing a heroic water plaza; a space that offers the sensation of being both inside and outside at the same time; a space we can rediscover again and again in Isozaki’s own work (Stewart, 1991, p. 53). Isozaki wrote extensively about all of these influences and what they meant for him, and about the intriguing capacity of Modernism to translate all kinds of artistic and urban qualities into a new language.

3.2. Architecture as an inherently urban discipline

Considering his writings about the production of new urban constellations, Isozaki refers to earlier utopian ideals, such as Wright's Broadacre City (1932), Le Corbusier's Radiant City (1930), and Ungers' and Koolhaas' Green Archipelago City (1977). He understood architecture as an inherently urban discipline. What also stands out was Isozaki's interdisciplinary approach: the ease with which he moved between the disciplines, from urban design to architecture and fashion design, from graphics and furniture to stage design – all of which influenced his ideas and thinking well beyond the field of architecture (Isozaki, 1998; Isozaki, 2006a).

The powerful but geometrically simple formal repertoire in his work always stunned me. He displayed a unique capacity for strong figure-ground compositions that declared architecture to be a compositional art, a celebration of willful formal expression, and a reminder of the urban possibilities that large buildings could offer. He frequently spoke about “buildings composed like paintings” and mentioned the collages of Spanish Cubist painter Juan Gris. Isozaki demonstrated that architecture is something to be composed, elaborated on, and celebrated, with unique ideas of space, which were then turned into a special atmosphere, generated by elegant theatrical spaces and extraordinary stage-like settings. With close attention to proportion, the conceptual originality for powerful designs would join strong geometric forms asymmetrically, such as juxtaposing a cylinder with an exact cube or a half-cylinder, with exquisite refinement and complexity of detail. Expressing geometrical rigor, order, and clarity were crucial for each project. The level of attention devoted to every detail, the willingness to search for the “perfect” materials, and the obstacles overcome to achieve perfection – all of these are the hallmarks of his working method and devotion to perfection and beauty. One critic put it this way: “What is most impressive about Isozaki is his ability to put together the basic building blocks out of which we make architecture, and then to twist them, sometimes quite literally, to create a composition or sometimes just an icon. And along the way, he erodes the certainty about what the building is or how it is organized, or even why it is” (Betsky, 2019).

His search was about an unbroken idea of beauty. It was a time without limitations and fear. Today, we ask if we are allowed to propose or say that. Whom could I offend? Who is going to correct me now? We all mourn this time and are sad that there are fewer and fewer people who have the courage to stand by what they think and say.

The idea of composing buildings as pure objects rather than socially engaged architecture is persuasive because it

is, indeed, how the buildings might appear to the visitor at first glance. However, any user would appreciate buildings also being socially engaged and user-friendly besides being a sculptural statement. While Isozaki's compositions were shaped by simple and visually calm forms – giant prism-shaped gallery spaces and spherical-shaped parts arranged with great order, like children's building blocks, organized across a site (such as at MOCA in Los Angeles or the Art Tower in Mito) – Isozaki's capacity to invent new forms was remarkable. Here, it is important to note that these compositions were not anti-functional, but able to resolve the organizational problem in a floor plan while simultaneously creating interesting solutions in section and elevation. Just like Bernini and Borromini before him, at the beginning of the Baroque era, he challenged the boundary between sculpture and architecture. Regarding this observation, Joseph Giovannini wrote: “Not since the French architectural visionaries of the 18th century have an architect used solid geometric volumes with such clarity and purity and never with his sense of playfulness” (Giovannini, 1986, p. 3).

The interiors of Isozaki's concert halls and cultural buildings were equally striking: here, he frequently used optical illusion, with curved or mirrored glass and printed patterns on glass, creating enigmatic optical distortion, and ensuring a full sensory experience in the elegant entry foyers – we can see this in the entrance hall at Gunma Museum, the Tsukuba Center Building, and Kyoto Concert Hall. These sublime theatrical spaces quickly became his trademark.

4. From Post-Modernism to Curatorship

4.1. The Triumvirate of Post-Modernism: Isozaki—Hollein—Stirling

Besides all his monumental playfulness, symbolic messages, and postmodern freedom, Isozaki was also a romantic architect, rooted in history: a tendency that could also be seen in the work of Hans Hollein (1934 – 2014) and James Stirling (1926 – 1992). A tendency, which would later be termed by Charles Jencks as “post-modernism” (1984). For instance, the Staatsgalerie Stuttgart designed by Stirling (1977 – 1984) and Hollein's Museum Abteiberg (1972 – 1982) are two masterpieces with a fondness for stage-like allusions. Both iconic structures became some of the most published examples of the trend. These buildings were not unlike Isozaki's “newly built ruin” of the Tsukuba Center (1979 – 1983): an entire new civic center, heavily referencing architectural history and consisting of cubist-like compositions of memorable fragments. Tsukuba was a collage of eclectic references ranging from Michelangelo to Borromini, Piranesi and

Ledoux, all composed in perfect synthesis in an “eclectic ruin of the future;” referencing John Soane’s painting of the Bank of England as a ruin (Muschamp, 1993). Tsukuba was drawing from the past to define a future. Importantly, Isozaki’s referencing of historical themes and fragments, narrative content and symbolic figuration, did not occur at the expense of the usability of these buildings, nor was it superficially attached, but well integrated: the functional organization of the compositions was usually marvelous. At this point, in the early 1980s, the three buildings by Isozaki, Hollein, and Stirling all signaled a clear and radical break with a tired and austere International Modernism and its well-documented shortcomings. All three were considered by many as the leading architects of their generation and as unparalleled innovators in postwar international architecture, with James Stirling arguably the most controversial figure (Leach, 2010; Cohen, 2012; Lehmann, 2017).

In 1978, theorist Colin Rowe suggested in “Collage City” that Modernism is not simply Functionalism but may also draw on history. According to Rowe, it was not only acceptable that Modernism would quote from the rich history of architecture but also that Modernism could be at its best when directly referring to history. He argued that in a postmodern reaction to modernism’s “total-design” approach, an urban design must be considered through “fragmentation, bricolage, and metamorphoses of interpretations” (Rowe & Koetter, 1978, p. 23). This was a completely new reading of modernism, which was exhausted and had gradually maneuvered itself into a dead-end.

Both Isozaki and Stirling had begun their careers with modernistic and Brutalist buildings before starting afresh and subverting the compositional and theoretical ideas behind the Modernist Movement. With this, they instigated controversy within an architectural culture that largely conformed to Modernist norms. Postmodernists questioned the West’s fundamental belief in Renaissance unity and functionalism in architecture. For Isozaki, architecture became predominantly a cultural practice – in his words, “a machine for the production of meaning.” He designed buildings with symbols and references, imbuing them with irony and humor.

Today, the completion of these three radical buildings (Stirling’s Stuttgart Staatsgalerie, Hollein’s Abteiberg, and Isozaki’s Tsukuba Center) is considered by many historians to be a watershed moment in 20th-century postwar architecture. Culture, not technology or utilitarian functionalism, was now seen as a driving force of architectural form. Combining platonic solids originating in the Mediterranean – cylinders, cubes, spheres, and

pyramids – they used bold geometric shapes to design public libraries, museums, and concert halls.

In Mito, Isozaki adorned a cultural center with a 300-foot-high tower made of 28 stacked, titanium tetrahedrons. Using solid geometric volumes with clarity, purity, and a sense of playfulness, the architecture of the triumvirate was different from the North American postmodernism of Michael Graves or Robert Venturi. “Unlike those American postmodernists who believed that classicism held the key to a usable past, Mr. Isozaki appeared to understand that no amount of historical excavation could uncover a firm foundation on which to build the present,” the critic Herbert Muschamp wrote in 1993.

Isozaki also realized the renewed relevance of his earlier provocative collage, re-exhibiting the 1968 “Re-ruined Hiroshima” photomural at the Japanese Pavilion at the 1996 Venice Architecture Biennale (Ku, 2011; Weiss, 2013). Japanese architecture has a long tradition of borrowing from foreign cultures (first from China, and then from the West), and much of Japanese design comes from a process of borrowing, transforming, and refining. Isozaki saw himself as nothing less than a key protagonist and actor in the history of the discipline of architecture, in line with other self-conscious innovators like Le Corbusier or Louis I. Kahn, who insisted on architecture as an art form, beyond the mere form–function dialectic. Architecture as objects allowed for all the mystery, surprise, and power these objects could hold. Isozaki displayed a strong understanding that the design of buildings is a serious intellectual activity and frequently related his own architecture to the works of the Renaissance masters, such as Michelangelo (Drew, 1982; Futagawa, 1983). His long friendship with Hans Hollein and enormous respect for James Stirling’s work allowed a shift of focus away from purely Japanese topics at the time.

The team of Isozaki–Hollein–Stirling was about to become known as the “Triumvirate of Post-modernism” (Jencks, 1984), and they soon emerged as the leading architects responsible for numerous new museums, art galleries, and cultural centers. The three became the key figures representing the most significant trends within architectural design at that time.

Isozaki’s global activity made him one of the first “Starchitects” and a true global citizen (a long time before the negative connotations now associated with the term “starchitect,” Isozaki embodied the master that travels from site to site and holds total control over his projects). Today, the concept of “star architect” has lost its relevance and young architects are searching for alternative working methods that effect change through the empowerment of others (Figure 8). The year 1980 was, however, the

beginning of trend setting and celebrity culture in architecture. Due to the international nature of his work, his more conservative Japanese colleagues started to call Isozaki “non-Japanese” and a foreigner (Muschamp, 1993; GA Document, 2004). To overcome this perception, Isozaki consciously emphasized the image of his Japanese nationality in public by frequently wearing kimonos in ceremonies and official portraits.

During the 1990s, Isozaki Atelier had become a busy place with commissions arriving from all over the world; about 12 projects were on the drawing boards or under construction at any given time. In addition, much of the extra work was for large-scale design competitions and curatorial works, such as exhibitions and stage designs. A creative force and an intuitive genius, Isozaki has always remained a soft-spoken, thoughtful, and charismatic figure, charming and polite, despite the pressures of the construction business. “Originality of ideas is not important,” he told London’s *Observer* newspaper in 1991. “We can borrow anything.”

Isozaki was able to visualize his ideas convincingly with beautiful hand-drawn sketches that have become collectors’ items. Meetings about projects would usually follow a strict ritual, in which Isozaki would sit on one side of the large table; without much talking, he would spend most of the time sketching different spatial ideas with an ink pen on thin yellow tracing paper. Regularity and irregularity were recurring themes when it came to sketching interior spaces, wall claddings, and suspended ceilings. The elaborate design of the ceiling was an important recurring theme that allowed the expression of the nobility and meaning of specific spaces or sequences of rooms. Stacks of exquisite drawings, often abstract, elegant hand sketches combined with urban diagrams, were produced in long meetings, in which he would work on ideas repeatedly, testing different solutions. It was then our task to “translate” those freehand drawings into more concrete line drawings that could become the basis for construction documents.

Besides hand sketching, Arata Isozaki was a pioneer of architectural representation through the medium of silkscreen prints. Figures 1–5 showcase a selection of typical hand sketches: made on thin tracing; these are exquisitely atmospheric and expressive sketches; while Figure 6A and B illustrate the use of silkscreen prints. Figure 7A and B show Arata Isozaki in his office sketching on thin yellow tracing paper.

4.2. The many other roles, including curatorial roles that Isozaki took on

His non-building work – curation, stage designs, collaborations with artists, writing, furniture design, and

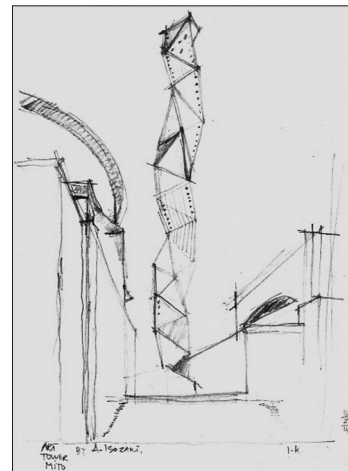


Figure 1. Sketch for Mito Art Tower, 1986.

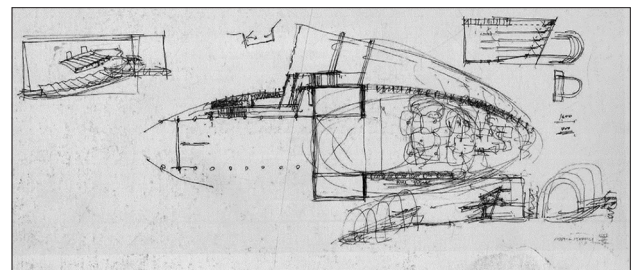


Figure 2. Sketch for Nara Centennial Convention Hall, 1992.

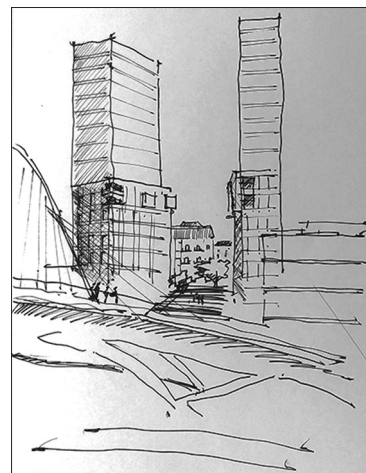


Figure 3. Sketch for Atea Bilbao Twin Towers, 1999. Source: Courtesy of Arata Isozaki and Associates.

so on – were equally important to him. Over the years, he took on numerous other roles besides his busy practice. Here, he displayed great generosity in an otherwise often egoistic profession. As an ambassador between cultures and disciplines, Arata Isozaki became an international power broker in his field, recognized for his support for young architects. Fostering young talent, he mentored

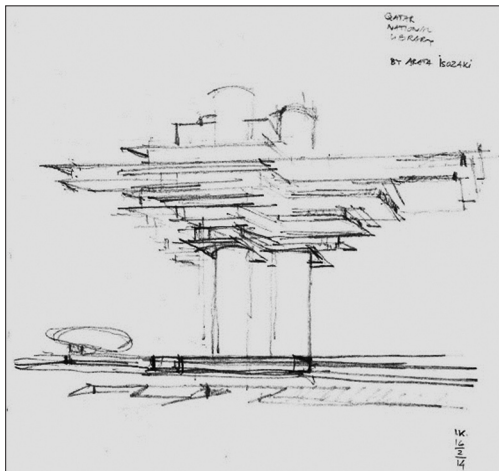


Figure 4. Sketch for the National Library Qatar, 2002. Source: Courtesy of Arata Isozaki and Associates.

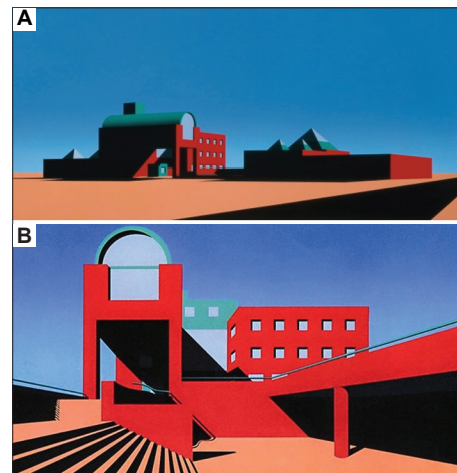


Figure 6. (A and B) Silkscreen prints of the Museum of Contemporary Art, MOCA (1981 – 1986), 1984, Los Angeles, California, USA. Source: Courtesy of Arata Isozaki and Associates.

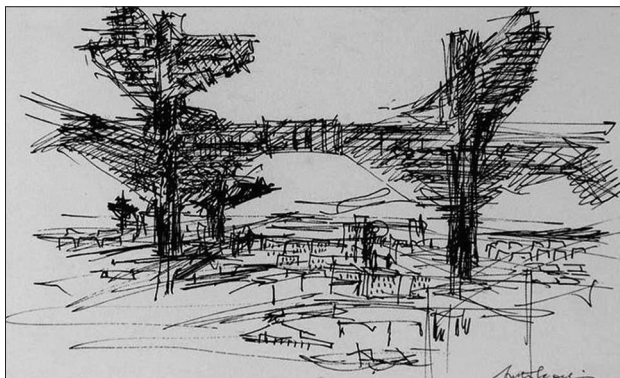


Figure 5. Sketch for City in the Air, Tokyo, 1960. Source: Courtesy of Arata Isozaki and Associates.

several generations of younger designers who flourished after working in his atelier. His patronage and his practice anticipated changes and pushed the field of architecture forward at each step. Hubertus Adam noted that “The tireless networker and intellectual architect masterfully combined his own and the foreign, tradition, convention, and innovation” (Adam, 2023). Isozaki regularly appeared as a speaker at numerous conferences. His contributions to the ANY conferences of the 1990s, the most important forum of international architectural discourse at the time (organized by Peter Eisenman), were particularly relevant. Twice, he was Commissioner of the Japanese pavilion at the Venice Biennale of Architecture.

Since the construction of the MOCA in Los Angeles, Isozaki has been increasingly active in the Western world – as an architect, but also as a mediator, interlocutor, and influential juror in competitions. Frequently invited as a guest juror at competitions, he sought out the most unconventional projects. Thanks to his commitment that

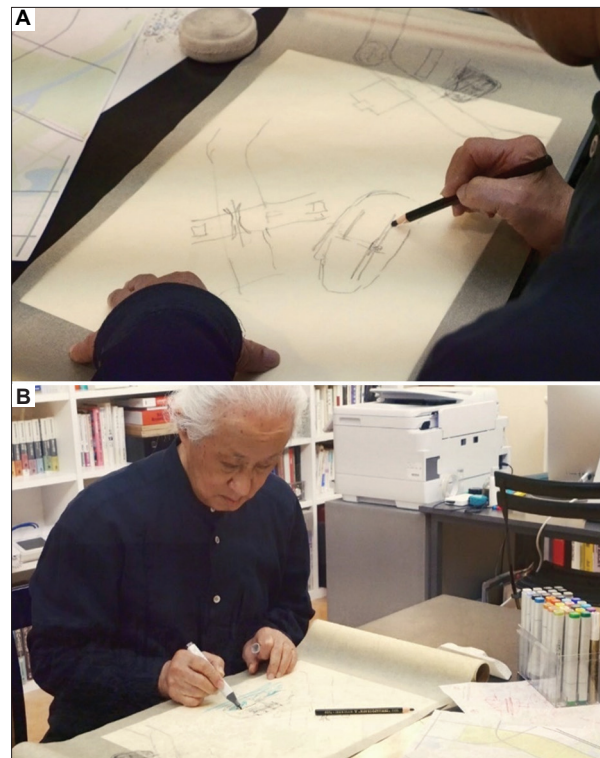


Figure 7. (A and B) Arata Isozaki sketching (1931 – 2022), photos around 2019. Source: Courtesy of Office for the Pritzker Prize in Architecture.

Bernard Tschumi was able to win the Parc de la Villette competition in Paris. In Hong Kong in 1983, as a daring juror, he paved the way for an international career for the then-unknown young architect Zaha Hadid by her winning the Hong Kong Peak sports club competition.

Conversely, in addition to his practical work as an architect, he campaigned vehemently for the promotion of



Figure 8. Group photo taken in 1996 in New York at Philip Johnson's 90th birthday. It shows the who-is-who in architecture; Isozaki is seated next to Johnson.

architectural culture in Japan. In 1988, he was appointed as the artistic director of the Kumamoto Artpolis, a position he handed over to Toyo Ito 10 years later. In 1989, he developed the masterplan for Nexus World, a large housing exhibition in Fukuoka, Japan: on the 8-hectare site, projects by Steven Holl, Rem Koolhaas, Mark Mack, and Christian de Portzamparc were realized at his invitation; these were their first projects in Japan.

In 1990, he curated the “Osaka Follies” program for the International Garden and Greenery Exposition in Osaka. Twelve architectural firms built pavilions, including Bolles + Wilson, Zaha Hadid, Ryoji Suzuki, Coop Himmelb(l)au, Daniel Libeskind, and MacDonald + Salter. Between 1994 and 2001, Isozaki was responsible for master planning a large housing development in Gifu, for which he commissioned only female architects, including Elizabeth Diller, Kazuyo Sejima, and the landscape architect Martha Schwartz.

In 1983, he published the book “Katsura Villa: Space and Form,” effectively elevating the imperial retreat in Japan to the status of the Piazza del Campidoglio in Rome and the Parthenon in Athens. As a theorist and author, Isozaki published a compilation of his writings in 2006, which frequently dealt with the Japanese architectural tradition, under the English title “Japan-ness in Architecture.” They are the result of his many years of exploring the question of what is specifically Japanese about the building culture.

5. Four distinctive phases in the work of Isozaki, spanning seven decades

In 2020, Isozaki moved from Tokyo to Okinawa to reduce his direct involvement in the operation of the practice. By then, he could look back on a long, diverse, and productive career spanning seven decades, during which he re-invented himself every 15 years – not unlike Le Corbusier. With

immense discipline and a strong work ethic, Isozaki was able to complete an astonishing number of projects and an almost unbelievable number of design proposals spread over five continents (see Arata Isozaki and Associates' website for a complete list of projects: www.iso-zaki.co.jp). Working as an architect as much as an urban designer, with many innovative large-scale urban proposals to his name, the challenge for any interpretation of Isozaki's diverse body of work is that he refused to restrict himself to any single signature style – unlike Richard Meier, for instance, who always resisted a singular stylistic brand. As a result, Isozaki's designs defy simple categorization, embracing the avant-garde and frequently challenging the status quo, constantly evolving, and always remaining fresh in his approach. With each of his buildings being unique, Isozaki never repeated himself. “To find the most appropriate way to solve these problems, I could not dwell upon a single style. Change became constant. Paradoxically, this came to be my own style,” he noted in 2019.

Nevertheless, I will take the risk to suggest that one might separate Isozaki's oeuvre into four distinctly different phases, each of them wholly original.

5.1. Phase I (1959 – 1973): Post-structuralism, design for a Postwar World

He established Arata Isozaki and Associates in 1963 after the Allied occupation had ended and Japan had regained its sovereignty and was seeking physical rebuilding amidst political, economic, and cultural uncertainty from the decimation of the Second World War. For nearly two decades, Isozaki built only in Japan, primarily on the southern island of Kyushu, where he was born. His work began locally, with buildings in his hometown Oita and in Fukuoka, and quickly expanded to Gunma and Tsukuba. Like Kenzo Tange or Kunio Maekawa, Isozaki benefited from the reconstruction programs and realized, among other things, Oita's Prefectural Library (1966; now Oita Art Plaza), an ingenious structure made of exposed concrete, in which the supporting structures and spatial sequences interpenetrate in a highly expressive way. At this time, he was strongly influenced by his European experiences with a style mixing “Western Brutalism” and “Japanese Metabolist Architecture,” such as the radical Oita Medical Hall (1959 – 1960), as noted by Banham (1976). In 1959, Le Corbusier built the National Museum of Western Art in Tokyo, which was an important influence on Japanese architects. The highly expressive language of Brutalism was particularly influential and well received in Japan. The early Brutalist phase of Isozaki's work had so much more feeling of space than others' Brutalist work in the UK, Brazil, or Japan, which needed only to be on “chunky” pilotis and expose some rough concrete texture.

These early buildings made a feature of their rough concrete structure and looked like machines; an architecture of repetition and components, which revealed how they were made and assembled. The elegant Gunma Art Museum (1974), Isozaki's most notable early project, gained international attention and confirmed him as an original force, securing a place for him on the global circuit. Gunma's system of abstract cubes and gridded frames was based on his concept of the "art gallery as void." His ideas about urban mega-structures (especially "City in the Air" and "City in the Sky," 1960 – 1962) with their references to organic biological growth and modular flexibility were similar to the theoretical position expressed in the Metabolism manifesto (published in 1960). It was also a reference to Russian Constructivism and El Lissitzky's "Wolkenbuegel," a utopian project from 1924 for Moscow.

I was always fascinated by the cultural relevance of some of his early works. "City in the Air" was envisioned as a futuristic plan for Shinjuku consisting of elevated layers of buildings, residences, and transportation suspended above the aging city below, in response to the rapid rate of Tokyo's urbanization. The concept was never realized but looking at the images of this futuristic city in the sky, they could very much be a vision of today. Isozaki was clearly ahead of his time. The structure of the "City in the Air" resembles a tree, with a large structural trunk that contains vertical circulation and services, which allowed building this "new city above the existing city" (Isozaki), only requiring a small plot of land at the ground level, suggesting that most of the land remained public space.

The hypothetical projects ranged from floating cities on the oceans or on reclaimed land (work in which Isozaki was involved with Kenzo Tange, including the Tokyo Bay Plan of 1960) to modular plug-in capsule towers (not dissimilar to Archigram's Walking City and Plug-in City, 1964; or Yona Friedman's Spatial City, 1963). The 1968 Electric Labyrinth installation portrayed a "Re-ruined Hiroshima" at the Milan Triennale. His formal approach continued to evolve with buildings such as the Fujimi Country Club (1973 – 1974) and Kitakyushu Central Library (1973 – 1974), a building that already introduced the following phase of his oeuvre.

Isozaki would always respond to significant changes in the world's situation with an equally significant shift in his approach to design. In 1974, he commented that the era of technological optimism ended with Tokyo's "failed EXPO 1970" and the world energy crisis; a new phase had begun.

Typical works from this phase include:

- City in the Air (1960 – 1961, unbuilt), Tokyo, Japan
- Ōita Prefectural Library (1962 – 1966; now Oita Art Plaza), Ōita, Japan

- Nakayama House (1964), Ōita, Japan
- Kitakyushu Municipal Museum of Art (1972 – 1974), Fukuoka, Japan
- The Gunma Museum of Modern Art (1971 – 1974; refurbished in 1997 and 2006), Gunma, Japan
- Fujimi Country Clubhouse (1973 – 1974), Ōita, Japan

5.2. Phase II (1974 – 1989): High Postmodernism: The symbolic, playful, and ironic in architecture

In 1974, the architect bade farewell to his Brutalist beginnings and increasingly turned to play with sometimes-ironic references, which made him the most influential representative of postmodernism in Japan. With the barrel roofs of the library by Kitakyushu (1974), he quoted Étienne-Louis Boullée's vision of a Bibliothèque Nationale: the tunnel-like space of the library was inspired by Boullée's proposed design for the French National Library (1785), organized in two neoclassical vaulted volumes made of precast concrete. In the large Tsukuba Center Building (1983), a new science city built from scratch north of Tokyo, he integrated a replica of the Capitol Square in Rome. It was a project full of contradictions. The Tsukuba Center was meant to represent the country's high-tech future; yet, Isozaki depicted the buildings in drawings as instant ruins.

During this second phase, Isozaki made such a dramatic impact on the world architectural stage that Charles Jencks wrote: "Isozaki has taken the Post-Modernism of the West one step further" (Jencks, 1984, p. 236). His designs became more inventive with daring geometry, at a time when architecture had to radically reinvent itself. Trust in technology had waned and the oil crisis showed the limits of growth. Isozaki's new approach to design emerged as a reaction against the perceived shortcomings of the 1960s and 1970s, with its lack of reference to the history of architecture and ignorance of local culture. Isozaki now worked closely alongside his third wife, the Japanese sculptor Aiko Miyawaki.

Pioneering the introduction of Japanese architecture overseas during this phase, Isozaki was able to realize a series of key projects in the US, including MOCA in Los Angeles and Team Disney in Florida, both of which were important buildings that introduced him to the US market. The MOCA, Los Angeles was the architect's first international commission outside Japan. MOCA is still considered one of Isozaki's masterworks: visitors to MOCA enter through a sunken red sandstone courtyard that is reminiscent of the Tsukuba Center in Japan. Large pyramidal skylights illuminate the serene galleries below. The first gallery space – voluminous, meditative, and visually still – introduced an emptiness full of possibilities. "That gallery space was worth the whole building," Frank Gehry said at its opening. The

completion of MOCA sets the stage for a four-decade-long international career. However, clashes with the museum project overseers almost led to Isozaki walking away. It is little known that the project nearly stopped when a building committee forced Isozaki into a design he repudiated in the press. However, failure in Los Angeles would have forced him to retreat to Japan in humiliation Giovanni (2022) writes, “Following the advice of the Los Angeles architect Frank Gehry, Mr. Isozaki won the support of a group of museum trustees, who rescued his design and, with it, both the project and his reputation.” In the end, Isozaki’s ideas remained mostly intact, with numerous critics praising the spatial sequence and refined lighting.

The Team Disney headquarters building in Orlando, Florida (evidence of the architect’s growing popularity in the US), was overloaded with symbolic meaning and colorful geometries: it resembled nothing ever built before and incorporates influences from Pop Art and postmodern humor, including the tongue-in-cheek metaphor of the main entry gate, in the form of Mickey Mouse’s ears. Two long office wings meet at a giant, cone-shaped lobby, which was brightly colored and equipped as a sundial. The building became an instantly identifiable icon.

Isozaki embodied the 1980s like hardly any other architect of the second half of the 20th century – a time that, stylistically, allowed everything. Isozaki could do postmodernism so much better than the others could, and appeared to enjoy himself in the process. In architecture, the 1980s meant a new era of beauty, sensuality, and an aura of mystery. These were different times compared to today. Today, in Japan, the interest in classic beauty and large, unmistakable geometrical forms is declining; while, in China, there appears to be a revival of interest in neoclassical architecture. Moreover, the overview was still possible: one simply knew who “Big Jim” was. One just knew who Hollein was, who Philip Johnson and Frank Gehry were, and of course who Isozaki was. These six eccentric architects were just legendary, and that is fascinating. I do not know if our present time can still produce such legends. In hindsight, it seems that aura ended and by 2000 was gone. By normal standards, it was sometimes hard to digest what these trend-setting architects designed at the time. They embodied the spirit of the ’80s, when you simply dared, still put everything on one card. It was a time that allowed open discussion about aesthetics, beauty, and proportion, a time that consumed everything. Furthermore, it consumed the eccentric people in a strange way. Now, one has the feeling that the next guard no longer has any understanding of this time. Many young people interested in architecture and design theory do not even know these names and works.

A spectacular competition-winning design for Tokyo’s New City Hall (1985) was never built – although ideas from this key project kept re-emerging in the office in later proposals. The typology of the large “ground-scraper” would occupy Isozaki for his entire career. Its large and airy indoor/outdoor atrium sliced by bridges re-emerged 10 years later for the Potsdamer Platz buildings C2/C3 in Berlin. Our proposal was the only non-skyscraper project in the design competition. The strategy was clever: when one turns a skyscraper on its side, creating a “ground-scraper,” all of its intimidating “bullying power” dissipates into a humbler serenity.

Isozaki commented that the phase of the Cold War era had ended, and this shift created an entirely new globalized situation, which followed the fall of the Berlin Wall in 1989 and the bursting of Japan’s economic bubble in 1992.

Typical works from this phase include:

- KitaKyushu Central Library (1973 – 1974), Fukuoka, Japan
- Tsukuba Center Building (1979 – 1983), Tsukuba, Japan
- The Museum of Contemporary Art, MOCA (1981 – 1986), Los Angeles, California, USA
- Palau Sant Jordi Stadium (1983 – 1990), Barcelona, Spain; sports arena for the 1992 Summer Olympics; followed by the Palafolls Sports Complex Pavilion (1987 – 1996), Barcelona, Spain
- New Tokyo City Hall (1985 – 1986, unbuilt), Tokyo, Japan
- Kamioka Town Hall (1975 – 1978), Kamioka, Japan
- Team Disney Orlando (1987 – 1991), Florida, USA
- Bond University, Library and Administration Building (1987 – 1989), Gold Coast, Australia
- Kitakyushu International Conference Center (1987 – 1990), Fukuoka, Japan
- Hara Museum ARC of Contemporary Art (1990, extended 2008), Gunma, Japan

5.3. Phase III (1990 – 2000): Architecture as a sculptural statement and experiment

The third phase of his career can best be described as a paradigm shift toward the thought that “anything seems possible,” further garlanding his career with high-profile projects and clients, firmly establishing Isozaki as the most influential figure in Japanese architecture in this decade: by now, his position was influential and truly international. Edan Corkill noted: “If the entire Japanese architectural fraternity was one big royal family, then Arata Isozaki would be a king approaching the end of a long and glorious reign” (Corkill, 2008, p. 4). Indeed, during this phase, his influence gradually spread further afield, mirroring the further growth of his stature.

The conceptually powerful and often provocative designs of this phase looked suddenly more Japanese when compared to the previous, internationalized phase. For instance, the buildings in Mito and Krakow revealed a typical Japanese aesthetic. Now globally admired, Isozaki developed also a more hyper-modernistic style, with buildings such as the Nara Centennial Hall and the Domus science museum, La Casa del Hombre, in Galicia, Spain. Both projects are monoliths with smoothly curved fortress-like walls clad in slate and ceramic tiles, departing from the language of his other buildings.

Much of his work in Spain was generated by the highly successful Olympic stadium Palau Sant Jordi on Barcelona's Montjuïc, in which he designed for the 1992 Summer Olympics. It was also a response to the beginning of Japan's economic recession, which forced architects to search for work beyond Japan. The bursting of the Japanese economic bubble made it necessary to look worldwide for new projects, and Isozaki was very successful in doing so. He once told me "If you lose commissions, you lose power – and that's hard to take." Arata Isozaki remained powerful – by winning numerous new commissions and constantly renewing himself both internally and externally.

With the Fall of the Wall (1989), Isozaki became a frequent visitor to the city of Berlin. He loved the 1920s utopian designs of creating a better world, and the old cities in Italy and Spain, which he frequently visited. In the 1990s, there was a renewed focus on European cities as the main area of cultural interest, which led to the "rebirth" of European urbanism. Many of the buildings designed and built during this phase are a string of elegant public works with a cultural function, ranging from large concert halls, museums, art galleries, universities, and libraries, to cultural centers and convention halls. Every project came now with a broader civic agenda, dealing with public space. New commissions were mostly won through design competitions. Museums became one of his important fields of activity, but also concert halls and public libraries. Isozaki, therefore, developed vast expertise in museum technology, lighting, and acoustics for concert halls.

During this period, he developed the concept of the Third Generation Art Museum (1991), which he described as a "site-specific and art-specific museum" (Lehmann & Feireiss, 1994). Brancusi's Infinite Column and the idea of an infinitely extendable tower influenced the design of Art Tower Mito; it created a powerful civic symbol for an otherwise non-descript new town (Figure 1). Despite the large-scale works, he always maintained an interest in small projects, such as the Nagi Museum (1994), furniture design, and temporary exhibitions. This was in line with the enormous respect that Japanese culture has for small things

and its dedication to refinement: just think of the ritual of the traditional Japanese tea ceremony or the delicacy of the Japanese gardens (GA Architect, 2000). Designs during this phase included fiercely elegant buildings such as Kyoto Concert Hall, the Nara Centennial Hall, and the Atea Twin Towers in Bilbao (Figures 2 and 3). For many, it came as a surprise when around 1998, Isozaki started to incorporate organic curved structural elements and surfaces in his designs; the use of curvilinear surfaces started to appear more frequently, enabled by new parametric capabilities (these became even more dominant in his later projects in China, Qatar, and for the Florence railway station proposal) (Carpo, 2017).

Isozaki would claim that the phase of contextual local architecture and critical regionalism had ended with a complete globalization of the architecture discipline.

Typical works from this phase include:

- Art Tower Mito Cultural Complex (1986 – 1990), Ibaraki, Japan
- Centre of Japanese Art and Technology (1990 – 1994), Kraków, Poland
- Donau City Twin Towers (1991 – 1992, 1st Prize, unbuilt), Vienna, Austria
- Kyoto Concert Hall (1991 – 1995), Kyoto, Japan
- Nara Centennial Hall Convention Center (1992 – 1998), Nara, Japan
- Mino Ceramic Park and Museum (1996 – 2002), Gifu, Japan
- Domus—La Casa Del Hombre Science Museum (1991 – 1995), A Coruña, Galicia, Spain
- Buildings C2/C3 at Potsdamer Platz (1993 – 1999), Berlin, Germany (Arata Isozaki and Steffen Lehmann)
- Nagi Museum of Contemporary Art (1991 – 1994), Nagi, Okayama, Japan
- Toyonokuni Library for Cultural Resources (1991 – 1995), Toyonokuni, Japan
- Shizuoka Convention and Arts Center GRANSHIP (1998), Shizuoka, Japan
- The Bass Museum of Art, Miami (2000 – 2001), Florida, USA
- COSI Columbus Science Museum (1994 – 1999), Ohio, USA
- The new entrance of the Caixa Forum Barcelona Building (1999 – 2002), Barcelona, Spain

5.4. Phase IV (2001 – 2020): The 21st century: Digital architecture as a form of global endeavor

Even in later years, he remained tirelessly internationally active. The anxiety around the new millennium, with huge expectations, which had quickly cooled off and led to cultural disappointment, shifting the focus away from the

European city to fast-growing cities in Asia and the Middle East. The recent building boom in China and the Middle East allowed the architect to finally realize ideas for urban planning that he first conceptualized 40 years earlier.

In this most recent phase, Isozaki continued to push the envelope of what was possible urbanistically, socially, and technologically, creating new forms with cantilevering parts that have often challenged gravity.

In an age where the difference between “urban” and “non-urban” has become increasingly blurred, the concept of the polycentric city had gained momentum. The projects completed in this phase can mostly be found in the fast-growing mega-cities of Asia rather than in Japan or the USA, a sign that architecture has become a truly globalized endeavor, catering to a new global consumer society. Arata Isozaki and Associates opened an office in China. Globalization also leads to an architecture that is less distinctive of any one place or country, because it is abstract rather than locally anchored by regional materials and typologies. Many of these projects, clusters of high-rise towers seen as variations of earlier themes, were now in China, Vietnam, and Central Asia, in the Middle East including Qatar. Among his numerous projects in the Middle and Far East, the proposal for the National Library in Qatar stands out: a high-rise tower that recalls the unbuilt “City in the Air” from 40 years earlier. Some ideas take a lifetime to finally be built (Figures 4 and 5).

Between 1998 and 2020, Chinese cities rapidly urbanized and built a large number of cultural facilities, including museums, libraries, concert halls, theaters, and infrastructure (e.g., during this time, more than 360 theaters were realized). Here, Isozaki had the opportunity to realize some of the important public buildings in large cities and apply his vast experience in museum lighting and acoustics. The Shenzhen Cultural Center and Library (1998 – 2007) includes a large vineyard-style symphony hall and theater. It quickly became one of the most remarkable landmarks of the young city of Shenzhen. The Art Museum of the Central Academy of Fine Arts (CAFA) in Beijing’s Chaoyang District (2003 – 2008) is another masterpiece that reminds of the curved design of Nara Convention Center. The gallery spaces of this large museum mainly used for temporary exhibitions offers a sensual and luminous combination of artificial lighting and daylight. Isozaki’s most recent cultural facility in China is the world-class Shanghai Symphony Hall (2008 – 2014), seating 1200 people. The foyer provides access to three halls, and it is the new home to the Shanghai Symphony Orchestra, the oldest symphony in China. The vineyard-style grand hall accommodates different settings

for a variety of performances and has been praised for its excellent acoustics. The Zendai Himalayas Art Center in Shanghai (2003 – 2010) is a three-dimensional collage of caverns and ornamental structures.

In 2005, the CityLife office tower in the former trade fair area in Milan was realized. The CityLife project, known as Torre Isozaki, is a dramatic 200-meter-high tower that, instead of the classic image of three parts (with base, shaft, and crown), builds on the concept of the “endless column,” referencing Brancusi’s work. His projects during this phase highlighted the contradictions and discontinuities of the contemporary city, where organized and orderly planning was now rarely possible, and sometimes evoked the idea of an informational city as an advanced network of ICT systems.

Not unlike Le Corbusier, Isozaki’s later work evolved to become more organic, often with curvilinear building forms derived from nature forming cave-like spaces and bone-like structures. Around 2000, Isozaki became interested in incorporating organically shaped structural elements and advances in parametric design and digital fabrication. The Himalayas Art Center and the Qatar Convention Center are both good examples of the organic phase with which Isozaki has searched for deeper meaning beyond ordinary criteria. Among his most unexpected designs was the Qatar National Convention Center: giant concrete “trees” with trunks and thick branches, the surreal forms contradicting the otherwise simple Modernist structure, support its roof. As one of the largest exhibition centers in the Middle East, it evokes tree structures – inspired by the symbol of the holy Islamic tree: two giant arms, which surround the glass façade and support the roof canopy.

At the beginning of the new millennium and in a tech-saturated age of new possibilities, these recent works appeared like “Google Earth Architecture” in the age of satellite surveillance, an era that has radically altered the way we perceive urban and rural environments. This applied especially to rapidly growing cities in China and the increasing uncertainty about their physical presence and longevity; these works made this uncertainty explicit. The impact of globalization and popular culture on architecture and cities has yet to be studied and investigated seriously. This fourth phase of his work was again highly creative with surprisingly fresh design concepts. This may well have been his most creative period.

Typical works from this phase include:

- Shenzhen Cultural Center and Library (1998 – 2007), Shenzhen, China
- Torino Palasport Olimpico Stadium (2002 – 2006), Turin, Italy

- Isozaki Atea residential twin towers (1999 – 2009), Bilbao, Spain
- Qatar National Library (2002 – 2007), Doha, Qatar
- Sohn's Retreat, Joshua Tree National Park (2005), California, USA
- Art Museum of the Central Academy of Fine Arts (2003 – 2008), Beijing, China
- Shanghai Symphony Hall (2008 – 2014), Shanghai, China
- New Concert Hall Building (2003 – 2010), Thessaloniki, Greece
- Zendai Himalayas Art Center (2003 – 2010), Shanghai, China
- Diamond Island and Metropolis Thao Dien (high-rise building cluster; 2006 – 2012), Ho-Chi-Minh City, Vietnam
- Coliseum da Coruña (1990 – 1991), A Coruña, Spain
- Qatar National Convention Center and Ceremonial Court, Education City (2004 – 2011), Doha, Qatar
- CityLife 'Allianz Tower' office high-rise (2003 – 2012), Milan, Italy
- The University of Central Asia's three campuses (2014 – 2016), in Kazakhstan and Tajikistan

6. On changing his design method

Arata Isozaki reflected on and self-analyzed his evolving design methodology. Why did he design the way he did? He fundamentally changed his design method around 1973, which was a key moment for him, moving away from functionalism toward an object-driven architecture of pure geometrical configurations. He compared the two different conceptual approaches, in which he applied to the design of Oita Prefectural Library (1962 – 1966) and to Toyonokuni Library for Cultural Resources (1991 – 1995); both libraries are located in Oita, but were built 30 years apart. Isozaki wrote:

I changed the way I design in the early 1970s, around the time when I published an essay entitled "About my Method." Earlier, I had designed the Oita Prefectural Library by means of what I called "process planning." In accordance with an orthodox, functionalist interpretation of modern architecture, I took the volumes required by the program and determined their functional relationships. Next, taking into account the anticipated growth of those functions, I broke down the volumes into sets (clusters) of rooms, that is, containers. I assumed that there was a one-to-one correspondence between form (container) and content (function). I was searching for a form that was responsive to changes in function as time passed. However, as my theory of process planning had indicated, the process could not be

entirely automatic. I came to realize that the idea of "planning," which I had embraced and which I had thought until then applicable to everything – the state, the economy, society, architecture, and the city – was bankrupt. I began to doubt the very idea of architectural planning. I became more interested in the automatic generation of forms. That is, I came to believe that basic forms existed *a priori* and that "planning" meant anticipating their self-generation. I sought determinants of form in pure geometrical configurations. This was very different from the way I had approached the design of the earlier library. The idea was based on superficial functionalism, that content (function) should correspond to form – the idea of honesty of expression – was turned on its head. Form (expression) was now allowed to generate content (function). The building type was still the same, but I took an entirely different approach to its design (Isozaki, 2006b).

7. The legacy of a prolific lifelong dedication to visionary architecture

Arata Isozaki's architectural position as a controversial artist-architect-writer was often polemical and, I believe, is still highly relevant today. His activities were not limited to architecture but included writing, criticism, the judging of architectural competitions, collaborations with artists (such as with British-Indian artist Anish Kapoor), exhibitions, and some teaching. His buildings, written works, exhibitions, and lectures had a deep impact on the discipline across both the East and the West, and he is often cited as the first Japanese architect to forge a lasting relationship between the two cultures. Chen (2022): "Isozaki was famously hard to pin down – he had no singular style – but in his depth, breadth, and versatility of thinking, he was remarkably consistent. Few architects have been so significant to so many architectural developments over so many decades – a position of centrality that he maintained, in large measure, through his insistence on staying on the periphery. He was fiercely, even stubbornly independent."

In major structures in a dozen countries, Isozaki absorbed and reinterpreted Eastern and Western traditions. However, despite all his success, his childhood experience in war-torn Japan underpinned his work and repeatedly broke new ground in the depiction of his buildings as ruins, such as the Tsukuba Center Building. In the 1962 dystopian vision "Incubation Process," he stated: "The cities of the future are also ruins. Our contemporary cities are born to live for a fleeting moment. Then, they lose their energy and turn back into inert matter."

Only later on, he was the recipient of the prestigious award. For a long time, he was overlooked for the Pritzker Prize – which was the only time I have seen him be bitter about the fact that he was a member of award juries numerous times – including for the Pritzker (in the late 1970s, Isozaki was part of the small group of architects who helped hotel magnate Jay Pritzker plan what became the Pritzker Prize; and between 1979 and 1984, he was a regular member of the Prize's juries), promoting avant-garde architects and helping younger architects to kick-start their career and make their ideas a reality – from Holl, to Hadid, to Sejima and Aoki, and numerous others. It has frequently been Isozaki who created the space and freedom for younger Japanese and Western architects to exhibit their designs and receive commissions. Therefore, it was long overdue when he was finally awarded the Pritzker Prize in Architecture in 2019, as the seventh Japanese architect to receive this award. This greatest honor came late, but still during his lifetime: when Isozaki received the Pritzker Prize, a younger generation of Japanese architects like Tadao Ando, SANAA, Toyo Ito or Shigeru Ban had already overtaken him.

Isozaki, once called “the Emperor of Japanese Architecture” by Tadao Ando (1985), had won multiple other international awards, including the RIBA Gold Medal in 1986, the Chicago Architecture Award in 1990, and the Leone d'Oro at the Venice Architectural Biennale in 1996. He almost won the Pritzker Prize earlier, in 1995, when the Pritzker committee debated whether to give the prize to Isozaki or Tadao Ando. According to Frank Gehry, then a member of the jury, Isozaki blamed him later, unraveling a long friendship. When asked about being passed over, Isozaki replied that he did not want the award: In his view, “a Pritzker concluded a career,” and he did not want to stop working. The situation became so obviously unfair and bizarre that one critic called him “the best and most influential living architect never to have received a Pritzker Architecture Prize” (Betsky, 2019).

In 2019, I was relieved to learn that he finally received the recognition. Thorne noted in the Pritzker Prize laudation (2019) that: “Arata Isozaki is an architect who didn't follow trends, yet evolved constantly over the years. If we look at the early works, compare them to the middle works, and then finally the most recent ones, we see that they are all quite different. In his search for meaningful architecture, he created buildings of great quality that to this day defy categorizations, reflect his constant evolution, and are always fresh in their approach.” When asked about the diversity of his oeuvre, Isozaki replied (2019): “My identity is that every time I like to create a difference. Not in one single style, but also always according to the

situation, according to the environment; an architectural style is a solution. Every time it's different.”

Reflecting on a seven-decade-long career blending architecture with urbanism, visual art, poetry, philosophy, theater, writing, and design, I would argue that each of his designs was a specific solution born out of the project's context, the realities of the site, and the building's program. Perhaps his use of a variety of historical references in an unrestrained way (during his postmodern phase) is that aspect of his work that was most misunderstood and complex, in hindsight sometimes triggering skepticism in a younger generation. Otherwise, the heterogeneous and constantly transforming oeuvre of Isozaki with its diversity and complexity requires some serious effort to fully understand its open-ended questions – not aiming to deliver simplistic, singular answers.

After spending a couple of years in the Tokyo office and becoming Isozaki's trusted aide, I was fortunate to enter into a project partnership with him in 1993 for two large buildings at Berlin's Potsdamer Platz, the result of our competition success. In 1995, when Isozaki lost interest in this distant project with a complicated client, the building's design and realization were entirely taken over by my own practice. Isozaki had become disinterested in working for commercial developers. Thanks to the generosity of Arata Isozaki, I was able to team up with him as a then-only 30-year-old young architect and have my name associated with him.

Today, architects are subjected to elaborate forms of quality control and project management, squeezing out all the time, it requires to develop complex geometric elements in the name of reducing the risks and costs of the project. Isozaki has shown us how powerful buildings can be as a cultural and social statement. However, the neoliberalism of the 1990s has led to the increasing disappearance of the “public” as the client, with the commercialization and privatization of public space. Toward the later part of his career, he was not interested in meeting private clients, such as developers, or spending any time with them; he always preferred to build for the public (rather than working for private interests) and spend precious time with artists and friends.

All of this is, I believe because the ideas and formal originality that continued to drive his architecture are still influential internationally. First is the search for a philosophy, followed by the application of that philosophy. There is no doubt that he was one of the most important and influential architects of the second half of the 20th century. His work, although not yet fully understood, is still very relevant (Oshima, 2009). However, his work remains difficult to categorize. Betsky noted, “His buildings

are difficult to categorize – being neither modernist nor postmodernist, neither deconstructive nor Neoclassical, neither western nor eastern, but all of that and more. (...). Isozaki has taught us not to believe in architecture, or even in his architecture, but to continue the quest toward what makes architecture matter. He does not have an answer, but he does have some pretty good buildings to show for his many decades of searching” (Betsky, 2019).

I predict that Isozaki’s oeuvre and legacy are such a rich resource that now, after his passing, they will become the subject of intensive study, rediscovery, and reappraisal; and they will be appreciated once again by future generations. The four phases of Isozaki’s work outlined in this article allow us to better understand his conceptual themes and evolution, appreciate his unique talent and influential position (and understand his refusal to be identified with one specific architectural style).

8. Conclusion: A career of restless exploration

8.1. Rethinking the Eurocentric epistemology of architecture and the formation of a Japanese modern architectural theory

When compared to other Japanese architects that are his senior (Mayekawa, Tange) and junior (Ando, Ito), Isozaki’s postmodern approach indicates his close affiliation with a Eurocentric epistemology of architecture, which points to a contradicting paradox and even antinomy with his Japanese identity (Kive, 2022). Early in his career, by following a narrow Eurocentric epistemology and attachment to European architectural history and theory (as seen in his work in Oita and Post-modern designs), he assumed a universalistic, objective point of view that undervalued other influences such as Japanese and Asian histories. This also hints at the postcolonial condition of Japanese architecture in the contemporary context of world architecture. An example of the widespread Western narrative of architectural history and theory is Sir Banister Fletcher’s book entitled *History of Architecture on the Comparative Method* (1896), and Pevsner’s *A History of Building Types* (1976), where the protocols that define what is considered scientifically correct were still based on exclusively Western criteria. Both books were known to Isozaki and part of his own architectural library.

Kostof’s *A History of Architecture* (1985) introduced a different position: he started to question this common narrative, and his book constitutes a change of thinking; it is an early endeavor to include non-Western traditions in the architectural survey and to rethink the Western canon. More recently, since around 1995, architectural theorists Jean-Louis Cohen, Andrew Leach, Dalibor Vesely, and Joseph Rykwert identified the most common categorizations encountered

in models and values based on Western types of thinking (including notions such as “style and period” or “typology and technique”), developing new approaches and research models. Charitonidou (2021) explores this phenomenon, noting: “First, an overwhelming majority of the buildings that have an important place in scholars’ collective memory, and in epistemology of architecture, are designed by architects whose approaches are based on Eurocentric or Western values; second, the majority of archival resources contain materials that are either representative of Eurocentric or Western values, or come from architects who were legitimized according to Eurocentric or Western ideals. Due to these facts, the protocols that define what is evaluated and legitimized as scholarly research are based on Eurocentric or Western criteria.”

However, Isozaki’s viewpoint started to shift over the years (from around 1989) to become more self-reflective of this position. Increasingly, he started to assume a narration of architectural history and theory based on synchronic structures rather than the diachronic structure that was common since the 1950s. He became deeply interested in Japanese influences, writing extensively about the paradox in Japanese architecture. Thus, in the following years, Isozaki significantly contributed to the formation of a Japanese modern architectural theory, analyzing various traditional Japanese structures, including Katsura Villa (Isozaki, 2005), and integrating Japanese concepts and elements in his works at home. In 2005, he wrote *Japan-ness in Architecture* (published in 2006). As a former project partner during these years, I was able to gain insight into his evolving thinking. For example, I observed that his approach to projects in Japan increasingly differentiated from his approach to projects outside Japan; moving away from an earlier universal conception of space independent from its geographical location (as seen in the works mentioned earlier in Phases III and IV).

8.2. Remembering the significance of Arata Isozaki’s work

The article provides a thorough overview of Arata Isozaki’s career and works and divides his oeuvre into four distinct sections with headings and subheadings.

Isozaki left a significant body of work and his concepts and theories over the last seven decades have been immensely influential and are still highly relevant to architectural design practice today. Within 20th-century architecture, Isozaki’s work is unusual and highly original. The author believes that this work has a renewed relevance, and that it is now timely to revisit the concepts and reappraise them in their full impact. One could argue that Isozaki created architecture so personal and sometimes contradictory in its ideas and concepts of space that it

defies characterization as belonging to any single school of thought (Figure 6a and b). His great personality, sense of humor and fascinating, complex character, combined with his modesty, and extraordinary generosity that has helped so many younger architects to launch their careers, will not be forgotten. Sir Peter Cook, a friend of Isozaki since the 1960s, wrote in the obituary for Isozaki (2023):

A personal loss, an architectural loss and a cultural loss. Arata Isozaki was the most generous and supportive of friends: sometimes hiding the depth of his wisdom behind humor, sometimes acting almost like a teacher, and always pointing to the wider or deeper significance of things going on around. Immensely generous in introducing fellow architects who might sometimes be regarded as rivals or eventual rivals without fear: this is very unlike most architects who are afraid to introduce rivals (Extract from the obituary by Cook, 2023).

The world has lost an important cultural voice, a thought leader, and a brilliant, provocative and poetic mind. As discussed in this article, his thinking was not only shaped by a multitude of influences, by observing the violence of war at the time he grew up but also by the immense optimism of this era. Early influences are critical to understanding how the characteristics of an artist's work emerge, coined by early life experiences. The importance of the early life of great creative leaders, and for that matter of any individual, cannot be overstated if we want to understand their actions in greater depth.

I was lucky to know Arata Isozaki well. In the 1990s, we designed eight projects together – for sites in London, Vienna, and a series of German cities, including Berlin; of course, not all of them were realized. I am immensely grateful to have been given the opportunity to know him and work closely with him. What I remember best are our many trips together to visit sites or to give presentations; travels to the opening of the Venice Biennale in Italy and the Documenta exhibition in Kassel. In 1991 in Austria, we taught together at a design studio with Hans Hollein. Traveling with Isozaki meant that we always met up with other architects of his caliber, on the global circuit: Stirling, Hollein, Portzamparc, Libeskind, and other leading figures. Good food and red wine were appreciated. In the evening, we enjoyed attending concerts to listen to the music of avant-garde composers John Cage or Luigi Nono (both of whom he met); at the Musikverein in Vienna or the Philharmonie in Berlin, we would marvel at the perfect acoustics. Isozaki's architecture was joyous and complex at the same time, and a celebration of independent thinking. He was a stylish man and made it all look effortless. He was breaking rules by creating architecture that was

unconventional and groundbreaking, like a real artist. I learnt that architecture does not always have to be taken seriously.

Possessing a profound knowledge of architectural history and theory, I was always impressed by how well Isozaki knew the historical architecture of Ancient China, as well as Vienna, Potsdam, and Munich, and the immense respect he had for the greats of the guild, such as the Neoclassicists, Karl Friedrich Schinkel and Leo von Klenze, or Otto Wagner, but also the work of the German modernists such as Mies van der Rohe, Hilbersheimer, Scharoun, and Ungers, which he knew in detail.

Five years before his death, Arata Isozaki donated his vast collection of books and drawings, and quietly moved with his partner, gallery owner Misa Shin, from Tokyo to Naha on the Japanese island of Okinawa, in search of warmer climes, living along the beach in a peaceful residential neighborhood, from where he continued to work. His brain remained sharp until the end. In the past years, I had plans to visit him again in Japan; however, it never happened. I should have made it real. Now, it is too late.

The firm, Arata Isozaki and Associates, has decided to continue to operate after the passing of its founder, informing their business partners: "The firm's experienced team who worked closely with Arata Isozaki over the years will continue to lead the ongoing projects around the world and seek new projects. Isozaki has left behind a legacy of many built and unbuilt projects which provide the blueprint for a rich philosophy and unique design approach that will guide the firm's efforts moving forward" (Direct email communication, January 2023).

A true visionary and master architect, Arata Isozaki died on December 28, 2022, at the age of 91.

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ORIGINAL ARTICLE

Microbial technologies: Toward a regenerative architecture

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(This article belongs to the *Special Issue: Regenerative Architecture*)

Abstract

This paper examines the applications of microbial technologies in regenerative architecture, which enliven the built environment and its territories by establishing a different relationship between waste, energy, human inhabitation, and microbial “life.” The specific platform discussed is centered on the microbial fuel cell (an ecologically “just” platform that provides bioelectrical energy, data, and chemical transformation from human waste streams), which are exemplified by a range of demonstrators that establish transactional systems between humans and microbes. These simultaneously “sustainable” and “smart” demonstrators establish operational principles for the wider deployment and uptake of microbial technologies in an urban context. The city-scale implementations of these regenerative systems have the potential to establish the foundations for “living cities,” which are fundamentally bioremediating, resulting in an overall increase in liveliness of our habitats and living spaces.

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1. Introduction

The built environment is everything people live in and around, for example, housing, historic buildings, transport infrastructure, services networks, cultural heritage, or public spaces, and uses vast resources accounting for half of all extracted material. The construction sector is responsible for over a third of the European Union (EU)'s total waste generation, and 40% of our energy consumption is by buildings (European Commission, 2020), including historic buildings and those designated as cultural heritage. Furthermore, greenhouse gas emissions (GHGe) resulting from material extraction, manufacturing of construction products, construction, and renovation of buildings, amount to around 5–12% of total national GHGe (European Parliament, 2023). The built environment is undergoing a rapid and irreversible transformation, challenging our understanding of how we make and maintain our buildings, which will affect every citizen in unprecedented ways. It is essential to imagine a built environment that works for people and nature, which challenges our preconceptions about how our cities are made and inhabited, while supporting the Sustainable Development Goals (SDGs) (SDG 7, SDG 9, SDG 10, SDG 11, SDG 12, and SDG 15). Regenerative architecture proposes a change of approach toward the built environment by moving away

from the extractive, resource consuming “machine” that characterizes modern infrastructure, toward approaches that increase the liveliness of environments by repairing and restoring natural systems by removing contaminated soil, installing new water management systems (e.g., rainwater collection), adopting energy efficiency measures and using sustainable, non-toxic, locally-sourced materials to reduce the environmental impact of building construction and maintenance. Regenerative architecture makes possible a basic construction portfolio capable of providing comfortable, warm living spaces, supported by vital building operations, while performing vital ecosystems services, to enable the advent of ‘living cities, that is, ones that are fundamentally life-promoting (biopositive). Consequently, regenerative architecture is an active field of research that advances the state of the art in restoring degraded environments, creating new materials with low embodied carbon, and establishing fossil fuel-free building systems. Such advances involve close collaboration between designers, engineers, and scientists to better understand the complex relationships between the built environment, resource management, human inhabitation, and the natural world.

2. Microbes as agents of regeneration

The most effective regenerative agents are microbes, which account for most of the world’s biodiversity (70 – 90%) measured in terms of the number of species (Lennon & Locey, 2018) where unseen microbes have a collective mass greater than all the animals (Ghosh, 2021) and have played a critical role in shaping the biosphere since the earliest stages of life on Earth (Fenchel *et al.*, 2012). Catalysing key biogeospheric processes, microbes create and maintain the biosphere through oxygen production (where photosynthetic bacteria, such as cyanobacteria, were the first organisms to produce oxygen as a byproduct of photosynthesis, enabling the evolution of more complex life forms), the actions of nitrogen-fixing bacteria such as rhizobia,¹ (which convert atmospheric nitrogen into a form that can be used by plants and other organisms), maintaining the carbon cycle (by breaking down organic matter and recycling carbon through the ecosystem, which regulates atmospheric carbon dioxide levels), enabling nutrient rich soil formation (that supports the growth of plants and other organisms), and promoting biodiversity (where microbes play a foundational role in the food chain to support the growth of other organisms). Small, versatile,

metabolically robust, extremely diverse, superabundant, biologically alien (in comparison with multicellular organisms) microbes exist within an ethical grey zone, as bacteria can both feed us or harm us through their ability to rapidly adapt to environmental change. Love them or revile them, Louis Pasteur observed that we cannot do without them, which has been confirmed by Gilbert and Neufeld who calculated that people could survive without microbes—but only for a few days (Gilbert & Neufeld, 2014). When this context comprises our immune system then, otherwise harmless bacteria can become life-threatening pathogens, while providing a metabolic platform capable of catalyzing radically new forms of environmental relationships through applications guided by architectural, engineering, and design practices (Armstrong, 2022). Importantly, microbes are fundamentally environmental actors, transforming their surroundings into high-value biological compounds by using their unique metabolisms to work within the carrying capacity of their different sites. The advances in microbiology from the late 20th century have provided new insights for technical applications of microbes within the practice of the built environment, comprising a new *life-based platform* for circular design, such as generating biofuel (Keasling *et al.*, 2021), improving indoor air quality (Wolverton & Nelson, 2020), water management (Waldrop, 2021), bioremediating hazardous waste and pollutants (Kumari *et al.*, 2018), and in the production of new materials such as mycelium biocomposites (Yang *et al.*, 2021), bioconcrete (Jonkers & Schlangen, 2008; Stewart, 2016), microbial cellulose (Fairs, 2014) and microbially-cured bricks (Cheng *et al.*, 2020) all with low embodied carbon compared with industrially-produced equivalents.

3. Introducing the microbial commons

In natural systems, microbes reside in biofilms which are organized heterogeneous assemblages of microbial cells (80% bacteria, archaea) that are encased within a self-produced matrix (Penesyan *et al.*, 2021) and collectively form the “microbial commons” (Dedeurwaerdere, 2010) where the free and open exchange of microbial materials forms a foundational biomolecular currency (metabolism) that performs critical “ecosystem services,” which generate ecosystem benefits at little or no resource cost, within the urban and global context (Bell *et al.*, 2005; Balvanera *et al.*, 2006). For example, nitrification and denitrification are microbial processes that are extensively used in urban wastewater treatment (Bitton, 2011), providing food for plants, and removing toxins, respectively, with substantial “health” benefits to the local environment. The term “microbial commons” originates from the biotechnology revolution where the generous exchanges of

¹ Rhizobia are a group of Gram-negative soil bacteria that adhere to and colonize the root cells of leguminous plants (soybeans, alfalfa) to form root nodules where they actively carry out nitrogen fixation.

microorganisms among culture collections, laboratories, and researchers worldwide formed an Open-Source facility for research activities to advance the scientific understanding of microbes. Commercial pressures from biotechnology firms in the late 20th century, however, altered this situation by restricting this access through intellectual property protections and gene patenting. In this paper, the term “microbial commons” is deanthropocentrized to decouple it from notions of human exploitation, protection and control, returning microbial communities to their position at the foundation of the biosphere, where their global exchange of *microbial goods* nourishes the living world beyond the confines of the laboratory. In this context, the notion of *microbial technologies* becomes *an economic system for microbial/human interactions*, through our obligate consumption of microbial goods through our everyday acts of living (Armstrong, In Press).

4. Principles of microbial economics

Over the eons, microbes have used their commons to invent all major forms of metabolism, multicellularity, nanotechnology, organic metallurgy, sensory systems, locomotive apparatuses, reproductive strategies, community organization, metabolism, and mineral conversion platforms, creating the basis for versatile and nature-based microbial technologies (Margulis, 1981). The incorporation of these agents into our living spaces within specific contexts creates a transactional, circular platform for sustainable interventions, potentially replacing modern plumbing with bioreactor systems that transform a variety of household wastes into usable resources (Lahiji & Friedman, 2017). Such technologically mediated access to the *microbial commons* operates according to mutualistic principles — *if you give me your waste, then I shall give you (something useful)* — escaping the capitalist logic of resource inequality (extreme stockpiling leading to resource depletion and gross inequalities), as the same things are valued differently by different actors, facilitating equitable transactions. Mutualistic relationships, however, break down in the presence of pathogens, which account for < 1% of all microbes, and are an exception to the principle rather than the rule — so much so, that biofilms actively destroy them (Pasternak *et al.*, 2019).²

While a regenerative technological platform that enables meaningful resource exchanges between humans and

² The exceptional and important behavior of pathogens is documented in detail in many medical papers. It is not the author's aim to downplay this important characteristic of some microbes but rather to emphasize that most microbes are beneficial to all life and can, therefore, be engaged within our living spaces using appropriate hygiene principles.

microbes may sound like science fiction, the functional integration of microbes into the built environment is feasible. Using the technology of ‘life’ and the new know-how from the field of biotechnology, a new regenerative architecture toolset is emerging that uses natural energy to run building operations, and grows non-structural materials, reusing them at the end of their lifespan. These advances are possible through the designed incorporation of biofilms and specific types of microbial consortia³ into solid matrixes (e.g., agricultural wastes) or bioreactors, for cultivation, where environmental parameters can be adjusted to encourage the microbes to perform different kinds of work. Collectively, these microbial populations turn waste streams into a range of materials and low power energy that can be made available to citizens across multiple social, economic, and political divides. Forming the operational basis for community transactions through access to the microbial commons, such microbial technologies establish a platform for a circular resource economy to activate regenerative architectural practices by enabling new kinds of urban exchanges (Timmis *et al.*, 2019). A vision outlining the principles of transforming urban impacts by incorporating microbial technologies into our buildings is shown below where the integration of microbial technologies and (low-cost/vernacular) materials into buildings enables the production of low-power living spaces with novel formwork, esthetics, and user experiences that advance the regenerative architecture toolset and portfolio (Figure 1).

5. Introducing the microbial fuel cells (MFCs)

MFCs offer a regenerative and decentralized solution for energy generation through their ability to convert organic matter into electricity (Potter, 1911) (Figure 2). Each cell has an anode and cathode, separated by a proton-exchange membrane that divides the liquids in the two chambers while allowing protons to pass from the anode to the cathode. Organic waste flows into the anode as feedstock for an anaerobic biofilm, which excretes electrons that are captured by electrodes, generating an electrical current sufficient to power electronic devices, while protons pass through the membrane where they combine with oxygen to produce water.

MFCs, however, produce more than just bioelectricity as the biofilms also recover nutrients, synthesize biofertilizer (in the stabilized sludge they produce, which is a rich source of nitrogen and phosphate), make disinfectant, treat wastewater, and kill pathogens while they excrete electrons

³ A microbial consortium or microbial community is when two or more bacterial or microbial groups live symbiotically but have not formed a biofilm.

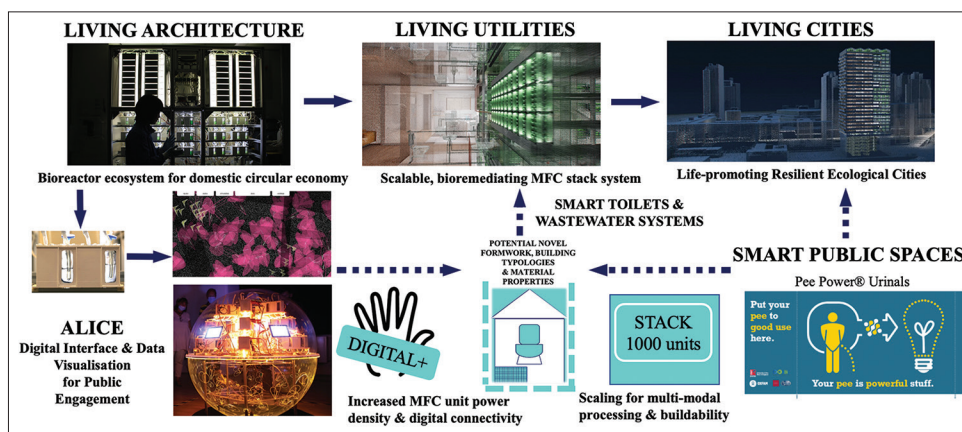


Figure 1. Environmentally regenerative “living cities” are enabled by microbial technologies that perform *building operations* based on an ecosystem of microbial fuel cell-based technologies—PeePower®, *Living Architecture*, and *Active Living Infrastructure: Controlled Environment*, providing a range of ecosystem services and energy for low powered electronic devices that can be housed in biodegradable microbially-produced biomaterials. Source: Figure courtesy of Rachel Armstrong, 2023.

— much like soil biofilms in natural ecosystems. MFCs also act as biosensors by generating voltage, which linearly correlates with specific quantities of toxins like heavy metals (copper, chromium, and zinc), and organic compounds (p-nitrophenol [PNP], formaldehyde, levofloxacin) (Zhou *et al.*, 2017). In this sense, MFCs are completely unlike batteries or other types of modern utilities, which are designed to process one type of resource at a time and are, therefore, well placed as a technological platform for meeting the SDGs.⁴ Providing a foundational platform that can change the impacts of human settlement across a range of parameters, MFCs catalyze the transformation of a range of organic wastes (e.g., urine, greywater, and blackwater which are feedstock for microbes) into bioelectricity while simultaneously providing environmental services (bioremediation, detoxification, and water purification) generating an overall net-positive impact on ecosystem health.

6. State-of-the-art

MFCs are not the only microbial technological platform to process waste into a range of new resources. Anaerobic digestion in *biodigesters* also produces fuel (*biogas*) removes biochemical oxygen demand (BOD) from sewage, conserves nutrients (especially nitrogen compounds), and

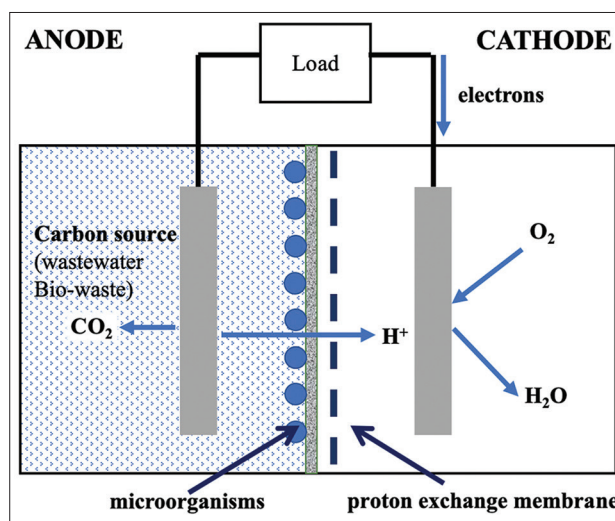


Figure 2. Technical diagram showing electrons produced from an anaerobic biofilm that are captured by electrodes to produce electricity while performing ecosystem services (bioremediation of wastewater). Source: Courtesy of Rachel Armstrong, 2019.

reduces pathogens. MFCs, however, have some advantages over *biodigesters* as they produce electricity without combustion, act as sensors, and can be used for the treatment of low concentration substrates at temperatures below 20°C, where anaerobic digestion generally fails to function. This creates specific application niches for MFCs that do not compete with, but complement, anaerobic digestion technology. MFCs still face important limitations in terms of large-scale application including investment costs, upscale technical issues, and the factors limiting the performance, both in terms of anodic and cathodic electron transfer (Pham *et al.*, 2006). To date, MFCs have

⁴ MFCs contribute to the following SDGs: 6 via clean water and sanitation; 7 providing affordable and clean energy; 11 by creating a platform for sustainable cities and communities; 4 enabling quality education via bioremediating digital services; 17 in creating partnerships for the goals by strengthening the means of implementation and revitalizing the global partnership for sustainable development Technology.

not been widely used as they are neither competitive with fossil fuels, nor renewables as a single source of electrical energy. Over the last two decades, MFCs have largely gained traction as a source of bioremediating green energy due to breakthrough advancements, which are predominantly confined to the laboratory. Field/pilot trials for the treatment of wastewater streams, such as urine, greywater, and blackwater, by MFC stacks have increased in number, for example, Pee Power[®] urinals (Walter *et al.*, 2018) and Urine-tricity (Oxfam International, 2015), but further research and development is still needed to advance the technology's commercial readiness for novel applications such as smart toilets and ultimately, installation within ecohomes. At scale, pilots engaging MFCs (such as in the brewing industry) are at relatively immature stages of development, so their potential impacts are cautiously reported (Singh & Sharma, 2010).

7. Bioelectricity for building operations

Although a vast range of microbially mediated processes are of value to households and industry, to date, the electrical outputs of bioreactors have generally been too weak to drive conventional electronic hardware (Koffi & Okabe, 2020). While MFCs cannot compete with the sheer power provided by other electricity generating systems (renewables and fossil-fuels), their (material) circularity is unsurpassed, providing a circular flow of resources within a household or building, which are metabolically constrained by the carrying capacity of the site. Part of the challenge for MFCs becoming a household system is that innovation in electrical appliances for the last 150 years has effectively operated within a conceptual frame where energy is unlimited and can be used to solve all challenges from refrigeration to climbing stairs, resulting in the voltage outputs for modern homes being standardized for 230V. Despite current innovation outputs being benchmarked against industrial expectations, significant advances in biotechnology, material sciences, and hardware design are creating the context for the installation of smaller, lighter, and more efficient MFCs that are currently being trialed in wastewater processing, enabling their installation in buildings. This new generation of MFCs benefits greatly from their compatibility with low-powered digital technologies, meaning they use energy in a much smarter way than other energy source through the juxtaposition of organic and “smart” (electronic) platforms that is mediated by biofilms at the bio-digital interface.

8. Introducing the bio-digital realm

The bio-digital interface is located at the MFC electrodes where the organic and electronic domains meet through biofilm attachment. Making an intrinsic connection

between microbial metabolisms and digital systems (screens, light-emitting diodes [LEDs], USB ports, etc.) through electron transfer, the bio-digital interface mediates the direct relay of MFC outputs (electrons, data, and chemical transformation) from an organic environmental platform (microbes) to low-power electronic devices. As the production of electrons by the biofilm are based on metabolic reactions, alterations in electron transport and carbon metabolism can also influence bioelectricity production, establishing the potential for two-way electro-biochemical exchanges between human and microbe, which are based on an electron economy to establish the principles of a human/microbial trading system. The following precedents offer a series of case studies based on working MFC prototypes for building systems organized in different configurations, which were developed for metabolic trading systems that operate at low-power thresholds of around 2–3 V, generated by 15 MFC units.

9. Living Architecture

The *Living Architecture project* is a “living” combined utilities infrastructure that uses 15 MFC complexes consisting of four chambers,⁵ to turn liquid household waste, such as urine and greywater, into valuable resources (electricity, biomass, water, reclaiming phosphate from washing-up liquids, and removing poisonous gases from the air) that can be reused in the household (Armstrong *et al.*, 2017) (Figure 3).



Figure 3. Detail of the fully inoculated *Living Architecture* “wall” and apparatus installed at the University of the West of England, Bristol, the *Living Architecture* project, 2019. Source: Photography courtesy of Rolf Hughes.

⁵ These chambers comprise two MFCs separated by two photobioreactors separated by ceramic plates that enable the different resident microbial systems to exchange nutrients between their respective populations.

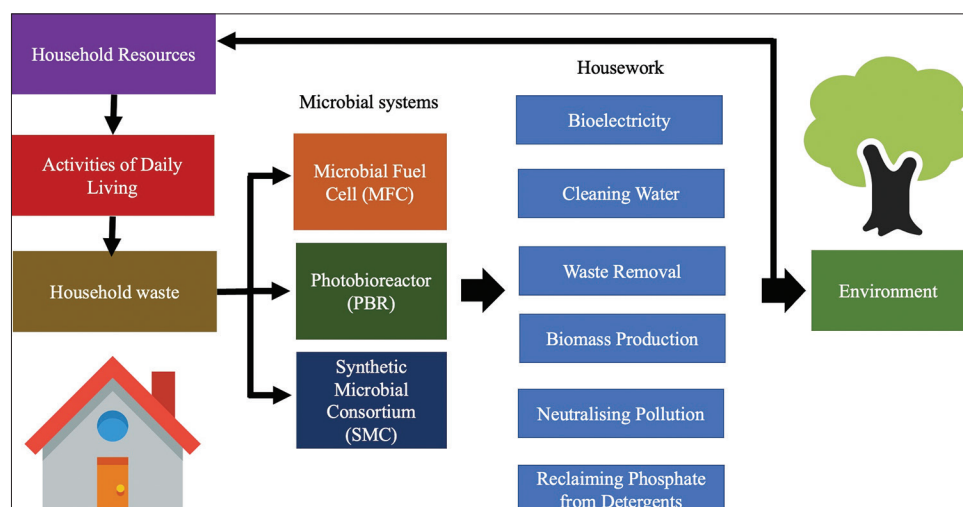


Figure 4. Process diagram of *Living Architecture* showing the circularity of resource use and environmental compatibility of waste streams (organic sludge and cleaned/polished water). Source: Courtesy of the *Living Architecture* project, 2018.

The performance of the biofilms is optimized using an artificial intelligence that is also powered by the MFCs, which operates simple mechanical controls that strategically deliver feedstock within the arrays. Enabling the smarter use of electrons, multiple tasks are performed within the apparatus from generating power to providing data and enabling a range of metabolic transformations as the basis for a circular resource economy established between humans and microbes. *Living Architecture's* circular economy is enabled by its integrated infrastructure, where people exchange their waste for cleaned water, bioelectricity, and a range of useful biomolecules, which are compatible with everyday activities of daily living (Figure 4). To facilitate this exchange, the MFC design was optimized to create the possibility of novel formwork by combining structure and flow by creating electricity-producing building blocks, or “living bricks” (You *et al.*, 2019).

The electrochemical characteristics of three different kinds of conventional house bricks were tested from two source locations. When fed with human urine, European standard off-the-shelf house bricks generated a maximum power of 1.2 mW (13.5 mW/m²)⁶, whereas Ugandan house air bricks⁷ produced a maximum power of 2.7 mW (32.8 mW/m²). The integration of MFCs into buildings

⁶ m² refers to the anode electrode surface area. Depending on how the MFCs are configured, the electrode material may form part of a wall's reinforcement or insulation (being like fibreglass) and so the electrode surface area (in m²) can be configured being equivalent to wall/brick surface area.

⁷ The choice of Ugandan bricks was based on using building blocks from a Pee Power® field site.

activates the microbial commons to enable a domestic economy that frees the household from its obligate consumption of resources, reducing electricity and utilities bills, while mitigating the amount of untreated waste discharged into the environment (Figure 5).

Interrupting modern technological silos *Living Architecture's living bricks* are suitable for different uptake communities within different architectural typologies for the construction of ecohomes, where the contributions by all who carry out the work-of-life, are valued through their ecological transactions, turning domestic spaces into sites of wealth generation. Inhabitants now have choices to make about how they use their ecological resources to reduce their dependency on centralized utilities or help others.

10. 999 years 13 sqm (the future belongs to ghosts)

The original version of *Living Architecture* could not be exposed directly to the public owing to the presence of genetically modified organisms, so an alternative wild-type microbial experience entitled *999 years 13 sqm (the future belongs to ghosts)* was developed for the *Is This Tomorrow* exhibition at the Whitechapel Gallery, in collaboration with artist Cecile B. Evans (Bevan, 2019) (Figure 6). An installation was prefigured as a minimal housing space (13 sqm) conferred with the longest possible lease (999 years) and powered using the natural biofilms in an array of 15 MFC complexes from the *Living Architecture* project producing ~200 mW/L urine. The only observable traces of humans were digital manifestations of the human past, present and future (ghosts), powered by microbes, highlighting the interdependencies between the species

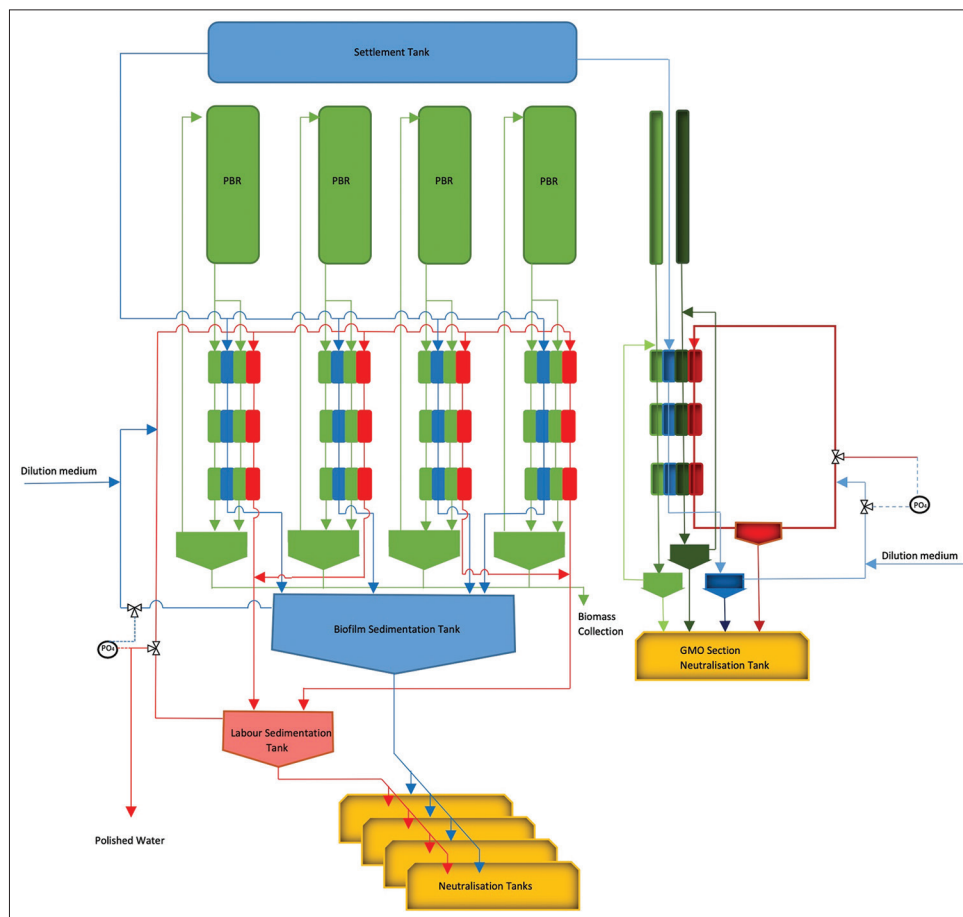


Figure 5. Technical diagram showing the positioning of microbial fuel cells (blue units) within the *Living Architecture* building system. The system shows greywater being collected in a settlement tank as feedstock, which then feeds a system of photobioreactors (green) and combined bioreactor units (red/green/blue) or “bricks” that are separated by membranes that allow the selective passage of substances between them. Waste streams contain cleaned water and organic sediments that contain a range of biologically valuable compounds like fertilizer. The smaller system on the right incorporates genetically modified organisms into the array that can program metabolic performance such as the detoxification of nitrous gasses and the reclamation of phosphate from household detergents. Source: Courtesy of the *Living Architecture* project, 2019.

through rituals of cleaning, feeding, and care in exchange for a range of services from cleaning wastewater to generating power for the installation. Emphasizing how poorly modern society values the microbial realm and discards nutrient-rich resource streams as “waste,” the installation invited audiences to adopt an ethical position in relation to resource recycling and consider what kinds of transactions are acceptable for activating the *microbial commons*.

11. Active Living Infrastructure: Controlled Environment (ALICE)

The *ALICE* prototype (2019 – 2021) advances the ambitions of the *Living Architecture* project by establishing the first bio-digital interface using its 15 MFC complexes to establish the foundations for collaboration with microbes using electron flow as a real-time language (Hughes & Armstrong, 2021).

Electrical activity from the biofilms provided a source for both power and data, generating ~200 mW/L urine (for 20 L urine), which was translated by software into animations that conveyed the overall status of the biofilm in relatable terms. Audiences could, therefore, respond to the microbial behavior, not by looking at unpleasant “slime” (the natural “face” of microbial colonies), but instead by interacting with appealing forms on a familiar screen-based interface. This world of “Mobes,” a characterful term coined for the data-based representations of microbes, offers a simple, probiotic approach to interspecies communication within the highly situated realm of microbes, in a relatable manner that could even become part of our everyday routines establishing new value systems that invite different kinds of (house) work as well as stimulating alternative domestic routines for our living spaces (Figure 7). Since MFCs are *living*, possessing a force and agency of their own, they require our

appropriate care and attention if they are to engage with us in a productive, co-constitutive manner (Bellacasa, 2017).

Presently, *ALICE* exists as a permanent online exhibit (*ALICE*, 2019) that can be accessed under the section Bio-Digital Interface by clicking the Launch Artwork button, which leads to an animated set of “Mobes.” On selecting different options from drop-down menus, the environmental parameters (temperature and pH) and performance (power output) of a real-world microbial community can be interrogated that inhabits a permanent MFC array installed in a scientific laboratory. Depending on how the visitor reads the health of the microbes, they can respond to the “Mobes” by feeding them using a remotely operated valve system, or by speeding up their metabolisms by activating an LED to warm them gently. The graphical symbols provide a language where factual propositions (environmental parameters) are represented, and further truths can be inferred to directly, or by means of a calculating system, which can be overridden by human intervention.

ALICE also existed as an embodied, real-world installation that premiered at the Digital Design Weekend, V&A, London, UK, as part of the London Design Festival from 24 to 26 September 2021 (Barto, 2021) (Figure 8) and was installed at the Electromagnetic Field Festival, from 2 to 5 June 2022 (Electromagnetic Field Camp, 2022). Inviting meaningful human/microbial transactions, *ALICE* demonstrated the potential for microbially powered technologies with bio-digital interfaces to become creature-like, becoming reliable entities that do not ooze, stink, or repulse, as an engaging a way of organizing our daily routines differently, where the microbial/human transactions are more than functional but have meaning, value and can be culturally adopted in life-promoting ways. Since these microbial systems are not based on simple substitutions for modern building systems, a set of design principles and protocols for their uptake and implementation is needed through the recognition of novel elements like bio-digital interfaces and an ethics of care that can assist the designer/architect in developing, innovating, and scaling new applications that are appropriately situated in an increasing variety of sites. By incorporating life-bearing microbial technologies into buildings, the architect’s role is to connect the home with the biosphere through economic transactions at the bio-digital interface, which ultimately enhance the overall life-bearing potential of a site.

12. Advancing the potential of microbial technologies

To adopt microbially produced materials and building operations into regenerative architectural practices, an



Figure 6. The installation *999 years 13 sqm (the future belongs to ghosts)* is an arts installation embodying a post-human apartment comprising a bank of microbial fuel cells and digital screens. The installation is by Cecile B. Evans and Rachel Armstrong for the *Is This Tomorrow?* exhibition at the Whitechapel Gallery, London. Source: Photograph courtesy of Rolf Hughes, 2019.

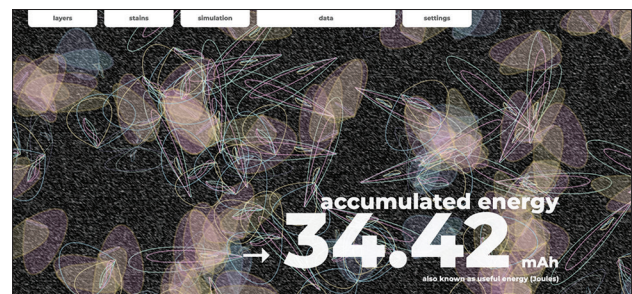


Figure 7. “Mobes,” from the *Active Living Infrastructure: Controlled Environment (ALICE)* website (<http://alice-interface.eu>) showing dynamic, interactive, and graphical representations of microbes. Source: Courtesy of the *ALICE* consortium, 2021 (screen shot from website).



Figure 8. The *Active Living Infrastructure: Controlled Environment (ALICE)* installation, a transparent orb powered by microbes that animate light-emitting diodes and iPads was installed during the Digital Design Week at the Victoria and Albert Museum, September 2021, embodying the bio-digital platform through the integration of microbial and artificial intelligences with biological and technical bodies. Source: Courtesy of the *ALICE* consortium: Ioannis Ieropoulos, Julie Freeman, and Rachel Armstrong. Photograph by Julie Freeman. © *ALICE* consortium.

integrated view of their potential must be taken. An appropriate starting point is to consider the idea of a toilet and consider how it may be transformed from a chute for debris that is flushed with water, into a parallel processor that converts the organic matter from our bodies into bioelectricity, cleaned water and a range of microbial “goods” that perform household tasks while bioremediating our surroundings. To perform the necessary work, the number of MFCs would have to increase dramatically where, for example, a system based on 1000 MFC units would comprise 46 modules of 5L geometrical volume each, which is 230L total volume. With a 50 L header tank and peripherals, this volume becomes 300L. With smaller MFC modules, 2 tiers of 22 MFCs/module can be produced, reducing the total number of modules to 23, which would be 115L total volume (~190L with tanks and peripherals). Technological advances are enabling the power density of MFC modules to reach 1 mW/mL feedstock (Gajda *et al.*, 2018), so, scaled to 1000-MFC units at 1–2 mW/MFC, 1–2 W, 24–48 Wh can be reasonably expected for 1 day, with 168–336 Wh/week, 720–1400 Wh for 1 month and 8.7–17.5 kWh for 1 year. A 1-Watt light bulb will be rated as 24 Wh, and a 4-bedroom house will require roughly 100 Wh just for lighting up the bedrooms. Rapid progress in semiconductor electronics support the possibility of low-power devices, resulting in widespread lifestyle trends in global society that enable energy saving, energy generation and distribution from renewable sources such as solar, wind, and microbial energy. This power electronics technology ranges from very high Giga-watt power like energy transmission, propulsion systems for ships, high-speed trains — to very low milliwatt power systems that run domestic appliances, mobile phones, or LED lighting (Pharkphoumy *et al.* 2023). At present, USB-2 rating is 2.5 W (5 V, 0.5 A), which is completely within the capabilities of MFCs to produce, but the USB-C rating is changing from 60 W (min) (20 V, 3 A) to 100 W (min) (20 V, 5 A) and even to 240 W (50 V, 5 A, in fact 250 W), which is, of course, in line with more power-hungry devices and lifestyles. The cost of MFC units will also continue to be reduced as the technology is further improved and refined. The MFC chassis can be made from a whole range of materials (including recycled materials and discards), so the baseline cost is set by the cost of the membrane and selection of electrodes. New configurations of chassis, electrode, and membrane can increase the MFC density while generating units that are easier to produce and install in the home, which together affect the overall cost and lifetime of the product (Santoro *et al.*, 2019). It is reasonable to assume that the costs of producing MFC units today will be halved within a year as material and design developments enable new methods and configurations for scaling up production and installation. The goal with MFC development, however, is not to match the expectations

of our current resource-squandering lifestyles but to create enough energetic and waste-processing potential to perform necessary work in a way that enables us to wean ourselves off fossil fuels while bioremediating and creatively reusing our waste streams as a resource. Increasing the number of MFCs therefore takes a significant step towards resource circularity for human settlements raising the possibility of 12 V regenerative domestic lifestyles that bioremediate the surroundings, while meeting — and perhaps one day surpassing — the basic expectations of a modern existence. The following renderings are based on holistic structures that house MFC stacks — each with 1000 units. The different types of construction create unique affordances that encourage new kinds of attitudes toward and expectations of waste streams. This means that should we adopt these types of built constructions within our



Figure 9. Microbial fuel cells toilet structure made from recycled wood, inspired by ship hulls at Seaplane Harbour. Source: Concept for the Estonian Maritime Museum, Tallinn, rendering by Anna Vershinina; courtesy of Anna Vershinina, 2023.



Figure 10. Microbial fuel cells toilet structure made from recycled wood, incorporated into a precision gardening unit with robot-farmed hydroponically grown plants. Source: Concept for Nova Gorica GO! 2025 festival, Slovenia/Italy, rendering by Anna Vershinina; courtesy of Anna Vershinina, 2023.

living spaces, then our assumptions about toilets, kitchens, gardens, and other sanitary spaces like bathrooms are likely to change (Figures 9–11).

13. Towards a regenerative architecture

The implications of using microbially produced materials and building operations as part of the toolset for regenerative architecture means that we can start to reimagine how we live and work in our cities. The three MFC-based installations presented provide demonstrators that each take different steps towards the implementation of a platform for circular design that is made accessible through the installation of a bio-digital interface (Table 1).

With ongoing refinement, the MFC platform will create a flexible chassis for “living bricks” that will become increasingly stackable, lightweight, and versatile in their design, enabling new kinds of formwork and ultimately inspiring new types of buildings.

Specific configurations include bioreactor systems, combined with plant roots in hydroponic configurations,



Figure 11. Microbial fuel cells toilet structure made from recycled wood, inspired by biofilm formations, as the structure for a bioelectrically powered data center. Source: Concept for Laboral Centre for Art and Industrial Creation, Gijón, rendering by Anna Verzhinina; courtesy of Anna Verzhinina, 2023.

such as those in the *Living Infrastructure: Energy, Environment and Climate Change* (LIVIN) proposal for the European Union’s FET Flagship initiative that invited long-term and large-scale research initiatives, paving the way with an ambitious vision. LIVIN proposed the development of *metabolically programmable* combined-resource utilization building systems, which plugged *LabourModules* into established infrastructure, like wastewater outlets, as modular systems consisting of many small-scale, networked elements (Figure 12). Supplied with organic residues, wastewater, air pollution, and toxins the *LabourModules* would process waste substances within greywater streams (typically 55 L/person/day) to recirculate the cleaned water for reuse in the building. Engaging a spectrum of complex, active organic processes that make up the physiological repertoire of organisms and link the webs of life and decay, these units aimed to change the very notion of household waste. The selective application of modules that combined the metabolic plasticity and robustness of microbes and plants established the principle for applications of programmable metabolic units, whose specific outputs are determined by species selection, that could perform many kinds of functions and under different conditions while generating bioelectricity at a target power output of 1 mW/mL feedstock, significantly reducing the circulation of toxic compounds, such as detergents, into the waterways while generating 55 W/person/day. This is comparable with solar panels, where alone, 55 W is enough for a small range of electrical devices, such as basic lighting, two-way radios, small TVs, and fish-finders. As part of an array, this can be expanded to include water pumps, refrigeration and so on, and if *LabourModules* are also plugged into sewerage systems, this further increases the systems power outputs. Importantly, the *biodigital platform* substantially increases the resilience of the built environment providing low-power energy autonomy from waste, enabling material resource circularity (turning effluents to electricity, cleaned water, and biomass) and

Table 1. Comparison of demonstrators using MFC arrays

Model	Power	Bio-digital capabilities	Bioremediation
<i>Living Architecture</i>	1.2 mW maximum output (from 150 mL urine and greywater feedstocks)	Self-powering 15 MFCs, powering an AI and a window-opening robot	Natural and synthetic biology-augmented actions, e.g. neutralizing NOx, reclaiming phosphate from detergents
<i>999 years 13 sqm (the future belongs to ghosts)</i>	200 mW/L (4 W total from 20 L artificial urine feedstock)	Self-powering 15 MFCs and an LCD screen	Cleaned water and metabolites
<i>ALICE</i>	200 mW/L (for both artificial urine and urine feedstocks)	Self-powering 15 MFCs, providing data for an animation software, and LEDs	Cleaned water and metabolites

NB. All demonstrators use 15 MFC units, so power outputs are comparable; however, *999 years 13 sqm (the future belongs to ghosts)* processed a fixed volume of artificial urine replenished weekly, while *Living Architecture* was a continuous flow system and *ALICE* was both continuous flow (in the laboratory) and fixed volume (in gallery exhibits). AI: Artificial intelligence; *ALICE*: *Active Living Infrastructure: Controlled Environment*; L: Litres; LCD: Liquid-crystal display; LED: Light-emitting diode; MFCs: Microbial fuel cells; mL: millilitres; mW: milliwatts; NOx: Nitric oxides; W: Watt; MFC: Microbial fuel cells toilet

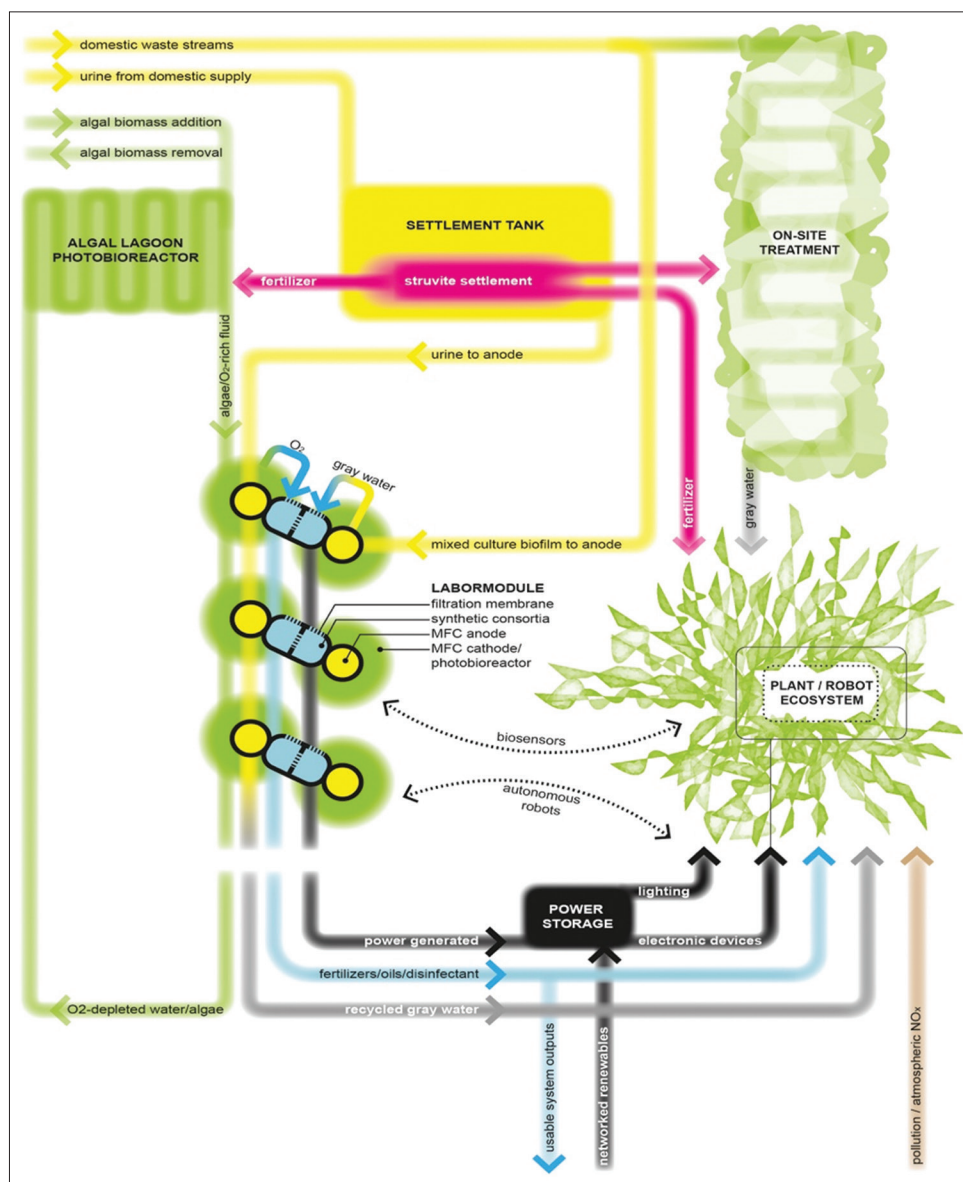


Figure 12. *LabourModules*, which are processing units that are enabled by convergent technological platforms integrating biotechnology with physicochemical-digital systems for treatments of residues and system feedback. Source: Drawing courtesy of Simone Ferracina for the LIVIN Flagship proposal, 2019.

creating a digitally compatible “hub” that bioremediates its surroundings in ways that can be monitored (smart), and are biologically sustainable (nature-compatible), ultimately establishing the building blocks for resource circular cities.

The metabolic power of MFC arrays can be further realized through a range of research goals that can extend the possibilities already discussed in this article. Different chasses that are biodegradable (including recycled materials and discards) can be developed for the MFC arrays including “living” mycelium biocomposites that provide an active layer for gardening bacterial-mycelial

symbiotic activity in the anode that augments overall metabolic activity. Anodal biofilms could also be designed through bioprinting to ensure that desired microbes are seeded in the membrane-electrode complex to confer the biofilm with further functional programmability. Living electrodes that are digested and produced by resident microbial colonies in the anode can be designed to “garden” microbial activity in ways that optimize electron transfer, facilitate biosynthesis, and effectively transfer water molecules and cations to the cathode. The MFC membrane can also be functionally integrated with hydroponics, so that plant roots can benefit from easy-to-

metabolize forms of nitrogen and phosphate, for example, struvite (magnesium ammonium phosphate) in the anode, while drawing water from the cathode. Finally, ambitious pilots that test MFC arrays at >1000 units are needed to establish pilot demonstrators that showcase the potential for the system development within the built environment, enabling iterations of improved designs that are tailored to their specific context and purpose, enabling new types of multi-functional construction to emerge.

Heralding an era of change, the potential of paradigm shifting building technologies based on microbial technologies that are cultured and grown in our homes and communities alongside us fundamentally change the impact of the built environment on our living world to become regenerative and resilient against climate change through new sources of bioenergy, sanitation, circularity for natural resources, increased soil and water health, with strong contributions to SDGs 6, 7, 11, 4, and 17. More than a natural way of providing electrical energy, or “grown” materials, the regenerative architecture portfolio of materials and systems also has the potential to become an off-grid emergency communications platform by powering low-power electronic devices such as 6G/Wi-Fi networks, mobile phones, and LEDs, which cannot be shut down by grid outages. In the medium term, smart toilet networks will generate bioelectricity and, through their coupled to low-power electronics, will enable a Green Digital Revolution. In all phases, the regenerative architecture platform comprises a technological framework for a Circular Economy and, in the longer term, establishes “living cities” that are constructed from microbially produced materials. When implemented at the city scale, the strategic integration of microbial materials and systems into a coherent building program — for retrofit, or new build — that is rolled out to the urban scale comprises a practice of regenerative architecture.

14. Conclusions

Neither optional extras nor an architectural fashion, installing microbial technologies in our homes, buildings, and cities will, literally, save lives. At a time of climate emergency, escalating fuel prices and the displacement of peoples from war, having access to basic utilities as a combined processing system can provide clean water, shelter, power, and sanitation, which maintains a basic livability made possible through the microbial commons to generate freely available materials, even in extremis.

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Conflict of interest

The author declares that there are no competing interests.

Author contributions

This is a single-authored paper.

Ethics approval and consent to participate

The involvement of human subjects in the *999 years 13 sqm (the future belongs to ghosts)* installation was by invitation to a gallery exhibition. The visitors observed the final work but did not participate in the study. Consequently, attendance was by formal invitation and no consent was obtained.

Consent for publication

No human subjects visiting the 999 years 13 sqm (the future belongs to ghosts) were involved in the publication of this article.

Availability of data

All data for *Living Architecture* are available at: <https://livingarchitecture-h2020.eu>.

All data for *ALICE* are available at: <https://alice-interface.eu>.

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ORIGINAL ARTICLE

Strategies for the dynamic protection and utilization of traditional villages in rapidly urbanizing areas: The case of Jiangbian Village in Dongguan City of China

Cheng Wei¹, Yue He¹, and Yuanxing Liu^{2*}¹School of Architecture, State Key Laboratory of Subtropical Building Science, South China University of Technology, Guangzhou, Guangdong Province, China²Dongguan Rural Revitalization Promotion Center, Dongguan, Guangdong Province, China(This article belongs to the *Special Issue: Cultural Characteristics and Application of Adaptive Inheritance Technology to Traditional Chinese Rural Areas*)**Abstract**

In recent years, along with continuous urbanization, traditional villages in rapidly urbanizing areas have encountered difficulties like “constructive destruction,” “material decay,” imbalance of the natural environment, and loss of historical culture due to modernization. Under the requirement of “comprehensively strengthening the protection and utilization of historical and cultural heritage and coordinating the protection of historical and cultural heritage with urban and rural construction, economic development, and tourism development” in the new era, it is crucial to study the protection and development of historical and cultural heritage. Since traditional villages are a living heritage, their sustainable development while respecting history is indispensable. Coordinating the relationship between heritage conservation and socioeconomic development to achieve sustainable development is currently the biggest challenge for traditional village conservation. Taking Jiangbian village as an example, based on the cultural heritage value of the village, this paper combines the traditional village with the general direction of urban development and proposes strategies of cross-regional development, linkage, and integration of surrounding resources, complementing the shortcomings of public facilities, and utilizing unused resources, so that Jiangbian Village can be actively integrated into the development of the city, the synergistic development of the village and the city can be promoted, and the dynamic protection and utilization of traditional villages can be realized, with the goal of enriching the research on the dynamic protection and utilization of traditional villages in rapidly urbanizing areas.

Keywords: Rapidly urbanizing areas; Traditional villages; Dynamic protection; Jiangbian Village***Corresponding author:**Yuanxing Liu
(Liuyuanxingdg@163.com)**Citation:** Wei, C., He, Y., & Liu, Y. (2023). Strategies for the dynamic protection and utilization of traditional villages in rapidly urbanizing areas: The case of Jiangbian Village in Dongguan City of China. *Journal of Chinese Architecture and Urbanism*, 5(1):406.
<https://doi.org/10.36922/jcau.406>**Received:** March 7, 2023**Accepted:** April 11, 2023**Published Online:** May 5, 2023**Copyright:** © 2023 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution-Non-Commercial 4.0 International (CC BY-NC 4.0), which permits all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.**Publisher's Note:** AccScience Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.**1. Introduction**

As the essence of farming civilization and the root of national culture, traditional villages are a living heritage with both tangible and intangible cultural characteristics, and their conservation and utilization are not only fundamental for the continuation of local cultural lineage and revival of local culture, but also the endogenous driving force for

adapting to the changes of rural natural and humanistic environment and promoting rural transformation and development in the new era (Hu *et al.*, 2014). Since 2012, China has published six batches of traditional village protection lists, and the protection and utilization of traditional villages have been carried out one after another nationwide, but they have been relatively ineffective. In recent years, along with the continuous promotion of urbanization, traditional villages have encountered difficulties like “constructive destruction,” “material decay,” imbalance of the natural environment, and loss of historical culture due to modernization. Traditional villages in rapidly urbanizing areas are subject to different degrees of interference from external environments and are gradually eroded or assimilated (Wei *et al.*, 2021). As representatives of traditional settlements in rapidly urbanizing areas, most of the traditional villages in Dongguan have been reduced to urban villages in the process of urbanization and have lost their original unique charm; the few villages that have been better protected have gradually integrated into the regional development pattern in the process of urbanization and have been reborn through organic integration into modern life while preserving and inheriting their own historical culture.

In September 2021, the General Office of the Central Committee of the Communist Party of China (CPC) and the General Office of the State Council issued the “Opinions on Strengthening the Protection and Inheritance of History and Culture in Urban and Rural Construction” (hereinafter referred to as “Opinions”). The Opinions require that “strengthening the protection and utilization of historical and cultural heritage should promote utilization through revitalization and preservation through utilization, so that historical culture and modern life can be integrated to achieve perpetual inheritance; and traditional cultural elements should be protected by encouraging inheritance and innovation, integrating the protection and inheritance of historical and cultural heritage into economic and social development, and integrating historical culture with urban and rural development” (General Office of the Central Committee of the CPC & General Office of the State Council, 2021), which provides an important policy basis for the regeneration of traditional villages. However, at the same time, due to the gap between urban and rural regional development, the diversification of individual needs and land use, the regional function of villages gradually transforms from a single-function to a multifunctional one (Liu *et al.*, 2016; Yang *et al.*, 2015), and presents significant spatial and temporal gap and regional differences (Long *et al.*, 2012). Therefore, grasping the special characteristics of traditional villages in rapidly urbanizing areas and turn them into developmental advantages is a key issue.

In this paper, current theoretical studies on the conservation and utilization of traditional villages were compiled. The previous literature on the living conservation of traditional villages in China was mostly focused on conservation models, conservation planning, and conservation methods (Zhang *et al.*, 2017; Sun & Zhang, 2017; Yang & Guan, 2018; Liu *et al.*, 2022). Some scholars have also noted that the protection of traditional villages should be coordinated with urban development and have recognized that the protection and utilization of traditional villages is a dynamic process that requires a holistic mindset to achieve both protection and renewal (Wei *et al.*, 2022; Feng, 2015; Zhang, 2017). Foreign scholars believe that for historical and cultural heritage, “conservation” represents utilization, reuse, and transformation, and has a broader meaning (Larkham, 2003), suggesting that environmental factors (including natural environmental factors and political, economic, and cultural factors) have a more profound impact on the development of settlements (Pinto-Correia & Kristensen, 2013; Sumarmi *et al.*, 2020), but some scholars have realized from early on that for the conservation of historical and cultural heritage in the period of rapid urbanization, it is necessary to follow the market rules and combine conservation and reconstruction (Lee, 1996; Yeoh & Huang, 1996; Aigwi *et al.*, 2019).

In general, there has been much research output in academia on the dynamic conservation and utilization of traditional villages. However, there is a lack of theoretical research on the “dynamic conservation” of traditional villages in rapidly urbanizing areas, especially research on the “living regeneration” of traditional villages with specific cases needs to be further developed. Based on this, we took Jiangbian Village in Qishi Town, Dongguan City as a case study, analyzed the driving factors of the dynamic conservation of traditional villages in the rapidly urbanizing areas, explored the dynamic conservation and utilization strategies of traditional villages in the local context, in hopes of providing case references for the conservation and utilization of traditional villages in rapidly urbanizing areas.

2. Analysis of historical heritage characteristics and urban-rural relations in Jiangbian Village

2.1. Historical and heritage features of Jiangbian Village

Jiangbian Village was included in the first list of traditional villages in China in 2012. It is located in the middle of Qishi Town, Dongguan City, Guangdong Province (Figure 1). The village was named after the Dongjiang

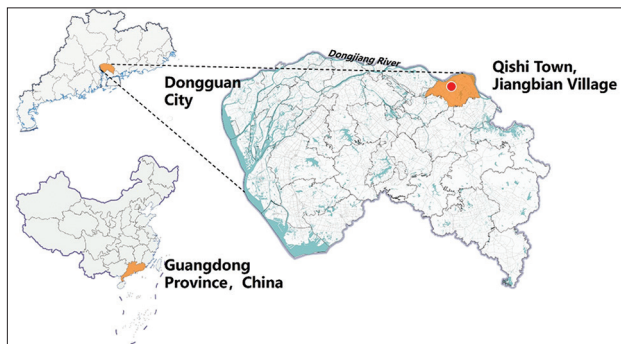


Figure 1. Location map of Jiangbian Village. Source: Compiled for the present study.

River in the north, formerly known as “Jiangbin” and is now called “Jiangbian.” Jiangbian Village was established around the Yuan dynasty (1206–1368) and gradually developed into a village, and flourished through Yuan, Ming (1368–1644), Qing (1616–1911), and Republican (1912–1949) eras for more than 700 years. It was not until the reform and opening-up that the village environment and infrastructure could no longer meet the demands of increasing population that villagers chose to find new land to build new homes. The village construction of Jiangbian Village is divided into two parts: one part is the traditional-style area, that is, the “old village,” where the historical buildings and spatial pattern are relatively well preserved; the other part is the “new village,” that is, the new houses built around the old village after 1978. At present, most of the villagers live in the new village, and in the old village, the village pattern, street space, and traditional buildings of the Ming and Qing dynasties are preserved, which has high historical, cultural, and landscape values. The Jiangbian Village described in this article refers to the old village area.

- (i) Settlement pattern by the mountain and water: Jiangbian Village is built on the back of the mountain and faces the water, along the gentle slopes. Luowuling Mountain behind the houses and Moyanting Pond in front of the houses paint a picture of “geese resting next to the water in a beautiful environment.” Gangbeiling Mountain on the left is the Green Dragon; Hubanling Mountain on the right is the White Tiger; Luowuling mountain at the back is the Black Tortoise; the former Luofu Mountain remnant is the Vermilion Bird; and the Dongjiang River is the White Jade Belt, which has a strong traditional Chinese *fengshui* cultural meaning (Figure 2).
- (ii) Rustic and distinctive building system: The Jiangbian Village is bounded by an old wall, covering an area of about 71,600 sqm, and is laid out in a well-shaped network, forming a lane system of “three vertical and

15 horizontal lanes.” The lanes are paved with red sandstone or hemp stone strips, ranging from 1 to 2 m wide, with 3 vertical lanes running North-South and 15 horizontal lanes running East-West, effectively building a favorable and convenient transportation system within the village, and connecting to the pond in front of the village to form a perfect drainage system, which has never been blocked for hundreds of years. There are 96 historic houses in the village, with 13 ancestral halls, four schoolhouses, 12 old wells, three gates, and five bawling towers (destroyed), mostly built during the Ming and Qing dynasties, with the most well-preserved buildings being those from the late Qing dynasty. There are several large and small ponds in the village, and most of the ancestral halls are built along the ponds. There are 13 ancestral halls, with the Huang Ancestral Hall as the main representative. In addition, there are seven ancestral halls arranged in a single line from east to west in front of the village, and the rest of the ancestral halls are scattered across the village, and the houses in the village are arranged in groups around each ancestral hall (Figures 3 and 4).

- (iii) Featured vernacular culture and surrounding resources.

Jiangbian Village, as a historic village on the shore of the Dongjiang River, is rich in cultural practices, with distinctive clan culture and folk customs. The importance attached to the clan ancestral hall reflects the people’s identification with and reliance on the clan system and reflects the culture of filial piety and ritual. Various historical buildings and the main streets in the village are important places for cultural activities. Festivals such as “Marching over the Palace” and “Wong Tai Sin Festival,” as well as local dishes and folk crafts such as Jiangbian Meatballs have a long history.

In addition to the historical settlement, there is Neolithic Wanfu An Shell Mound, which is about 5000–6000 years old, to the west of Jiangbian Village (named “Wanfu An Shell Mound” because of an old temple called “Wanfu Temple”¹). It is also one of the earliest Shell Mound seen in the Pearl River Delta region. In addition, in the Qiufeng Park of Jiuwei Village in the south of Jiangbian Village, there is a *Bischofia javanica* tree that is more than 1000 years old², which is still green and vibrant after 1000 years of wind and rain, reflecting the pleasant beauty of the traditional and historic village of Lingnan (Figures 5 and 6).

¹The people of Qishi used to refer to temples “An,” so this place is called “Wanfu An.”

²The only existing thousand-year-old tree in Dongguan City.

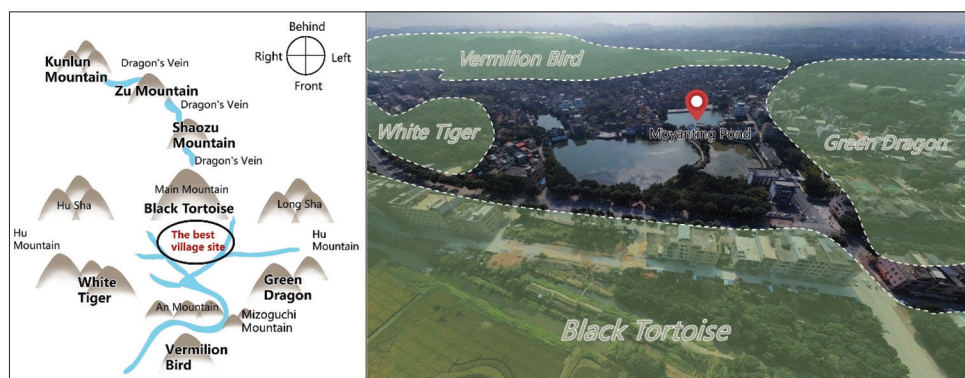


Figure 2. Feng Shui ideal pattern diagram and Jiangbian village settlement pattern diagram. Source: Compiled for the present study.

2.2. The relationship between Jiangbian Village and the environment of the urban-rural development

Since the reform and opening-up in 1978, rural urbanization process are subjected to multiple factors. Jiangbian Village is in the suburban area of Dongguan City, less directly affected by the economic development of the urban area, so the village construction and economic development in the past was slow. In 1978, with the beginning of China's reform and opening-up policy, many "the 'three-plus-one' trading-mix"³ enterprises stationed in Guangdong, mostly at Dongguan, at this time the Jiangbian Village was also affected, a large number of industries in the village, and Jiangbian Village began to embark on the road of rural industrialization. After 1992, with the end of Deng Xiaoping's southern tour speech, various regions accelerated infrastructure construction, increased the intensity of opening up to the outside world, and introduced a large amount of foreign capital. As a result, the industry was further developed, and the development of village-type "the three-plus-one trading-mix" enterprises represented by Dongguan City accelerated, and the scale of production space required by enterprises also gradually increased. Land that was previously used for agricultural production is slowly being leased and mostly used for new industrial parks. Due to the further development of rural industrial parks, the boundary of town and village functions between Jiangbian Village and Qishi Town is

³The "three-plus-one trading-mix" is the initial form of foreign (mainly Hong Kong) investment in Mainland China. With the Pearl River Delta (PRD) region having the advantage of being adjacent to Hong Kong and Macao, a large number of foreign investments in the form of "incoming material processing," "incoming sample processing," "incoming assembly," and "compensation trade" implanted in the PRD region's villages. "Assembly of parts" and "compensatory trade" in the form of implantation in the villages of the PRD region became the base of industrial transfer from Hong Kong and Macao, forming a "front store and back factory." This phenomenon is especially notable in the Dongguan area, also known as the "Dongguan model."

gradually blurred, accompanied by the rapid development of township enterprises, which intensified the narrowing of the gap between town and village and enhanced the urban-rural interaction link to a certain extent. Due to the expropriation of land, the industrial structure of Jiangbian Village has also undergone transformation. The basic status of agriculture is gradually declining, the function of the village mainly in agriculture is slowly disappearing, while the function of the city mainly in market economy has not been fully established, and the retained part of agricultural economy makes Jiangbian Village and the surrounding areas become a place where rural agricultural economy and modern urban industry coexist.

- (i) The pursuit of urban-rural integration goals in the context of the new era

In 2019, the state released the work of carrying out comprehensive territorial spatial planning (Ministry of Natural Resources, 2019), and governments at the provincial, city, county, and township levels have been carrying out preparation work one after another. In the process of compiling the territorial spatial planning in Qishi Township, Jiangbian Village was included within the township development boundary of Qishi Township. This meant that Jiangbian Village was no longer an independent village in the traditional sense, so the coordinated development of industry and agriculture and urban and rural areas became an inevitable choice. In the same year, Dongguan Songshan Lake High-tech Zone⁴ proposed the "one park and nine towns"⁵ integrated development model, which as a whole shifted its goal

⁴Songshan Lake High-tech Zone is located in the middle of Dongguan City, and is a comprehensive national science center led by science and technology innovation industry and advanced manufacturing clusters.

⁵"One industrial area and nine towns" includes Songshan Lake High-tech Zone (one industrial area) and Shilong, Liaobu, Dalingshan, Dalang, Hengli, Dongkeng, Qishi, Shipai, and Chashan (nine towns).

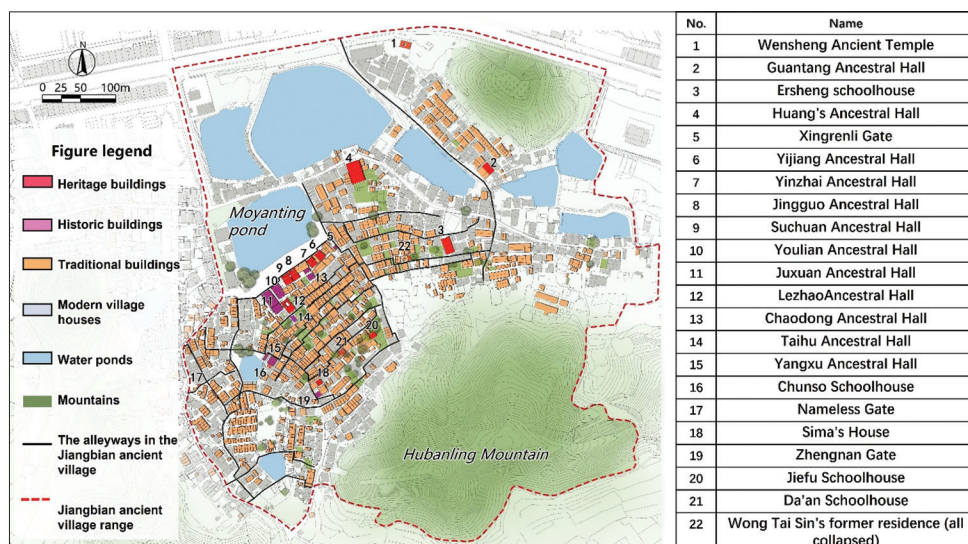


Figure 3. Map of historical texture and spatial characteristics of the historic village of Jiangbian. Source: Compiled for the present study.

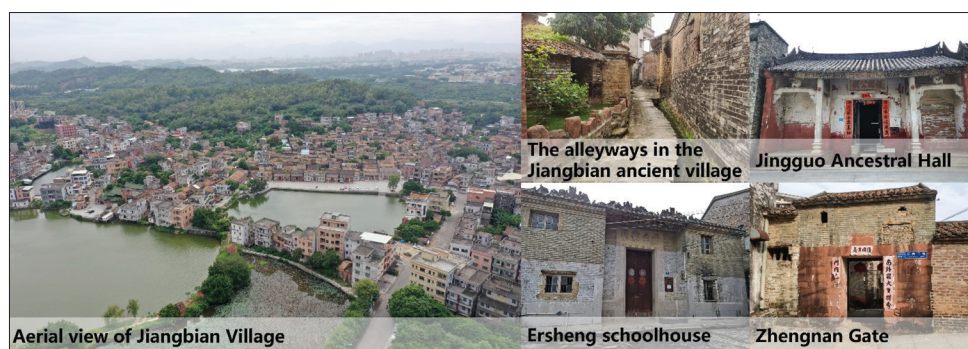


Figure 4. Current photo of Jiangbian Village. Source: Compiled for the present study.



Figure 5. Map of analysis of resource points around Jiangbian Village. Source: Compiled for the present study.

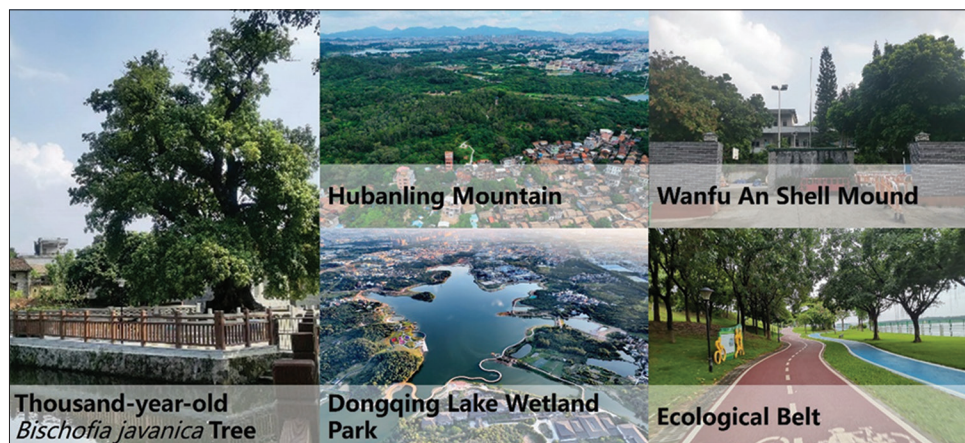


Figure 6. Current photos of resource sites around Jiangbian Village. Source: Compiled for the present study.

from being a high-tech zone to a scientific city, and began to put forward many opportunities for spatial shift development, bringing new opportunities to the surrounding areas. To allow more room for industrial development, Songshan Lake promoted the development of Songshan Lake East Industrial Park (Figure 7), which includes Hengli, Dongkeng, and Qishi towns. As an important part of the development of Songshan Lake Park, 607 hectares of undeveloped land in the northern part of Qishi are included in the advanced manufacturing development group. With the rapid development of the northern industrial park in Qishi Town, the surrounding area will turn into a continuous urbanized development area, and further affect development of the surrounding villages. The advent of the era of territorial spatial planning, the development of urban and rural areas in an integrated planning and control strategy will accelerate the coordinated development of the region.

Rapid urbanization has caused the urban built-up areas in most regions to expand outward year by year, and the surrounding suburban villages are gradually integrated into the cities, and rural settlements are constantly surrounded by urban construction sites, forming urban villages (Yan *et al.*, 2004), most of which used to be traditional villages in the suburbs of the cities. For example, the historic village of Huangpu in Guangzhou (Figure 8) was also annexed under the wave of urbanization. In response to social and economic development, Huangpu villagers have demolished many historic buildings and built new ones, intertwining old buildings with modern residential buildings, and constantly destroying the village's original appearance. The traditional villages, which are interspersed with high-rise buildings, are constantly being destroyed, causing great difficulties in the protection of traditional villages. However, a small number of traditional villages

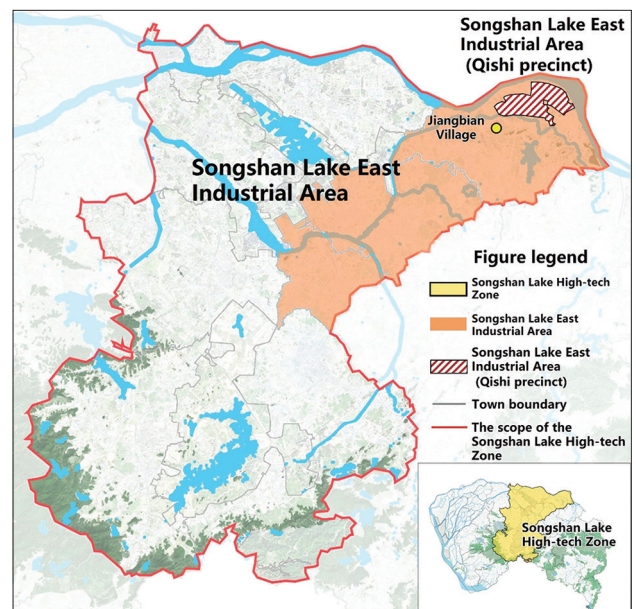


Figure 7. Location of Songshan Lake East Industrial Area (Qishi Precinct). Source: Compiled for the present study.

in urban villages have accurately seized the development opportunities, actively responded to the wave of urbanization, and successfully achieved development transformation. Due to the constraints caused by land development, to free up more space for development, many villagers coped with the situation by taking multiple measures to revitalize the unused land in the village through the introduction of market entities to cooperate with multiple parties to create a new rural industrial growth pole. For example, through the establishment of Nanshe Creative Culture Tourism Development Co., Nanshe Historic Village in Chashan Town, Dongguan City is protected and utilized by the method of piecemeal protection, taking into account the classification,” and the

historic village tourism is upgraded to an immersive cultural experience; Fang Hua Culture Group was introduced to develop and operate Xixi Historic Village in Liao Bu Town, Dongguan City in phases and integrate the village into the development of the surrounding China Incense Culture Museum, Tooth Incense Street, and other advantageous resources, forming a new cultural tourism industry. In the process of protecting the village, its cultural charm will be released, thus realizing the revival of the village.

A few traditional villages like Jiangbian Village are still in the outskirts of the city. The villagers also responded to urbanization to protect and perpetuate the local character of traditional villages. For example, General Ye Ting Memorial Park was built in Zhoutian Village in Huizhou City, Guangdong Province to spread red culture. Historical buildings were also repaired to restore former life scenes, and the idea of promoting good local customs was ingrained in overseas Chinese, which can be another way of cultural revival through cultural heritage. New ways of rural development are constantly explored in Zhoutian Village, capturing the development opportunities of the regional cultural tourism market and introducing the cooperation between the village and enterprises of the Cinnamon Garden Group to build the “Feng Yue – The Valley” project, transforming the 100-year old Hakka house, Song Qiao House, into a boutique B&B on the basis of preserving the traditional historic buildings and local culture, as well as expanding the cultural display, leisure B&B, field picking, and the cultural tourism industry. The project will also expand the functions of cultural tourism, such as leisure B&B, garden-picking, and B&B experience. Through corporate investment, the stock space is revitalized and reused to realize the transformation and development of the village and the transmission of the cultural lineage (Figure 9).

For the Jiangbian Villages located in the suburban area and to be included in the development boundary of the town in the future, its protection and utilization should be considered from the perspective of urban-rural integration and the principle of regional coordination. Drawing on the successful experience of the historic villages of Nanshe and Xixi, we will gradually resolve the complex conflicts in urban-rural integration in a planned manner and maximize the advantage of its location, resource, and its market advantages, and find a path suitable for its own development characteristics, so as to prepare for urban-rural integration. For the protection and utilization of Jiangbian Village, we cannot simply apply the traditional method of village protection and revitalization. Instead, we should make full use of its cultural heritage while protecting its original attributes and adapting to the developmental needs of modern society, so as to achieve



Figure 8. The current situation of mixing old and new buildings in Huangpu Village. Source: Photographed for the present study.



Figure 9. Status of historical buildings and development in Zhoutian Village. Source: Compiled for the present study.

the goal of long-term development of rural economy with protection as the premise, and prevent it from becoming urban villages in the process of urban space expansion and development (Figure 10).

3. Analysis of the dynamic conservation-driven needs of Jiangbian Village

3.1. Cultural tourism market demand in the era of the Greater Bay Area

Through an analysis of statistical data of the past 3 years, the average annual number of tourism receivers in Guangdong Province reached about 230 million⁶, with a huge

⁶Source: Data published by the Ministry of Culture and Tourism of Guangdong Province (Note: As of February 2023, the Ministry of Culture and Tourism of Guangdong Province has not yet published data for 2022).

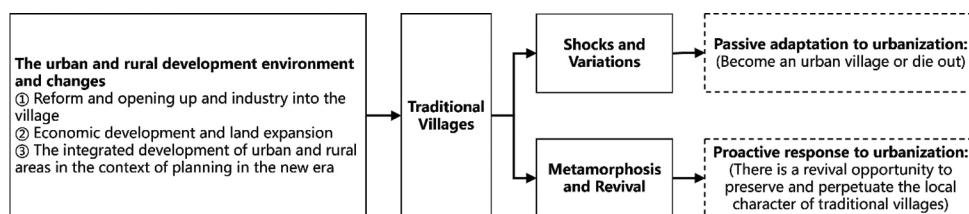


Figure 10. The relationship between traditional villages and urban and rural development environment. Source: Compiled for the present study.

proportion coming from domestic tourism. In particular, the Guangdong-Hong Kong-Macao Greater Bay Area⁷ city cluster has a strong leisure tourism consumption market and great advantages in the development of cultural and tourism industry. In recent years, due to the continuous expansion of cultural tourism space, people's choice of tourism space has long extended from scenic spots and resorts to suburban and rural diversified choices, and the construction of beautiful countryside has become an important aspect of the future ecological and environmental health development of the Greater Bay Area. As a national historical and cultural city, many historical sites and cultural monuments are still retained in Dongguan City. In the past 3 years, Dongguan City has received an average of about 19 million tourist arrivals each year, accounting for about 8% of the entire Guangdong Province. As a historical and cultural tourism hub in the Guangdong-Hong Kong-Macao Greater Bay Area, Dongguan will undoubtedly become one of the most promising areas in the Guangdong-Hong Kong-Macao Greater Bay Area city cluster. With rich cultural tourism resources, under the strategic rural revitalization and the construction of the Great Bay Area, the villages in Dongguan awaits a beautiful and major construction.

The natural environment and the geographical conditions of the mountains and waters of Jiangbian Village have opened up another space for tourism development. Dongguan Ecological Belt (Qishi section) of the full line through, based on perfecting the supporting facilities, several landscape nodes such as Wong Tai Sin Park and Water Resources Science Education Park are linked together to become a good place for recreational activities. In addition, Dongqing Lake Wetland Park is the "green heart" of Qishi Town and even the eastern part of Dongguan, surrounded by peaks, mountains, and lakes; Dongqing Lake Wetland Park is adjacent to Jiangbian Village across the Hubanling Mountain. The park has become a prominent place in the region by utilizing the

Ecological Belt and integrating local cultural features. During weekends and holidays, people will visit Dongqing Lake Wetland Park after work, hike the characteristic waterfront trestle Caolong Bridge, and touring the Qiufeng Pier. According to the interviews, the traffic of Qinghu Village section of Dongqing Lake Wetland Park alone can reach 2,000 – 3,000 people/day on weekends⁸. The demand for tourism driven by the greeneries of Dongqing Lake has further expanded the new space for tourism development. Utilizing the environmental resources and creating project clusters around the supporting facilities of Dongqing Lake and the Ecological Belt, and their complementary relationship can create development opportunities for Jiangbian villages by attracting investments through infrastructure development.

3.2. Development opportunities driven by "one industrial area and nine towns" in Songshan Lake functional area

Relying on the strong radiating grid of the Songshan Lake Park, the town of Qishi will play an important role in shaping the regional production and collaboration network by taking the initiative to undertake the industrial spillover from Shenzhen and integrating into the web of the innovation resources of the Songshan Lake Park. Under the coordination of Songshan Lake (Ecological Park Management Committee), major industries will be introduced into the 607 hectares of land in the Eastern Industrial Park (Qishi precinct) making it a new industrial carrier. The rise of its industrial sector will bring employment opportunities to about 100,000 people⁹. As the 2.0 version of Songshan Lake Park, the goals of Songshan Lake East Industrial Park area are more on the construction of living support, laying a good foundation for the development of high-end industries in the future, and driving the development of the surrounding area with the construction of supporting areas, so that the surrounding residents can benefit from the development of the park. Under the high-density concentration of diversified enterprises, relying on

⁷Guangdong-Hong Kong-Macao Greater Bay Area (GBA) includes the Hong Kong Special Administrative Region, the Macau Special Administrative Region, and the cities of Guangzhou, Shenzhen, Zhuhai, Foshan, Huizhou, Dongguan, Zhongshan, Jiangmen, and Zhaoqing in Guangdong Province (Chen *et al.*, 2010).

⁸An interview recorded by the author on December 20, 2022, with the person in charge of the entrance to Qinghu Village, Dongqinghu Wetland Park, Qishi Town.

⁹Data source: Songshan Lake East Industrial Park Planning, 2019.



Figure 11. Effectiveness of village construction - human living environment improvement. Source: Compiled for the present study.

the advantages of the industrial platform, it brings a strong potential for enterprise group construction consumption. The rapid rise of the new industrial sectors will significantly promote the development of Qishi Town and bring many consumers; and the unique natural idyllic landscape of Jiangbian Village will become the preferred destination for consumption in the vicinity of the industrial zone.

3.3. Village development and construction based on the endogenous power

Due to the market demand and policy factors, the internal driving force of Jiangbian Village started to be affected. The potential of the consumer population brought by the tourism market in the Bay Area has led to a gradual climb in the demand for leisure, accommodation, and other cultural tourism. Coupled with the constant stimulation of the surrounding regional tourism dynamics, the road to developing a rural tourism economy and building a cultural tourism brand became the obvious choice for the development of Jiangbian Village. This allowed the village space of Jiangbian Village, which had been idle for a long time, to slowly show the hope and possibility of revival. The Jiangbian Village committee seized the moment of revival to organize historical and cultural resources to prepare for development. As a result, Jiangbian Village undertook the construction of a special boutique model village in 2020¹⁰, the total planning of the project covers an area of about 58.6 hectares and is developed in three phases to create a beautiful village step by step. The Jiangbian Village committee introduced Huijing Investment Co., Ltd. to renew the physical environment of the village by developing a village construction planning program,

increasing efforts to promote habitat improvement, improving infrastructure construction and basic public services, and optimizing the environment of Jiangbian Village as a whole in combination with the traditional culture of Jiangbian Village (Figure 11). The first phase of the project site is about 14.3 ha, with three thematic experience areas strung together in a timeline of Dongguan civilization from ancient times to the present, creating a Lingnan cultural immersion experience and suburban micro-vacation leisure destination for consumers. The excavated artifacts from the Wanfuan site are also used as inspiration in designing the historic village mascot and creating an archaeological base for the new era. At the same time, Huijing Company has been developing the Jiangbian Village in a point-like fashion through the compilation and consolidation of some idle resources. The six projects signed in the early stage are intended to create a cultural display area and a folklore commercial street, implanting commercial consumption, cultural display, comprehensive services, and other business formats¹¹. At present, the restored ancestral buildings and cafes have been put into use, which provide supporting services for better tourist experience and create employment opportunities for the village, and to a certain extent, attract the aborigines to return to reshape the popularity of the place and renew the vitality of the historic village, thus driving its economic development and creating a virtuous cycle of protection and development (Figure 12).

The development of Huijing Company prompted the villagers to see the hope of village revival, and some of them gradually invested in the village construction. “Now that the village environment is better and there are more

¹⁰In 2020, 50 villages (communities) throughout Dongguan City were selected as pilot projects to accelerate the construction of beautiful villages.

¹¹An interview with Director Huang of Jiangbian Village, Qishi Township, recorded by the author on December 21, 2022.



Figure 12. Effectiveness of village construction - Business implantation. Source: Compiled for the present study).

tourists, my new fish ball workshop will reopen soon, so that more people can eat the traditional dish of Jiangbian Village,” said Uncle Quan, the inheritor of Jiangbian’s municipal intangible cultural heritage¹². More people are also willing to lease their houses as unused resources to Huijing Company. The village committee is also actively working with the villagers and Huijing in this process to carry out the second and third phases of village construction, hoping to bring the 700-year-old village back to life.

Tourism development has changed the living environment of historic village residents from relatively closed to open, increasing their exposure to exotic cultures. Besides, tourists’ interest in local culture has promoted the revival of local culture and helped residents deepen their identification with local culture to some extent (Esman, 1984); and the regional cultural elements closely linked to tourism development (such as historical buildings, old trees, and folk festivals in historic villages) have also received more attention, further stimulating local residents’ to learn and love local culture. As the income level of tourism increases and the residents’ dependence on tourism deepens, the residents will be more aware of the sociocultural and environmental effects brought by tourism (Kong *et al.*, 2016), and thus more consciously protect the culture of historic villages.

4. Strategies for the dynamic conservation and use of Jiangbian village

For the Lingnan Water Villages region, the rapid transmutation and alienation of urban space in the process of rapid urbanization will likely lead to the countryside becoming a natural extension of urban territorial expansion and then becoming an urban village among many urban-rural combinations (Li, 2002). As a rare old village in a rapidly urbanizing area, Jiangbian village needs timely and effective spatial control in the development process and action planning and intervention to avoid its eventual evolution into an urban village.

¹²An interview recorded by the author on December 22, 2022, with Uncle Quan, the municipal non-genetic inheritor of Jiangbian fish balls in Qishi Town.

4.1 Taking advantage of the surrounding development to achieve cross-regional linkage

Jiangbian Village is located in a strategic location and is only an hour’s drive from Dongguan, Huizhou, and Shenzhen. Although its location reduces the travel time of visitors to Jiangbian Village, it also reduces the village’s ability to retain customers. On one hand, the rise of Songshan Lake East Industrial Area (Qishi precinct) will bring a large number of employment opportunities and huge crowd consumption potential for Jiangbian Village; on the other hand, Jiangbian Village should utilize the resources of traditional villages and take advantage of the new tourism power of Dongqing Lake and the Ecological Belt to actively integrate into them. Through the analysis of the demand and characteristics of the surrounding space, it was found that the historical and human resources of Jiangbian Village are compatible with the pursuit of rural recreation and leisure of Dongqing Lake Wetland Park, Ecological Belt, and the industrial platform. With the future industrial platform construction in Qishi and the influx of a large number of urban consumers, using the current Hubanling Mountain observation deck, and through constructing an aerial slow walkway, the connection between Dongqing Lake and Jiangbian Village can be strengthened, and Dongqing Lake can be further upgraded, thereby achieving a win-win situation. In addition, by enhancing the connection between Jiangbian Village and Songshan Lake East Industrial Area (Qishi district) and the Ecological Belt, the integrated development of “industry, city, humanities, and tourism” can be achieved.

4.2. Linkage: Linkage integration of special resource points inside and outside the village

At present, the new village on the periphery of Jiangbian Village has basically taken shape, and the contrast between the new village and the old village is obvious. Most of the villagers’ daily production and life is concentrated in the new village, and the old village has become the part that needs to be protected and utilized urgently. Linkage integration of the village inside and outside the major characteristic resource points, to clarify the functional positioning of different areas so that the major resources can

be interconnected in the construction. Taking into account the consumption demand of tourist crowds brought by the industrial sector of Songshan Lake, Dongqing Lake Wetland Park, and Ecological Belt, integrated planning is carried out for each characteristic resource point, such as Jiangbian Village, Wanfu An Shell Mound and Qiufeng Park, to improve and enhance the overall touring experience of Jiangbian Village. Moreover, on the basis of spatial linkage, the construction of various supporting services and facilities for tourism in the historic village is improved, and fresh and diversified cultural displays and leisure activities are provided to enhance the attraction and retention capacity of Jiangbian Village, so as to achieve mutual assistance in function and complementary industry patterns. While leaving nostalgia for urban development, it promotes the development of the village and realizes the harmonious coexistence of the village and the city.

4.3. Making up for shortcomings and improving quality: Renewal of physical environment while protecting rural characteristics

The existing physical environment of Jiangbian historic village is still unable to meet the actual needs of villagers and cannot accommodate new urban functions. Therefore, the village's infrastructure and living environment should be comprehensively improved on the basis of continuing the original village pattern and preserving its overall spatial and cultural values. Secondly, for historical buildings, the appearance should be retained and the internal space should be appropriately renovated to meet the new functional needs. In this process, it is important to fully excavate the most characteristic material and intangible cultural elements of the village to strengthen their prominence to ensure the effective inheritance of the village culture.

- (i) Street and alley space presentation and continuation
For many years, the infrastructure construction in the Jiangbian Village has been stagnant, with damaged roads, blocked drainage and sewers, and poor environmental sanitation, causing many inconveniences. Most of the "three vertical and fifteen horizontal" lanes are 2 m wide, and the connection between the street should be sorted out based on their status. Besides, the street patterns should be preserved, and lanes <1 m wide should be widened to at least 1.5 m to meet fire fighting requirements. Historic lanes that are damaged and uneven should be repaired; stones, weeds, and debris should be removed, and the characteristics of the lanes should be preserved. Moreover, the lighting facilities such as streetlights should be improved, and the power supply lines, network lines, TV signal lines, etc. should be

installed underground as much as possible to avoid pulling them.

- (ii) The intentional creation of landscape nodes
The layout of Jiangbian Village reflects the principle of cultural scenery everywhere, and the alignment of the main longitudinal lanes all take the mountain view into consideration. For example, Shangxianheng alleyway overlooks Hubanling Mountain; De alleyway faces Hubanling Mountain, where the mountain is visible after entering the village. The organic combination of water body and lane connection, the construction of reservoirs (small reservoirs with landscape design), the use of important public buildings (such as Sima's house, Xingrenli Gate, etc.) to form several control nodes, beautifying old wells and trees, etc., with roads, water bodies, ditch string, organized into an extremely organic village pattern. The landscape nodes are created to preserve history and promote innovative development. Through the organization the public space in the historic village, using the unused vacant land in the village, combined with the surrounding buildings, old trees, etc., the overall landscape environment is enhanced and transformed into a pocket park, outdoor exhibition hall, public activity center, etc. for the leisure and entertainment of villagers and tourists.
- (iii) Highlighting the native features of cultural relics
The architectural space of Jiangbian Village is well-defined, well-preserved, and has outstanding characteristics. The residential, historical, ritual, cultural, and educational buildings, and other types of buildings, the overall planning and design of the historic village building should be completed according to the category and its degree of preservation intact classification, the preservation - renovation - restoration, and other ways. The wasteland should be cleared, and the environment of cultural relics ontology should be improved. The architectural style around the site should be restored, and the derelict buildings should be renovated and transformed to improve the environment around the cultural relics. For example, the original courtyard pattern of Huang's Ancestral Hall, Sima's house, and other well-preserved original buildings should be restored, so that their history can be preserved. Besides, the existing structure of complete buildings should be well-protected, and the main structure of the buildings should be reinforced to keep them intact. Moreover, the fire and insect prevention should be improved for wooden structures. Buildings that are seriously damaged should be repaired by replacing part of the beams and columns and the missing wooden components. Finally, the

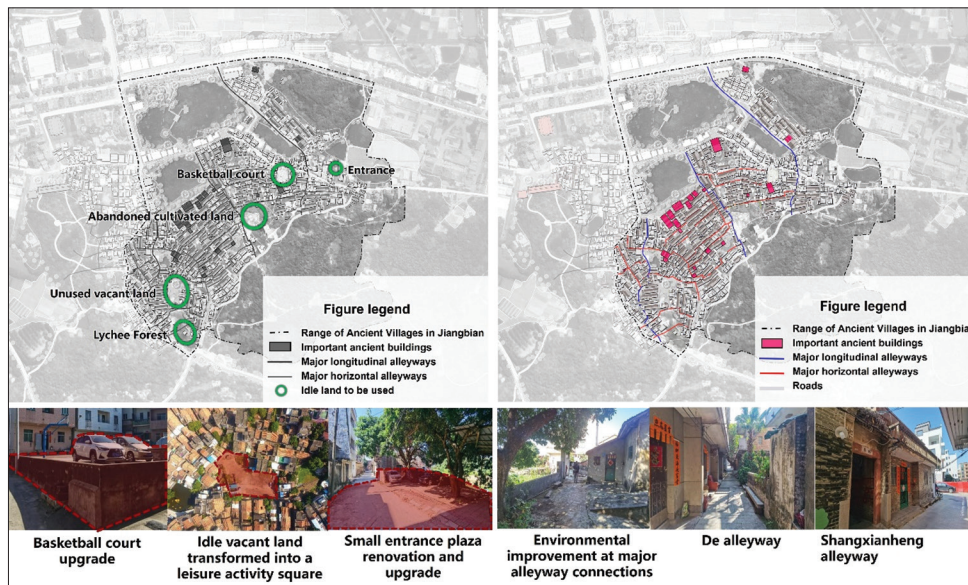


Figure 13. Alleyway and public space creation in Jiangbian Village. Source: Compiled for the present study.

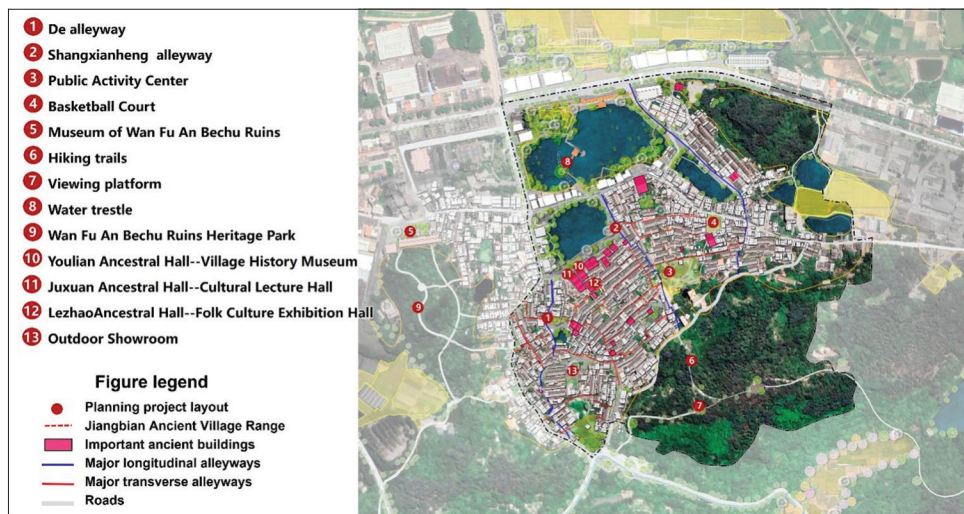


Figure 14. Planning diagram of Jiangbian Village. Source: Compiled for the present study.

traditional style should be restored using the original building components (Figures 13-15).

4.4. Activation: Stimulating the potential use of various types of idle resources

The land in the surrounding rapidly urbanizing areas is limited. Therefore, to free up space for development, some measures are taken to revitalize the village's unused land through the introduction of market-oriented cooperation to create a new rural industrial growth pole.

Jiangbian Village is in a rapidly urbanizing area, and its external environment is in the process of continuous change, so an inflexible and monolithic functional

implantation is difficult to survive in this environment for a long time, which requires Jiangbian Village to adopt the principle of multiple coexistence in the process of taking over urban functions, to adapt to the constantly updated development needs.

In the case of Jiangbian Village, the functions implanted within the village can first be physical experiences based on existing resources, including idyllic sceneries, traditional residence, and folk culture. On one hand, idyllic sceneries promote the transformation of the original economic model and enhance the tourism value of the surrounding natural environment; on the other hand, traditional residence and folk culture highlight the



Figure 15. The development intention of Jiangbian Village rendering. Source: Compiled for the present study.



Figure 16. Schematic representation of the transformation of the Wanfu An Shell Mound. Source: Compiled for the present study.

enhancement of the material and intangible cultural values of the village and provides a way for the identification and dissemination of the cultural values of the historic village (Li, 2009), so that it can be better protected and inherited. The second is the implantation of commercial consumption, cultural display, and comprehensive services relying on tourist experience, which can be further activated by renting the unused buildings in the historic village to Huijing Tuan and implanting related cultural business. Besides, the abandoned old buildings of Wanfu An Shell Mound can be used for cultural facilities in the historic village, such as museums and folk culture showrooms (Figure 16) to increase the cultural connotation of the historic village. Taking the protection and continuation of Lingnan traditional culture and the sustainable benefit of the villagers as the starting point, by revitalizing the natural environment and historical and human resources in the village, Jiangbian Village

will be built into a destination with a beautiful natural environment and a rich cultural heritage, instead of a tourism spot with only an empty shell.

5. Conclusion

This paper started by explaining the dynamic conservation objectives of Jiangbian Village, the cultural tourism consumption market in the Greater Bay Area, and the rural development opportunities brought by the rise of innovative industrial platforms and the tourism demand driven by ecological resources. Combining the characteristics of Jiangbian Village's historical and cultural heritage, the dynamic conservation and utilization strategies of “leveraging, linking, shortening, and activating” are proposed in hopes of bringing into play the innovative dynamics and advantages of different subjects, highlighting the developmental characteristics of Jiangbian Village, and realizing differential developmental goals. This will deepen and enrich the existing research on the dynamic conservation of traditional villages and provide reference for the conservation and utilization practices of traditional villages in rapidly urbanizing areas.

In the context of tourism development in the new era, urban talent, capital, technology, and other elements continue to flow to the countryside, providing multiple opportunities for the transformation and development of traditional villages. Under the requirement of strengthening the protection of historical and cultural heritage in the new era, effectively collaborating with the sustainable development of local economy, culture, society, and promoting the protection and inheritance of cultural heritage can stimulate the protection of traditional villages. Through the case study of Jiangbian Village in Qishi Town, Dongguan City, we found that the protection and development of traditional villages in rapidly urbanizing areas should grasp the unique characteristics of traditional villages, anticipate the developmental needs of the surrounding market and urban and rural construction, and make reasonable control and prediction. As for the cultural heritage characteristics of the village itself, the surrounding resources should be integrated efficiently to prevent the village from becoming an urban village. Of course, we should also note that the sustainable developmental path of traditional villages in China is still being explored, and the traditional villages in different regions differ greatly in terms of regional developmental background and urban-rural developmental paths. Therefore, it is necessary to conduct more in-depth research, summarize the general rules and specific paths, and jointly promote the protection and utilization of traditional villages in China.

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Conflict of interest

None.

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ORIGINAL ARTICLE

Exploring the appropriate technology for green renovation of rural buildings incorporating regional culture: Taking the renovation of village houses in Conghua, Nanping, Guangzhou as an example

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Abstract

In view of the rising energy consumption of rural buildings in recent years and the neglect of the connection with regional architectural culture in the construction process, this study explains the connotation and representation of regional culture based on the theoretical tool of cultural regional character, and constructs a suitable technical system for green transformation of rural buildings incorporating regional culture from five aspects, which are regional character creation, outdoor environment improvement, envelope structure performance optimization, indoor environment quality improvement, and renewable energy utilization. Based on the construction of this system, this study takes the renovation of the village residence in Nanping, Conghua, Guangzhou as an example, and explores the ways to achieve green and sustainable development in the renovation of rural buildings in the Lingnan Guangfu area with the guidance of the system and method of integrating regional culture and modern green building technology. The study compares the buildings of Nanping village residence in Conghua, Guangzhou, before and after the renovation, and finds that after the renovation, the building consumes less energy, the spatial quality is improved, and the overall spatial and stylistic expression is more in line with the regional cultural characteristics, which provides theoretical and practical references for the green renovation of rural buildings.

Keywords: Regional culture; Green building technology; Green renovation of rural buildings; Nanping Village; China

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1. Introduction

Implementing green retrofitting of rural buildings is the key to comprehensively deepening rural green construction. Exploring rural appropriate green building retrofitting technology reflecting regional culture has become one of the focuses of green building technology research in rural China. On February 4, 2018, the State Council of the Central Committee of the Communist Party of China pointed out in the Opinions on the

Implementation of Rural Revitalization Strategy that “rural revitalization, ecological livability is the key.” It emphasizes the improvement of rural living environment and the promotion of green development in the countryside. At present, due to the lack of scientific design guidelines and suitable technical support, as well as economic constraints, rural buildings in China generally suffer from high energy consumption, low efficiency, and poor comfort (Research Center for Building Energy Efficiency, 2020). As there are great differences between urban and rural areas in terms of natural resources, economic conditions, and energy characteristics, copying urban technical methods without considering the actual conditions of rural areas will certainly cause greater waste of resources. At the same time, the modern green building design with “index system” and “technical control” as the normal construction system also makes the green transformation of buildings often blindly use high technology and ignore the connection with the regional architectural culture, which leads to the increase of construction cost and the disconnection of architectural culture. This has led to regrettable results, such as increased construction costs and disconnection of architectural traditions. In response to the above problems, domestic and international research has been conducted on green renovation strategies for rural buildings (Liu, 2017; Liu, 2015; Lei, 2016; Ren *et al.*, 2020; Wang *et al.*, 2016; Wei, 2012; Zheng *et al.*, 2020), technical system construction and practicality assessment (Nie *et al.*, 2021; Rocchi, 2018; Zhang, 2019), exploring the sustainable development of rural buildings (Huang *et al.*, 2021; Yang & Liu, 2021), and resource reuse based on regional cultural heritage (Zheng, 2020; Zeng, 2021), but little research has been conducted on appropriate rural green renovation technologies that incorporate regional culture. Based on these researches and the theory of regional cultural characteristics, this paper provides a profound interpretation of regional culture, clarifies the extraction of regional cultural factors, and combines the statistical analysis method and empirical method to try to build a suitable technical system for green transformation of rural buildings by combining qualitative and quantitative methods, and further tests its feasibility with empirical cases. To achieve the organic integration of regional culture and green technology, the green development of rural areas is encouraged, and the theoretical and practical references for the green renovation of rural buildings are provided (Figure 1).

2. Extraction of cultural factors of regional architecture

China's rich and diverse ethnic, linguistic, religious, and regional characteristics have combined to form a hundred different regional architectural cultures in

traditional architecture (Sun *et al.*, 2020). Regional culture in architecture presents three levels of expression in architectural technical characteristics, architectural symbolic characteristics, and cultural ideological connotations (Lu, 2008). The theory of regional cultural characteristics of architectural aesthetics interprets regional architectural culture from three dimensions: Regional technical characteristics, social and contemporary spirit, and humanistic artistic character. The three dimensions are interconnected and influence each other, presenting a high degree of natural adaptability, social adaptability, and humanistic adaptability, and jointly influencing the formation and development of regional architectural culture (Tang, 2010; Wang & Tang, 2015).

Regional architectural culture is the soil that nurtures the green wisdom of regional architecture, and green building technology is an important guarantee for the sustainable development of rural architecture, and the green transformation of rural architecture should be based on the comprehensive interpretation and excavation of regional culture, extracting regional cultural factors, and achieving organic integration with the appropriate technology for catalyzing green transformation. The extraction of regional architectural cultural factors should follow the following aspects.

- (i) Reflecting uniqueness through extracting regional architectural cultural factors such as architectural shape and color, cultural symbols, construction techniques, and condensing and manifesting regional cultural characteristics.
- (ii) Attaching importance to systemic nature of culture. Regional culture is formed by the joint influence of natural, social, humanistic factors and is the result of the joint action of multiple factors.
- (iii) The pursuit of innovation. The innovative refinement, reproduction and application of regional cultural factors is not only an important initiative to save energy, but also the inheritance of the local spirit of the region.

3. Construction of appropriate technology system for green renovation of rural buildings incorporating regional culture

The development of appropriate green technology based on the integration of regional culture is an important way for the healthy development of rural architecture. The spatial organizational pattern, enclosed structural form, and construction practices of regional architecture contain simple green camping concepts and techniques to cope with different climates, terrains, resources, and other environmental challenges (Sun *et al.*, 2020). The green

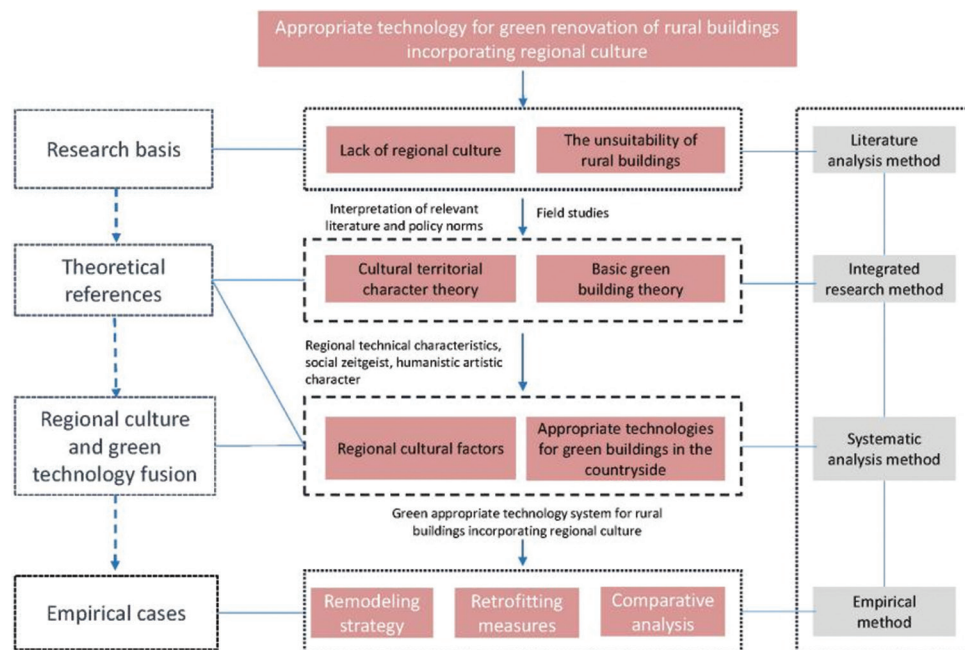


Figure 1. Research idea map for this paper. Source: Drawing by the author.

renovation of modern regional buildings should respect and inherit traditional green wisdom while combining modern green technologies to make active and passive energy conservation complement each other.

It is appropriate for the green suitability transformation of Chinese rural buildings to be based on relevant standards and codes such as the Evaluation Standard for Green Transformation of Existing Buildings (GB/T 51141-2015) and the Energy Conservation Design Standard for Rural Residential Buildings (GB/T50824-2013), and to closely follow the actual situation and problems of rural buildings, from the creation of regional characteristics, outdoor environment improvement, envelope structure performance optimization, and indoor environment. The key technologies of rural green suitability are discussed in five aspects, thus forming the suitable technology system of rural building green transformation as shown in Figure 2, with the aim of achieving the integration of regional culture, promoting the shaping of rural characteristics, reducing energy consumption, and improving the quality of rural living environment in rural building green transformation.

3.1. Creation of regional characteristics

First, the continuation of traditional residential architectural style: The building plan inherits and develops the planned organizational form of traditional architecture; the façade extracts the form and practice of traditional architecture’s composition, roofing, and other parts, and adopts the typical colors and decorative elements

of regional traditional architecture to reflect distinctive regional characteristics. Second, scientific application of traditional ecological techniques and regional building materials: The ecological techniques of traditional regional buildings are optimized in terms of sun shading and heat insulation, ventilation and moisture prevention, and drainage and shock absorption developed in the long-term climate response practice with modern technology, while actively exploring regional building materials and using modern material technology to improve the performance of traditional materials. Third, scientific configuration of regional plants: In the rural landscape transformation, through the scientific proportioning of regional plants, the landscape characteristics of traditional rural plants are continued, the regional recognition is enhanced, and the sense of identity of residents is strengthened.

3.2. Outdoor environment improvement

Scientific and reasonable design of rural landscape, creation of pleasant rural public space with outstanding regional characteristics, green suitability transformation of outdoor environment in terms of soft and hard landscaping, use of appropriate and efficient green ecological technology, combined with the rural habitat environment improvement project, and deepen the construction of green countryside. The microclimate can be effectively improved by adopting regional plants and increasing the greening area; at the same time, permeable materials are used for paving the larger and hard landscaping to control rainwater runoff and increase rainwater infiltration, combined with the

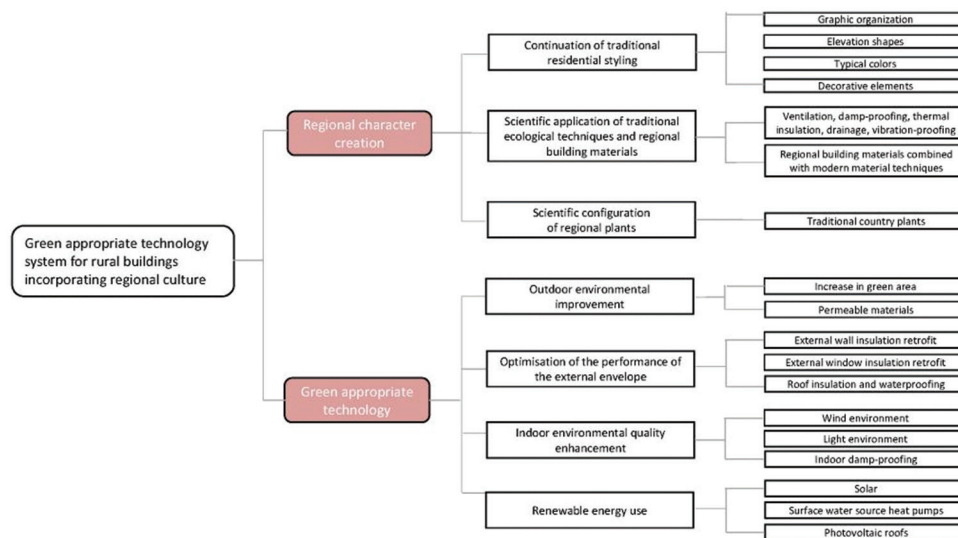


Figure 2. Diagram of the appropriate technology system for green renovation of rural buildings incorporating regional culture. Source: Drawing by the author.

setting of rain gardens and rainwater ponds to supplement, and protect groundwater resources.

3.3. Exterior envelope performance optimization technology

Energy saving and consumption reduction is the key point of suitable green renovation of rural buildings. Through the renovation of exterior walls, exterior windows, roofs, and other components of the envelope structure, the thermal insulation performance of the exterior envelope structure is improved, which can effectively improve the indoor thermal environment and reduce energy consumption, as shown in Table 1. In the renovation of exterior wall thermal insulation, according to the regional climatic conditions and the actual situation of the project, two methods can be used: Internal insulation of exterior wall and external insulation of exterior wall, and the materials can be selected from foam glass insulation board, polystyrene insulation board, inorganic insulation mortar, and so on, so that the thermal performance of exterior wall can meet the requirements of relevant standards. When the thermal performance of the original exterior wall meets the standard, it can be coated with thermal insulation reflective coating to further improve the thermal insulation performance. In the heat insulation transformation of exterior windows, the heat transfer coefficient of exterior windows can be reduced and the air tightness increased by replacing insulating glass plastic windows, coated glass windows, double-layer insulating LOW-E glass windows, and other energy-saving windows that can effectively block heat radiation. If the original window frame has good air tightness, the original ordinary glass can be replaced with coated glass, insulating glass, and so forth, to improve the

thermal insulation performance of the exterior windows. The exterior window shading system can be combined with the exterior façade regional characteristics transformation by adding shading components or internal shading facilities. In the transformation of roof heat insulation and waterproofing, it is appropriate to choose appropriate transformation measures according to the original roof structural form and the actual situation of the protection layer, waterproof layer, and heat insulation layer to improve the heat insulation performance of the roof. The application of traditional roof forms or green roofs can be considered, while practicality should be taken into account to facilitate rural life and production.

3.4. Indoor environment quality improvement

The green suitability transformation for indoor wind environment, light environment, and moisture control is beneficial to improve the problems of poor indoor thermal environmental comfort, insufficient light and poor ventilation, which are common in rural buildings, and can improve the quality of indoor environment. In terms of indoor wind environment improvement, the ventilation wisdom of traditional regional architecture is combined with modern technology to actively realize natural indoor ventilation. First, optimize the design of building plan, elevation, and section, adopt wind pressure and thermal pressure ventilation, reasonably design elevation openings and indoor ventilation paths, and actively organize ventilation through the hall; second, increase or widen the internal courtyard to enhance ventilation; third, penetrate the staircase part in the section to achieve the effect of “pulling wind”; fourth, consider using mechanical ventilation to assist in improving when

Table 1. Techniques for optimizing the performance of the external envelope

Type	Typical construction	Features
External wall insulation retrofit		
Internal insulation		<p>Main advantages</p> <ol style="list-style-type: none"> (1) Low requirements for waterproofing and weather resistance of finishes and insulation materials (2) Simple construction and easy to operate, without damaging the original building façade (3) Construction is not affected by climate (4) Lower cost of construction <p>Main disadvantages</p> <ol style="list-style-type: none"> (1) Difficult to avoid thermal bridging (2) Easy to produce condensation, humidity and even mold on the inner surface of the thermal bridging area (3) Not easy to use indoors
External insulation		<p>Main advantages</p> <ol style="list-style-type: none"> (1) Avoids the formation of thermal bridges (2) Does not affect the use of indoor space (3) Reduces water vapor condensation inside the insulation layer (4) Construction is not restricted by indoor constraints <p>Main disadvantages</p> <ol style="list-style-type: none"> (1) Construction is limited by weather (2) The finish layer (except for dry hanging finishes) is prone to cracking (3) Relatively high cost
External window insulation retrofit		
Replacement energy-efficient windows		<p>It can effectively improve the insulation performance of external windows, blocking thermal radiation, improving indoor comfort, and reducing the energy consumption of air conditioning in summer.</p>
Additional external window shading system		<p>Lower cost, better shading and insulation, and can be combined with the transformation of the façade's regional character</p>
Roof insulation and waterproofing retrofit		<p>Effective in improving the waterproofing and insulation of roofs</p>

Source: Drawing by the author

natural ventilation is insufficient. In the improvement of indoor light environment, we increase the area of light opening by increasing the window-wall ratio to strive for indoor natural light, at the same time, we can choose energy-saving lamps and lanterns to ensure low energy consumption while improving indoor illumination. In the design of indoor damp-proofing, the use of easy construction and economic use of indoor flooring cement mortar damp-proofing transformation can effectively improve indoor dampness, improve air quality, ensure the quality of use and durability of structural materials, and prevent illness among occupants in areas with high air humidity due to wall mold and flooring dampness.

3.5. Renewable energy utilization technologies

The widespread popularization of safe, clean, environmentally friendly, and economic solar energy utilization technology in rural areas can effectively change the energy consumption pattern of rural areas and ease the situation of energy supply tension. Rural areas can make full use of abundant solar energy resources due to lower building density and volume ratio, and less shading and larger roof areas. In rural areas with abundant rainfall and surface water sources, surface water source heat pump technology also has great potential for development. In addition, the integrated rooftop photovoltaic design as shown in Figure 3 can be carried out to achieve photoelectricity utilization.

4. Practice in Nanping Village

The case study of the renovation project is located in Nanping Village, Conghua District, Guangzhou City, which was completed at the end of 2018, and is a villager's self-built house, which is 7.8 m high, two-story residential building with brick and concrete structure and a floor area of 168 sqm. Before the renovation, the original building had a poor design, with a dilapidated appearance, unreasonable layout, a lack of service facilities, disorderly

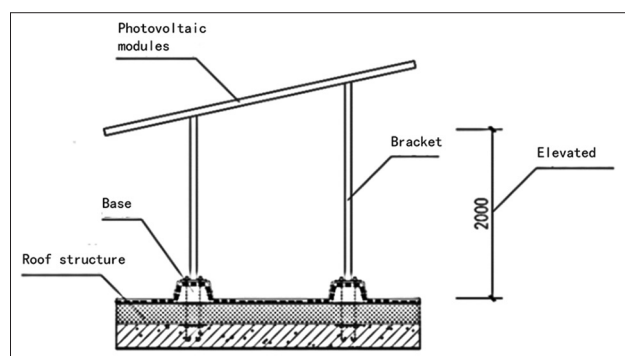


Figure 3. Schematic diagram of overhead PV roof construction. Source: Drawing by the author.

plan organization, and low space utilization, as well as technical problems, such as poor thermal insulation, poor lighting and ventilation, low indoor comfort, and high energy consumption (Zeng *et al.*, 2018). In view of the current problems of the renovation project, five measures for the green suitability renovation of rural buildings integrated with regional culture are proposed to achieve the goal of sustainable development of the renovation project adapted to the region.

4.1. Green renovation strategy

According to the construction of green appropriate technology system for rural buildings integrated with regional culture, and in response to the original building problems and owner's needs, we propose a suitable green renovation strategy that integrates local traditional Hakka culture, with passive technology as the focus and active technology as the supplement, to save energy and reduce consumption, and create a livable and comfortable indoor environment.

The renovation starts from the following levels:

- (i) In terms of creating regional characteristics, mainly reflected in the transformation of the exterior shape of the building, the traditional Hakka residential features of Nanping Village are retained to echo the features of the surrounding buildings.
- (ii) In outdoor environment improvement, regional plants are used in landscape design, and permeable materials are used for paving.
- (iii) Optimizing the performance of the exterior envelope, improving the heat insulation and waterproof performance of the exterior envelope, such as the exterior walls, windows, and roofs, strengthening natural ventilation, and reducing energy consumption.
- (iv) To improve the quality of indoor environment, adjust the plan organization and functional layout of the building, make full use of space, and improve the comfort of the indoor environment, with a view of creating a high-quality, high-utilization indoor space.
- (v) In terms of renewable energy utilization, use renewable energy, such as solar energy, to save energy and reduce emissions.

4.2. Green renovation measures

According to the appropriate green transformation strategy, corresponding transformation measures are adopted to constitute a technical system with clear objectives and intensive technology to achieve the purpose of highlighting regional characteristics, effectively reducing energy consumption, and improving indoor comfort. Specifically, the measures are as follows:

- (i) The building form inherits traditional Hakka culture and considers the users' spiritual demands and practical needs. The roof form is based on traditional Hakka roof form, with a combination of flat slope and traditional color of white walls and tiles of Hakka dwellings, which is compatible with the environment of Nanping Village in terms of color; the balcony railing vent extracts the typical decorative patterns of Hakka architecture, which organically combines form and function.
- (ii) In the outdoor environment improvement, plants with distinctive regional characteristics such as thousand suns, cocklebur, bread tree, and golden banyan are applied to create rich landscape layers, while permeable material concrete is used to pave the outdoor flooring.
- (iii) On the optimization of heat insulation performance of external enclosed structure, the internal heat insulation of external wall is selected for renovation, new green inorganic coating aluminum silicate heat insulation coating is adopted, external windows are replaced by plastic steel aluminum hollow double-glass windows from original aluminum alloy ordinary windows, louvered internal sunshade is added, roof heat insulation and waterproof renovation, polystyrene foam board heat insulation material is adopted, and indoor flooring is treated with cement mortar moisture-proof. The typical exterior envelope technology and material application used in this design are shown in Figure 4.
- (iv) Rationalization of the original layout and functional adjustment to improve space utilization and indoor

- environmental quality. First, the kitchen area was enlarged, dining room, storage room, living room, and bathroom were added to meet the needs of daily life and improve the quality and convenience of life; second, the location of the bathroom was changed to make the natural wind path smooth, and the window hole in the north wall was enlarged to enhance the circulation of the dominant wind in summer; third, the location of the stairwell was adjusted to strive for the south orientation of the bedroom, which improved the indoor daylighting.
- (v) In terms of resource conservation using renewable resources, a solar photothermal system was added to the roof of the residential building to provide domestic hot water, while water-saving appliances were installed, and interior lighting was replaced with energy-saving lamps.

4.3. Comparison of green performance and benefit analysis before and after retrofitting

Through the empirical method, using ECO-TECT software to simulate and compare the ventilation, lighting, and indoor temperature distribution before and after the project renovation, it can be obtained that:

- (i) Ventilation effect is significantly improved. The ventilation of the residential buildings before the renovation was poor, but after the renovation, due to the smooth layout of the plan, smooth ventilation paths and increased air circulation space, the indoor wind speed was mostly between 0.83 m/s and 1.66 m/s, and the ventilation was significantly improved.
- (ii) Light conditions are obviously optimized.

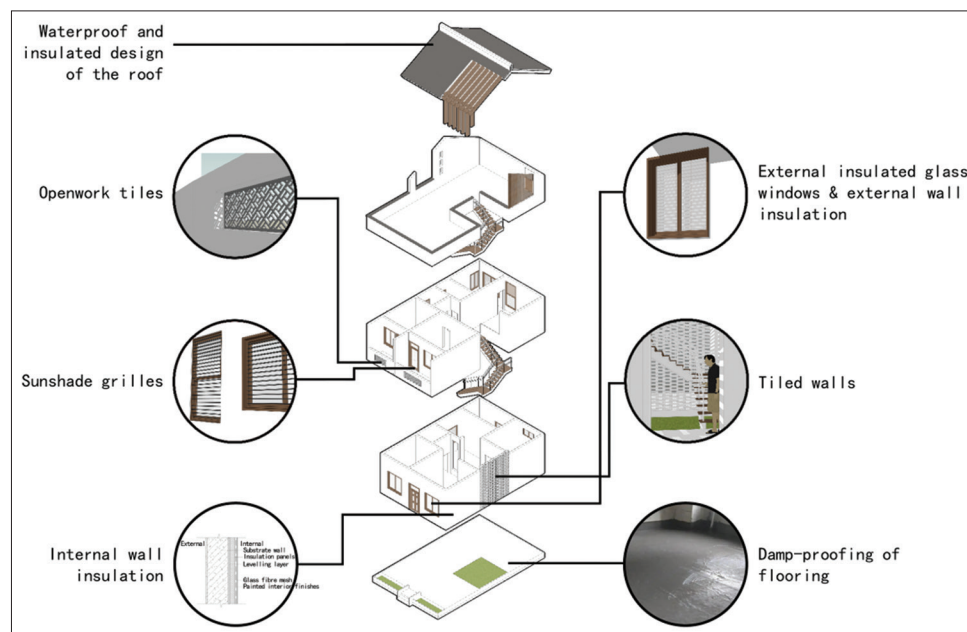


Figure 4. Examples of envelope technology and material applications. Source: Drawing by the author.

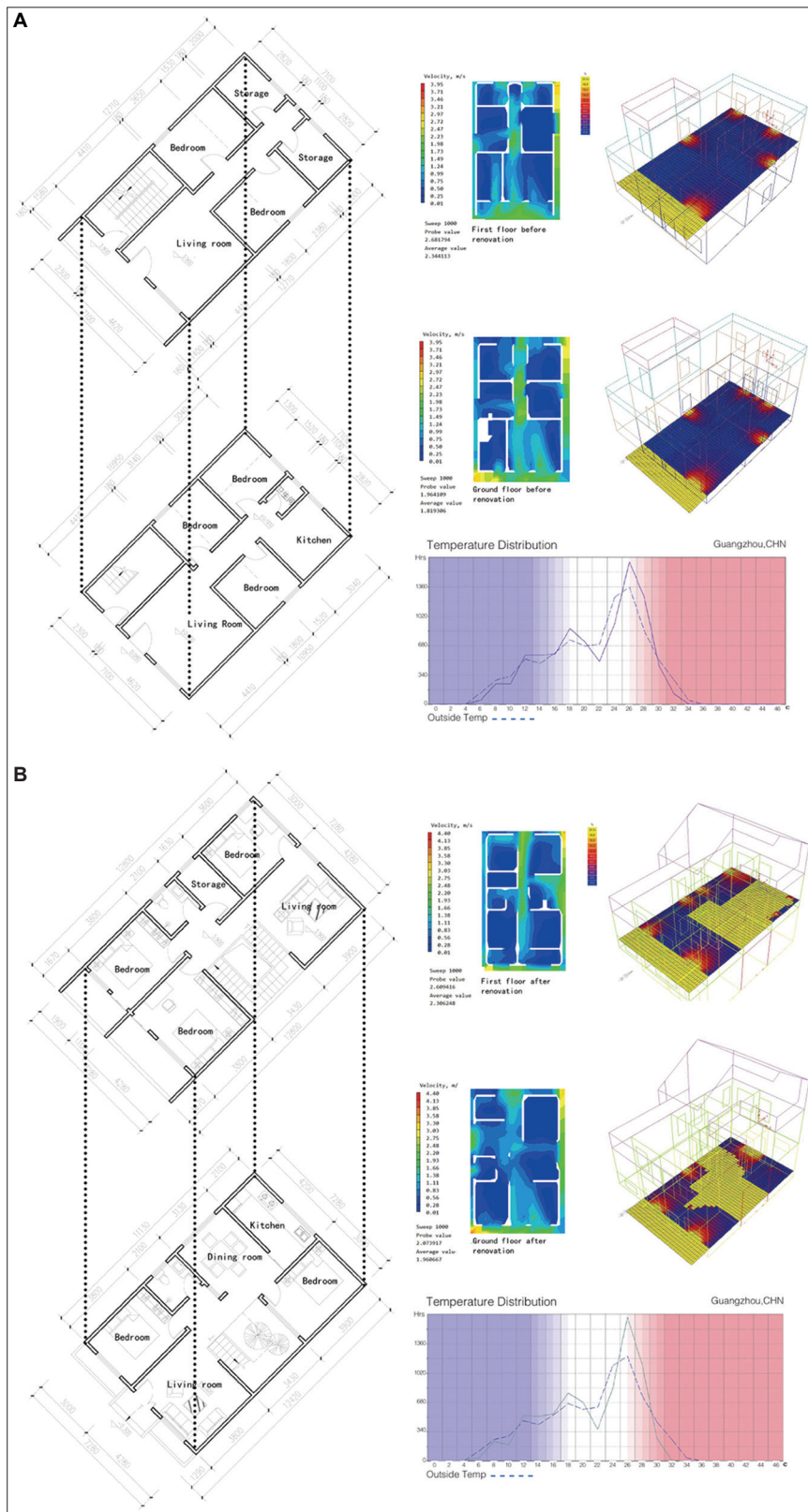
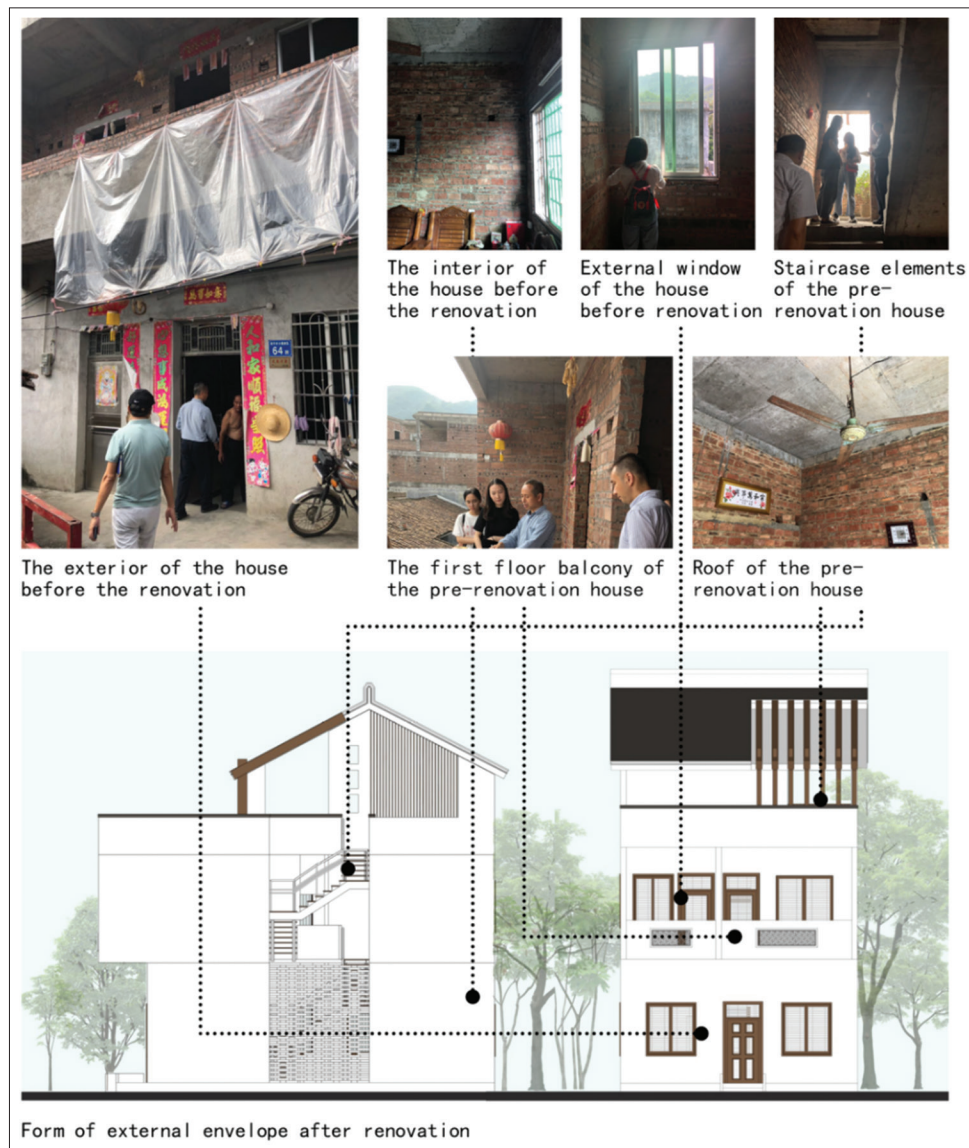


Figure 5. Improved indoor environmental quality before and after renovation. Source: Drawing by the author. (A) Ventilation, light, and room temperature distribution in the room before the renovation. (B) Interior ventilation, light and room temperature distribution after renovation.



Name of the structure	Thermal resistance (R) (m ² k)/W	Thermal inertness index D=R*S	Solar radiation absorption coefficient	Heat transfer coefficient W/(m ² K)
Before renovation				
External walls	0.207	2.300	0.77	2.73
Roofing	0.090	1.431	0.74	3.99
After renovation				
External walls	0.546	2.804	0.75	1.34
Roofing	0.973	2.983	0.75	0.88

Figure 6. Comparison of envelope structure and thermal performance indicators before and after renovation. Source: Drawing by the author.

The area of natural light coefficient 2.0% of the residential building before the renovation is large, and the indoor light is dim, while the natural light coefficient of the public space, such as living room and

dining room, is sufficient after the renovation, while the distribution of light is more even.
 (iii) The heat insulation performance of the envelope structure is obviously improved

The heat insulation character of the building maintenance structure is obviously improved compared with that before the renovation. Without using active equipment to improve the indoor temperature, the proportion of natural room temperature in the comfortable 18–26°C range is increased after the renovation, and the indoor thermal environment is better than that before the renovation, which better improves the indoor thermal comfort. The visualization of indoor environmental quality improvement before and after the renovation is shown in Figure 5, and the comparison of enclosed structure and thermal performance index before and after the renovation is shown in Figure 6.

The simulation calculation after green renovation shows that the green performance of the case study building is significantly improved, the indoor environmental quality is improved and the comfort level is increased.

In addition, the incremental cost of the project's green renovation is about RMB 102,100, which can save about RMB 1,522 in building energy consumption per year and has good economic benefits, which is a prominent research outcome of the green appropriate renovation technology for rural buildings incorporating regional culture, supplementing the proof of the components of the appropriate technology system for green renovation of rural buildings incorporating regional culture, scientifically and practically.

5. Conclusions

This study clarifies the principles of extracting regional cultural factors through relevant theoretical methods, constructs a framework of green suitability technologies that incorporate regional culture, and proposes five key technologies for green transformation of rural buildings in terms of creating regional architectural characteristics, outdoor environmental improvement, exterior envelope performance optimization, indoor environmental quality improvement, and renewable energy utilization. In this paper, we have proposed key technologies for green renovation of rural buildings.

Compared with the current research on green buildings in rural areas, which mostly focuses on energy-saving renovation of rural buildings, climate adaptation of residential buildings, and the concept of rural green building design, this paper innovatively proposes a suitable technical system for rural green renovation that integrates regional culture, and verifies the feasibility of the technical framework through case study buildings.

The green renovation of rural buildings presents intricate and complex problems that cannot be solved by

a single architecture due to its special nature. We should pay attention to the real situation and the way of life in the countryside, choose a practical route of retrofitting implementation, and promote the completion in various aspects together. The problems of rural building renovation planning and post-occupancy and maintenance are related to the virtuous life cycle of renovation practice, which should be further studied and deepened in the future works.

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Conflict of interest

The authors declare they have no competing interests.

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Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data

The data in this paper were obtained through real measurements and software verification.

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ORIGINAL ARTICLE

Revitalizing resource-depleted community
through community empowerment: The case of
Shougang Laoshan community in BeijingXinli Tian^{1*}, Yiyao Zong¹, and Aobo Ran^{2,3}¹Department of Urban Regeneration, Tsinghua Tongheng Urban Planning and Design Institute, Beijing, China²Think Tank Center, Tsinghua University, Beijing, China³Institute for Urban Governance and Sustainable Development, Tsinghua University, Beijing, China(This article belongs to the *Special Issue: Theoretical and Practical Innovations in Relation to China's Urban Regeneration*)**Abstract**

In the process of transformation and development, resource-depleted areas face the parallel situation of economic system transformation and social foundation reconstruction. Since community building is an important aspect of social foundation reconstruction, how to revitalize resource-depleted communities is a critical issue faced by the transforming resource-depleted areas. This study starts from this background and explores how resource-depleted communities can be revitalized through community empowerment. Through a community regeneration case study of Shougang Laoshan Community in Beijing, two key points of community empowerment to resource-depleted communities in its early stage are proposed, namely, the professionals' channeling to local level, and the linkage of resources. The most important goal of community empowerment is to energize individuals in the community, encourage their communications, and increase their mobilities by cultural empowerment and resource mobilization.

Keywords: Community empowerment; Resource-depleted community; Local revitalization; Principal planner institution; Resource connection

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1. Introduction

As China's urban development is changing from incremental development to development in built-up area, there are increasing urban regeneration projects in the scale of community in built-up areas. The concept of community empowerment was introduced to mainland China from Japan and Taiwan, which is a hot term in the field of neighborhood planning and community regeneration in China in recent years.

Community empowerment is a means to realize participatory planning. In one of the most famous theories about public participation – Arnstein's ladder of citizen participation, it states that participation is the redistribution of power that enables the have-nots citizens to be deliberately included (Arnstein, 1969). The categories on the top rungs of the ladder, which means high participation, are partnership, delegated power,

and citizen control. Community empowerment is the way to achieve so by letting people get to know and realize their ability to participate.

Community empowerment has become an important practice in urban regeneration in China today, though still with some challenges. Small-scale participatory projects have emerged in China since the reform and opening-up in the 1990s (Plummer & Taylor, 2013). However, in 2011, Professor Zhang Xiaojun from Tsinghua University frankly stated that in most cases in China, it is “*canjia*” rather than “*canyu*” (Nitzky, 2013). The difference between “*canjia*,” which refers to taking part in or attending, and “*canyu*,” which refers to taking part in with contribution, is whether participants’ opinions are actually considered. As for present, whether community empowerment practices in China have increased “*canyu*” and achieved better effects need to be further explored. In general, community empowerment in the Asia-Pacific region faces many challenges, such as poorly organized governance, and imbalanced political structures, but it is currently gaining momentum (Pawar, 2009).

Among the various types of communities targeted for community empowerment work, one type of community has attracted particular attention from urban scholars, namely, the declining, inactive, and “forgotten” communities. These communities are often economically disadvantaged, demographically declined, with little identical local culture, and few voices heard in society. Although the socioeconomic infrastructure of such communities is poor, they retain a great deal of social capital and attachment to the local area (Johnstone & Lionais, 2004). They need community empowerment to revitalize and drive local development.

This study focused on resource-depleted communities, using Shougang Laoshan Community in Beijing as a case, to explore how community empowerment can help them be revitalized. The study focused on the participatory process of community regeneration and the interaction between the different actors (mainly residents and the people carrying out community empowerment activities, in this case these people are planners), to understand the practical logic of community empowerment, and to draw practical suggestions for community empowerment and local revitalization in resource-depleted communities with their characteristics. This paper provides some fresh first-hand experiences and practical reflections on community regeneration in China, a detailed research case for academics, and it enriches the understanding of the existing research by addressing two key ideas: first, it is necessary to carry out community empowerment with the professionals channeled to local level at this current stage of

social development; and second, exploring and revitalizing the hidden recourses in the community is the fundamental path to resource-depleted community regeneration and development.

2. Literature review

2.1. Urban transitions in China

There have been huge urban transitions in China since the 1970s. Urban space was very limited due to the backward economic development, the society was under collectivization, and it did not change until the Reform and Opening-up in 1978. Since early 1980s, a large amount of countryside labors migrated into cities to earn their livings, and the urbanization rate started to grow up. Satellite towns were built to absorb the influx of population and private capital (Leaf, 1995). With economic growth and private sector enlarging, urban development occurred at an even higher speed in the 1990s and 2000s. Friedmann (2005) observed that personal autonomy and citizenship started to emerge during this time period in China. At the same time, urban redevelopment in the inner city accelerated. In the 2010s, urban renewal projects started to be one of the most important kinds of project in cities, especially in large cities such as Beijing.

Spectacles such as mega-events and festivals are becoming the dominant tool and process in the production of urban space (Debord, 2012). Gotham (2005) believes that two major functions of spectacles are profit making and bureaucratic control. Olympic Games – 2008 Summer Olympic Game and 2022 Winter Olympic Game – are two of the most influential and comprehensive mega-events held in Beijing in the past 20 years.

2.2. The concept of community empowerment

Following the notion of participatory planning, the term “community empowerment” emerged in the 1980s. “Empower” means “the ability to choose” or “to increase one’s capacity to define, analyze, and act on one’s own problems” (Kent, 1988). One cannot “empower” others; one can only help others facilitate the process, reduce barriers, and enable others to “empower” themselves (Labonte, 1989). Community empowerment as a process was initially associated with the concept of community development when it first emerged. Laverack (1999) subdivided community empowerment into nine domains to guide the operation and evaluation of the practice. The nine domains are as follows: participation, leadership, organizational structures, resource mobilization, problem assessment, asking why, links with others, outside agents, and program management. Participation, and its closely

related concept of empowerment, is a tradition rooted in Western democracy that cannot be betrayed (Burke, 1979; Fagence, 2014).

In the East Asian world, community empowerment is problem-solving oriented. In the regions where the concept of community empowerment first emerged, such as Japan and Taiwan, community empowerment aims at narrowing the urban-rural gap, saving local culture, solving ecological crisis, and so on. As a community building practice or social movement, community empowerment has played an important role in promoting the development of economic and social transformation in Japan and Taiwan (Wang & Liu, 2022).

In China, research on community empowerment is mainly within the disciplines of sociology, anthropology, political economy, and architecture and planning. The sociological perspective focuses on the construction and maintenance of social network capital, which scholars believe that it is not only creating a “community” but also creating a “new society,” a “new culture,” and a “new people” (Chen, 2005; Luo, 2004). From the perspective of anthropology, community empowerment aims to build a sense of community by establishing emotional ties between people and their environment based on local identity (Zeng, 2007). In the political economy perspective, measures to revitalize community resources focus on community empowerment and collective community actions (Zhan, 2004; Wang, 2016). The perspective of architecture and planning focuses on the articulation of hard and soft community construction and the esthetic design of its living space, and considers community empowerment as a practical activity of spatial planning and design transformation that fits values, mechanisms, and functions (Chen & Yan, 2014).

Local revitalization is a specific purpose of community empowerment. By proactively exploring and managing local characteristics, it enhances local (economic) vitality and helps build shared values and community capacity in the region. Under the perspective of endogenous development theory – centered on residents, Fan & Wang (2020) argue that the experience of local revitalization can be summarized as follows: revitalizing local industries are the understructure, leveraging resource advantages is the ground, cultivating social power is the key, and innovating governance mechanism is the guarantee.

Community empowerment is an important way for community revitalization. This paper takes resource-depleted communities as a common type of communities to be activated and explores how community empowerment can play a role in the process of rejuvenating the vitality of such communities.

2.3. The practice of community empowerment

Japan is the birthplace of community empowerment (*machizukuri*) in East Asia, and much attention has been paid to it in the academia. The prosperity of community empowerment in Japan is not accidental, but is based on its specific spatial unit – *machi*. Japan’s urban structural tradition is patchwork, and the modern *machi* has local attributes, small-scale communities with social and functional diversity, which provide a place for community empowerment (Hein, 2008). It has undergone three waves: the first wave originated in the late 1960s and early 1970s, roughly the same time as the rise of participatory planning in Europe and the United States; the second wave began in the mid-1980s and centered on community participation, highlighting collaboration and co-creation; and the third wave began in the late 1990s and tended toward regional and community management, working together to solve urban problems through multi-actor participation (Satoh, 2019). Some scholars argue that the development of community empowerment in Japan is directly related to the bursting of the bubble economy, where many public affairs had to be solved by society from the bottom up (Sorensen, 2007).

Community empowerment activities in Japan have developed in a rich variety of scenarios, resulting in many experiences that are applicable to different situations. For example, as an earthquake-prone country, Japan’s post-disaster reconstruction has been characterized by a gradual revitalization of the community through the care of social workers and the mutual help and empowerment of people (Araki, 2013); Japan is responding to the severe aging population through an increasing number of community empowerment activities, rather than relying on existing social pension programs (Inaba, 2016); and Japan is responding to community decline and the need for sustainable tourism development through community-based tourism (Hiwasaki, 2006). The current *machizukuri*, while diverse in form, has three main strategies – building consensus among residents to voluntarily adhere to regional development guidelines, presenting a unified face for external negotiations, and working with good government to ensure legitimacy and access to resources (Sorensen *et al.*, 2008).

In addition to Japan, other regions have also produced rich experiences in community empowerment. Community empowerment in both South Korea and Taiwan has gone through a process from government-driven to resident-initiated. Unlike other regions where community empowerment activities originated in cities, community empowerment in South Korea began in rural areas (Brandt, 1979). In the 1970s, to solve the huge urban and rural gap in South Korea, then-president Park Chung-hee started the

New Village Movement (Saemaul Undong) and established related institutions from the central government to the local government. The Saemaul promotional councils, the role of women, and the Saemaul education system all promoted resident participation in rural communities (Kim, 2012). Participatory rural community empowerment remained government-led during and long after the Park Chung-hee regime, and it was only in the late 1990s that policy shifted to resident-led integrated community development (Park *et al.*, 2008). Some Korean community empowerment projects had a strong government overtone and do not really rely on residents, while failing to create sustainable rural modernization (Yang, 2018). The concept of community empowerment in Taiwan first originated in the U.S. and later grafted on the Japanese concept of machizukuri. In the 1960s, Dr. Zhang Hongjun and U.S. consultants from the United Nations brought the concept of community empowerment to Taiwan, but participatory community planning did not develop much under the oppressive political environment until the 1990s, when the Council for Cultural Affairs began to promote comprehensive community building (Chen & Ku, 2017; Lin, 2015).

Research on community empowerment in Japan, South Korea, and Taiwan reveals the importance of civil-society-state relations in community empowerment in East Asia, and therefore, it is still relevant to study bottom-up community empowerment in China under an authoritarian system (Heberer, 2009; Hsu *et al.*, 2017). Research on community empowerment in China is still in ascendance. Western scholarship has paid early attention to the term of community construction, but they have taken a pessimistic stance on state-led community renewal programs (Bray, 2009; Shieh & Friedmann, 2008; Yan & Gao, 2007). Friedmann (2007) has long paid attention to placemaking in Chinese microspaces, and he analyzed the impossibility of state reconfiguration of the territorial order of small spaces from the perspective of civil resistance. However, these studies have not discussed the public participation that has flourished in China in recent years, especially the joint participation of professionals and people (Li *et al.*, 2020; Zhang & Liao, 2022). Based on the above-mentioned explorations of community empowerment in various regions of the world as well as in China, this study will add the phenomenon and impact of community empowerment that has flourished in China in recent years to the existing studies, summarize lessons from experiences, and provide a more diverse reference for practitioners.

2.4. Resource-depleted area and resource-depleted community

Resource-depleted areas are generally defined as areas where resource-led industrial development has led to economic

decline, environmental degradation, and social drain. In a broader sense, depleted resources do not only need to refer specifically to production materials such as minerals, but also to the loss of human resources (i.e., young population) and social capital. In addition, not only the massive development of raw material resources may lead to the depletion of local resources but also external factors such as policies may lead to the suspension of local industrial development, resulting in the depletion of resources. It is under this definition that the concept of resource-depleted communities is proposed, which refers to the supporting residential communities in resource-depleted areas.

There have been many studies on the transformation of resource-depleted regions, and most of them take macroeconomic transformation as the entry point (He *et al.*, 2017; Hu & Yang, 2019). Gao (2016) and Gong *et al.* (2012) studied the economic and policy factors that influence the transformation of old industrial bases from theoretical aspects, including institutional and structural factors, that is, economic management, market environment, industrial structure, and so on. Zhao (2000), Yuan (2015), and Yang (2006) summarized the successful transformation experiences of industrial diversification and the use of gradual transformation strategies by studying international cases of Ruhr region (Germany), Pittsburgh and Detroit (USA), and Kyushu (Japan), respectively. Li *et al.* (2016) also summarized the experiences and models of transformation and development of old industrial bases in China.

Meanwhile, research on urban sociology in resource-depleted areas is relatively limited: Wang (2006) suggests that China's industrial urban communities have undergone "de-unitization" in the process of resource depletion, and community building requires the organic unification of physical capital, human capital, and social capital based on a weak sense of community. Liu (2006) discusses the social basis of economic development in resource-depleted areas and its reconstruction from the perspective of human resources, community organization, and social security system. Guo & Pan (2013) took a community of Wuhan Iron and Steel Group as a case study, studying it from the perspective of the aged people, and argue that such resource-depleted communities have the foundation to and need to be transformed into "age-friendly communities."

Existing studies have provided some guidance on the economic and social revitalization of resource-depleted areas, and this has some implications for the regeneration of resource-depleted communities at the micro level in cities. In this study, we explored the regeneration of resource-depleted communities from the perspective of community empowerment as a complement to the existing research on resource-depleted areas.

3. Research methods and case introduction

3.1. Research methods

Fieldwork and participant-based observation were adopted as research methods in this study. The fieldwork was conducted during the author's tenure as a principal planner in the case study area, i.e., from 2019 to 2022. As a member of the principal planner team, the author was fully involved in the process of community empowerment, and had both the "top-down" perspective of a planner and the resident's perspective gained as a communicator. This case study aims to use the author's in-depth first-hand work experience to fully investigate a local case with regional characteristics, and to draw up a local practice model that can be used in an operational way. This study attempts to depict the operation and role of community empowerment in the context of resource-depleted communities and to provide a generalized summary of effective community empowerment work methods.

3.2. Case introduction

This study takes Shougang Laoshan community (Figure 1) (hereinafter referred to as "Laoshan community"), which is located in Laoshan Jiedao¹, Shijingshan District, Beijing, as the research site. Shijingshan District is positioned in the official planning as a national demonstration area for industrial development and transformation, and a demonstration area for ecological livability, where Shougang² and its supporting industrial areas were located before the relocation. Laoshan Jiedao (i.e., subdistrict) is located in the eastern part of Shijingshan District, with a street area of 6.1 sqkm and a resident population of about 43,000. The Laoshan community is located on the west side of Laoshan Jiedao and is a supporting residential community for Shougang, consisting of four Shequs³.

¹ In Chinese urban administration system, Jiedao is the level directly under district. In other words, The term Jiedao equals to sub-district.

² China Shougang Group is a famous state-owned-enterprise (SOE), which mainly produces steel. Shougang's old plant is located in Shijingshan District, Beijing, only 17 kilometers from Tiananmen Square. After the founding of New China, Shougang became the benchmark of Beijing's industry, accounting for a quarter of the city's total tax revenue in its heyday; however, as the capital's urban areas developed, regional conditions and environmental pressures limited its further expansion. Shougang's production not only caused serious air pollution, but also water shortage, which restricted Shougang's further development.

³ In Chinese urban administrative system, Shequ is the grassroot level of governance. Usually, the scope of a Shequ may be a residential estate, and a dozen of Shequs consist of one Jiedao.

Laoshan community is a typical old neighborhood, which was built in 1982, with less public space and supporting service facilities, and a high rate of aging population.

As Figure 2 shows, Laoshan community is surrounded by rich resources: a natural recreation park (Laoshan City Recreation Park) in the north; the district government and many business districts (Galaxy Business Center, Wanda Plaza, Wanshang Business Center) in the south; the characterized cultural district (Babaoshan Revolutionary Cemetery and Langyuan Park) in the east; and the Laoshan stadium complex (Beijing Olympic Cycling Stadium and BMX Park), which is used as a competition venue and training venue for the Olympics, and a large amusement park (Shijingshan Amusement Park) in the west.

As a supporting residential area for Shougang, Laoshan community became a typical resource-depleted community left behind after the relocation of Shougang. Shougang initiated the relocation in 2005 in conjunction with the Beijing Olympic Games bid, and officially ceased production in 2010. The shutdown involved the layoff and re-employment of more than 20,000 workers. At this time, Shougang workers suddenly lost their stable jobs, and the psychological gap was inevitably large. In the following 10 years, Laoshan lost 2500 people who were relocated elsewhere (Beijing Shijingshan Bureau of Statistics, 2021).

The principal planner institution is an institutionalized community planner system that has been piloted in several Chinese cities in recent years⁴. The scope of work

⁴ Beijing officially implemented the principal planner system in 2019 as an important initiative to strengthen neighborhood renewal and grassroots governance. In March 2019, Beijing's newly amended Beijing Urban and Rural Planning Regulations formally proposed to "implement the principal planner system to guide the implementation of planning and promote public participation." The "Implementation Measures of the Beijing Principal Planner System (for Trial Implementation)" was released immediately afterwards, marking the formal establishment of the principal planner system at the Beijing municipal level. In 2020, the "Guidelines for Principal Planners in Beijing (for Trial Implementation)" and "Assessment Measures for Principal Planners in Beijing (for Trial Implementation)" were issued in September and November respectively, further clarifying the functional positioning, work content and evaluation methods of principal planners. As an independent third party, the principal planner is selected and hired by the district government (Jiedao and township), and planners, architects and relevant social organizations can be hired to guide the implementation of planning, promote public participation, and provide professional guidance and technical services for planning, construction and management actions within the scope of responsibility.



Figure 1. Birdseye view of Laoshan community. Source: Laoshan Jiedao Office.

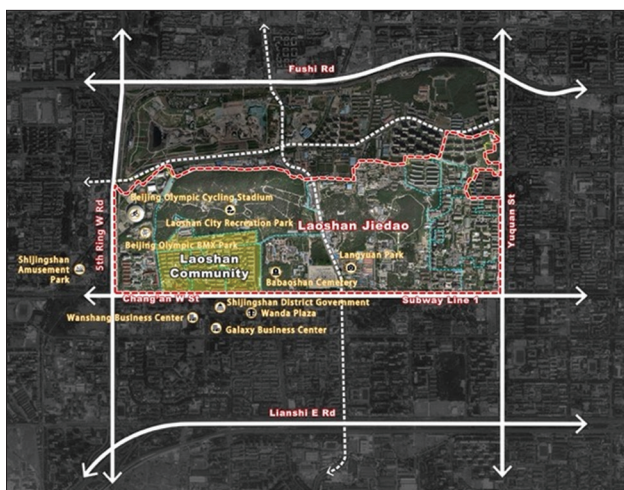


Figure 2. Resources around Laoshan community. Source: Author.

of the principal planner is the Jiedao (subdistrict, or neighborhood community) to which the planner belongs, and the channeling down of the principal planner to the Jiedao is an important measure to help the grassroots carry out urban renewal work and assist in the refinement of urban governance with professional power. As a member of the responsible planner team in Laoshan Jiedao, the author has been involved in the community empowerment work of Laoshan community since 2019.

4. Three types of community empowerment practice

In the 3-year community empowerment process, the principal planner summarized three working themes, namely, cultural construction, resource connection, and public participation. The renewal and renovation work in resource-depleted communities should not only be limited to the transformation of physical space but also focus on the social benefits and sustainable development

significance behind the spatial improvement, strengthen the organic link between spatial resources and social groups, and link resources from a larger regional level across the community (Ran *et al.*, 2018).

4.1. Cultural empowerment to generate sense of place

The creation of the IP (Intellectual Property, by extension, a cultural brand bringing high exposure) of Laoshan Jiedao and the “Laoshan Forever Young⁵ Revitalization Action Plan” is a fundamental part of the initial phase of community empowerment. Before deciding to create the IP, Laoshan Jiedao had already done some work in the field of community empowerment in a piecemeal manner, such as the upgrading of various small and micro spaces. However, the Jiedao believes that Laoshan needs an overall leading spiritual brand to support the community empowerment work. First, it was because the original visual brand was relatively mediocre and could not reflect the local temperament of Laoshan, and it was more difficult to meet the demand of revitalizing the community through the brand effect; second, it was because some Jiedaos in Beijing have started to adopt various creative media marketing work methods in community empowerment after the Beijing Municipal Committee Urban Work Conference held at the end of 2018, which has also given some inspiration to Laoshan Jiedao.

After the principal planner team came to Laoshan Jiedao in 2019, Laoshan Jiedao proposed to create its own IP and entrusted the principal planner team to carry out related work. The Laoshan Forever Young Revitalization Action Plan aims to enhance the influence and comprehensive service capacity of Laoshan by tapping into the rich resources of the street and linking multiple forces to participate in the neighborhood revitalization, activating the area with social innovation. A team from the Academy of Arts and Design, Tsinghua University was invited to design the logo of Laoshan Jiedao and the Laoshan Forever Young Revitalization Action Plan, and the final proposal was selected by residents through an online voting process. As shown in Figure 3A, the logo of Laoshan Jiedao abstracts the terrain of Laoshan as the basic figure, with different colors to represent modern sports, technology, culture, and other resources of the local Laoshan area. As shown in Figure 3B, the logo of the Laoshan Forever Young Revitalization Action Plan is based on this and links all kinds of resources together through a Möbius Ring, which symbolizes the spirit of infinite possibilities and integration, implying that multiple cultures and

⁵ Laoshan in Chinese literally means “the Old Hill”. The naming of Laoshan Forever Young responses to this literal meaning, saying the Old Hill is not really old.

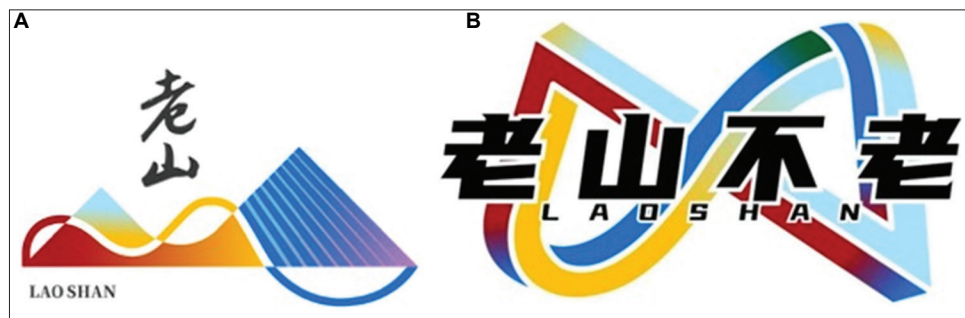


Figure 3. Logos of Laoshan: (A) The logo of Laoshan Jiedao; (B) The logo of Laoshan Forever Young Revitalization Action Plan. Source: Author.

resources are intermingled in Laoshan, and the people of Laoshan use these cultures and resources to create a Laoshan community with infinite possibilities. These logos are applied to various work of the Jiedao, especially the promotion of community empowerment work, helping to build up the brand of Laoshan. When the Jiedao introduces the Laoshan Forever Young Revitalization Action Plan to local resources and invites them to join, the plan is to package it as an IP. The cultural arrangement of Laoshan makes people to have a clearer perception of the resources they were used to.

Regarding the construction of local culture, the Dual Olympic Games had a great impact as a mega event that took place in the region. After the 2008 Summer Olympics, several venues on the west side of the Laoshan community will continue to be used for summer training, in-competition services, and post-competition recuperation for athletes during the preparation and hosting of the 2022 Winter Olympics, and will be partially opened to the public for sports activities during the non-Olympic period, creating an “official” Laoshan sports culture. For the Jiedao, packaging the project as a project related to the theme of the Dual Olympic Games would ease the application for special construction funds. For example, Laoshan Jiedao tries to package a street on the west side of the Laoshan community that connects the sports venues and the main road (Chang’an Street) as the “Street of the Dual Olympic Games,” showing the theme of the Dual Olympic Games through some sculptures and posters, creating an Olympic atmosphere and sports spirit in the area, and taking the opportunity to renovate the street itself.

However, the Dual Olympic Games as a big event has the effect of amplifying the influence of local resources, but at the same time, it is too ambitious and often makes it difficult to make good use of the resources in a sustainable way. The venues on the west side of Laoshan are mainly cycling and bicycle racing venues, both of which are niche sports with high maintenance costs, and the general body is not able to hold such assets and operate them continuously.

The General Administration of Sports of China had attempted to transform these venues into thematic cycling industrial parks with the help of post-Olympic afterglow, but this did not happen due to various reasons.

Compared to the obvious official leadership of the Dual Olympic Games culture and sportsmanship, the residents’ practice of sportsmanship is unconsciously revealed. The Laoshan community is home to a number of “hidden” sports celebrities, including a world triathlon champion who teaches children to swim, a retired motocross athlete who coaches, a well-known blogger on mountain biking forums, and so on. As the area has more hills and sports resources, residents are used to this environment and the demand for public fitness is higher than elsewhere, and something gradually happens, such as some gymnasiums and a youth steeplechase course being opened around the west venues, and trails built in the Laoshan are paved with a synthetic surface as fitness trails. A principal planner believes that the future use of sports resources in Laoshan is toward marketization and fitness for all. It is the choice of sports resources by the residents here that has shaped the unique sports culture of Laoshan.

In addition to the comprehensive culture and sports culture of Laoshan, the collective memory and culture associated with Shougang is also a key point. The community’s full set of service facilities used to be an important feature and advantage of the Shougang residential compound, although the community facilities are basically in a state of non-operation due to the disappearance of the benefits brought by the enterprise after Shougang’s relocation. In a survey on the demand for community facilities for the residents, the residents, who are mostly retired Shougang workers, gave somewhat unexpected feedback: they most wanted to add a bathhouse to the community. Because they often need to wash their bodies after working in the steel mill before going home, the bathhouse is an indispensable place given their working pattern, and it is also a scene of their social interaction. The residents’ demand for a bathhouse not only reflects the

shaping of Shougang culture for the community residents but also reflects the continuation of the community culture by the residents' independent choice.

Young people in Laoshan are also building the community in their own way. The founder of Laoshan Cafe, whose family are Shougang employees, has been running a boutique cafe in the Laoshan area since 2013, maintaining long-term interaction with regulars in the community, recording customer visits with a wall full of photos, and building a place full of connection and a sense of belonging for his customers. He is a representative of the young people who come from and serve Laoshan, bringing back freshness from outside the community, and building a fresh place to interact.

4.2. Connecting resources to make a comprehensive revitalization plan

The Laoshan Forever Young Revitalization Action Plan is a comprehensive plan to revitalize the area by tapping resources and linking multiple parties. The plan is divided into four steps: In the first step, Laoshan Jiedao, as the first initiator of the plan, started to link a wide range of local resources through a recruitment process. The Jiedao will sort out the needs of all parties to find cooperation points, list several activities or projects that can be included in the theme of "Laoshan Forever Young," find the parties actively involved, and quickly release some activities to increase the power, thus triggering the participation of more subjects. At the same time, the Jiedao recruits co-sponsors, such as enterprises, associations, industry organizations, social organizations, individuals, and so on, to participate in the program in various forms, such as creative cultural activities, events, construction projects, and the like. The second step is to continue to release thematic activities and further link up regional resources. The activities that can be implemented immediately under the theme of Laoshan Forever Young will be released gradually according to the time, and each body will be required to introduce further customized activities or projects based on the theme of Laoshan Forever Young. At the same time, the Jiedao will organize regular communication among participants and discuss multiparty cooperation to increase the influence and communication power and form a resource platform and communication matrix. The third step is to gradually accumulate and normalize activities to form the influence of Laoshan IP. The fourth step is to jointly promote the development of Laoshan area through resource linkage and multiple synergies, and to stimulate the vitality of the area by means of social innovation.

The principal planner team acts as an intermediary in this process. First, the principal planner learns directly

from the community itself through communication with the residents; second, the principal planner team, as the delegated party in the Jiedao, is able to communicate with the government and coordinate with various government departments to provide resources to help revitalize the area; in addition, market players see the principal planner team as a link and are willing to communicate with them about projects that have both community value and market value.

The "Response to Whistles"⁶ mechanism is an effective mechanism for quickly linking street departments, higher-level planning and other related departments, community residents, and local units. Unlike the previous mechanism where the grassroots departments had to communicate and negotiate separately with different higher-level departments to solve problems, "Response to Whistles" brings together inter-departmental and cross-regional leaders to solve problems at once, enhancing the strength of the grassroots. In the comprehensive renovation of the old estate in Laoshan, the principal planner team and the Jiedao assisted all departments in understanding the real demands of the residents, considering the renovation work in an integrated manner, optimizing the relationship between the renovation work and the key work of each department, and assisting the property rights unit and the implementation body in understanding the needs of all parties and clarifying the focus of the post-management and operation services, as shown in [Figure 4](#).

There is a need for market players to establish connections between subjects, and the Revitalization Action Plan is designed to address this need. For larger-scale area resources, such as the cultural space Langyuan Park and the community's west-side sports venues, the Jiedao generally coordinates the establishment of working connections between the resource and the principal planner team. Some local resources will borrow the platform of the Revitalization Action Plan to interact with other resources, such as the TUS-Ice and Snow Venue, suggesting that they could work with Langyuan Park across the street to develop a regional leisure and entertainment center together. For smaller individual resources, such as the Laoshan Café and the "Spirit of Dog" dog training school, the principal planner team will explore these resources through community visits. During the communication with the café manager and the founder of the dog training school, they both expressed interest in organizing community activities related to their own fields. For example, the café manager expressed his desire to use his own venue to provide more diverse services for the community and create a "15-min living circle," while the founder of the dog training school

⁶ It literally means "all government departments respond to the gathering call of Jiedao."



Figure 4. The principal planner team connecting with different departments (e.g., planning department, landscape department, and property management department). Source: Author.

expressed her desire to organize an event about scientific dog raising to help build a polite community environment. From this, it is concluded that many local resources are interested in community building and have practical ideas, but it was difficult to realize or implement the imagined activities and projects due to asymmetric information and other factors.

4.3. Public participation to build neighborhood living space

Public participation is an important part of community empowerment. In Laoshan community, its organization is mainly done by the Shequ Residential Committee and social work groups. The Residential committee is quite familiar with residents because they have many interactions in daily lives. Using modern communication methods such as WeChat (a social contact application on mobile phone) and traditional methods such as bulletin board, the Residential Committee connected with residents and invited them to participate in the renovation plan show and related voting activities. In addition, social workers were responsible to organize the communication process between residents and the design team. The goal of social workers was to facilitate the process so that everyone could speak for themselves.

In the Laoshan community, public participation has reached some effects, but overall, it is still being explored. In the comprehensive renovation project of the old estate in Laoshan, the responsible planner team and design team have conducted several rounds of point-to-point communication with residents, in addition to widely soliciting opinions through the distribution of questionnaires, as shown in [Figure 5](#). However, the opinions obtained from such public participation are highly individual, and although beneficial to individuals, it was not efficient enough, nor established a normalized public participation mechanism.

It can be observed that the awareness of public participation among the residents of Laoshan community has increased after certain community empowerment activities. Public participation activities were conducted in



Figure 5. Public participation with resident representatives and the design team. Source: Author.



Figure 6. Comparison of before and after the renovation of the community park. Source: Author.

the Laoshan Dongli North Small Microspace Renovation Project completed in 2021, where the residents went through multiple rounds of design proposal consultation process. This experience was new for many Laoshan residents, who were able to express their views on public affairs and be seen to do so. In the subsequent all-age friendly park project on the south side of the Laoshan community, which was completed in 2022, as shown in [Figure 6](#), residents' interest in the park's construction has increased significantly. The results show that the park in 2022 is more popular and better utilized by residents than the small microspace in 2021.

5. Discussion

Taking the community empowerment work in Laoshan community as a representative example of community

empowerment work in China today, two characteristics can be observed: first, at this stage, the professionals (in this case, principal planners) channel down to the grassroots to carry out community empowerment and place-making work; second, one of the important tasks of community empowerment and local revitalization is to sort out, link, and gather resources that may be covered.

5.1. The professionals channeling to local level

The channeling down of the professionals provides more empirical support and legitimacy to their community-oriented work. In practice over time, professional planners have often been the party invited to give professional advice, just come and then leave, and are not closely associated with the community, but have the authority to direct its matters. The principal planner institution, which places the planner as a professional in the community on a permanent basis, gives him or her enough time and energy to engage more closely with the community to understand the strengths and demands of the area, which provides some justification for the planner as a professional to make professional recommendations to the community.

When community residents have not formed a clear resident interest group or advocacy group, the arrival of a professional is helpful in shaping the community building efforts into a more organized, implementation-oriented framework and leading the way in various efforts. In the case of Laoshan, the arrival of the principal planner team contributes to the completion of many tasks, such as the creation of Laoshan IP, the promotion of the Revitalization Action Plan, and the linking of local resources. This type of work is not something that the average individual resident is equipped to carry out, as they are usually only interested in resources that are closely related to them, and hardly ever have comprehensive access to all types of community resources and the willingness to be a resource aggregator.

It is important to note that the arrival of the professionals is not a measure worth adopting in the long term, but only has clear advantages in the early stages of community empowerment. The arrival of the professionals is a starting point, but the real purpose is to empower residents to carry out various community building activities and projects. In fact, residents are inherently capable of community building through the choices that they make about the use of spatial resources. For example, in the Laoshan community, residents have enriched the sporting culture of the area with general fitness activities. When residents are empowered to a certain extent, the core of people who lead community building will change from the professionals to the experts. While the professionals emphasize the accumulation of knowledge, the experts emphasize the accumulation of experience, especially experience that is applicable to the

local context. Some community leaders are well equipped to become experts, and they are an important group that will lead the community to sustainable development in the future. For more non-leader residents, ideally, they will have institutionalized channels to speak for themselves in the future and continue to participate in shaping their communities through informal voices, such as place-making. The market-oriented local teams as the experts are the sustainable choice to provide a constant driving force for a long-term development of the community.

5.2. Resource sorting out, linking, and gathering

For old communities, many resources are often neglected for a long time, and the excavation, sorting, linking, and convergence of such resources can help solve the painful problems of resource-depleted communities at the root. Resource-depleted communities may seem to have lost the advantageous resources of the past, but in fact the historical spaces produced in the past are still retained locally, and these spatial resources have the possibility to be revitalized, thus driving the development of the area. Although not all these resources have been effectively utilized for the time being, they are still the resources that make the future of this area possible of changes. What can be observed is that no matter how big the titles of these resources previously carried, they are all facing the trend of marketization and public use in the future. The emergence of marketized gyms and steeplechase course near the stadium venues on the west side of the Laoshan community supports this trend.

Community talents are also community resources, and this type of intangible resource is more difficult to explore and utilize than the tangible spatial resource. In communities where community empowerment is not yet deeply carried out, there are cases where community talents who want to contribute to community development have no channel to realize the idea. This kind of contribution to the community may not be a big project, for example, the founder of a dog training school wants to start a dog training workshop. However, they need a platform to gather resources and some opportunities for everyone to realize their ideas. The Laoshan Forever Young Revitalization Action Plan is an attempt to create such a platform, and it is already showing initial progress that connects all parties.

5.3. Understanding community empowerment comprehensively

The channeling down of the professionals and the linkage of resources are important tasks in community empowerment and local revitalization. For resource-depleted communities: first, it needs to explore local advantageous resources, such as sports resources and

welfare facilities resources in Laoshan community, so as to prepare the foundation for carrying out the work; secondly, it needs to revitalize local industries based on resources, such as sports industry and leisure and entertainment industry in Laoshan community, so as to attract people inside and outside the community to visit and bring more vitality; third, it needs to actively cultivate social forces and give full play to the community talents to move one step forward to revitalize the community; finally, the participation of residents and market resources in community building needs to be guaranteed institutionally so that the empowerment of residents is not only a result of momentary public participation activities but also can become a long-term force for participation in community life.

6. Conclusion

The core conclusions of this study are drawn from the observation of a case study of a resource-depleted community in China, as a complement to the current academic research on community empowerment in resource-depleted communities: at this stage, the channeling down of the professionals is necessary to carry out community empowerment and achieve local revitalization; besides, sorting out, linking, and gathering resources that may be neglected is an important path to activate resource-depleted communities. The most important part of community empowerment is the activation, interaction, and mobility of people, and the activation of people's power requires cultural empowerment and resource flow. For example, after a community park is built, it not only becomes a central area for activities in this community, attracting nearby residents to come and play, but also becomes a public space for interaction with residents of other communities, attracting residents of other communities to come and play, and enhancing interaction between different communities and types of people. As more people are attracted to this community, more people see the diverse possibilities of this place, and more people and industrial resources flow in, local vitality is further stimulated.

This study summarizes in some details a case experience of community empowerment in the context of the principal planner institution in Beijing, providing practical experience and suggestions for implementing the principal planner institution throughout China. This study argues that the principal planner institution is an important part of community empowerment in China today, and although this paper describes many of the advantages of the principal planner institution at this stage from multiple perspectives, the long-term development of community empowerment requires the introduction of market-based

management teams from the perspective of efficiency and other considerations.

The study only selects one representative case for research, and some research discussions may emphasize a bit much on local characteristics. Laoshan is rather unique due to its special location on the main street of Beijing and as heritages of former industries. There are rich resources of Laoshan that other communities may not have. It is hoped that more cases from different regions should be added for comparative studies in the future to draw more generalized conclusions.

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The authors declare they have no competing interests.

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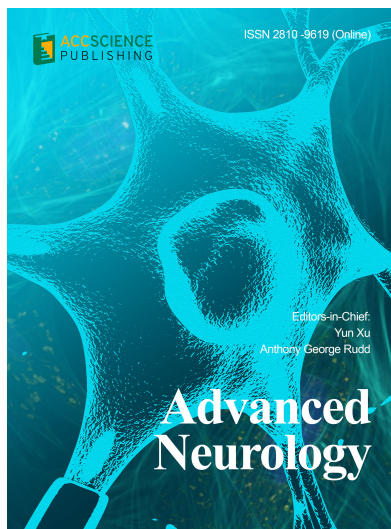
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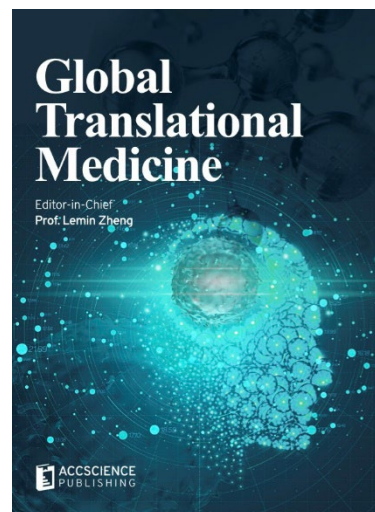
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