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# Undertrack (Re)Fill: Transforming Railway Infrastructure Into Community Spaces in Japan

**Miguel Freitas Silva**

formaurbisLAB, Research Centre for Architecture, Urbanism and Design (CIAUD), Lisbon School of Architecture, Universidade de Lisboa, Portugal

**Correspondence:** Miguel Freitas Silva (josemiguelsilva@edu.ulisboa.pt)

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## Abstract

In contrast to the notion of the "useless city," Japan has long engaged in the practice of repurposing the spaces beneath railway and highway infrastructure for a variety of uses, including commerce, dining, nightlife, industrial storage, and, occasionally, residential functions. The concept of undertrack (re)fill, however, specifically refers to 21st-century urban regeneration initiatives that aim to adapt these interstitial spaces for programmes centred on social interaction and cultural expression, closely embedded within local communities. This study aims to develop a synthesised framework for understanding community spaces situated beneath infrastructural viaducts, focusing on two key adaptive processes: juxtaposition and addition. Employing a morphological approach, the research explores the spatial relationships between these interstitial areas, the infrastructure above, and the broader urban context, through several case studies in Yokohama and Tokyo. Methodologically, the study characterises each case through a combination of architectural drawings and photographic documentation, drawing on existing design projects. Notable examples include the Koganecho Art Centre in Yokohama, as well as sites in Tokyo such as the Elevated Garden at Nerima and the Chuo Line House Koganei in Koganei. These spaces encompass community centres, local art exhibitions, open-air markets, and cultural venues, each contributing to a stronger sense of belonging and collective identity. By integrating local traditions and cultural practices into contemporary urban regeneration, Japan demonstrates how development can be both environmentally sustainable and culturally enriching.

## Keywords

community space; morphogenesis; railway infrastructure; undertrack refill

## 1. Introduction

Major linear infrastructural systems have played a key role in the growth and mobility of cities. However, in many cases, they have also given rise to urban discontinuities, continuous and impassable masses that divide the territory. In some instances, they have been sites of disruptive and informal occupations, while in others they remain vacant and unused. It is therefore essential to understand the role these structures might still play in contemporary processes of urban and sustainable regeneration, particularly through the reuse of their interstitial spaces as communal areas. Interstitial spaces emerge "in-between" the physical structure of the city, occupying the threshold between obsolescence and the opportunity to create new urban fabric. Such spaces, for instance, can be oriented towards local communities, where their own uses and meanings may emerge, whether planned or spontaneous, institutional or informal. In this sense, interstitial spaces should not be regarded merely as physical voids, but rather as critical urban conditions that expand the possibilities of urban life (Brighenti, 2013).

Grounded in project-based readings, this study seeks to construct a theoretical framework for the development of community spaces beneath infrastructure. To this end, it draws upon case studies from Japanese cities in the 21st century, especially those involving the construction of transitional and interactive spaces beneath railway infrastructure. However, this study is confined to examining the (re)use of interstitial spaces beneath railways that continue to be operational.

What are the common characteristics of infrastructural appropriation in the Tokyo metropolitan area, and how do they differ from the Western examples? How do contemporary examples of infrastructural appropriation in and around Tokyo further and build on the Japanese notions of constructing communal spaces? The residual spaces created by these linear infrastructures are here considered as opportunities to introduce programmes that are central to contemporary European urban discourse. It is important to emphasise that the objective is not to undertake a comparative analysis between the Japanese reality and the European context. The intention is, however, to identify a hypothesis that may be applied to intervention practice across different contexts. Infrastructure may thus transcend strategic impasses, offering new solutions for the production of community space, whether permanent or temporary, everywhere.

Thus, in order to address the research questions, the case studies were selected according to four themes—shared residential space, informal green space, multifunctional space, and shared commercial space—to identify within them two intervention processes: juxtaposition and addition. This approach makes it possible to establish a relationship between the notions applied in the construction of community spaces in Japan and the emerging themes in the West, enabling their appropriation according to neighbourhood-specific needs and aspirations through new forms of occupation and programming.

Methodologically, the representation of each case is supported by graphic and textual reference materials collected through literature review and information supplied by the respective architectural offices and project design authors. The representations produced (i.e., plans and sections) are not direct transcriptions of the gathered information, but rather syntheses of the existing spatial conditions, while the written component informed by the collected architectural design reports is identified as "personal communication," seeking to clarify the underlying concept, form, and organisation of the spaces, situated within their morphological and social context.

The study is structured in two parts. The first addresses community space in the traditional city, seeking to demonstrate that such spaces are neither ordinary nor undifferentiated but are, rather, full of significance and constrained by private urban form. This argument serves to highlight the exceptional nature of community spaces created beneath railway infrastructure. The second part addresses community space in the infrastructural context, focusing specifically on design projects representative of distinct intervention processes and developed since 2005. The transition into the 21st century is understood as a paradigmatic shift, in which community space moves beyond the traditional city and becomes integral to urban regeneration, particularly of infrastructure. To this end, the study offers a synthesis of various modes of occupation, which may be theoretically recognised as hypotheses for application in other intervention contexts and geographical settings.

Japan has, over time, exemplified both the opportunities and the latent potential inherent in adapting the interstitial spaces of railway infrastructure to accommodate a diverse range of programmes. Yet, the deliberate application of such spatial transformations within a community-oriented framework remains a relatively recent phenomenon. This article advances the argument that these spaces possess significant capacity to address contemporary social challenges within the context of reusing to reduce the human footprint (ter Steege, 2023), drawing upon current precedents of urban-scale interventions to substantiate this claim.

## 2. Literature Review

One of the most complex and enduring issues in the debate on the city is the obsolescence of built form, namely the loss of utility or underutilisation of urban areas. This is a cyclical and diffuse phenomenon, increasingly prominent in contemporary times. The idea of reuse and recycle emerges not only as one of the most fundamental manifestations of sustainability in architecture (ter Steege, 2023; Wong, 2022) but also as an intrinsic condition of urban production, transcending the limits imposed by individual building plots. In a sense, this is exemplified by the idea of undertrack (re)fill, which repurposes the interstitial spaces beneath railway viaducts.

Works such as Atelier Bow-Wow's *Made in Tokyo* (Kaijima & Kuroda, 2001), Arnon Snapir's *A Research on the Inhabited Viaduct Architecture in Tokyo* (Snapir, 2012), Habitar Group's *Rehabitar. La casa, el carrer i la ciutat* (Monteys, 2013), and Jorge Almazán's *Emergent Tokyo* (Almazán & StudioLAB, 2022) form an important bibliographic foundation to discuss the idea of undertrack (re)fill. However, in these studies, the (re)use of railway infrastructure is typically defined as diverse and transitional, rather than as a form of community space. In contrast, Jordan Sand's *Tokyo Vernacular: Common Spaces, Local Histories, Found Objects* (Sand, 2013) offers a perception of Japanese spatial practices through the lenses of communal, community, and common space. Similarly, Marco Borsotti and Sonia Pistidda's *Abitare i rilevati ferroviari. Strategie innovative di rigenerazione* (Borsotti & Pistidda, 2020) and Eva Prats's *Building Communities* (Prats, 2024) consider community space in transformed contexts as an integrated process of local engagement and spatial appropriation.

Arnon Snapir argues that viaducts are not merely technical elements of railway networks, but can act as catalysts for the urban fabric, contributing to the creation of new informal public spaces and to the functional and social integration of city areas. He also highlights the risks of urban fragmentation posed by such structures, particularly when poorly integrated into their surroundings. According to the author, the urban quality of these interstitial spaces depends not only on their occupation, but more importantly on the

types of uses they accommodate and how they are articulated with the surrounding urban fabric and community (Snapir, 2012).

The interstitial space may be understood as a gap within the urban fabric, an "in-between" space without a defined use where formal and informal situations occur simultaneously. However, more than simple voids or residues, these spaces are conceived as expectant, with the capacity to act as catalysts for new centralities at both local and city scales. From this perspective, such "terrains vagues" (Solà-Morales, 1995), abandoned or disused, reveal themselves as productive in their transformative potential, operating as zones of intermediation between the consolidated city and the opportunity to imagine new architectural forms or uses.

At the same time, the intermediate territories situated between the urban and the rural, or between compact and dispersed zones, the "espacements" described by Françoise Choay, appear as fragments and intervals resulting from diffuse urbanisation (Choay, 2003), which break with the model of the historical, dense, and compact city, composing instead a discontinuous landscape of superpositions, juxtapositions, and unexpected uses. Sieverts' notion of "in-between space" (Sieverts, 2003, 2011) assumes a more interdisciplinary and flexible character, capable of encompassing diverse urban realities that may include three-dimensional combinations of unconsolidated plots through processes of overlapping or intersection: the railway infrastructure, for example. The spaces beneath railway infrastructure—viaducts—constitute a "typology of linear space with porticoes," comprising a covered, permeable area articulated by the rhythmic sequence of pillars and arches, spaced apart, which endows the interstitial space with a distinctive "urban potential" for appropriation (Monteys, 2013, p. 136). It is precisely within the coexistence of consolidated and unconsolidated elements that we encounter such urban interstices: hybrid spaces that elude the order of planning and urban design, but which, through their openness and indeterminacy, prove fundamental for understanding and rethinking the complexity of the contemporary city (Phelps & Silva, 2018).

Nevertheless, the adaptation of linear (infra)structures is not a new theme in the context of the reused city. From Roman aqueducts to medieval bridges, many have historically been superimposed, juxtaposed, or added with diverse forms and programmes, such as housing, restaurants, or commerce. In Portugal, for example, the Prata Aqueduct in Évora (1531) and the Ribeira Wall in Porto (1370) stand as historical precedents of occupied infrastructure. While aqueducts and walls provided the structural support necessary for appropriation, larger infrastructural viaducts enabled these structures to become truly lived spaces, places of shelter and habitation.

Contemporary occupations of urban railway infrastructure resonate with various early 20th-century visionary proposals that imagined the future city as a linear, multifunctional system. Arturo Soria y Mata's linear city, an urban model that organises the city along an axis integrating a public transport system with residential plots, facilities, and green spaces (Soria y Mata, 1913), and partially realised in Madrid's Ciudad Lineal neighbourhood, based on the Soria y Mata's 1882 project, was part of the imagination of many thinkers as a process of city-making. Others introduced the concept of viaduct-buildings containing multi-level streets, where infrastructure is inseparable from the urban fabric, defining both the physical and visual structure of the ideal city. Edgar Chambless proposed Roadtown (Chambless, 1910), a continuous linear city organised along an infrastructural axis that integrated housing, transport, and services. At the same time, Eugène Hénard's Rue Future, conceptualised the street as a stratified section in which urban functions—traffic, commerce, housing—were vertically superimposed, foreshadowing the morphological

complexity of the modern city (Hénard, 1911). Later, Le Corbusier's Plan Obus for Algiers in 1930 introduced an elevated structure superimposing a modern city upon the existing one, an overtly vertical, infrastructural approach to urbanisation (Boesiger, 2013, pp. 140–143). In the 1960s, Peter Eisenman's Jersey Corridor Project revisited the logic of linearity as a territorial organiser, incorporating mobility, housing, and collective functions into a single infrastructural corridor (Stern, 1966, p. 7). These proposals share a common vision of the city as a continuous organism, in which infrastructure ceases to be mere support and becomes an inhabitable space.

Since the 1980s, as urban infrastructures have increasingly become obsolete or underutilised, there has been a renewed interest in their reuse and recycling. In numerous cities, disused railway corridors have been transformed into multifunctional pedestrian public spaces, fostering their integration into the urban fabric and promoting collective appropriation. Notable examples include the Promenade Plantée in Paris, designed by Patrick Berger (1989–1993) and constructed atop the Viaduc des Arts (active since 1945); New York's High Line, coordinated by James Corner Field Operations and Diller Scofidio + Renfro (2008–2023); and the Jardins de Sants in Barcelona, designed by Sergi Godia and Ana Molino (2016). These projects share a common goal: to re-signify abandoned infrastructure as green pedestrian corridors, offering accessible pathways and spaces for leisure and rest. Also noteworthy are the examples of the Savignyplatz Station viaduct in Berlin (from the 1980s) or Zurich's Market Hall and Viaduct Arches, designed by EM2N (2004–2010), which utilise the space beneath active viaducts for a variety of programmes while maintaining operational railway use. In such cases, infrastructural heritage becomes a catalyst for urban development, without compromising its structural integrity.

## 3. Community Space in the Japanese Traditional City

In Japan, the concept of community space and/or communal space transcends mere functionality, assuming a central role in mediating the relationship between the individual and the surrounding social context. These spaces are not simply sites of physical co-presence, but cultural and symbolic devices that emerge in the thresholds between the private and public city. Both community and communal spaces involve collective use and social interaction, but their scope differs. Community spaces are typically open to the public and serve broader social, cultural, or civic functions within a neighbourhood. Communal spaces, by contrast, are shared among a defined group, such as artists in a cultural hub or residents of a shared housing project, and are intended for more private use (Sand, 2013). In the Japanese context, these spaces are embedded within the built fabric, being more closely associated with the private city than with common or generic public space.

The notion of the "common city" here refers to a city conceived as a shared good, a collectively produced and participatory space with a strong communal identity. For Stavros Stavrides, for instance, "common space" is neither a pre-existing public space nor a merely shared private one. Rather, it is a space in continuous collective production, socially constructed through practices of use, appropriation, and sharing. The city is understood as a social and collaborative process sustained by relationships of care, use, and solidarity (Stavrides, 2014, 2016).

Community space in the traditional Japanese city is not codified through monumental and open public space, but emerges through liminal, spiritual, and vernacular forms, rooted in intimacy, ritual, and everyday sociability. The square, as a monumental and social space, is absent from Tokyo. The historical lack of a strong public dimension may help explain this phenomenon. In the 17th century, for example, Edo had wide

areas near its bridges initially designated for military functions, which over time were informally appropriated for commercial activity (Jinnai, 1995). As the city grew and was reshaped, these areas were absorbed into the urban fabric, creating a dense and compact landscape. Tokyo has consistently evolved through infrastructural development, with public space functioning primarily as circulation rather than as communal or community space. Exceptional spaces are the urban parks created in the early 20th century: Hibiya Park (1903), Ueno Park (1920–1936), Sumida Park (1923), and Kōkyogaien (1945).

The Japanese city was never conceived as a "democratic" place of "free intercourse" (Sand, 2013, pp. 30–31). The Kōkyogaien National Garden, or Outer Garden of the Imperial Palace, in Tokyo, exemplifies this. Established on land expropriated from the samurai during the Meiji period (1868–1912) and left vacant following imperial military occupation until 1945, it was later designated as sacred space (*seichi*, 聖地) to prevent its appropriation by political demonstrations, such as the May Day protest of 1952.

In the absence of shared public spaces, it is the private city that accommodates community celebration and interaction. Public baths, spiritual spaces and festivities, neighbourhood associations, and commercial streets are longstanding social practices that have persisted since the Edo period (1603–1868).

Japanese public baths, notably bathhouses (*sentō*, 銭湯) and hot springs (*onsen*, 温泉), have played a central role in Japanese culture beyond hygiene. Historically used for purification after funerary activities, they remain sites of social interaction in the modern age. Bathhouses were frequented daily by urban residents, especially when private bathing facilities were lacking. In this context, public baths functioned as extensions of the domestic sphere, enabling informal neighbourhood interaction. Thus, bathing becomes not merely a functional act but a social rite, a relational space, and a cultural practice rooted in collective values.

Theodore Bestor and Scott Clark describe bathing as a form of social equalisation, enabling inter-class and intergenerational coexistence that transcends social divisions and reinforces neighbourhood belonging. The absence of clothing, professional indicators or hierarchical symbols, and, of course, the shared experience of hot water, creates an environment stripped of status markers. Temporarily, all become equal, a concept culturally aligned with the practice of hanging out naked (*hadaka no tsukiai*, 裸の付き合い), which refers not to a sexual encounter but to a state of complete honesty. This act seeks to emphasise sincerity and transparency in human relationships (Bestor, 1989; Clark, 1994).

Originally constructed in wood, public baths were either freestanding structures or integrated into spiritual complexes. Architecturally, they resembled Buddhist temples, with ornate entrances, gender-segregated sections, waiting areas, and communal soaking tubs. In the Edo period, Buddhist temples often featured outdoor public baths that included a small, enclosed compartment with an integrated tub (*todanaburo*, 戸棚風呂). In the case of hot springs, typically located in rural or mountainous areas, bathing spaces were sometimes crossed by streams connecting them to rivers, offering both a retreat and a reconnection with nature, alongside the promotion of physical and spiritual well-being.

Despite the urban transformations during the Meiji period and after the Great Kanto Earthquake of 1923, public baths remained community centres. New types of communal baths (*kyōdōburo*, 共同風呂) have emerged, built within private plots and shared among neighbours, often permitting mixed-sex bathing. With housing modernisation, however, this private social activity disappeared, and bathhouses also went into

decline. In some cases, they were repurposed as cultural hubs with galleries, cafés, and local events, in an effort to retain their communal role in urban life. Ofuroso, in Kawasaki City, is one such example. Converted from the former Takatsu Sentō by architect Miho Nakamura, the project preserved the traditional entrance with the traditional noren curtains and dual doors, but the former women's section was transformed into a shared atelier for six artists and the former men's side into a community library and event room.

Communal interaction also takes place in the transitional spaces of the traditional Japanese house. Günter Nitschke highlights the role of liminal spaces in fostering horizontal social relations (Nitschke, 1993), such as an external corridor on the outer side of the house (*engawa*, 縁側) and an entrance or entryway (*genkan*, 玄関) at the front (Figure 1). The *engawa* is a peripheral wooden veranda which serves for resting, contemplation, and informal reception, blurring the boundary between inside and outside. It embodies spatial liminality, mediating private and collective life. The *genkan* is more than a threshold; it is a ritual site of purification (e.g., removing shoes) and a symbolic boundary between common and intimate domains, preparing for social interaction.


**Figure 1.** Examples of an *engawa* (a, b) and a *genkan* space (c).

Shinto shrines and Buddhist temples offer additional examples of community spaces in the Japanese tradition. In Edo, prior to the Meiji revolution, sacred spaces were often located in the city's lower, densely populated residential zones. Rather than occupying central sites, shrines typically lie on the edges of neighbourhoods. For example, the Myōjin and Hie shrines in Kanda, along with the Sensō-ji temple in Asakusa, underpin urban organisation and structure the surrounding working-class district. The denser the urban surroundings, the more central the shrine's role, both in spiritual significance and in hosting periodic markets and fairs (Jinnai, 1995).

The Shinto shrines are often set in natural environments, and host rituals, festivals, and moments of collective introspection. Their architecture foregrounds nature and underlines the spiritual dimension of community communication. During festivals, the shrine approach road (*sandō*, 参道) becomes an informal space for conviviality with food stalls and sets of cultural manifestations; the portable Shinto shrine (*mikoshi*, 御輿), carried in processions through the streets during festivals, symbolically marks neighbourhood boundaries and expresses communal devotion (Imazumi, 2013; Silva, 2017).

Buddhist temples were often relocated to urban peripheries to anchor new residential zones, becoming integral to Edo's expansion and community formation. They are usually surrounded by cemeteries and often

established on former waste grounds. Over time, they evolved into popular gathering spaces combining religious, hygienic, economic, and festive functions. These zones often included bathhouses, theatres, tea houses, food stalls, and formed vibrant public environments (Silva, 2017).

The Sensō-ji temple in Asakusa exemplifies how such spaces maintain close ties with local traditions. Already a spiritual hub before Tokugawa's establishment of Edo as the capital in 1603, it remains central to Japanese spirituality. The Asakusa Sanja Matsuri (spring festival, May) and New Year's Day prayers continue to attract thousands. Notably, the daily market along the *sandō* (Nakamise-dori), between the gate (*Kaminarimon*, 雷門) and the main building (*Kannondo*, 観音堂), evokes Edo-period religio-economic dynamics.

Since the 1950s, the idea of community space in Japan has also encompassed civic self-organisation through neighbourhood associations, the chōnai-kai in cities and the buraki-kai in rural villages. These associations manage the everyday use and appropriation of private urban spaces for community life, cultural activities, and production (Nitschke, 1993; Santos, 2021). For instance, in Tokyo, during the Obon festival, a chōnai-kai association, in Ueno, repurposes a school courtyard for Bon Odori dances to celebrate the end of summer and honour their ancestors.

Traditional social habits also survive in Tokyo's commercial streets, such as in Shinjuku or Ueno. Yokocho streets, narrow alleys filled with yakitori stalls, sake bars, and karaoke venues, shift the city from its structured daytime corporate persona to a nocturnal, informal environment. This is an urban vernacular, where Edo-period forms persist in modern infrastructures (Jinnai, 1995). They inhabit voids beneath viaducts and between buildings, becoming spontaneous, bazaar-like common spaces. Ameyoko or Ameya-Yokochō, for instance, is a popular market under the Yamanote Line between the Ueno and Okachimachi stations. Its name, a contraction of "candy store alley" or "America alley," reflects its post-war black-market origins. As a place where people gather, communicate, and exchange sentiments, the Japanese market streets are a "unique cultural creation" that reflects the enduring need for shared communal experience amid the pressures of everyday urban professional life (Balsas, 2016, p. 228). According to João Rafael Santos, "these commercial and public facilities become local nodes for a 24-h living socio-spatial fabric" (Santos, 2021, p. 84).

## 4. Adapted Railway Infrastructure

The Tokyo Metropolitan Area encompasses approximately 13 km², with around 50 km (equating to 780,000 m²) of elevated railway infrastructure within the 23 central wards. These viaducts form part of a dense public transportation network, structured through modal interchanges between 16 railway lines and the subway system. The total railway length is approximately 2,124 km, of which 887 km belong to public lines (such as the Yamanote and Chuo Lines operated by JR East Urban Development Corporation, along with Sobu, Saikyo, and Keihin-Tohoku), and 1,237 km to private lines (including Tobu, Seibu, Keisei, Keio, Tokyu, Keikyu, and Odakyu). Nevertheless, according to the study of Arnon Snapir, it is estimated that only 40% of the space beneath these viaducts is currently being utilised. In Tokyo, the closer one gets to the lower city, the greater the intensity of occupation beneath elevated railway viaducts. Conversely, in peripheral areas, it is common to find these spaces vacant or used primarily for car and bicycle parking, particularly in proximity to railway stations (Snapir, 2012).

The occupation of vacant space between infrastructure and public space has, at several historical moments, resulted from informal uses—following the Great Kanto Earthquake of 1923, after August 1945 in the aftermath of the Second World War, and again during the Tokyo Olympic Games in 1964. Over time, the infrastructuring of the territory and subsequent occupations beneath viaducts led to the creation of continuous "urban walls" composed of small- and medium-scale structures such as housing, warehouses, restaurants, clinics, schools, and offices. With the exception of the Oimachi Line (Tokyu Company), most residential developments located beneath the infrastructure in Tokyo have gradually been removed.

Jorge Almazán suggests that infill beneath elevated railway infrastructure in Tokyo is not solely the result of formal planning, but also of a spontaneous growth that maintains a strong connection to the scale of the surrounding urban context. He argues that it is the presence of small-scale commercial units that generates the diversity and unique character of this form of occupation (Almazán & StudioLAB, 2022). These spaces are appealing precisely because they are not constrained in the manner of conventional shopping centres. Instead, they are organised along structuring axes or interior streets, both longitudinal and transversal in relation to the infrastructure. Open-fronted shops facing the public space establish connections between both sides of the viaduct, enabling the creation of passages that attract pedestrians and serve as extensions of the street itself (Almazán & StudioLAB, 2022; Silva Leite, 2025).

The relationship between infrastructure and topography is key to understanding the contextual integration of these systems. Most occupations beneath viaducts occur in the lower-lying areas of the city, as if the railway infrastructure were levelled from the higher city throughout its entire extent. The diagram in Figure 2 seeks to illustrate this spatial separation: The red line denotes the elevation threshold of 15 metres above sea level, marking the transition between the upper and lower parts of the city.


**Figure 2.** Graphical synthesis illustrating railway infrastructure and viaducts in the Tokyo Metropolitan Area, differentiating between occupied or partially occupied spaces (orange) and vacant spaces (black) beneath.

The Yamanote Line, for instance, extends for approximately 34.4 km, of which 5.1 km are elevated viaducts crossing the "lower city" between the Ueno and Shimbashi stations. Along this stretch, the structural systems of the viaducts vary in material, height, and spacing of apertures. One type is composed of reinforced concrete viaducts with pillars and slabs—these porticoed spaces may be traversed longitudinally, resembling a covered street. This protective condition allows the city to appropriate the space with a variety of programmes, either juxtaposed or added. Another type consists of vaulted brick-and-mortar structures with ornamental stonework—private arcaded systems, originally constructed in the early 20th century to support railway logistics and movement.

Since the early 21st century, the physical and social degradation of certain spaces beneath viaducts has become a central concern within the context of urban intervention in Japanese cities. Railway infrastructure has emerged as a potential setting for commercial and cultural activities characterised by strong community dynamics. Its pillars and arches have been reinterpreted as compositional elements within community interaction spaces, organised among and within singular or composite, permanent or ephemeral volumes, reflecting a tension between tradition and modernity in architectural expression.

### *4.1. Production Processes*

Interventions beneath railway infrastructure may be categorised into two transformation processes: juxtaposition and addition. These processes share the idea that the infrastructure can be used as a shelter and the pillar structure can serve as a metric for organising space beneath it. However, they differ in that juxtaposition inserts new elements between the pillars, defining them as part of the circulation, whereas addition incorporates the pillars into the design and organisation of the interior space of the new buildings. Such interventions tend to emphasise the coexistence of infrastructure and programme, enabling uses such as housing, markets, cultural centres, sports facilities, or leisure areas, arranged alongside or within the railway structure. Given the focus on active viaducts, where original use is preserved—there is no change of order—the process of superimposition is excluded from this synthesis.

Juxtaposition refers to interventions where new forms or spaces are inserted between existing pillars. Typically, these are autonomous built elements that nest within the infrastructure, retaining their own identity while generating communal or community spaces. The sense of community is enhanced through the interplay between the new volumes, the memory conveyed by the infrastructure, and the surrounding urban fabric. Two case types are explored to illustrate this intention: shared residential space and informal green space.

Shared residential space refers to the appropriation of urban structures as lived-in environments, whether for permanent or temporary use, fostering community at two urban scales: among inhabitants themselves and between these inhabitants and their neighbourhood. This relational and adaptive mode of dwelling strengthens the idea of regenerating fragmented urban fabrics. Within this approach, infrastructure becomes part of an affordable and shared housing method, composed of small, aggregated housing units using the space between pillars as shelter.

Informal green space beneath linear infrastructure refers to the reuse of interstitial, unused, or expectant spaces through the integration of vegetation and water management systems, thereby converting residual

areas into habitable green corridors. This hypothesis reinforces the notion that repurposing derelict, privately owned urban fragments can serve as a viable strategy for integrating new green infrastructure into dense urban fabrics (Lux, 2024). In Tokyo, the relevance of this approach is particularly pronounced. Strategies such as "permeable areas" and "adaptive planting" not only mitigate environmental impacts but also catalyse community dynamics by juxtaposing circulation and rest areas with temporary activities such as markets.

Addition concerns intervention strategies that add a new building to the viaduct structure, creating a symbiosis between the viaduct's supporting elements and the new spatial composition. Here, the pillar structure is actively incorporated into the design of the inhabited space. The arches and columns cease to be mere supports and become central components of the spatial experience. Addition thus represents both spatial and symbolic fusion between city and community space, capable of creating (a) shared commercial space and (b) multifunctional space.

Shared commercial space exemplifies an intervention where space is structured as a co-working system, with dedicated studios and workstations for local artistic communities to create and sell their products. Spatially, these community spaces consist of small work units, either isolated or interconnected, free-standing or attached to the viaduct structure, all unified by a shared axis or circulation spine.

Multifunctional space refers to the activation of interstitial space as a receptacle for hybrid community practices, blending social, cultural, and productive functions. Through formal appropriation, local management, or shared programming, these spaces evolve from mere functional voids into three complementary outcomes: infrastructures of proximity, sites of diverse inhabitation, and spaces for community experimentation. Community space, in this sense, is not simply a spatial typology but a relational condition that values citizens' active participation in the (re)definition of their immediate environment.

### *4.2. Case Studies*

The selected case studies share a common vision: to transform infrastructure into inhabitable and inclusive architecture without losing their original use. Each example was chosen to represent a distinct approach across different scales, structural compositions, community programmes, histories, and, crucially, construction processes. These examples are organised according to the criteria and themes previously established.

#### 4.2.1. Shared Residential Space: Chuo Line House Koganei, Koganei Ward, Tokyo

Koganei developed as a dormitory town on the outskirts of Tokyo during the post-war economic boom. The proximity of the Chuo Line contributed to the city's expansion but also created neglected residual areas adjacent to the railway. The Chuo Line House Koganei emerged in this specific context as part of a pilot programme for participatory urban regeneration, simultaneously aimed at enhancing the infrastructure and providing student housing at affordable and low rents (Tsune et al., 2020).

The project was developed in 2010 by the collective Workshop, led by architects Akio Yachida, Ko Kitayama, and Michirou Kinoshita. It is based on typological hybridity, dissolving the boundaries between private and public space, dwelling and culture, and leisure and work (personal communication, May 7, 2025). The buildings are simple, compact volumes, opaque in private areas and transparent in their shared spaces, establishing a direct relationship with the railway and the surrounding urban fabric (Figure 3).


**Figure 3.** Chuo Line House Koganei, (a) before and (b) after the intervention. Courtesy of Workshop Architects.

Chuo Line House Koganei extends for 350 metres beneath the elevated infrastructure, between the Higashi-Koganei and Musashi-Koganei stations. It consists of three blocks (L, H, C) of small-scale housing, each based on the repetition of an aggregated typology, and two communal spaces including a restaurant and a library, which aim to foster interaction between residents and the wider city (Figure 4). To maintain affordability, the formal scale of the spaces is restrained, and their material execution carefully controlled.

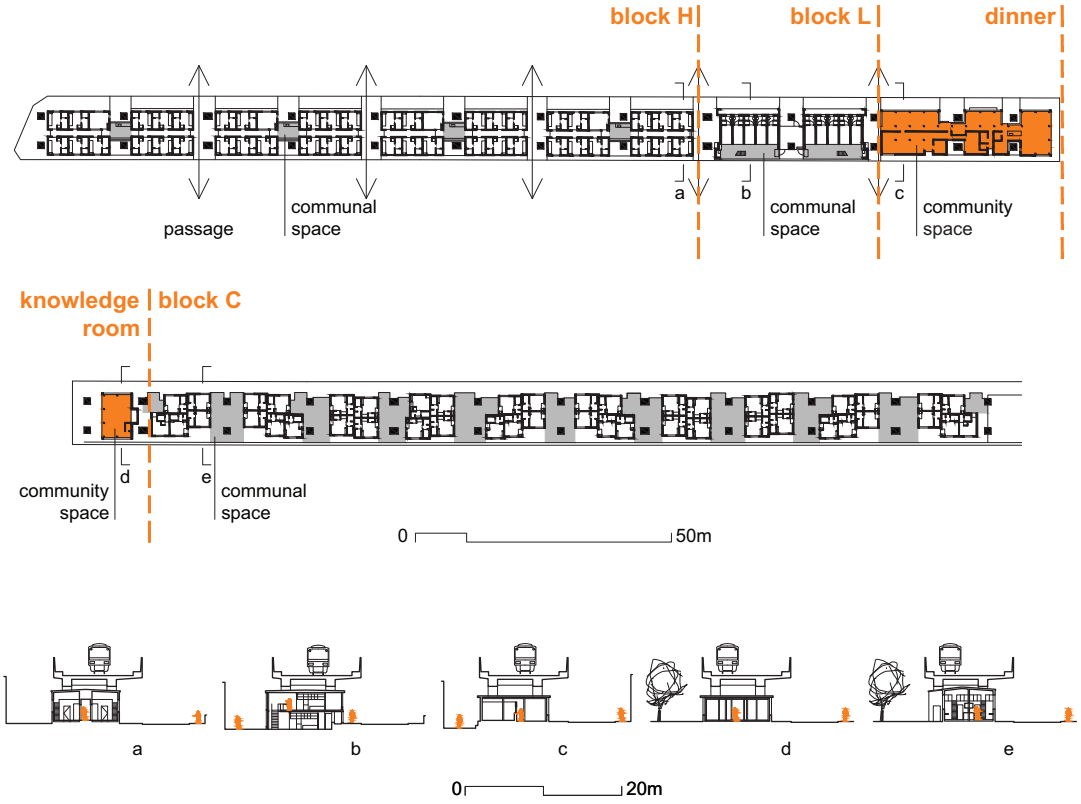


**Figure 4.** Chuo Line House Koganei: The drawings identify the different housing typologies that make up the housing complex (Blocks H, L, and C) and their relationship with the community spaces (dining and knowledge rooms) and communal areas (passages that cross beneath the infrastructure and between the houses). The sections, labelled from a to e, are intended to show the vertical organisation and scale of each of the identified blocks and spaces.

In the current European debate on affordable housing, this example offers a model for (temporary) housing that could be applied to underused urban spaces, infrastructure voids, vacant lots, or unused buildings, especially in contexts with social aims or student housing needs.

Here, the idea of juxtaposition does not differ substantially from other spatial configurations: Formally, the volumes remain autonomous, without physical contact between them. However, the appropriation of the resulting interstitial spaces occurs according to two distinct strategies. The first, corresponding to blocks L and H, concerns the transitional spaces located beneath the viaduct and between the pillars. These assume a public character, functioning as public passages to connect two adjacent streets and access areas to the housing units. In these cases, the communal spaces are located in the kitchens incorporated within the internal space of the building and are shared by groups of 10 to 20 residents. The second, observable in block C, develops between the infrastructure and the housing units, within the private domain. Nevertheless, these spaces are conceived as an extension of the domestic sphere, fostering interaction and sharing among four to five residents.

#### 4.2.2. Informal Green Space: Elevated Garden, Nerima Ward, Tokyo

Built in 1997, the railway viaduct in Nerima Ward was elevated to an unusually high level to minimise the noise impact of trains on adjacent residential areas. As a result, the interstitial space beneath the structure remained unused, enclosed and bounded by fencing. In 2024, this space was finally reappropriated for community use. Its atypical height allowed for the creation of a space ventilated and filled with natural light, evoking a sense of lightness and permeability.

The Elevated Garden was designed by architect Kiyoaki Takeda as part of his studio's ongoing research on the reuse of urban infrastructure into sustainable structures. The project posed a question: "Is a garden beneath an elevated railway line possible?" (Takeda, 2024). In a poetic reading of the place, Kiyoaki Takeda likened the continuous, robust structure, punctuated by a sequence of pillars, to a reservoir capable of capturing and retaining the city's rainwater, referencing Tokyo Metropolitan Area's Outer Underground Discharge Channel in Kasukabe, for instance (personal communication, May 16, 2025).

The proposal thus consisted of the creation of a garden, a form of nearby nature within the heart of a residential neighbourhood, featuring vegetation, a pedestrian path, and seating areas for everyday appropriation by the local people: a multifunctional social and community space. Structurally, the project incorporates distinct systems of occupation that respect the limits of the infrastructure, subverting its purely technical role into an "intimate" and vegetal relationship with the local residents (Figure 5).

Conceptually, the project aligns with the principles of the Fiber City framework, cities structured by hybrid infrastructure that integrates technical and ecological systems. The Fiber City concept, developed by Japanese architect and academic Hidetoshi Ohno, proposes a reconfiguration of the contemporary city based on continuous, linear infrastructure as a response to the excessive centralisation and rigidity of nodal urban models. Fiber City envisions the city as restructured along infrastructural lines (railways, roads), forming a fibrous and interconnected pattern that generates green corridors. Linear infrastructures thus cease to be merely a transport system and become resilient structures capable of adaptation, regeneration, and responsiveness to the challenges of over-densified urban areas. The idea of a continuous green city is

**Figure 5.** Elevated Garden, Nerima, 2024. Courtesy of Kiyo Takeda Architects.

not solely based on an ecological principle but instead seeks to integrate public and infrastructural space with residential, ecological, and social programmes within the same urban fabric (Ohno, 2016).

Takeda's Elevated Garden is an architectural realisation of this principle: The interstitial, latent space beneath the elevated railway is transformed into a habitable green fibre, populated with vegetation, walkways, and social spaces. The intervention makes use of light, reversible, and modular structures that can be adjusted, dismantled, or expanded according to changing urban and environmental needs, such as accommodating a street market.

The proposal to establish relationships between vegetation and forms of ephemeral appropriation may evoke the practices developed by local communities around Shinto shrines and traditional Japanese gardens. These spaces, although belonging to the private sphere, function as places of public encounter, articulating a tension between the natural dimension—understood as a cultural product—and the artificial, dense structures of the city. In this sense, the project literally applies the idea that infrastructure can be reprogrammed as an active, cultural, and sustainable urban fabric. This constructive approach gives it the flexibility and temporality required for appropriation by diverse programmes, dissolving technical infrastructure into micro-centralities that are both green and social.

### 4.2.3. Shared Commercial Space: mAAch ecute Kanda Manseibashi, Chiyoda Ward, and 2k540 Aki-Oka Artisan, Taito Ward, Tokyo

Examples such as mAAch ecute Kanda Manseibashi (Chuo Line) and 2k540 Aki-Oka Artisan (Yamanote Line) illustrate the transformation of residual infrastructure into hubs of cultural and commercial activity. The first intervention occupies a vaulted structure, each arch delineating a spatial unit open at both ends. The new volume is added to the existing building, establishing a symbiotic dialogue between structural and spatial elements. The second intervention is inserted within a porticoed framework, where space is modulated by the rhythm of the pillars and articulated through a sequence of small work and retail units. Unlike the first, this

intervention has diverse forms of occupation and operates between autonomous and embedded structures, negotiating a delicate balance between juxtaposition and addition (Figure 6).

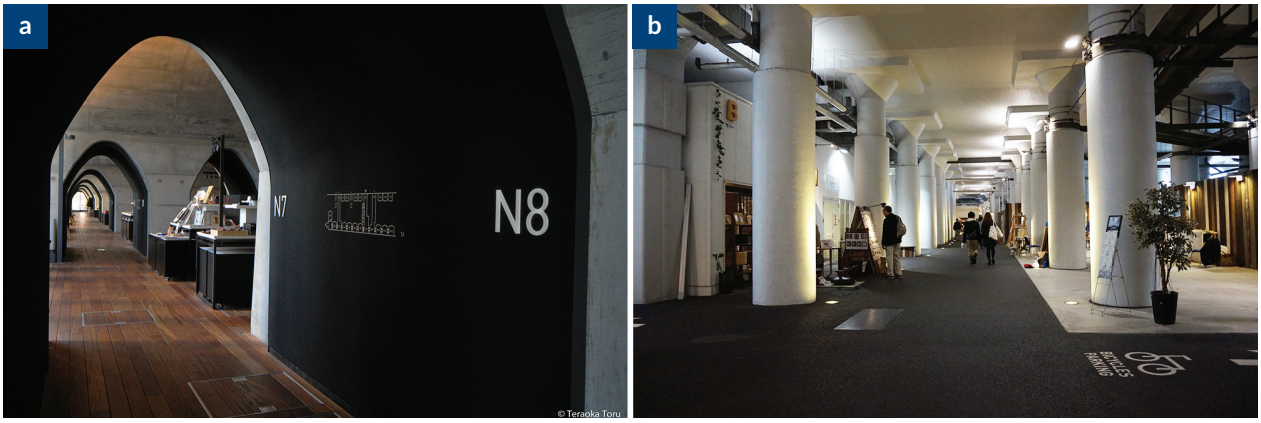


**Figure 6.** Interior spaces showing (a) the arches of the mAAch and (b) the colonnade of the 2k540. Courtesy of MIKAN Architects.

The mAAch project, designed by the architecture studio MIKAN, proposed reopening the vaults towards the public space, establishing a pedestrian walkway that reconnects the street to the adjacent Kanda River. The interior was meticulously reconfigured to highlight the existing materiality—brick, concrete, and iron—through an intervention that prioritises spatial continuity over the insertion of new built volumes (personal communication, May 2, 2025). Although it accommodates commercial functions, the building acts as an urban interface, embedding elements of collective appropriation within the contrasting dynamics of the surrounding neighbourhoods. The ground floor is conceived as a continuous common space open to diverse uses, while the upper level provides a café and viewing platform over the former railway platforms, weaving together memory and present use (Figure 7).

In contrast, 2k540 Aki-Oka Artisan is a commercial gallery located between the Okachimachi and Akihabara stations. Created in 2010 by JR East Urban Development Corporation, and inspired by the 19th-century Arts and Crafts movement in Europe, the space was transformed from a former warehouse, restaurant, and car park zone into a community centre dedicated to Japanese craftsmanship.

The "Artisan Street" hosts 49 artisan stalls aligned along both sides of a 100-metre-long covered "street," where two rows of pillars vaguely recall the intercolumniation of a dipteral Greek temple or the colonnade of St Peter's Square in the Vatican, designed by Gian Lorenzo Bernini between 1656 and 1667, though here they are interspersed with built volumes for housing work and retail spaces (see Figure 6). These units, arranged in a uniform white palette, are composed of ephemeral structures punctuated by glazed openings that foster close interaction between artisan, product, and visitor. In addition to shops, the facility includes practical workshops and a communal events area, promoting a dynamic and socially engaged atmosphere.

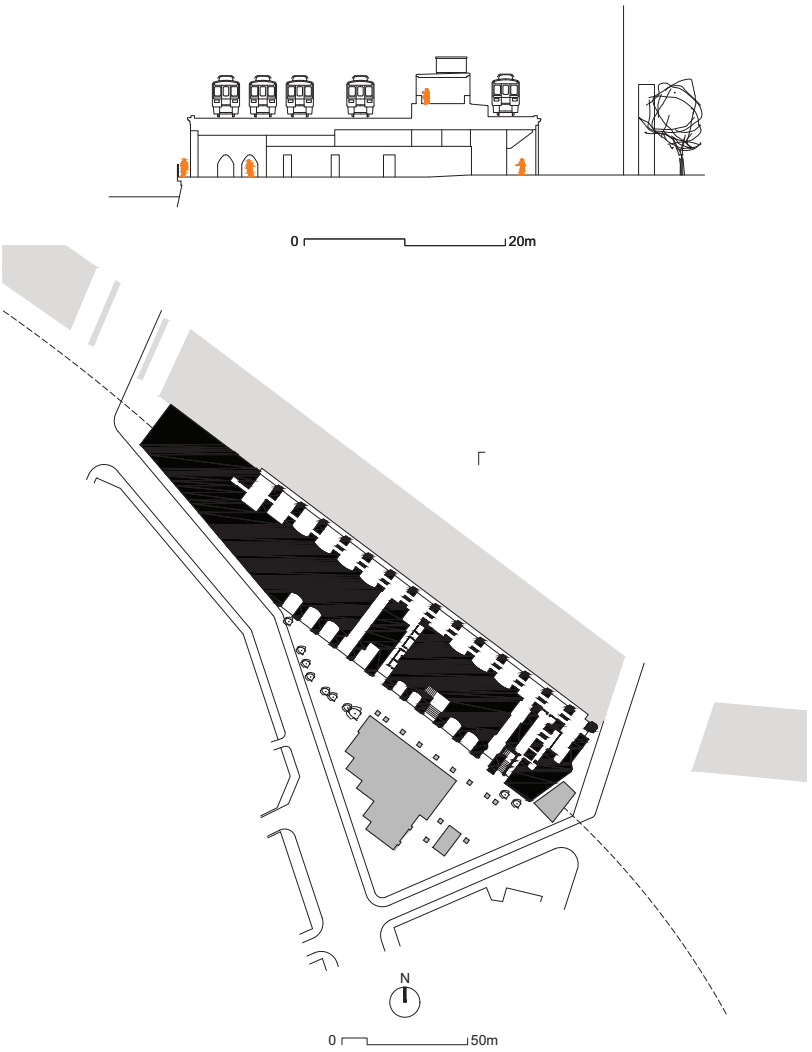


**Figure 7.** mAAch ecute Kanda Manseibashi: cross-section showing the passage beneath the viaduct between the public space and the Kanda River (top); and ground-floor plan illustrating the shape of the arched galleries and spaces (bottom).

### 4.2.4. Multifunctional Space: Koganecho Area Management Center, Naka Ward, Yokohama

The Koganecho area, located in Naka Ward, between the Ooka River and the Keikyū railway line in Yokohama, was known until the early 21st century as a marginalised district, marked by sex work and illegal activity. The Keikyū Line was constructed in the 1930s as part of the city's reconstruction following the Great Kanto Earthquake of 1923, but it was the Second World War that generated a complex and divergent occupation of the area. The presence of Allied forces in the city centre prompted a migratory shift to the peripheries, where the voids beneath the viaduct were appropriated for commercial uses. These small "restaurants" provided American soldiers with entertainment, a social function immortalised by Akira Kurosawa in the film *Heaven and Hell* (1963).

Historically, however, Koganecho was always a "commonplace," a peripheral residential district established on former agricultural land along the river's northern bank. The space beneath the infrastructure consisted of a dense urban fabric, combining residential and commercial uses and shaped by the rhythm of the viaduct's

spans, one house between every two pillars, and varied building heights of one to two storeys. The idea of producing shared spaces, in 2005, galvanised the desire to transform the site in service of the local community, leading to the demolition of many of the existing buildings under the viaduct.

Integrated into Yokohama's Creative City programme in 2008, the Koganecho Area Management Centre project aimed to reimagine the now-vacant shopfronts and the spaces beneath the infrastructure as places for artistic expression and community engagement, while re-establishing the neighbourhood's relationship with the Ooka River. Developed by several Japanese architectural design offices (Figure 8), the project was based on urban permeability, transforming the enclosed space beneath the railway into an open, transparent, and programmatically diverse area with seven spaces, such as studios, art galleries, social lounges, and a "public square" (Yamano & Suzuki, 2021).

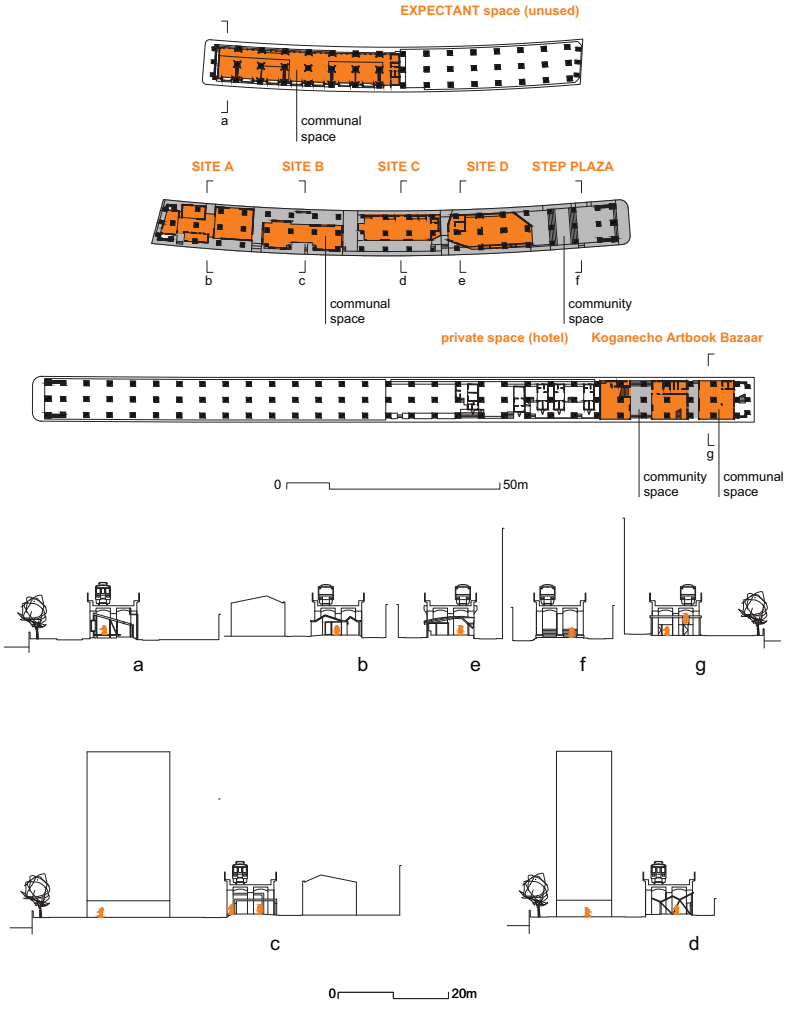


**Figure 8.** The Koganecho Area Management Centre ground floor plans showing the different spaces that make up the ensemble, as follows: Kogane Studio (studios), designed by Sogabe Laboratory, Kanagawa University, in collaboration with Mati Design; Site A (gallery), designed by Contemporaries Atelier; Site B (office), designed by Studio 2; Site C (workspace), designed by the architectural office Workstation; Site D (meeting room), designed by Kuisimi Architecture Office; Step Plaza (Kaidan Square), designed by Nishikura Architectural Design Office; and Koganecho Artbook Bazaar (Hinode Studio), jointly designed by YGSA – Yoshihiko Iida Studio, Yokohama National University's Graduate School of Architecture and Urban Design, and SALHAUS. The sections, labelled from a to g, are intended to show the vertical organisation and scale of each of the identified sites and spaces.

The Kogane Studio allows its façades to fully open towards the street, facilitating a fluid transition between interior and exterior and enabling the space to be adapted to various uses, such as a market. Inspired by a fusion of the *engawa* and the *genkan*, transitional spaces in traditional Japanese architecture, the project establishes a subtle boundary between the artists' workspace and the public space. This space is identified in the architectural drawings as a "compacted earth floor" (*doma*, 土間), similar to a *genkan* and strongly connected to the street; however, the *engawa* is a transitional space that links a private room with the exterior, as is the case here (personal communication, May 10, 2025). Although situated within a modern urban context, the building integrates traditional architectural elements (Figure 9).

**Figure 9.** The *doma* in the Kogane Studio serving as a transitional space between the street and the artists' workspace. Courtesy of Masashi Sogabe.

Sites A, B, C, and D (see Figure 8) propose the coexistence of a new urban fabric with the existing structure, employing concrete to form diffuse, organic volumes and roofscapes that engage with the infrastructural pillars. These new masses appear as extensions of the viaduct, simultaneously revealing and concealing themselves—that is, alternating between addition and juxtaposition as a formal strategy. Between these elements, spaces emerge that evoke both squares and streets, offering subtle and continuous connections to the wider city, particularly towards the Ooka River. This layering of spatial elements generates urban vitality, both physical and visual, transforming the spatial experience of the neighbourhood.

To this end, the architectural design-projects prioritised visual and pedestrian access, continuous openings, and a sequence of small-scale spaces for artistic exhibition, local culture, and independent commerce. These passages enable gatherings and movement, serving as sites of community life, capable of revitalising existing uses or accommodating new, temporary, or permanent functions (Mireille, 2017). Architecture here acts as a mediator between infrastructure and community, promoting "continuous use" as a strategy for safety and social cohesion. The passage proposal shown in Figure 10 is more provocative. The idea, developed by the architectural office Studio 2, led by Miya Akiko and Shinpei Miki, envisions a connection between a nearby street to the north and the river, passing through Site B—and Site C by extrapolation—and the ground floors of two private buildings on the southern side. However, these passages remain closed to the public (personal communication, May 19, 2025).

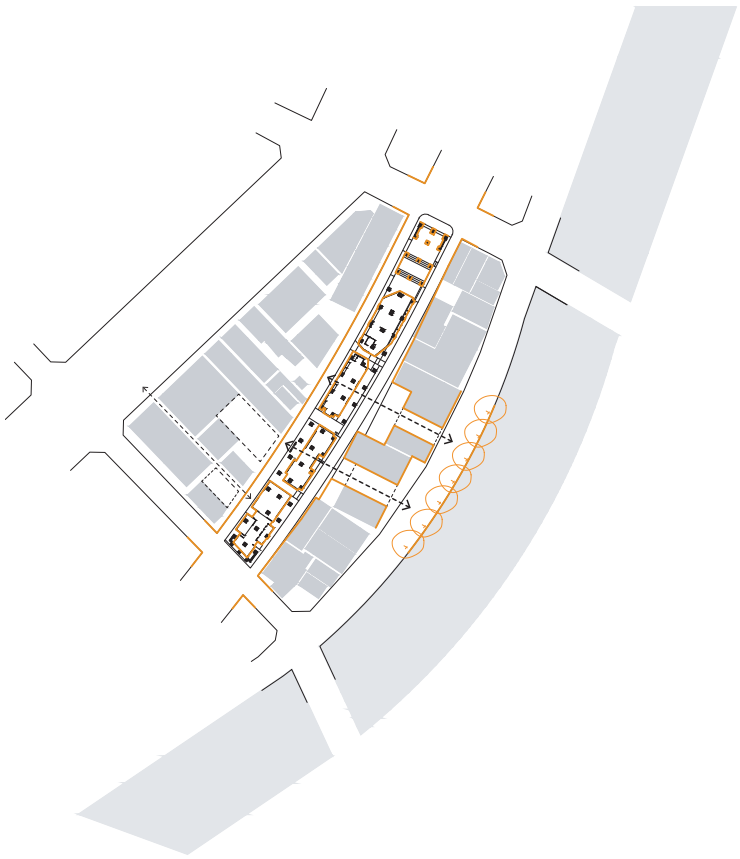

**Figure 10.** Passage proposal for Sites B and C (see Figure 8).

The Step Plaza is a large public space accessible to the community and suitable for a wide range of events and everyday activities. Its position at the intersection between the urban layout and the infrastructural system grants it a unique character, being fully accessible from all sides. The design promotes flexibility and acts as a catalyst for community interaction, accommodating activities such as markets, dance, music, and play. The plaza is composed of six transverse steps facing two stages, which also function as transitional and circulation spaces. The timber flooring contrasts with the concrete pillars, emphasising the plaza's role as a space for appropriation and collective engagement.

The Koganecho Artbook Bazaar, or Hinode Studio, was built as a series of structures separated by ground-level transverse passages yet connected by a shared rooftop walkway accessible from the public space. This longitudinal axis, running between the viaduct and the Artbook Bazaar buildings, frames views through the pillars towards the surrounding urban landscape. These passages function as transitional zones that dissolve the boundary between interior and exterior, creating gallery-like spaces for events, exhibitions, and public activities.

## 5. Conclusion

Infrastructure possesses a transformative capacity that exceeds its technical purpose, often becoming a generator of urban space and social meaning. Form and function are not fixed, but open to reinterpretation across time and at different scales (Ellin, 1999). When infrastructure engages with the city, it can act

simultaneously as a means of connection—a carrier of memory—between planning and spontaneous dynamics. Its interactions with the urban fabric are not merely physical but also cultural and symbolic, producing effects that were neither intended nor fully predictable. A more integrated perspective recognises infrastructure as an active and evolving component of urban life. As seen above, it possesses the capacity to accommodate a variety of community-scale programmes without compromising its (infra)structural significance. By acknowledging its potential to support, disrupt, and reconfigure both spatial and social structures, infrastructure emerges not only as a technical system but as a critical element in shaping the future of cities, one that connects past and present, and offers possibilities for inclusive and dynamic urban development (Villalonga Munar, 2025).

Although less common, European cities have also begun to explore semi-permanent uses of viaduct spaces, as seen in the Les Grands Voisins in Paris or the Viaduct Arches in London. But still, numerous examples demonstrate its potential through temporary uses such as skateparks, cycle paths, or informal markets. In contrast, however, the Japanese context highlights a different potential for spaces beneath viaducts within the urban environment. It supports the hypothesis that these spaces can be permanent, housing emergent and built programmes such as residential units or centres for social and/or community interaction.

The Japanese private city often takes the initiative in creating community-oriented environments. This perspective challenges European approaches and redefines the boundaries between public and private domains, revealing new forms of collective urban experience. The blurring of boundaries between public and private spaces generates complex urban dynamics, challenging traditional interpretations of the city. Yet, this ambiguity enhances spatial versatility and fosters new, enriching modes of urban living. An arch or a colonnade beneath a viaduct possesses the capacity to unleash "a series of high-potential modes of urban habitation" (Silva Leite, 2025, p. 108).

Interstitial urban spaces expose the tensions between planning and the spontaneous dynamics of urban life, while simultaneously offering opportunities for design experimentation and (re)use. From this perspective, the areas beneath viaducts emerge as active laboratories for rethinking common, communal, and community spaces within the contemporary city. These spaces can become part of the city's regeneration process, establishing a dialogue with the surrounding urban context while fostering openness to the community through the creation of shared spaces. Such characteristics enable the transformation of previously undervalued residual areas into places of social, cultural, and organic value. The appropriation of vacant space beneath infrastructure therefore emerges as a strategic opportunity to address contemporary urban challenges, such as land scarcity, the need to promote social cohesion, and the integration of green and residential areas within the existing urban fabric (Phelps & Silva, 2018).

Rather than opposing the infrastructural grid to the formal structure of the city, these interventions frequently operate within and alongside the infrastructure, utilising the repetitive rhythm of viaducts, the linearity of railway paths, and the modular logic of supporting pillars. This embeddedness enables a fine-grained relationship between architectural form and social use. The spatial configurations often adopt strategies of porosity, continuity, and accessibility, allowing both integration with surrounding neighbourhoods and the emergence of new forms of collective life. As such, the shape of the city is not only preserved but subtly rearticulated through these acts of civic reprogramming.

By reclaiming and reprogramming infrastructural voids as active urban components, these design projects challenge the traditional dichotomy between structure and use, offering a critical framework for inclusive and adaptive urban spaces, whether permanent or temporary, and whether achieved through juxtaposition or the addition of new forms. At the same time, Japanese culture remains deeply embedded in contemporary urban design, not as a nostalgic reference but as a continuous process of city-making. This dynamic interaction between tradition and innovation sustains a living architectural identity that continuously redefines urban space. Infrastructure transitions from a purely technical element to an active role in urban life, supporting everyday uses that reinforce both the sense of belonging and the centrality of community in the ongoing process of transforming the city.

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## Conflict of Interests

The author declares no conflict of interests.

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## About the Author

Miguel Freitas Silva, architect, holds a master's degree in rehabilitation of architecture and urban nuclei (2010) and a PhD in urbanism (2017) from the Lisbon School of Architecture, Universidade de Lisboa, where he is an invited assistant professor. He is an integrated member of CIAUD – the Research Centre in Architecture, Urbanism and Design, and of the formaurbis LAB – urban morphology research laboratory. His research focuses on the morphological study of urban heritage, particularly on processes of urban regeneration and the reuse of the built fabric.