

## Article

# The Sustainability of Regenerative Cafes Utilizing Idle Industrial Facilities in South Korea

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**Abstract:** This study investigates the sustainable values of cafes established using idle industrial facilities that are a part of the cultural heritage of South Korea in terms of the characteristics of the architectural space and consumers' space utilization. Twenty regenerative cafes in five regions were selected, and five of them were analyzed by comparing their characteristics with those of the conventional cafes. Unlike conventional cafes, regenerative cafes have architectural spaces that seem to be non-everyday and elicit a feeling of the passage of time. Users utilized these cafes as spaces for activities and experiences for long periods compared to conventional cafes. Consequently, regenerative cafes were found to contain sustainable values as complex networking spaces, as cultural heritage that can be experienced and as independent tourist destinations. Regenerative cafes have become unique differentiated architectural spaces utilized by several users.

**Keywords:** idle industrial facilities; regenerative cafes; consumer's space utilization; cultural heritage; sustainable value of regeneration

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## 1. Introduction

### 1.1. Background and Purpose

South Korea has witnessed a rapid increase in the number of cafes from the late 1990s. Currently, there are over 100,000 cafes, and this figure is gradually increasing [1]. Cafes have become a life-oriented business and has been established as a part of everyday culture. Cafes' deep penetration into people's daily lives within such a short period implies that they also reflect the unique characteristics of South Korea. As many people are using cafes in their daily lives, the space of café is now deeply involved in people's lives and had to be constructed as familiar spaces. Users also take it for granted.

Various attempts are being made to set up the cafe space differently. Cafes are trying to increase both consumer satisfaction and consumption by combining consumer requirements with unique spatial and experiential characteristics of cafe spaces. In particular, cafes with spaces that are completely different from the architectural space characteristics and space utilization of conventional cafes are increasing. These are cafes created by utilizing idle industrial facilities that are valued as a part of cultural heritage (In this paper, these cafes are defined as "regenerative cafes"). Regenerative cafes are based on non-everyday architectural spaces that the general public previously could not experience daily such as idle industrial buildings. Counterintuitively, regenerative cafes inevitably emphasize everydayness by utilizing these overlapping non-everyday architectural spaces. Therefore, regenerative cafes have features and values that are different from conventional cafes and research on this subject is still insufficient.

Regenerative cafes also draw the interest of the general public because they form unique architectural spaces owing to the combination of various architectural styles. As

consumers, the general public values the utilization of architectural space characteristics of regenerative cafes that are different from the general ones. In other words, regenerative cafes make the non-everyday spaces more conspicuous by merging non-everyday spaces with the everyday ones. Moreover, as the demands of the general public are satisfied with non-everyday spaces that are appropriate for regenerative cafes, more regenerative cafes have been constructed [2].

This study attempts to identify the unique spatial features of regenerative cafes that have combined everyday architecture with the non-everyday ones, the characteristics of space utilization preferred by consumers, and the reasons why consumers prefer non-everyday spaces that are organized by regenerative cafes. As a part of a series of studies focused on analyzing the sustainable characteristics of regenerative cafes according to theoretical basis, this study aims to provide a typical guide to similar projects utilizing buildings with the different characteristics [3].

## 1.2. Subjects and Method

### 1.2.1. Precedent Research Review and Necessity of Research

The research results on cafes in Korea and abroad were searched from the 21st century to the latest (Table 1). First of all, it was found a thesis that analyzed the cafe in terms of space and social roles. In other words, five previous studies were investigated, categorized into the categories of cafe space and social role. The existing research on space mainly mentions the physical and structural characteristics of cafe facilities, and in the research on social roles, there are many explanations for various social functions including cafe communication. In a narrow sense, a number of regenerative cafes are actually being made as consumption of architectural culture, but the theoretical basis for integrating these phenomena is still lacking. However, it was difficult to find a paper dealing with both the physical space of a cafe and the social function of the cafe's users. In particular, at this point where consumption of architectural culture is increasing rapidly around the world, the research is needed to link these two types into a single subject. Here, 'consumption of architectural culture' refers to the demands and attitudes of consumers who want to enjoy the culture in the space-space experience-architecture. In other words, it means that 'regeneration' is a broad meaning that it should consider including architectural plans, physical space composition, user needs, and social functions.

For example, Eom, J. S. paper [3] deals with almost similar objects but analyzes the physical space from the architect's perspective. However, this study deals with the characteristics of space and the source of consumption that consumers feel. Cafes should be architecturally sensitive to consumer demands. The sensitive reaction of the cafe is an important factor that can have sustainability toward the cafe. In particular, this is because 'Regenerative Cafes' covered in this study particularly require consumers' demands and sense of sustainability.

Like Eom's paper [3], the previous studies mean that the evoked social sustainability has a sufficient and important value of its own social sustainable indicators. This study aims to establish another theoretical concept with a new perspective based on the values researched in the previous studies. Therefore, this paper is not a scientific or statistical approach to regenerative cafes. It can be said that it is most appropriate to use a humanistic and theoretical method. It seems that it is important to grasp the fundamental concept of consumer demand more logically. This is because it can help to create a theoretical framework for ensuring long-term sustainability for regenerative cafes.

**Table 1.** Precedent research through analysis type.

Space	A study on the public use system of street space in Europe and the united states: A case study of the control on sidewalk cafes in six cities → Kato, K. and Wantanabe, T., Izawa, T., Kitahara, T., <i>Journal of Architecture Planning and Environmental Engineering</i> , Vol.-/No.530 (2000) [4]
	Ghostly foundations: Multicultural space and Vancouver's Chinatown in Sky Lee's Disappearing Moon Café → Martin, D. <i>Studies in Canadian Literature</i> (New Brunswick), Vol.29/No.1 (2004) [5]
	The thinking space: The café as a Cultural Institution in Paris, Italy and Vienne → Leona R. and W.Scott H., Jeffrey H.J., <i>Routledge</i> (2013) [6]
	A study on the regenerative characteristics of cafes utilizing idle industrial facilities in South Korea: Focusing on the recent cases regenerated from large modern cultural heritage → Eom, J. S., <i>Journal of the Architectural Institute of Korea Planning and Design</i> , Vol.35/No.7 (2019) [3]
Social Role	Characteristics of retro design through space upcycling: Focusing on the commercial space of café → Jung, D.I. and Park, B.R., <i>Journal of the Korean Institute of Spatial Design</i> , Vol.15/No.3 (2020) [7]
	Brands and Urban Life: Specialty coffee, consumers and the co-creation of urban café sociality → Bookman, S., <i>Space and Culture</i> , Vol.17/No.1 (2014) [8]
	Assessment of the urban design elements in urban regeneration space of community business type → Lee, H.J. and Kim, Y.J., Kim, J.G., <i>Journal of the Urban Design Institute of Korea Urban Design</i> , Vol.15/No.6 (2014) [9]
	Urban multi-culture and everyday encounters in semi-public, franchised café space → Jones, H. and Neal, S., Mohan, G., Connell, K., Cochrane, A., Bennett, K., <i>The Sociological Review</i> , Vol.63/No.3 (2015) [10]
	The café as affective community space: Reconceptualizing care and emotional labour in everyday life → Jo, W. and Dawn, T., Gerry, B., <i>Critical Social Policy</i> , Vol.33/No.2 (2012) [11]
	Brand experience of café about factors affecting in local place as alley: Focusing on cases of small business and franchisees → Jang, S.K., and Lee, J.H., <i>Journal of Communication Design</i> , Vol.66/ No.- (2019) [12]
	The effect of the type of recycled building café on the customer's satisfaction and suggestion: Focusing on experience factors of service scape → Lee, M.K. and Lee, Y.J., <i>Journal of the Korean Society Design Culture</i> , Vol.26/No.2 (2020) [13]

### 1.2.2. Research Subject

The subjects of this study are the cafes regenerated from idle industrial facilities, which are valued as a part of the modern and contemporary cultural heritage of South Korea. We selected idle industrial facilities that are stimulating or are believed to stimulate local areas from the perspective of urban regeneration because they are located in places with varying industrial structures that have lost their original purpose and have preservation value as a part of the cultural heritage. In Precedent Research, there are examples of such cases in other regions and countries. However, in order to organize and grasp the integrated values through the above selection criteria, the cases were analyzed with limited scope.

For the basic survey, we examined the regional distribution of regenerative cafes. Regenerative cafes have been widely distributed in South Korea since 2010. Five cities that have large populations and high population densities based on national statistics data (2014–2018, Statistics Korea) were selected: Seoul, Busan, Daegu, Incheon, and Gwangju. We investigated regenerative cafes that are popular these cities or their neighboring cities, because as we will discuss later, cafes in South Korea started in cities. The former industrial facilities were built in the period between the Japanese occupation and the 1970s when South Korea was undergoing early industrialization. As the population moved to

cities and heavy industries were developed, these spaces lost their function as industrial facilities around the 2000s. As the industrial structure changed and urbanization progressed, it became more valuable to change industrial areas to residential areas. When this occurred, the idle industrial facilities became locally unwanted.

Although they lost their function as industrial facilities, they still had value as part of cultural heritage. Hence, discussions on maintaining rather than dismantling them arose in the late 2000s. Consequently, the trend of turning these idle industrial facilities into cafes has appeared since the 2010s (Table 2).

Consumers demanded features of ‘non-everyday’ space from these regenerative cafes that are different from the ‘everyday’ spatial features of existing cafes. The number of regenerative cafes must have increased sharply because they satisfied this demand. Therefore, regenerative cafes were inevitably constructed in such a way to emphasize the features of ‘non-everyday’ architectural spaces. This study is interested in this aspect.

**Table 2.** Recent examples of regenerative cafes using idle industrial facilities.

No	Regenerative Cafe	Address	Original Facility	Opening Year	City
1	Daelim-Changgo	78, Seongsui-ro, Seongdong-gu, Seoul, 04784	Rice mill, warehouse	2016	Seoul
2	Anthracite	10, Tojeong-ro 5-gil, Mapo-gu, Seoul, 04073	Shoe factory	2010	
3	Onion	8, Ahasan-ro 9-gil, Seongdong-gu, Seoul, 04797	Metal factory	2016	
4	La crescenta	92-5, Mullae-ro, Yeongdeungpo-gu, Seoul, 07295	Paper mill	2015	
5	Terarosa	20, Gurak-ro 123, Suyeong-gu, Busan, 48212	Wire factory	2016	Busan/ Gyeongsang-do
6	Notice	135, Daegyo-ro, Jung-gu, Busan, 48943	Grain warehouse	2018	
7	Kuku-Ona	113, Jukjeon-gil, Geochang-eup, Geochang-gun, Gyeongsangnam-do, 50128	Rice mill	2018	
8	Dol-Changgo	487, Sports-ro, Seo-myeon, Namhae-gun, Gyeongsangnam-do, 52411	Grain warehouse	2016	
9	Billy-Works	41, Goseongbuk-ro 10-gil, Buk-gu, Daegu, 41594	Steel Factory	2018	Daegu
10	Soeil de Seojae	13, Seojae-ro 31-gil, Dasa-eup, Dalseong-gun, Daegu, 42924	Wholesale warehouse	2018	
11	Archi-n	8, Secheonbuk-ro 14-gil, Dasa-eup, Dalseong-gun, Daegu, 42922	Material warehouse	2018	
12	Coffe-Munhwa	17, Biseul-ro 506-gil, Hwawon-eup, Dalseong-gun, Daegu, 42956	Textile factory	2018	
13	Joyang-Bangjik	12, Hyangnamu-gil 5, Ganghwa-gun, Incheon, 23033	Textile factory	2017	Incheon
14	Valor	47, Baekbeom-ro 578-gil, Bupyeong-gu, Incheon, 21448	Steel factory	2014	
15	Cosmo40	9, Janggogae-ro 231-gil, Seo-gu, Incheon, 22827	Chemical factory/refinery	2018	
16	Archive-Cafe-Bingo	7-1, Gaehang-ro, Jung-gu, Incheon, 22314	Ice warehouse	2015	
17	Vintage 399	650, Pyeongdong-ro, Gwangsan-gu, Gwangju, 62460	Grain warehouse	2016	Gwangju/ Jeolla-do
18	Supple	14, Gaeksa 2-gil, Damyang-eup, Damyang-gun, Jeollanam-do, 57340	Grain warehouse	2016	
19	Tre	81-13, Samnyeyeok-ro, Wanju-gun, Jeollabuk-do, 55343	Grain warehouse	2013	

20	Migok Storage	253, Guam 3.1-ro, Gunsan-si, Jeollabuk-do, 54043	Grain warehouse	2017
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### 1.2.3. Research Method

This study evaluates the sustainable value of regenerative cafes by comparing the regenerative cafes having non-everyday architectural spaces with existing cafes having everyday architectural spaces in terms of the location of the regenerative cafe, architectural space, and the consumers' use of space. Therefore, this study tries to find the value of the regenerative cafe by conducting comprehensive research and case study with the base as a starting point (Table 3).

First, we investigate the everyday spatial features of cafes in Korea and the space usage characteristics of consumers. Subsequently, we examine the characteristics of the architectural space and the contribution to cultural heritage of the industrial facilities before they became regenerative cafes. By comparing the 'everyday space' of conventional cafes with the 'non-everyday' space of industrial facilities, we traced the fact that regenerative cafes developed differently from conventional cafes. We identified the non-everyday characteristics of the architectural space of regenerative cafes and examined how the non-everyday architectural space is utilized.

We selected the most representative five examples among the surveyed twenty cafes in diverse region of South Korea as case studies. In addition, we investigated their specific characteristics, such as location, architectural space characteristics, and users' spatial utilization characteristics with these five examples. Lastly, we tried to find the value of the regenerative cafes as a part of the cultural heritage.

**Table 3.** Research process.

Theoretical Study	Find the Spatial Features	General Korean Cafes (Everydayness)	+	Idle industrial Facilities (Non-Everydayness)
Comprehensive study	Find the Characteristics	20s Cafés regenerated: Everydayness by overlapping non-everyday architectural spaces		
Case study	Find the Value	5 representative Cafes regenerated: Value as a complex networking space Value as a cultural heritage that can be experienced Value as an independent tourist attraction		

We expected that the regenerative cafes were special from the planning intention of the architectural space, and the intention was actively reflected in the design and use of the architectural space by consumers.

## 2. Architectural Space Characteristics of General Korean Cafes and Idle Industrial Facilities

### 2.1. Spatial Features of General Korean Cafes

#### 2.1.1. Overview of the European Cafes

Historically, the cafes appeared as a space for meetings and socializing in the 17th century, specifically the open-air cafes on the first floor of buildings around a city square. Cafes were often designed to function as outgoing spaces that expand into squares visually and spatially.[3] Since early Roman times in Europe, open spaces have been used to exhibit symbolic structures, such as statues, around the palace, stadium, cathedrals, and markets where people can gather, and these open spaces functioned as squares, and cafes started to gather around these squares. Representative examples include the Bastille in Paris, France; San Marco Square in Venice, Italy; and the Grand Place in Brussels, Belgium.

In France, cafes were used as places for gathering and socializing among the aristocratic class in the early days, but later changed to places for public communication. This change started when Procope from Italy opened a luxury interior cafe that served coffee and drinks in Saint-Germain in 1686, unlike other many cafes serving mostly alcoholic

beverages that were popular at the time. This cafe attracted artists as well as the upper class, and gradually became established as a space for discussion for intellectuals. Since the eighteenth century, great literary writers and thinkers such as Balzac, Rousseau, Voltaire, and Victor Hugo, as well as politicians such as Jean-Paul Marat, Napoleon Bonaparte, and Danton, who led the French revolution, discussed their opinions in this cafe. Furthermore, Les Deux Magots, which opened in 1885, and Café de Flore, which opened in 1887, were popularized by Jean-Paul Sartre, Ernest Hemingway, and Simone de Beauvoir [14].

In a social sense, “Whether you call them taverns, cabarets, estaminets, brasseries or bistros, Parisian cafes are in themselves ‘places of memory’ of the history of France. If the capital was nicknamed the ‘coffee of Europe’, it is the place where these ‘parliaments of the people’, according to the formula of Balzac, allowed the emergence of a French passion: that of the conversation.” [15].

In terms of space, “Cafes in Paris are characterized by being closely spaced together and a display of light vinyl chairs outside on the street. In particular, the terrace chairs are mostly facing the street, so you look outward rather than your party who came to drink coffee with you. Because of this, people prefer the terrace. Even if the space is small, the cafes do not hesitate to put out chairs and tables. Cafes facing a wide street put up an awning or create an expanded space with glass partitions even in rainy or cold days.” [16].

The square is a space where various activities take place, and the cafes around it play the role of seats for viewing the square as well as a space for communication. Furthermore, like the Champs-Élysées in Paris, cafes located on the side streets, not on the square, also have a terrace space because there is a wide space for pedestrians and many activities besides walking can take place [3].

European cafes generally have a space for communication between individuals or groups of people, a space for viewing various activities, and a convenient space that is easily accessible while walking. In other words, cafes in Europe have had such a spatial identity that they have been regarded as an everyday space for the public for a long time.

### 2.1.2. Overview of Korean Cafes

In South Korea, with the rapid industrial development, cafes have primarily developed as business spaces rather than common ones in urban areas and are located inside the buildings. Hence, instead of having a connection with the nature outside, these cafes are directed toward the inside where the personal activities are centered [3].

During the period of Korean Empire and Japanese occupation, cafes functioned as high-class western bars and were used as spaces by the upper class to show off their luxurious lifestyles.

During industrialization, the cafe culture slowly spread to the public, and cafes in downtown office areas came to be known as places for conversations or resting. In the 1990s, as the industry became service-oriented and foreign franchises emerged, cafes grew into new cultural spaces where young people gathered, different from those of previous generations. In the late 2000s, cafes came to be used by individual consumers, especially for take-out, unlike the existing trends of usage by groups of consumers. With the rise of the popularity of cafes among consumers and the spread of the culture of drinking large amounts of coffee, the number of cafes increased rapidly.

### 2.1.3. Architectural Space Features of General Korean Cafes

Cafes in South Korea are mostly located in densely populated places. Starting from the corners of hotels and urban office areas, they have now spread even to residential areas. Moreover, many different kinds of demands such as conversation, rest, meetings, working alone, and takeout can be satisfied. This means that conventional cafes have become everyday spaces that are easily accessible to a large number of consumers

The second characteristic of Korean cafes is that they have developed to occupy spaces inside buildings unlike those in Europe. Moreover, most cafes use spaces in existing buildings. They are not directly connected to the outside and are even located on the second or higher floors. Therefore, the internal spaces of cafes are disconnected from the outside. Even if the internal and external spaces are interconnected, only a small terrace plays the role of a space connected to the outside in some cafes. Thus, cafes inevitably have structures involving a single floor height and limited area in existing buildings. Consequently, the space of cafes is already a space of height and area familiar in the daily urban life, and they have no choice but to be a universal and standardized space without room for expansion in the city. Therefore, it can be said that the space of cafes has the size of an everyday space that people are already familiar with.

Thirdly, because cafes are located in the city center and have developed into a place for everyday life, they are often perceived as being attached to certain facilities (e.g., cultural facilities, resting facilities, office facilities). In this case, it is difficult to create an independent space for cafes, and it is also difficult for consumers to perceive them as an independent space. In contrast, some cafes such as franchise stores are perceived over time as completely independent and distinct spaces that are not affected by their surroundings. These cafes focus on showing their brand rather than the features of individual cafes (for example, Starbucks and the typical interior design of Starbucks). As a result, not only is the space disconnected from the outside, but it is also difficult to reveal the unique and interesting characteristics of individual cafes through the character of the internal space.

Fourthly, the rapid increase in the number of cafes has created a lack of diversity. Cafes can be classified into franchise, takeout, or independent coffee shop. People have already become accustomed to the homogeneity of the spatial characteristics of each typical franchise store and the takeout stores are not large enough to be part of the discussion on the composition of space. Only a small number of independent coffee shops are trying to create value as special spaces. However, they are inevitably limited by the urban environment and the demands of consumers.

#### 2.1.4. Consumers' Space Use Characteristics for Conventional Cafes

As mentioned above, cafes in South Korea started as a luxury cultural item before shifting to places for conversation and rest. Now they are used as everyday spaces.

Before the 1990s, cafes were often used by two or more consumers together. After the 1990s, cafes gradually came to be used as a space for individuals, mostly for resting and personal work. In this respect, the purpose of cafes in South Korea is to occupy space for passive movements that focus on resting, conversation, and personal work. Thus, the spaces of cafes were constructed to meet these needs because these spaces are rare in South Korea. Therefore, it was difficult to discuss the unique spatial composition of individual cafes or the individual tastes of consumers. Any cafe can be good from the consumer's viewpoint if they can relax, have a conversation, or work.

In terms of the usage time of consumers, as most cafes were located in densely populated areas such as downtown and residential areas until the 1990s, they were mostly used as a space occupied for a short time for short breaks and conversations. However, in the 2000s, the usage time tended to become diverse as the usage also became diverse.

In the late 2010s, as cafes emerged in the suburbs, the trend of consumers appreciating the architectural characteristics of the cafe itself began to appear; the cafes became independent and allowed users to enjoy the space, rather than being an attached facility or a place that focuses on the activities of consumers. This is a new trend for cafes different from the existing one.

## 2.2. Spatial Characteristics of Idle Industrial Facilities

### 2.2.1. Overview of Idle Industrial Facilities

Since new ports opened in Korea, industrial facilities increased rapidly and spontaneously. After the Korean War, construction of industrial facilities over the ruins increased with economic development.

Extremely fast industrialization led to unbalanced development. Industrial facilities were built first and the cities developed later. Consequently, industrial facilities, which were originally built in the suburbs of cities, became urban centers as the cities developed. In such cases, most industrial facilities are perceived as unpleasant facilities and were moved outside of cities. The old original industrial facilities were left idle.

Sometimes, due to the rapid industrial development, the industrial facilities were closed down as the industry became obsolete and profitability declined earlier than the original architectural life-span of the buildings. In this case, most of the large industrial sites were dismantled and were changed to facilities that meet the needs of the times. However, nowadays, the demands for preservation and utilization are rising because the public have come to value these industrial facilities as part of cultural heritage.

### 2.2.2. Characteristics of Architectural Space

The original industrial facilities such as factories and warehouses were located in places that were not easily accessible to people. Therefore, even if they have become urbanized or abandoned, they are now unpleasant facilities that still have poor accessibility.

Second, the factories and warehouses selected for this study are large buildings with high floor to ceiling heights and large floor areas for work and storage. These large spaces are non-everyday spaces that are uncommon for the public to experience.

Third, these large spaces consist of multiple interconnected buildings, and even the external spaces are connected as workplaces. The internal and external spaces are conveniently interconnected and the entrances are much larger than the usual size. Besides the large openings, they have a traffic line system to functionally interconnect the internal and external spaces for efficient work.

Fourth, they were built with highly frugal materials that were faithful to their intended functions. The façades are made of quite simple materials with few decorations. Sometimes, the facilities of the factory and warehouse are still preserved in these buildings and these construction materials and structures cannot be easily experienced by the public.

Fifth, due to industrialization and increasing population density, the need for large sites is increasing in South Korea, where the useful lands are narrowly divided and the number of large sites is decreasing. In particular, the number of large sites that can be used by the private sector is decreasing and land utilization is rising.

Consequently, factories and warehouses are inaccessible and unpleasant facilities for the public and have non-everyday locations and spaces. Nevertheless, their values as large spaces and sites are growing, and the demand for the regeneration of idle factories and warehouses is rising.

### 2.2.3. Value of Cultural Heritage

In South Korea, only traditional wooden buildings have been recognized as a valuable cultural heritage for many years. However, with the enactment of the registered cultural heritage system in 2001, modern and contemporary industrial relics have been highlighted as part of cultural heritage. Moreover, the concept of preservation for buildings with historical and cultural values, even if they are not registered by the Cultural Heritage Protection Act, has been generalized, and various methods to utilize this cultural heritage have been suggested [17,18]. Attempts at finding the value of utilization as well as preservation of cultural heritage have increased. The direct experience by consumers of cultural heritage has become important, beyond their role as tourist destinations only visible from a distance [19]. As these attempts are increasing, opportunities for consumers to find and experience cultural heritage have also increased.



To better utilize old buildings, it is important to emphasize their value to cultural heritage [20]. For such buildings showing cultural heritage value plus the addition of historical and cultural storytelling, the consumer trend of visiting and experiencing these buildings has increased.

Recently, the concept of cultural heritage has expanded, and preservation of warehouses and factories as industrial heritage has been embraced [21]. Thus, utilization and preservation activities for idle industrial facilities have increased.

### 3. Characteristics of Cafes Regenerated from Idle Industrial Facilities

A regenerative cafe refers to a cafe that still maintains the architectural characteristics and features of cultural heritage after being converted from idle industrial facilities. Therefore, they inevitably have a different concept compared to conventional cafes in downtown areas. In particular, we examine the characteristics of regenerative cafes in terms of non-everyday architectural space and users' space utilization.

#### 3.1. Non-Everyday Space

Existing cafes have been developed in downtown areas or densely populated areas as everyday spaces pursuing the values of easy access and utilization. However, regenerative cafes provide the non-everyday experience in a non-everyday space as their value.

First, regenerative cafes are located in places that are not easily accessible to the public because they were factories or warehouses in the past. Therefore, their location is a non-everyday location that must be accessed intentionally depending on the purpose of use. An area can be activated only when the consumers are attracted by the location.

Second, factories and warehouses have a high floor to ceiling height and a large area. Since the cafes entered this space while maintaining such characteristics, users inevitably feel a different spatial sensation from the ordinary cafe.

Third, factories and warehouses are surrounded by large working fields. Thus, they have a large external space that is different from conventional cafes and visitors can experience not only the large internal space but also the external space.

Fourth, the walls and roofs of factories and warehouses mostly use frugal materials with a rough facade, and these are brought into the cafe space as they are. Furthermore, the entrances are also large.

Fifth, the experience of using factories and warehouses for everyday activities is unusual and special.

Sixth, visitors can experience the flow of time. Visitors will have a dual time experience of both the factory warehouse space and the modern cafe space.

#### 3.2. Users' Space Utilization

The architectural space of cafes in urban areas and densely populated areas is centered on the static activities of consumers that can be represented by conversation, personal rest, and work. Hence, once consumers enter, the internal space is configured appropriately for these activities rather than accommodating the interest in the space. That is, conventional cafes have passive and secondary space configuration, whereas regenerative cafes have active and independent space configuration as follows.

First, they have a large area that can be used for dynamic activities or connected to spaces for activities. Second, users can experience moving along the interconnections between the internal and external spaces. Third, the space itself is unusual, which can be a topic of conversation. That is, it is a space that has things to see and talk about. Fourth, it is a unique space in which the value of cultural heritage can be enjoyed. Manifestations of cultural heritage generally involve unique spaces that are not easily accessible, but even though regenerative cafes are embodiments of cultural heritage, people can enter, enjoy them, and even touch them and stay in them for a long time.

Therefore, regenerative cafes have unique values as spaces for dynamic non-every-day experiences. Moreover, they have the character of a space in which people can stay for a long time while enjoying dynamic non-everyday experiences.

#### 4. Individual Case Studies of Cafes Regenerated from Idle Industrial Facilities

In this chapter, five of the 20 cases including one representative case for each city are investigated in detail: Daelim-Changgo in Seoul, Terarosa in Busan, Billy Works in Daegu, Joyang-Bangjik in Incheon, and Migok Storage in Jeollabuk-do (Figure 1). We selected them because they are the most active in each city and possess the above-mentioned characteristics of a regenerative cafe. These five cases will be examined in terms of the characteristics of location, architectural space, and the consumers' use of the space.

In addition to describing the cafés in terms of ambience and infrastructure, we describe the manner in which the people react and feel about the architectural elements in the spaces of the said cafés.



**Figure 1.** Site map of regenerative cafes in South Korea, examined in detail.

##### 4.1. Joyang-Bangjik

###### 4.1.1. Location

The Joyang-Bangjik factory was first built in 1933 and was the center of the prospering textile industry in Ganghwa until the late 1950s. It became an abandoned site when the textile industry in Ganghwa declined. The textile industry requires a large manpower, and the factory of Joyang-Bangjik was located near the Ganghwa-gun office in Ganghwa-eup, where the population was majorly concentrated in the Ganghwa-gun area (Figure 2).

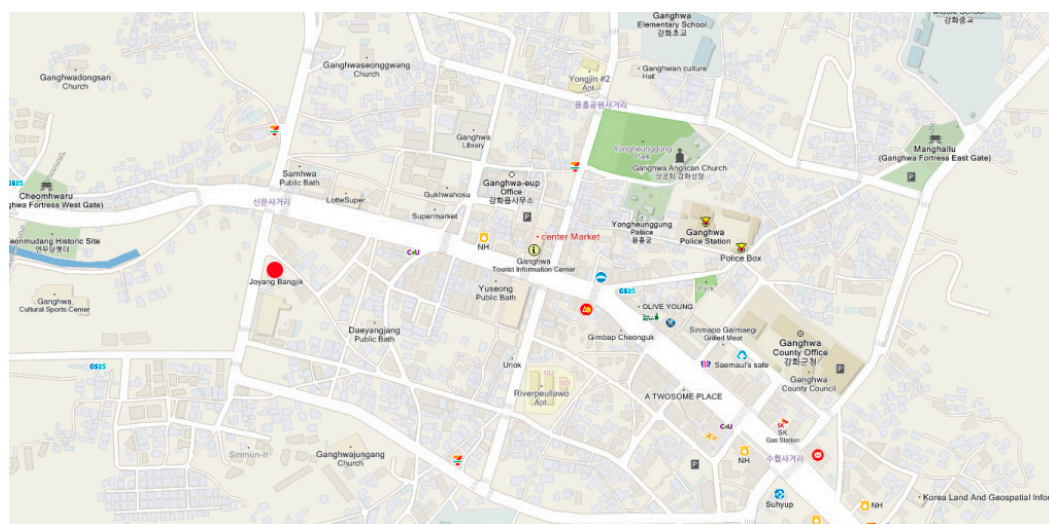
The Ganghwa area is an island accessible by car and is also a preferred tourist destination owing to its beaches and cultural heritage. Furthermore, the island also has other tourist attraction sites such as Mount Gyeongja, Goryeo palace, and Ganghwa mountain fortress. The island was strategically constructed as an alley (Sochang-gil) to re-enact the prosperous days of the bygone textile industry and is attracting more tourists after the Joyang-Bangjik has been turned into a café by a private owner [22]. This regenerative cafe is more conveniently accessible by car because the public transportation has not been developed as much as in the capital area because of the area's low population density.

###### 4.1.2. Architectural Features

The regenerative cafe has a site area of 6990 m<sup>2</sup> and comprises the factory and an attached building. The building used as cafe is a single-floor space, but some parts have a two-story structure. Including the height of the inclined skylight, the factory is a two-story-scale factory building with a gross floor area of 661 m<sup>2</sup> [23]. The outdoor space and

attached buildings are used as facilities for exhibitions and themed spaces connected with the café (Figure 3a).

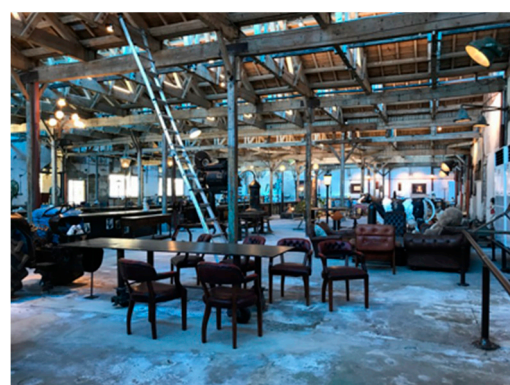
The factory building used for the cafe maintained the exposed ceiling for lighting, and the internal wooden triangular truss structure (Figure 3b). The traces of the existing factory building were maintained to the utmost level in case of the exterior walls, except for open windows installed in some parts (Figure 4a). Furthermore, the inner walls were made of cement mortar and bricks, and the concrete floor inside the building has been left with no repair to emphasize temporality. Except for the existing window frames, most interior props, including a cultivator, tractor, wooden horses, mannequin, and projector, have been collected and arranged by the building owner. Various old items that do not seem to harmonize well with one another are utilized to maximize the sense of an extraordinary but emotional space (Figure 4b).



**Figure 2.** Location of the Joyang-Bangjick factory.

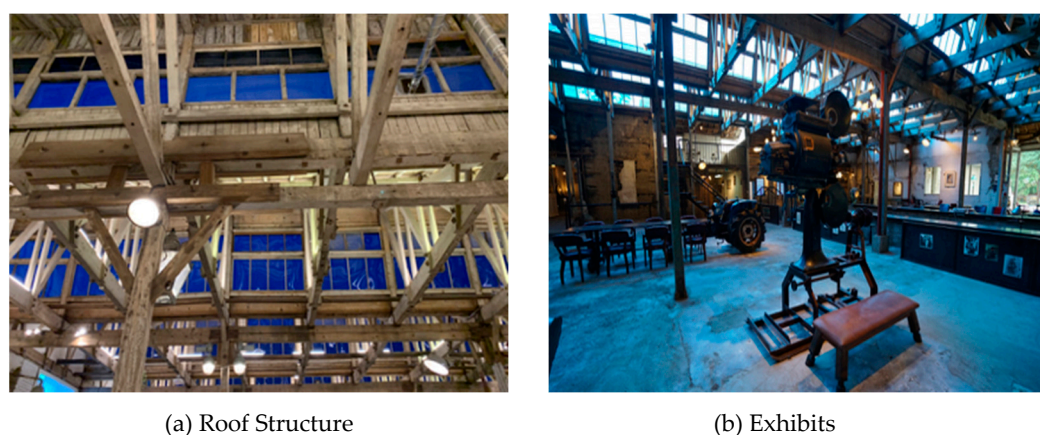


(a) Exterior



(b) Interior

**Figure 3.** Appearance of Joyang-Bangjik.



(a) Roof Structure

(b) Exhibits

**Figure 4.** Spatial composition of Joyang-Bangjik.

The existing buildings are arranged along the main road, and the outer space is separated from the road, forming a relatively safe and cozy space. Furthermore, the outer space surrounded by the buildings can be organically connected with the inner space.

#### 4.1.3. Consumers' Space Utilization

Recently, this regenerative cafe was acknowledged as a Ganghwa tourist destination and was included in the Ganghwa Story work Project. It has become a famous site that is visited intentionally by the public. The regenerative cafe used a spatial strategy, taking advantage of the place's strengths to induce people to stay there for a long time (Figure 5a).

This regenerative cafe has a sufficient outdoor space for exhibitions, plays, and resting spaces. The external space is not only an extension of the regenerative cafe but also functions as a type of boundary or a transitional space between the area and the regenerative cafe. This external space not only entices consumers to stay longer because it expands the scope of experience of the cafe but also becomes an element that maximizes the impact of the regenerative cafe building. Consumers can spend much more time here than in cafes in the city center because of these space utilizations (Figure 5b).

Another characteristic of the Joyang-Bangjik cafe is that it serves as an independent tourism resource rather than as an attached facility, through connection with surrounding tourism resources. This also means that regenerative cafe has become a part of the non-everyday activity of tourism for consumers.



(a) Indoor

(b) Outdoor

**Figure 5.** Activities in Joyang-Bangjik.



## 4.2. Daelim-Changgo

### 4.2.1. Location

Daelim-Changgo was built as a rice mill in the 1970s. In 1990, it became a warehouse for storing materials for factories. This location hosted industrial activities centered on light industries, but gradually declined as the industrial paradigm changed after the 1980s. It is located near the downtown area close to Jongno-gu and Yongsan-gu, where the transportation infrastructure is well established. As it was located in a hub connected to the Gangbuk region, it enjoyed glory days after the development of Gangnam (Figure 6).

With the recent regeneration of the area, Daelim-Changgo's locational feature is emerging as an advantage that can increase public access to new facilities. Furthermore, this regenerative cafe, which opened in 2016, is contributing a lot to local revitalization as it is close to large parks such as Seoul Forest and Children's Grand Park. It also caters to young consumers from Konkuk University and leading commercial centers such as Seongsu-dong cafe street.



**Figure 6.** Location of Daelim-Changgo.

### 4.2.2. Architectural Features

The regenerative cafe is a building complex with a gross floor area of approximately 660 m<sup>2</sup>. It uses parts of the old Daelim-Changgo building which has been transformed into a cultural complex centered on a cafe. It consists of a single space, and although there is no separate external space, part of the ceiling is open, and there are green areas in some parts. Thus, it has created an outdoor environment even though it is an indoor space (Figure 7a).

The building has two floors. The first floor consists of a cafe, a restaurant, and an exhibition space. The second floor consists of exhibition and creative spaces in a duplex structure with a void. There is a rooftop floor used as an outdoor cafe space. A high open ceiling was secured by exposing the wooden triangular truss structure of the roof, and the features of the existing warehouse building have been kept such as the masonry on the façade and the iron gate, which serves as an entrance (Figure 7b).



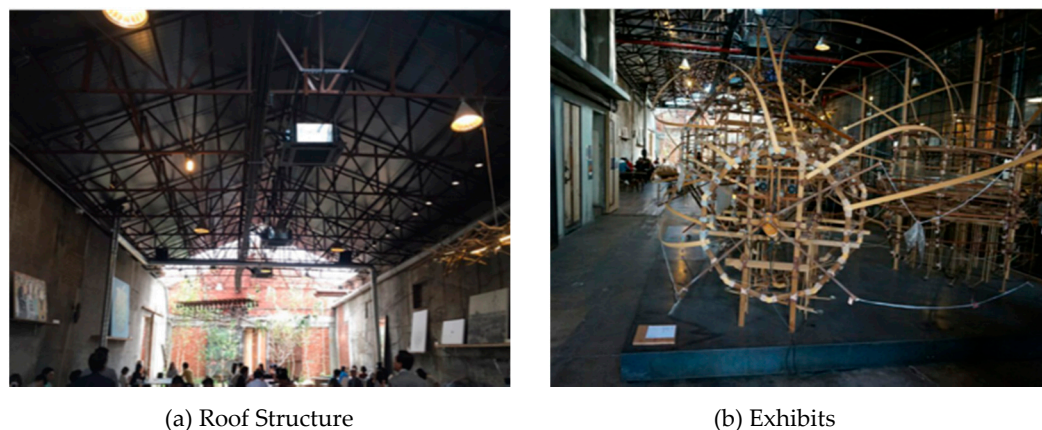
(a) Exterior

(b) Interior

**Figure 7.** Appearance of Daelim-Changgo.

In particular, the interior of the first floor largely consists of two parts. One part is a cafe area where the rough finishing of the reinforced concrete columns and beams, the inner walls made of cement mortar and bricks, and the concrete floors were maintained. The second part is mainly a restaurant area using existing bricks painted in white and wooden flooring, which provide visual contrast (Figure 8a).

The cafe elicits a strong emotional response as a cultural space by exhibiting art installations and paintings of various artists. This regenerative cafe generally focuses on the interior space and uses a variety of spaces on each floor to form a three-dimensional structure centered on a single space (Figure 8b). Even though access is somewhat inconvenient because there is no separate parking lot, it is conveniently accessed by public transportation (Seongsu subway station and buses).



(a) Roof Structure

(b) Exhibits

**Figure 8.** Spatial composition of Daelim-Changgo.

#### 4.2.3. Consumers' Space Utilization

This regenerative cafe has become a spot for tourist attraction in Seoul as it plays a representative role in galvanizing the commercial district of Seongsu-dong cafe street. The space had a dark image as an industrial complex in the past but has now been transformed into one that gives out warm emotional stimuli. The cafe uses a strategy of diversifying its interior spaces, concentrating on the existing facility itself within the limited range of a city with a high population density and expensive land prices.

The cafe increases the time spent by consumers inside with a varied selection of activities such as dining, galleries, experiences, and resting spaces in each floor while centering on the cafe. Moreover, it is recognized as a non-everyday space in the city center by

emphasizing the storytelling aspect of the building by placing a courtyard that communicates with the external environment inside the building to attract natural light (Figure 9).



**Figure 9.** Activities in Daelim-Changgo.

#### 4.3. Billy Works

##### 4.3.1. Location

Billy Works is estimated to have been built during the Japanese occupation. This area was once an active industrial complex that was developed gradually until after the Korean War. However, it succumbed to recession since the 1990s as the industrial structure changed. This area drove the industrial development of Gyeongsang Province as it is located in Buk-gu, Daegu, where the Gyeongbu Railway Line was constructed.

However, since the 2000s, active redevelopment of the region was needed due to the rise of slums and the lack of infrastructure, and projects have been carried out in some areas from a regeneration perspective. In addition, proposals have been made recently to improve its accessibility by reorganizing streets and creating specialized streets along with revitalizing commercial districts, such as the neighborhood markets. In 2018, the Billy Works cafe was developed by a private owner and became a major attraction that can lead the revitalization of the area. The regenerative cafe has a separate parking lot and is easily accessible by public transportation such as subways and buses (Figure 10).



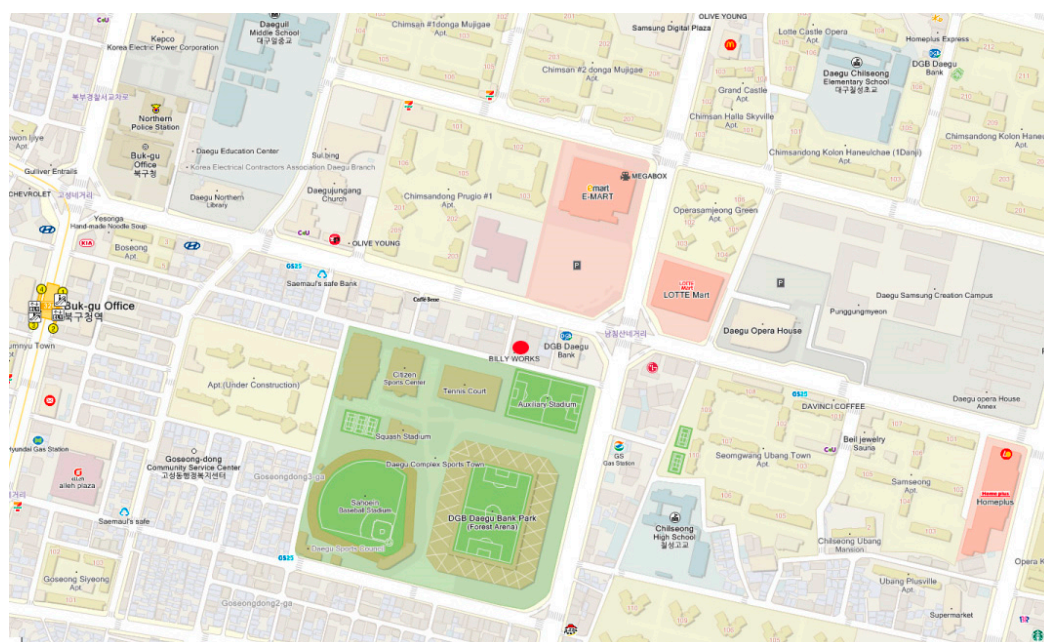


Figure 10. Location of Billy Works.

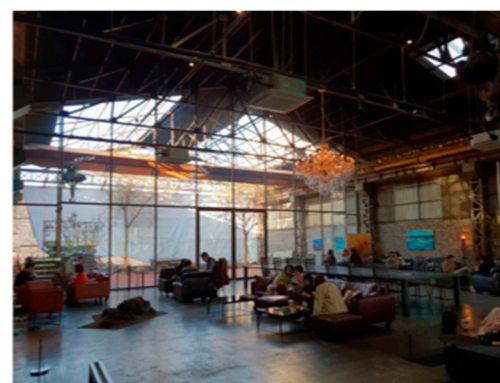
#### 4.3.2. Architectural Features

The regenerative cafe is a combination of three buildings, including a two-story steel factory (with a separate rooftop) and an adjacent closed church, with a gross floor area of approximately 1525 m<sup>2</sup>. The cafe is composed of a single-space cafe. Because there is no separate external space, it is similar to the case of Daelim-Changgo cafe which introduced vegetation by making an inner courtyard and opening part of the skylight [24].

The courtyard is maximized using relatively dark materials, and the space is divided three-dimensionally by a duplex construction. On the second floor, a cozy space is created in contrast with the first floor. The rooftop is used as a transitional space where nature meets architecture while highlighting the continuous feeling of the floors by keeping the temporary wall as it is (Figure 11).



(a) Exterior



(b) Interior

Figure 11. Appearance of Billy Works.

In the large single space on the first floor, which is used as a cafe, the effect of the steel triangular truss structure is exposed to ensure sufficient openness, and the exterior retains the texture of the original finishing materials while adding a few windows. In the interior space, only the concrete floor was coated, and the reinforced concrete columns and beams and the masonry bricks of the inner wall were kept intact, and white paint finishes were used in some parts (Figure 12a).



As interior props, iron gates and cranes used in the original space are used to revive past memories. The cafe is used as a cultural space where baked items are sold, and various exhibitions and performances are held (Figure 12b).



(a) Roof Structure

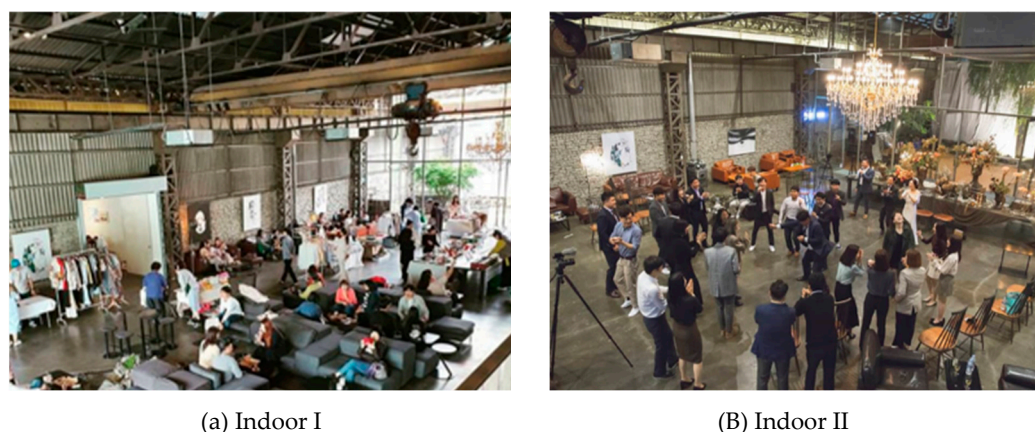
(b) Exhibits

**Figure 12.** Spatial composition of Billy Works.

#### 4.3.3. Consumers' Space Utilization

This regenerative cafe received support from the public as it became famous, helping revitalize Buk-gu, Daegu, which is a historical industrial site. The cafe has a limited area because it is located in a densely populated city center, so it tends to focus on the existing facility itself. In other words, the large single space around the cafe is divided into a duplex or into different floors to give a three-dimensional effect, and at the same time, it is configured to accommodate various functions such as a bakery and a gallery (Figure 13).

Furthermore, the storytelling aspect of the building and the courtyard that draws natural light are energizing the existing facilities that were rather dark, thus creating an environment where people can stay and enjoy the atmosphere for long periods.



(a) Indoor I

(B) Indoor II

**Figure 13.** Activities in Billy Works.

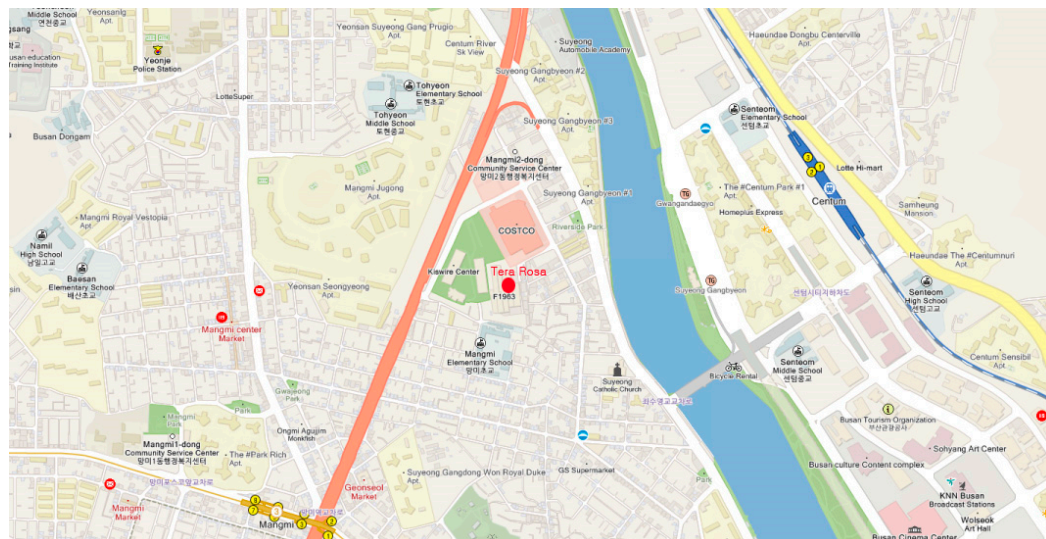
#### 4.4. Terarosa

##### 4.4.1. Location

Terarosa is a regenerative cafe constructed on some old facilities of the Korea Wire factory, which was built in 1963. The factory, which produced wire ropes, was originally located in an undeveloped area but moved to Yangsan, Gyeongsangnam-do in 2008 since the gradual establishment of the downtown area and the closing of the existing facility.

Later, when the Busan Biennale was held in 2016, a proposal was made to reuse this neglected facility through an agreement between the public and private sectors to create

a new cultural complex. The cafe has become a representative tourist attraction since 2016 and attracts several tourists owing to its proximity to Suyeong Historical Park and BEXCO, which are located within 2 km, and Haeundae and Gwangan Bridge, which are located within 5 km (Figure 14).



**Figure 14.** Location of Terarosa.

#### 4.4.2. Architectural Features

This regenerative cafe is approximately two stories (the observation deck has three stories), but the main area of the actual cafe is a single space with a high ceiling. This cafe uses 2148 m<sup>2</sup> of the gross floor area of 10,650 m<sup>2</sup> in the form of commercial space. The cafe has enhanced the linkage with the external space by securing a large site area of 22,279 m<sup>2</sup>, which includes outstanding hydroponic facilities, a courtyard, and a promenade utilizing the wastewater treatment plant of the old factory [25] (Figure 15).



(a) Exterior

(b) Interior

**Figure 15.** Appearance of Terarosa.

As the cafe has an 874 m<sup>2</sup> courtyard, the indoor space enjoys sufficient natural light, and this courtyard serves as a transitional space for communicating with nature. Moreover, the existing exterior outline has been sufficiently maintained using the expanded metallic material, and wires are used as an interior element to highlight the memory of the old factory while maintaining the existing steel triangular truss structure and columns [26] (Figure 16).

Some walls of the driveway have been demolished, and glass curtain walls have been installed instead. Traces of structural reinforcements can be seen in many places. Cement



blocks or some steel windows have been added to the inner wall, which harmonize with the original form.

The cafe functions as a cultural complex because it offers various programs and activities with galleries, libraries, and a horticultural space coexisting with the large external space. Furthermore, this regenerative cafe is similar to the Joyang-Bangjik Café, which stages various programs with an indoor space connected to the external space. It is located in a more densely populated downtown area than Joyang-Bangjik Cafe, which requires access by car. Thus, it has the advantage of convenient access by public transportation such as subways and buses.



(a) Roof Structure



(b) Exhibits

**Figure 16.** Spatial composition of Terarosa.

#### 4.4.3. Consumers' Space Utilization

This regenerative cafe is located in Gangneung, Gangwon-do. This cafe has been recognized by the public as a tourist attraction and has recently gained national popularity. It is located in a previously undeveloped area away from the city center; thus, it was not easily accessible to the general public. Today, it has become a cultural complex that people are encouraged to visit.

Similar to the Joyang-Bangjik Café, this regenerative cafe has created a large space by securing a large land area. This regenerative cafe has a space structure that encourages the public to linger by providing various activities. In particular, the courtyard, as a transitional space that draws nature into the interior, satisfies both the expansion of the cafe space and the visual expansion to consumers (Figure 17).

The creation of an external space expands the experiential range for the public by connecting the line of internal movement with the outdoors, increasing the time spent by the public in the cafe. As a result, space storytelling and various activities can be enjoyed in this cafe, and the public can deliberately spend time visiting this place unlike other conventional cafes in the downtown area.



(a) Indoor

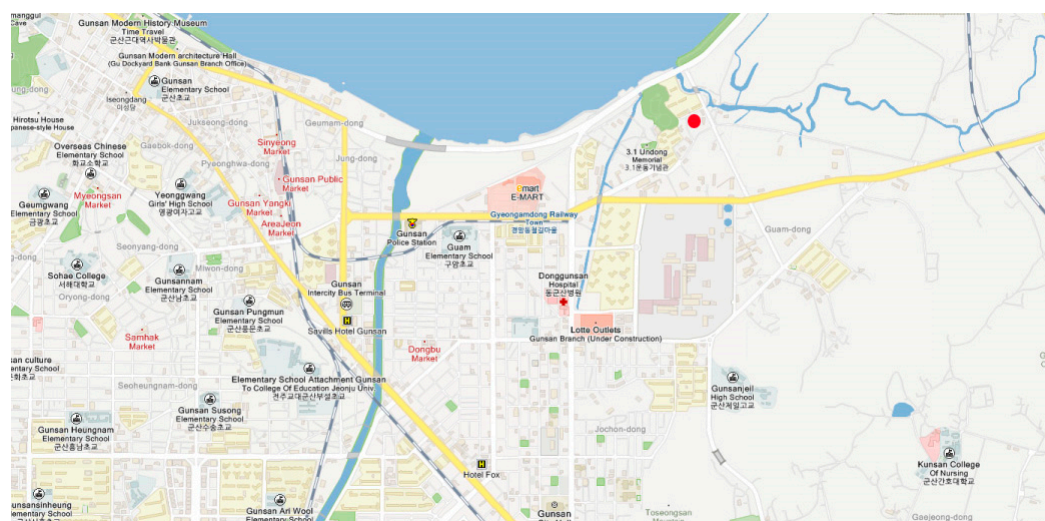
(b) Outdoor

**Figure 17.** Activities in Terarosa.

#### 4.5. Migok Storage

##### 4.5.1. Location

Migok Storage was constructed in 1976 as a rice storage warehouse. This area was an agricultural production area far from the city center, and the warehouse was built to store rice harvested from neighboring farmlands or to control rice yield. However, the utilization of this facility rapidly declined since the 1990s when the rice market was opened up by national policy [27] (Figure 18).

**Figure 18.** Location of Migok storage.

As this area was mainly farmland, it was not very accessible to the public from the city center, and existing facilities also had some limitations in terms of usability because they had standardized shapes and sizes. Today, however, the daily cultural content of a cafe opened in 2017 has regenerated this underdeveloped area. More and more consumers are visiting this regenerative cafe as the modern cultural street, the Gyeongam-dong railroad village, and Saemangeum embankment in Gunsan have emerged as tourist destinations.

##### 4.5.2. Architectural Features

This regenerative cafe uses one of the two warehouses comprising a single reinforced concrete structure, with a gross floor area of approximately 457 m<sup>2</sup>. The cafe is a typical warehouse facility with a high ceiling of about two stories, and the interior uses duplex spaces at both ends around a single space. Although it has some exterior spaces such as a parking lot and outdoor deck, they were not developed much. There is another adjacent warehouse of a similar shape that is currently used as a photo studio, but they are relatively unrelated because their owners and customers are different from each other (Figure 19).



(a) Exterior

(b) Interior

**Figure 19.** Appearance of Migok Storage.

The appearance of the cafe is similar to other existing facilities due to the use of primary colors. Only glass windows were added for visual opening and lighting, but the wooden triangle trusses and upper ventilation windows were maintained. The concrete floor was only epoxy-coated, thereby maintaining the feeling of original materials. Moreover, the cement mortar of the inner wall and some brick finishes were kept. Both sides of the single space in the cafe are flanked by purpose-built rooms such as a roasting room, bakery, meeting room, and gallery (Figure 20a).

This cafe utilizes paintings by various artists as interior props and emphasizes emotional functions as a cultural space by using the gray wall of a single space as a screen (Figure 20b). This regenerative cafe has some external spaces, but the main focus is on the internal space. In terms of accessibility, it is far away from the city center, so public transportation is inconvenient. Hence, it is more convenient to come by car via the national road, and there is a separate parking lot.



(a) Roof Structure

(b) Exhibits

**Figure 20.** Spatial composition of Migok Storage.

#### 4.5.3. Consumers' Space Utilization

This regenerative cafe became a major tourist attraction together with other destinations in the Gunsan region. Many people visit the cafe, and the cultural contents of the cafe that are cognitively close to the public have been created by reusing idle facilities outside the city center. In other words, a space that is considered an everyday space but is located in a non-everyday place is stimulating the curiosity of consumers.

Although the cafe is close to an agricultural area with a low population density, it has a limited land area, and the facilities on the site have different owners. Thus, the cafe uses a strategy of diversifying the internal spaces by concentrating on the facility itself. It



provides the excitement of movement through the three-dimensional configuration of both ends of the single space at the center, and stages various programs centered on the cafe on each floor so that consumers can spend a long time in the cafe. Furthermore, additional windows have been installed on the ground floor which can be used to see the outside from the inside (Figure 21). It also attracts natural light, and the storytelling of the building itself is outstanding. Consequently, the cafe is receiving positive response as a space for communication.



**Figure 21.** Activities in Migok Storage.

## 5. Sustainable Values of Regenerative Cafes

Based on the representative cases discussed in Section 4, this section examines the non-everyday architectural space characteristics of regenerative cafes and discusses the manner in which these sustainable values can be maintained by the way consumers use these architectural spaces. As mentioned earlier, it is said that the theoretical and integrated but general concept is to be extracted by integrating individual and specific cases. This is because the concepts that emerged by doing this reveal the unique value of regenerative cafes, and these values are intended to be the basis of sustainability that can be found and planned in other cases.

### 5.1. Value as a Complex Networking Space

Conventional cafes are aimed at engaging consumers' attention for a short time in city centers or densely populated areas and focus on the consumers' static activities rather than on the value of the architectural space. However, regenerative cafes are spaces that consumers intentionally access and take their time to use and enjoy.

Firstly, regenerative cafes are composed of architectural spaces that have a storytelling aspect, and by interconnecting internal and external spaces, provide a feeling of openness not present in conventional cafes.

Secondly, regenerative cafes are complex networking spaces that can host various programs that allow users to spend long periods in the cafe.

Thirdly, regenerative cafes are often a part of tourist attractions as they are close to sightseeing and entertainment destinations, or they could be in hard to access locations that consumers have no choice but to plan a long period of stay in the regenerative cafe.

### 5.2. Value as a Cultural Heritage That can Be Experienced

From the perspective of industrial facility regeneration, regenerative cafes provide an opportunity to experience architectural cultural heritage directly, adding unique value to consumers' space utilization. For a long time, it was almost impossible to touch and experience the inner spaces of these architecturally and culturally significant buildings.

Regenerative cafes are valuable as part of cultural heritage and also as active cafes. As such, they have the values of a space in which we can experience heritage.

In another perspective, the regenerative cafes have the value of experiencing the passage of time created by the architectural space as a cultural heritage. When the long accumulation of time that old buildings have spent as industrial facilities is recognized as a cultural heritage, turning them into cafes allows consumers to experience this cultural heritage. Therefore, the visual representation of the long accumulation of time has a high value for the regenerative cafe. Experiencing such accumulation of time is a unique experience in terms of consumers' space utilization because conventional cafes are not designed for such experiences.

### *5.3. Value as an Independent Tourist Attraction*

Unlike conventional cafes in the city center, regenerative cafes encourage the dynamic activities of consumers and provide various experiences through the construction of complex spaces. Furthermore, the regenerative cafes evoke a sense of the passage of time reflecting a place's cultural heritage; this encourages the customers to stay in these cafes for long periods of time. In contrast, conventional cafes are static and ancillary to consumers, and therefore, the experience in itself is not the focus, and the consumers therefore spend a short time in such cafes. In other words, regenerative cafes can be thought of as independent spots for tourist attraction.

As mentioned above, the three values could be explained by the concept that shows the sustainability of regenerative cafes. Therefore, these three values through the notion of the 'non-everydayness' must operate as the sustainability of architectural space and the user's spatial utilization of regenerative cafes.

## **6. Conclusions**

The present study examined the spatial characteristics of cafes that have been created by regenerating old warehouses and factories, which are idle industrial facilities, in comparison with conventional cafes. We identified the characteristics of the architectural spaces and the unique sustainable value of the regenerative cafes so that they can be used for future projects.

According to the theoretical point of view, the architectural spatial feature of a conventional cafe was 'everydayness'. On the other hand, the spatial feature of industrial facilities as cultural heritage was 'non-everydayness'. In this comprehensive study, it was found that the regenerative cafe emphasizes 'non-everydayness' by utilizing this overlapping 'non-everydayness', and it was also revealed in terms of the characteristics of architectural space and the user's spatial utilization. Through the case study, we have found the value as a complex networking space, value as a common advantage that can be expected, and value as an independent tour list.

As a result, unlike conventional cafes, regenerative cafes are non-everyday architectural spaces in terms of location, scale, height, and utilization of internal and external spaces. Second, they are active and independent spaces for experiencing old buildings or cultural heritage. Third, they are complex networking spaces where consumers can enjoy dynamic activities and spend a long time. Fourth, regenerative cafes have values as part of cultural heritage and as independent tourist attractions, and as such, they are sustainable architectural spaces.

The above concepts mean values that architects must consider in terms of consumers when they want to regenerate idle industrial facilities into cafes. These values will help ensure the general and long-term sustainability of Regenerative Cafes, rather than setting concrete and scientific standards.

This study attempted to show an architectural solution as a response to consumer's demand and sense through case analysis on Regenerative Cafes. The integrated theoretical concepts extracted from individual cases as mentioned above are working as independent values with the sustainability of Regenerative Cafes. Since this study deals with

the theoretical basis, it is considered that there is a possibility that it can be extended and applied to similar buildings, regions, and countries. This is because consumers can expect a similar consumer's response to Regenerative Cafes.

Therefore, this study showed that regenerative cafes have unique and sustainable values and features that can be used to regenerate other idle industrial facilities, and these values need to be continuously researched so as to facilitate further applications.

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