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RESEARCH ON THE IDEAS AND CHALLENGES OF CREATING A WALKABLE PEDESTRIAN NETWORK BY UTILIZING UNDERGROUND SPACE

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Abstract: In recent years, urban development plans have been underway around the world to make it easier for pedestrians to get around by creating and networking walkable spaces that prioritize pedestrians. In such plans, there are many cases where underground space is effectively utilized. There are two types of underground utilization methods. The first method is to relocate functions for non-pedestrian transportation such as cars and trains underground and reorganize the above-ground area as a safe, secure, and comfortable walking space. The second method is to create an attractive underground walking space by taking advantage of the advantage of underground space, which is not easily affected by weather and temperature, and by addressing the problems of underground spaces where it is dark and where it is difficult to distinguish between locations. In this study, we focus on examples of effective use of underground space in forming walkable spatial networks, classify and analyze the characteristics of usage methods, and consider ideas and issues in urban development planning.

Keywords: walkable pedestrian network, urban development

1. INTRODUCTION

In Japan, the population is decreasing, and the population is aging, making it difficult to maintain and manage social infrastructure. On the other hand, values such as emphasis on work-life balance are diversifying, and there is a need to improve the attractiveness of cities. Considering this situation, the Ministry of Land, Infrastructure, Transport and Tourism is considering urban development that promotes urban, economic, and social diversity and creates added value. At that time, "WEDO" (Walkable, Eyelevel, Diversity, Open) was proposed as a keyword to describe the new urban image.

Therefore, in collaboration with private investment, we aim to realize a rich, human-centered lifestyle, create new value through innovation, and resolve regional issues. We are transforming public and private spaces into human-centered, easy-to-walk spaces, and promoting initiatives to create cities that are "comfortable and inviting to walk" where diverse human resources can gather and interact. To further promote these efforts, there are an increasing number of cases in which underground space is being effectively utilized.

This research focuses on the concept and issues of an easy-to-walk pedestrian network that utilizes underground space and aims to obtain suggestions for future urban development based on its characteristics and effects.

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2. CASE STUDY

There are many examples of creating easy-to-walk spaces that prioritize pedestrians and making effective use of underground spaces. There are two types of underground usage methods. The first method is to relocate functions that were previously above ground underground, making it possible to walk on the ground safely, securely, and comfortably. The second method is to create a pedestrian network that is less affected by weather and temperature by making the underground space itself easier to walk through.

2.1. Relocation of functions from aboveground to underground

First, we focus on the functions that are transferred from aboveground to underground and classify them into three types. It is expected that these will solve the problems that existed on the ground and make it possible to walk on the ground safely, securely, and comfortably. Table 1 shows the correspondence between each case.

Table 1. *Classification focusing on the type of functions that go underground*

Functions relocated from above ground to underground	Effect on the ground	case study
Car Route	Creation of water-friendly green space	Soseigawa Avenue (Sapporo City)
Railway	Eliminating traffic congestion and urban division caused by railroad crossings	Keio Line (Chofu Station)
Bus Terminal	Reducing congestion on the ground by buses and passengers	Bus Terminal Tokyo Yaesu (Tokyo Station)

2.1.1. Example of relocating a car route underground (Sapporo City)

Soseigawa Avenue in Sapporo City used to be an eight-lane road, but four of those lanes have been moved underground, and there are several underground passages. At this time, a water-friendly green space was created above the newly relocated underground vehicle running space. This created a plaza space that served as a place for local activities and interaction and was used by a diverse range of people. In addition, by creating a space where people can walk comfortably, it has become possible to create a lively town.

Looking at the activities in the ground area after the relocation, the most frequent visits were for purposes such as walking and resting, and nearly half of the people stayed for more than 30 minutes. This is thought to be because more people spend time in the well-maintained plaza rather than using the surrounding facilities as their destination, and it is believed that this has the effect of creating a lively atmosphere.

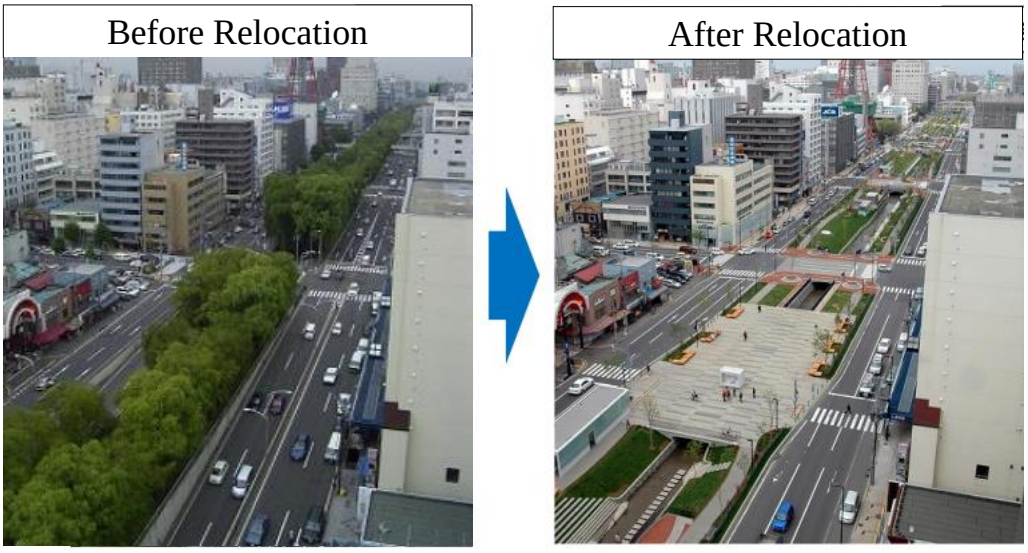


Figure 1. *Before and after relocating car routes underground*

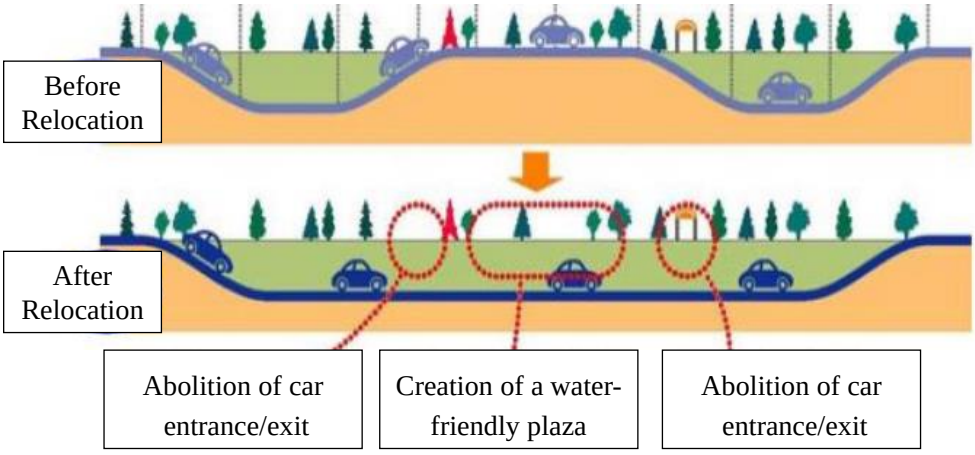
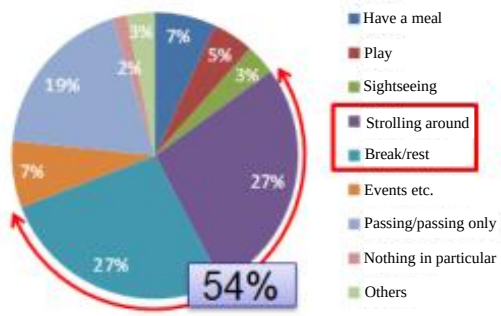


Figure 2. *Areas that changed before and after relocation*



Purpose of visit

Figure 3. *Status of above-ground activities after relocation*

2.1.2. Example of relocating a railway underground (Keio Line, Chofu Station)

The railway (Keio Line) that ran above ground caused traffic jams at railroad crossings and divided the city. This is an example of how moving underground railways can alleviate traffic congestion and make cities more continuous. As a result, the plaza in front of Chofu Station has been upgraded above ground, and its function as a transportation hub has been strengthened by connecting multiple transportation systems. In addition, a plaza that can be used for multiple purposes has been developed, and events are held here, making the town more lively.

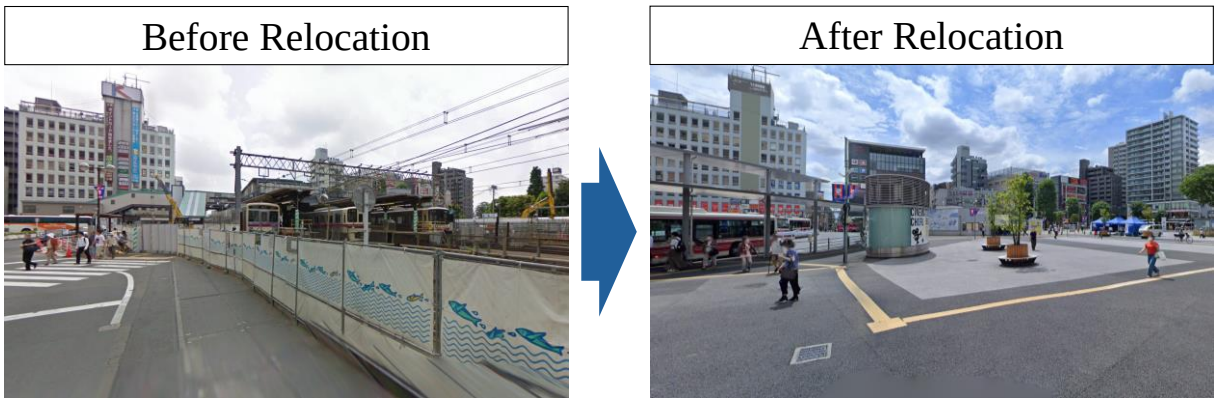


Figure 4. *Before and after relocating a railway underground*

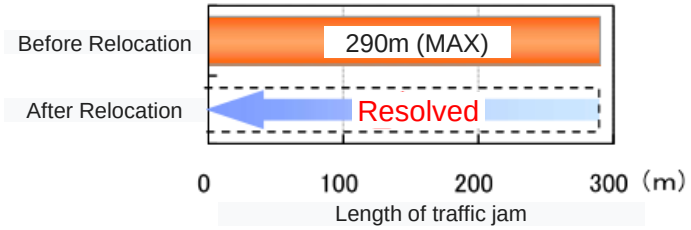


Figure 5. *Comparison of maximum length of traffic jams*

2.1.3. Example of relocating a bus terminal underground (Bus Terminal Tokyo Yaesu, Tokyo Station)

In the Yaesu area near Tokyo Station, bus stops are scattered over a wide area, and the surrounding roads were crowded with buses and passengers. In response to this, an underground bus terminal was constructed in conjunction with large-scale redevelopment to improve convenience for buses and passengers. This eased congestion on the ground and created a comfortable and safe space for pedestrians.

The functions of the bus terminal include a ticketing counter and information desk on the first basement floor, and bus stops on the second basement floor. The above-ground area has become a comfortable space for pedestrians, allowing access to the adjacent underground mall.

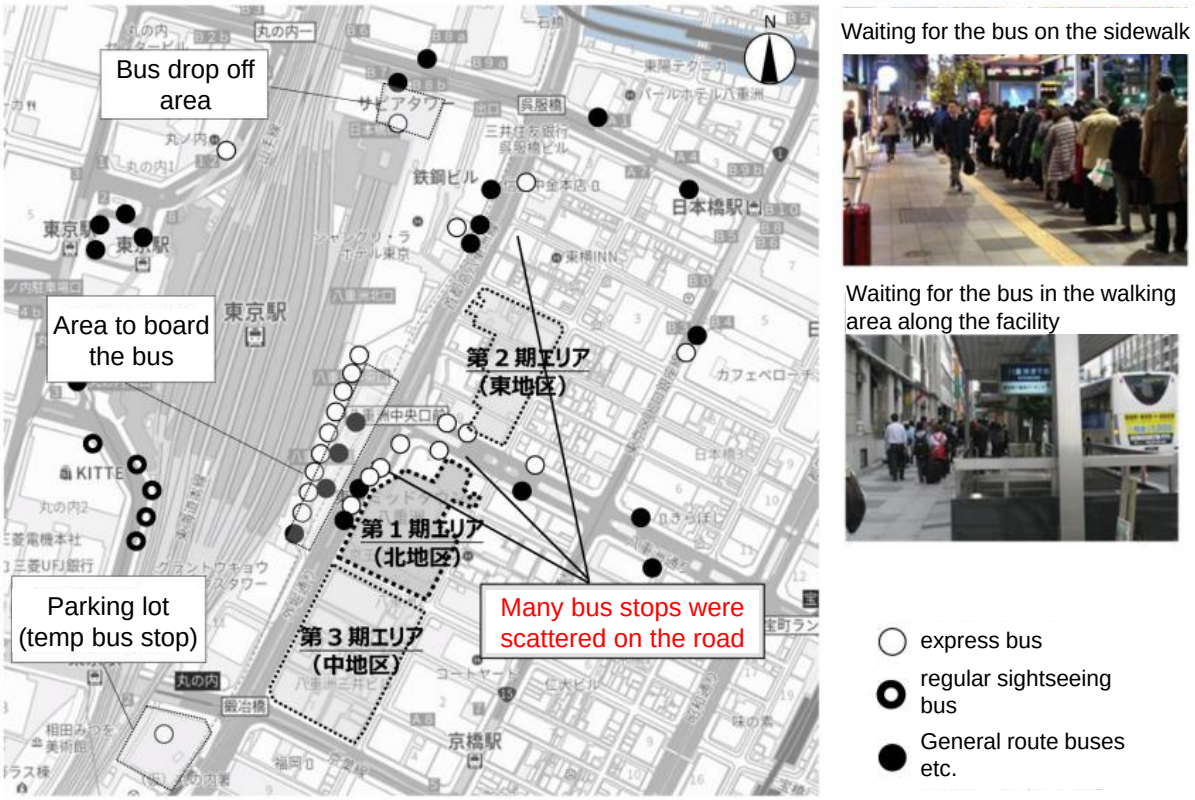


Figure 6. *Location and appearance of the bus stop before relocation*

Figure 7. *Flow lines and stay space at the underground bus terminal*

2.2. Ideas for making underground spaces a comfortable walking space

We have summarized the possibilities of making underground walking more enjoyable and comfortable by creating a device that serves as a sign so that people walking underground do not lose their direction or location, a device that allows them to grasp their positional relationship with the above-ground space, and a device that encourages various activities such as not only walking but also staying.

Table 2. *Ideas and expected effects for underground walking space*

Ideas for underground walking space	Expected effects in underground space
Design at eye level	● Signs to prevent people walking underground from losing their direction or location
Lighting from above ground	● Understand the positional relationship with the ground
Utilization at events etc.	● Encourage various activities such as staying in addition to walking.

2.2.1. Design at eye level

When walking underground, it can be difficult to locate where you are because the scenery remains the same and there are few facilities or information that can serve as landmarks, so there are examples of creating spaces that are easy to walk by creating landmark designs and placing facilities at eye level. For example, Fukuoka City's Tenjin Underground Mall has been made easy to understand by installing unique lighting and designs, and at Shinjuku Station, huge digital signage has been installed to create a space that can be used for meetings.

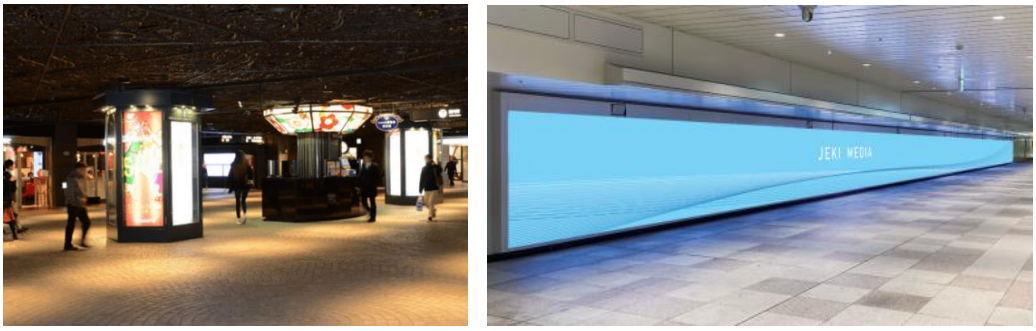


Figure 8. *Unique lighting design (left figure) and huge digital signage (right figure)*

2.2.2. Lighting from above ground

The disadvantage of underground pedestrian spaces is that they tend to be dark, and it is difficult to determine their position in relation to above-ground areas. Therefore, when creating an underground pedestrian space, in addition to letting in light from above ground to make it brighter, there are also cases where large openings are installed so that landmarks on the ground can be seen, the direction of sunlight can be seen, and pedestrians can see their location on a map. For example, in Sapporo City, where there is a lot of snow, the underground area of Ekimae-dori Avenue has been developed as a long linear walking space, with large openings arranged in succession to make it easy to see the positional relationships. Furthermore, in Fukuoka City's Tenjin Underground Mall, unique lighting and designs have been placed around the openings, making the space easier to locate.

Figure 9. *Continuous arrangement of multiple openings (left figure) and uniquely designed openings (right figure)*

2.2.3. Utilization at events etc.

Underground spaces have the disadvantage that because they are closed spaces, few people stay there for long periods of time, and they are often just spaces for walking. Therefore, by relaxing restrictions on the use of underground spaces for events, etc., and clarifying the organization responsible for management, including licensing, there are examples of creating diverse spaces that vary depending on the season, day of the week, and time of day. For example, Sapporo City has established a specialized town development company, and Shizuoka City is encouraging active use of its underground event space by renting it out free of charge. Through such innovations, the basement is not just a space to walk through, but a space where you can stay and engage in a variety of activities, leading to the creation of a fun and comfortable town.

Figure 10. *Underground marche (left figure) and underground performance (right figure)*

3. CONCLUSION

In this study, we confirmed that there are a wide variety of examples of creating walkable spaces that give priority to pedestrians, and that there are especially many examples of effective use of underground spaces. Therefore, we analyzed the usage of underground space by dividing it into two types: making the above ground a walkable space and making the underground a walkable space. To make above-ground areas walkable, there is a perspective of relocating functions that are not related to pedestrians, or functions that sometimes hinder safe and comfortable walking underground, and we confirmed the effectiveness and development potential of this approach. On the other hand, when creating an underground pedestrian space, it has the advantage of being less affected by weather and temperature, but it also has the disadvantage of making it difficult to create an attractive space because it gets dark and makes it difficult to understand the positional relationship, so it was confirmed that there are various ways to maximize the function as a network for pedestrians.

In future urban development, we believe it will be important to create spaces that support a variety of activities, such as not only walking, but staying, relaxing, and enjoying, by incorporating ways to proactively utilize underground spaces, while sharing the functions of the entire region. To this end, it will be necessary to clarify the concept of division of functions and the effects obtained by effectively utilizing underground space in the "Guidelines for Underground Space Utilization in Cooperation with Urban Development", which we are currently aiming to introduce. For example, we should aim to be able to quantitatively evaluate the benefits of underground projects, such as not only smoother roads by relieving traffic congestion, but also economic effects from promoting a variety of activities and creating hustle and bustle. In the future, I would like to consider and propose indicators for evaluating these and their calculation methods.

4. ACKNOWLEDGMENTS

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