Basic Research into Ideal Way of Underground Space of District Around Osaka Station

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ABSTRACT

Taking the situations above, this thesis aims to search the way an underground space should be, not only based on the comfortable underground space that specialists (planners/designers/constructors) consider from their points of view, but also on the investigation and study of the way of underground space that users want, by conducting the investigation to the general underground users on what they want for underground space and what impressions they have for underground space.

1. INTRODUCTION

With heightening calls for effective use of underground space along with the urban growth, it is expected to promote active utilization of underground space including deep subterranean, because of concentration of the population into urban areas and the necessity of intensive land use. Underground malls and passages have been developed as the underground pedestrian space from the aspect of traffic segregation, also aiming at enhancement of infrastructure, revitalization of the surrounding area and for other purposes. For its effects, it helps as the functions to mitigate the traffic congestion on the above-ground level and to connect transport nodes such as railroads. It would appear, however, that the existing underground spaces have not really been developed under the space designing or planning from the viewpoint of the users due possibly to pursuit of convenience. Moreover, as the individual underground spaces have been connected without a masterplan based on a long-term perspective, there are quite a few places where the elements of safety, security and amenities are not satisfactory. Therefore, the purpose of this study is to explore the ideal way of underground space, after examining and studying the way of underground space the users require by conducting a questionnaire survey on the matters including what the general users of underground space require and what impression they have on underground space.

2. OUTLINE OF THE STUDY

In this clause, the subject is the area around Osaka Station in Osaka City, where an underground space network has already been developed and another development of underground space is scheduled for the future.

2.1 Outline of the Study Subject Area

(1) Urban Outline of Osaka City
Osaka is situated slightly to the west of the centre of Japan, adjacent in the east to Kyoto and Nara, the ancient cities with many World Heritages, and in the west, Kobe that has the world’s leading
international trade port, and other cities abut on, forming the second economic zone in Japan. The major central urban area situated virtually in the centre of this zone is Osaka City. The gross regional production of Osaka City is about 171.9 billion US dollars, which exceeds Hong Kong, equivalent to the scale of a country such as Poland and Norway.

(2) Urban Outline of the Area around
Osaka Station, situated slightly to the north of the centre of Osaka City, is one of the largest transport nodes in Japan where six stations accumulate in the vicinity including underground railway, with multiple railways directly linking with Kyoto and Kobe (Fig. 1). The underground malls and passages are developed to link those stations. The total floor area is about 82,000m2, which makes an important pedestrian network for the visitors of this area.

![Fig. 1. Osaka station.](image)

2.2 Outline of the Questionnaire

The questionnaire survey was conducted on 513 users of the underground malls in Osaka. The attributes of the respondents are shown below (Fig. 2).

![Fig. 2. Attributes of the Respondents of the Questionnaire.](image)
2.3 Survey on the Form of an Underground Space

The survey method was to show the pictures of three spaces with different cross-sectional forms (proportion of ceiling to width) to the users, and ask their “favourite space, comfortable space, walkable space” as a cross-sectional form of an underground space. Then asked about the illuminance appropriate to each space. After that, we asked “The space you can comfortably walk through supposing you are in the underground mall” and obtained the answers from the underground users.

<table>
<thead>
<tr>
<th>Ceiling: Width</th>
<th>Underground space I</th>
<th>Underground space II</th>
<th>Underground space III</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5:1</td>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
<td><img src="image3" alt="Image" /></td>
</tr>
<tr>
<td>1:1</td>
<td><img src="image4" alt="Image" /></td>
<td><img src="image5" alt="Image" /></td>
<td><img src="image6" alt="Image" /></td>
</tr>
<tr>
<td>1:2</td>
<td><img src="image7" alt="Image" /></td>
<td><img src="image8" alt="Image" /></td>
<td><img src="image9" alt="Image" /></td>
</tr>
</tbody>
</table>

(1) Result of the Questionnaire Survey

The mean value of the answers of the underground users (513 users) was calculated for each question to investigate the impression that the underground users have to each underground space.

【Favourite space, Unfavourite space】

<table>
<thead>
<tr>
<th>Favourite space / Unfavourite space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unfavourite</td>
</tr>
<tr>
<td>Acceptable</td>
</tr>
<tr>
<td>Favourite</td>
</tr>
</tbody>
</table>

The result of the comparison of the three spaces shows that Underground Space II is the most favourite space. Though it could be considered that this result might be due to the specifications of the components of each space that are set slightly extremely for Underground Space I and III, the result indicates that the existing underground space does not give a feeling of oddness to the users.

【Comfortable space ・ Uncomfortable space】

The result of the comparison of the three spaces shows that the males feel comfortable in Underground Space III and the females feel the same in Underground Space II. For the reason why the males chose III, it can be considered that they quite commonly recognize the underground space as a passage. On the other hand, females have two kinds of purposes for the underground space, passing and shopping,
consequently they chose II as a comfortable space because wide passages might be an impediment when they do shopping.

【Walkability】

The result of the comparison of the three spaces shows that both males and females think III is desirable as a walkable space. When walkability is assessed, the passing traffic volume has a great impact on the assessment result. But as the assessment in this survey is performed assuming the similar level of congestion, consequently it is considered that Underground Space III that has the widest passage was chosen as the most walkable space.

【Choice of Space Illuminance】

The result of the comparison of the three spaces shows that for the choice of the space illuminance, the space where the respondents felt the necessity to brighten most is in the order of Under Spaces I → II → III. In the case of the renewal of existing underground spaces, the users perceive a good impression when the illuminance is heightened, therefore it is desirable to set the illuminance of underground space comparatively bright.

As indicated above, there are some difference concerning the favourite cross-sectional form between the males and the females because of the purposes to use the underground space. The survey found that the underground users tend to prefer a wide space because there is less interruption when they walk.

2.4 On the Existing Underground Space

This clause shows the spaces that underground users cited as their favorite among the spaces in the area around Osaka Station.

<table>
<thead>
<tr>
<th>Features of the Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Glass ceiling to take in natural light, sunlight.</td>
</tr>
<tr>
<td>• Looks clean due to thorough maintenance of passages, etc.</td>
</tr>
<tr>
<td>• Gives sense of season by changing design according to seasons</td>
</tr>
<tr>
<td>• Used as a lively space including use as a space to give events</td>
</tr>
<tr>
<td>• Takes off the sense of being underground because of high ceiling</td>
</tr>
</tbody>
</table>
The four above are the spaces that underground users supported most. For the reasons why they prefer these spaces, the following keywords are considered.

Space with sense of openness
Intake of lights to space
Space to give sense of season (greens)
Space to give sense of linking with the outside air
Designed space

Considering according to the keywords, what is desired to underground space is not the part of passage but rather the place with the element of underground plaza. In that underground plaza, it becomes possible to put an accent in the monotonous space by setting a different type of distinct design. And the users can recognize the visibility of where they are and which direction they want to go to by passing through those distinct spaces.

3. PROPOSAL FROM THE UNDERGROUND USERS ON COMFORTABLE UNDERGROUND SPACE

It is one of the desired matter to provide comfortable space to the users by improving the design and the specifications of the components of the underground space such as ceilings, walls and floors, however, it was found that if the space is simply widened or the typical specifications are changed, it would not largely change the users’ image of the underground space.

Among the existing underground spaces, the one with a well or where plants are arranged are preferred. These facilities can put an intonation to the space that is apt to be monotonous, and create a comfortable urban space in the underground space that is likely to be inorganic.

On the other hand, many users express that it is difficult to recognize where they are now. Different from walking on the above-ground, similar spaces continue through underground, and this makes the space very monotonous and unrecognizable.
As a solution to that monotonous space, it is considered to be necessary to improve the continuity to the above-ground part, make plans as a continuous space of underground and above-ground, and establish a space that clearly shows the continuity with the above-ground (Fig. 3).

![Fig. 3. Continuous above and underground space.](image1)

In the present urban area, a wide open space is arranged underground as a place where people get together and relax, which is a sunken garden that is actively introduced into plans in recent years (Fig. 4). Around a sunken garden, people gather and have a relaxing time. The space with an open sunken garden can also be utilized for evacuation and shelter in the event of disaster including fire.

In the future, utilizing the fruit of this study, we would like to make propositions actively on improvement plans of the existing underground spaces and on new plans. And we hope to make plans of underground spaces where the underground users can spend the time safely and comfortable.