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Utilization of Deep Underground Space in Tokyo -Urban Renewal with the City's New Backbone Lifeline-

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Abstract

In 2001, the Law concerning Deep Subterranean Utilization went into effect in Japan. The law states that the use of space at a certain depth underground does not violate the right of the private above-land ownership. In order to provide for urban disaster mitigation in Tokyo and lessen the environmental burden, technological planning should be applied to Tokyo. This paper focuses on deep underground space as the last precious unused space of the mega city, Tokyo. We present an effective way of developing a deep underground space network in a closed-off section of Tokyo Bay to promote urban renewal in Tokyo.

Keywords: deep underground space; deep subterranean utilization; mega city Tokyo; urban renewal; lifeline

1. Introduction

It is important to revitalize the urban areas of Tokyo. As part of the nationwide urban renewal efforts, the Law concerning Deep Subterranean Utilization was recently enacted, which permits the use of deep underground space in urban renewal.

We established an industry-government-academia research group to promote urban renewal projects. Figure 1 shows the recommended measures. To realize the important key projects, appropriate institutions and policies must be developed.

The purpose of urban renewal in mega city Tokyo is the prompt establishment of an effective and efficient urban foundation in the course of day-to-day activities and the securement of capital functions in times of emergency.

This paper introduces studies on deep underground space network projects. In order to realize urban renewal over the next ten years, it is important to select an appropriate initial project.

With this in mind, we considered the deep underground space network in the closed-off section of Tokyo Bay.



Fig. 1. Concept of Urban Renewal

2. Deep underground space network project

The deep underground network can become the city's new lifeline.

We proposed a deep underground space network project to alleviate problems in Tokyo regarding both disaster prevention and improvement of the urban environment.

The underground system is composed of a vertical tunnel that connects the surface of the earth with deep underground bases, and a horizontal tunnel that joins each of the underground bases. The horizontal tunnel is a multipurpose underground conduit, as shown in the illustration (Figure 2).

The routes and functions of the Tokyo underground network are shown in Figure 3.

Our previous feasibility study shows that the deep underground space network project has considerable potential to improve the urban environment and enhance disaster prevention in Tokyo. As the financing of major projects such as this is problematic, we paid close attention to the external economic effects of the project and decided that it should be financed through a private finance initiative (PFI). This project is feasible by integrating urban disaster

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prevention projects with urban environment improvement projects.

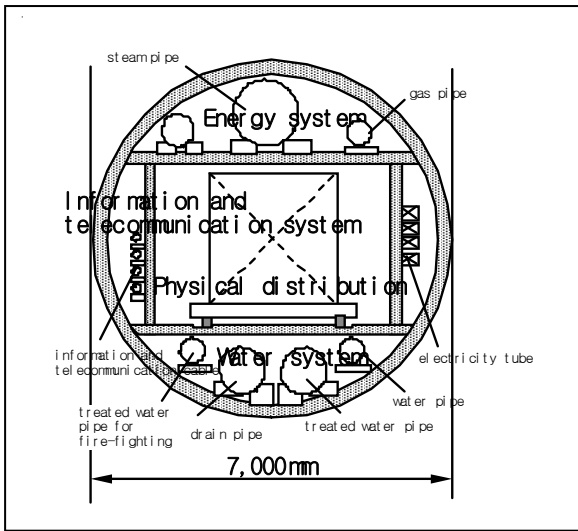


Fig. 2. Section of the network (Route A)

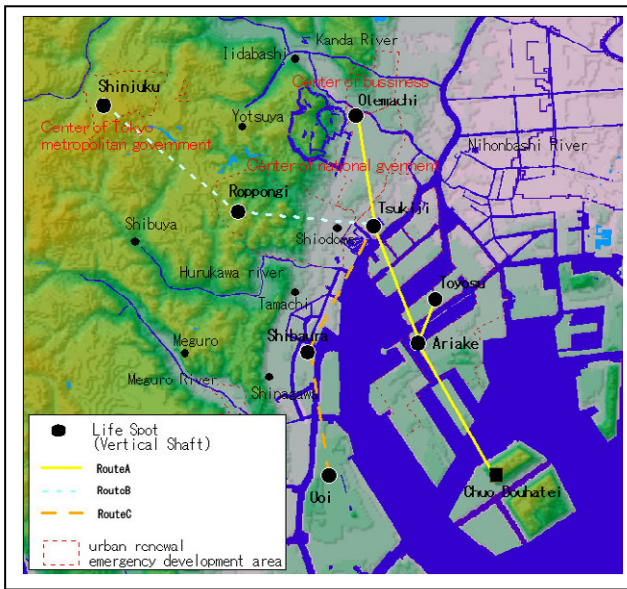


Fig. 3. Routes of the Tokyo network

There were 3 main routes originally, as shown in Figure 3, but from last year, we especially focused on and took up the line from Ariake to Otemachi (part of Route A) in the closed-off section of the Tokyo Bay shown in Figure 4. We named it "the city's backbone lifeline."

A phased approach is appropriate, so we made a plan to develop the deep underground lines and systems step by step. Development along the line from Ariake to Otemachi in the closed-off section of Tokyo Bay was positioned as the breakthrough for this project because it is financially viable and has

excellent environmental and urban disaster mitigation as benefits for Tokyo.

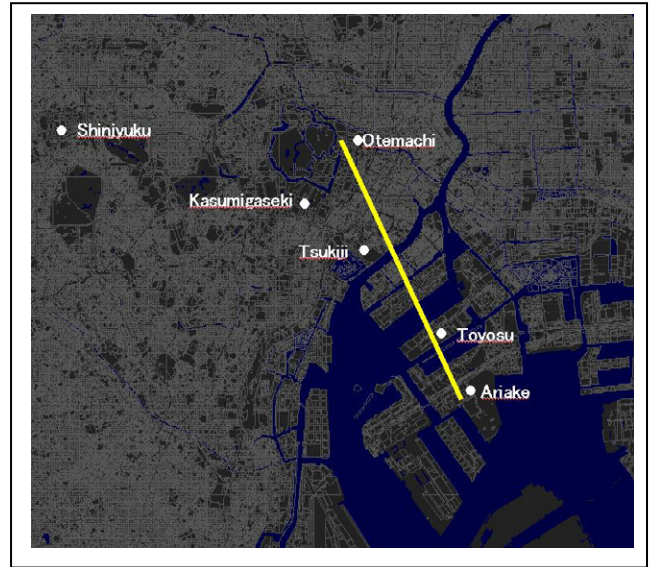


Fig. 4. Routes of the city's backbone lifeline (Initial project)

3. Three viewpoints on the new lifeline

We evaluated the development of Tokyo's backbone lifeline from three viewpoints.

The first is the value of the route in providing a lifeline for emergency relief in the case of an earthquake disaster.

The second is the value of the route in contributing to reducing environmental problems and improving the urban environment for Tokyo citizens.

The third is the value of the route in contributing to the urban structure for the formation of a cityscape and creating a natural fresh breeze from the sea for adequate ventilation of the city..

3.1. Lifeline for emergency relief in the case of an earthquake disaster

The project would provide a lifeline for emergency relief in case of an earthquake disaster. At the same time, the lifeline would secure capital functions in emergencies. Public disaster-prevention facilities are localized in the bay areas, especially Toyosu and Ariake. A national disaster prevention facility will soon be established at Ariake.

At Toyosu, there is a major gas line, electricity line and waterworks. Furthermore, a large public market will be built here in several years. For these reasons, the area is ideal as a disaster-prevention base (Figure 5).

The city's backbone lifeline can transfer this potential to the inner area of Tokyo around Otemachi, which is the business center of Tokyo, to enable

assistance to reach affected people and buildings.

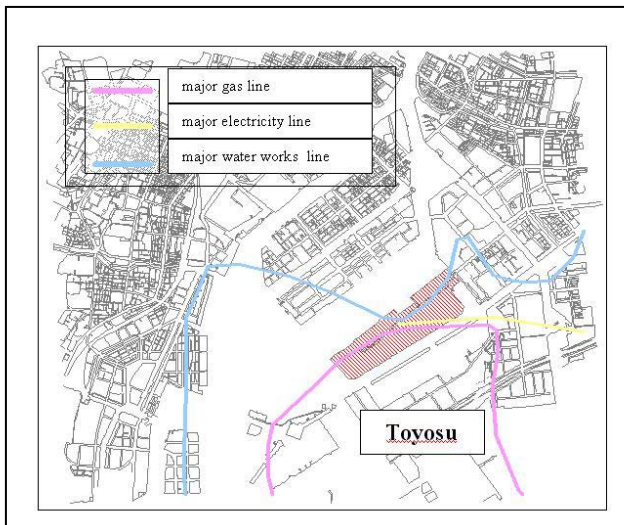


Fig. 5. Concentration of major lines at Toyosu

In addition, there is sufficient open space for relief supplies for earthquake victims to be received and distributed. The space allows relief operations to be carried out.

3.2. Lifeline to assist high-efficiency day-to-day city activities

This section considers the daily lives of citizens. It is essential to the sustainable development of the city to balance high-level city activities with contribution toward the global environment and urban environment.

The bay areas are both a heat source and a heat sink. By conveying exhaust heat from the large CGS(Co-generation System) plant to the plants of the district heating and cooling systems around Otemachi through deep underground lines, it is possible to save energy and to reduce greenhouse gas emissions.

Furthermore, by circulating cooling water between the bay areas and areas around Otemachi, it is possible to convey exhaust heat from the district heating and cooling plant not into the center of the city, where there are residents and daily city activities, but into seawater. Accordingly, we can ease the heat island phenomenon in Tokyo. There have recently been sharp temperature rises in large cities due to the heat island effect. This is a drastic solution to improve the urban energy supply and dispose of heat to heighten urban energy efficiency.

3.3. Lifeline for the formation of a cityscape and creating a fresh air conduit

We try to reform our city, which is a stage of our life and on which we live a city life over a century. We have to pursue our city's life of high quality thoroughly over a long time.

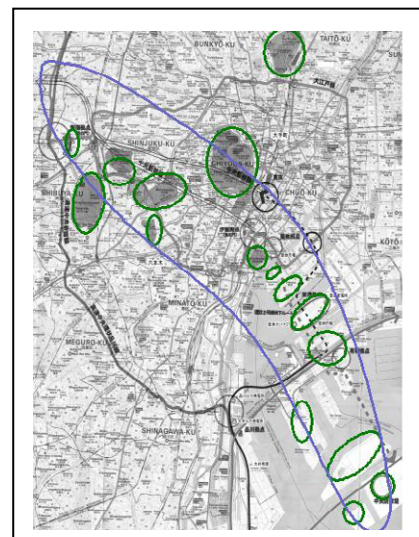


Fig. 6. Green networks and fresh air conduit

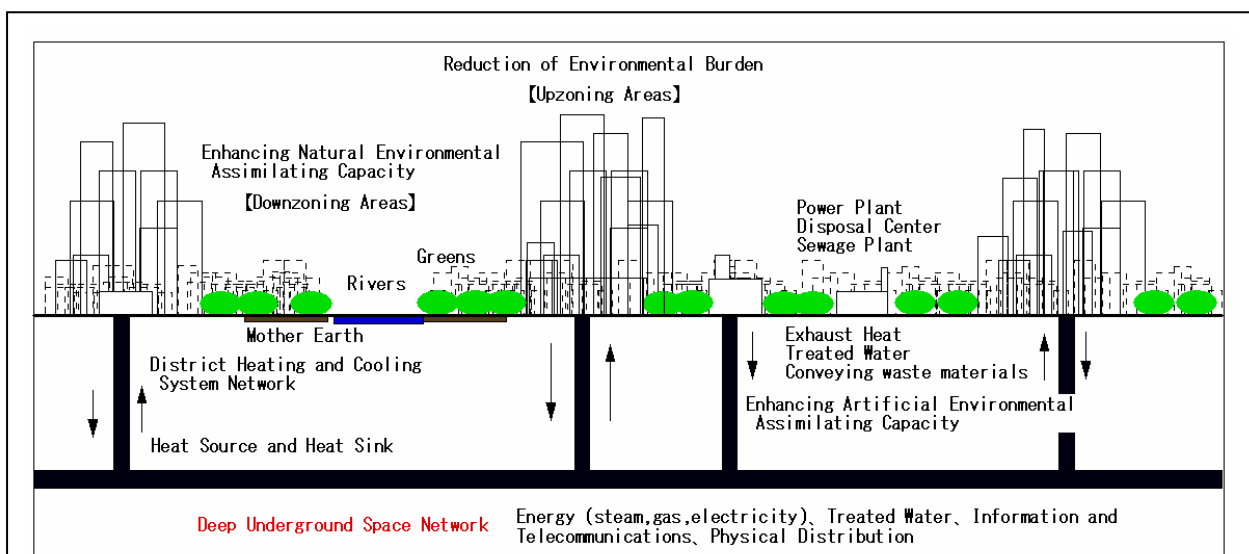


Fig. 7. Concept of Urban Cluster Model

To develop underground lines in an orderly fashion, the aboveground spaces on the lines will also restore order. It will be possible to establish a network of green spaces and create a conduit for fresh breeze from the sea. (way of wind)

Our research group proposed an ideal city model, the Cluster Model, of the Tokyo urban area. The basic concept and image of the Cluster Model of Tokyo is shown in Figure 7. In this model, buildings are consolidated on the terrace and are supported by an essential main line of infrastructure with safe, deep, underground spaces to assure security, efficiency, and low impact on the local urban and global environment.

Between such up-zoning areas, rivers and green spaces separate the developed areas. It is important to put natural infrastructure, such as rivers and green spaces, into urban areas to prevent suburban sprawl and urban heat islands.

Open spaces around rivers will nurture the green spaces. The flow of water and greenery along the rivers are expected to attract and create wind channels. Derivation of an urban structure will also inspire the formation of an attractive cityscape.

4. Conclusion

This paper proposes a deep underground space network project as part of the urban renewal of Tokyo.

We evaluated the new city's backbone lifeline from three viewpoints. The values are a lifeline for emergency relief in the case of an earthquake disaster, an important contribution toward the global environment and urban environment and the derivation of urban structure for the formation of a cityscape and the creation a conduit for fresh breeze from the sea. (way of wind)

We will continue to work on the urban renewal project by combined technological improvement based on environment engineering theories.

References

- 1) Toshio, OJIMA., 1991. Imaginable Tokyo, Process Architecture, Tokyo, JAPAN.
- 2) Toshio, OJIMA., 1995. Advanced Scene of Tokyo, Waseda University,, Tokyo, JAPAN.
- 3) Toshio, OJIMA., and Gideon S., GOLANY, Geo-Space Urban Design, John Wiley & Sons, Inc., New York, USA
- 4) Yukihiro Masuda., 2003. Utilization of the Deep Underground Space in Tokyo., Second International Symposium on NEW TECHNOLOGIES FOR URBAN SAFETY OF MEGA CITIES IN ASIA., p.149-155