

OHASHI JUNCTION “COMMUNITY, ROAD, RE-DEVELOPMENT INTEGRATED PROJECT”

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ABSTRACT RÉSUMÉ

Metropolitan Expressway Company Limited, in Tokyo, is constructing the world 2nd longest road tunnel, called the “Yamate Tunnel,” in the centre of the capital, in order to alleviate heavy congestion on the motorway network in Tokyo. The Yamate Tunnel is an essential part of the Metropolitan Central Circular Route (the Central Circular Route) which is one of uncompleted ring roads in Tokyo.

The Ohashi Junction connects two routes within the congested urban area: the Yamate Tunnel, a newly opened ring road, and the Metropolitan Expressway Route #3 (Route #3), an existing radial road. There is no other junction in the world that can rival the junction for technological perspectives.

The Ohashi Junction is a totally new urban junction, and has provided innovative solutions to city planning, smooth traffic, roadside environment, and other issues in the construction of urban expressway in the Tokyo Metropolitan area. First of all, three dimensional zoning system is used to encourage compact development and effective land use within the redevelopment area. Secondly, the rooftop park and garden as well as the greenery around the junction is expected to reduce the negative environmental impact on the surrounding neighborhood. In addition, the policy on higher safety on disaster-prevention and comfort of driving is adopted since the Ohashi Junction has particular condition. This paper reports various environmentally friendly approaches to realize a sustainable community.

1. OUTLINE OF THE CENTRAL CIRCULAR ROUTE

The Central Circular Route, a ring expressway with a total length of 47 kilometers, encircles Central Tokyo, an eight kilometer radius area. The Central Circular Yamate Tunnel (the Yamate Tunnel) forms the western part of the Central Circular Route, an 11 kilometer long tunnel. T The Central Circular Shinagawa Route (the Shinagawa Route) forms the western part of the Central Circular Route, an eight kilometer long tunnel. Both tunnels are planned under the existing surface road, Tokyo Metropolitan ring road #6. These tunnels include a very complicated large-scale underground structure, composed of 3 junctions, and 12 on/off ramp tunnels. The full opening of the Yamate Tunnel was on March 28, 2010, and the Shinagawa Route is scheduled to open in 2014 (Fy 2013).

The Central Circular Route aims to make Tokyo’s transportation network more efficient and easier to use. At present, inter-city expressway users who travels between two cities seated across Tokyo must transit Tokyo Central via the Metropolitan Expressway Inner

Circular Route (the Inner Circular Route). Such inter-city traffic accounts for approximately 60% of the traffic on the Inner Circular Route, and the transit traffic is one of the primary causes of chronic congestion on the Metropolitan Expressway. Completion of the Central Circular Route will provide alternate connections with intercity routes and ease congestion throughout the system (Figure 1).

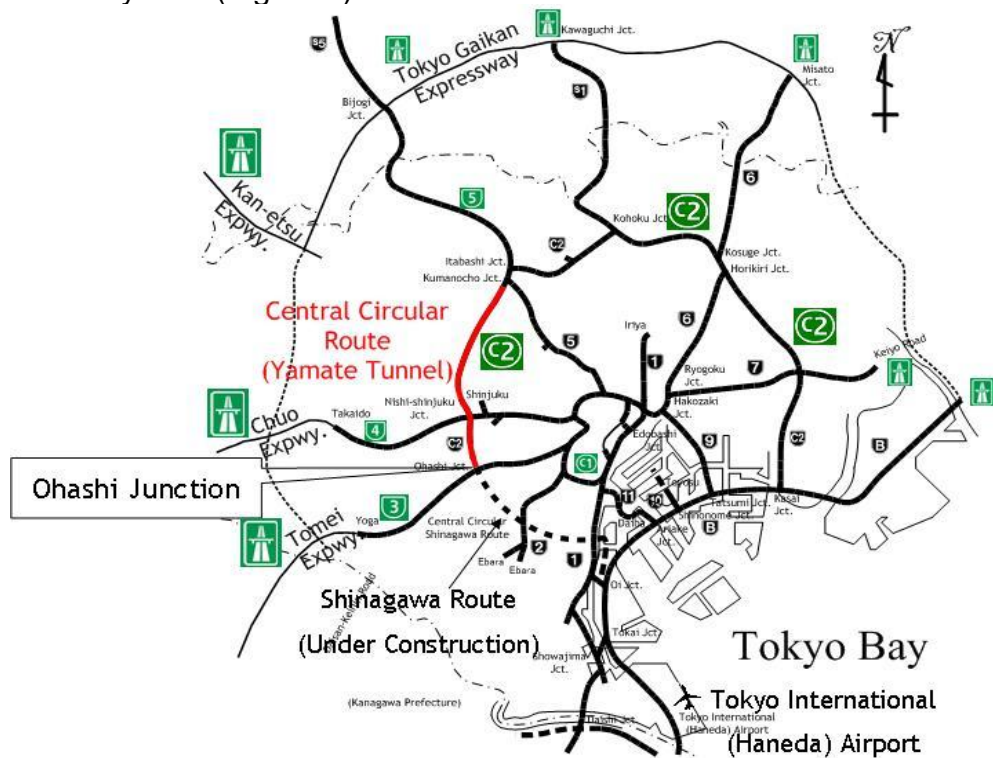


Figure 1 – Metropolitan Expressway Network

Passing through residential and business district, the Yamate Tunnel and the Shinagawa Route intersect numerous streets and railways. (Figure 2). Utilizing the latest environmentally sound construction methods, we are making efforts to keep construction noise and vibration to a minimum and to avoid disruption of existing traffic flows. Our aim is to complete the Central Circular Route with minimum negative impacts on the environment. Thus, the Yamate Tunnel and Shinagawa Route run almost entirely underground, and effective measures are adopted to reduce traffic noise and emissions.

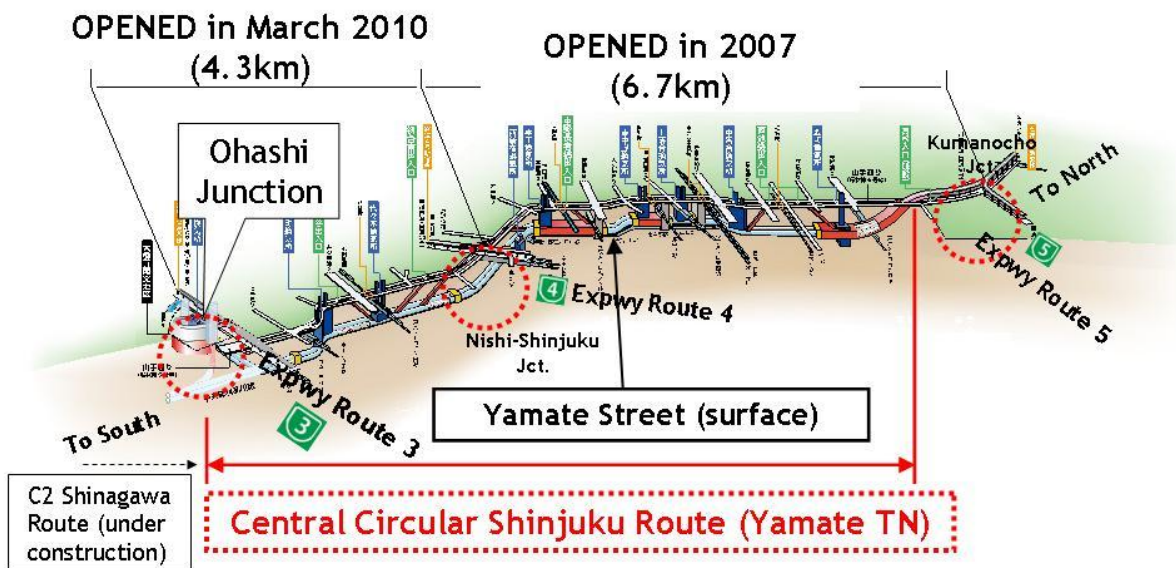


Figure 2 – Location of Yamate tunnel and Ohashi Junction

Construction has been carried out by shield tunnelling machines that can burrow underground, avoiding disruptions to above-ground traffic flow and minimizing the noise and vibration associated with large-scale construction projects.

2. OUTLINE OF OHASHI JUNCTION

The Ohashi Junction is a loop junction that connects the Central Circular Route (the Yamate Tunnel) with the Metropolitan Expressway Route 3 (Shibuya Line; Route #3) running above the National Route 246 (Tamagawa Street; Route #246) (Figure 3). This junction has a compact four-level, two-way, loop ramps to resolve the vertical difference of 70 meters between the Yamate Tunnel, which goes about 35 meters below the surface, and Route #3, which goes about 35 meters above Route #246. The roughly 400 meter perimeter is covered with well-designed concrete walls and slabs and the ventilation station is installed inside the loop.

Construction of this junction also involves its surrounding local communities as part of the Ohashi district’s “Community, Road, Re-development Integrated Project,” which allows the Ohashi residents who opposed to relocate, within the project area to be exempt from expropriation for removal: after the completion of the project, they have a choice to move in the newly-developed condominium building in the redevelopment area. The scheme had definite advantage on land acquisition for motorways, since it could reduce the risk of significant delay in the project.

The carriageways are fully covered with solid walls and slabs in order to reduce the environmental impacts, such as air pollution and traffic noise in the surrounding neighbourhoods. Meanwhile, a park is constructed on the concrete slabs intending to provide green spaces for local residents in the highly developed urban area.

In addition, to ensure safe and comfortable driving on the steep spiral ramps, various tried-and-trusted driving support measures the surface of the road is coated with different colours to guide drivers intuitively to the routes to their destinations.

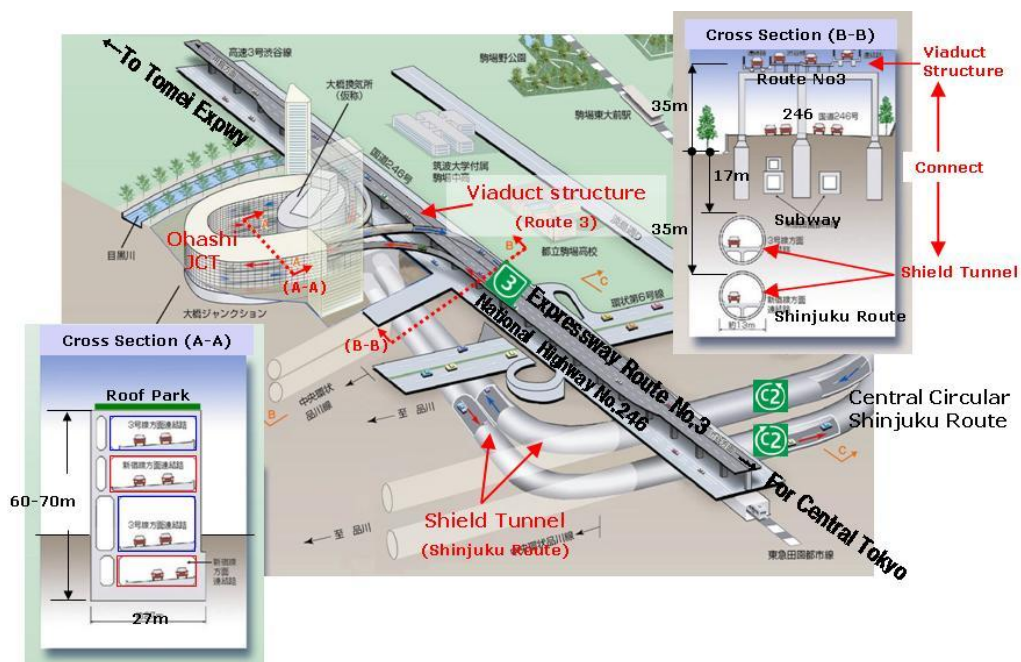


Figure 3 – Configuration of the Ohashi Junction

In this way, the project contributes to realizing a sustainable community through various environmentally friendly approaches. Also, the project is now entering the peak project period while the Ohashi Junction has already been in service since March 2010. It will be accomplished in 2012 with fully opening of the newly developed condominium building.

3. OHASHI RE-DEVELOPMENT PROJECT

The construction of the Ohashi Junction is a part of the larger Ohashi redevelopment project. It is a citywide comprehensive project, which involves the Tokyo Metropolitan Government, the Meguro-city Government, local community organizations, and Metropolitan Expressway Company Ltd. These stakeholders have been effectively working together on the redevelopment project.

Because construction of the Ohashi Junction required large area and caused community severance, there was concern regarding various negative impacts, such as environmental issue, transfer problems of residents, revitalizing of local community, etc: it is highly necessary to construct this junction involved local communities as part of the Ohashi district's "Community, Road, Re-development Integrated Project" in order to resolve these problems, taking into account long-term vision of community renovation around this district (Figure 4).

Community involvement in the planning and decision-making process is important in helping to create a sustainable community. To promote constructive participation of many stake-holders, we have been holding weekly meetings, which are a forum to discuss the land use plan, the building and street designs, and the management of the park and open spaces, which are intended to help to revitalize the surrounding community.

It is expected that these collaborative activities will bring benefits to each stakeholder: the redevelopment project will rapidly be accomplished while a comfortable life will soon be provided to the local residents. Also, landowners and leaseholders are promptly compensated for their property in the area to be redeveloped.

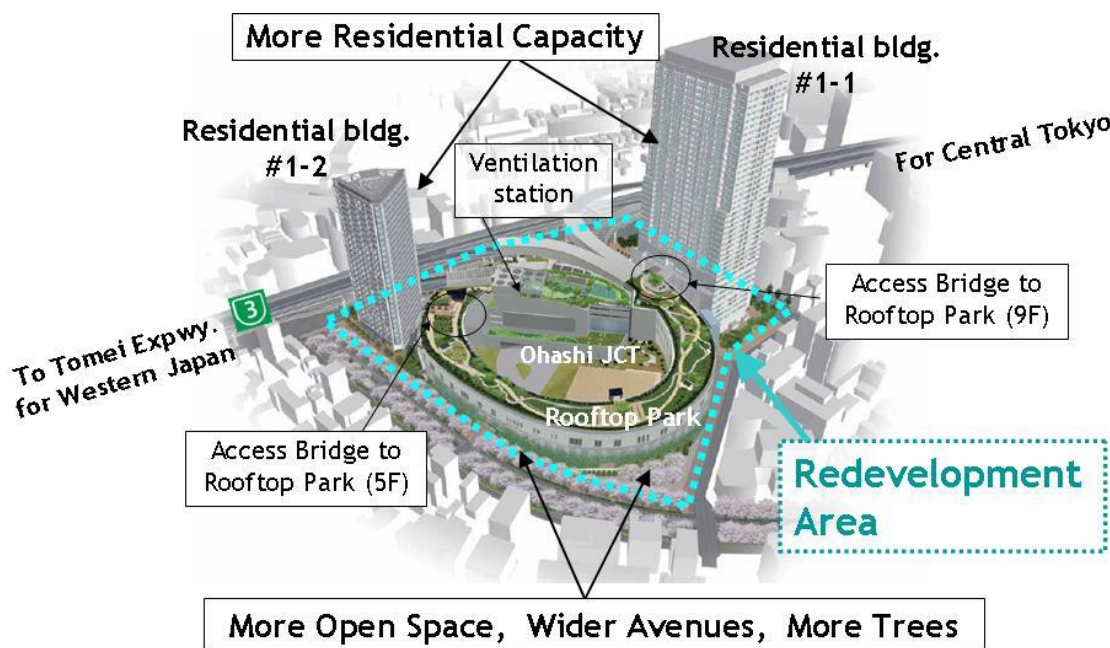


Figure 4 – Ohashi Redevelopment Project

3.1. Three-dimensional zoning system

Generally, construction of architectural structure is not permitted in the road area for a road management reason, while it is difficult to acquire land for road in densely populated area. So, the three dimensional zoning system was created to use intensive land. This system is that land owners and leaseholders are allowed to exercise private rights except three-dimensional space of the road by setting the three-dimensional zone for road. As the result, it is possible to construct buildings above the road area (Figure 5).

The system allows for the three-dimensional, duplicate use of the expressway: for, buildings, space and the public park. The compact development will also help to increase the use of public transit and bicycles in the area by parking lot for bicycles.

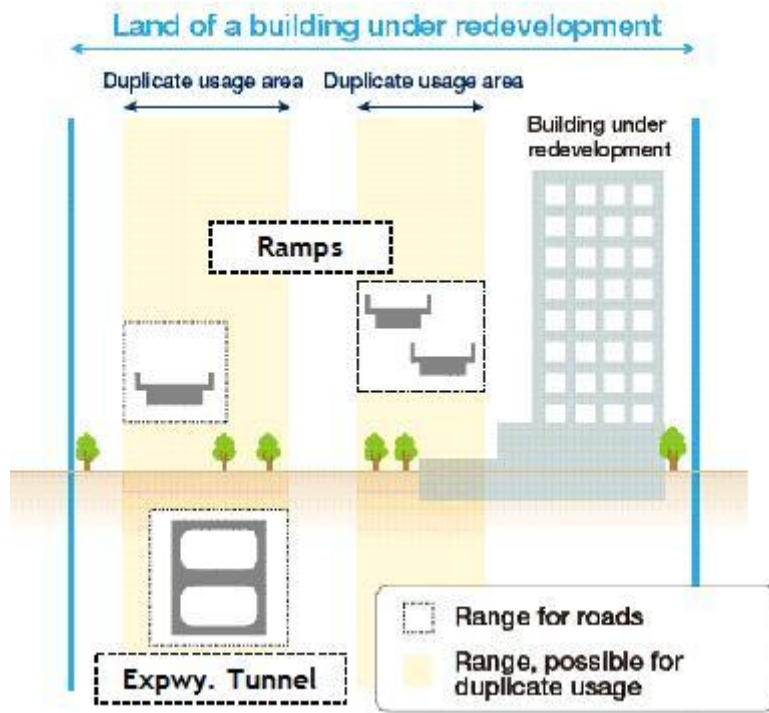


Figure 5 – Intensive Land Use Plan



Junction of I-110 and I-105 in Los Angeles

Figure 6 – Size of Ohashi Junction

3.2. Land use plan

The redevelopment area is relatively small (about 40000 m²) in size (Figure 6). There are, however, many facilities with the project: as the Ohashi Junction itself and the ventilating station, two residential complexes with commercial areas, a rooftop park, and open spaces with bicycle parking. About two thousand residents, including the residents displaced by the construction, will be able to live in the new high-rise residential buildings with direct access to the rooftop park on the junction. Many functions are integrated in a balanced way.

3.3. Design of municipal park and open space

We are now proceeding with an environmentally friendly project which includes three green policies, to improve the surrounding environment, greenery on the junction wall, a park with trees on the junction roof, and a garden for conservation of biodiversity on the ventilation station roof (Figure 7). In addition, the project includes widening roads and developing open space for the municipal park around the junction.

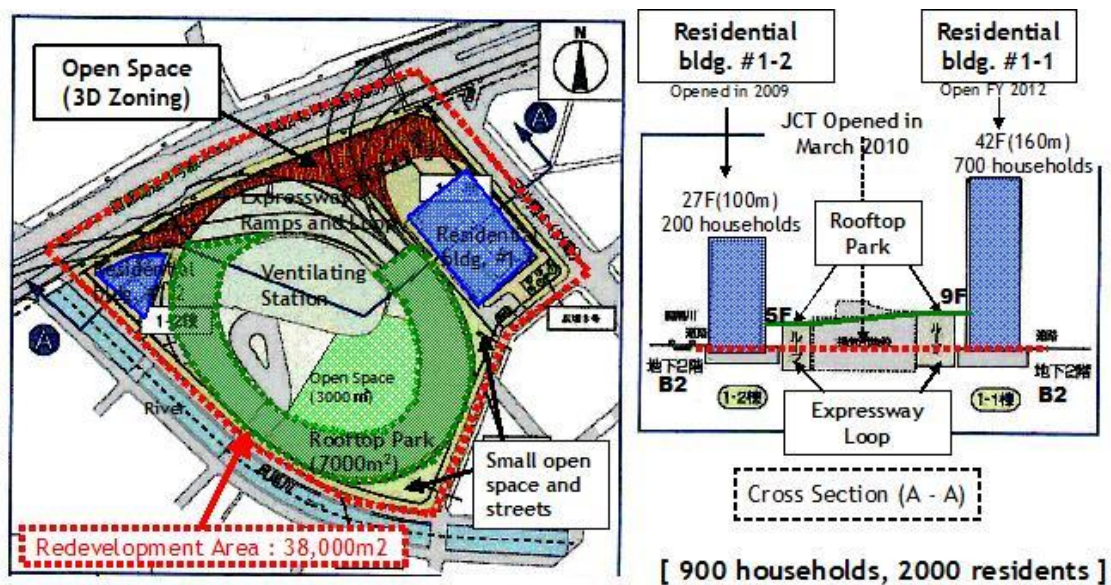


Figure 7 – land Use Plan

3.4. Synergy effect between community development and road project

There are a lot of advantages on this collaborative project as noted below. We are expected that the synergy will produce one and a half times as much socioeconomic benefits as the total benefits obtained through each project carried out separately. (Figure 8).

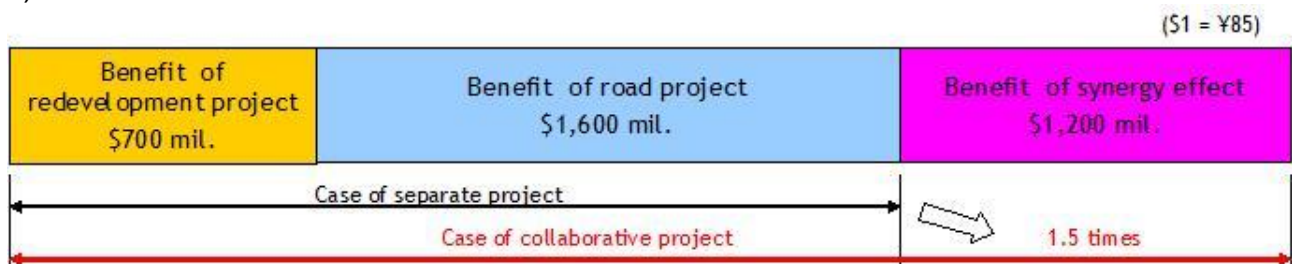


Figure 8 – Estimation of Synergy Effect

3.4.1 Effective land use of site redevelopment

As duplicate use of this area by the three dimensional zoning system enabled available area to increase: offices, public facilities, and open spaces have been developed; and urban functions have been enhanced. It is estimated that floor space increases from 69,000 m² to 101,000 m².

3.4.2 Early completion of the expressway the “Yamate Tunnel”

The collaboration for road and redevelopment project enabled prompt decision-making of stakeholders to be facilitated. And also, it was achieved to shorten the time schedule because the two projects of area redevelopment and junction construction were promoted simultaneously. It is considered that this collaboration lead to early completion of the Yamate Tunnel: the tunnel was completed five years ahead of the target date which was intended if the two projects were planned separately.

3.4.3 Various fringe effects on community development

This collaboration project will produce various effects on community development: incorporating public opinions through community forums, wooden buildings were rebuilt into fireproof buildings, public utilities were laid underground, and trees and other greenery were increased, which improved urban landscape and environmental amenity.

4. OHASHI “GREEN” JUNCTION

The Ohashi “Green” Junction project is an environmentally friendly project which includes three green policies to reduce the urban heat island effect, prevent global warming, and conserve biodiversity, i.e. greenery on the junction wall, greenery on the junction roof, and greenery on the ventilating station, toward the opening of the town in fiscal 2012 (Figure 9). It contributes to developing an ecological network interconnecting the green spaces around the junction in the urban area.

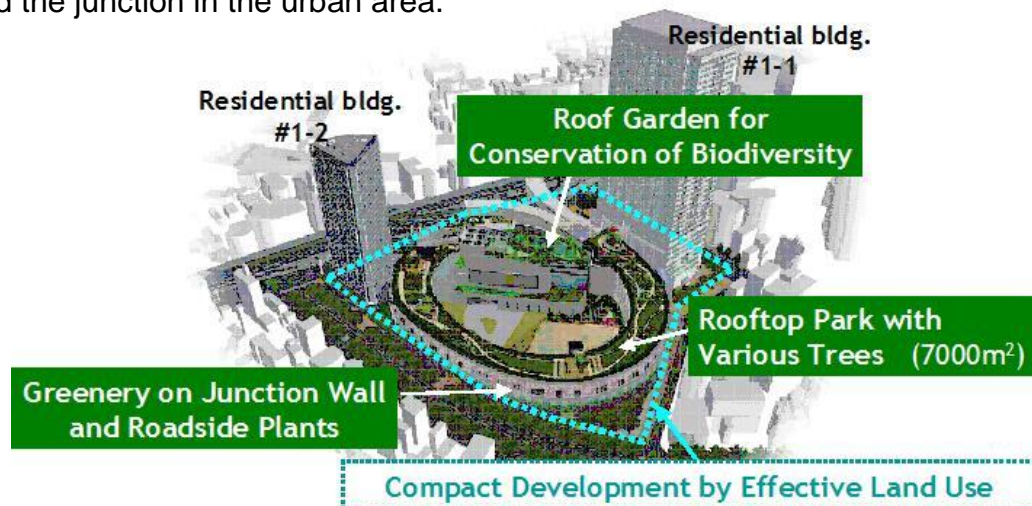


Figure 9 – Ohashi Green Junction; Environment-Friendly Approaches

4.1. Concept of the Ohashi “Green” Junction Project

4.1.1 What’s Ecological Network?

The sea breeze blows during the daytime, and the land breeze blows during in the nighttime. This is called breeze circulation. Breeze circulation as well as vegetation has a function to reduce the urban heat island effect. Green space which has a role as cool spot

cools the air and promotes flow of the wind. It is highly useful to create rooftop gardens and greenery on the junction wall in this district that suffers from the urban heat- island effect.

An ecological network is a network to interconnect the green spaces in the town such as parks, lines of trees along streets or rivers, etc. in order to recover damaged ecosystems and to conserve biodiversity in the urban area. The greenery at the Ohashi Junction contributes to the formation of the ecological network interconnecting the plants and trees in Yoyogi and Komaba Parks and those along the Yamate Street and the Meguro River (Figure 10). Therefore, the greenery of the Ohashi Junction is expected to take a role of a junction of environmental network in Central Tokyo.

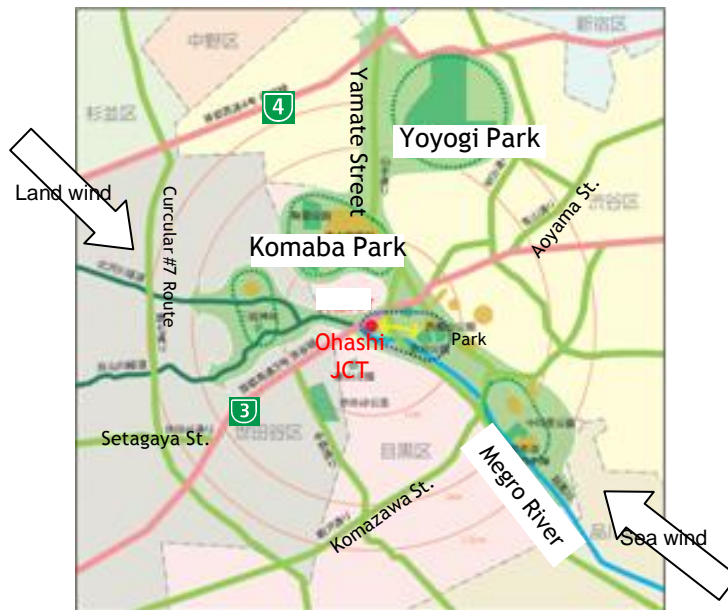


Figure 10 – Ecological Network around the Ohashi Junction

4.1.2 Fundamental Policy about “Green” Junction

We are making efforts to develop an ecological network by three green policies, i.e. greenery on the JCT wall, greenery on the JCT roof, and greenery on the ventilating station. The greenery policy around the junction is contribution to environmental improvement formed by the harmonious design of the junction and greenery.

4.2. Roof park with trees and rooftop gardening

This is the first attempt in Japan to build a public park on the roof covered loop ramp in collaboration with the Meguro ward in Tokyo. The park is a circuit style Japanese garden, based on the concept of “Meguro Sky Garden” to showcase Japanese culture to not only local communities but also throughout Japan and the world. In the park people can enjoy the nature in all seasons and the Japanese culture of harmony. We aim to create a new type of park in the urban area that contributes to revitalizing of local communities through collaboration with local residents and strengthening relationships among people in local communities.

Rooftop of JCT has about 7,000m² areas and 24m difference in height. There are three access pathways to the roof park on this rooftop, which are the ways from the pedestrian bridge above Route #246 and both residential buildings. The inhabitants of #1-1 and #1-2

can directly access to the roof park. And also, there will be multipurpose space which has 3000m² areas inside this loop (Figure 11).

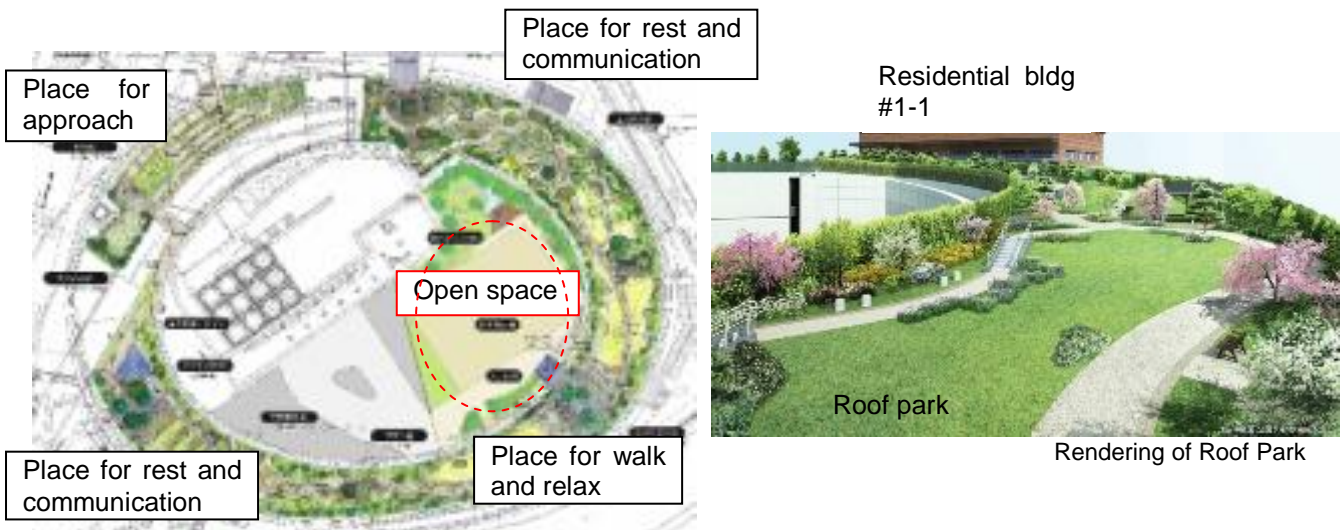


Figure 11 – Junction Rooftop Park

4.3. Greenery on the junction wall

The walls of the junction are covered with creeping figs (climbing plant) from the ground surface in harmony with the landscape of the junction. The planting trees around the junction will contribute to improving the regional environment, blending in with the landscapes of the surrounding areas as time advances, softening people’s heart and giving the leafy junction a distinctive character. Creeping figs will grow from 0.5 to 1 m height per year (Figure 12). The greenery on the junction wall as well as the rooftop park aids in mitigating the urban heat island effect. The temperature on a wall surface with greenery will be about 2-3 degree lower than that one without greenery.

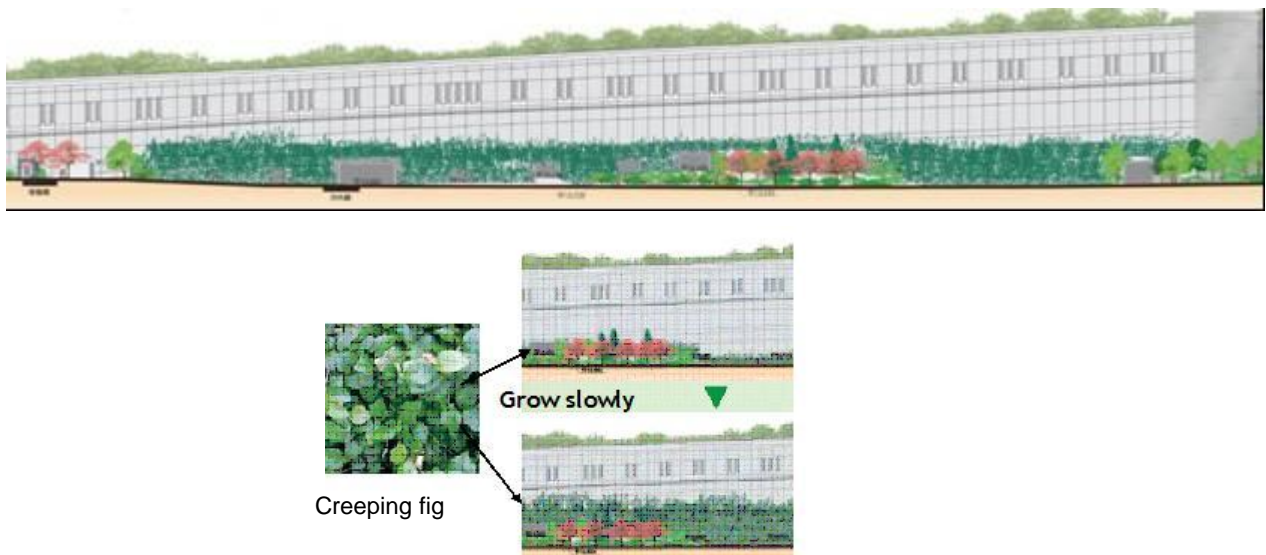


Figure 12 – Greenery on the Wall

4.4. The rooftop garden of ventilation station for conservation of biodiversity

Ecological restoration spaces modelled on the original landscape along the Meguro River are created on the roof of the ventilating station. Spaces for planting trees are built to

contribute to the improvement of regional environment as a part of the ecological network that interconnects the green spaces in the town (Figure 13, 14).

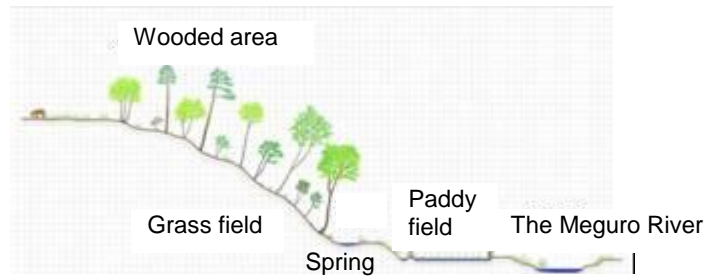


Figure 13 – Original Landscape along the Meguro River

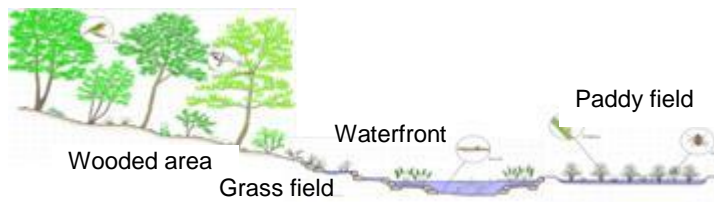


Figure 14 – Image of Naturally-regenerated Space

The roof garden, an area to conserve biodiversity, is being constructed on the ventilating station. In this garden, indigenous plant species will be planted around rice paddies (Figure 15). The local residents will be able to participate in the management of the garden as well as the participants in the environmental education programs conducted in the garden area. Both of these are effective tools to help residents become involved in, and to thereby develop their community.



Figure 15 – Roof Garden on the Ventilating Station

4.5. Design of landscape

The theme of landscape around the Ohashi Junction is “Making stylish town in which they can pleasantly walk, and kindly to habitants” We designed this junction while imaged the Colosseum in ancient Rome, because the dimensions of its above-ground part and the

outline are almost same as the Colosseum in Rome. The surface was fabricated with slit rib, and had dummy window above window sill. As a result, the junction has an elaborately-wrought appearance (Figure 16).

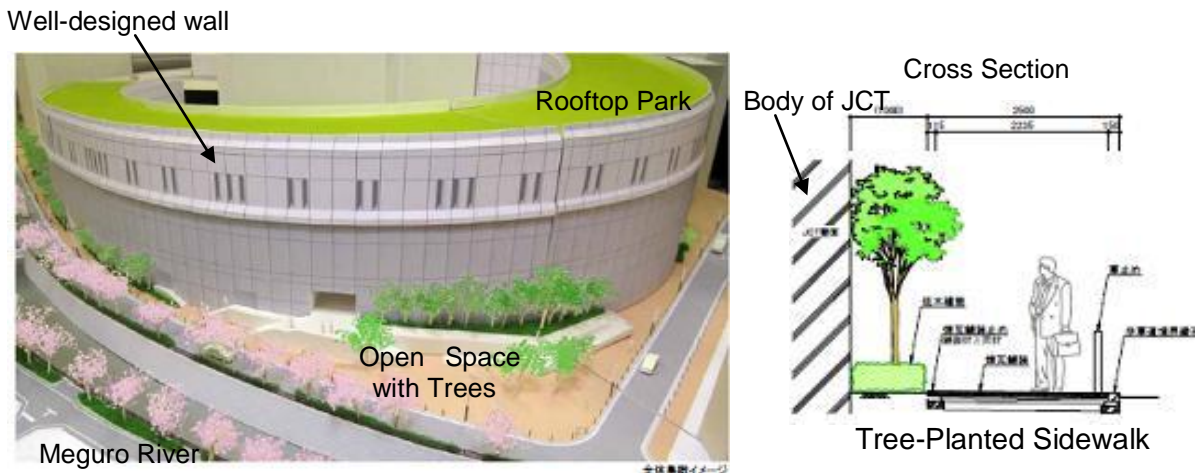


Figure 16 – Greenery Design around JCT

4.6. Covered junction equipped ventilation station

The loop ramps and part of the elevated section connecting to the Metropolitan Expressway Route #3 (Shibuya Line) are covered with concrete walls and slabs to reduce the environmental impacts, such as air pollution and traffic noise on the surrounding neighbourhoods. Since the junction is covered, the construction of a ventilating station is necessary to improve the air quality in the loop tunnel (Figure 17).

The ventilating station equips low-concentration nitrogen dioxide (NO₂) removal system. The system helps to reduce the environmental impacts of the flue gases from the ventilating station. The system has been installed to all ventilating stations on the Central Circular Shinjuku Route. It has removed more than 90% of NO₂ and has filtered out more than 80% of the suspended particulate matter (SPM) on a daily average basis (Figure 18).

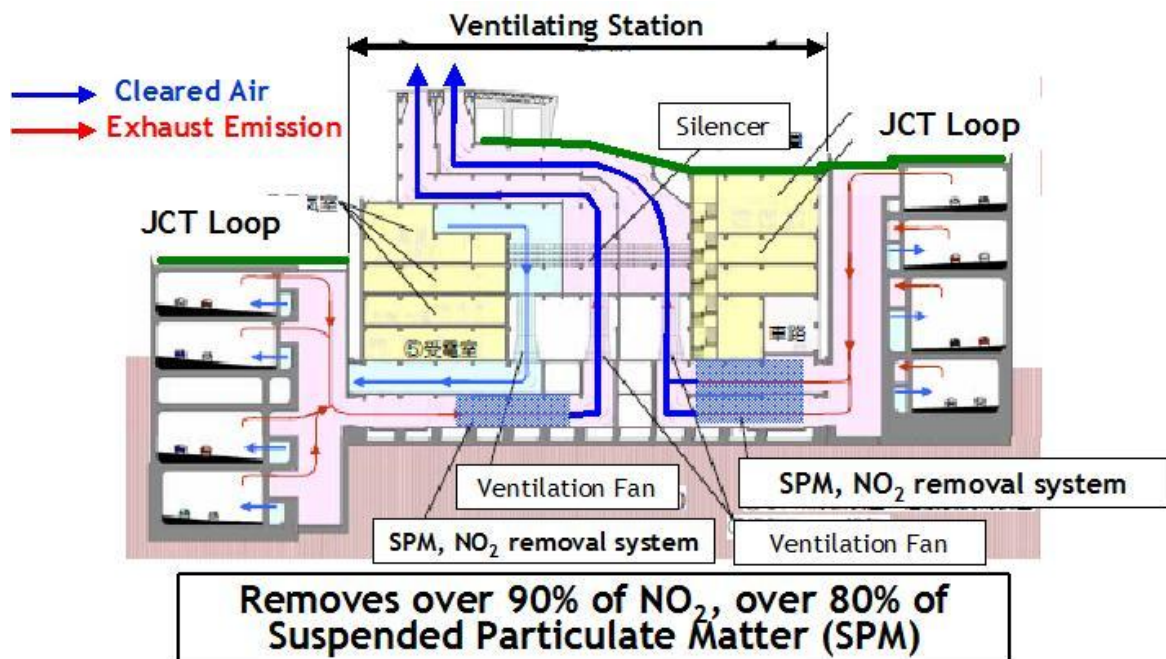


Figure 17 – Ohashi Ventilating Station

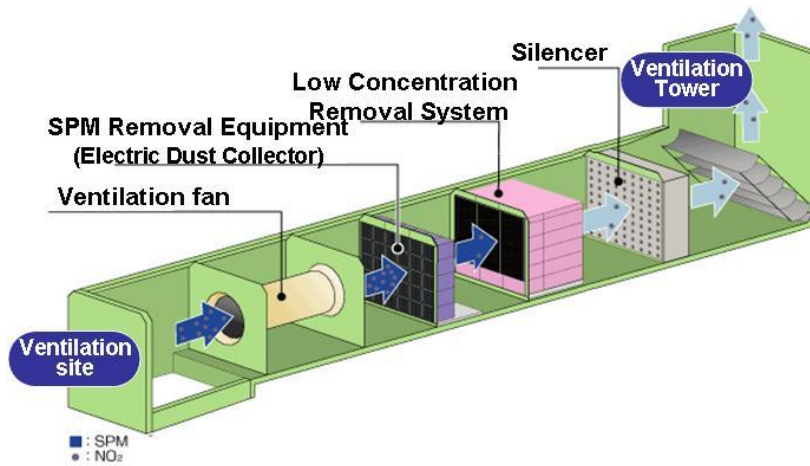


Figure 18– Ventilation Facility (No₂ and SPM Removal System)

5. FACILITY FOR SAFE DRIVING

There are a lot of facilities in the tunnel because much higher safety on disaster-prevention and traffic are required in a confined space.

5.1. Measures to assist drivers for smooth and comfort

We adopt nearly natural light to improve visibility for drivers and pro-beam lighting system at the junction or the ramp to increase illumination intensity, because the Ohashi Junction is covered with concrete and drivers can not see scenery outside road, in addition, drivers must go twice turn along this spiral course at the Ohashi Junction, drivers are likely to lose sense of direction. Therefore, to assist such drivers, the surface of pavement at the Ohashi Junction is coated with two different colours according to destinations (Figure 19). Drivers who want to go toward Central Tokyo use the red lane and drivers toward outer city for western Japan use the blue lane. This measure is expected to guide drivers easily, especially beginners unused to urban expressways

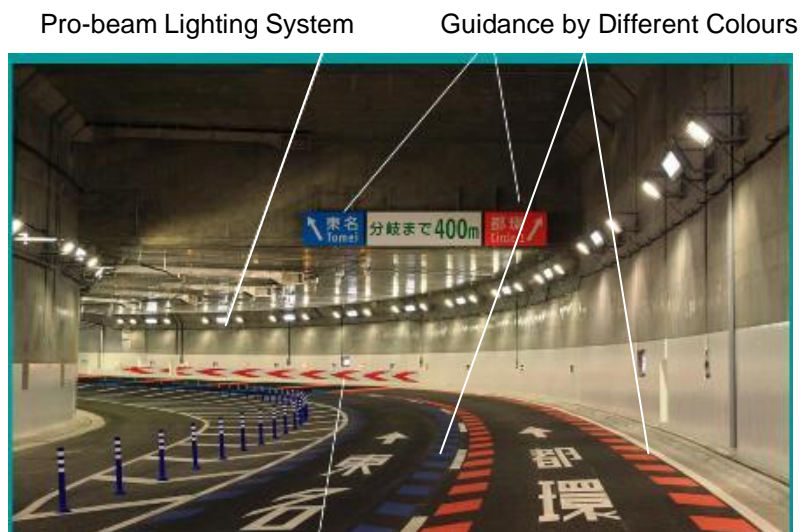


Figure 19– Example of Measures to Assist Drivers

5.2. Disaster-prevention measures for drivers

In the past, devastating catastrophe happened in Europe such as the fire accident on the Mont-Blanc Tunnel (1999) and on the Gotthard Tunnel (2001). These accidents showed that it was important rapidly to inform users in tunnel of the outbreak of an accident and guide to go out on the ground, and also necessary to maintain safe evacuation space. In case a disaster strikes in the tunnel, the variable message signs and the system of radio broadcasting are installed to rapidly inform tunnel users of incidents and how they should respond. These signs and announce will surely guide refuge in the direction of emergency exit. The refuge can safely evacuate because the emergency exits in the tunnel are located approximately every 300m.

The signal above upon entrance of tunnel and crossing gates are installed to prevent vehicles from going into the tunnel during extraordinary accident. These equipments will contribute to reduce the number of vehicles entering the tunnel in the event of an incident. In addition, a remote-controlled TV camera deployed in the tunnel has a function to automatically detect unexpected states and size up the situation by manipulating an image. The administrators can instantaneously perceive what is going on in the tunnel owing to this system.

When emergency is happened, motorbike patrol teams exclusively for this tunnel can rapidly arrive at accident site even under traffic congestion within 10 minutes from detection of an incident. Emergency vehicles also will be able to reach at site within 15 minutes.

CONCLUSION

This redevelopment project contains many elements on the concept of sustainability such as environment, land use and transportation. We believe that this Ohashi "Green" junction project will be the first project to actually realize the concept of sustainability through collaboration with the local community.

Urban residents are increasingly recognizing the importance of trees and vegetation beyond their visual contribution to the landscape. In this redevelopment area, the construction of the rooftop park on the junction, the roof garden on the ventilating station and greenery on the junction wall are all moving forward. The added trees and vegetation in the area will reduce carbon dioxide by about 40 tons/year.

We have challenged construction of tunnel-to-viaduct junction in one of the most congested urban areas in Japan. Main measures on this Ohashi "Green" junction project are as follows;

We have tried to create the junction as compact as possible, without sacrificing drivers' safety. Because of this size, we could minimize the change in this area that is in the congested neighborhood in Tokyo. And also, compact development will be brought to reduce urban sprawl and encourage the use of mass transit.

The compact junction is considered for landscape design and environmental impact to the surrounding area, such as the roof park and ample open space with a lot of trees, well-designed junction walls surrounded with trees, and widened streets with tree-planted sidewalk. And also, the junction itself is covered by much greenery. (Those greeneries are estimated to have the ability to reduce 40-ton CO₂ a year.)

We could create open space around by introducing 3D zoning system. This redevelopment project has duplicate usage area for effective land use of limited space. Residential buildings are also developed next to the junction to accommodate former residents.

Since many people are living near junction, air pollution and noise should be well concerned issues. The covering structure of this junction effectively works on reducing air pollution and noise.

To clean up the emission within the junction loop, ventilating station was installed (to remove 90% of NO₂ and 80% of SPM.)

This project also takes into consideration comfortable driving and road user's safety, while referring to former incidents, most recent findings based on experimental and analytical study and advice from experts.

In conclusion, the construction of expressway and the creation of on attractive and a sustainable community can be compatible through environmentally friendly approaches.

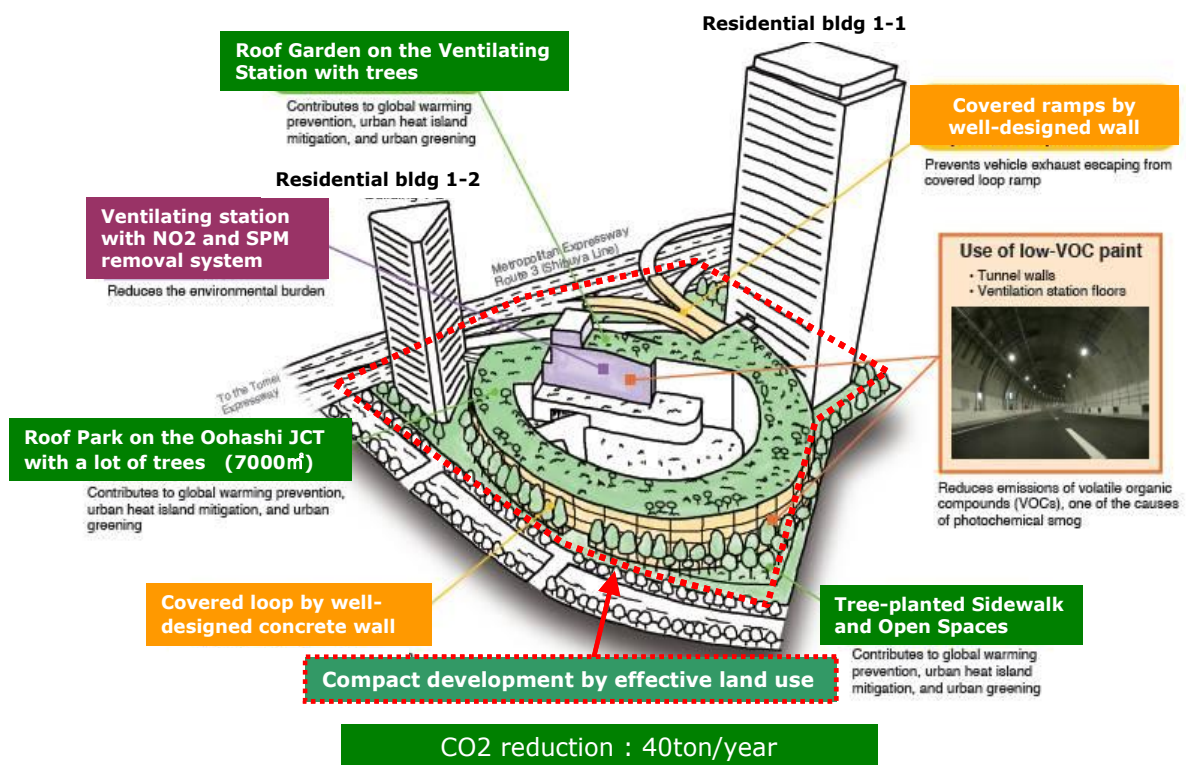


Figure 20 – Summarization of Ohashi “Green” Junction

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