

Transport, Roads and Traffic

1 Introduction

More than half a century has passed since the start of full-scale efforts to build up Japan's road network. As construction requirements have evolved, the national road network has come to play a major role in supporting the social and economic activities of the country.

High economic growth has supported the nationwide expressway network and urban expressways until now, but approximately 50 years after the opening of the first expressway, dealing with aging roads and the transition from a toll system emphasizing development to one emphasizing service have become major issues.

Unprecedented aging of the population and expanding globalization of fields such as shipping and tourism exemplify the rapid changes currently taking place in Japanese society. The optimization of road network use is expected to enable roads, the fundamental facilities supporting the economy and people's daily life, bring about economic and social innovations.

At present, initiatives such as the building of ring roads in the Tokyo metropolitan area are advancing the formation of an expressway network that allows multiple route choices over a broad area. Moreover, thanks to innovations in ICT, big data on road traffic can be collected efficiently and continuously, paving the way for an understanding of the road conditions required for more efficient road use. Although more remains to be done in terms of, for example, sections that remain two-lane expressways, Japan's road policy has reached the stage where it must not only consider how to develop and maintain roads, but also squarely face and properly tackle the additional issue of how roads are used.

In light of the situation described above, this article presents the progress of road development with a focus on the three ring roads in the Tokyo metropolitan area.

2 Progress of Road Development

2.1. Road types and lengths

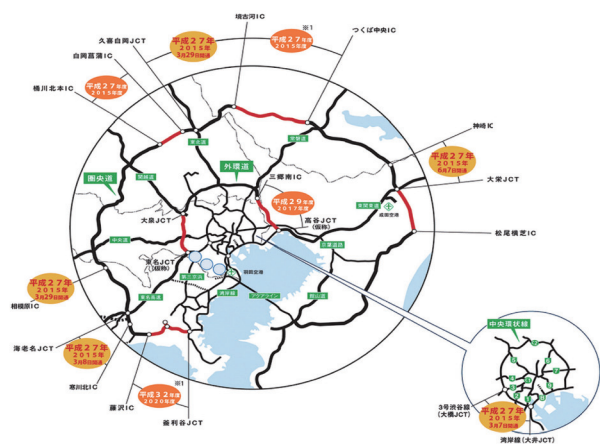
Based on data from the Road Statistics Annual Report (1), Table 1 shows the actual road length broken down by type of road as of April 1, 2013. Although municipal roads make up the majority of total road length with a proportion of 84.1%, their improvement rate of 57.9% is the lowest. Arterial roads such as national expressways make up only a small proportion of total road length.

2.2. The three Tokyo metropolitan area ring roads

In 1963, a network of 3 ring roads and 9 radial roads was planned as a road traffic framework for the Tokyo metropolitan area. Since then, expressways extending

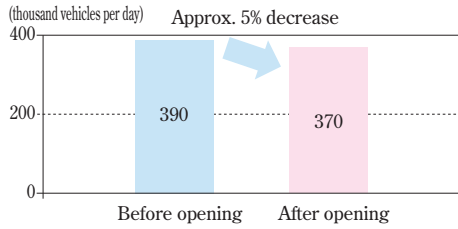
Table 1 Road types and length

	Actual length	Proportion	Completed improvements	Improvement rate
National expressways	8 358.3	0.7 %		
Designated national highway sections	23 516.8	1.9 %	23 516.8	100.0 %
Other national highway sections	31 915.4	2.6 %	29 216.6	91.5 %
Main regional roads	57 930.9	4.8 %	50 191.9	86.6 %
Ordinary prefectural roads	71 444.0	5.9 %	53 076.8	74.3 %
Municipal roads	1 023 962.4	84.1 %	592 815.0	57.9 %
Total	1 217 127.8	100.0 %		



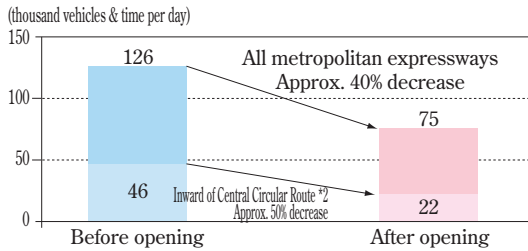
* The period for the opening Section 1 depends on procedures stipulated in the Compulsory Purchase of Land Act. The period shown assumes prompt acquisition of the land.

Fig. 1 The three Tokyo metropolitan area ring roads



Data used: weekday average data from vehicle detectors
 Before opening: March 10, 2014 (Mon) to April 7, 2014 (Mon)
 After opening: March 10, 2015 (Tue) to April 7, 2015 (Tue)

Fig. 2 Changes in volume of traffic due to Inner Circular Route use



*1 Time lost to congestion

Scale of congestion represented as the delay relative to the required travel time when cruising at the mandated speed limit, applied to all traffic.

[Travel time (hours) - travel time when cruising at mandated speed limit (hours)] × volume of traffic (number of vehicles)

*2 Inward of Central Circular Route

Excluding the Central Circular Route and Bayshore Route

Data used: weekday average data from vehicle detectors
 Before opening: March 10, 2014 (Mon) to April 7, 2014 (Mon)
 After opening: March 10, 2015 (Tue) to April 7, 2015 (Tue)

Fig. 3 Changes in time lost to congestion

outward, such as the Tomei, Chuo, Kan-Etsu, and Tohoku have been built. In contrast, the construction of roads leading toward the ring has been delayed. The three ring roads collectively designate, from innermost to outermost, the Central Circular Route, the Tokyo Gaikan Expressway, and the Ken-O Expressway (Fig. 1). Completion of the ring roads is expected to alleviate the concentration of traffic in the city center and eliminate chronic congestion. The current state of the individual ring roads is described in the next sections.

2.3. The Central Circular Route (2)

The Central Circular Route is located about 8 km from the city center and has a total length of approximately 47 km. The route connects to Tokyo subcenters such as Shibuya, Shinjuku, and Ikebukuro, the Tokyo Bay Area, and to the Haneda Airport and Port of Tokyo traffic hub facilities. With the opening of the Yamate Tunnel in the Shinagawa segment on March 7, 2015, all segments of this ring road are now open.

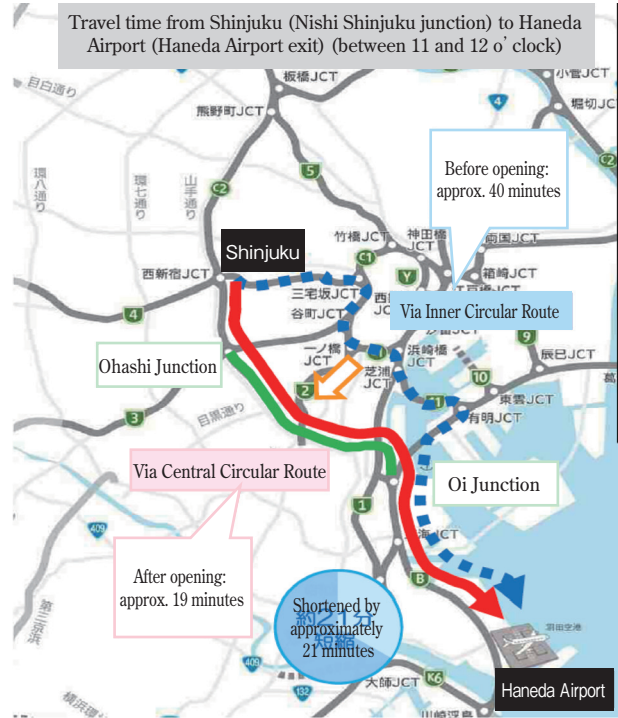
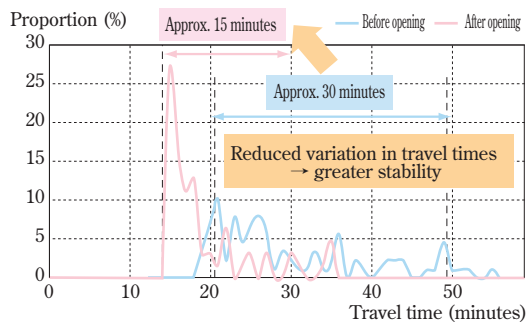


Fig. 4 Travel time between Shinjuku and Haneda Airport

Results for the first month after the route became fully operational (3) showed a roughly 5% decrease in the volume of traffic on the Inner Circular Route (Fig. 2), which is further inward than the Central Circular Route. Time lost to congestion (Fig. 3) was reduced by approximately 40% for metropolitan expressways as a whole, and by approximately 50% from the Central Circular Route inward. Even a small decrease in the volume of traffic leads to a considerable reduction of loss due to congestion.

In the specific case of the time required to travel from Shinjuku to Haneda Airport, travel duration during the congested morning 11 o'clock hour was shortened by approximately 21 minutes, dropping from around 40 minutes before all segments opened to about 19 minutes since the opening of the entire route (Fig. 4). Variation in travel times on the same route have also become considerably more stable, dropping from approximately 30 minutes to about 15 minutes (Fig. 5). The calculation of the variation in travel times uses a fluctuation range that excludes the top and bottom 10% of the probability density distribution.

In terms of impact on peripheral roads other than the metropolitan expressways, a pre- and post-opening comparison of the seven metropolitan routes and Yamate-dori (Circular Route No. 6), which are close to the newly opened segment, shows that travel times have decreased



Data used: probe data collected from on-board ETC 2.0 devices at ITS spots. (Data provided by the National Institute for Land and Infrastructure Management of the Ministry of Land, Infrastructure Transport and Tourism)
 Before opening: average for March 2 (Mon) to 6 (Fri), 2015
 After opening: average for March 9 (Mon) to 13 (Fri), 2015

Fig. 5 Stability of travel time from Shinjuku to Haneda Airport



Fig. 6 Overview of the Tokyo Gaikan Expressway

(Fig. 6). Simply put, the reduction of travel times due to the full opening of the Central Circular Route also extends to ordinary roads.

As the above shows, approximately one month after the opening of Central Circular Route, various concrete measurements of its effectiveness have been taken. It is expected that user awareness is still low only one month after the full opening of the route, and its effectiveness is expected to increase over time as map data in navigation systems is updated and user awareness grows.

2. 4. Tokyo Gaikan Expressway (4)

Located roughly 15 km from the city center and measuring about 85 km in total, the Tokyo Gaikan Expressway connects to the municipalities on the periphery of the city subcenters (Ota, Setagaya, Nerima, Kawaguchi, Ichikawa, and others), as well as areas such as the Keiyo Industrial Zone (Fig. 6).

The approximately 34 km section between Oizumi and Misato Minami opened by 2005, functioning as a network linking the Kan-Etsu, Tohoku and Joban expressways. Work to open the Tokyo section, which runs from Oizumi to the Tomei Expressway, and the Chiba section, which runs from Misato Minami to the Bayshore Route (Koya), as early as possible is underway.

2. 5. Ken-O Expressway (5)

The Ken-O Expressway is located 40 to 60 km away from the city center and has a total length of approximately 300 km. It connects to Yokohama, Atsugi, Hachioji, Kawagoe, Tsukuba, Narita, Kisarazu, and other cities, as well as to Narita Airport and the Port of Yokohama (Fig. 7).

Table 2 shows the main line sections opened since



Fig. 7 Overview of the Ken-O Expressway

2014. The road spans a wide area, and sections are opened in stages as work progresses in individual regions. As the Ken-O Expressway is a ring road well away from the city center, there are high expectations that, in addition to traffic-related effects such as alleviating congestion, it will also lead to stock effects such as stimulating tourism and encouraging businesses to select sites near the expressway. Analyses based on that premise are underway.

3 Conclusion

Although the preceding section on road development focused on the progress and effectiveness of the opening of the three Tokyo metropolitan area ring roads, steady progress is also being made in developing other expressways and ordinary roads throughout Japan. In particular, a well-developed network that consists not only of

Table 2 Ken-O Expressway sections opened since 2014

Date	Section	Length
April 12, 2014	Inashiki to Kozaki	10.6 km
June 28, 2014	Sagamihara Aikawa to Takaosan	14.8 km
March 8, 2015	Samukawa Kita to Ebina Junction	4.3 km
March 29, 2015	Kuki Shiraoka Junction to Sakai Goka	19.6 km
July 7, 2015	Kozaki to Taiei Junction	9.7 km

roads extending outward, but also of ring roads that connect to such outward-bound roads, will increase the number of cases allowing a choice between multiple routes to a given destination. In addition to providing alternate routes when extraordinary situations such as a traffic accidents or natural disasters arise, such a network is expected to contribute to alleviating overall traffic congestion in everyday situations as well through the clear selection of a route based on current congestion or other traffic conditions. In short, combining a well-developed road network with the preparation of appropriate more abstract measures such as providing proper information on congestion will further increase the effectiveness of

the road network.

References

* All the following references are in Japanese only

- (1) Road Statistics Annual Report, <http://www.mlit.go.jp/road/ir/ir-data/tokei-nen/>
- (2) Central Circular Route, http://www.ktr.mlit.go.jp/honkyoku/road/3_kanjo/chukanjo/index.htm
- (3) Metropolitan Expressway Company Limited press release concerning the results one month after the opening of the Central Circular Route (from the Bayshore Route to the Shibuya Route), http://www.shutoko.co.jp/company/press/h27/data/04/24_onemonth/
- (4) Tokyo Gaikan Expressway, <http://www.ktr.mlit.go.jp/honkyoku/road/3kanjo/gaikan/index.htm>
- (5) Ken-O Expressway, <http://www.ktr.mlit.go.jp/honkyoku/road/3kanjo/kenoudo/index.htm>