

History of Roads in Japan

Japan is a country comprised of four major islands and numerous minor islands. It is configured as a crescent shape and situated to the east of the Asian continent in the Northwestern Pacific Ocean. Of its 378,000 square km of land, about 70% is comprised of mountainous terrain. It is inhabited by more than 120 million people.

It is a country that has achieved harmony between its traditional culture from ancient eras and its modern society with advanced technology. Yet, Japan's fascinating natural environment is one that changes from season to season.

The history of land transport in Japan began over two thousand years ago and can roughly be categorized into the following four eras: 1) Age of People and Nature (ancient times until the Meiji Restoration in 1867), 2) Age of Modernization (from the Meiji Restoration until the 1950s), 3) Age of High Efficiency Networks (from the 1950s to the present day) and 4) Age of Optimal Maintenance and Management for Maximum Utilization of Existing Roads.

I. Age of People and Nature (ancient times until the Meiji Restoration in 1867)

1) The Ancient Foundations of Modern Japan

The oldest written record of roads in Japan appeared in a Chinese history book from the 3rd Century called Gishi-wajinden. At that point in time, Japan was in the process of unifying the country under the Yamato Dynasty. People travelled on foot or horseback for hundreds of years until the Meiji Restoration, when Japan opened its doors to the modern nations of the West late in the 19th century, which resulted in modern conveniences becoming available and then prominent in Japan.

Unlike in China and the European countries, horse-drawn carriages never fully evolved in Japan. The historical lack of use of horse-drawn carriages could be due, in part, to the country's terrain which is mostly mountainous and criss-crossed by numerous creeks and inlets.

After the Reformation of the Taika Era (645 C.E.), an elaborate central government system, characterized by emerging administrative and judicial institutions, was established. A new road network was developed at this time that connected Honshu (the largest island) to Shikoku (the smallest of the four main islands) and then continued all the way down to Kyushu (the southernmost and third largest island).

This nationwide public road network was called "Seven Roads" and was composed of Tokaido, Tosando, Hokurikudo, San-indo, San-yodo, Nankaido and Saikaido ('-do' in Japanese means 'road'). After bitter struggles with the rough terrain of the country, the Seven Roads were completed and in later years were used as the prototype for highways and roads. Almost all of the Seven Roads routes were used as arterial railways during the Meiji Era (1868-1921 C.E.) and then expressways that opened after 1964. In short, ever since the Seven Roads were first established during this age, they have continued to serve as the backbone for transport routes in Japan.

2) User-friendly Roads Can Be Traced Back to Early Times

Along with the establishment of the Seven Roads came another system called "Ekiba, Tenma" (Post Horse System), which eventually became the modern international word "Ekiden" (a relay road race). In this Chinese-originated system, an "Eki" (meaning station) was located at each interval of 16km along a road and would provide necessary services for the officials and people of high rank who travelled that road on their journeys. Approximately 400 "Eki" were developed across the country. In the mid-8th century, a number of fruit trees were systematically planted along the Seven Roads, which eventually led to the tree lined roads of today.

Later, in the 16th century, a road signage system called "Ichirizuka" was established by referencing a similar practice from ancient China. This system can be viewed as the Asian version of the Roman milestone-system. After the Edo Shogunate was established in 1603 C.E., the ichirizuka system was transformed when ample facilities were created and the 5 Major Highway System, radiating from Edo (the old name for Tokyo), was formed. The Shogunate specified that the five major highways should be about 11m wide and



Numazu-juku as depicted by Hiroshige
Source: National Diet Library



Nihombashi in the Meiji Era
Source: National Diet Library

secondary roads should be 5.5m wide. The roads were to be filled with gravel and cobbles to a depth of 3cm and topped with sand after treading them down.

Sir Rutherford Alcock, the first British Minister to visit Japan, wrote about his visit at the end of the Shogunate era, saying, "Their highways, the Tokaido, the imperial roads throughout the kingdom, may challenge comparison with the finest in Europe. Broad, level, carefully kept and well macadamized, with magnificent avenues of timber to give shade from the scorching heat of the sun, it is difficult to exaggerate their merit."

3) Road Construction with Consideration for People and Scenery

Japanese people frequently traveled, to such a degree that foreigners were astounded by how far and how often they traveled in comparison to themselves. The Japanese did not hesitate to travel because there were such excellent road facilities and services even back then.

In the middle of the Edo Era (1690 C.E.), Englebert Kaempfer, a German doctor who came to Japan to work for a Dutch trading house, wrote: "An unbelievable number of people travel the highways of this country every day. The reason for this is the high population of this country, but another

reason is that, unlike inhabitants of other nations, the Japanese travel extremely often."¹

The Hakone Road was already paved by 1680 C.E. Sir Ernest Satow, a British diplomat who came to Japan at the end of the Edo Shogunate (mid-19th century), wrote in his book, "A Diplomat in Japan," about his astonishment at the pavement there: "Next morning, we started at half-past six to ascend the pass which climbs the range of mountains by an excellent road paved with huge stones after the manner of the Via Appia where it leaves Rome at the Forum, and lined with huge pine trees and cryptomerias."

Unlike the Via Appia, Japanese surface transport routes were developed primarily for people and horses, because horse-drawn carriages were not common prior to the Meiji Era (~1868 C.E.) For this reason, roads were usually in good condition since damage caused by traffic was not severe and maintenance was relatively easy to complete. Road cleaning and other regular maintenance was not performed by the Shogunate or the government of feudal clans, but by roadside residents on a voluntary basis. This implies that there was a general understanding that roads were not the exclusive property of the overlords, but considered to be "public property".

¹ "Geschichte und Beschreibung von Japan"



The state of roads in the mid-1950s was as "incredibly bad" as Watkins wrote in his report.

2. Age of Modernization (from Meiji Restoration to the 1950s)

After ending two hundred years of isolation, the revolutionary government of the Meiji Era (1868-1912 C.E.) quickly started modernizing the surface transport system by importing new technologies from Europe. Unlike China and Europe, Japan did not have a history of horse-drawn carriages as a method of transport. It was thus impossible to transform the ancient roads, designed strictly for the passage of people and horses, into modern roads in a single step.

The beautifully maintained pre-modern roads of the Edo Era began to deteriorate under the burden of modern horse-drawn carriages and human-powered vehicles (or rickshaws). Arthur Crow, who visited Japan in 1881 C.E., recorded this observation in "Highways and Byways in Japan": "The Tokaido is in a dreadfully bad state, with ruts and holes large enough almost to swallow a cart, and yet traffic is very heavy, both for horse and man-power vehicles".

The slow improvement of roads can be partially attributed to the decision by the Meiji Government to give rail and sea transport higher priority over roads. This decision was intended to allow Japan to catch up with the advanced nations of the West as quickly as possible. The backwardness of the road system in Japan continued until 1945 when the World War II ended and the entire national landscape was devastated by bombings and other catastrophes of war. During the reconstruction process in Japan, the modernization of roads in Japan was fully accelerated along with the development of railways.



April 1968
Vehicles driving from Okazaki IC to Komaki IC after the opening ceremony of the Tomei Expressway
(Photo: Mainichi Shimbun)

3. Age of High Efficiency Networks (from the 1950s ~ today)

1) Arrival of the Motorization Age

Automobiles proliferated quickly as the Japanese economy recovered from hardship after the war and the standard of living improved. Only 130,000 vehicles were registered at the end of World War II, but the number increased rapidly, reaching 500,000 vehicles by 1951, then doubling to one million in 1953, and doubling again to two million in 1957. The Age of Motorization had finally arrived in Japan.

However, the road system in Japan remained insufficient to support the ongoing rapid motorization. Ralph J. Watkins, an economist invited by the Japanese Government to conduct research on the Meishin Expressway, wrote in his 1956 report, "The roads of Japan are incredibly bad. No other industrial nation has so completely neglected its highway system."

Indeed, Japan's road system in those days was truly terrible. Only 23% of the first-class arterial national highway system was paved. Only two-thirds of national Highway Route 1, supposedly the major arterial highway connecting Tokyo with Osaka, was paved. The Japanese Government at that time accepted Mr. Watkins' proposals and immediately put them into practice. Thus, road improvement in Japan moved into high gear, propelling the nation into the high economic growth era of later years.

2) The Five-Year Road Development Program, Toll Road System and Tax Revenue System with Earmarks for Roads

Without a long history of horse-drawn carriages, the roads in Japan were severely underdeveloped. What was worse, road

development was inevitably slow because the development of railways was given priority over the development of roads. Under these circumstances, the Five-Year Road Development Program was launched so that road development could be fully accelerated.

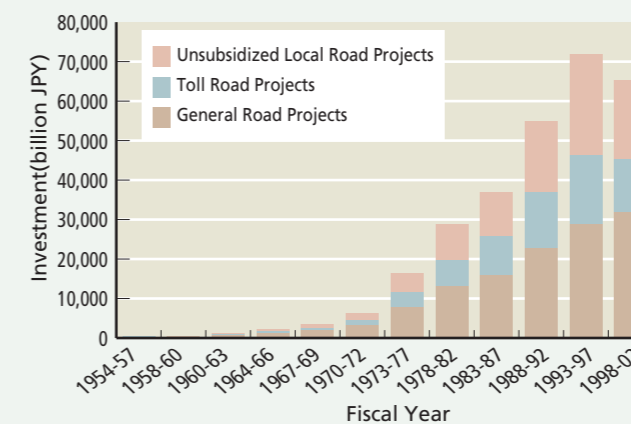
Since the public works budget, under the general revenue scheme, was insufficient in meeting the ever-increasing road traffic demand, two new financing systems were introduced: the toll road system and the tax revenue system with earmarks for roads. These systems allowed for a significant number of road projects to be undertaken in a short period of time.

The former "Act on Special Measures concerning Road Construction and Improvement", which was enacted in 1952, introduced the toll road system and enabled the national and municipal governments to borrow sufficient funds to develop roads. After the new roads were complete, the borrowed money would be repaid using the toll revenue from the roads.

The toll road system was used primarily for national expressway projects. In 1956, the Japan Highway Public Corporation was founded, so that expressways would be efficiently managed and financial resources from the private sector could be widely utilized.

With its founding, toll road development was now led by JH instead of the National Government. Although the mechanisms of the toll road system are similar to that of current PPP projects, the former included an ingenious system that enabled them to carry out unprofitable road projects if the road was recognized as necessary from a point of social benefit. The National Government reduced the business risk of unprofitable road projects by guaranteeing the loan and by paying a fixed rate of interest. In addition, the Government utilized the pool system, in which revenues and expenditures were balanced throughout the toll expressway network. This system enabled them to develop not only profitable expressways in urban areas but also unprofitable expressways in rural areas across the country.

Investment change in the Five-Year Road Development Program



Note:
 1) Reserve fund (150 billion) is included.
 2) Reserve fund (100 billion) is included.
 3) Reserve fund (500 billion) is included.
 4) Reserve fund (700 billion) is included.
 5) Adjustment cost (1,300 billion) is included.
 6) Adjustment cost (1,300 billion) is included.
 7) Adjustment cost (1,400 billion) is included.
 8) Adjustment cost (5,000 billion) is included.
 9) Reserve fund (11.2 billion for Okinawa) is included in the total of the 6th plan.

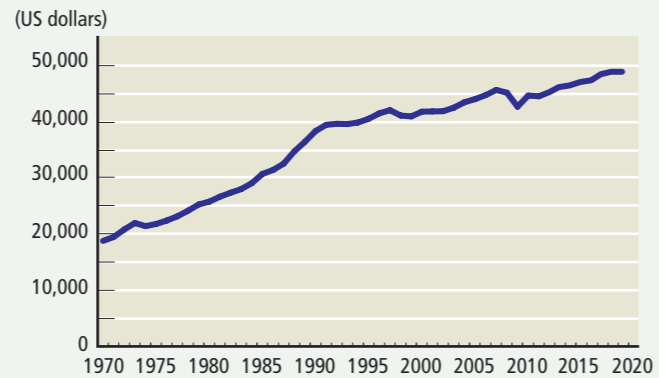
In 1953, the “Act on State’s Tentative Financial Measures for Road Construction Projects” was enacted and thus ushered in a new tax revenue system with earmarks for roads. This system, based on the “beneficiary-pays” principle, earmarked the revenue from fuel tax and other automobile-related taxes for road projects. This measure secured stable financial resources for the long-term development of roads, including the 1st Five-Year Road Development Program and the subsequent 11 programs that followed.

The toll road system and the tax revenue system with earmarks for roads supported the development of the nationwide road network for more than 50 years. During those years, all major roads were paved and more than 10,000km of expressways were developed across the country.

However, there were increasing calls for a change in both of the financial revenue systems since the road network in Japan had reached an almost adequate level of development. There were various critiques and opinions about road development, including the belief that roads were developed wastefully and sometimes redundantly, spending a large amount of both borrowed money and the national budget. At the same time, the repayment and management costs were not being sufficiently preserved due to the high-cost structure of JH’s toll road system. As a result, JH was privatized and reorganized into the Japan Expressway and Debt Repayment Agency (JEDRA) and 6 regional Expressway Companies. The main purposes of this change were to ensure the repayment of the massive road debt that had reached 40 trillion yen, to streamline the administrative authority and to provide various services for road users by utilizing experience from the private sector. When the expressway companies were privatized, the toll collection period was set at 45 years (until 2050). However, in 2014, in order to cover the increasing costs related to the maintenance and renewal of the expressways, the period was extended by 15 years to 2065

There was also increasing criticism of the tax revenue system with earmarks for roads. Critics argued that fixed expendi-

■ Change in real GDP per capita



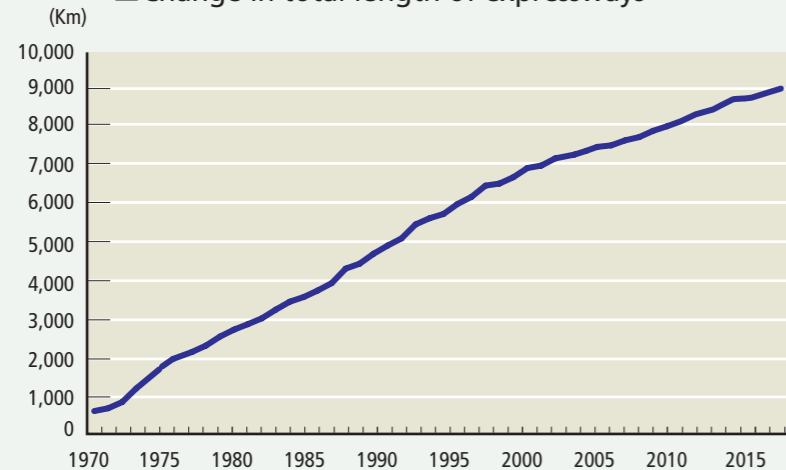
tures from the abundant financial resources resulted in unnecessary road development. In 2009, the tax revenue system with earmarks for roads was abandoned and the Government decided to pay for road expenditures using funds from the general revenue.

4. Age of Optimal Maintenance and Management for Maximum Utilization of Existing Roads

By the beginning of the 21st century, the total length of expressways had reached more than 8,000 km and the public opinion was that Japan had almost sufficient road networks, especially in urban areas. At the same time, Japan entered an age of declining birthrates and an aging population (the national population has been declining since it peaked in 2008).

In addition to these social changes, ever-increasing social security costs and the fragile national financial condition brought about the wide-spread belief that public investments should be economized. As discussed in the previous section, this led to the abolition of the tax system with earmarks for roads and the reorganization and privatization of JH. While road development is slowing down, utilization of existing

■ Change in total length of expressways



road networks and improvement of asset management is becoming the focus of current programs.

The first task of asset management is to map out strategies for the aging road infrastructure, which was largely developed during the high-growth period of the Japanese economy (from the late 1950s to the 1960s).

The second task is to continually provide road transport services and to support the lives and economies of the people who live in a country that is prone to natural disasters such as earthquakes and typhoons.

The third task is to provide road services that are safe, accessible and environmentally friendly by utilizing evolving ITS technologies and by improving the quality of roads. The third task is to provide road services that are safe, accessible and environmentally friendly by utilizing evolving ITS technologies and by improving the quality of roads.

1) Strategies for Aging Road Infrastructure

The majority of roads and bridges were constructed in the high-growth period of the Japanese economy and will be 50 years old in the next 10 years. To maintain the safety of this aging infrastructure, periodic investigation and database management, as well as systematic repair work, are required. It is a new technical challenge to efficiently investigate and repair 5.2 million bridges and 10,000 tunnels. At the same time, this is also a significant challenge in terms of the financial and human resources that are needed to meet road demands. The Road Act was amended in 2013 and the 2014 Ministerial Ordinance obligates road administrators to conduct close visual inspections once every 5 years.

2) Preparing for Natural Disasters

The Great East Japan Earthquake in March 2011 forced the reevaluation of the importance of road networks in the face of large-scale natural disasters. 20% of world-wide earthquakes with a magnitude of 6 or higher occur in Japan. As an earthquake-prone country, disaster prevention measures, including improvement of bridges’ quake

resistance, have been deemed necessary after the repeated experience with these disasters. In addition, it is necessary to enhance road networks to guarantee alternative routes in the event of road closures after a large-scale disaster and in order to add disaster prevention functions to existing roadside service facilities. As climate change is increasingly occurring on a global scale, Japan has been experiencing more frequent heavy rains and snows. Overcoming landslides on slopes and snowbound traffic are always serious challenges in a country with precipitous terrain. Japan road administration has been implementing countermeasures that include: constructing slope protection, establishing a snow removal system, installing road monitoring systems and improving operations.

3) Improvement of Road Service Provisions using Intelligent Transport Systems (ITS)

Ring roads are being developed in the Tokyo Metropolitan Area, where traffic congestion is a serious problem. Once complete, ring roads are expected to provide more route options and smoother traffic flow.

Since they were introduced in the 1990s, ITS technologies have provided various services, including car navigation systems and Electronic Toll Collection (ETC). Even now, the technologies are evolving to meet the demands of road infrastructure and the automobile sectors. Newly introduced automobiles with crash-avoidance systems offer the potential for fully automatic driving systems sometime in the near future. In the road infrastructure sector, dynamic traffic guidance, warning messaging and vehicular controlling technologies are being studied as part of road-to-vehicle and/or vehicle-to-vehicle communication systems.

The advancement of technology is going to integrate road infrastructure and automobiles into a new synthetic transport system and will provide a breakthrough solution for traffic congestion, traffic accidents and environmental pollution, all of which have been major issues since the modernization of the road system began.

■ Change in number of registered vehicles

