

Key Issue: 14- Development of Regional Industries

Climatic Zone:

Cf : Temperate Humid Climate

Subjects:

- Tourism development centering Kurobe Dam

Effects:

- Preservation of natural environment
- Development of popular tourist spot
- Provision of access to remote area for general public use



Project Name: Kurobegawa No.4 Power Plant
Country: Toyama Prefecture, Japan (Asia)

Implementing Party and Period

- **Project:** The KANSAI Electric Power Co., Inc. 1961 (Completion of construction) -
- **Good Practice:** The KANSAI Electric Power Co., Inc. 1964 (Commencement of operation) -

Key Words:

Environmental protection, Tourism, Discharge for sight seeing

Abstract:

The project was the first large-scale construction project in Japan that addressed the task of environmental protection. The Alpine Route developed in relation with the project has now become one of the major sightseeing spots in Japan, attracting more than 1,000,000 tourists annually.

1. Outline of the Project

The construction of the Kurobe Dam (Kurobegawa No.4 Power Plant) was planned by Kansai Electric Power Co., Inc. to cope with the increase in power demand due to the rapid economic recovery after the Second World War. The dam development plan was developed as the core of the consistently planned development of the Kurobe River System. The scheme was planned to allow future construction of new power plants and expansion of the existing power plant downstream, and involved the development of a large reservoir at the most upstream end of the Kurobe River to enable the existing downstream power plant to be operated during the winter season when there is less rainfall to ensure a stable supply of electricity.

Table-1 Kurobegawa No.4 power plant and Kurobe dam specifications

Item		Specification
River system		Kurobe
Catchment area		202.85 km ²
Power plant	Start of operation	January, 1961
	Max. Output	335,000kW
	Max. Power discharge	72.0m ³ /s
	Max. Effective head	545.5m
Dam	Name	Kurobe
	Type	Arch
	Crest length	492 m
	Max. Height	186 m
	Volume	1,583,000 m ³
	Design Flood Discharge	1,260 m ³ /s
Reservoir	Catchment area	184.5 km ²
	Impounding area	3,450 km ²
	Max. Reservoir capacity	199,285,000 m ³
	Effective depth	60 m
	Normal water level	EL. 1,448.0 m

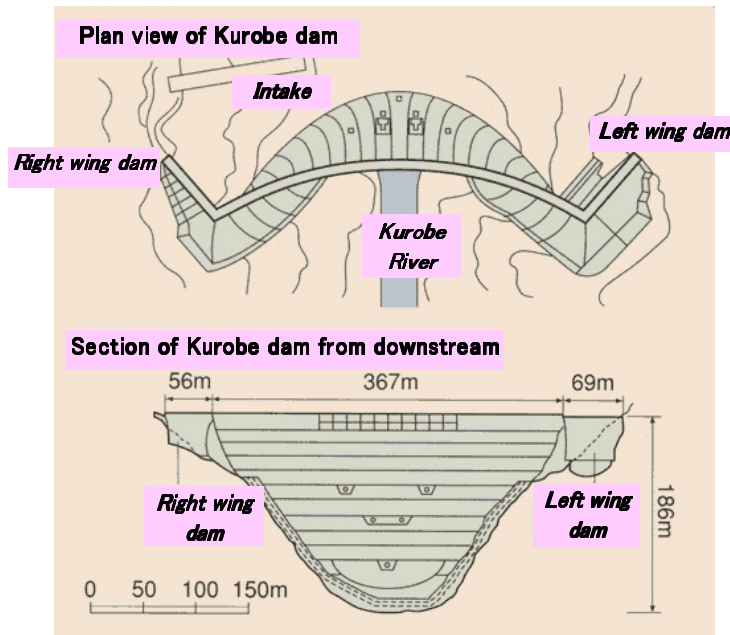


Fig.-1 Plan and section view from downstream

The Kurobe Dam construction site was located in the Chubu Sangaku National Park, which lies among high mountains of about 3,000m high. The plan was a giant project, partly funded by the World Bank, involving the construction of the largest arch-type dam in Japan (and the largest in the world at the time) with a height of 186m in a highland of about 1,300m above sea level lying between very steep cliffs. The dam provided a total reservoir capacity of approximately 200 million m³, and a maximum power generation capacity of 258,000 kW (presently 335,000 kW). The project attracted a great deal of attention at the time since civil engineers in Japan at the time had no experience with such a grand project, which posed a variety of difficulties, including construction

in steep mountain range areas and restrictions imposed by the National Park Law. Table-1 gives power plant and dam specifications. Fig.-1 shows a plan of the dam and a dam section from downstream.

2. Features of the Project Area

Approximately 86 km long Kurobe River with its average inclination as steep as 1/40 originates in the Northern Japan Alps comprised of mountains with their altitudes around 3,000m and flows north into the Sea of Japan.

The site is located in one of Japan's most rainy and snowy regions with an average annual precipitation of about 4,000mm. Abundant rain in the summer months and snow in the winter months provide the Kurobe River with a constant, abundant supply of water throughout the year. Because of its ideal climate, the Kurobe River basin has been developed for hydropower generation for many years.

The Kurobe River was originally formed by uplifts due to orogenic movements and thousands of years of erosion by ice, snow, and flowing water from the Ice Age.

The banks of the main stream have been sharpened off by its steep flow where a number of tributaries merge along the way leaving gorges and cliffs in places. The canyon, the Kurobe River Canyon, had

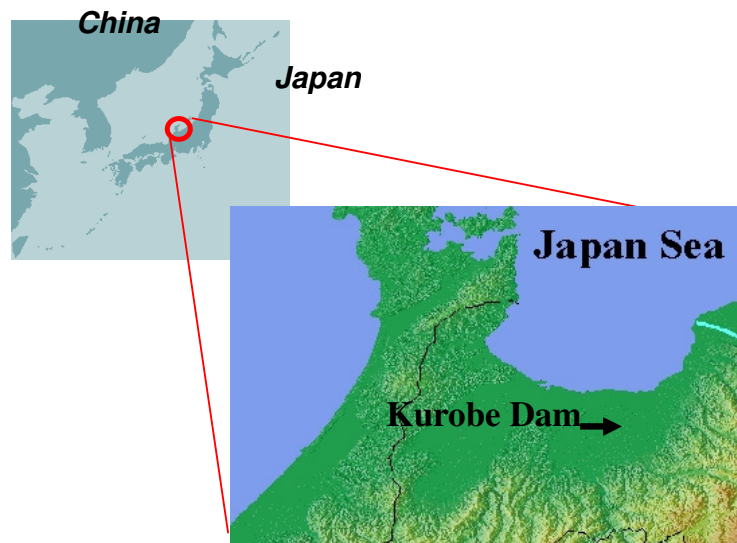


Fig.-2 Site location

been regarded as one of the untouched natural beauties in Japan where most of the Canyon is designated as Chubu Sangaku National Park for its beautiful landscape. However, because of the steep topography and harsh climate, the beauty of the Canyon had been hidden from the general public except for some mountaineers.

Majority of the area surrounding the Kurobe Dam site is designated as National Forests, with especially important parts of the area designated as special zones or special conservation zones. The hunting of wildlife such as Japanese serow, a specially protected species, ermine, and ptarmigan, the alpine plants, and construction of structures are strictly restricted.

3. Benefits

3.1 Characteristics of the Dam Construction

1) Protection of the Natural Environment

The construction of the Kurobe Dam was the first large-scale dam construction project in Japan that addressed the task of preserving natural environment. The dam construction site was located in the Chubu Sangaku National Park and under strict regulation under the National Parks Law (enacted in 1931 and changed into the Natural Parks Law in 1957). In order to achieve economical efficiency and a satisfied level of safety under the unique topographical and climatic conditions as well as the need to preserve the natural environment of the precious area, Kansai Electric Power Co., Inc. constructed a fully underground power plant with all power generation and transformation facilities (including water channels, surge tanks, penstocks, plant buildings, transformer station, and switching station) buried underground and only a few facilities such as the dam body and water intake appearing above ground.

2) Discharge for Sightseeing

One of the conditions, imposed by the Ministry of Health and Welfare (now the Ministry of Health, Labour, and Welfare) that had to be met to commence the project was to discharge dam water to the downstream corridor around Juji-gorge, sightseeing spot. The dam currently discharges up to $15\text{m}^3/\text{s}$ of water depending on the season and the time of the day in a form of mist via howell-bunger valves installed in the dam body. This way of discharging is primarily to protect the bedrock immediately downstream of the dam. However it has now become a sightseeing attraction creating a rainbow over the downstream face of the dam (See Fig.-3).



Fig.-3 Discharge from Kurobe Dam

3) Material Hauling Road

As the site was located in a remote area, efficient hauling of considerable amount of construction materials and large equipment into the Canyon was the key to successful construction within given short period of time. The only roads in the mountain range that led to the dam site were trekking path for mountaineers at the time, and there was a necessity to construct an appropriate material hauling road.

As a result of careful route mapping taking into consideration various factors such as the route length, site conditions, and harsh winter climate, it was decided to adopt a 25.2km route connecting to Ohmachi City in Nagano prefecture. This long route was comprised of a 5.4km tunnel section (Kanden Tunnel) that was to run through Mt. Akazawa (E.L. 2,678m) and Mt. Narusawa (E.L. 2,641m) from the right bank of the dam, a road that was to be newly constructed, and existing road section that was to be upgraded. The excavation of the tunnel became troublesome when a serious fracture zone was hit. The struggle to penetrate became widely known throughout Japan that a movie on the struggle was created starring a famous actor.

The permission to construct the hauling road was given by the government on a condition that the road is to be available for public use after completion of the project. The road is now being used as a touring route.

3.2 Development of tourism spot centering Kurobe Dam

The Kurobe Dam standing in harmony with nature has been a tourism spot since the completion of the project. The former material hauling road connecting the dam from its right bank and Nagano allows tourists from Nagano prefecture to visit the site. In addition, Tateyama-Kurobe Tourism Co developed a route connecting the dam from its left bank and Toyama prefecture. Hence by 1971, the route connecting Nagano and Toyama prefecture via the Kurobe Dam, the Tateyama-Kurobe Alpine Route, was completed. See Fig.-4 below.

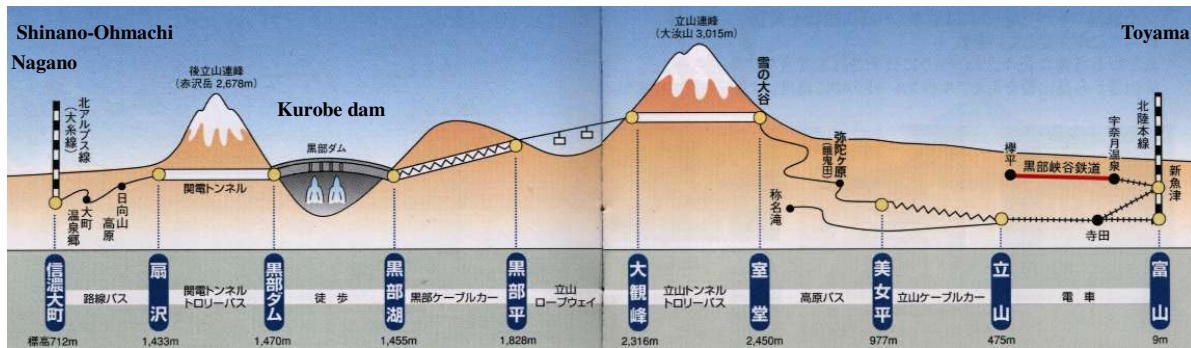


Fig.-4 The Tateyama-Kurobe Alpine Route

The 90km long Alpine Route allows tourists to visit the 3,000m high Northern Japan Alps and enjoy beautiful panoramic views from 8 different means of transportation including trolley bus, cable car, and ropeway (See Fig.-5). In particular, the Kurobe Dam having the largest dam height in Japan and the dam reservoir with emerald water are regarded as the highlight of this route. Various facilities, including boats, lakeside walks, and resting places and lookouts on the dam, have been developed in and around the area.



Fig.-5 The Rope way with Kurobe dam behind

4. Effects of the Benefits

The Tateyama-Kurobe Alpine Route that was developed in relation with the Kurobe Dam construction project has now become one of the major tourists' spots in Japan, attracting more than 1,000,000 tourists every year. It also ranks top for the most popular tourism spot to visit in Toyama prefecture and the spin-off it provides to the local economy can be considered significant.

5. Reasons for Success

The reasons that enabled the Kurobe Dam construction project to spin-off a number of socioeconomic benefits in addition to its fundamental function to provide hydroelectric power can be thought as follows:

1) Location

The Kurobe Dam is located in the Chubu Sangaku National Park that lies in an area abundant of untouched nature and considered as one of the few untouched beauties in Japan.

2) Protection of the natural environment and preservation of natural landscape

The project has given a great deal of consideration to the fact that the site was located in a national park and strived to protect and preserve natural environment and landscape by constructing fully

underground facilities or by carrying out re-vegetation of damaged areas due to construction work. The 186m-high Kurobe arch dam is also designed in perfect harmony with the surrounding natural environment of the Canyon.

3) Cooperation with the Local Community

The project assisted the local government and local tourism developers in their development of a magnificent sightseeing route including a route through the Kurobe Dam as one of the major sightseeing spots, by providing the hauling road for public use or assisting the construction of tourism facilities in and around the Kurobe Dam site.

4) The popularity of the project

The Kurobe Dam project is known as a “project of the century” throughout Japan. The great success of the movie depicting the long and hard struggle to excavate Kanden Tunnel is thought to have a significant effect in publicizing the project and its spin-offs.

6. Outside Comments

1) Kitanihon Shimbun (Feb. 24, 2001)

Kazuo Kido, a trustee for World Heritage of the National Federation of UNESCO Associations in Japan (Tokyo), said, “Tateyama-Kurobe has values as both a Natural Heritage and a Cultural Heritage,” indicating a possibility that Tateyama-Kurobe may be registered as a Combined Heritage, in which case it would become the first Combined Heritage in Japan.

Kido said, “Tateyama is an internationally famous mountain range tourism spot that has a long history of mountain worship religions which dates back to 1,300 years ago and beautiful, magnificent natural landscapes. On the other hand, the Kurobe River Canyon has untouched nature and a history of environmentally-friendly power development with related facilities such as the Kurobe Dam and Kurobegawa No.4 Power Plant.”

7. Further Information

7.1 References

- 1) “An Overview of Toyama Prefecture”, Toyama Prefectural Government

7.2 Inquiries

The Kansai Electric Power Co., Inc.

URL: <http://www.kepco.co.jp/english/index.html>

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