Universal Value of Tateyama Sabo from the Viewpoint of National Resilience

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INTRODUCTION

The Joganji River, with its headwaters located at the Tateyama Caldera, is a steep river, measuring 56 km in length, with a catchment area of 368 km2 and an average gradient 1/30. The Tateyama Caldera has a large oval-shaped depression, 6.5 km from east to west and 4.5 km from north to south.

In 1858, the Hietsu Earthquake, occurred around the Atotsugawa fault as the hypocenter. Due to this earthquake, Mt. Tonbi located in the Tateyama Caldera collapsed and formed a landslide dam, then debris flow hit the Toyama Plain in the downstream. The large amount of unstable sediment still remains in the Tateyama Caldera.

A group of precious sabo facilities with long histories exist along the Joganji River that flows through the Tateyama Caldera located. Those facilities convey the wisdom and efforts of people devoted to protecting Toyama Plain from massive sediment discharge, an undertaking which has continued for over 100 years for the purpose of enhancing national resilience.

In this report, we attempt to verify the outstanding universal value of those facilities from the viewpoint of national resilience by looking back on their history and introducing their characteristics.

TATEYAMA SABO'S REPRESENTATIVE FACILITIES WITH LONG HISTORIES

The Shiraiwa Sabo Dam, located about 42 km upstream of the mouth of Joganji river where the outlet of the caldera is located, was designed by Masao Akagi, who is referred to as the "Father of modern sabo" in order to raise the eroded riverbed and stabilize the Tateyama Caldera and prevent sediment discharge that became active after the Hietsu Earthquake in 1858. It is a core sabo dam, of the "Joganji River Sabo Construction Plan" prepared by Akagi.

It is regarded as a structure with high academic value which shows one of the great technological achievement of modern sabo facilities. It became the first sabo facility designated as an important cultural property of Japan in 2009 and has been placed under protection since then.

The dam type, for the overflow and center part of the non-overflow sections, is gravity type concrete dam. For the left bank part of the dam, he did not adopt a gravity type concrete dam because the deposition of weak volcanic ejecta existed at the foundation. Instead, he adopted a fill type dam consisting of an embankment and checkerboard frames that protect the surface of the embankment. The upstream side of the fill type dam section was covered with revetments so that overflowing debris flow would not damage the downstream side. Several sabo dams were also built on the upstream to guide flowing water to the right bank where bedrock existed. (Fig.1, Fig.2)

Furthermore, noting the major earthquake in the Ansei Period, seismic design was adopted for the first time in Japan. According to our survey, there is no other prewar (before the 1940s) sabo dam equivalent to the Shiraiwa Sabo Dam in terms of scale, structural complexity, and seismic design. At the same time, a series of Dorodani Sabo Dams and hillside works in the upstream and the Hongu Sabo Dam in the midstream were also constructed. Together with the Shiraiwa Sabo Dam, those facility greatly improved the safety of Toyama Plain.

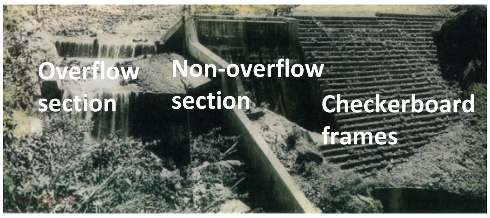

Fig.1 Shiraiwa Sabo Dam (completed in 1939)

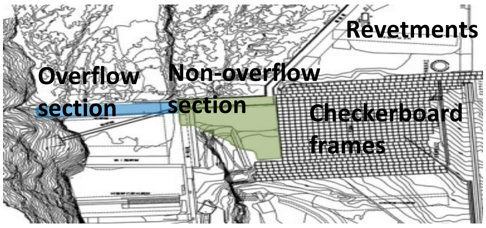

Fig.2 Shiraiwa Sabo Dam Plan view

Shiraiwa Sabo Dam

○Design details
Catchment area 22.1 km^2
Design flood discharge 380 m^3/s
Gradient of original riverbed 1/7
Design sediment storage 1 million m^3
Dam length 76.0m
Dam height (main dam) Overflow section 20.0 m
Non-overflow section 63.0 m
Altitude of overflow section 1,082 m
○Dam type
Hybrid of gravity type rubble concrete and earth fill
Right bank part Gravity type rubble concrete dam (front slope 1:0.2)
Center part Gravity type concrete dam (front slope 1:0.64)
Left bank part Earth fill dam (covered with checkerboard frames)
○Construction period 1929-1939

(Source: "70-year History of Tateyama Sabo")

CONCLUSIONS

Flooding damage at the Joganji River increased after the Hietsu Earthquake in 1858, but the damage gradually decreased with the advancement of sabo works at the Tateyama Caldera. The city area in the Toyama Plain at the downstream of the Joganji River expanded. Also, greenery came back to the devastated caldera area.

In the severe sediment environment riddled with steep mountains, brittle geology, frequent earthquakes, and large amounts of precipitation, which is uncommon around the world, Tateyama Sabo completed the construction of the Shiraiwa Sabo Dam, Hongu Sabo Dam, and a series of Dorodani Sabo Dams successively by mobilizing the most advanced technologies and wisdom at all times in the 1930s.

The combination of the installed facilities along the large river basin, including those for the control of sediment production at the upstream and others for the storage of flowing sediment at the midstream, has been producing an excellent effect as a disaster prevention system for the Toyama Plain.

In terms of the scale of the target conservation area, and the mobilized technologies, wisdom, and devices, we can say that Tateyama Sabo is the culmination of modern watershed management technologies involving sediment. It is an excellent example of erosion and sediment control measures and disaster prevention technologies that emerged from severe natural conditions at the Joganji River in Japan, which is located at the boundary of four crustal plates and is susceptible to sediment-related disasters triggered by earthquakes, volcanic eruptions, and typhoons.

Tateyama Sabo shows a kind of outstanding solutions to universal common themes, disaster mitigation and national resilience. We will continue the effort to pass down these facilities to future generation as a shared valuable heritage.

MAIN REFERENCES

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Key words: Tateyama Sabo, watershed management, modern sabo, outstanding universal value, world cultural heritage