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Erosion & sedimentation

Dashidaira Dam, Japan

A flushing channel, sediment gates and appropriate operating rules have overcome potential sediment retention impacts at Dashidaira Dam, in a Japanese river system noted for fast flow and very high sediment loads.

Overview

The Kurobegawa No. 4 Power Plant lies on the Kurobe River system, within the rugged Chubu Sangaku National Park, Japan.

Kurobe Dam was completed in 1961 and commenced operation in 1964. Located 1300m above sea level in the Kurobe River Canyon, the scheme is situated in some of the most remote and inaccessible country in Japan. The site is also one of the most precipitous in the country, with average annual rain and snowfall of around 4000mm.

Construction of the Kurobe Dam was a massive joint undertaking between the Kansai Electric Power Co., Inc. and the World Bank, and was intended to meet the power demand associated with the rapid post-war economic recovery of Japan. At the time of completion, the Dam was the largest arc type dam in the world. At 186m in height it remains the largest of its kind in Japan.

Dam name

Scheme operator

Kansai Electric Power Company

Size of scheme (MW)

124

Country

Japan

Catchment area

461.18km²

River

Kurobe

Effective reservoir capacity

1.66 x 10⁶ m³

Construction years

1982-85

Reservoir size

Details

Although the Kurobe River catchment is primarily situated in national park, the very high annual rainfall (4000mm/yr average) and low water retentive geology has resulted in approximately 7000 landslip areas. As a result, sediment loads in the river tend to be very high. The construction of a conventional dam would result in:

- Rapid sediment accumulation in the storage, requiring frequent dredging, diversion works or other strategies to maintain the capacity of the storage. These operations would have significant impacts on the downstream environment and would be difficult and expensive due to the inhospitable terrain at the dam site.
- The retention of sediments and bedload that, under natural conditions, would move down the river system and discharge to sea. Strong community opposition to the dam centered on the potential for riverbed and coastal erosion as a result of altered sediment transport regimes.

To overcome these issues, the Dashidaira Dam was designed with a unique flushing channel and sediment gates to enable free flow of water when the lake level is low. This provides the opportunity for the unimpeded passage of floods, the timing of being matched to natural flood events using flow and sediment transport models. The resulting sediment transport patterns closely match natural sediment transport events.

Monitoring of the downstream environment since construction of the dam has indicated that:

- Turbidity in the downstream environment is declining annually
- Turbidity and organic carbon loads are temporarily high in the vicinity of the river mouth during sediment flushing, but return to background levels within one day of a flushing event
- No changes in the nature of riverbed sediments have been detected subsequent to sediment flushing.
- Aquatic faunal communities downstream of the dam are altered during and immediately after during flushing events, but return to normal after a period of 1 month. This is similar to trends observed during natural flood events.

Other Aspects

Safety

In 1995 an extremely heavy rainfall event resulted in rapid deposition of sediments, threatening the stability of the Dashidaira Dam. The ability to routinely reduce sediment loads and make emergency sediment releases is an important safety feature.

Environmental flows

The ability to allow free flow of water during periods of natural flooding produces a hydrological regime that in some way mimics natural flood events. This has important implications not only for sediment transport and other geomorphological processes, but also for biological processes that are stimulated by such flow events.

Resource Use

The development of sediment management strategies has enabled sustainable hydropower development on a river system that might otherwise have been unsuitable for this purpose.

Cost benefits and economic performance

Due to the extreme sediment loads, controlled downstream release is economical and has less impact on the environment than dredging operations. In addition, the burning of fossil fuel to operate dredging machinery is not necessary.

Longevity of benefits

The design and operating regime of this system reduces sediment accumulation, provides natural movement of bedload and passage of floods, providing long term economic and environmental sustainability.

Community engagement and acceptance

Community concerns around the impact of the project on sediment movement both within the Kurobe River and the adjacent coastline have been addressed, and there is general stakeholder acceptance of the project.

Further information

Source: Hydropower Good Practices Workshop, Annex VIII - Examples for Good Practice Report, Villach, Austria, October 2005. International Energy Agency.

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

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