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A
Report on
Field visit to Sunkoshi Hydropower Plant

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1. Introduction

This is a report on field visit to Sunkoshi Hydropower station located at 81 km east from Kathmandu in Sindhupalchowk district. The powerhouse was commissioned in January 1972 with a friendly cooperation of the Water Conservancy and Electric Power Ministry of the People's Republic of China and Government of Nepal. The cost of the project was approximately NRs. 109.37 million including transmission line up to Kathmandu. The cumulative generation of the station has reached 2,027.46 GWh in 2011/12 from the first run. The station has generated 60.36 GWh in FY 2010/11 and 66.38 GWh in FY 2011/12 with an increase of 9.99%. The station has a share of 1.59% of the total energy in the INPS in 2011/12.

2. Objective

- ✓ to know about the components of ROR hydropower project form intake to powerhouse
- ✓ to know how the components were laid and their working
- ✓ to know about the threats to hydropower project like landslide etc.

3. Salient features of Sunkoshi Hydropower Plant

The salient features of Sunkoshi Hydropower station as obtained from the NEA website are :

Type	Run off River, Medium head plant
Location	Sindhupalchowk
Installed capacity	10.05MW
Annula design generation	70 GWh
River discharge	88 m^3/s
Design discharge	39.9 m^3/s
Maximum net head	30.5m
Length of canal	2.653 Km
Daily regulating pond capacity	67000 m^3
Forebay capacity	18000 m^3
Diameter of penstock	2.54m, 3 nos. with 13.3 m^3/s discharge in each
Turbine Generator set	3 nos.
Shaft configuration	Vertical
Turbine	Type : Francis (Model HL123a-LJ-140) Output : 3530KW Speed : 300 rpm
Generator	Type : Synchronous, 3 phase (Model : TS 325/36-20)

	Capacity : 4000 KVA Rated voltage : 6.3 KV, 50Hz Rated current : 361 A Rated power factor : 0.85
Transmission Line	66KV, Single circuit
Project Inception date	End of 1968
Project placed in service	January 1972
Project financed by	People's Republic of China and Government of Nepal
Project Cost	NRs. 109.37 million(including transmission line)

4. Components of Sunkoshi Hydropower Plant

The Components of Sunkoshi hydropower station visited are:

1. Barrage
2. Intake
3. Headrace Canal
4. Settling basin
5. Spillway
6. Peaking pond
7. Fore bay
8. Penstock
9. Power house
10. Tailrace canal

Each components are explained below:

4.1 Barrage

The barrage of Sunkoshi consists of six radial gates as outlet gate with hoist for opening closing of gates when required. The dam increases the head, enough to divert the water towards intake. About 10% water are let pass towards the downstream of river for as an environment flow.

Radial gate: It is most common and economical type of gate. The radial gate is operated by rotating around its hinge about horizontal axis. Opening and closing of gate is controlled at the hoist above it. While opening it occupies less space than that of vertical gate.

Divide wall: The divide wall is provided to prevent cross current i.e. for one directional flow.

Under sluice: Under sluice gates are provided to flush the sediments downstream of river.

4.2 Intake

It is a hydraulic structure constructed to withdraw required amount of discharge from river. There are 4 side intakes in Sunkoshi hydropower station. At entry, trash rack has been provided to prevent entry of logs, floating bodies, dead animals, etc.

4.3 Headrace Canal

A canal is provided to convey the water from intake to fore bay. A side canal has also been provided which comes into use during cleaning of settling basin. The length of canal is 2.653 Km.

4.4 Settling basin

The settling basin is one of the most efficient devices for hydropower schemes, constructed on the head race canal for removal of sediment load upto 0.2mm diameter particles from flowing water which cannot be trapped by gravity trap.

The settling basin of Sunkoshi consists of enlarged section at entrance to reduce the velocity and hence the turbulence so that the bed load gets settled. Baffle walls are also provided to facilitate the reduction of velocity. The settling basin is of hooper type. The section of the basin becomes converging into similar shape and size of headrace canal at outlet.

Flushing : When the sediments exceeds, deposited material tend to reduce X-sectional area of basin which increases the velocity ultimately decreasing the trap efficiency. So flushing should be done. In sunkoshi, three flushing gates are provided with hoist for gate operation and flushing is continuous.

4.5 Spillway

To discharge the excess water, overflow spillway of ogee shaped has been provided at downstream of settling basin. When water flows over the crest of spillway, it must always remain in contact with or slide over the surface of spillway. The spilled water is mixed with the river through the channel.

4.6 Peaking Pond

The peaking pond of the Sunkoshi Hydropower Plant is utilized during the dry (winter) season when very low sediment concentration exists in the river. During the wet (monsoon) season, the inlet gates of the peaking ponds are closed to stop the access of sediment-loaded water. Since the peaking pond is located just upstream of the fore bay and is only used during the dry season, the annual sediment deposition rate in the peaking pond is low.

4.7 Fore bay

A fore bay or head pond is a temporary water storage, regulating reservoir provided at downstream end of canal just at upstream of penstocks. At instance when turbine rejects the load, it acts as a storage reservoir whereas it supplies water as a sort of regulating reservoir when load increases.

In Sunkoshi, fore bay has been provided just upstream of penstock. A spillway has also been provided at side of fore bay to spill the excess water. The water spilled is mixed into the river by dissipating its energy at stilling basin. Flushing gate has also been provided to flush the sediments of fore bay.

Stop logs has also been provided. It is a gate used to prevent the flow through spillway or canal during the routine maintenance.

4.8 Penstock

Penstock is a pipe which carries water under pressure from fore bays to turbine installed in powerhouse. Three penstock pipes has been provided in Sunkoshi hydropower station, each of diameter 2.5m and length 76m supported on saddle.

4.9 Power house

Power house is a multi-storied structure consisting of power generating equipments like turbine, generator, switchboard, control room, etc. The net head is of 30.5m.

In Sunkoshi hydropower station, three turbine-generator units are provided. Water from 3 penstock pipe hit turbine. Control room is provided to manually control the power generation. The type of turbine used is Francis turbine. It is reaction turbine and is used for medium head hydropower project. In runner water enters radially and leaves axially so it is also called "*mixed flow turbine*". Major part of available water energy is converted into kinetic energy at the entrance to runner and a considerable remaining part is also utilized as pressure

energy. Both kinetic and pressure energy are directly converted into mechanical energy by turbine runner before generating electrical energy.
Step up transformer is used to step the produced voltage of 6.3KV to 66KV.

For control and protection device, there is 10 circuit breaker (3-generator,2-power transfer,2-station supply and others 3 for local supply). MOCB (minimum oil circuit breaker) has been replaced by VCB(Vacuum circuit breaker has been used). Natural air cooling, air forced cooling,water forced cooling are used as cooling system.

4.10 Tailrace canal

The function of tailrace canal is to discharge the water from powerhouse to river safely.

5. Present condition of Sunkoshi hydropower Plant during visit

A huge landslide disaster was occurred on August 2, 2014 (2071/04/17 BS) Saturday, at 2.36 Am in the Jure, Ward no 1 and 5 of Mankha Village Development Committee (VDC) and Ward no. 5 of Ramche VDC, Sindhupalchowk district. This destroyed the dam and radial gate. Also due to falling of tower connecting to the national grid, the power is being supplied to the local only and one turbine is shut down because the power generated cannot be supplied. Currently only two turbine are in operation during our visit.

6. Photos of Components of Sunkoshi hydropower Plant

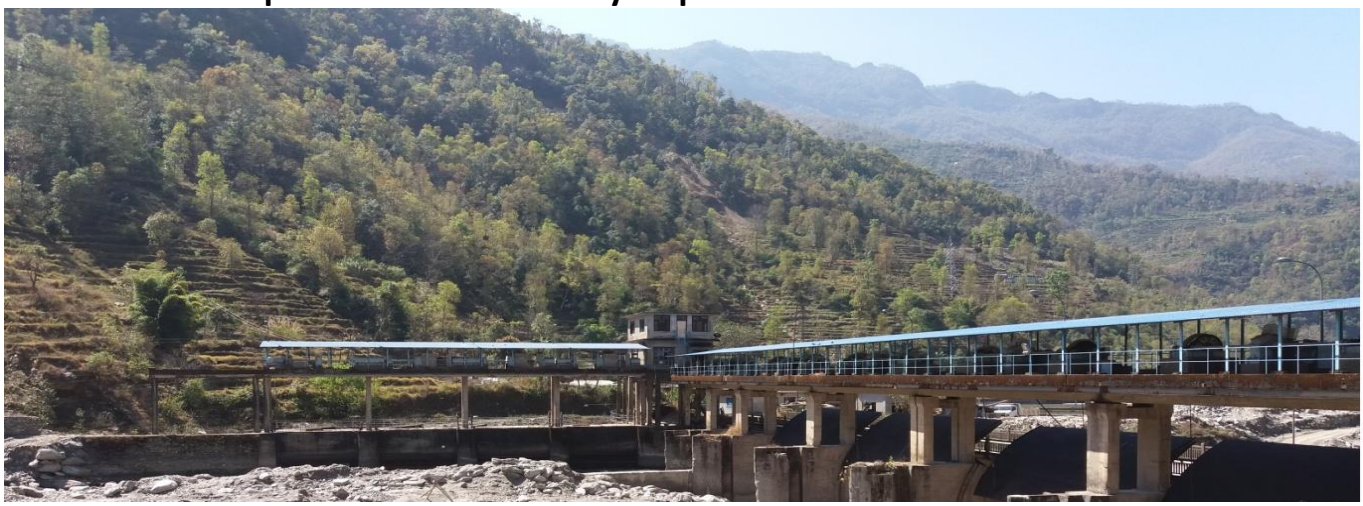

fig. Dam showing radial gates with hoist and intake

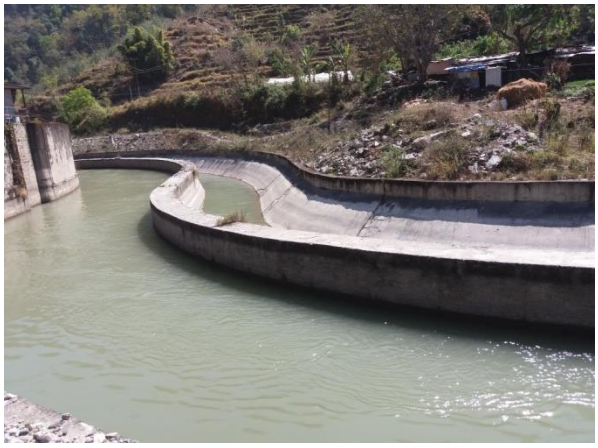

fig. Headrace canal and side canal

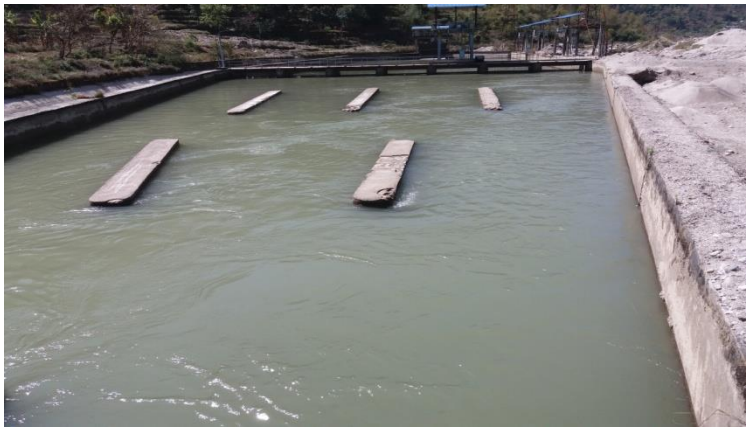

fig. Settling basin showing baffle wall

fig. flushing gate of settling basin

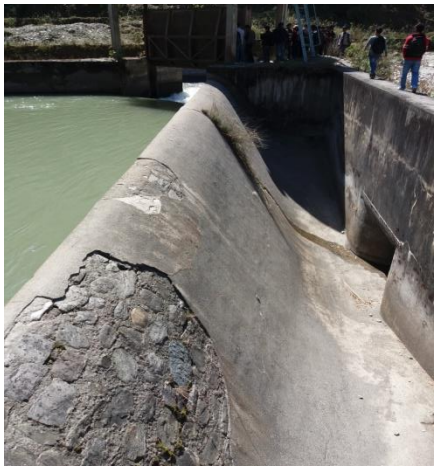

fig. spillway

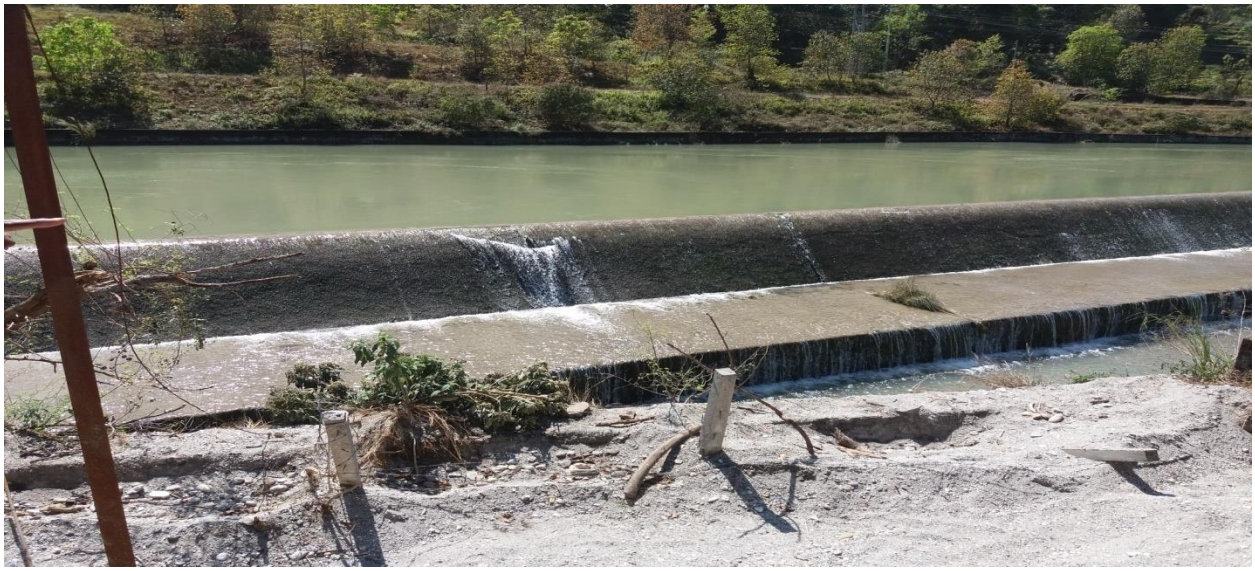

fig. forebay with spillway

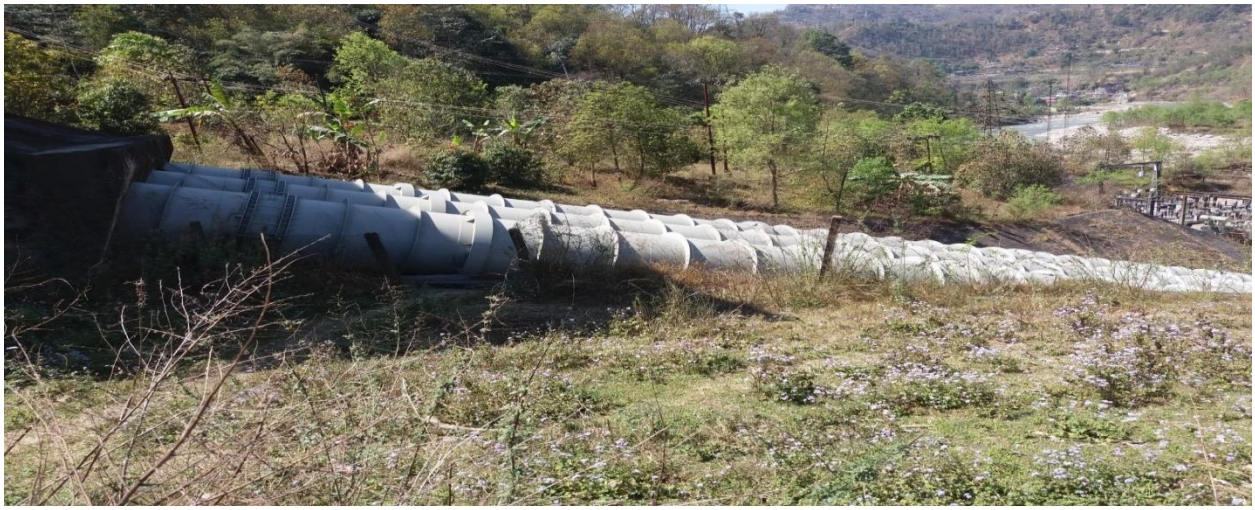

fig. three penstock pipes

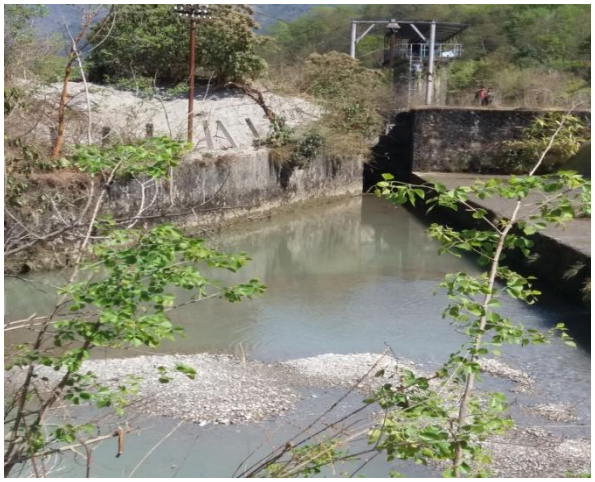

fig. Stoplog in forebay

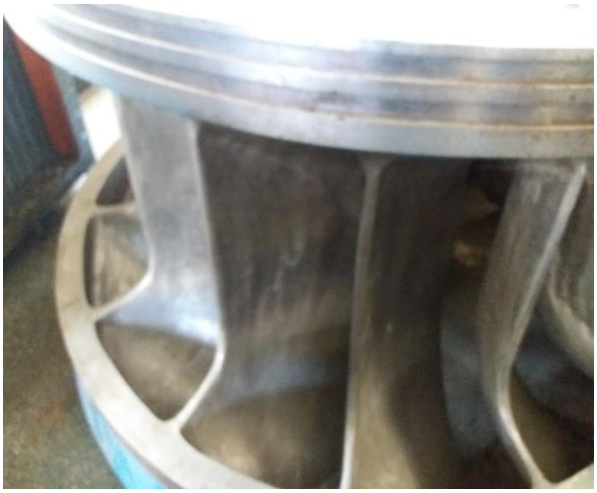

fig. Francis Turbine

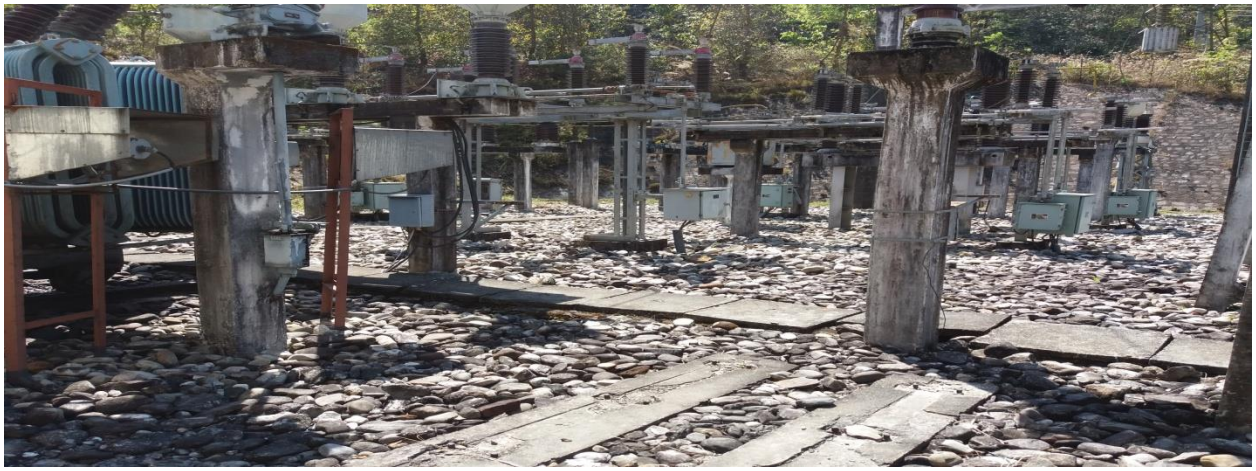

fig. transformers

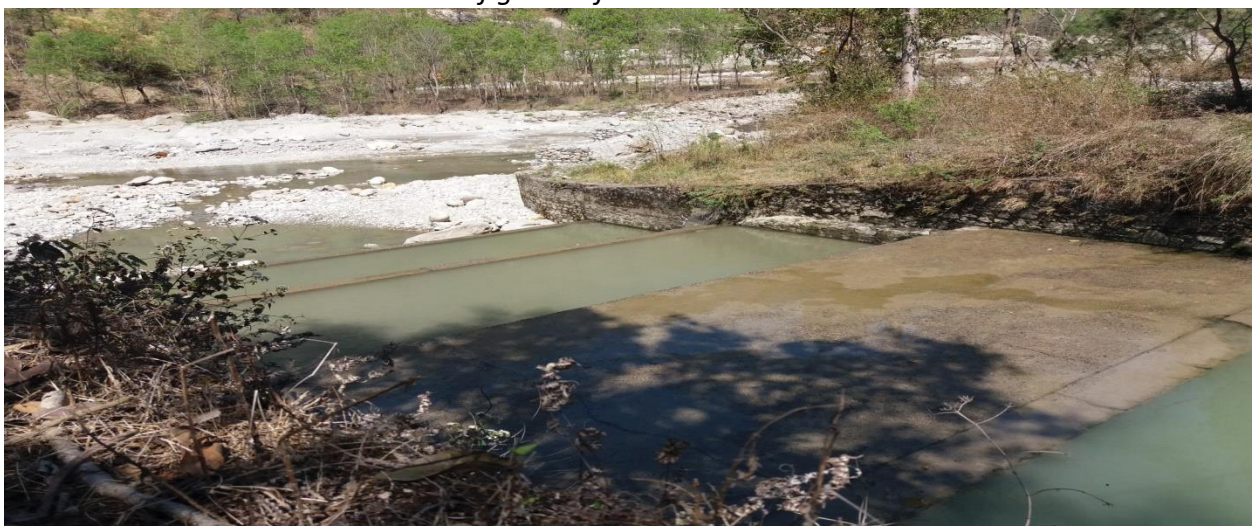

fig. stilling basin

6. Conclusion

The field visit helped to know about the headwork structures of ROR hyrdropower station, how they are placed, how they work. Almost all the structures of the ROR hydropower plant included in the course were visited which cleared the concept more and enhanced our knowledge. The present condition of the Sunkoshi hydropower station is worse lately due to landslide of Jhure which damaged the dam. So the dam should be repaired as soon as possible and mitigating measures should be taken to prevent landslide from damaging the dam.

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