THESIS

DESIGN OF U/S OVERFLOW COFFERDAM OF PATRIND HYDROPOWER PROJECT

By

MUHAMMAD RIZWAN FARID
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ABSTRACT

The Patrind Hydropower project is runoff river project, located in NWFP on Kunhar River near Muzaffarabad. Major project components envisaged under the proposed scheme include a 26 m high main weir structure equipped with three bottom outlets of 3 m diameter each, within the Kunhar River bend. An intake structure is located slightly upstream of the weir, leading to the headrace tunnel, through a multi-chamber sand trap. The headrace tunnel opens into an underground surge tank, a vertical pressure shaft, a horizontal pressure tunnel (penstock), trifunction into manifolds to a surface type Powerhouse located on the right bank of the Jhelum River. Installed capacity of the power plant is 150 MW.

The construction of main weir will be done by short circuiting the river from upstream to downstream of the construction area through the 7 m internal diameter tunnel. The cofferdam shall be built just downstream of the diversion tunnel mouth to plug the river and divert the flow through the tunnel. The river diversion arrangements are planned in such a way that during low flow season (308 cumecs) only diversion tunnel will be operated and carry the total low season flow of 308 cumecs. During the monsoon period (maximum flow ≈1034 cumecs), flow of more than 680 cumecs will pass through the diversion tunnel with increased head and remaining flow will be allowed to spill over the cofferdam and flow through bottom outlet provided in the main weir.

Cofferdams are temporary structures used to divert a stream or to enclose an area during construction with the concept that it will not be overtopped. An

overflow type of cofferdam is proposed for cost saving of diversion work. The low level outlets in the main weir will be built during low flow period and can take part of high flow floods requiring a smaller sized cofferdam that could be overtopped and the spilled water easily passes through the low level outlet. The objectives of the study included the design of an overflow type upstream cofferdam; estimate the quantity of spill water over the cofferdam during high flood, evaluating adequacy of under sluices / low level outlet and the determination of the downstream required protection work for the cofferdam for safety against overspill flood flows.

Relevant data was collected from the Feasibility Study of the Patrind Hydropower Project prepared by Consultants. For the design of the overflow type cofferdam two seasons low flow (308 cumecs) and high flow (1034 cumecs) seasons were selected against the 10 years return period. Adequacy of the diversion tunnel was checked during the low flow (Q_L) condition and the quantity of the spill water (Q_s) over the cofferdam was estimated against the high flow (Q_H) seasons. For these purposes HEC-RAS model was used.

The HEC-RAS Model was run against Q_L and maximum water surface level 749 m is obtained against this simulation. The crest of the cofferdam is at an elevation of 750 m amsl and the bed elevation is 734 m amsl. The model was run against Q_H to estimate the quantity of spill water over the cofferdam against this simulation 181 cumecs (Q_s) is spill over the cofferdam with maximum water elevation of 752.1 m amsl. The model was run against the Q_s with continuous and stepped chute gabion at the downstream side of the cofferdam to obtain the

maximum velocity and check the adequacy of the low level bottom outlet. The maximum velocity 8.53 m/sec and 7.95 m/sec was obtained against continuous and stepped chute gabion respectively. Downstream slope of the cofferdam is protected against 7.95 m/sec velocity. The stone / gabion size is estimated by using the Isbash method and the estimated stone size against 7.95 m/sec is 2.5 m which is very large and difficult to place on the site. So the stepped gabions of minimum 1 m high 3 m wide are provided at the d/s slope of the cofferdam. The downstream floor is also required to be protected against scouring against the maximum velocity 2.47 m/sec at the toe of the cofferdam. The scour depth is calculated by using the Lacey's formula which is 2.6 m and the length of apron is provided 1.5 times the maximum scour depth.

A 16 m high rock fill cofferdam is proposed with upstream membrane of clay and downstream fine filter. The downstream slope of the embankment is proposed to be protected by a stepped chute of gabion along the slope of the embankment. Upstream slope of the embankment is steeper i.e. 2H: 1V while slope of the downstream face is relatively flatter 3H: 1V and 10 m wide crest of cofferdam is proposed. 1 m thick concrete slab is also provided on the crest of the cofferdam to prevent the damage from overflowing water. During high flow season 181 cumecs water is overtopped over the cofferdam with 2.1 m water depth above the cofferdam crest. The pondage is created between cofferdam and diversion weir upto the elevation of 740.8 m amsl, so the main weir should be completed upto the elevation of 741 m amsl before the high flow season. Seepage quantity i.e 0.001 cumecs is estimated through the cofferdam. The cost of the non overflow type cofferdam is 46% more than the overflow type cofferdam.