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EXPERIMENTAL STUDY OF FLOW IMPACT AT SAND POCKET

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ABSTRACT

The Bili-bili multipurpose dam was commenced since 1992 and completed in 1999. The location of Bili-bili dam is at south east of Makassar city, about 31 km from the river mouth of Jeneberang River and about 1.6 km of the confluence of the Jeneberang and the Jenelata rivers. This project comprised Sabo dams in upstream reaches from Bili-Bili reservoir, and 5 (five) units, sand pocket of which serves as a sediment control structure and sand mining location. On March 26, 2004, the gigantic collapse of the Sorongan ridge (caldera of mount Bawakaraeng), which is the headwaters of Jeneberang river. This experimental study of flow impact at sand pocket shown that even the velocity of the flow not too high the hydraulic jump caused the very deep of scouring, as the hydraulic jump not occur in the stilling basin, but in the downstream of the sand pocket , at the apron. To prevent the very deep scouring, at the downstream, the level of the apron must be constructed lower , and the rip rap construction must be implemented.

Keywords: experimental study, flow behaviour, sediment control structure, sand pocket.

1. INTRODUCTION

At Bili-bili dam system, there are 5 (five) units of sand pocket which constructed as sediment control structure, and also as a sand mining location. But, after several years, all of the structure has been ruined. This experimental study doing by physical model in the laboratory to evaluate the flow behaviour which caused a very deep scouring.

The focus of this experimental study is sand pocket number 3 which has 336 meter length, 7 meter height and has a storage capacity of 129,000 m^3

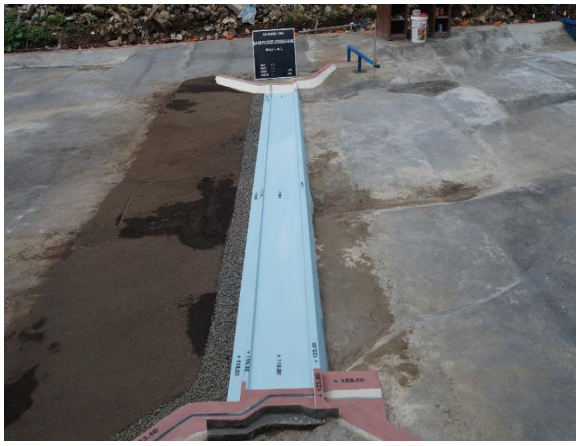


Figure-1. Physical model of sand pocket.

Figure-1 shown the physical model, of which the geometry scale of this model is 1 : 40.

2. METHODOLOGY

The scale of the model done by applying the theory of hydraulic model, froude criteria, dynamic motion criteria, roughness criteria, tractive force criteria, critical tractive force, and sediment/bed load transport criteria.

This experimental study using the fixed bed model for getting the similarity of roughness , and to evaluate the changes of flow parameters, such as water level, direction and velocity of the flow.

The discharge (Q) using in this experiment are 720 m^3/s or 30% of design discharge, 1440 m^3/s or 60 % of design discharge, 1900 m^3/s (at the sand pocket number 3), and 2400 m^3/s

The physical model included about 200 m from upstream of the sand pocket and up to 400 m downstream of the sand pocket.

3. RESULT AND DISCCUSIONS

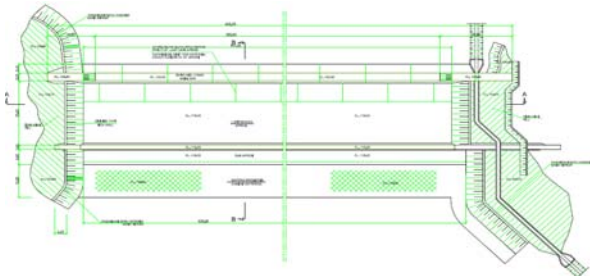


Figure-2. Plan of sand pocket.

Figure-2 shown the plan of the Sand Pocket, which could be seen that, the elevation of the main dam is +125.80, the elevation of apron is + 118.

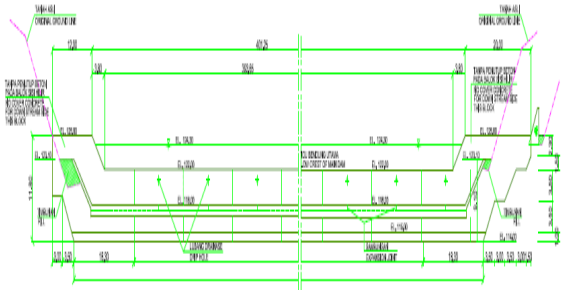


Figure-3. Section A-A.

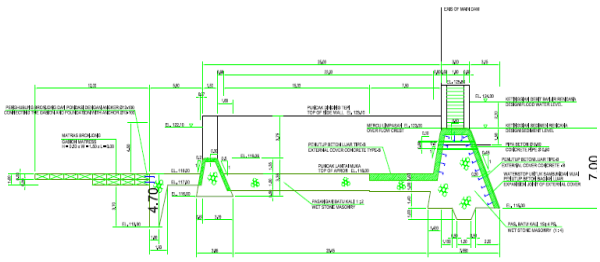
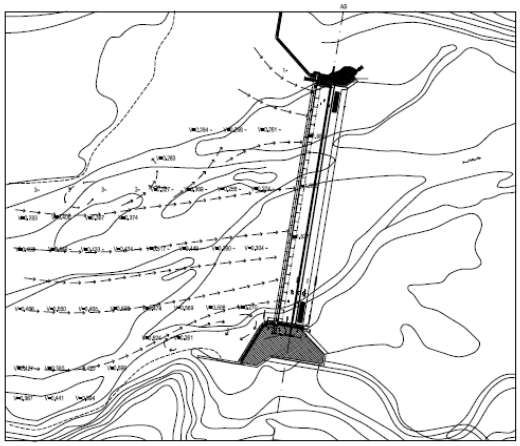


Figure-4. Section B-B.

In Figure-3 and Figure-4 shown the elevation of top of the side wall is + 123.10 m, elevation of overflow crest is + 122.00, elevation of top of apron is + 118.00, and design flood water level is + 124.30.



Fugure-5. Flow direction with Q = 720 m^3/s.

In Figure-5, shown the flow direction with a discharge of 720 m^3/s. The flow direction on the left side shown a different pattern with on the right side. The velocity of the left side is about 0.261 m, on the right sides, 0.384 m/s in the middle, and 0.270 m/s , some vortex happened at the upstream of the sand pocket, on the right side ,even the velocity not increasing, and the water level at the upstream is + 123.000, and at the downstream is + 117.330.

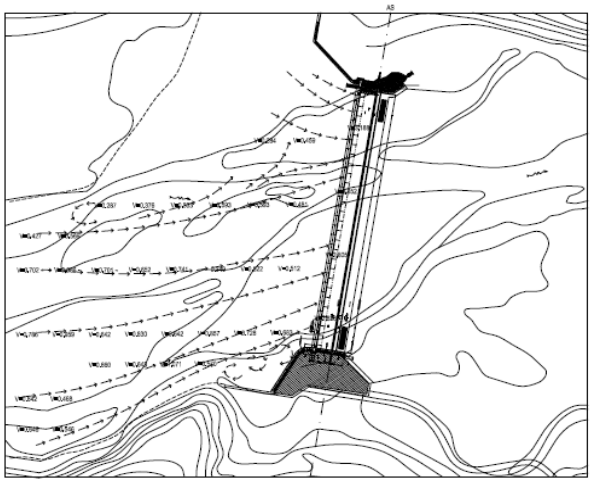


Figure-6. Flow direction with Q = 1440 m^3/s.

In Figure-6, shown the flow direction with a discharge of 1440 m^3/s. The flow direction on the left side shown a different pattern with on the right side. The velocity of the left side is about 0.459 m/s, on the right sides, 0.683 m/s, and in the middle, 0.512 m/s, some vortex happened at the upstream of the sand pocket on the right side Even the velocity not increasing, and the water level at the upstream is + 123.700, and at the downstream is + 118.100.

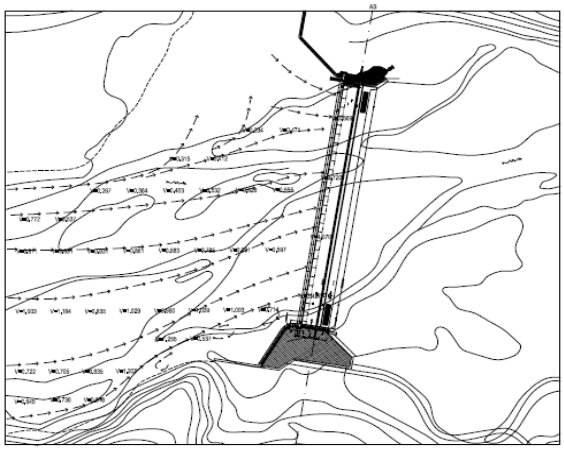


Figure-7. Flow direction with Q = 1900 m^3/s.

In Figure-7, shown the flow direction with a discharge of 1900 m^3/s. The flow direction on the left side shown a different pattern with on the right side. The velocity of the left side is about 0.471 m/s, on the right sides, 0.714 m/s, and in the middle, 0.597 m/s, some vortex happened at the upstream of the sand pocket on the left side and on the right side near the structure, even the velocity not increasing, and the water level at the upstream is + 123.930, and at the downstream is + 118.600.

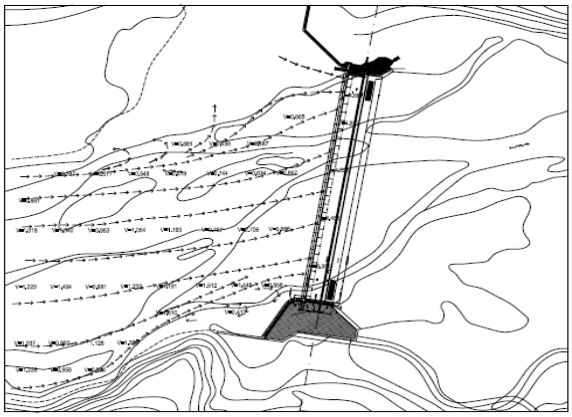


Figure-8. Flow direction with Q = 2400 m^3/s.

In Figure-8, shown the flow direction with a discharge of 2400 m^3/s. The flow direction on the left side shown a different pattern with on the right side. The velocity of the left side is about 0.665 m/s, on the right sides, 0.956 m/s , and in the middle, 0.686 m/s , some vortex happened at the upstream of the sand pocket on the left side and on the right side near the structure, even the velocity not increasing, and the water level at the upstream is + 124.230, and at the downstream is + 119.030.

Based on the experimental study shown on Figure 5, 6, 7, and 8, the direction of flow lout fairly evenly toward the crest, and at the middle flow crow's n nest perpendicular axis. the pattern of the flow direction distributed quite evenly on each reach of the cross section, and vortex occurs mainly in the wing hick flow to the right

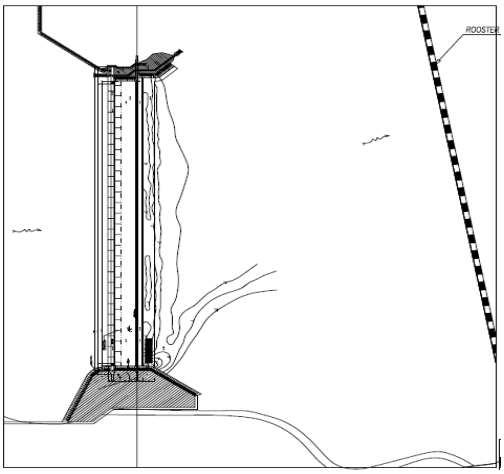


Figure-9. Scouring pattern (Q= 720 m^3/s).

Figure-9 shown the scouring with 30 % design discharge (Q= 720 m3/s), scouring occur in downstream, and the deepest scouring occurs on the right side of the side wall.

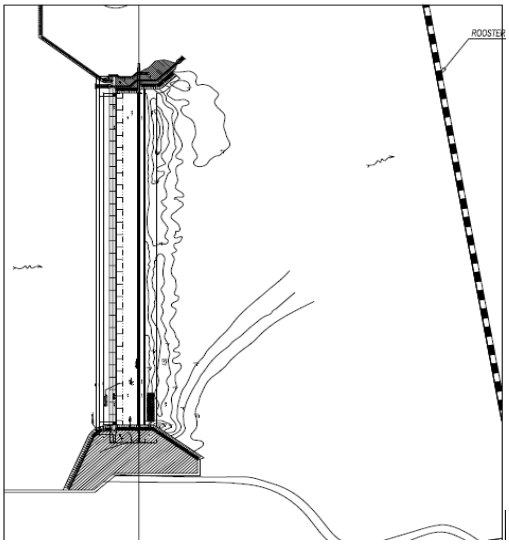


Figure-10. Scouring pattern (Q= 1440 m^3/s).

Figure-10 shown the scouring with 60 % design discharge (Q= 1440 m3/s), scouring occur in the downstream, and the deepest scouring occurs on the right side of side wall, about 6 m.

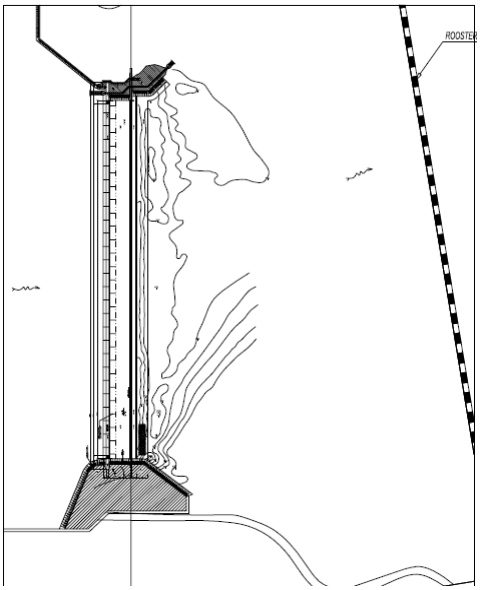


Figure-11. Scouring pattern (Q= 1900 m^3/s).

Figure-11 shown the scouring with discharge (Q= 1900 m3/s), scouring occur at the downstream, and the deepest scouring occur at the right side of side wall, about 6 m.

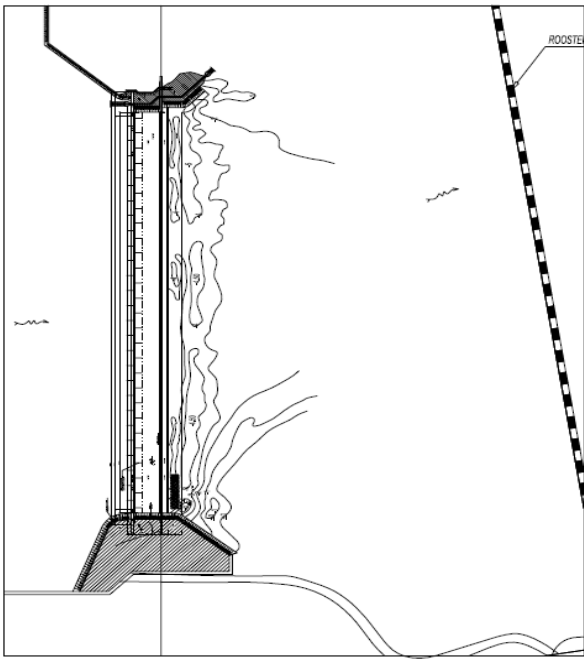


Figure-12. Scouring pattern (Q= 2400 m^3/s).

Figure-12 shown the scouring with discharge (Q= 1900 m3/s), scouring occur in the downstream, and the deepest scouring occurs on the right side of the side wall, about 6 m, and at the middle of bed level at downstream about 4.5 m.

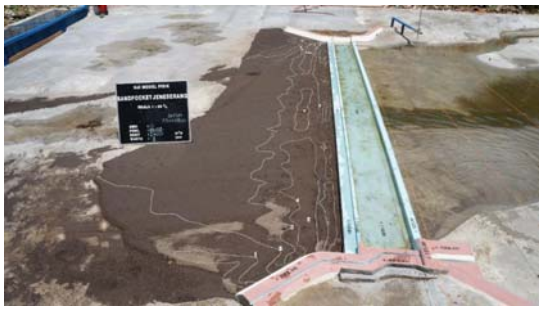


Figure-13. Scouring pattern (Q = 2400 m^3/s).

Figure-13, shown the photo while doing the experiment with design discharge (Q = 2400 m^3/s) The scouring experiments done with the old drainage 1 hour in model that simulate the flood time in the field for 6.5 hours.

Based on the experiment, shown that the capacity of the sand pocket of Jeneberang river could accommodate the design discharge. River flow from upstream The flow from upsream not evenly distributed to the opening of the sand pocket. The hydraulic jump does not occur at the stilling basin, but jump directly to the apron at the downstream of the sand pocket.

4. RECOMMENDATION

As the hydraulic jump does not occur in the stilling basin, the level of the apron best be lower (from the elevation of + 118 m to + 115 m), and rip rap construction best be implemented about 15 m length

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