INTERNATIONAL ASSOCIATION FOR HYDRAULIC RESEARCH

STILLING BASIN WITH DIVERGING SIDE WALLS

(Seminar 3)

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In a conventional jump type dissipator, the side walls are kept parallel and the transition structure is provided only after the dissipator. An attempt has been made to solve a dissipator with diverging side walls so that the same structure can be used for energy dissipation as well as flow transition, reducing the cost of construction thereby.

It is found that ordinarily the jump in a diverging basin with level bed is Skew in nature. A high velocity jet swings on one side, the other side being occupied by a large body of stalled fluid. The unstable high velocity jet contains high kinetic energy as revealed from high value of kinetic energy correction factor, α_2 . This is capable of bringing untold damage to the bed and sides of the tail-channel.

The problem of design of a dissipator with diverging side walls is in essence a problem of stabilising the jump, ensuring that the side rollers are symmetric and are contained within the basin. Hydraulically, the fundamental difference between a dissipator with parallel walls and that with diverging walls lies in the fact that while there is an axial component of wall reactions acting in the forward direction in the later, there is no such forward force from walls in the former. It was, therefore, felt that if the forward force could be neutralised by equal amount of backward force by providing reverse slope to the basin floor, the jump might be stable. Angles of the reverse slope (β) for known angles of divergence of side walls were computed by equating the forward and the backward forces. β - values so calculated were found to be 1° - 45', 2° -37' and 5° - 16' for diverging walls having side slope governed by 3:1, 2:1 and 1:1 splays respectively. Each basin (as determined by a given splay) was provided with four different bed slopes (β) and was tested for three different flow conditions. Each flow was tested with conjugate depth and also at a depth 33% less than conjugate depth. 79 experiments were conducted altogether. In each experiment flow pattern was observed and velocity distributions were recorded after the basin for computing α_2 and efficiency (η) of jump as an energy dissipator.

Performance of the basin improved considerably by provision of reverse slope to the basin floor. The optimum angle (β) , however, differed from the analytical values, perhaps due to simplified assumptions made in the momentum equation used for calculating conjugate depth. It was observed further that out of the three basins tested, the basin having 3:1 side splay with a bottom slope (β) of 3° was best. In the other two basins, the side rollers (although made symmetrical) could not be accommodated within the basin resulting in non-uniformity and certain amount of instability of flow at the exit and of the basin.

Flow conditions in the basin with 3:1 side splay and 3° bottom slope improved further when one row of U.S.B.R. type basin blocks was introudced at a distance of approximately 1.8 d_2 (where d_2 is the conjugate depth) from the toe of spillway. Efficiency of this new type of basin with and without bottom slope is compared in the table given below:

Type of Basin	Flow Conditions					
	Q=31 L/S, F_1=5.15		Q=15.5 L/S, F_1=6.97		Q=7.75 L/S, F_1 = 9.54	
	% η	α_2	% η	α_2	% η	α_2
1. Level Basin 3:1 side Splay, β =0°	94.02	6.92	96.27	8.34	97.85	9.46
2. Basin with 3:1 side splay β =3° No basin block	99.58	1.51	99.76	1.46	99.95	1.18
3. Basin with 3:1 side splay β =3° one row of basin blocks	99.86	1.24	99.96	1.17	99.98	1.13

Results given in the table above correspond to tailwater depths equal to conjugate depths. Improved performance of this new type of basin can be realised further from the fact that even when the tailwater depths were reduced by about 33%, the basin performed extremely well. Fig. show the typical distribution of velocity at the exit ends for the three different basins as illustrated in the table above.