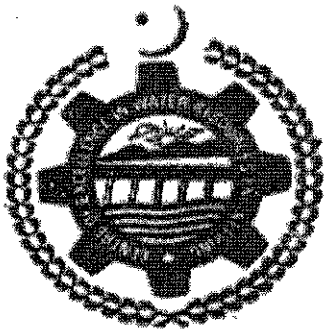
THESIS

# NUMERICAL MODELING OF SEDIMENT FLOW IN SAND TRAP FOR GOLEN GOL HYDROPOWER PROJECT BY USING SSIIM CFD MODEL



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(2006-PG-WRE-31)

For the Degree of

MASTER OF SCIENCE

IN

WATER RESOURCES ENGINEERING

CENTRE OF EXCELLENCE IN WATER RESOURCES ENGINEERING
University of Engineering and Technology, Lahore, Pakistan.

2009

# ABSTRACT

Sand traps are required at hydropower plants to remove sand particles of size ~ ≥ 0.2 mm, which are damaging to turbine blades. This Study is based on design and evaluation of Sand trap of Golen Gol Hydropower Project (106 MW). This evaluation is based on simulation of the sand trap using numerical model program named as SSIIM (SSIIM stands for Sediment Simulation in Intakes with Multiblock Option) developed by Dr. Nils Reider B. Olsen, Professor at NTNU, Norway. The program is a stepping stone in the field of Computational Fluid Dynamics (CFD).

The Sediment load for Golen Gol was determined by using hydrological data of Golen Gol at Babuka bridge and neighboring stream in the area i.e. Mastuj River. On these bases a sand trap was designed having three chambers for an inflow discharge of 10 $m^3/s$ per chamber. Particle size of 0.2 mm was selected to be settled down. Final design was selected with specification of total length 123.68 m including 12.49 m initial and end transition zones and 98.7 m long and 6.38 m wide settling basin with downward bottom hopper.

For sand trap evaluation by SSIIM, the grid was generated through out the sand trap from inlet to outlet with the co-ordinate system 'i' 'j' and 'k' representing stream-wise (x-direction), cross stream-wise (y-direction) and vertical (z) directions respectively. Each cross section in sand trap was divided into eight numbers of profiles along Y-axis and eight numbers of levels or profiles along Z-axis. Length wise (x-direction) the initial transition zone, settling basin and end transition zone was divided into 11, 78 and 11 cross sections respectively. So the geometry has 100 x 8 x 8 gridlines i.e. 100 x-sections,

8 profiles along transverse directions and 8 profiles along vertical directions. The co-ordinates of the intersecting points of cells were determined by selecting a reference coordinate origin. Four particles size 0.059, 0.108, 0.157 and 0.205 mm were simulated for flow and settling.

All the input data i.e. grid co-ordinates and different parameters used are appended in two files named 'koordina' and 'control' to run the program. The model was run for 8110 seconds with time step of 5 seconds. Graphical results were obtained in the form of velocity vectors, horizontal velocities, vertical velocities and sediement concentrations of all four particle sizes on Map, Longitudinal profiles and X-sections from variable menu bar. The trap efficiency of each particle size was extracted from the output boogie file. Horizontal velocity of 0.1177 m/s to 0.1229 m/s and vertical velocity of 0.0168 m/s to 0.0161 m/s (downward) is attained in the settling basin of the sand trap which are satisfactory for deposition of 0.2 mm size sediment. The simulation has been run just for inferior four grain size and particle size of 0.059, 0.108, 0.157 and 0.205 mm are removed 36%, 73%, 95% and 100% respectively. Total trap efficiency of these four sizes is 76% so it is obvious that particles having more than 0.205 mm are removed 100%. By adding the 100 percentage removal of the sediment sizes having diameter more than 0.2 mm, the trap efficiency for all sizes is worked as 90.4%. So the simulation results were found satisfactory to propose the sand trap design.