INDO SWISS JOINT RESEARCH PROGRAMME (ISJRP)

RESEARCH FELLOWSHIPS

EXCHANGE GRANT REPORT

Grant No.: JUAF03

Part 1 - General Information

<table>
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<th>Project Title:</th>
<th>Study of sediment deposition and removal from shallow reservoirs behind run-of-the-river diversion barrages</th>
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<td>Keywords:</td>
<td>Reservoir sedimentation, sediment removal, river diversion structures, numerical simulation</td>
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<td>Start date:</td>
<td>May 12, 2009</td>
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<td>Duration:</td>
<td>2 months</td>
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Part 2 - Exchange Participant(s) Details

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HOSTING SCIENTIST

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Part 3 - Scientific & Technical Information

3.1 Purpose of visit

The purpose of this exchange visit was to carry out experiments on sediment deposition and removal from shallow reservoirs behind run-of-the-river diversion barrages using the advanced experimental facilities available at the Laboratory of Hydraulic Constructions (LCH) of the EPFL headed by Prof. Dr. Anton J. Schleiss. The results of the experiments carried out at the laboratory are expected to be useful in understanding the behaviour of the sedimentation pattern of prototype barrages. It may be mentioned that diversion barrages are used to generate hydropower with the diverted water as well as to use it for agriculture, domestic and industrial water supply, etc.

3.2 Short description of work carried out during the visit

The experimental setup of one of the erstwhile Ph. D. students of LCH, Dr. Sameh Kantoush, was modified to replicate the configurations of a model barrage. Fig 1 shows a part of the tank with the gates installed. The inflow of water, in this case distributed uniformly over the entire width of the tank, is at the far end on the upstream.

Figure 1. Configuration of used for conducting experiments on shallow reservoirs behind barrages

As may be observed from the setup, there are 10 gate bays of width 200 mm and height 300 mm. Each gate was equipped with a sill of which 4 were of height 20 mm and 6 of height 50 mm. The smaller sill heights represented the undersluice bays and the greater sills represented the river sluices.
For conducting the experiments, the discharge was adjusted to the maximum possible, that is, 7 l/s. The sediment introduced to assess the depositional pattern was crushed walnut shells, which was introduced from a hopper installed above the constant head water tank for the setup. The outflow from the system was passed through a sedimentation tank, where the outflowing sediments were collected.

The flow pattern was observed using the Large Scale Particle Image Velocimetry (LSPIV) method. Local point flow values were observed with the Ultrasound Velocity Profiler (UVP). The sediment concentration was measured by taking samples from the water inflowing passage. At the end of each experiment, the deposition of sediments was measured using a mini echo-sounder.

### 3.3 Outcomes

The experiments suggest that since unequal gate opening is common for run-of-the-river diversion barrages, stagnation of flow in the shallow reservoir in front of the closed gates is inevitable. This leads to sedimentation in front of these gates which give rise to the shoals or sediment deposition mounds with time. However, the higher velocities in front of the opened gates do not allow sediment deposition.

### 3.4 Future collaboration with host institution

The present research work conducted at the Laboratory of Hydraulic Constructions (LCH) of the EPFL was the initiation of a series of experiments planned for future. A research scholar is likely to further extend these studies and obtain meaningful results in future which would add not only to the theoretical understanding of the sedimentation process in the shallow reservoir behind diversion barrages but also may pave the way to manage gate operation for prototype barrages. Also, most of the time at the LCH laboratory was consumed in physical experimentation leaving insufficient time for numerical simulation. It is hoped that the numerical simulation studies would be carried out in future after returning to the parent institute.

### 3.5 Various comments

The studies planned were conducted well with the facilities available in the laboratory. However, the experiments involved setting up large ancillaries like sedimentation tank, light shades for PIV measurements, etc., which took a substantial amount of time leaving less time for experimentation.

### 3.6 Projected publications/articles resulting or to result from the exchange (if applicable)

The results of the experiments carried out so far on the setup and that of the future studies likely to be continued by a research scholar are expected to produce a significant technical publication that would try to draw conclusions from the results of the experimentation studies. Also, comparison would be made with numerical simulations which are to be carried out shortly. Attempts would be made to find out ways by which the results from the model studies can be extended to prototype barrages.