B09

Experimental and Numerical Study of Tidal Basin Management around Link Canal: A Case Study of Bangladesh

○Rocky TALCHABHADEL, Hajime NAKAGAWA, Kenji KAWAIKE, Kazuyuki OTA

The presence of coastal polders de-linked the flood plain leading to gradual silting up of rivers which, in turn, has resulted serious water logging rendering large tract of land uncultivable. To solve this problem, temporary de-poldering is done by cutting embankment that connects river and selected tidal basin.

Under natural movement of sediment-borne tidal water, muddy water enters the tidal basin during high tide with a thick concentration of sediments, depositing major portion of suspended sediments before flowing back towards the sea during low tide. This sedimentation would occur into the riverbed if the tidal basin is not utilized for storage as a sedimentation trap. Over time the deposition of sediments raise land level in the selected tidal basin. Such tidal basins are to be rotated among various lowlands within the system so that farmers of one tidal basin do not have to suffer for long time, the process known as Tidal Basin Management (TBM).

deposited on riverbed. During low tide, the outgoing water erodes the river bed so the depth of the riverbed also increases and makes the river congestion free. This paper has attempted to understand TBM through laboratory experiments and numerical simulation. Different experiments with varying opening size of link canal were carried out at Ujigawa Open Laboratory (shown in **Fig.1**) to investigate impact of opening size in effectiveness of TBM.

Suspended sediment concentration (SSC) & deposition are intensively measured in this study. Final bed level is measured using laser displacement sensor and also with photogrammetric processing of digital images to generate three dimensional (3D) spatial data. Adjustable gate facilitated at downstream is closed and downstream discharge is provided to represent high tidal flow from sea and is opened and downstream discharge is stopped to represent low tidal flow during experimental evaluation. Same processes are repeated to represent tidal cycle.

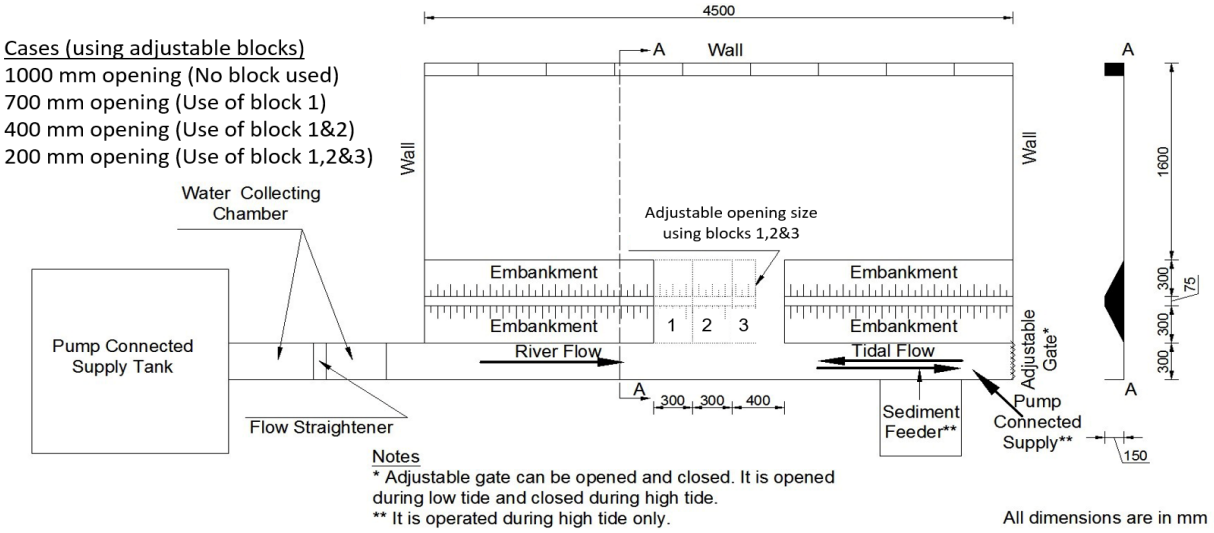

Fig.1 Schematic view of the experimental setup

Efforts have been made to formulate (3D) numerical model including suspended and bed load sediment transport. The hydrodynamic model consists of a Reynolds-averaged Navier-Stokes (RANS) model, *k-ω* shear stress transport (SST) turbulence closure, and a volume of a fluid (VOF). The performance of numerical model is tested with laboratory experiments.

Sample results of experimental and numerical analysis are presented in **Fig.2-4**. Our findings show sediment carrying capacity is a function of velocity. Moreover, only increasing the width of link canal will not allow more sediment to deposit in selected tidal basin. Natural force will tend to restore the equilibrium condition by sedimentation in spacious opening of link canal. It is also found in experiment that near the embankment where tidal flow enters, vortex like formation tries to erode the material which in real case also happens.

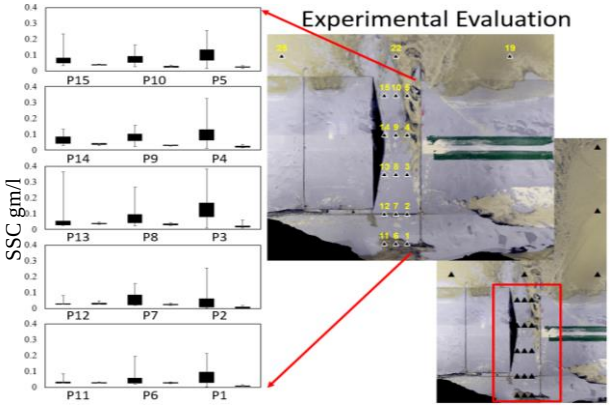

Fig.2 Spatio-temporal variation of SSC at sampling points (left box plot: high tide, right boxplot: low tide for each point)

SSC fluctuation has been simulated and compared with 36 sampling points (sampling points around opening size shown in **Fig. 2**), has good agreement with experimental results. Moreover, the accuracy of photogrammetry analyzed bed level is checked with laser displacement sensor at 2711 points and they both have acceptable agreement with 2.45 percent bias, 0.4 mm mean error and regression coefficient 0.82. For spatially large area, photogrammetric processing of digital images seems wise decision for preparing data for numerical study.

The next plan is to simulate TBM process numerically with real field based data of Bangladesh for which depth averaged two dimensional (2D) numerical model is currently in progress. East Beel Khuksia TBM is taken as case study area after the field visit around South West region of Bangladesh.

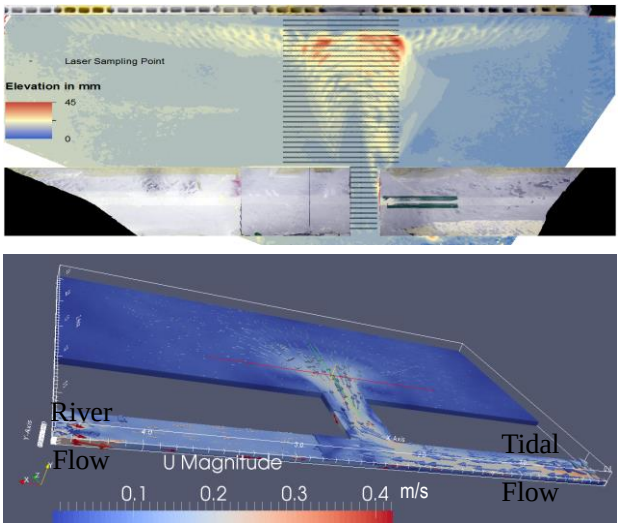

Fig. 3 Final bed level for 200 mm opening (Top) & simulated 3D flow during high tide for 400 mm opening (Bottom)

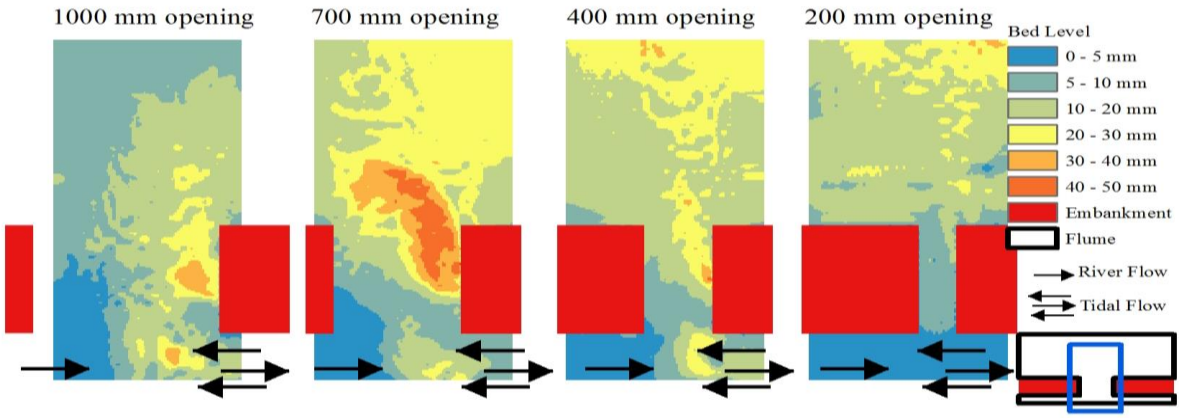

Fig. 4 Final bed level for different cases after 10 hrs of experiment