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# Three Dimensional Numerical Modeling of Flow Field and Flushing Channel Formation in Reservoirs

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Flow pattern in wide and shallow reservoirs with sudden expansion of inlet section may become unstable, which produces large-scale transverse motions and recirculation zones due to the transverse disturbance because of the high sensitivity of flow pattern to the initial and boundary condition (Dewals et al. 2008). Flow velocity distribution pattern plays major role in sediment transport, sedimentation, detention time, and re-suspension process. Furthermore, when large-scale transverse motions and turbulent coherent structures emerge in shallow reservoirs, the sediment transportation pattern (i.e. sedimentation) would be seriously affected by the flow velocity field. A decreased storage volume due to the sedimentation reduces the reservoir function for flood control purpose, electricity production and water supply. This loss of storage volume represents a huge economic loss and the reduction of flood control benefits (Morris & Fan 1998).

The sedimentation problem is serious for small and medium sized reservoirs with high sediment inflow. Subsequently, the accurate assessment of flow velocity field enables the decision makers to predict the favorable sedimentation zone which leads to efficient sediment management strategy in reservoirs. Such kind of assessment is also useful for flood risk management issues especially for reservoirs close to the urban areas.

For controlling the reservoir sedimentation, different approaches such as bypassing, dredging, flushing, sluicing and upstream sediment trapping have been developed to gain the maximum effect, the flushing and sluicing method plays an important role in the sediment removal and reduction, as they are efficient hydraulic sediment removal technique to restore the reservoir storage capacity (Morris & Fan 1998, Liu e al. 2004).

Application of numerical models during the early stage of designing and also during the operation stage of the dam reservoirs would be useful to optimize the sediment management strategies through assessing the effects of upcoming sedimentation or sediment flushing event in the reservoir as well as upstream and downstream areas. The one and two dimensional models are not able to directly simulate the secondary current influences which are very common phenomenon in the natural flow fields. Also, it is difficult for advanced quasi-3D models to reproduce complex 3D flows. Subsequently, 3D numerical models are necessary to simulate the complex 3D flow pattern and bed variation in rivers and reservoirs.

In the present study, a fully 3D numerical model was employed to analyze the 2D surface flow pattern as well as 3D velocity field in the various shallow reservoir geometries with fixed and deformed equilibrium bed condition. Then, the flushing channel formation and evolution trend were reproduced by the numerical model. The Numerical model could represent the asymmetric flow pattern in symmetric geometry setup, consistent with the observations, by introducing a slight disturbance in the initial and boundary condition. The experimental measurements were utilized for numerical model validation and outcomes show good agreement between the simulated and measured flow velocity field.