Defence Seminar

Seminar Title	: Experimental and Numerical Investigations of Velocity Profiles for Unsteady Open Channel Flow
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Venue	: CE Department Seminar Hall
Date and Time	: 09 May 2025 (3.00pm)

Abstract

: This research addresses three-pronged approaches to study the unsteady open channel flow: experimental investigations, numerical investigation and mathmatical modeling. The experimental results meticulously examines the variation of longitudinal velocity profiles in an unsteady open channel and compares well with steady flow. Two single repeated hydrographs with distinct unsteady parameters are introduced into a smooth rectangular channel, and velocity profiles are measured at specific cross-sections for two distinct flow depths (representing one low flow depth with aspect ratio 4.29 and one higher flow depth case with aspect ratio 2.73) within each hydrograph. Comparative analysis with steady flow conditions reveals that steady flow velocity profiles typically reside between the rising and falling limb profiles for corresponding flow depths. Depth-averaged velocities (DAV) are calculated by integrating local point velocities, providing further insights into the discrepancies between the two unsteady flow depths and the steady flow case. It is observed that for both the Hydrographs, the steady flow velocity profiles are placed within the velocity profiles of same depth of rising and falling limb cases. Computational Fluid Dynamics (CFD) simulations using ANSYS Fluent, utilizing established turbulence models like *k-&omega* and *k-&epsilon*, compare simulated results with experimental data for depth-averaged velocity and boundary shear stress profiles. The analysis reveals that the RNG*k-&epsilon* model exhibits greater suitability for predicting depth-averaged velocity, while the SST *k-&omega* model demonstrates superior accuracy for boundary shear stress profiles. To test and compare this numerical model with unsteady flow condition, OpenFOAM software is used instead of ANSYS Fluent. This comprehensive approach provides a detailed understanding of open channel flow dynamics under unsteady conditions. By using this knowledge that for the smooth channel, the Std*k-&epsilon* model is utilized for numerical simulation of unsteady flow for the same geometry and flow condition for both the hydrographs comprising unsteady flow. The study also proposes a modified log-law approach for predicting velocity profiles in unsteady flow channels. The model's accuracy is rigorously validated against experimental data, demonstrating its effectiveness in predicting velocity profiles across a wide range of Reynolds numbers.