INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	Ph.D.
Thesis Title:		Turbulent Flow Structures and Morphological Characteristics of Mining Affected Alluvial Channel
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Thesis Submitted to the Department/ Center	:	Civil Engineering
Date of completion of Thesis Viva-Voce Exam	:	20-08-2018
Key words for description of Thesis Work	:	Sand Mining; Turbulent characteristics, Migration of pit

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Research on in-stream sand mining is imperative as it may have a significant impact on channel morphology. Following this quest to quantitatively comprehend this phenomenon, experimental studies were carried out to investigate the impact of sand mining on hydrodynamics and channel morphology. The channel bed profile shows erosion at the bank of the pit and that the erosion expands to the whole width of the channel and propagates downstream with time. The turbulent structures of the flow have been analyzed for the mining region including upstream and downstream of the pit. Velocity profile shows the presence of reversal velocity at the central bottom of the pit. Results show that velocity profile for the inner zone of flow does not satisfy the modified logarithmic law at center of the pit and also at downstream edge of it. The maximum value of Reynolds shear stress occurs at the center of the pit. The Reynolds shear stress is also higher at downstream of the pit as compared to the upstream of it. The disturbance on the channel bed as a form of mining pit increases the Reynolds shear stress, turbulent intensities in the mining pit region and downstream of it as compared to the upstream section. Analysis of the bursting phenomenon shows that the contribution of sweep and ejection events to the total Reynolds shear stress is more dominant over outward and inward interaction events. The dominance of the sweep event over ejection is observed at the near-bed region from upstream to downstream of the pit and the thickness of dominance of sweep event in the pit and downstream of the pit is found to be more than the upstream. The increase in thickness is responsible for the increase in bed material transport. The increased sediment transport capacity at the mining pit and downstream of it caused the deformation and lowering of channel bed at downstream. The quantitative understanding of sand mining is important for sustainable development. In this context, analysis has been carried out for quantification of pit migration and the scope of numerical model for simulating pit migration is discussed. The celerity of mining pit is calculated from both physical characteristics and multi-scale statistical analysis of bed profile series. The physical characteristic of mining pit celerity shows an increase in celerity with increase in discharge into the channel. The application of multi-scale statistical analysis gives the length scale dependent celerity of mining pit. The celerity of mining pit from multi-scale analysis also shows an increasing trend with increase in discharge. However, with increase in length scale, celerity decreases. The length by width ratio of the pit plays an important role for calculating the celerity of mining pit. Both physical and statistical approaches impart increase in the mining pit celerity with increase in the length by width ratio of the pit. An empirical formulation is developed for calculating celerity or the migration speed of mining pit based on pit geometry (length by width ratio), average flow velocity and critical shear stress of bed material.