INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Extraction of sand from streambed has catastrophic repercussions on aquatic animalia habitat, surface water quality, and environment. Sand mining in an active alluvial channel can compromise the streambed stability of the hydraulic structures nearby. The complex nature of flow approaching and interacting with the bridge piers after passing over a mining pit and the streambed response around the piers is not fully understood. Gravity flow experiments were performed in a sand bed channel to investigate the effects of a mining pit on the hydromorphology around bridge piers.

Significant alterations in the nature of turbulence around a circular pier, oblong pier, and two circular piers in tandem were observed in a sand mined channel. Mean velocity profiles, Reynolds stresses, kinetic energy fluxes, and turbulence scales were analyzed at critical locations along the channel bed as well as in the proximity of the pier. At the approach location where flow had passed over the pit and was approaching the pier, substantial increments in the near-bed velocities, bed shear stress, and Reynolds stresses were observed. Dredging of the pit increased the strength of the horseshoe vortex in the scour hole region, and amplification of the instantaneous bed shear beneath the turbulent horseshoe vortex zone was observed as compared to no-pit case. Pit excavation also amplified the shedding frequency of trailing vortices at the rear of the pier.

These effects were instrumental in the alteration of local scour as well as erosion and deposition patterns around bridge piers. Severe transverse erosion at the pier base, as well as lowering of channel bed upstream of the pier was observed because of channel dredging. Streambed instability was a function of the distance between the pit and pier, as well as flow Reynolds number. Streambed instability was analyzed based on two non-dimensional parameters, namely, pier exposure factor and normalized upstream incision depth. The maximum values of both these parameters were observed when the mining pit was dredged closest to the pier. We also observed growth in streambed instability with an increase in flow Reynolds number.