Environmental Engineering and Management Journal March 2022, Vol.21, No. 3, 493-506
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

"Gheorghe Asachi" Technical University of Iasi, Romania

COUPLED DYNAMICS OF RIVER BANK UNDERCUT DEPTH INCREMENT DUE TO RANDOM VELOCITY FIELD

Sayahnya Roy[1], Vikas Kumar Das[2], Krishnendu Barman[3]*, Buddhadeb Mondal[3], Koustuv Debnath[2]

[1]KPR Institute of Engineering and Technology, Department of Mechanical Engineering, Arasur, Tamil Nadu 641407, India
[2]Indian Institute of Engineering Science and Technology (IIEST), Department of Aerospace Engineering and Applied Mechanics, Shibpur 711103, India
[3]Vidyasagar University, Department of Applied Mathematics with Oceanology and Computer Programming, Midnapore 721102, India

Abstract

River bank undercut leads to mass failure of river bank material resulting in land loss and is of great socio-economic importance all over the world. The current work underlines on the appraisal of the turbulent flow characteristics as soon as the undercut depth increment process commences in a cohesive river bank. Moreover, the asymmetry of the probability density function, the probability of exceedance of undercut depth increment and instantaneous Reynold's shear stress are evaluated to get in-depth insight into the bank undercut development mechanisms. Along with the asymmetry, the probability density function of undercut depth increment exhibit decay in their tails indicating tail behaviour. It is observed that the undercut depth increment is directly proportional to the corresponding flow Reynolds number and a lower asymmetry index of normalised instantaneous Reynold's stress leads to the amplification of positive undercut depth increment. It is hypothesized that the positive increment of the tail index, is most likely the sporadic events of the turbulent flow field. It imposes a flapping motion on the sediment aggregates which play an essential role in the spatio-temporal development of undercut depth within a river bank.

Key words: asymmetry index, bank undercut process, cohesive sediment, probability of exceedance, statistical moments

Received: January, 2021; Revised final: October, 2021; Accepted: December, 2021; Published in final edited form: March, 2022

* Author to whom all correspondence should be addressed: e-mail: krishnendubarman07@gmail.com; Phone: +91 8777809557