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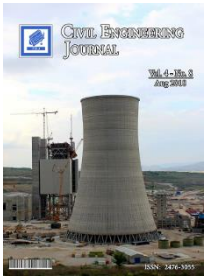

Field Study of Morphological Parameters in Step-Pool Streams

Abbas Torbizadeh [a], Ahmad Tahershamsi [a*], Mohammad Reza Majdzadeh Tabataba [b]

[a] *Faculty of Civil Engineering, Amirkabir University of Technology (Tehran Polytechnic), Tehran, Iran.*

[b] *Faculty of Civil Engineering, Abbaspour School of Engineering, Shahid Beheshti University, Tehran, Iran.*

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Abstract

Nowadays, step-pool formations have attracted a lot of attention, which are distinguished by the successive arrangements of the bed, suitable geometry, and the tumbling flow pattern, which can highly disperse water energy. Field study of a step–pool channel, along with one of the upper reaches of Kamandan River indicated a strong correlation between several morphological parameters of the river such as reach slope, step length, step height, pool depth, local slope, and the like. The length of the reach under the study is 145 meters and has an intermediate morphology based on Montgomery and Buffington's classification. Therefore, twelve distinct step units were identified for 145 meters upstream while the rest was formed by steep morphology. In the present study, different definitions of wave length were applied to establish the relationships among the above parameters. For instance, the difference between apexes of every two successive step elevation was found to have a considerable relationship with the wavelength with a determination coefficient of 0.9. In addition, bankfull width and depth, along the profile for different cross-sections, were determined to establish a relationship between these parameters and pool spacing. Further, the parameters were applied to create a relationship with step heights.

Keywords: Step-Pool; Kamandan River; Morphology; Mountain River.

1. Introduction

Step-pool channels are considered as a series of stream morphological kinds which change downstream within watersheds. Channel types in mountain watersheds typically progress downstream from disorganized cascade reaches to fluvially organized step-pools, plane beds, pool-riffles, and dune ripple channels. Step-pool morphology is defined by a series of steps, similar to a staircase in the river bed [1]. Step-pool bed forms were identified at low discharges following the morphological classification of Montgomery and Buffington (1997). In their classification, step-pool streams are identified by longitudinal steps formed by large clasts which separate the pools including finer material. Cascades are typically longitudinal and they are laterally regarded as disordered bed materials including individual boulders separated by small pools [1]. In the classification of Grant et al. (1990), step-pools and cascades operate differently while the step-pools of Chin (1999) include both cascades and step-pools. The step-pool bed results in alternating critical to supercritical flow over steps and subcritical flow in pools. Step-pools are a typical bed morphology in streams exceeding ~2–3% gradient [1-3]. Generally, step-pool morphology is associated with steep gradients, and small width to depth ratios. Although step-forming clast sizes are typically comparable to annual high flow depths, a stepped longitudinal profile may be developed in steep sand-bedded streams [4]. Chin (1989) suggested that step-pools can be recognized by their staircase-like longitudinal profile resulting from accumulating cobbles and boulders which are located transversely across the channel, alternating with pools including finer material. In addition, step-pools change the path of water and sediments from uplands to lowland basins [5], which received a great deal of support by many researchers to maintain upland aquatic ecosystems [6-8]. Chin et al. (2009) concluded that reproducing the physical

* Corresponding author: tshamsi@aut.ac.ir

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