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Structural and Physical Aspects of Construction Engineering

Urban Water Retention Measures

Martina Zeleňáková[a,*], Daniel Constantin Diaconu[b], Ketil Haarstad[c]

[a]*Technical University of Košice, Faculty of Civil Engineering, Vysokoškolská 4, Košice 042 00, Slovakia*
[b]*University of Bucharest, Faculty of Geography, Nicolae Balcescu 1, Bucharest 010041, Romania*
[c]*Norwegian Institute for Bioeconomy Research, Oslo, Norway*

Abstract

Many cities and urban areas are located in flood plains because land is fertile and flat which is suitable for agriculture and urban development. Rivers provide water supply for domestic, industrial and irrigation uses; they also provide convenient means for navigation, transportation and communication. Cities have large percentage of impervious areas that prevent effective infiltration of rainfall into soil. To have successful flood control and flood risk management, we should consider not only hydraulic and engineering aspects but also socio-economic and environment aspects. Flood management should have involvement of various stakeholders including concerned authorities such as urban planners, civil and water resources engineers, civil disaster defence authorities, health and social services, etc. The best flood mitigation measures from all main points of view – social, economic and environmental are natural water retention measures. Natural water retention measures cover a diversity of measures that are implemented by different sectors or considered in different planning processes dealing with water, food risk management, biodiversity protection, climate change adaptation or urban planning. Some of these measures aim to directly modify the ecosystem, while others focus on changes of practice of economic operators. The paper presents natural water retention measures suitable for application in urban areas.

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Keywords: flash flood; urban development; water retention; mitigation measures.

* Corresponding author. Tel.: +421 55 602 4270; fax: +421 55 602 4003.
E-mail address: martina.zelenakova@tuke.sk

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1. Introduction

From the 1980s to the last decade, the annual economic losses caused by natural disasters have increased from $50 billion to $180 billion and of these losses, 75% are linked to extreme weather events. The trend suggests that losses will continue to increase in future years due to economic development, population growth, rapid urbanization and climate change. In order to mitigate the significant damages associated with natural disasters and extreme hydro-meteorological events in particular, it is recommended to integrate disaster risk management which include mitigation measures into various planning, design and operational policies and regulations [1,2]. There are practical links between disaster risk management and sustainable development leading to the reduction of disaster risk and re-enforcing resilience as a new development paradigm. There has been a noticeable change in disaster management approaches, moving from disaster vulnerability to disaster resilience; the latter viewed as a more proactive and positive approach [3,4]. Floods have the greatest damage potential of all natural disasters worldwide and affect the greatest number of people. Causes of floods are due to natural factors such as heavy rainfall, high floods and high tides, deforestation, etc., and human factors such as blocking of channels or aggravation of drainage channels, improper land use, deforestation in headwater regions, etc. [5,6] Floods result in losses of life and damage properties. Population increase results in more urbanization, more impervious area and less infiltration and greater flood peak and runoff. Problems become more critical due to more severe and frequent flooding likely caused by climate change, socio-economic damage, population affected, public outcry and limited funds [7]. Recognizing that traditional flood management interventions focus on defence, attempting to eliminate contingencies in the urban relationship with rivers, an emergent perspective, spearheaded by spatial design, seeks to deal with floods through a more holistic framework. In contrast to the prevalent ‘design against floods’ approach that targets either the hazard or the exposure components of flood risk, ‘design with floods’ focuses as well on the assets at stake (including the built envelopes of exposed people and activities, usually covered under the term vulnerability), duly acknowledging the intertwining of natural and human processes [8]. Analyses of Hobeica and Santos [8] have so far suggested that ‘design with floods’ requires a positive stance through which problem-solving and sense-making approaches are merged to provide both safety and urbanity (enriched urban realm and experience), without eliminating floods per se, accepted as a complex hybrid process. According to Water Framework Directive [9] in making operational the programmes of measures specified in the river basin management plan for surface water Member States shall implement the necessary measures to prevent deterioration of the status of all bodies of surface water with the prioritization of environmental measures. The paper presents natural water retention measures as a flood protection measures for urban areas with aim to achieve goals of Water Framework Directive.

2. Methodology

Under the 2013-2015 Work Programme of the Common Implementation Strategy for the Water Framework Directive, and in response to the 2012 Blueprint to Safeguard Europe's Water Resources proposals, the Working Group Programme of Measures is asked to develop a guidance or other tool for supporting the implementation of Natural Water Retention Measures (NWRM) in Europe [10]. A guide to support the selection, design and implementation of Natural Water Retention Measures in Europe - capturing the multiple benefits of nature-based solutions, has been developed as part of the NWRM project. It places the emphasis on the multiple-benefits NWRM can deliver and on the required policy coordination and coherence that is required to make best use of NWRM. It aims to support the selection, design and implementation of NWRM in Europe. It targets managers, decision makers, experts and stakeholders involved in the selection, design and implementation of NWRM as part of plans and programmes addressing water, floods, biodiversity, climate change adaptation, forestry, agriculture or urban issues [11].

Natural Water Retention Measures are multifunctional measures that aim to protect and manage water resources using natural means and processes, therefore building up Green Infrastructure, for example, by restoring ecosystems and changing land use [10,11]. NWRM have the potential to provide multiple benefits, including flood risk reduction, water quality improvement, groundwater recharge and habitat improvement. As such, they can help