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Investigating the Performance and Optimization of New Management Methods (LID-BMP) to Improve Surface Runoff in Tehran-A Case Study of District 22

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Abstract

This research presents urban flood risk management through new management approaches including the implementation of Infiltration Trenches, Bioretention Basins and permeable pavements in the surface water collection network. The multi-objective optimization model presented in this research is based on the multi-objective MOPSO algorithm that is combined with Surface Surface Simulation Modeling Software by SWMM software. The application of the proposed method has been described on a case study of the Surface Surface Network of Tehran 22nd District, which consists of four different scenarios; the first scenario examines the performance of new management methods for improving surface runoff quantity without using BMP, and second scenarios, Third, and fourth, BMPs including Infiltration Trenches, Bioretention Basins and permeable pavements, which were applied in six, four and two percent of the sub basins for the return period of two, five and ten years, were used respectively. Modeling results show that Bioretention Basins are more capable of reducing peak courier than Infiltration Trenches and permeable pavements. Also, with the increase of the return period, the impact of BMPs decreases, so that the Bioretention Basins are 10% more effective than Infiltration Trenches and about 20% more than penetrating pavements in reducing peak cours. The goal of the optimization model is to reduce peak coursing, which results suggest that using the optimal combination of all three new approaches leads to a 51% to 54% reduction in peak versus the most effective BMP.

Keywords: *Flood Management, LID-BMP, Urban Surface Water Collection Network, Vulnerability, PSO*

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Extended Abstract:

1. Introduction

Management of water is needed to integrate managed with multi purpose considered such as the flood control, water conservation and water circulation. In addition, in order to maximize the flood prevention and water resource utilization, a distributed water management must be considered (Han et al., 2009). Demanding possible ways to perform a distributed water management, the low-impact development(LID) is required, prior to development by normalizing the water circulation through such as transformation from impermeable surface to permeable surface or disconnection with impermeable surface, furthermore it can support the transition to the state of the ecosystem. Its influence can be reduced impermeable area through the development, reducing the impermeable surfaces can have function that recovery of the water quality and water ecosystems and water circulation soundness from quantitative aspects (Jang et al., 2013). LID is meaning the distributed stormwater management techniques to minimize the impact due to the increase of the rainfall runoff pollutants by soil and vegetation from the source (City of Los Angels, 2011). There are many definition about the low impact development, but they have same aims in common that maintain the previous the water circulation system (Ministry of Environment and Korea Environment Corporation, 2013).

2. Materials and methods

In this study, by combining MOPSO optimization algorithm and SWMM software, runoff rainfall modeling was performed on area 22 in west of Tehran. To this end, the effects of applying some new management strategies including permeable pavements, infiltration trenches and Bioretention Basins to reduce runoff discharge in the area 22 were studied. Different scenarios have been considered for using these management strategies, which in all cases have shown the efficacy and effectiveness of using these three types of BMP in reducing runoff runoff. Permeable pavements, infiltration trenches, and Bioretention Basins as studied BMPs in SWMM software environment were simulated in four scenarios for rainfall with a return period of 5, 2, and 10 years, and modeling results showed that Bioretention Basins were compared to infiltration trays and Permeable pavements have a greater ability to reduce peak discharge.

3. Tests results

BMPs also decrease with increasing return period, So that Bioretention Basins 10% more effective than infiltration trenches and 20% more effective than permeable pavements in reducing peak discharge. However, since each of these solutions alone could not improve runoff quantities, it was concluded that by combining BMPs, they obtained the most suitable compound that had the highest effectiveness in controlling runoff volume. For this purpose, a linkage between the optimization algorithm and the simulation software was used to perform the decision variables based on the percentage of best management strategies at the sub-basin level using SWMM software. The results show that applying the optimal combination of all three novel approaches results in a 51% to 54% discharge peak to the most effective BMP.

4. Conclusion

The results presented between the different dimensions of best practice options and the reduction of peak discharge indicate the ability of the proposed method to estimate the quantitative properties of runoff despite different combinations of BMPs.

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