

## Roof Runoff Control by Using the Green Blue Roof and Blue Roof in the Urban Area

Muhammad Shafique<sup>1</sup>, Daehee Lee<sup>1</sup> and Reeho Kim<sup>1,2</sup>

<sup>1</sup>Construction Environmental Engineering,  
Korea Institute of Civil Engineering and Building Technology Campus,  
University of Science and Technology,  
283, Goyangdae-ro, Ilsanseo-gu, Goyang-si, Geonggi-do, Republic of Korea  
<sup>2</sup>Environmental & Plant Engineering Research Institute,  
Korea Institute of Civil Engineering and Building Technology,  
283, Goyangdae-ro, Ilsanseo-gu, Goyang-si, Geonggi-do, Republic of Korea  
shafique@ust.ac.kr, daehee1212@ust.ac.kr, rhkim@kict.re.kr  
Corresponding Author: rhkim@kict.re.kr

**Abstract.** This study addresses the role of green (vegetated) blue roof and blue roof in the stormwater management in urban area. Green-blue roof and blue roof were constructed at two different location in Seoul, Korea. These two roofs can retain, delay the rainfall runoff and can also reduce the peak flow which are very helpful to avoid the flash flooding in urban areas. This study evaluated performance for rainfall runoff management of the Blue roof and Green blue roof comparing monitoring data measured at two LID facilities and control roof. The data used for this research were collected during the actual rainfall events of more than 30 mm/hr and 60 mm/hr rainfall intensity in July and September 2014 at green blue roof and blue roof respectively. Through this process, the runoff and peak flow reduction on the roofs have been analyzed. Result indicated the runoff outflows reduction were 1.55 l/s to 0.45 l/s in blue roof and 0.3 l/s to 0.1 l/s in green blue roof respectively. It is also indicated that the green blue roof are more effective in case of big storm events, whereas the blue roof are less expansive for small runoff control.

**Keywords:** stormwater, low impact development (LID), runoff, green blue roof, blue roof.

### 1 Introduction

One of the effect of the urbanization is the permeable areas is changed into impermeable areas. With respect to the stormwater management infiltration decreases and surface runoff increases which causes flooding and heat island phenomena in urban areas [1]. Nowadays, Low impact development (LID), a new stormwater management practice has been acquiring more attention [2]. Blue roofs are very effective for retrofitting options for the stormwater management and are applying in the pilot projects around the world [3]. Numerous studies indicated that the green roofs have many positive effects in the urban area which includes, to retain and detain a large amount of storm water [4]. Green-blue roof is also has the same concept as the

green roof but in these type of roofs an additional storages is available below the soil media which helps to store more water. Green-blue roof and blue roof that were installed at Seoul City Hall Annex Seosomun and Chungwoon middle school respectively in Seoul, Korea. The study evaluated the rainfall runoff control and peak runoff delay from these two roofs with respect to control roof. Results indicated that these two roofs are the suitable LID practices for the roof rainfall runoff management in the urban areas.

## 2 Materials & Method

### 2.1 Blue roof design

Blue roof are non-vegetated roofs that use to detain and retain the stormwater. Blue roof was installed on Seoul City Hall Annex Seosomun, Korea and has catchment area is  $50\text{m}^2 \times 2$  points. These catchment areas have the fence height of about 0.14m and has individual storage capacity can  $6.7\text{m}^3$ . In this catchments areas, one is the common roof that is temporary storage where all surface water is the runoff. The second is the blue roof where water can retain and pass slowly through the orifices which helps to retain large amount of rainfall and to reduce the peak flow. In this roof, water gauge, flowmeter and rain gauge were installed. In order to analyze the rainfall runoff outflow from the two roofs the data of the rainfall of more than 60 mm/hr rainfall intensity in July 2014 were collected. The detail of the blue roof as shows below (Figure 1).

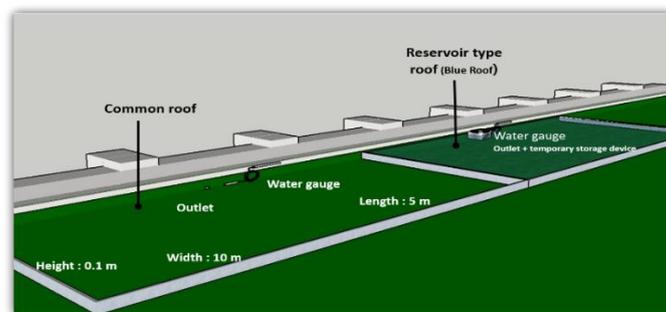


Fig. 1. Detail of blue roof Seoul City Hall Annex Seosomun

### 2.2 Green blue roof setup

Green blue roof was constructed at the Chungwoon middle school building, Seoul, Korea. The catchment area of the green-blue roof is  $285\text{m}^2$ . The roof systems were designed in several  $0.5 \times 0.5 \times 0.2\text{m}$  assemblies as shown in Fig. 2. Green blue roof assembly is made of plastic that consisted of vegetation and storage layers. This roof have some orifices from where water can enter into storage layer this process also

reduces the water demand for vegetation of the green blue roof. Control roof is on the right side which has no soil and vegetation (figure 2). Green blue roof works same as the green roof as to control rainfall runoff and to maintain the natural environment in an area. In order to analyze the rainfall runoff outflow from the green blue roofs and control roof the data of the rainfall of more than 30mm /hr rainfall intensity in September 2014 were collected.



Fig. 2. Green blue roof at Chungwoon middle school

### 3 Results and Conclusion

The storm with maximum 90 mm/hr rainfall intensity that was occurred between 22/7/2014 – 25/7/2014 analyzed on the common roof and blue roof. From the analysis, results indicated that the rainwater outflow form the blue roof and without blue roof is 0.45 l/s and 1.55 l/s respectively. Peak flow of blue roof also reduced as compared to common roof.

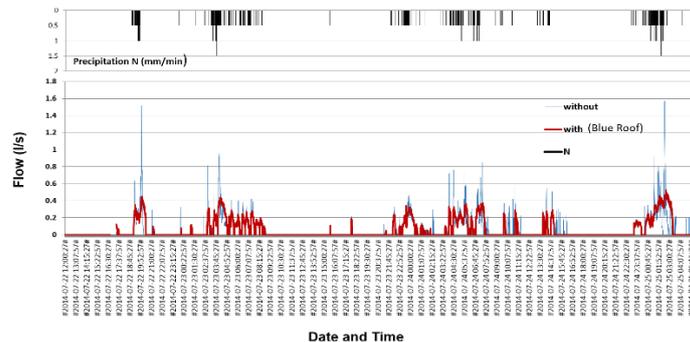
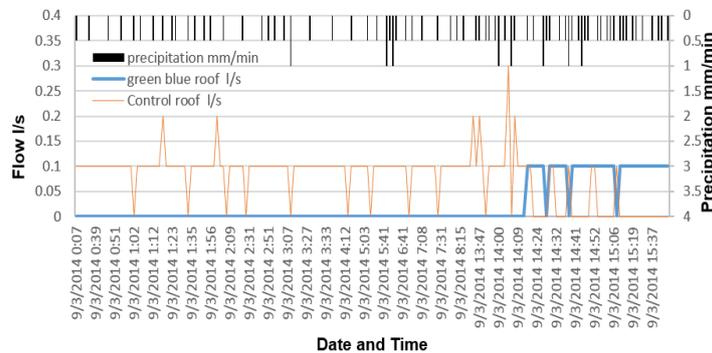


Fig. 3. Variation of outflow (l/s) in at the blue roof. (Rainfall on the July 2014, Maximum rainfall intensity: 90 mm/hr,)

Rainfall outflow and peak flow reduction between green blue roof and control roof were monitored in a real storm event of September 3, 2014, when the maximum

rainfall intensity was 60 mm/hr. Results indicated that rainfall runoff outflows from the green blue roof and control roof were 0.1 l/s and 0.3 l/s respectively. This also reduced the peak outflow which increases the time of concentration that are very helpful to control rainfall runoff. Green blue roof is multi beneficial LID facility which can control rainfall runoff, reduces the peak outflow and reduce the heat island phenomena. This facility is expansive but it can work efficiently and effectively in case of small or big storm events. On the other hand, blue roof are less expansive practice to control the runoff and effective in case of small storm events in urban areas. Nowadays, there are several types of urban problem and we need to develop the multi beneficial LID facility with low economy to handle urban problem.



**Fig. 4.** Variation of outflow (l/s) and peak flow reduction at the green blue roof. (Rainfall on the September 2014, Maximum rainfall intensity: 60 mm/hr.)

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