Citation:
Blagojević B., Vasilevska M., Vasilevska Lj. (2016) Outdoor sports and recreational facilities as elements in urban stormwater runoff management systems. International Congress Sports Facilities (2016; Belgrade). Sports Facilities – Modernization and Construction : intenational monograph : SPOFA 16 / editor in chief Goran Ćirović. – Beograd : University, Faculty of Sport and Physical Education. ISBN 978-86-89773-16-3 pp. 297-308.

OUTDOOR SPORTS AND RECREATIONAL FACILITIES AS ELEMENTS IN URBAN STORMWATER RUNOFF MANAGEMENT SYSTEMS

Borislava Blagojević, Magdalena Vasilevska, Ljiljana Vasilevska

Faculty of Civil Engineering and Architecture, University of Niš, Niš, Serbia

Introduction

In the last decades of XX century, an integrated stormwater management approach has surfaced in the developed countries. It is an answer to the adverse effects of urbanization, industrialization, socio-economic and physical changes in the urban catchments (Dietz, 2007). The approach includes measures aimed at surface water and groundwater quality protection, and pluvial flood risk management. These measures contribute to pollution loads and flow volumes stress reduction in quite a different way compared to the traditional stormwater management systems. In the U.K. the innovative approach is called Sustainable Drainage Systems (SuDS). The SuDS elements alone or combined in a 'treatment train' are integrated in the urban environment through the urban planning and design activities at the local level. The key to flow volume stress reduction in an urban drainage management system becomes careful distribution of porous and non-porous surfaces.

In this paper we examine potential of sports and recreational facilities to provide benefits for urban drainage system. The main research goal is identification of sports and recreational facilities types adequacy for retrofitting open space while serving as elements of urban drainage runoff management system.

There are three basic roles of SuDS elements in an urban runoff management system: 1) conveyance, 2) volume storage (retention/detention), 3) infiltration, and/or 4) reuse. Some elements are designed to have one role, while some offer combination of roles.

Methodology

Sports and recreational facilities studied in this paper include sports and recreational outdoor facilities. We show good practice examples of newly constructed and retrofitted urban recreational area through descriptive method. Through the analysis of the good practice examples of sports and recreational areas - grounds and courts, we deduct conclusions on potential role of these facilities, in their parts or as a whole, in urban drainage management systems.

Recreation as urban function

Recreation is one of the main urban functions. It includes a complex both individual and group psycho-physical regeneration of people in an urban environment. Recreation is realized aiming at: 1) relaxation (restoring and improving a psycho-physical balance), 2) entertainment, and 3) development of a versatile personality. For its implementation two basic conditions are essential: 1) appropriate activities, and 2) appropriate spaces. Motives for the use of recreational activities and spaces are different and stand out as the most important need for quality use of leisure time, the need for a change of environment, and the need for other forms of social interactions.

In broad terms, under the recreational area we consider any space in urban area with functional, formal and environmental attributes appropriate for recreational activities. Depending on the applied criteria, recreational area types are shown in Table 1.

Table 1. Recreational area typology (Vasilevska LJ, 2006).

Criterion	Recreational area (RA) type
Dependence level, functional and spatial links with town	Primary, independent, town significant
	Integral, part of town significant, within land use type: 1) residential 2) public service 3) business 4) mixed use 5) traffic
	Connecting independent or integral areas
Recreational and sports activity type	Sports and recreational centres
	Leisure time centres
	Sports facilities
	Parks
Sports and recreation purpose	Multipurpose
	Specialized
Level of use	Intensive use (all day or specific daytime)
	Extensive use – permanent
	Extensive use – temporary
Time of use	All year round - unlimited
	Specific season use
	Specific season use combined with other urban use
Exposition level	Public
	Public – private (semi-private)
	Private
Spatial significance	Regional
	Town
	Part of a town
Preservation level	Unconditioned- unlimited use
	Within protected zones (conditioned by nature and landscape protection measures)
	Within protected zones (conditioned by cultural, historical, architectural and ambience protection measures)

GOOD PRACTICE EXAMPLES

Children playgrounds in residential areas

Children playgrounds are integral recreational areas mostly present in residential and public service areas. They offer many opportunities for including SuDS elements with different roles, one of the widely applied being infiltration through instalment of porous pavement. This type of surface also increases safety and security and contributes to the aesthetic level of the space (Figure 1).

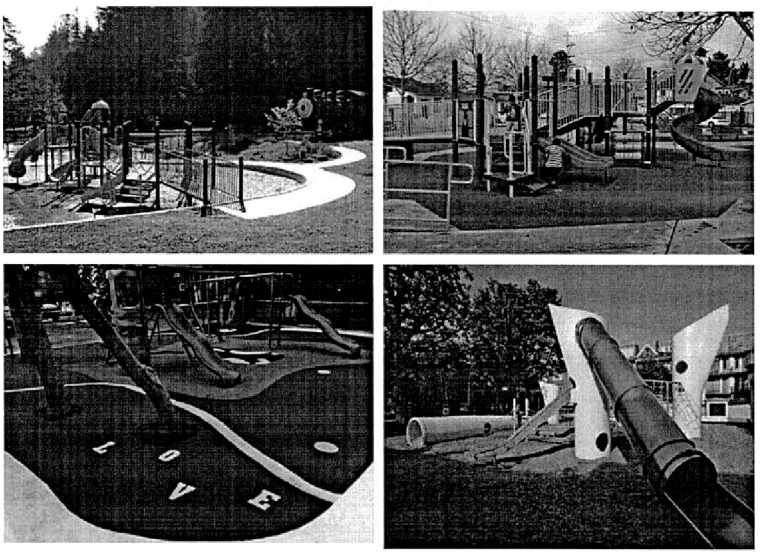

Figure 1. Children playgrounds – different types of porous pavement

An example of recently constructed low rise high density housing area in Vienna, Austria, named 'Quartires Verts', includes children playground with a runoff volume detention and infiltration role in the urban stromwater management system (Vasilevska and Blagojević, 2013). The playground occupies the largest part of the area free open space. It is organized on porous surface, where porosity is achieved by gravel base layer on the ground (Figure 2- left). The runoff volume detention role is achieved through placing playground in the terrain depression (Figure 2-right). Through artificial terrain modelling, dynamics of space is achieved.

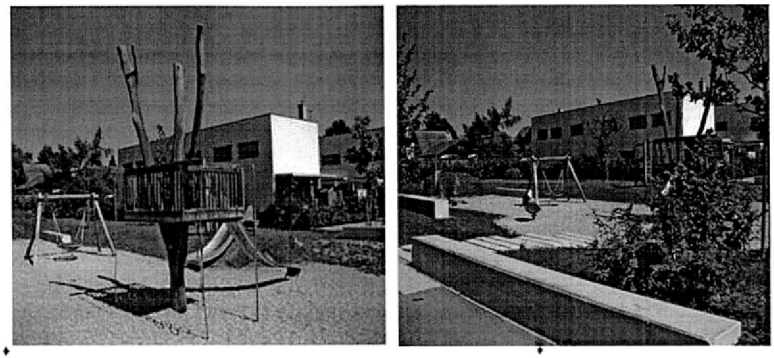

Figure 2. Quartires Verts, Vienna - Children playground (Source: authors)

School playgrounds

School playgrounds are also suitable recreation and sports areas for implementation of SuDS elements. An interesting example can be found in the playground at Public School 261 in Brooklyn, N.Y., which is the first of 40 new green public school playgrounds that New York plans to install over the next few years within New York City Playgrounds program (Figure 3). Reducing the amount of asphalt in school playgrounds allows the city to reduce runoff and overflows.

Hard asphalt (non-porous) playground at Public School 261 in Brooklyn has been mostly replaced with a garden, an open play area, an outdoor classroom, and child-friendly features. The green playgrounds include green roofs on storage sheds, rain gardens and rain barrels, artificial turf fields, and reducing asphalt areas pitched to direct stormwater runoff into green areas to reduce runoff.

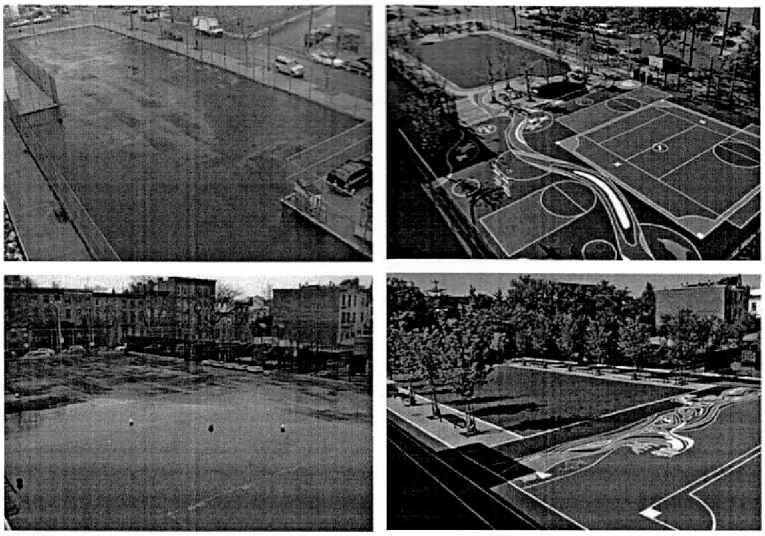

Figure 3. School playground at Public School 261 in Brooklin, N.Y. – Before and after renovation which included implementation of wide range of SuDS technical elements (Source: http://news.wef.org/nyc-school-playgrounds-they-arent-just-for-recess-anymore/)

Recreational centres

Recreation centres are suitable type of recreation area which allows implementation of wide range of SuDS technical measures, both in newly built and renovated (retrofitted) existing centres. A good practice example can be found in Herron Playground in South Philadelphia (Figure 4). The original recreation centre was dominated by non-porous cover, lacking the capacity to manage stormwater runoff. In the renovation process, the key goal was to capture 100% of the site's first inch of stormwater and recycle it back into the landscape areas. (http://www.temple.edu/ambler/csc/t-vssi/bmpsurvey/herron_playgrd.htm). The approach taken to reach this goal was to minimize connected non-porous areas as much as possible, to promote infiltration, and increase evapotranspiration. Therefore, the existing structures and pavement were demolished. The centre became a public urban green space for all age groups, because the urban designers included three key features: a rain garden, basketball court and playground (Figure 4). In the urban runoff management system, the basketball court and rain garden function as one space, with multiple roles of collecting, storing and dispersing water. Rain garden was designed as a concave retention basin.

Figure 4. Herron Recreation Centre, South Philadelphia. Basketball court with porous paving and playground after project completion. Directly below the basketball court's porous asphalt surface is a storage tank composed of separate stone cells which capture runoff. Each cell is graded so that captured runoff flows towards the rain garden. (Source: http://www.temple.edu/ambler/csc/t-vssi/bmpsurvey/herron_playgrd.htm)

Sports courts

Sport courts serves as an example of suitable type of recreation area which allows implementation of porous pavements as well as other technical measures. For example, to improve the quality of the courts and reduce the volume of stormwater that flows into the combined sewer, the basketball courts Mill Creek Playground in Philadelphia were retrofitted with porous asphalt over an infiltration bed (Figure 5). For the same reasons, the porous pavement is used of Tennis Courts at The Ohio State University Outdoor Sports Complex (Figure 6).

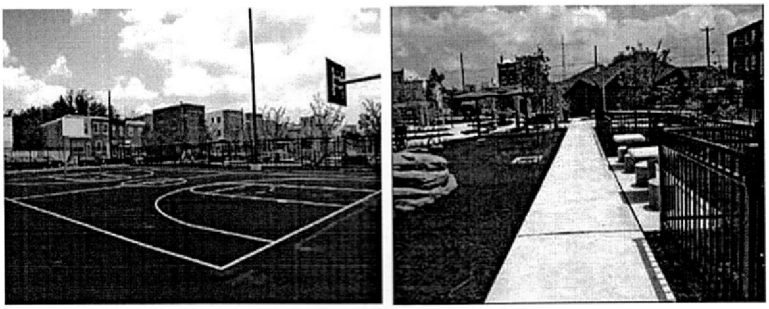

Figure 5. Sport courts – Basketball courts Mill Creek Playground in Philadelphia (Source: http://www.phillywatersheds.org/what_were_doing/green_infrastructure/projects/porous_court_mill_creek)

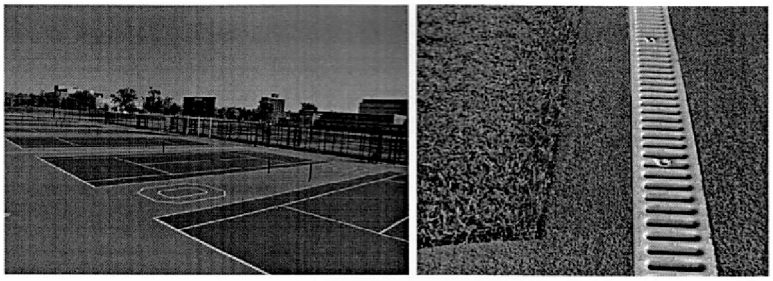

Figure 6. Sport courts – left: Tennis Courts at The Ohio State University Outdoor Sports Complex (Source: http://www.flexiblepavements.org/awards/2011/03/paving-tennis-courts-ohio-state-university-outdoor-sports-complex). Right: Surface drainage system (Source: http://www.sportsedge.com/stormwater-management/surface-drainage/)

Multi-functional public space – water square

The water squares, placed in strategic locations of the city, are seemingly simple multi-functional public spaces. The water square shown in the Figure 7 is all-year-round recreational facility.

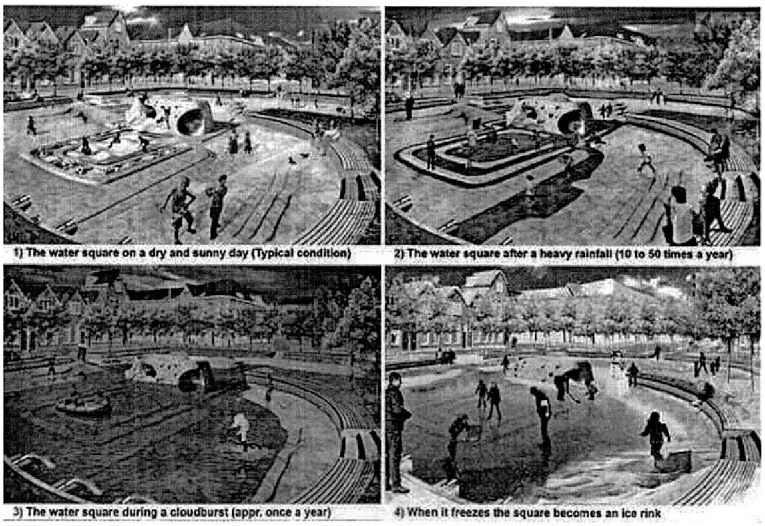

Figure 7. Multi-functional public spaces - Water square (http://www.rinnovabili.it/green-building/water-squares-piazze-dacqua-attirano-la-pioggia-564/)

It is used in the dry weather, which is most of the time. In the case of heavy rains and floods, it turns into catch (retention/detention) basin, or collection of smaller basins, depending on the storm intensity and duration, and storage of rainwater. It eases the pressure from sewer system and has the ability to reuse the collected water at times of drought and water stress. The water square can also be used for recreation in winter time when water freezes. The retention of rainwater in a Benthemplein Water square in Rotterdam, Holland, designed by De Urbanisten, adds new qualities to the public space (Figure 8). The square has three concrete basins of different depth, which collect rainwater and provide a place for different leisure activities in dry weather, including sport and recreation. Two shallower basins collect runoff from the roofs of the surrounding buildings and the ground. The deepest basin, which captures rainwater from the largest roof and the surrounding area, only becomes filled during heavy, continuous rainfall (Figure 8).

Figure 8. Multifunctional public space. Benthemplein Water square in Rotterdam, Holland, by De Urbanisten (http://www.uncubemagazine.com/blog/13323459)

Discussion

Outdoor open space SuDS elements include 1) porous pavement; 2) filter stripes; 3) filter and infiltration trenches; 4) dry and wet swales; 5) retention basins; 6) rainwater tanks; 7) raingardens; and 8) ponds, and may be well mimicked in recreational areas, as shown in good practice examples. Characteristics of recreational activities and recreational area influence selection of SuDS elements. In the Table 2, a general assessment of applicability of SuDS elements through their roles is shown for selected recreational area typology. While generally applicable and non-applicable categories are straightforward, we assigned a category of conditional applicability for areas where local conditions or type of sports and recreation have significant influence on applicability of SuDS elements.

The identified sports and recreational area types according to several selected criteria in Table 2, show that there is an almost equal potential for general and conditional applicability of such areas for fulfilling SuDS elements roles, while general non-applicability is rather low.

Table 2. Selected recreational area typology and SUDS element role applicability assessment.

Criterion	Recreational area (RA) type	SuDS element role			
		C	S	I	R
Dependence level, functional and spatial links with town	Primary, independent, town significant	■	■	◆	■
	Integral, part of town significant, within land use type:				
	1) dwelling;	■	◆	■	◆
	2) public service,	■	■	■	■
	3) business	◆	◆	■	◆
	4) mixed use,	◆	■	■	■
	5) traffic	■	□	■	□
	Connecting independent or integral areas	■	◆	■	◆
Recreational and sports activity type	Sports and recreational centres	■	■	■	■
	Leisure time centres	■	■	■	■
	Sports facilities	◆	◆	◆	◆
	Parks	■	■	■	■
Sports and recreation purpose	Multipurpose	■	■	■	■
	Specialized	◆	◆	◆	◆
Level of use*	Intensive use (all day or specific daytime)	◆	◆	◆	◆
	Extensive use – permanent	◆	◆	◆	◆
	Extensive use – temporary	■	◆	◆	■
Exposition level	Public	■	■	■	■
	Public – private (semi-private)	■	◆	■	◆
	Private	◆	■	◆	■

Key: C- conveyance, S- storage, I- infiltration, R- reuse; n-generally applicable, u-conditional applicability, o -generally non-applicable.

Conclusion

In most of the developed countries, an integrated stormwater management approach (like SuDS the U.K.) is required in all new major developments and favoured in redevelopments. Therefore, awareness by practitioners and regulators and its implementation is steadily increasing. In the participatory approach to urban design, where citizens are included in the decision making process, it is possible to choose between different options for common space contents in urban blocks. Sports and recreational facilities offer a significant potential as SuDS elements that deliver multiple benefits, as shown through good practice examples, and systematized in Table 2.

In our further research, we will look for the main criteria for including specialized sports and recreational facilities in open space of developed urban catchments, while serving as SuDS elements. We will further study outdoor sports grounds and fields as candidates for urban open space contents, regarding the following criteria: 1) dimensions, 2) range of pavement porosity, and 3) noise level produced from individual and collective sports and recreational activities. Then, we will be able to produce sports and recreational facilities 'menu' for decision makers in the urban redesign, redevelopment and/or retrofitting process, as an output from our research. The outcomes we are aiming at include increased number and accessibility to sports and recreational areas, and reduction of urban pluvial flooding risks.

References

1. Dietz, M.E. (2007). Low Impact Development Practices, A Review of Current Research and Recommendations for Future Directions. Water Air Soil Pollut 186:351–363. DOI 10.1007/s11270-007-9484-z.
2. Marinković, A., Vasilevska, Lj., Mirić, A., Perić D. (2012). Functional and design potential of city squares related to social sustainability. *TTEM*, Journal of Society for Development of Teaching and Business Processes in New Net Environment in B&H, Vol. 7, No 4, DRUNPP, Sarajevo, 2012., pp. 1446-1462
3. Vasilevska Lj. (2006). Urban function – Recreation. Lecture 9, Lecturer notes, in Serbian, available at http://gaf.ni.ac.rs/index1.php
4. Vasilevska LJ, Blagojević B. (2013). Integrated stormwater management in dwelling areas: Case study, Quartires Verts, Vienna, in Serbian, Proceedings of the Faculty for Civil Engineering and Architecture, University of Niš. 2013; (28):1-14.
5. Vasilevska, Lj., Blagojević, B. (2014). Morphologic effects of stormwater management application in the urban design process.Proc. V International symposium I&A building service and architecture, University of Belgrade, Faculty of Architecture, Belgrade, Serbia, 04 December 2014, 2014., pp. 71-77.
6. http://izcreativeconcrete.com/wp-content/uploads/2015/06/4.jpg
7. http://news.wef.org/nyc-school-playgrounds-they-arent-just-for-recess-anymore/

8. http://www.flexiblepavements.org/awards/2011/03/paving-tennis-courts-ohio-state-university-outdoor-sports-complex
9. http://www.a10.eu/magazine/issues/56/water-square-rotterdam.html

CIP - Каталогизација у публикацији -
Народна библиотека Србије, Београд

725.8(082)
796.028(082)

INTERNATIONAL Congress Sports Facilities (2016 ; Belgrade)
Sports Facilities - Modernization and Construction : international monograph : SPOFA 16 / editor in chief Goran Ćirović. - Beograd : University, Faculty of Sport and Physical Education, 2016 (Smederevo : New Press). - 324 str. : ilustr. ; 25 cm

Tiraž 50. - Str. 7-10: International Congress, SPOFA 016, Sports Facilities - Modernization and Construction / Goran Ćirović. - Napomene i bibliografske reference uz tekst. - Bibliografija uz svaki rad. - Registar.

ISBN 978-86-89773-16-3

1. Ćirović, Goran, 1954- [главни уредник] [аутор додатног текста]
a) Спортски објекти - Зборници

COBISS.SR-ID 223694348