Scientific Bulletin of Politehnica University of Timişoara

Transactions on HYDROTECHNICS

Volume 61(75), Issue 1, 2016

Technical solutions and example of ecological parking lots in Timișoara

Ștefănescu Camelia[1] Stăniloiu Cristian[1] Girbaciu Alina[1]

Abstract: The realization of the ecological parking lots is essential in all case where is impossible relying on traditional enforcement techniques nor resort to use of the materials commonly used for flooring, such as bitumen, asphalt, concrete (areas subject to landscape restrictions, areas of special environmental interest). The establishment of ecological parks stems from an acute necessity to have more parking spaces for cars and increase the area covered vegetation in urban areas.

In this articles it is the development and application of existing stormwater management theories with a focus on emulating natural on site hydrological processes and discusses the design intentions, merits, and weaknesses of each theory. A new stormwater management theory is then proposed using elements found in each of these existing theories.

Green parking areas are currently the focus of urban architects in all crowded areas of cities constitutes a practical and effective solution ecological and economical.

Keywords: protection and conservation of the environment, green parking, storm water, reducing leakage of water, water cycle.

1. INTRODUCTION

“Green” parking lot is a term increasingly used to describe parking lots that may incorporate a variety of environmentally preferable features, including a minimized footprint and/or impervious surfaces, stormwater best management practices, and alternative parking surface materials. To date, however, information on green parking lots has been scattered across planning, construction, stormwater, engineering, and landscaping resources. The goal of this paper is to present the fundamental planning and design concepts of a green parking lot and connect readers to existing resources on the environmental benefits and cost effectiveness of green parking approaches.

Most parking lots are made of pavement a combination of asphalt concrete, the most widely used paving material in the Romania , and aggregates such as sand, gravel, or crushed stone. Pavement is an impervious, heat absorbing material that collects storm water on its surface and does not allow it to filter into the soil, inhibiting the natural water cycle. With this in mind, parking lots have traditionally been built with the primary goal of channeling storm water into receiving water bodies as quickly as possible, via means such as gutters, drains, and pipes. As a result, runoff that is contaminated with many types of petroleum residues, fertilizers, pesticides, and other pollutants from parking surfaces enters receiving waters at an unnaturally high rate and volume, negatively impacting the surrounding ecosystem. Hence, parking lots degrade water quality, strain storm water management systems, consume large amounts of land and resources, and enable urban sprawl. Furthermore, materials used to construct parking lots have a variety of impacts on air, water, and biodiversity throughout their life cycle [2].

2. ECOLOGICAL PARKING. GENERAL DESCRIPTION. BENEFITS

Ecological car parks are car parks that reduce runoff storm water and pollutant emissions. It refers to a series of techniques applied simultaneously to reduce the total impervious surface of a parking space, decrease the temperature of the surface and maintain a green island in crowded areas.

Goals pursued by making green car parks:

- Minimum volume of water drained
- Improving air and water quality;
- Ensuring maximum parking space;
- Providing a space (all maximum, if possible) to achieve green zone.

Parking ecological advantages:

- The avoidance of environmental pollution due to vehicle emissions;
- Reduce heat islands human;
- Reduce exposure to UV radiation, because the canopy of trees;
- Taking over the canopy air pollutants;
- Reducing leakage of water from precipitation;

Types of materials used to build environmentally friendly parking:

- Permeable pavement - is pavement that allows water infiltration. It is available in a variety of shapes and colors, improving their aesthetic appearance.
- Or the lattice grid systems - rigid plastic structures are filled with gravel or vegetation.

[1] Politechnica University Timişoara, Department of Hydrotechnical Engineering, George Enescu Street, no.1A, Zip code 300022,Timisoara, Romania, e-mail: achim_camelia@yahoo.co.uk

- Aerated concrete - is similar to conventional concrete as structure and form, except that fine materials have been removed, allowing the infiltration of storm water through voids

3. NEED FOR PARKING SPACES IN TIMISOARA

The establishment of ecological parks stems from an acute necessity to have more parking spaces for cars and increase the area covered vegetation in urban areas.

Green parking areas are currently the focus of urban architects in all crowded areas of cities constitutes a practical and effective solution ecological and economic.

Currently the number of cars registered in Timisoara is almost 100,000. To these are added and cars with numbers recorded in other counties. Number of parking spaces is 9,000 cars. Thus, the fact that the number of parking spaces is too small (1 parking 10 cars) drivers parked cars along the streets, creating traffic jams true. Also, cars are parked on green areas, thus destroying the ecology of the area.

Timisoara road infrastructure was not dimensioned to the reality of modern traffic, connected to the realities of modern urban traffic, connected to new developments quantity and quality of urban fleet. To cover the necessary parking spaces were built underground parking and was tried as a new above-ground car parks to be constructed so as not to affect groundwater leakage and comply with low impact development and methodology of minimal impact (MIM).

4. METHODOLOGY OF MINIMAL IMPACT (MIM) APPLIED ON VERY SMALL AREAS (PARKING)

By applying MIM aims to reduce leakage, increasing the time of concentration and control of the first stream (flow) of water that is trying to become leakage but is held before the initial arrangement. This reduction in water runoff is easily exceeded by bio retention existing techniques. These techniques involve making a green area or a permeable concrete, to take the leak in conditions close to the pre-development situation

These facilities can be located in areas with bio retention before water discharge directly or indirectly bio retention surfaces as a separate facility, to ensure that the first stream containing pollutants do not we find him downstream [4] .

A natural surface drainage conditions, runoff hydrograph is shown in Figure 4.1 green. If it was adapted for a parking area concrete drainage volume and peak flow increases, the situation is much different from the natural situation is presented through a drainage hydrograph shown in Figure 1 is red. Storm water detention is one theory created to address the negative consequences of conveyance systems. Detention system design was developed with the idea that holding excess runoff on site and releasing it at a controlled rate would reduce peak flows to pre-development levels and minimize downstream flooding. This concept is also illustrated with a triangular hydrograph in Figure 1.

The total volume difference between pre and post-development design storms can be calculated with the equation:

$$V = (\text{post } Q_p \cdot T_oC \cdot 80.1) - (\text{pre } Q_p \cdot ToC \cdot 80.1)$$

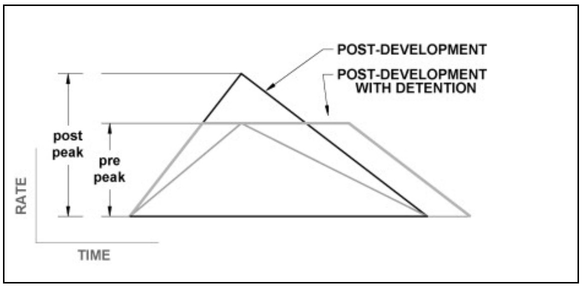

Figure 1. Simplified detention hydrograph.

Calculation of surface required for an ecological parking

To determine retention volume, pre-development initial abstraction runoff depth is multiplied by impervious surface area. For example, a typical 20 m × 3 m parking bay accommodates two parked cars and a circulation aisle. If this 60 m^2 parking area is built on a site with a pre-development initial abstraction runoff depth of 3.4 cm and a pre-development Curve Number of 60, its runoff volume would be calculated as: (3.4 cm/100) × 60 m^2 = 2 m^3. Hence, the parking area would require approximately 2 $m^3$of retention. If the retention facility were built 0.2 m deep, it would then be accommodated by a space 3 m × 3 m, as shown in Figure 2 [6].

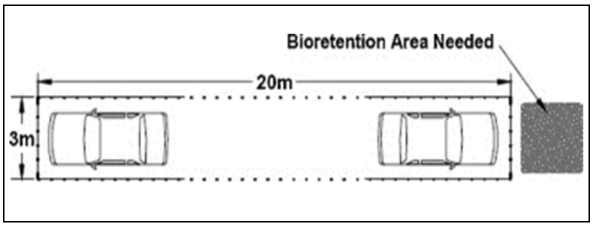

Figure 2. Retention area required for parking unit

It is advantageous that this area may be reduced if we increase the depth bio retentions surfaces. This simple reasoning for bio retentions surfaces for parking two cars can be extended to a much larger park, with bio retention area will be constructed as shown in Fig. 2.

5. STEPS FOR ECOLOGICAL DESIGN OF A PARKING

- Determination of the rate of water infiltration into the soil;
- Determining the direction of flow of rainwater and place their collection;
- determination of opportunity pavements and green spaces permeable natural drainage:

- calculation of drainage area target each spy natural green space;
- incorporation of porous pavements where it does especially in areas of parking overflow, alleys exhaust and areas least used [1] ;

- determination spares required dimensions such that aria collection and practice be sufficient;
- identification of location and structures of supra flow of their connection to the sewer;
- Insurance is the ground resistance:
  - Core strength, ie foundation - having 10-50 cm thick, is to take over and support the weight of tasks. foundation runs using crushed stone and geotextile to prevent accumulation of water, then put a layer of sand ballast, which is compressed by compaction and reinforcement of gravel;
  - The base layer with thickness of 20-60 mm is to ensure uniformity and surface flatness. Runs using sand and crushed stone from 2-5 5 cm, then apply a layer of soil (earth flower) 20 mm;
  - Grilled lawn 38-45 mm thick, is mounted the mixture of topsoil, which is intended to take over tasks that seek to protect sown lawn [5];

An example of ecological park lawn grids made RECYFIX Standard street heroes from the Paulis, Timisoara [1] (2007).

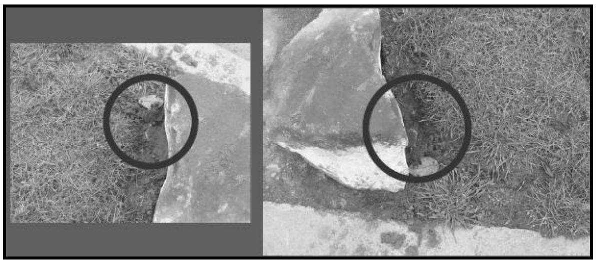

Figure 3. The ecological park lawn grids

6. EXAMPLES OF GREEN PARKING VERSUS PARKING WATER-PROOFED IN TIMISOARA

Despite the fact that the technology of making parking permeable high infiltration is unknown (applying in Timisoara for several years), and the necessary materials are cheap and easy to obtain, still practiced parking completely waterproofed with asphalt, with drains scarce and often faulty located.

The following figures are presented as parking, fully waterproof executed in Timisoara since 2008.

At these fully waterproofed car parks is observed that water stagnate both periods of high rainfall periods of rain and mild because rarely spouts are located.

The following images are presented permeable parking sawed slabs made of concrete (Figure 6 and 7), cheap and easily obtainable materials.

Figure 4. Parking fully waterproofed, Vaida Street,Timisoara

Figure 5. Parking fully waterproofed, Timisoara

Figure 6. West University parking detail in Timisoara

Figure 7. Parking sawed slabs of concrete, West University, Timisoara

Another technical solution very current with collars of plastic (polypropylene), even if it involves a higher price is particularly effective because it has a very low degree of waterproofing. In the following pictures we have examples of very small parking waterproofing collars made of plastic (Figue 8, 9) [5] .

Figure 8. Parking in plastic gratings Şagului Way

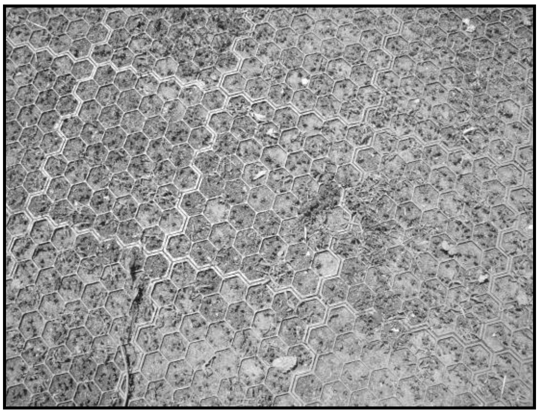

Figure 9. Detail parking grilles plastic Şagului Way (Low grade waterproofing)

This last is the most advantageous solution, even if it involves a higher cost, deoparece degree of sealing is very low, so this parking comply MIM after fitting natural drainage conditions are kept very close to the natural, predevelopement.

Figure 10. Ecological parking, I. Nistor Street, Timişoara

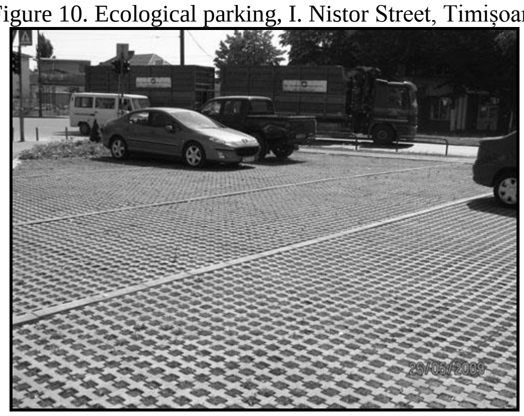

Figure 11. Ecological parking, Prinţul Turcesc Street, Timişoara

1. CONCLUSIONS

Split-flow theory combined with evolving non-point source pollution storm water management systems creates new opportunities to better emulate natural landscape processes. Rainwater harvesting systems, for example, could be coupled with landscape irrigation systems to restore natural landscape evaporation levels; green roof systems that filter rainwater could be combined with non-potable water systems in structures to reduce runoff; and bio retention systems could work in tandem with infiltration systems to filter water and recharge groundwater levels [5].

Future storm water system design could focus more on emulating natural landscape hydrological processes, and thus realize a greater diversity of public health, safety, and welfare objectives [6].

The split-flow theory provides a strategy to achieve these goals. It does not preclude the use of existing retention- and infiltration-based practices, but rather adds other options that can be applied to existing urban development practices.

REFERENCES

[1] http://www.dmmt.ro/;
[2] http://www.streamteamok.net/;
OGE, PSAT, 2006;
[3] Stefanescu, C. 2006, Modelling methods to mitigate surface runoff through artificial infiltration systems on small pools doctoral thesis;
[4] www. Lid_Manual 2005;
[5] Stuart E., 2008, Split-flow theory: Stormwater design to emulate natural landscapes;
[6] B.,K.,Ferguson,1995, Storm-water infiltration for peak-flow control..