# Researches regarding the ecological parking used in the arrangement of the public grass plots from Timisoara Municipality

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**Abstract** The car parks are integrated part of the landscape of the constructions from towns. The parking places are considered essential for the market success of commercial buildings. The municipal officials must balance the need of parking spaces with other desires of the community, like: urban design oriented towards the pedestrians and the endurance of the circumambience. The car parks with a large surface highlight the problems related to pollution, water outflow, increase the urban heat islands and trouble the eye.
If we analyze these failures, the most efficient alternative from the point of view of the quality requirements regarding the landscaping, water and pollution is the „ecological parking" or „green parking".

**Key words**

ecological parking, grass plots, landscape, paving blocks, lawn

On the census of 2002, the population established in Timisoara Municipality was of 317,660 inhabitants, the density of the population being of 2,622 inhabitants / km.

Presently, the number of the cars registered in Timiş County is nearly 150,000 and most of these are from Timişoara, and the number of the parking places barely reaches 9,000. This number of parking places is nearly equal with the cars registered in 2007.

Beside the number of 150,000 cars registered in Timiş county there are added the cars with Bucharest plate numbers, those registered in other counties, as well as those traveling through. Thus, the drivers who do not have where to park their cars, line them up one behind another along the streets, which creates sometimes a real traffic jam. If we make a calculation, reporting the cars existent into town to the available parking places, the relation is approximately of 10:1.

Timisoara road infrastructure was not sized to the realities of a modern urban traffic, connected to the new qualitatively and quantitatively evolutions of the urban fleet of cars.

From a total of approximately 1,000 streets of Timişoara, only 179 are managed by the Telpark Service of Administration of the Public Estate, amounting approximately 9,000 parking places. Only 38 streets have specially developed parking, with safety islands, amounting 3,221 parking places.

## Material and Method

The parking places are delimited usually by yellow or white markings with a width of 12-20 mm. When the parking place is bordered by a wall, these lines are often marked at a height up to 1 m for increased visibility. The guiding rails in the floor along the edges proved to be popular for the demarcation of the limits of the parking place and may have approximately 50-60 cm length, 20 cm width and 10 cm height. In the places where the vehicles are parked in line with the front towards the wall or at the edge of the parking in a superposed car park we habitually there are put barriers or rails or balustrade up to the height of the axle in order to prevent the falling of the cars.

The parking places must have a length bigger than 5 m and a width of 2,3 m, and the parking places for persons with locomotive disability must have a minimum width of 3,5 m.

Table 1

**Angles towards the road centre line of the parking places**

| **Disposal of the parking places** | **Area/space (inclusively with open doors)** | **Possible number of spaces /100 $m^2$** | **Possible number of spaces / 100 m of road (only on one side parte)** |
|---|---|---|---|
| 1. 0° angle towards the road centre line. The entrance and exit from the parking place are very difficult. This is appropriate to the narrow roads. | 2 | 4,4 | 17 |
| 2. 30° access angle from the road. Easy entrance and exit from the parking place. Occupies a large area. | 26,3 | 3,8 | 21 |
| 3. 45° towards the road centre line. Good entrance and exit from the parking place. Relatively small parking area / place de, is the most frequently encountered one | 20,3 | 4,9 | 31 |
| 4. 60° access angle from the road. The entrance and exit from the parking place is relatively good. Small parking area /place. Arrangement used frequently. | 19,2 | 5,2 | 37 |
| 5. 90° towards the road centre line. Parking spaces with a width of 2,5 m. It is necessary a tight curve for entrance/ exit from the parking place. | 19,4 | 5,1 | 40 |
| 6. 90° towards the road centre line. Parking spaces with a width of 2,3 m. Small parking area /place, ideal for compact parking. Used frequently. | 19,2 | 5,2 | 37 |

The green parking is a parking which reduces the outflow of the rain waters and pollutant emissions.

The ecological car parks refers to a series of techniques applied simultaneously in order to reduce the total waterproof surface of a parking place, to decrease the temperature at the soil surface level and to maintain a green island in the crowded areas. These car parks improve the morale of the drivers and pedestrians by creation of the green islands beside the multitude of constructions. Decreasing of the outflows of the rain waters is possible by using the permeable paving and natural draining systems.

The ecological paving blocks represent a new ecological solution within the paving field of an area. These are used for a series of developments: car access area, car parks, parking places, pedestrian alleys and sidewalks, protection of the earthworks, consolidation of gradients, slopes, embankments, solidification of the river or lake banks and many other uses, as the paving of the inside yard.

Grate-type slabs have the form of a concrete grating, studied, in order to favor the normal growth of grass half way from the covered area. Therefore in order to perform alleys for cars it is recommended, car parks in sightseeing area or in any other place which allows the passing over grass plots.

The square grate-type blocks are made of concrete and offers the soil the possibility to breath (special ecological requirement), as a resistance to freezing-thawing cycles.

In the development, these play an extremely important role, because they integrate very beautifully the grass plot within the design ensemble.

The ecological paving blocks are a system of cellular paving which complies with and protects the nature. The cellular paving system 'guttagarden'

performed of recycled polypropylene (PP) is a shockproof one and is destined especially for building of the parking places, car and pedestrian alleys. Due to the prominence of the anchorage system is an ideal solution for the solidification of the river or lake banks.

The square grate-type blocks or the ecological paving blocks are plastic/concrete structures which are filled with gravel or vegetation.

**Fig.1 Ecological parking**

**Fig.2 Ecological parking**

The surfaces where it can be used lawns are closer to nature, the healthy exchange between the nature elements reducing the pollution almost totally. On this lawn there can be organized parties, picnics, sports games. Taking care of the grass is an easy thing to do, and if the mounting instructions are observed, we will have high satisfactions.

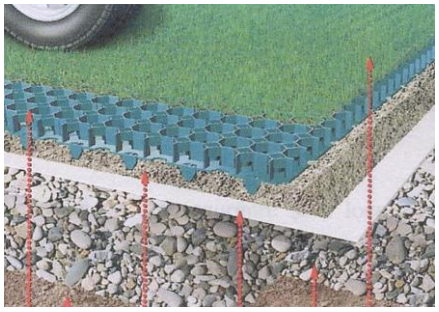

**Fig.3 Layers of an ecological parking**

For the lawn, the necessary microclimate, meaning the dampness of the soil, evaporation and drainage of the water is important to create. On its turn, the lawn allows the production of oxygen. The mounting of the paving offers the ideal solution for protection of the lawn against the weight of the vehicles. Due to the special form, hexagonal or squared, the weight of the cars is overtaken and divided between the component cells, so that not to cause any harm to the grass root or to its own support.

**Fig.4 Image field**
**County Hospital Timisoara**

**Fig.5 Image field**
**County Hospital Timisoara**

An ecological parking is composed of the following layers:

- basic layer: with a thickness of 20-60 mm has the role to ensure the uniformity and smoothness of the surface. It is executed using sand and broken stone from 2 to 5 mm, whereupon it is applied a layer of fertile soil (flower soil) of 20 mm.

- grate systems: with a thickness of 38-45 mm, are fitted on the mixture of flower soil, which has the role of to overtake the duties that stresses it and to protect the grass sowed.

- lawn: has an esthetic role, being sowed in the alveoli of the slabs /casings which confers a very distinct aspect to the lake. Therefore the beauty of the lawn must be maintained, observing some rules regarding the microclimate.

The lawn takes from the soil the water and nutritive elements, thus needing a soil with a suitable quality. Beside the heavy duties that this supports due to the traffic, it is also subject to weather conditions and dryness. Therefore, after placing the paving it is filled with vegetal soil, it is settled, and over this it is put flower soil of 10-20 mm, and then it is sowed the grass. Then this is covered with a layer of sieved soil, mixed with sand, on a thickness 5 mm. This is rolled, and afterwards it is watered daily until the emergence of the grass, depending on the precipitations and humidity from the soil. It have to be avoided the excess watering, because the water doesn't have to make any puddles.

In order to avoid the creation of water puddles, it is good that the resistance layer has an inclined side, of 0, 8-10% and this could be drained. Annually the soil is completed and there are applied nutritive substances. The best months for the application of the fertilizers are March and April and it is preferable to be administered after cutting the lawn. For the absorption of all granules it is recommended the watering by flooding.

All techniques of the ecological car parks may apply to new development areas, and some of them also to redevelopment projects, depending on the spreading and parameters of the project. The level of the efficiency depends on how reduced is the waterproof surface, as well as on the combination of techniques used in order to create a parking with a more pregnant ecological character.

In North California the new project for an ecological parking reduced the waterproof surface with 40%, increased the parking place with 20% and saved 1, 6 millions of dollars (20%) of the costs related to the construction of an original conventional project.

The building of an ecological parking must be the result of testing numerous „optimum managerial practices" which filters and ensures the water infiltration, as well as the decreasing of air pollution.

The designers shall supervise the water quality and the volume of outflows, as well as the air quality in order to compare them to those from an adjacent conventional parking.

The benefits resulted after the development of the ecological car parks are the following:

- minimum volume of discharged water;
- improvement of the water and air quality;
- ensuring of a maximum parking space;
- ensuring of a space for performing of the grass plot.

In order to choose the optimum solution it is necessary to analyze the limits imposed by the soil, drained layer, discharging of outflows, underground water.

By using the ecological paving system it shall be avoided the insulation of the surface, and this shall contribute substantially to prevent the forming of the floods. The precipitations shall not be directed towards the sewerage systems, and afterwards very quickly in rivers and brooks, but shall be assimilate slowly and uniformly by the soil, contributing to preservation of the natural level of the underground water. Due to larger green areas thus created, it is improved the quality of the environment.

The permeable paving blocks are surfaces which allow the water to pass through the holes of the paving material and /or empty spaces between the paving stones, until it is ensured a stable surface for supporting of the weight.

The stages for designing of an ecological parking are the following:

- determination of the speed for infiltration of the water in soil;
- determination of the direction for flowing of the rain water and their storage place;
- determination of the opportunity for incorporation of the permeable paving and of the natural grass plots of draining by:
  - calculation of the draining area directed towards each natural grass plot;
  - incorporation of the permeable paving in the place where they fit, especially in the parking areas with overflowing, discharge alleys and less used areas;
- determination of the sizes required for the natural grass plots so that the storage area is sufficient and practical.
- identification of the locations of the overflowing structures and the their connection place to the sewerage system. An important component of the paving is represented by the base drained layer, which ensures the stability of the supporting surfaces, as well as underground storage of the outflows.

The installation of the ecological car parks supposes the following stages:

- excavation and compaction of the soil**:** the soil must be compacted uniformly to 95 % of the optimum density before placing the gravel, sand and the lawn slabs;
- placing and compaction of the gravel base: the gravel used for the construction of the roads is acceptable in order to be used with the lawn slabs.
- laying of the sand bed: it shouldn't be used

brickwork sand. The sand must be spread uniformly and must have also uniform dampness content (unsaturated) before placing the alveoli slabs. The sand laid doesn't have to be handled.

- positioning of the alveoli slabs on the sand bed: the alveoli slabs must be placed with a space of minimum 2 mm between their edges. If the slabs come into contact with one another, these may get chipped and may crack after repeated tests.

- vibration of the alveoli slabs in the sand: use a plate vibrator, with small amplitude and high frequency (3500-5000 cycles/second). The alveoli slabs must be protected by cracking and chipping by application of a rubber carpet on the foot of the vibrator. If it is not available, you can use boards on the surface of the alveoli slabs.

- spreading of the fertile soil or gravel into the alveoli: the grass seeds and the fertilizer can be mixed with the fertile soil or placed directly on a surface, and the pushed in openings and articulations.

The advantages of the ecological car parks taken into account include avoiding of the environment pollution due to the vehicle emissions, reduction of the urban heat islands, reduction of the exposure to UV radiation due to trees canopy, overtaking of the air pollutants by the canopy, decreasing of the water outflows from precipitations, possible extended life of the pavement in case of shaded car parks. These prevent the forming of puddles on the alleys destroyed, from car parks or other large surfaces, ensure the suitable drainage, allow the grass to grow through the off-cuts, and at the same time do not allow the land to slide, keep the natural aspect of the grass, but has the stability of the paving blocks, allow the growth of the lawn in the best conditions, increase the surface of grass plot, protecting the natural balance, ensure the resistance of the soil on which are mounted, and on these can be stressed by heavy duties.

These types of car parks are not recommended in gas stations, vehicle service, car wash, in the areas with plentiful industrial activities (pesticide, detergent, pharmaceutical products factories) or where there is and increased level of underground water. In order to avoid the blocking-up of the pores from the permeable paving it is not recommended the spreading of the granular materials.

Other concerns regarding the execution of the ecological car parks include the potential conflicts related to the lighting, visibility, security and damages caused to the vehicles by the vegetable remains.

## Results obtained

Actually, the grass plot which is situated in front of the County Hospital remained broadly as it was thought and planted initially. Due to this cause, some species are spoiled and aged; some of them grew way too much, some of them degenerated, died or have been stripped. Although many of them must be replaced or toileted, it is necessary to mention the valuable species which must be turn to advantage, especially because there is a unique tree in the Banat - *Quercus robur "Umbraculifera"*. Meanwhile there occurred changes maybe due to the new reorganizations (for example the Center for Diabetics was relocated, and now the entrance is on an alley developed recently in the right side of the building), have been generated new routes or interest centers.

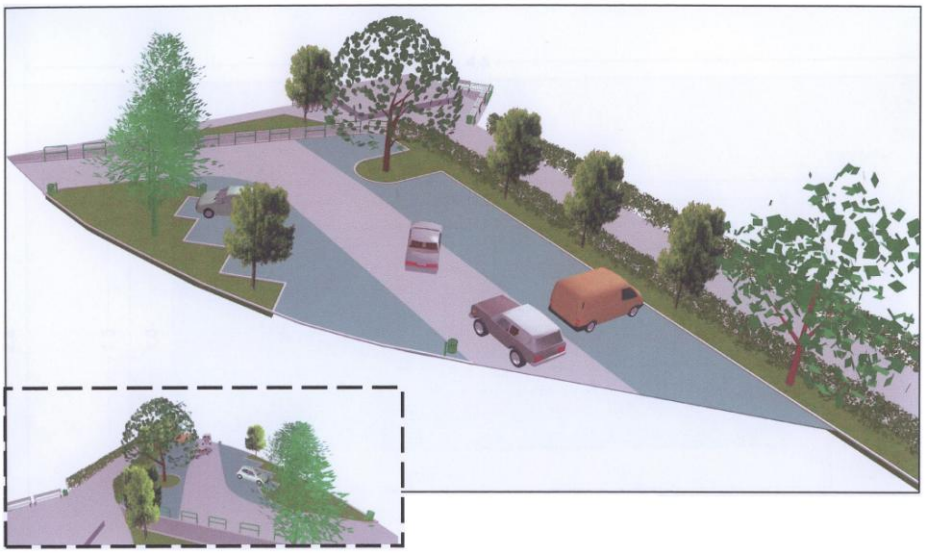

**Fig.6 Ecological parking - perspective**

The style chosen for this development is a mixed one, because there are parts for which we adopted a rectangular style (along the main centerlines), and the other parts were developed as close as possible to the natural environment.

The form of the space to be developed is given by the building, and there resulted a space with rectangular form, bordered by a hedgerow. In order to protect the grass plot, it was planted the surrounding hedgerow, and the sidewalk is bordered by a line of trees (*Prunus cerasifera var. Pissardii*) in order to reduce the noise.

**Fig.7 Ecological parking - perspective**

The area of the land is of approximately 2500 $m^2$, with three alleys which lead to the building entrances (one main entrance and two secondary entrances).

The County Hospital is situated in an area with high traffic, due to the importance that it has as an institution as well as due to the surroundings. It is an accessible area from the point of view of common transportation, served by a trolley line (line 16), two bus lines (express 2 and 3) and a tram line (line 9).

In the neighborhood we have three medical centers (Bleeding Center, Casa Austria Polytraumatology Clinic and Orthopedics Clinics), a shopping center, a stadium, recreation bases, a gas station and a fast-food, one block of flats, all these interest points being responsible for the agglomeration of the area.

The access into the hospital is carried out through one main, central and generous entrance. There are another two entrances: one for the Polyclinic No. l (in the left side) and the other one for the Diabetics Center, Nutrition and Metabolism Diseases (in the right side). Between these entrances the pedestrians created new routes. On the redevelopment of this space it shall be taken into account first of all by these three entrances, by the reorganization of the traffic shall be carried out also depending on the needs of the users. Thus, from the main entrance towards the other two secondary entrances shall be placed slabs on one alley with a width 2 m. Towards the Policlinic No. 1 there is an connection alley between the main entrance into the hospital and the entrance into the policlinic, but this proves to be very narrow due to the increased flow of pedestrians (using the same alley you can go towards Casa Austria or Orthopedics Clinic – recently constructed buildings). Beside these two, it shall be developed another alley which makes the connection between the entrance-exit from the parking and Diabetics Center – main entrance.

**Fig.8 Perspectival image rendered**

**Fig.9 Perspectival image rendered**

In order to protect the grass plot it was planted a surrounding hedgerow, and the sidewalk is bordered by a line of trees (*Prunus cerasifera var. Pissardii*) – in order to reduce the noise. These shall be kept, being just replaced where applicable (if these are dried or are missing).

Table 2

**Summary of rough estimates**

| No. | Name of the work | Estimated cost (RON) |
|---|---|---|
| **1** | Paving of alleys | 12,820.92 |
| **2** | Ecological parking | 26,254.36 |
| **3** | Urban furniture | 26,479.62 |
| **4** | Redevelopment of the grass plot | 13,214.05 |
| **5** | Plants | 26,857.5 |
| **TOTAL** | | **110,614.77** |

Table 3

**Rough estimate - Ecological parking**

| No. | NAME | MU | Quantity | Unit price (RON) | Total price (RON) |
|---|---|---|---|---|---|
| 1 | Grey TRAFORATO paving | $m^2$ | 501,60 | 29,00 | 14.546,40 |
| 2 | Sand | $m^3$ | 25,08 | 43,40 | 1.088,47 |
| 3 | Ballast | $m^3$ | 15,05 | 45,90 | 690,79 |
| | Broken stone | $m^3$ | 125,4 | 18 | 2.257,2 |
| 4 | Fertile soil | $m^3$ | 20,06 | 20 | 401,2 |
| 5 | Terasin NS (geotextile) | $m^2$ | 501,60 | 1,86 | 932,97 |
| 6 | Turf (40 g/$m^2$) | kg | 200,64 | 6,95 | 1394,44 |

| | | | | | |
|---|---|---|---|---|---|
| **Total of materials** | | | | | **2.131,47** |
| 1. | Manual digging | $m^3$ | 25,08 | 14,50 | 363,66 |
| 2. | Laying of protection layer | $m^3$ | 501,60 | 4,32 | 2.166,91 |
| 3. | Ramming up | $m^3$ | 501,60 | 4,82 | 2.417,71 |
| 4. | Loading/unloading different materials | t | 376,20 | 39,34 | 14.799,70 |
| 5. | Operation of truck | ore | 80 | 43,64 | 3491,2 |
| 6. | Operation of utility car | ore | 27 | 32,73 | 883,71 |
| **Total of manual work** | | | | | **24.122,89** |
| **Total** | | | | | **26.254,36** |

## Conclusions

The problem of the parking places was solved by development of a parking with controlled access for the staff employed by the hospital. But for the patients or visitors the parking still represents a problem. Therefore, it shall be increased the parking space by development of two ecological car parks, additional to those already existent, with a capacity of 26 places.

These ecological car parks shall be positioned in the space from the left side of the hospital (the triangle near the L. Rebreanu Boulevard) and that from the left side of the Policlinic. There shall be kept the existent trees (which are suitable form ecological and esthetic point of view) and it shall be completed tree lines planted in alveoli. The parking shall be developed with alveoli slabs, sewed with turf.

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