Method of creating additional parking spaces in the “Tudor Vladimirescu” University Campus

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Abstract. The increasing number of vehicles in recent years has yielded a lot of problems regarding road vehicle infrastructure in residential areas, especially in towns. The problem is that roads dimensioning and especially parking spaces are under dimensioned for the current number of vehicles in use. The current paper addresses the problem of the lack of parking spaces in the “Tudor Vladimirescu” University Campus. The Campus infrastructure was built in the early 1970’s and has received only a slight upgrade regarding access roads width, the access roads that were enlarged were Prof. Vasile Petrescu Street and Prof. Gheorghe Alexa Street. On the first specified road, parking spaces at 45 degrees were created, but this does not cover the number of needed parking spaces.

1. Introduction

Humanity has discovered, from the oldest times, the need of organizing the traffic and planning the roads, one example being the Roman road that made the connection between Rome and Constantinopol, road that had a single lane but that opened the human development path regarding the traffic, the urbanization and the transport and traffic organization.

The subject of this paper is the development of a viable solution for the parking spaces from „Tudor Vladimirescu” University Campus from Iasi.

The study objectives are diverse. Starting from the traffic safety inside the campus, among dorms, both of pedestrians and drivers, we can also think about infrastructure protection and conditions improvement for students.

The necessity of this project theme appeared from the fact that the road infrastructure from the campus has suffered a lot in the past years because the frequency of the transition grew.

The infrastructures are part of the system structure, are related and functional and represent integrum the necessary support for the system to identify himself, to individualize himself, to create relations with other systems, to stabilize and to work in the end.

The idea of the project appeared because we are facing difficulties regarding the road traffic, the ease of travel and the lack of parking spaces inside of campus and not only.
2. Structural characteristics of the location area

In this study we analysed and presented the implications regarding the fluency of the traffic from the „Tudor Vladimirescu” University Campus and by default the fluency of the road network that includes driveways, service roads and designated parking space.

“Tudor Vladimirescu” is one of the biggest University Centers from Romania. The total surface of the Campus property is about 137148 square meters, approximately 14 ha [1]. The first campus buildings T1-T2 and T3-T4 were built in 1969, and the most recent, T18 and T19 have been finalised in 1982, additional to these, T24 building was finalised in 2011.

The buildings from the Campus are mostly dorms and the apartment’s blocks Q1 and Q2 (former blocks for the workers that worked for the campus) that were raised before 1990, the housing capacity of the campus is over 8000 people. Taking this into consideration and also that the road infrastructure was created to satisfy the automotive needs before 1990, the problem of traffic fluency and parking spaces is well over passed by the current situation.

The traffic and pedestrian research identified a central area of „Tudor Vladimirescu” University Campus around which spins the whole Campus as seen in Figure 1. The study also described these streets as the ones that take the largest number of vehicles. The streets we are talking about are:

- Prof. Vasile Petrescu Street;
- Prof. Gheorghe Alexa Street;
- Prof. Dimitrie Atanasiu Street.

![General map of the analysed location](image)

**Figure 1.** The general outline map of Campus “Tudor Vladimirescu”
For the study of predicting the traffic was also taken into consideration the traffic volume for these streets, paying particular attention to the traffic on the access roads from Q1, Q2 and T16 area.

The access roads network sums up approximately 1260 meters long, paved surface, plus service roads for access to certain parking, to Q1, Q2 and Sports Hall.

The location of „Tudor Vladimirescu” University Campus is presented in Figure 2 it is in Iasi and is bordering by:

- In North: Cristofer Street, various private properties;
- In South: Chimiei Street;
- In East: Stanciu Street;
- In West: Tudor Vladimirescu Street (DN28) and Iulius Mall.

For access in and from the Campus there are 3 options provided for drivers:

Main entrances in Campus:
- Around T19 dorm from Cristofer Street, Figure 3;
- Around T10 dorm on Prof. Dimitrie Atanasiu Street, Figure 4;
- From Chimiei Street (two-way), Figure 5.

Main exits from Campus:
- Passing by T17 dorm – Mopseria Magic Pizza (with access in Tudor Vladimirescu Street);
- Passing by the church (with access in Tudor Vladimirescu Street);
- On the Chimiei Street (two-way) (with access in Tudor Vladimirescu Street).

Figure 2. Highlight aerial map of the campus boundaries [2]
Figure 3. View of intersection T19, entrance in campus.

Figure 4. View intersection T10, entrance in campus.
Figure 5. View intersection Chemistry Street, entrance and exit from campus.

It can be observed the fact that regardless the exit used, the traffic from „Tudor Vladimirescu” University Campus is taken greatly on Tudor Vladimirescu Street (DN24) which link the exits from Iasi.

3. Traffic problems identified in the analyzed area
Like any residential area from Iași, „Tudor Vladimirescu” Student Complex faces issues related to road traffic management, safety and parking spaces. Therefore in this traffic research was taken into account the problems identification and based on the simulations and on the mathematical calculations to implement the best and suitable solutions for the existing problems. Some problems from the Campus were acknowledged and photographed in order to demonstrate their seriousness.

Thus, from all the problems that exist in Campus we will list the ones that are relevant for the analyzed area, namely the area comprised around Prof. Vasilescu Petrescu Street:

- Illegal parking because of the fact that „Tudor Vladimirescu” University Campus is a zone strongly populated by students. When the campus was built the number of vehicles that Romanians had was small but with the growth of living standards and the cars number the infrastructure from the Campus was not changed. There are a lot of illegal parking because the students do not have where to park their cars in the parking lots. Some of the illegal parking are blocking the access paths on the Campus (an example is the garbage truck that does not fit through some sections of the road) and this may cause a tragedy if cars as firefighters or rescue vehicles cannot access the Campus. (Figure 6, 7, 8, 9, 10, 13)

- Problems with rainwater release exist because of clogged drains and because the level of ducts is higher than normal. These problems are disturbing the drivers are endangering the smooth running of the road traffic and are causing inconvenience to the pedestrians that must dodge them in order to
reach some areas from the Campus. Besides these, in the cold season the water becomes ice and this damage faster the asphalt. (Figure 10)

- The problem of asphalt degradation and the problem of sites that are not developed for traffic are problems that the Sport Hall zone feels especially because there is no arranged properly road see in Figure 11. Because of some heavy vehicles in some places the road collapses.
- The problem of abandoned cars as seen in Figure 12, that are occupying parking spaces and are bringing a bad image of the Campus because some homeless people are staying there.
- The lack of proper signaling of the intersections is something that can cause traffic accidents and is not a single problem, many intersections from the analyzed area are in the same situation. Some of these intersections are: the one between Vasile Petrescu Street and the Street that goes to Q1 and Q2, the one from the Sports Hall and the one from Prof. Vasile Petrescu and Prof. Gheorghe Alexa Streets. Speaking about signaling, the one for the heavy limit is missing from the entrances.
- Failure to comply the speed restrictions is a fact that is demonstrated in this case study as well.
- Failure to comply the restriction about gross vehicle weight is another problem that „Tudor Vladimirescu” University Campus has.

![Figure 6. Chaotic parking in front of the Sport Hall](image1)

![Figure 7. Parking on the sidewalk in front of the Sport Hall.](image2)

![Figure 8. Parking on green space in front of the canteen.](image3)

![Figure 9. Illegal parking in front of the canteen](image4)
4. Long term parking places arrangement and calculation methodology

Long term parking spaces are special arranged locations in which vehicles can park for more than 4 hours. Long term parking spaces are usually located outside the road surface and they need to respect specific design normative, like NP-27-97[3], through these norm they will need to have:

- Inclines so that the rain water will go to the drains;
- Clearly marked parking spaces and marked road surface;
- To assure the minimum radius for turning;
- Traffic signs.

For arranging the parking surface, the following steps of design will be followed:

1. Determining the number of vehicles that will defined the maximum number of parking spaces (Nv);
2. Determining the incline in regards with the terrain in which the parking lot is built;
3. To determine the vertical platform of the terrain, so as to decide where to mount the collective drains for rain water;
4. Marking the surface in regards to the actual architectural design of the zone;
5. The model of transversal section.
Determining the capacity of parking depends on the necessary space for parking one car (vehicle) and the space needed for access roads and space for manoeuvring:

- The necessary parking space for one vehicle as presented in Figure 14 is determined by the dimensions of every auto vehicle. But a reference dimensions is reglemented by the state normative for parking spaces, these dimensions are presented in Table 1.

- The geometry of parking spaces are set in such a way to allow a ergonomic space for manoeuvring the vehicle. They are designed for one way access roads or for two way access roads, in any case, the width of the access road plays a key role. Different available variants for arranging the parking spaces and also the dimensions that they should have are shown in figure 15 to figure 23.

Figure 14. Required handling space for vehicle and overall dimensions

| Dimensions and performance (mm) | Index | European vehicles | USA vehicles |
|---------------------------------|-------|-------------------|--------------|
| Length                          | A     | 4750              | 5500         |
| Width                           | B     | 1800              | 2030         |
| Heigth                          | C     | 1700              | 1630         |
| Opening of door                 | D     | 500               | n.a.         |
| Wheelbase                       | E     | 2900              | 3250         |
| Front axle                      | F     | 900               | 890          |
| Read axle                       | G     | 1100              | 1350         |
| Turning radius of exterior wheel| H     | 6500              | 6550         |
| Turning radius of interior wheel| I     | 5600              | n.a.         |
| Turning radius between walls    | J     | 7000              | 7010         |
| Ground clearance                | K     | 100               | 125          |
Figure 15. 90° parking – both way traffic

Figure 16. 90° parking – one way traffic.

Figure 17. 90° parking – both way traffic.

Figure 18. 75° parking – one way traffic.

Figure 19. 75° parking – both way traffic

Figure 20. 60° parking – one way traffic
5. On terrain collection of data for actual parking spaces

Using human operators, all the vehicles parked in the “Tudor Vladimirescu” Campus were numbered, the operation took place at night, Tuesday 26.02.2013 in the hours of 11:30 PM and 00:30 AM.

During the numbering, the climatic conditions where optimal for vehicle drivers, it was not raining, fact that would have led to the formation of big puddles in the campus area, this would have created situations in which certain parking spaces would not be usable. Also no traffic incidents were recorded. The measuring was conducted, taking into consideration and noting all the vehicles that were parked legal and all the vehicles that were parked in such a way that they blocked the traffic access. A map that shows the analysed area is presented in Figure 24. On this map the vehicles marked with red are the ones that are parked in spaces that block the access road.

In Table 2, we have presented the number of vehicles identified in the parking spaces census.

| Parking mode | Correct | Incorrect | Total |
|--------------|---------|-----------|-------|
| No. of vehicles | 31 | 33 | 64 |

It can be easily observed that the number of inappropriate parked vehicles is bigger than the number of vehicles parked according to the reglementations, this aspect arises big access problems in the area, in some areas the inappropriate parked vehicles even blocking one side of the road surface.
6. The actual maximum capacity of parking spaces

The actual maximum capacity of parking spaces is clearly low, under the number of vehicles that are normally present in the area.

Calculations of parking capacity and opportunities for landscaping parking lots according to the methodology described in section 3.5. in regards to the organization of parking spaces, were made directly on the dimensions of the locations suitable to accommodate parking spaces, these locations have the following characteristics:

- They are on asphalt or concrete terrain,
- They have adequate drain systems,
- They have sufficient space for access,
- They don’t block the access to other locations.

**Figure 24.** Analysed zone with parked vehicles

Following these criteria one location was identified as appropriate for marking of parking lots, it is near the corner of Prof. Vasile Petrescu Street and the access to the gym. In this location, people already use to park, but chaotic, the area is actually provided as refuge for vehicles going to the gym, to give passage to those coming out of the gym. This marked location can be seen in Figure 25. Following this reglementations, 22 parking spaces could be marked, a modest number for current needs.

Longitudinal parking lots in front of the canteen, along Prof. Vasile Petrescu Street have been taken in consideration, only that marking these parking spaces would lead to less than 5 meters of space for the two-lane road.
Another option would be the creation of parking spaces at the gym, only that the land does not meet the minimum requirements location for car parking. *Note: the terrain has be fully rebuilt and now a parking lot is present in front of the Sport Hall.*

![Figure 25. Possible marking of the parking spaces on the actual infrastructure](image)

7. **Capacity analysis of proposed parking situation**

Parking spaces on the proposed organizational variant is one for the near future, the idea is that the car parking lots on the long term must be organized in special places, on levels, so as not to cover a large area of campus space.

As for situations in the near future, the proposed solutions require only basic repairs to the existing infrastructure and expanding on some portions, this expansion is well planed to not take much of the green space available. If necessary additional green space in the campus, can be created in other areas, that are with no traffic.

The proposed variant from Figure 26 envisages repairing the infrastructure in front of the gym and expanding the width of Prof. Vasile Petrescu Street in front of the Canteen to create parking spaces.

This new arrangement leads to the creation of about 93 parking spaces, among them the new parking spaces in front of the canteen are considered.
Figure 26. Proposed variant for parking spaces.

8. References
[1] http://www.dss.tuiasi.ro/campus
[2] https://www.google.ro/maps/
[3] Normativ Parcari: NP- 27-97

Acknowledgments
Providing parking spaces in the campus is a key priority in the nearest future, as bottlenecks caused by illegal parking must be prevented. The direct cause of these illegal parking situations is due to the fact that the number of vehicles has steadily increased, and will continue to do so, making the creation of new parking spaces in the campus area a must.