

# COGNITIVE ERGONOMIC ANALYSIS OF THE PARKING FLOW OF REAL TRAFFIC ENVIRONMENT

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**Abstract:** The goal of the ergonomic analysis of the parking flow is cognitive data collection that will be the basis for the development process of increasing the efficiency and capacity both of the parking zone and of the direct connecting road. In order to determine the possibilities; increase in the number of parking places, dynamics of parked vehicles exchange and dangers resulting from the change in the movement pattern within the newly designed parking flow, both for the pedestrians and for the other traffic participants, the actual facts have been defined. A large number of violations, violations of law and non-compliance with traffic regulations have been noted which have direct impact on normal traffic flows. This is especially emphasised since it refers to a very busy wider city centre, both regarding the traffic of road motor vehicles, and regarding the circulation of pedestrians. Based on the analysis, a layout plan of traffic signs, equipment and road markings for the current condition has been provided and new improvements have been given in the form of more efficient and safer traffic design solutions.

**Key words:** SAFETY ERGONOMICS, COMPUTER ANALYSIS, VISIBILITY ZONES VIRTUALIZATION

## 1. INTRODUCTION

Cognitive perception i.e. monitoring is the gathering of data about the phenomena through their direct cognitive survey. It is justified to assume that the cognitive data obtained by scientific monitoring will be more accurate than the data whose forming during the process of acquisition and processing takes longer and which includes participation of several persons, especially if they fail to have professional competencies necessary for scientific monitoring gathering of data. Therefore, the respective series of the phenomena of the detected possibilities of drivers' behaviour within an observed parking flow has been chronologically, photographically, and statistically documented by trained and professionally drilled staff. The cognitive survey expands significantly the research primary experience and facilitates the acquisition of realistic impressions and results in the comprehension of the integral traffic situation being studied.

One can monitor only empirical contents, only what exists or is going on at the time of the monitoring itself [1]. Figure 1 shows a photographic presentation of correct sequential parking and illegal parking of road motor vehicles at the respective location, in accordance with the existing solution that has been defined both by horizontal and vertical signalization.



Fig. 1. Examples of regular and illegal parking

The aim of observing the parking flow is to gather the data that will form the base of the development process of increasing the efficiency and capacity of the parking and the directly connecting road. Using the cognitive scientific monitoring, the aim is to identify the problems which result from inadequate design of the parking environment.

Monitoring is suitable for the gathering of data on the external manifestations of the phenomena, but by monitoring the external

forms of the behaviour of drivers, road motor vehicles and other traffic participants, it is very difficult, although not impossible, to form a more complete scientific picture of the parking flows and their interrelations and interactions, especially of its more integral forms of the higher organizational structures. The entire complexity of the mentioned forms of the possible behaviour of the traffic participants is understandable only when it is considered in the wider context of the network, interconnected traffic flows of the urban units, visible from the cartographic displays of the urban plan of the narrower town area, within which the respective study took place, Figure 2 [2].



Fig. 2. The narrower area of the Town of Čakovec

## 2. PARKING FLOW OBSERVATION

The observation task is to monitor the methods of parking and driving at a parking lot and one-way two-lane road which extends laterally to the parking area. The number of acquisitions has been determined by 5-minute time intervals, photo-documented and statistically recorded. Two groups of cognitive observers were established; the first group carried out the monitoring on Wednesday, 20 October 2010, and the second group on Friday 22 October 2010. The monitoring was carried out during the parking charging times which in that part of the city (zone 0) is from 7 a.m. to 8 p.m. Regarding weather conditions and guidelines of the study of work and time the monitors took turns every 60 minutes, recording their observations about the parking methods and the behaviour of the traffic participants on adequate forms.

### 3. PARKING FLOW SURVEY

The scientific cognitive survey was carried out in order to identify the ergonomic problems resulting from illegal parking as well as from the shortage of parking spaces, which is at the same time the direct cause-effect for violating the law and illegal parking. Many people park also parallel with the parking spaces, forming thus two-row parking, either due to the fact that all the places are occupied or because they are in a hurry, assuming that there is no time for regular parking, thus usually blocking by these activities the exits of those who have parked regularly.

It has also been found that a relatively small number of motorists pay for the parking and that many stay in the parking space longer than allowed. Many drivers park also on X-marked place (approach road which is definitely no parking space), which is prohibited, and interferes to a large extent with the drivers who merge into the connecting road [3]. Even one isolated case has been recorded when two cars parked at the same time in that space, thus blocking the exit from the roundabout and preventing normal flow of traffic along the main city road [4].

In some cases there have been situations when the drivers parked differently, and thus some were close-parked and that they had to wait for the negligent owners of other vehicles so as to be able to leave the parking lot. There were even cases that some spaces remained empty since parking was impossible, e.g. parking spaces A and C are occupied, and parking space B is empty since the gap left in between is too small. Here the drivers managed somehow by parking at an angle, i.e. violating the horizontal signalization, thus managing to park their car regarding the parking space width not interrupting the normal flow of traffic along the connecting road [5]. One of the more frequent violations was parking on the disabled parking space, all due to the shortage of parking places.

At the respective parking lot there is a noticeable problem of the parking being time limited and intended for parking up to a maximum of 30 minutes, which was neglected by many drivers as can be seen from a separate part of the observation survey list, leaving their vehicles on the respective parking location for a much longer time than permitted, Table 1.

Tab. 1. Observation survey presented in tabular form

| RB. | Vrijeme:    | X | A | B | C | D | E | F | In |
|-----|-------------|---|---|---|---|---|---|---|----|
| 1.  | 7:00 - 7:05 | ● | ● | ● | ● | ● | ● | ■ | ■  |
| 2.  | 7:05 - 7:10 | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ■ | ■  |
| 3.  | 7:10 - 7:15 | ● | ● | ● | ● | ● | ● | ■ | ■  |
| 4.  | 7:15 - 7:20 | ● | ● | ■ | ● | ● | ● | ■ | ●  |
| 5.  | 7:20 - 7:25 | ↓ | ↓ | ■ | ● | ● | ● | ■ | ■  |
| 6.  | 7:25 - 7:30 | ■ | ■ | ■ | ● | ● | ● | ■ | ■  |
| 7.  | 7:30 - 7:35 | ■ | ■ | ■ | ● | ● | ● | ■ | ■  |
| 8.  | 7:35 - 7:40 | ■ | ■ | ■ | ■ | ● | ● | ■ | ■  |
| 9.  | 7:40 - 7:45 | ■ | ■ | ■ | ■ | ● | ■ | ■ | ■  |
| 10. | 7:45 - 7:50 | ● | ● | ● | ● | ● | ■ | ■ | ■  |
| 11. | 7:50 - 7:55 | ● | ● | ● | ● | ● | ■ | ■ | ■  |
| 12. | 7:55 - 8:00 | ↓ | ↓ | ↓ | ↓ | ↓ | ■ | ■ | ■  |
| 13. | 8:00 - 8:05 | ↓ | ↓ | ↓ | ↓ | ↓ | ■ | ■ | ●  |
| 14. | 8:05 - 8:10 | ↓ | ↓ | ↓ | ↓ | ● | ■ | ■ | ↓  |
| 15. | 8:10 - 8:15 | ● | ● | ● | ● | ● | ● | ■ | ■  |
| 16. | 8:15 - 8:20 | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ■ | ●  |
| 17. | 8:20 - 8:25 | ● | ● | ↓ | ↓ | ↓ | ↓ | ■ | ↓  |
| 18. | 8:25 - 8:30 | ↓ | ↓ | ↓ | ■ | ↓ | ↓ | ● | ↓  |
| 19. | 8:30 - 8:35 | ● | ■ | ■ | ■ | ● | ↓ | ■ | ■  |
| 20. | 8:35 - 8:40 | ↓ | ■ | ■ | ■ | ↓ | ↓ | ■ | ●  |
| 21. | 8:40 - 8:45 | ↓ | ■ | ● | ● | ● | ● | ■ | ↓  |
| 22. | 8:45 - 8:50 | ■ | ■ | ↓ | ↓ | ↓ | ↓ | ■ | ↓  |
| 23. | 8:50 - 8:55 | ● | ■ | ↓ | ↓ | ↓ | ↓ | ■ | ■  |
| 24. | 8:55 - 9:00 | ↓ | ■ | ↓ | ↓ | ↓ | ● | ■ | ●  |
| 25. | 9:00 - 9:05 | ↓ | ■ | ↓ | ● | ↓ | ↓ | ● | ↓  |

### 4. TRAFFIC SOLUTIONS

In case of changing the parking lot design, i.e. if the places were set at an angle, the parking lot would gain more parking spaces, Figure 3. This intervention would increase the number of parking spaces, and further reduce the risk of collisions, simplifying also the activities and procedures involved in the parking itself, thus facilitating entry and exit from the parking spaces. This would reduce also the number of traffic violations, and additionally accelerate the traffic flow through the mentioned parking zone and the directly concerned road.

Furthermore, it would be necessary to carry out stricter control of the parking zone and to more frequently fine the motorists of the illegally parked cars, as well as the motorists staying parked for a longer time period than the permitted 30 minutes. In our opinion an extremely high fine should be given for occupying the disabled parking space, of course, in case they have no such permission or it was not clearly displayed according to the law [6].



Fig. 3. Proposal of correct angle parking

### 5. CONCLUSION

During the observation, the monitors have encountered vehicles that satisfied all the regulated conditions of parking methods at the given location, as well as vehicles that occupied parking positions inadequate, illegal, fineable, and regarding safety very dangerous in the modification of the regular basic parking method.

The monitored parking system consists of seven parallel parking spaces, one of which is reserved for the disabled. The ergonomic cognitive analysis has undoubtedly found that there is possibility for a relatively modest investment-organisational intervention which would have a dual effect. There would be an increase in the number of parking spaces, and an improvement of the ergonomic traffic safety, both for the vehicles using the parking zone, and for the vehicles driving along the respective connecting road.

Since traffic density and the need for the parking spaces within the cities is constantly growing, apart from efficient design of both approach roads and the parking environment, special attention has to be paid to the behaviour of the motorists using this environment.

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