



# Analysis and Proposed Solutions for Parking in Rajecké Teplice

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**Abstract.** The article is focused on parking in the spa town of Rajecké Teplice. Spa towns are attractive in terms of transport and attract traffic. The most frequently used mode of transport is the individual automobile transport. The increasing number of visitors of Rajecké Teplice is also causing an increase in the number of cars and parking demand. A common problem for cities is the lack of space and land ownership to build new parking spaces. The result is parking on the streets, public space and green areas, which harms the environment and retrench the traffic flow and other participants of transport. A survey of the number of parking vehicles, the average length of parking and the purpose of parking was carried out in the town. The inhabitants of the town also expressed their opinion on the situation with parking in the questionnaire. The outputs of this questionnaire are given in the article. Based on the results of the survey and a questionnaire, solutions were proposed to improve the parking in the spa town of Rajecké Teplice.

**Keywords:** Parking · Traffic survey · Questionnaire · Rajecké teplice

## 1 Introduction

Rajecké Teplice (R.T.) is located in northwestern Slovakia in the district of Žilina. It is a spa town and is one of the smallest towns in Slovakia. R.T. is an important traffic node of valley of Rajec. Before building the bypass, all vehicles were passing through the town centre. The bypass significantly reduced the proportion of transit traffic passing through the town centre. Nevertheless, a certain proportion of transit traffic still passes through the town centre.

There are several private parking lots in the town, which are owned by spas, various hotels, restaurants and so on. Few parking spaces are owned by the city. Only parking places around the square are charged. A parking ticket can be purchased from the parking ticket machine. Inhabitants with permanent residence in the town have the opportunity to purchase a resident parking card. An important parking lot is located on both sides of the road I/64. This parking lot is important now and also for the future because its location is outskirts. At present, it is owned by the Slovak Road Administration, but soon, it should be owned by the city. A part of Osloboditeľov street near the swimming pool is one of the most problematic places in terms of parking. Another problem with parking

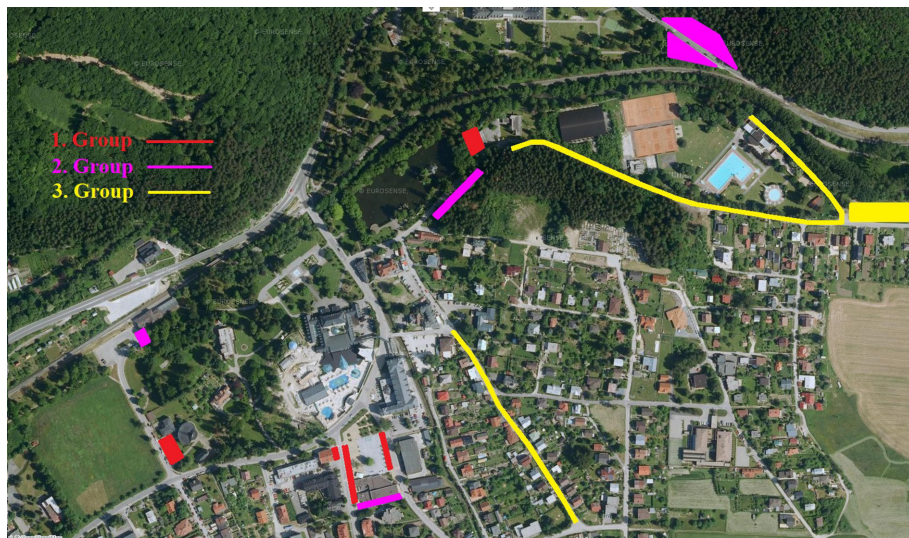
is on Rudolf Sůlůvský Street, in parking spaces around the square, near the church and its surroundings during church services on Sundays and church holidays. The biggest problems with parking are during the summer [1, 10, 11].

## 2 Parking Analysis

The issue of parking in Rajecké Teplice was analyzed in two ways. The first way was to do a parking questionnaire in R.T. The questionnaire consisted of two parts. The Respondent Data Collection Part and the second part, which included questions about parking in R.T. At the end of the questionnaire, respondents had the opportunity to comment on parking in the city.

The second way of parking analysis in R.T. was a survey of the number of parking vehicles, the average length of parking and the purpose of parking. This survey was conducted at selected locations and parking lots. Individual places and parking lots were chosen based on knowledge about parking problems, or those parking lots that are widely used. Prior to the survey, a meeting was held with the mayor of the town, who was informed about the survey and the places included in the survey. The mayor of the town proposed to include in the survey R. Sůlůvský street too [7, 20].

### 2.1 The Survey of the Number of Parked Vehicles, the Average Length of Parking and the Purpose of Parking



**Fig. 1.** Marked locations included in the survey [own processing based on [19]]

Parking areas and places included in the survey (Fig. 1):

- parking places around the square,
- parking lot behind the municipal office,
- parking lot by the church,
- parking lot near the bus station and railway station,
- Rudolf Súllovský street
- gravel parking lot near the pond,
- parking lot by the pond,
- Osloboditeľov street,
- road by the swimming pool to the bridge before the Jozef Gabčík street,
- parking lots near road I/64.

The survey was conducted on Tuesday (14.8.2018) and Sunday (19.8.2018) to compare the average day of the week with the weekend. The time of realization was divided into two parts. The first part took place from 8:00 am to 12:00 am. The second part took place from 14:30 to 19:30.

The number of vehicles parked was checked every 15 min. The number plates of vehicles parked was recorded. The evaluation of the survey revealed the percentage shares of vehicles from the district of Žilina (ZA), other districts of the Slovak Republic and vehicles from abroad. The average length of parking was calculated based on the total number of parked vehicles during the realization of the survey and the amount of time each vehicle spent on the parking lot (also includes the inappropriately parked vehicles outside the parking lot). During the survey, the purpose of parking was determined by asking the driver a question. The results of the survey are divided into 3 groups:

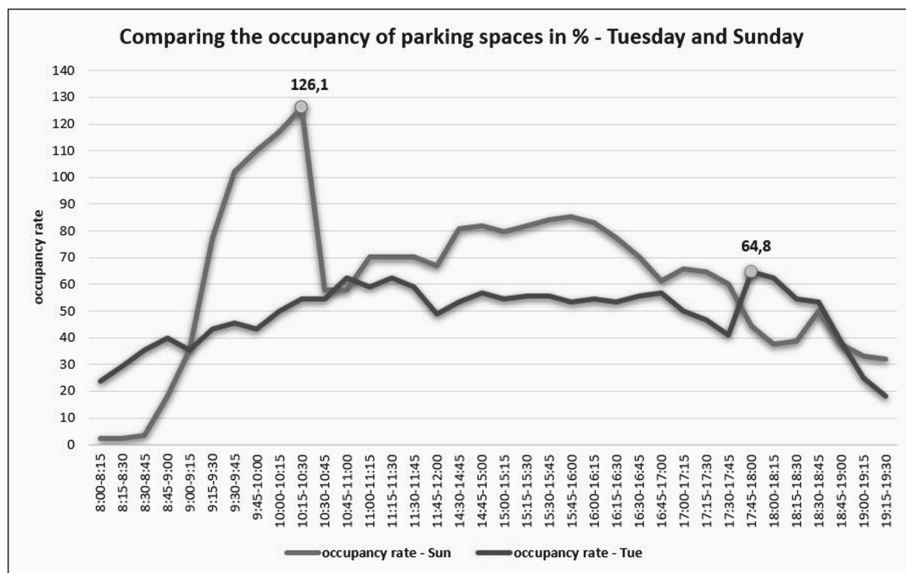
### **1. group – Parking lots with the marked parking spots**

This group includes the following parking lots:

- parking spaces around the square,
- parking lot by the church,
- parking lot by the pond.

There are 88 parking spaces in these parking lots. Parking spaces around the square are charged. Parking on parking lots by the church and by the pond are free of charge. The results of the survey of the number of parked vehicles are listed in Fig. 2. The occupancy of parking places in these parking lots was higher on Sunday. On Tuesday, the highest occupancy was 64.8% (57 vehicles) from 17:45 to 18:00. On Sunday, the highest occupancy was 126.1% (111 vehicles) from 10:15 to 10:30 a.m. The occupancy of parking spaces was over 100% from 9:30 a.m. to 10:30 a.m. The vehicles were parked inappropriately and restricted other traffic participants. The main reason for the high occupancy at this time was church service in the church. There are only 23 parking spaces in the parking lot by the church. There are often inappropriate parked vehicles on the streets and sidewalks during church services on Sundays and church holidays. The

parking lot is also limited by a traffic sign allowing parking only at times of the church services. Despite the traffic sign, several vehicles are parked here throughout the day, as a result of the lack of parking spaces in the city [8, 9].



**Fig. 2.** Comparing the occupancy of parking spaces in % - Tuesday and Sunday [own study]

On Tuesday the average parking time was 1 h and 55 min. On Sunday the average parking time was shorter - 1 h and 30 min (Fig. 3).

On Tuesday, drivers most often mentioned the option “recreation” (48) and “other” (58) as the purpose of parking. The option “other” - the most frequently mentioned reasons were - services (34) and church service (19). On Sunday, drivers most often mentioned “recreation” (131) and “other” (130) as the reason for parking. The most common reason for parking was “church service” (119) in the option “other”.

## 2. group – Parking lots where parking spots are not marked

This group includes the following parking lots and locations:

- parking lot behind the municipal office,
- parking lot near the bus station and railway station,
- gravel parking lot near the pond,
- parking lots near road I/64.

There are no marked parking spaces and parking is not charged at these locations. Parking is possible for a smaller number of vehicles because of inappropriate parking. The following figure shows the course of the number of parked vehicles on Tuesday and Sunday (Fig. 4).

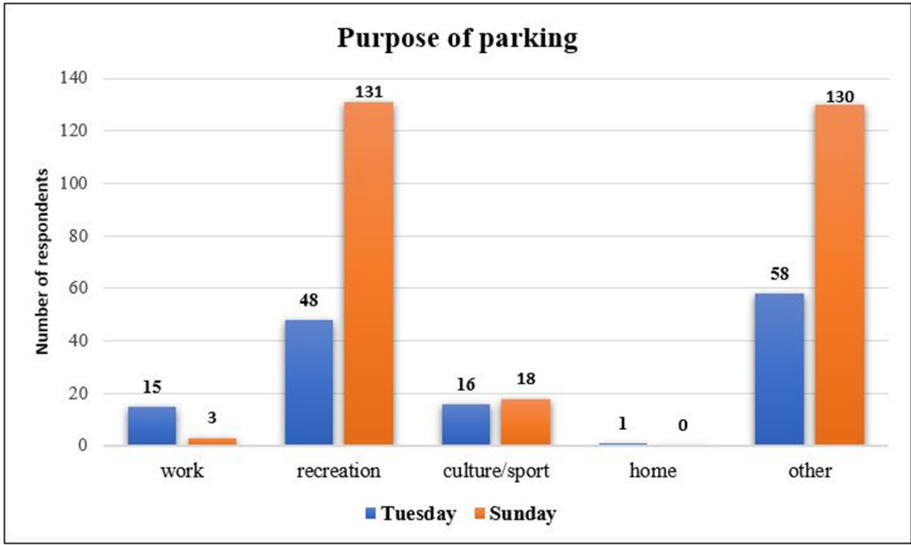


Fig. 3. The survey of the purpose of parking - Tuesday and Sunday [own study]

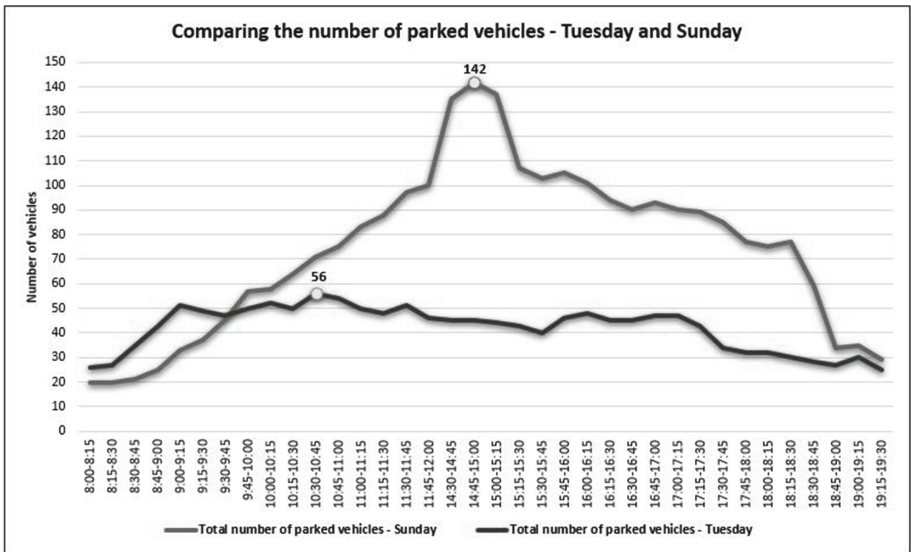


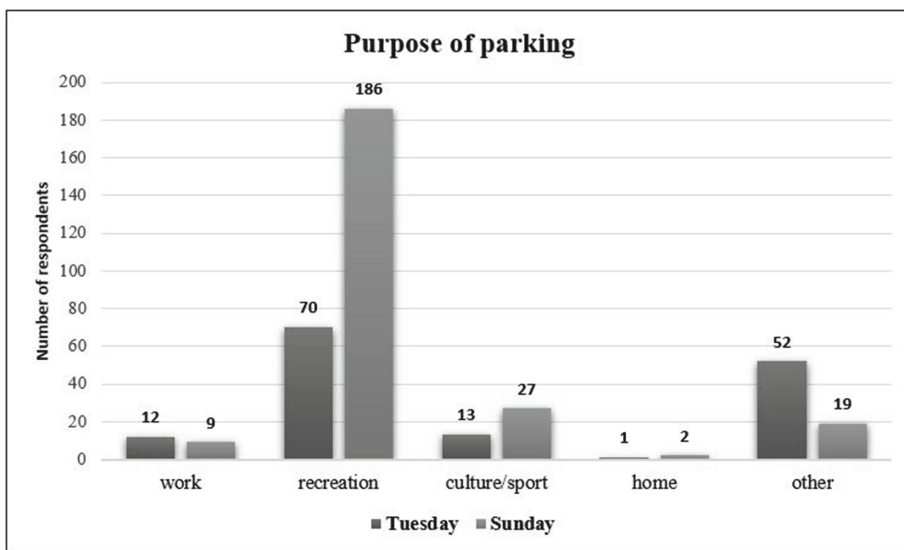
Fig. 4. Comparing the number of parked vehicles on Tuesday and Sunday [own study]

The results of the survey show that on Sunday (approximately from 9:45 am) there was a larger number of parked vehicles. On Sunday, the largest number recorded was 142 parked vehicles (between 14:45 to 15:00). On Tuesday, the largest number of parked vehicles was 56 vehicles (between 10:30 am to 10:45 am). During both days, the vehicles

were parked inappropriately and the parking areas were not fully utilized. In addition, other traffic participants (pedestrians, cyclists) were restricted at the pond.

On Tuesday, the drivers most frequently mentioned the option of “recreation” (70) and “other” (52) - stop/pause (33), services (6), dinner (4), etc. On Sunday, recreation (186) and culture/sport (27) were the most common reasons.

On Tuesday the average parking time was 2 h and 34 min. On Sunday the average parking time was longer - 2 h and 47 min (Fig. 5).



**Fig. 5.** The survey of the purpose of parking - Tuesday and Sunday [own study]

### 3. group – Places and areas, on which is not allowed parking

This group includes places where parking is inappropriate and restricts the traffic participants. It is parking on the streets and on grassy areas. This includes the following places:

- Rudolf Sůlovský street,
- Osloboditelov street,
- road by the swimming pool to the bridge before the Jozef Gabčík street.

Parking in these places causes significant problems and restricts traffic especially during the summer season. There are no marked parking spaces and parking is not prohibited or charged at these locations. Figure 6 shows the number of parked vehicles on Tuesdays and Sundays. On Sunday, the number of parked vehicles was significantly higher. The highest number of parked vehicles was recorded between 14:30 and 14:45–223 vehicles. On Tuesday, the largest number of parked vehicles was recorded at 2

intervals - from 16:30 to 16:45 and from 17:00 to 17:15–56 vehicles. The weather on Tuesday was not favourable and the results were not as we expected. The number of parked vehicles is also large during weekdays and traffic in these places is severely limited (Fig. 7).

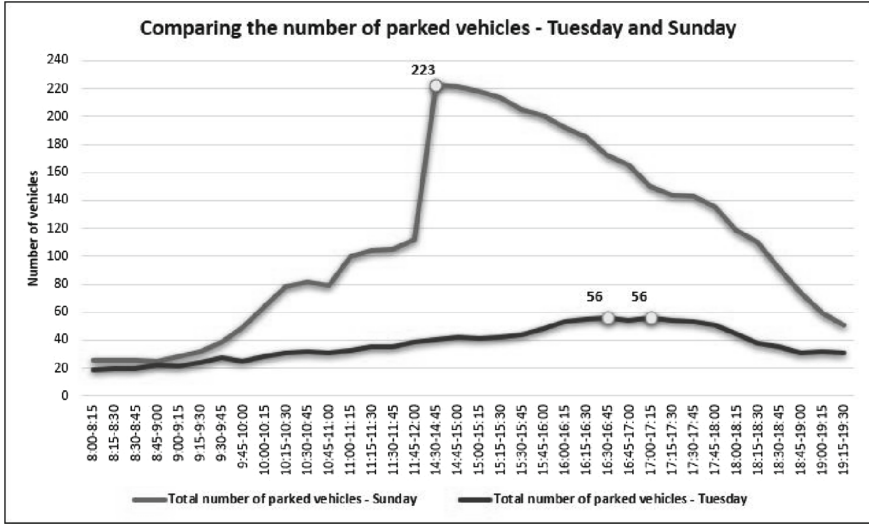


Fig. 6. Comparing the number of parked vehicles on Tuesday and Sunday [own study]

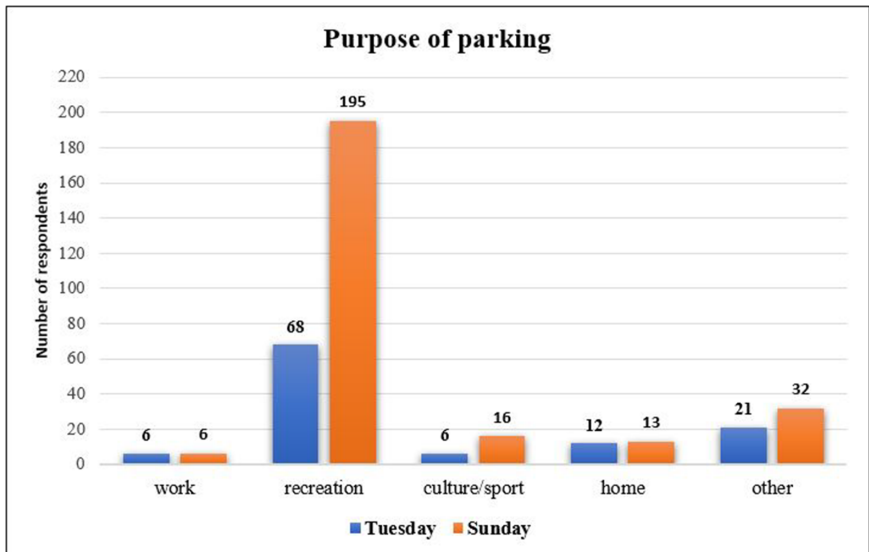


Fig. 7. The survey of the purpose of parking - Tuesday and Sunday [own study]

The results of the survey of the purpose of parking again brought the results, when drivers most frequently mentioned the option of “recreation” on Tuesdays and Sundays.

The second most common option was 'other'. In this option drivers most often mentioned as a reason for parking - a restaurant. There are several restaurants on and near the Rudolf Sůľovský street which attract traffic but do not have enough parking spaces. On Tuesday, the average parking time was 2 h and 50 min. On Sunday, the average parking time was longer - 3 h and 43 min.

## 2.2 Questionnaire Survey

The aim of the questionnaire was to find out how the visitors and residents of the town perceive parking in R.T. The questionnaire focused primarily on the residents of the town. A minimum sample size of the questionnaire had to be calculated before the realization of the survey. This sample size was based on the population of Rajecké Teplice (3 017). The result was a sample of 245 responses. We have received 249 responses from residents of the town and 43 responses from people who are not residents of this town. A sufficient number of responses was achieved only from the residents of the town (Table 1).

**Table 1.** Results of the questionnaire [own study]

<b>Do you think parking in Rajecké Teplice is a problem to be solved?</b>	
<b>yes</b>	<b>no</b>
217 (87%)	32 (13%)
<b>Did you not find a free parking spot and had to park improperly outside the parking lot?</b>	
<b>yes</b>	<b>no</b>
179 (76%)	57 (24%)
<b>Did you get constrained by improperly standing vehicles? (You were in the position of a pedestrian, cyclist, driver of a motor vehicle, ...)</b>	
<b>yes</b>	<b>no</b>
206 (83%)	43 (17%)
<b>Do you think it is necessary to regulate parking in Rajecké Teplice?</b>	
<b>yes</b>	<b>no</b>
216 (87%)	33 (13%)
<b>Would you accept a solution in the form of charged parking to improve the current situation?</b>	
<b>yes</b>	<b>no</b>
120 (48%)	129 (52%)
<b>Do you think it is necessary to build new parking spaces, even if this should be at the expense of green areas?</b>	
<b>yes</b>	<b>no</b>
128 (51%)	121 (49%)



### 3 Proposals for Improving the Current Situation

The proposals for the new organization of parking are based on the results of the surveys that have been carried out. Problem with parking in R.T. is evident and needs to be addressed. Below are the individual proposals for improving the current situation.

#### 3.1 Parking Regulation

Parking regulation is one of the most important and easiest ways to improve parking. It is necessary to regulate parking especially in places that have been a problem for a long time and have not been addressed in any way. Parking regulation is suggested in 3 ways [5, 6].

1. Charging for parking - not only on the square but also on the streets. These are the most problematic streets - Osloboditeľov street, Rudolf Súl'ovský street, Lúčna street and Školská street. Currently, parking is only available at the square (€ 0.30 per half hour). The following table shows the parking rates I propose for parking areas near the square (zone RT1) and on the mentioned streets (zone RT2) (Table 2).

**Table 2.** Proposed price list of parking [own study]

Parking time	Fee
<i>Parking areas near the square – RT1</i>	
1. half an hour	1,00 €
Each additional half an hour	1,00 €
<i>Parking on the streets – RT2</i>	
1. hour	1,50 €
Each additional hour	1,50 €

Parking fees can be paid via mobile app, SMS, cash or bank card. We suggest paying the parking fee via SMS to the number 2200 and in the specified form of SMS. Several cities in Slovakia are using this phone number. SMS is designed as follows:

– RT(space)RT1/RT2(space)number plate

In the middle of the SMS is the name of the zone where the vehicle will be parked. The system recognizes the zone and determines the appropriate parking fee.

2. No parking - in certain places, streets. It is important to ensure smooth traffic on the streets without constraints created by improperly parked vehicles. Parking regulation using a parking ban is also possible in combination with charging for parking at the designated parking spots located on the street. It is necessary for municipal police to

levy fine for improperly parking vehicles. Without the intervention of the municipal police, the problem with inappropriate parking will be repeated.

3. Marking of parking spaces – several parking areas have no marked parking spaces, therefore it was designed to be marked according to the relevant standard STN 73 6056, which lists the dimensions of parking spots for parking - perpendicular, parallel and angle. At present there is unsuitable parking, where the parking spaces are not used sufficiently. Drivers, who were involved in parking research required for marking parking spots [3, 4].

### 3.2 Parking Cards

Just a resident parking card for residents of the town is available. The price of this card is 10 € and is valid for 1 year from the date of purchase. We propose to establish resident and abonent parking cards (Table 3).

**Table 3.** Proposed price list of parking cards [own study]

Number of vehicles	Fee
<i>Resident parking card</i>	
1. vehicle	20 €/year
2. vehicle	60 €/year
Each additional vehicle	180 €/year
<i>Abonent parking card</i>	
1. vehicle	50 €/year
2. vehicle	150 €/year
Each additional vehicle	450 €/year

In the event of loss, theft or damage to the card, you will be required to pay a 5 € fee to issue a new card. The parking card will only be valid for the vehicle whose vehicle registration plate is on the parking card. The parking card will be available at the municipal police in the municipal office building.

### 3.3 Parking App

Currently, in R.T. is not possible to use any mobile app for parking. Longer search times for a free parking spot increase fuel consumption and emissions. Considering that R.T. is a spa town, it is necessary to improve air quality and not conversely. A parking app can help to reduce emissions thanks to a shorter search time for the free parking spot. Before driving, the driver can view free parking spaces and start navigating to that location [12, 13, 15].

We propose to create a parking app for the town or to cooperate with an existing company that has a functioning parking application (e.g. ParkDots, Parkio, Parkopedia).

In this proposal, it would be appropriate for the town to cooperate with organizations operating in the town that have available parking spaces for visitors. These are especially hotels, pensions and SPA Aphrodite Rajecké Teplice (SPA RT). Sensors would be installed in parking spots to provide real-time information about the availability of these parking spots. Thanks to that the driver will see where he can to park the vehicle and start navigating to that location. The app will be able to notify the driver before the end of the validity of parking. The driver will receive this warning 10 min before the end of the paid parking period. The driver will be able to extend the parking time [2, 16, 18].

### 3.4 Parking House

Several respondents stated in a questionnaire survey that it would be necessary to build a parking house. Another important reason to build a parking house is the smaller ground area required. The town does not own enough land plot to build a parking house. For this reason, it is necessary to cooperate with entrepreneurs who own several large land plots where a parking house could be built [17].

The parking house is designed to be built in 2 locations (Fig. 8). The parking house with the number “1” is designed near the bus station and railway station, but also near the church. Here SPA RT plans to build a parking house. The parking house can solve the problem of improper parking on road I/64 and the surrounding streets during church service. Also, this parking house will have the potential for use in the P + R (park and ride) system. The location of the parking house is on the outskirts of the town [14, 21].

The parking house with the number “2” is designed near the swimming pool, where is currently a building used as a warehouse for SPA RT. SPA RT is planning to build here parking spaces on the ground level soon and then in the future, there is the possibility

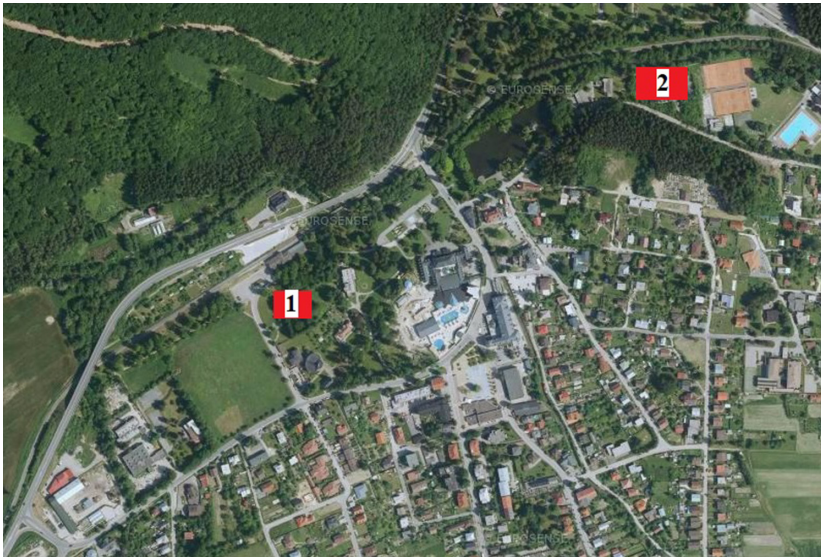


Fig. 8. Proposal for the location of parking houses [own processing based on [19]]

to build a parking house. Parking house would improve the situation with parking in the most problematic part of the town - Osloboditeľov street. From an architectural point of view, both parking houses should be designed to minimize interference with the surrounding environment.

## 4 Conclusion

Problems with parking occur all over the world. Solutions are often costly but need to be applied. It is important to change people's thinking in order to increase the demand for public transport or other alternatives (cycling and walking).

The town of Rajecké Teplice has problems with parking for a long time. It was necessary to carry out traffic surveys to solve this problem. These were surveys of the number of parked vehicles, the average length of parking time and the purpose of parking. Later, a questionnaire survey about parking was carried out. By carrying out surveys have achieved one of the stated objectives - analysis of the current situation.

The proposals are another objective that has been achieved. The proposals include solutions to regulate parking, which is a necessary means of improving the current situation with parking. Problems with parking will not improve without parking regulation. In addition to parking regulation, other solutions to the problem with parking are also proposed. Through these proposals, it is possible to achieve a better situation compared to the current situation. Some proposals require a change in people's thinking, as already mentioned. We believe that the realization of the proposals can solve the problems related to parking in Rajecké Teplice.

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