OBLICZANIE POPYTU NA MIEJSCA PARKINGOWE

Sjoerd Stienstra
ir. Sj. Stienstra Adviesbureau stedelijk verkeer BV, Vredenoord 133, 1852 WL Heiloo (Netherlands), tel.: +31 72 533 8293, e-mail: stieverk@wxs.nl

Streszczenie. *W projektach budowlanych jest przyjęte, że liczbę miejsc parkingowych ustala się na podstawie przyjętych standardów. Wykorzystywanie tych globalnych wzorców powoduje ignorowanie istniejącego zróżnicowania zachowań komunikacyjnych (i parkingowych). Ta różnorodność prowadzi do szerokich granic przyjętych wzorców i w konsekwencji standardów parkingowych. Takie różnice wynikają ze zróżnicowania grup użytkowników, warunków lokalnych jak dostępność, zagospodarowanie przestrzenne itp. W artykule opisano metodę obliczeniową, w której bierze się pod uwagę lokalne uwarunkowania. Zasadniczymi elementami w obliczeniach są: liczba przyjazdów, okres parkowania i dopuszczalny poziom zajętości parkingu.*

Słowa kluczowe: *zapotrzebowanie na miejsca do parkowania, poziom zajętości, zachowania klientów*

1. Introduction

In building-projects it is usual that the amount of parking spaces to be built is established by the use of parking standards. These standards are determined by local authorities, and usually are based upon national benchmark-data. By using these global benchmarks the wide variety that exists in travel (and parking) behaviour are ignored. This variety leads to wide margins in benchmark-data, and consequently in parking standards. These differences are caused by the specific target groups a certain kind of land-use aims at, local circumstances like accessibility, urban structure, etcetera.

Calculation of parking demand, based upon the specific characteristics of the future visitors of a development, for instance based upon the business-plan of the future users, is preferable. We developed a calculating method that takes into account these local specific circumstances. The estimation of parking demand is not based upon land-use data (as is the case when using parking standards), but is based upon data on actual (or expected) behaviour of visitors of the different functions in the project. Essential element in the calculations are the number of arrivals, the duration of visits and the acceptable occupancy rate of parking facilities. By adding the parking demand of the several types of land-use you get a clear understanding of the amount and the composition of parking demand.

This paper describes and explains this calculation method.

2. Parking benchmark data only give a rough estimation of the future parking demand

General practice in building plans is that the required parking capacity that has to be built is estimated by using parking norms. In the Netherlands these parking norms are laid down in municipal by-laws, and are often based upon the publication issued by CROW, called 'Kencijfers parkeren en verkeersgeneratie *(Benchmark data for parking and traffic-generation)*' [1].

Although CROW in its introduction of the publication clearly states that these benchmark-data only can serve as a resource to establish a rough estimation of the number of parking spaces needed at the planned land-use, the benchmark-data in practice get a much more absolute value, both in establishing the required parking norms as well as in appeal-procedures in court against planned building and development plans.

In doing that the big variety within the used categories of land-use is neglected, a variety that results in the (often considerable) margins that are indicated for parking benchmark-data. These margins are the result of the differences in visitors-behaviour of socio-economic functions, even when they belong to the same type of land-use. These differences have to do with the specific group of users the company / institute targets at, local circumstances like accessibility, urban structure, etcetera.

Parking benchmark-data are therefore not fit for assessing the parking demand of a specific land-use development. Ill-considered use of data leads to building too few parking spaces (and parking problems after realizing the project), or building an abundance of (unused) spaces. Both scenarios may imply considerable financial consequences.

When it is necessary to use benchmark-data to assess parking-demand (e.g. when the actual end-users of a land-use development project are not yet known), this data has to be used in a well-considered way:

- Parking benchmark-data are in the first place meant for new building projects; not for:
  - adapting/ enlarging existing buildings,
  - assessing the parking demand of city-centres, existing shopping centres, etcetera
  - multifunctional developments (e.g. a health-care centre);
- Multifunctional use of parking spaces goes beyond inter-exchangeability by (part of the) day;
- When using benchmark-data make a well-considered choice within the margins, based upon proper knowledge of the local situation
  - **not based upon opinions** ('*in our municipality we have a high car-ownership*', so maximum parking demand),
  - **but on facts** (*car-ownership is 97% of national average*, so average parking demand would be logical).

3. Average acceptable occupancy-rate

An important element in the calculation of parking demand is the definition of the critical moment for peak demand. It is not advisable to design parking capacity to be able to receive the demand for the busiest moment in the year. Parking demand will always vary a bit during the year, although the famous December--peak and holiday-dip are less extreme than usually thought (figure 1).

On the other hand, it is neither advisable to design a parking capacity with a structural built-in shortage (e.g. designing a parking capacity for a shopping--area that can accommodate the usual weekday parking demand, but not the (higher) demand on Saturdays), because that will create a parking- and accessibility problem frustrating the economic opportunities of the area.

In the method for calculating parking demand the parking demand is tailored to the peak demand in a normal week (usually in spring and autumn), in many Dutch city centres that will be the peak demand on Saturday. The *average acceptable occupancy-rate* will be put at a value that implies that on the busiest hour still a free capacity of ca 10% will be available.

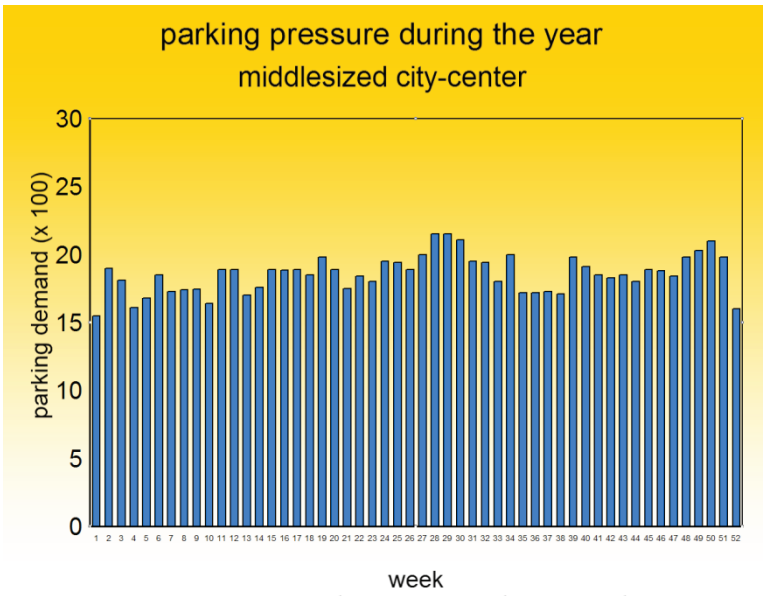

Fig. 1. Parking demand during the year in a middle-sized Dutch city-centre
Source: Goudappel-Coffeng

This criterion, which is generally accepted in the parking world, was defined by prof. P. Hakkesteegt of the Technical University of Delft [2]. The background for this is that when the occupancy-rate exceeds 85 - 90% it will become difficult for arriving car-drivers to find a free parking space, and search traffic will be generated, leading to congestion and irritation. The parking supply will be experienced as (too) crowded, and the image of accessibility of the area will be damaged. When occupancy-rates reach 95% or more an even stronger increase of search-traffic will occur [3].

Especially in areas with many changes in parking occupancy, such as shopping areas, an acceptable peak-demand of 90% is advisable, usually corresponding with an average occupancy-rate (during working hours) of 70 – 75%. That way there will be sufficient parking capacity available to cater for the normal fluctuations of parking demand during the year. During peak-periods (e.g. in December) people will experience the parking situation as (temporarily) crowded. In areas with fewer changes in parking occupancy (specific office or residential areas) the average acceptable occupancy-rate can be put higher.

4. Calculating method for parking demand

When it is possible to make a good estimation of the (characteristics of) future users of a development a calculation of the parking demand, based upon the user characteristics, is preferable.

The number of parking spaces needed for the development, the parking demand, can be calculated by using the formula:

$$P = \frac{A * D}{\mathrm{B} * \mathrm{T}} \tag{1}$$

where:

P - the number of parking spaces needed, the parking demand,

A - the number of car-arrivals during the survey-period (e.g. working day or Saturday),

D - the average parking-duration of parkers,

B - the average acceptable occupancy-rate,

T - the survey-period, the number of hours (minutes) of the survey-period.

Attention: D (average parking-duration) and T (survey-period) have to be expressed in the same units (either hours or minutes).

Explanation:

The occupancy of a parking facility is built up by individual parked cars; the development of the occupancy(-rate) is determined by the time of arrival and the parking duration of every car.

The parking duration of individual cars is given as d_i. The average parking duration then is:

$$D = \frac{\Sigma\, d_i}{\mathrm{A}} \tag{2}$$

The total number of **used parking-minutes** then is:

$$A * \frac{\Sigma\, d_i}{\mathrm{A}} = A * D \tag{3}$$

The total number of used car-minutes can also be calculated in another way:

The total number of (necessary) parking spaces is P.

The total number of supply of available parking-minutes (during the period of survey) adds up to

$$P * T \tag{4}$$

In general, the parking facility will not be fully (100%) occupied during the day (survey period), there will be fluctuations in time. To achieve an adequate supply of parking spaces at the peak-moment the average acceptable occupancy-rate (B) will be lower than the occupancy-rate at the peak-moment.

The relation between maximum and average acceptable occupancy-rate depends directly from the development of the occupancy-rate during the survey-period. When the occupancy rate is developing rather evenly during the day the difference between maximum occupancy-rate and average acceptable occupancy-rate will be small. When parking occupancy shows a very high peak in only a short period of time the difference will be very big.

In shopping areas (assuming a maximum 90% peak occupancy) the average acceptable occupancy rate will be around 70% throughout the day.

This way the number of really **used parking-minutes** will be calculated with:

$$P * T * B \tag{5}$$

The two calculations, thus, are equal:

$$A * D = P * T * B \tag{6}$$

or:

$$P = \frac{\mathrm{A} * \mathrm{D}}{\mathrm{B} * \mathrm{T}} \tag{7}$$

5. Application

Based upon these calculations of parking-demand for individual types of land--use a method for analysing the (future) parking demand of a developing area was developed. Essentially, this focuses on the parking demand for the different types of land-use in the area, not only at the peak-demand but also the demand during the day and the week. By adding together these individual demands you get an insight into size and composition of parking demand at different moments, which can be used for optimising the use of parking facilities and developing parking strategies.

The structure of this analysing method is given in figure 2.

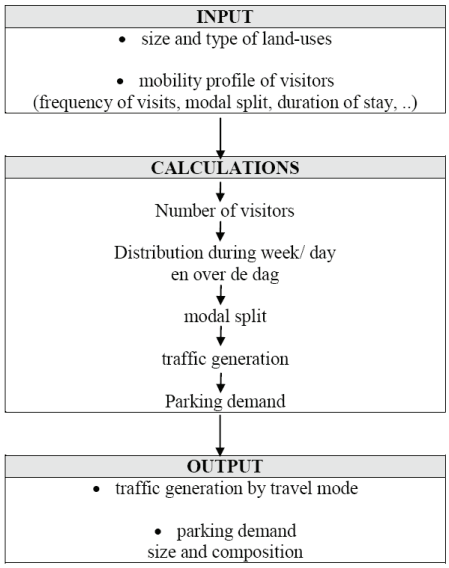

Fig. 2. Structure for analysing parking demand
Source: own

This makes it possible to understand the mechanisms behind parking, the influence of the local circumstances and the ways to optimise the use of parking facilities. The analyses show the possibilities of inter-exchangeability of parking between user-groups. It also shows the effects of reserving part of the parking capacity for one user-group (e.g. residential parking) on parking demand.

A visual impression of such an analysis is given in figure 3.

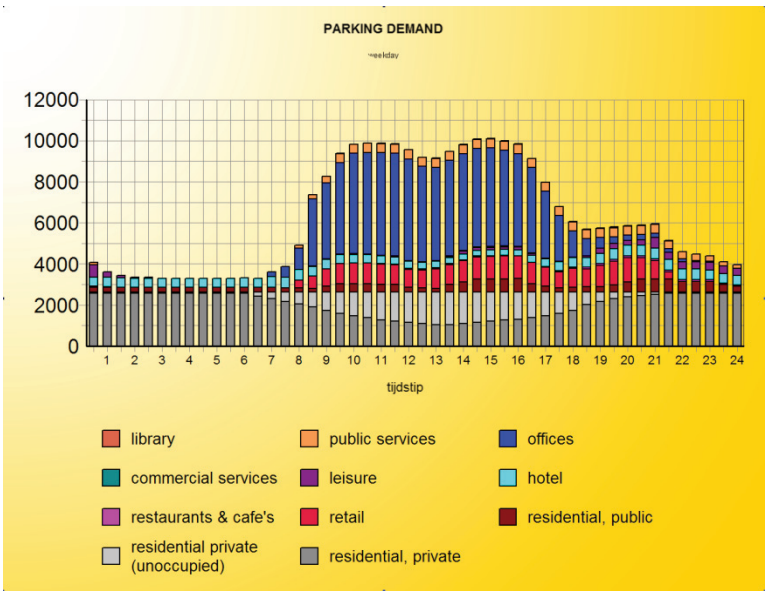

Fig. 3. Example of parking demand analysis
Source: own

Calculating (instead of guessing) parking demand, and applying these calculations in an analysis of parking demand based upon the specific, local, circumstances may lead to a more efficient, and widely supported parking policy.

References

[1] CROW, Kencijfers parkeren en verkeersgeneratie, CROW-publication 317, Ede, October 2012.
[2] Hakkesteegt, prof. ir. P., College notes hb 15, par. 13.4.3., Bezettingsgraad, toelaatbare bezettingsgraad; Technical University Delft, ca 1990.
[3] Martens, K. and I. Benenson, Evaluating urban parking policies with agent-based model of driving parkers behaviour, Transportation Research Record, journal of the Transportation Board, 2046: 37-44, 2008.