

THE LIGHTING OF RESIDENTIAL YARDS

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THE LIGHTING OF RESIDENTIAL YARDS (SUMMARY)

The "woonerf" (residential yard) is conceived in order to enhance the amenity (quality of life) in residential districts. It is put into effect by a series of legal measures, road construction and traffic management measures, planning measures and social measures. The quality requirements for the public lighting include apart of amenity, aspects of road and public safety. Suggestions for photometric requirements are given.

ÉCLAIRAGE PUBLIC POUR DES CLOS RESIDENTIAUX (SUMMAIRE)

Le "woonerf" (clos résidentiel) est conçu pour augmenter la qualité de la vie dans les régions urbaines. Il est effectué par des séries des mesures légales, des mesures de construction et d'aménagement du trafic, des mesures de planologie et des mesures sociales. Les exigences pour l'éclairage public n'entraînent pas seulement la qualité de la vie, mais aussi des aspects de la sécurité routière et civile. On a donné des suggestions pour les exigences photométriques.

DIE BELEUCHTUNG VON WOHNHÖFEN (ZUSAMMENFASSUNG)

Das "Woonerf" (Wohnhof) ist konzipiert worden um die Lebensqualität in Wohngebieten zu verbessern. Es wird verwirklicht mittels einer Reihe von gesetzlichen Massnahmen, auf dem Gebiet des Strassenbaus und der Verkehrstechnik, der Stadtplanung und durch soziale Massnahmen. Die Forderungen an die Beleuchtung betreffen neben der Lebensqualität, Gesichtspunkte der Verkehrssicherheit und der öffentlichen Sicherheit. Vorschläge für photometrische Forderungen werden gegeben.

1. INTRODUCTION: THE WOONERF

At present, the quality of life - the amenity - in many residential areas is low, and it is obvious that this results to a large extent from the proliferation of the private motor car. It should be realised, however, that present-day residential areas, particularly suburban areas, could not possibly exist without the private car. Trying to improve the amenity by banning the car is not always successful for residential areas. It may be noted in passing, that car-free zones are successfully and frequently used in other areas, like e.g. shopping areas and other pedestrian precincts.

A more modern approach is based on the realisation the the private motor car is an essential part of modern daily life, and that it should be integrated in, and not banned from living. The most consequent and complete elaboration to date of this idea is the "woonerf" concept (residential yard concept) which has been developed in recent years in The Netherlands. The basic idea is that the houses and the open space between the houses together should form "homes" for the residents to live in, not only to find shelter. The woonerf therefore is primarily aimed at improving the quality of life, the amenity.

The increase in amenity is realised by four independent sets of measures.

1. Legal measures

A complete new set of regulations has been introduced. The most striking regulations are:

- Authorities must comply to a number of standards before a street may become a woonerf.
- Vehicles may not proceed faster than at a walking pace.
- Parking is permitted only on designated places.
- The normal rules of priority are not valid in the woonerf.
- The paved area is available for all users: all drivers and pedestrians - and children! There is no distinction between the carriage-way and the sidewalk.

2. Road construction and traffic management measures

- The actual driving path is narrow (some 2 to 3 m).
- At a spacing of maximum 50 m physical and visual obstructions must be erected, which force drivers to obey the speed limit.

3. Planning measures

- The woonerf concept should not be restricted to individual streets. Establishments that attract much traffic should be left outside the woonerf (hospitals, shopping centres, etc.).
- The woonerf should clearly look like a woonerf; it must be clearly indicated as such.

4. Social measures

- Citizen participation is considered to be an integral and essential part of the decision processes regarding the woonerf.

Although most elements of the woonerf concept are well-known and applied in many countries with positive results, it is the combination, the total concept, which makes the woonerf an outstanding new development.

Further details are given in ANWB (1976), De Jaeger (1977), Schreuder (1977), Van den Bogaerde (1977).

The woonerf is a new concept; the first application is only four years ago. However, it is quite popular; at the moment it is applied in many hundreds of places. The problems are hardly those of costs but more the drastic change in mentality which is required and the citizen participation. Furthermore the lack of experience resulted in some design errors. However, the woonerf is clearly a success and it receives considerable interest from other countries, both in and outside Europe.

Before the lighting of the woonerf can be discussed, a few remarks about the idea of "amenity" will be made.

The amenity of urban regions is a complex concept. At least four different aspects seem to play an important role:

- the way the objective stress is restricted (noise, air pollution, visual intrusion, and other factors intruding the personal privacy);

- the way the subjective stress is restricted (expectation regarding road safety, particularly for children, and expectation regarding public safety - mugging and assault);
- the way the social contacts can be established (primarily, but not only the possibilities to play);
- the way the mobility is ensured (more in particular how the relation with the world outside can be maintained; this includes driving, parking easily and requires road safety).

2. LIGHTING REQUIREMENTS IN THE WOONERF

Regarding the lighting, the woonerf differs markedly from other streets and roads. Firstly, the amenity is the major aspect of the woonerf concept: this has repercussions on the lighting. Secondly, the physical and visual obstacles that are required in the woonerf, necessitate a careful planning of the lighting. And thirdly, the fact that pedestrians and playing children may use the whole paved area will result in more "conflicts" between pedestrians and motorists. Public lighting plays an important role in avoiding that the "conflicts" are so serious as to result in collisions or accidents. On the other hand, the very low driving speed (walking pace is to mean in practice 10 km/h or less) reduce the difficulties in some ways (Schreuder, 1979).

In order to be more specific, it should be realised that the lighting should favour those out-doors, and should not disturb those in-doors. The lighting requirements should therefore be based on the following considerations:

- Essential for social contacts and for most games is that not only the other can be recognised, but also that the facial expression can be recognised. This requires a fairly high adaptation luminance level and a high, but widely varying illuminance on different planes to ensure adequate modelling. Furthermore, colour rendition should be good, and the colour of the light itself should be pleasant.
- An important factor in the amenity is the subjective appraisal of possible dangers - particularly for the members (the children) of the family. This subjective appraisal is evidently difficult to assess, but one may expect that the belief that all sources of danger are quite clearly visible is important, and that this will correlate with the actual, objective visibility.
- Those who drive or ride in the woonerf are obliged to do this slowly, not only by the legal speed limit, but also by the obstacles that are placed precisely for this purpose. Obviously these obstacles must be clearly visible. This is more pressing because these obstacles are placed in such a way as to make

purposely the driving more difficult and therefore forcing the drivers to reduce speed. These obstacles, however, are not meant to be traps! This requires again very good visibility of all sorts of objects, and therefore a high adaptation luminance level, high but variable vertical illuminance and good colour rendition.

- The subjective stress is depended upon the (real or alleged) effectiveness of the police surveillance. And here again similar requirements could be mentioned.

- Variations in the paving of the road are important in the woon-erf. Not only from aesthetical point of view, but also because the driving path, the parking places and many of the obstacles in the road are marked by means of differences in paving. This leads to requirements regarding the reflection properties of the surfaces both in dry and in wet conditions, and on the distribution and the colour of the lighting. This implies requirements regarding the positioning of the lanterns.

- Finally, those in the houses require to be undisturbed, e.g. by light from the street lanterns shining directly into their houses. This requirement has repercussions for the selection of the lantern type, the mounting height and the installation geometry.

3. RECOMMENDATIONS FOR THE LIGHTING OF THE WOONERF

3.1. Introduction

The following recommendations are based to a certain extent on earlier considerations (Schreuder, 1978). Further, use has been made of the results of an investigation regarding the required lighting for residential streets which were not a woonerf (Tan, 1978a, 1978b; Schreuder, 1979). And finally, the recommendations are based to a large extent on the results of an enquiry that has been circulated under some 800 people who live in a woonerf in a number of Dutch cities. This enquiry was organised by the Ministry of Roads and Waterways in The Netherlands and the Netherlands Institution for Illuminating Engineering. The results are summarised here; they will be published in detail in the near future (Schreuder & Tan, 1981).

It should be stressed that the recommendations given here are not yet accepted by the official bodies; they are purely tentative.

3.2. The enquiry

The enquiry covered 13 types of woonerf in six Dutch towns, and includes 44 streets and some 2500 homes.

From these, 750 homes were randomly selected where forms were delivered. The forms were of two types. Type I (500 copies) consisted of one question: Do you consider the lighting of the woonerf you live in as

- excessive
- good
- mediocre
- bad

Type II (250 copies) included furthermore questions regarding the

- visibility of the course of the road
- amenity
- colour of the lamps

- security
- light shining into the room, the bedroom
- shape and position of the lanterns.

Finally, there was a "general remarks" column, which was used extensively. The answers to the general question are listed in Table 1, details will be published elsewhere.

Furthermore, another 100 homes in residential streets adjacent to a woonerf were selected. Here, the "residential street" questionnaire after Tan (1978b) has been used; it contained the same question as the Type I form. The results are added to Table 1 together with the overall data of Tan (1978b).

For all 44 streets included in the enquiry, the relevant photometric and geometric data are collected. It turned out that all lighting installations were quite similar, so that only marginal differences did occur. Thus, the average illuminance ranged only from 1.5 lux to 3.5 lux. Based on the preliminary analysis, only two aspects will be mentioned here. The lighting level (crudely indicated as "high" and "low", corresponding broadly with > 2.5 lux and < 2.5 lux) and the type of light source (e.g. fluorescent tubes and high-pressure fluorescent mercury) turned out to have some influence. More in particular, in both cases the difference in the appraisal "good" was noticeable but not statistically significant; the difference in the appraisal "mediocre" was considerable and significant. This is included in Table 1. The results indicate that a high level is preferred (but not very strongly) over a low level and mercury lamps over fluorescent tubes. High and low pressure sodium lamps, and incandescent lamps are not applied at all in a woonerf.

3.3. The lighting level

It is difficult to give a strict recommendation. The value of 5 lux given earlier (Schreuder, 1978) can be justified on the basis of visibility in the road and on the experience in residential

streets (CIE, 1977a; NSVV, 1977; Hendriks, 1978; Schreuder, 1979). The subjective appraisals of inhabitants, police and lighting experts in residential streets, however, suggest a considerable lower value of some 2-3 lux. See Figure 1. (Tan, 1978b). This is confirmed by the results of the woonerf enquiry. Similar values are found in investigations regarding the public lighting on cycle tracks (Padmos, 1979). An average road surface luminance of 0.2 cd/m^2 (3 to 5 lux) corresponded to an appraisal between "acceptable" and "good". And so did a minimum luminance of 0.14 cd/m^2 .

3.4. The distribution of the light

The minimum illuminance on the main paved area should be not much lower than 0.5 to 1 lux for pedestrians to be able to see where they walk, without tripping over loose tiles etc. These values are deduced from recommendations for emergency lighting. NNI (1971) and CIE (1977b) require 1 lux.

Clark & Clark (1978), however, suggest a much higher value - 10 lux, and Simmons (1975) suggests a much lower value - some 0.2 lux. See also BSI (1975). Padmos (1979) suggests a slightly higher value; see section 3.3.

The illuminance on a vertical plane at important locations within the woonerf should be about 20 lux. This is sufficient to be able to recognise facial expressions; a requirement that is important for the social aspects of life, like meeting people or playing. The value of 20 lux is based on the investigations of Fischer (1972, 1973). The liveliness of the surroundings is favoured by a certain variation of the lighting in different spots. A value of 20:1 for the horizontal illuminance seems reasonable. A more uniform lighting might be dull; a greater non-uniformity might be unfavourable for visibility. It should be noted that this non-uniformity is greater than what is normally recommended both for interior lighting and for general road lighting. All the (physical and visual) obstacles, which are placed in the street in order to reduce the speed of driving, should be made very clearly visible, particularly at night under adverse weather

conditions. In order to ensure this, the positioning of the luminaires must be considered very carefully.

3.5. The colour of the light

Because the major requirement of the lighting in the woonerf relates to amenity, the colour of the light should be pleasant and the colour rendition should be quite good. It is suggested that the colour temperature be lower than some 3800 K or the colour rendition factor Ra over 60, and preferably both combined. This implies that most types of fluorescent tubes can be used, and to a certain extent also high-pressure fluorescent mercury and high-pressure sodium lamps - and, of course, incandescent lamps. In this respect, the slight preference for high-pressure fluorescent mercury lamps is not taken into account. Low-pressure sodium, though considered as acceptable in some residential areas, do not seem to be adviseable for the woonerf. Which type lamp is to be preferred is to a large extent dependent on other considerations - notably costs, but also glare and the preferred mounting height.

3.6. Glare

Glare should be restricted, and it should be avoided that too much light shines directly into the houses. This put severe restrictions to the type of luminaire and to the mounting height. Quantitative data, however, are difficult to give.

Schreuder (1977) suggested a rather strict restriction in the disability glare to $TI < 0.20$ and a rather mild restriction of the discomfort glare $3 < G < 5$ (TI and G are explained in detail in CIE, 1977a). These indications are only of very limited value, as TI and particularly G cannot always be applied to the lighting installation for the woonerf.

3.7. The road surface

In a woonerf, just as in any street, the road surface is an important factor to consider. More specifically, the surface should have a high, diffuse reflection in dry, damp and wet conditions, and it should enable certain variations in aspects. Bricks or paving stones are most suitable, although asphalt concrete can be acceptable as well.

Requirements regarding the skidding resistance of the road surface in the woonerf are difficult to give at present.

4. EXAMPLES

Two examples will be described here: one woonerf which is a converted residential street, and one that is built directly as a woonerf.

Example 1

A fairly wide urban street with 200 houses of 3 storeys, built around 1920. No front gardens, width of open area 10-15 m. A variety of objects is placed in the street (flower beds, humps, bicycle racks, trees etc.).

Lighting is from diffuse mast top fittings on 3.5 m high columns with circular 40 W fluorescent tubes, spaced at about 20 to 25 m, but arranged according the driving path and the obstacles.

Average illuminance is difficult to define; E_{\max} under the lamps about 30 lux.

Table 2 gives the results of the enquiry for this street and of an adjoining street from the control group.

Example 2

The woonerf of example 2 is part of a new suburb, consisting of fairly small family houses with garden and car ports. The houses are arranged in clusters or courts. Parking and playing facilities are located in the centre of each court.

The lighting is from clear, reflector type mast top fittings on 4 m high columns with circular 40 W fluorescent tubes, arranged according the driving path and the obstacles. The illuminance ranges from 30 lux under the lantern to about 1.3 lux.

The results of the enquiry are included in Table 2.

	excessive	good	mediocre	bad	N	excessive	good	mediocre	bad	∑ (%)
<u>Woonerf</u>										
All results (44 streets)	4	254	40	7	305	1,3%	83,3%	13,1%	2,3%	100%
Control group (8 streets)	1	30	4	1	36	2,8%	83,3%	11,1%	2,8%	100%
Matched subgroup (14 streets)	1	63	15	2	81	1,2%	77,8%	18,5%	2,5%	100%
High level (> 2.5 lux, 26 streets)	4	158	20	1	183	2,2%	86,4%	10,9%	0,5%	100%
Low level (< 2.5 lux, 18 streets)	0	96	20	6	122	0 %	78,7%	16,4%	4,9%	100%
<u>Residential streets</u>										
1.5 lux						2%	77%	15%	6%	100%
2.5 lux						1%	80%	15%	4%	100%
5 lux						3%	85%	11%	2%	100%
		good	average	bad	N					
<u>Appraisal of colour</u>										
Fluorescent tubes		29	10	4	43					
High pressure mercury		37	2	1	30					

Table 1.

		Example I	Control I	Example II
Number of houses		83	71	280
Number of questionnaire	I	30	25	50
	II	20		35
Number returned	I	12	12	31
	II	7		13
Appraisal questionnaire	I			
	excessive	0	0	1
	good	13	9	41
	mediocre	4	2	2
	bad	2	1	0
Appraisals questionnaire	II			
Course of the road	good	2		5
	average	3		7
	bad	1		1
Vis.obstacles	good	2		8
	average	2		5
	bad	2		0
Amenity	good	3		10
	average	3		3
	bad	1		0
Colour lamps	good	4		11
	average	3		2
	bad	0		0
Security	good	3		6
	average	1		6
	bad	3		1
Light in rooms	good	4		12
	average	2		1
	bad	0		0
Shape, position	good	7		13
	average	0		0
	bad	0		0

Table 2

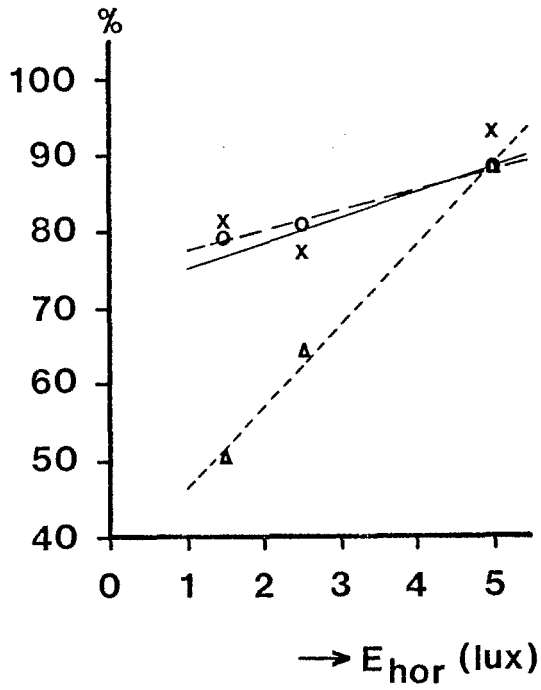


Figure 1. Illuminance versus appraisal (excessive + good) in residential streets

x police; o inhabitants; Δ lighting experts.

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