EVALUATION OF MAINTENANCE CRITERIA BY ROAD-USERS

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SUMMARY

The ANWB Traffic Department, whose function includes promoting the interests of dutch road-users, often has to deal with complaints on the state of maintenance of road paving.
During discussions with responsible road maintenance authorities about specific complaints, it often appears that the road maintenance authority and the road-users perceive the problem differently. The road maintenance authority often refers to the standards for the state of paved surfaces drawn up under the supervision of the C.R.O.W[1]), laid down in the publications on Pavement Management
It was decided to carry out an indicative survey in order to find out whether these quality standards are in line with the perception of road-users.
The core of the survey was the assessment of a 63 road sections by both test drivers (road-users) and road inspectors. The latter group assessed the various sections according to the C.R.O.W-method of visual inspection.
It appeared that in dry weather, the opinion of the road-users on the state of both the asphalt and the block pavements is determined by the damage type "surface irregularities". As far as the paved cycling paths are concerned the opinion of the moped riders/cyclists is determined by a combination of all damage types. In additions to these, the growth of grass and weeds on the surface and loose flags have a strong influence on the rating given by moped riders/cyclists. These damage types are not registered with the current inspection method.
Furthermore the standard for "surface irregularities" used by C.R.O. W makes that action is undertaken only when 40-50% of the road users is dissatisfied. The ANWB finds this unacceptabel and has brought the results under the attention of the C.R.O.W with the request to ensure better alignment between the quality standards and the wishes of the customers.

1. INTRODUCTION

The ANWB Traffic Department, whose function includes promoting the interests of road-users, often has to deal with complaints on the state of maintenance of road paving.
During discussions with responsible road maintenance authorities about specific complaints, it often appears that the road maintenance authority and the road-users perceive the problem differently. The road maintenance authority frequently does not accept the complaint and often refers to the standards for the state of paved surfaces drawn up under the supervision of the C.R.O.W, laid down in the publications on Pavement Management (1,2, and 3).
The question arose as to whether this was a chance set of differences of opinion between road-users and the road maintenance authority, or whether it was a structural problem. It is a fact, however, that for the road maintenance authority as "producer" of the infrastructure, it is essential that the "customers", in this instance the road-users, are satisfied with the product supplied. The fact that the producer-customer relationship is somewhat obscure, because payment of the goods supplied does not take place directly

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between the road-users and the road maintenance authority, is no reason to ignore the wishes of the customers. The fact that, as far as the market aspect is concerned, the road maintenance authority has a monopoly position, because in most cases a competitive product (read: another road or route) is not available, also plays a part here.

2. SURVEY

It was decided to carry out an indicative survey in order to find out whether the quality standards, as they are used In the pavement management system, are in line with the perception of road-users. The sole purpose of the survey was to determine whether there is a difference in rating (if so, to which degree) between both parties. It is not the intention to define proposals for changes in the pavement management system. Such changes would require supplementary research and could only be carried out in close consultation with the parties concerned.
The core of the survey is the assessment of a number of test sections by both test drivers (road-users) and road inspectors. The latter group assessed the various sections according to the C.R.O.W.-method of visual inspection. The survey comprised four phases:

1. The selection of the test sections and planning of two routes over these road sections;
2. the organization of an users survey with as its main element assessment of the selected road sections by test drivers;
3. a general and detailed visual inspection of the test sections according to the damage classification of the C.R.O.W (3);
4. a comparison of the results of phases 2 and 3 (analysis of results).

Phase 1 was carried out in March and April of 1990, phase 2 in the period of March through June, phase 3 in June and phase 4 in August. The phases in question will be discussed in more detail in the following chapters.

3. TEST SECTIONS AND ROUTES

The selection of road sections and the planning of the routes was carried out by Grontmij in consultation with employees of the Provincial authority of Noord-Brabant and the municipalities of Oss and Mill. Use was made of the conclusions and recommendations of earlier surveys based on group assessments of pavements (4) (5). In those instances where in (4) and (5) the relationship between the group assessment and a roughness measurement was investigated, our survey was carried out by means of visual inspection. The reason for this is that because of the comparatively high costs of roughness measurement, these measurements are rarely used for the evaluation of the state of maintenance of pavements (the Dutch State Highway Authority is an exception here). The outcome of the visual inspections according to (3), on the other hand, are often the basis for the planning of necesssary maintenance.

The aim of this indicative survey was to assess a range of road classes and pavement types which was as comprehensive as possible. The underlying principle for the selection of the number and the type of the test sections was the classification of roads (A through D), which is used by the GR.O.W. Also for practical (the length of the route) and organizational reasons (the number of road maintenance authorities to be approached for the test), some 60 sections were selected. The distribution of the test sections over the road classes and pavement types is shown in Table 1. Although the survey of the different assessment criteria, valid specifically for block pavement, was not an explicit goal of the survey, this article will pay special attention to this type of pavement.

Class	Road classes	Pavement types	Number of sections
A	residential street	concrete paving blocks or clay bricks	16
B	rural road	asphalt	14
C	urban access road, secondary or tertiary roads	asphalt asphalt	3 12
D	cycling tracks, residential streets used as cycling paths	concrete flags concrete paving blocks or clay bricks	8 9

Table 1: A survey of the test sections in the pavement

4. USERS SURVEY

Phase 2, the organization of the users survey, was carried out by the Traffic Department of the ANWB. Phase 2 started with a call for test drivers in the "Kampioen", the official ANWB publication. Seventy teams were selected from the large number of applications. These may be deemed representative of "Dutch road users". This means a varied group from all parts of the country, distributed according to age, driving experience and type of vehicle. The test drivers covered the car/motor-cycle route in their own vehicles. For this route the opinion of the driver was relevant, the passenger acted as map-reader and noted the findings. The same teams were also used on the moped/cycle route. For this route the opinion of all participants was asked.

The instruction given to all participants was; "Drive at your usual speed (adapted to the traffic) and give the road section in question a mark (on a one (very bad) to ten (very good) scale). If a bad mark (less than six) is given, justify this in your own words". The survey ultimately led to 63 assessments per "car/motor-cycle section" and 123 assessments per moped/cycle section. It should be noted here that the tests were carried out in dry weather.

5. INSPECTION

The purpose of the survey is verification of the standards for the maintenance of roads set by the C.R.O.W system. It is obvious that for the determination of the state of maintenance of the selected road sections the inspection methods of the C.R.O.W have to be used. Only then comparison is possible with the standards.

Part C (3) of the damage classification contains a definition of the types of damage which may occur on asphalt and block pavement. These types of damage may be grouped in the damage classes, texture, evenness, integrity, marginal strip and miscellaneous. A survey of the specific damage classes and types for block pavement is given in table 2.

Damage class	Damage type
texture	reduced skid resistance
evenness	transverse evenness surface irregularities longitudinal unevenness
integrity	deformed joints damage to paving blocks holes
marginal strip	damage to road edge damage to kerb
miscellaneous	ineffective surface drain damage to shoulder damage to parking strip/ bus stop

Table 2: Damage classes and types for block pavement

An inspector indicates per road section and per damage type the degree of damage (in categories light (L), medium (M) and serious (S) damage) and the extent of the damage. The definitions of the degree and extent are laid down in the damage classification (3). The appendix includes the definitions of the most important damage types for the block pavements.
In this way a univocal method for registering the state of maintenance of road pavements is available.

The C.R.O.W system defines two methods for visual inspections:
* general: with this form of inspection the general extent of the normative degree of each particular damage is registered; within the pavement management system this inspection is intended for the selection of road sections which will shortly be eligible for maintenance; a general inspection results in a damage classification of each type of damage according to table 3 for each section.

Damage classification	Definition of the damage
0	No damage
L1	Light damage on a small scale
L2	Light damage on some scale
L3	Light damage on a large scale
M1	Medium damage on a small scale
M2	Medium damage on some scale
M3	Medium damage on a large scale
S1	Serious damage on a small scale
S2	Serious damage on some scale
S3	Serious damage on a large scale

Table 3: Damage classifications for general visual inspection

The general inspection is carried out from a moving car at a speed of approximately 15 km/hour.

* detailed: within the C.R.O.W method this inspection is intended for more accurate registration of the damage to those road sections that have been selected for maintenance in the short term. The detailed inspection leads for each section to the exact amount of light, medium and serious damage per damage type. The detailed inspection is carried out on foot.

Before it is possible to compare the test results and inspections it should be indicated that in general (this depends among other things on the type of damage) the classification M3, S1, S2 and S3 are considered as exceeding the standard (immediate maintenance is desirable). In the case of M2 the road maintenance authority is warned that maintenance will be necessary in the near future (in approximately 2 years). The primary decision was for the general visual inspection. This was based on the the following reasons:

the road users also give a general assessment;

both the road users and the inspectors carry out the assessment from a car, which will result in the inspectors being unwittingly influenced by the car's movements as well;

the speed of the detailed inspection is very low (walking speed) and is very different from the assessment time of the test drivers (20 sec.); with the general inspection this difference is less marked.

As a way of checking the road sections were inspected in detail as well.

In order to make the influence of the weather (temperature and humidity) on the comparison between the results of the inspection and the user's assessment as small as possible, the inspection was carried out in the first two weeks of June (the test days were 5 and 11 June).

The road sections were inspected in detail by a team of two inspectors, the general inspections were carried out by a second team. Both teams have a wide experience with visual inspections according to the system of the C.R.O.W.

6. COMPARISON OF THE RESULTS

In this fourth phase the opinion of the road users was compared with that of the inspectors (read: road maintenance authority). The opinion of the road maintenance authority was laid down by means of a classification varying from 0 (no damage) to S3 (serious damage on a large scale) per damage type. The opinion of the road users was laid down by means of the mark per section and the reasons for any bad marks. In order to make it possible to compare the results with each other as to indication, both sets of results have been converted to a workable form. For this purpose the assessment of the test drivers were converted to an average number of "bad marks" per test section (with the aid of the assessment figures) per damage type (with the aid of the reasons for the bad marks). The inspection results have been converted according to a classification per damage type as in table 3.

6.1 Normative damage

On the basis of the percentages of bad marks and the damage classifications per section, it was first determined which damage type had the strongest influence on the opinion of the road users. This was done in order to find out which damage is decisive for the road user.

The most important conclusion from this first part of the analysis is that in dry weather the state of both the asphalt and the block pavements of all the inspected road types, with the exception of paved cycle paths, is solely determined by the surface irregularity. With block pavements the traverse unevenness of the road and problems with the joint width and marginal strip turned out to be hardly decisive for the road users. No significant difference was noted between the assessment by motorists and motor-cyclists.

Hie opinion of moped riders/cyclists on paved cycle paths turned out to be dependant on combinations of damage types. In addition to this it was found that two damage types are of vital importance for moped riders/cyclists, being the growth of grass and weeds on the pavement and loose (rattling) flags. These damage types are not described in the damage classification list of the C.R.O.W and consequently, were

not registered with the current method.
The analysis was then concentrated on the extent of the damage type "surface irregularities" and the assessment of test drivers for the road classes A, B and C. A further analysis of the relationship damage-assessment for the cycle paths with block pavement turned out to be not meaningful because of the small number of sections and the complexity of the damage-assessment relationship.

6.2 Influence of the vehicle

Secondly, the influence of the type of vehicle on the assessment of the surface irregularities on a section was looked into. For this purpose nine sections on residential streets with block pavement were assessed by cyclists, moped riders, motor riders and motorists. The fact is that for these residential streets there is but one maintenance standard per damage type, although they are used by several different road users. Generally speaking, a residential street will be maintained for motorists, while a substantial number of road users cycle on this type of road. It was found that there was no difference between the assessments by motorists and cyclists, motorists were sooner inclined to give a bad mark, and moped riders gave less bad marks. However, caution is called for when drawing conclusions on the "normative vehicle", because the average assessment ratings per section, given by motorists and cyclists, are more reliable than those of moped riders and motor riders, because of the larger number of assessments.

6.3 Maintenance standards

Finally, the relationship damage-percentage was looked into for the damage type "surface irregularities". To this end all the results of the three road classes (A, B and C) and the types of vehicles (cars and motor cycles) were averaged. The analysis focussed on the question as to at which percentage of "dissatisfied customers" the road maintenance authority currently undertakes action when using the C.R.O.W.-method and -standards, or which percentage of the road users gave a bad mark in case of the damage classifications M3, S1, S2 and S3. The outcome of the comparison is shown in table 4. This table shows the results of asphalt and block pavement combined. Because of the small number of sections (or the complete lack of them) with certain classifications, this table does not specify for block pavement. Light damage mainly occurred on asphalt pavements, medium and serious damage on block pavements.

Damage classification	Percentage of bad marks
0	1
L1	7
L2	22
L3	40
M1	22
M2	30
M3	-
S1	58
S2	69
S3	-

- = no sections with this classification

Table 4: Comparison of the damage classifications for "surface irregularities" and the assessment of the road users

The dotted line in the table indicates which classifications are currently considered as exceeding the standard (M3, S1, S2 and S3).
Table 4 shows that the road maintenance authority only undertakes action (maintenance) at the time when 40% to 50% of the road users is dissatisfied. Another striking aspect is that more road users give a bad mark to light damage on a large scale (L3, 40%) than to the medium damage on some scale (M2, 30%).

A conclusion on the correctness of the current standard entirely depends on the percentage of dissatisfied customers one wants to accept. If, for example, it was considered acceptable that 20% of the people are dissatisfied, damage with the classification L2 would already be unacceptable.
It is also possible to view the problem from another angle, by means of the average rating per damage classification. Table 5 showes these average ratings per damage classification. Here the damage classifications have been grouped according to decreasing ratings.

Damage classification	Percentage of bad marks	Average rating
O	1	7.1
L1	7	6.3
M1	22	6.2
L2	22	6.0
M2	30	6.9
L3	40	5.7
M3	-	-
S1	58	5.3
S2	69	5.1
S3	-	-

- = no sections with this classification

Table 5: Average ratings given by test drivers

What strikes one first is that the variation in the average assessment figures (ratings) is slight One would expect that the classification "no damage" (0) would receive a much higher and the classification S2 a much lower rating. In addition to this it appears that serious damage is considered unsatisfactory (mark of around 5). M1 and L1 receive an average rating higher than 6, in other words "satisfactory". L2 and M2 score a round 6 (just satisfactory), while L3 scores lower than 6 (unsatisfactory).

7. CONCLUSIONS

It appears that in dry weather, the opinion of the road users on the state of both the asphalt and the block pavements of the road classes A, B and C, is determined by the damage type "surface irregularities". As far as the paved cycling paths are concerned the opinion of the moped riders/cyclists is determined by a combination of the damage types surface irregularities, tranverse unevenness, road edges/kerbs. In addition to these, the growth of grass and weeds on the surface and loose flags have a strong influence on the rating given by moped riders/cyclists. These damage types are not registered with the current inspection method. Without drawing definite conclusions or different standards from the results of the survey, the results are

sufficient indication that the perception of the state of road pavements by road maintenance authorities is different from the perception by road users. The standard for surface irregularities used by C.R.O.W. makes that action is undertaken only when 40-50% of the road users is dissatisfied. With a regular market mechanism this would be unacceptable, with a monopoly position this should certainly be food for thought

8. RECOMMENDATIONS

The results of this pilot study justify the carrying out of a larger scale survey, which would need to include more differentiation in the road sections to be assessed. Also in less favourable weather (rain) the opinion of the road users will need to be the underlying principle for the qualify of the product supplied. It is for this reason that the ANWB has brought the results of this preliminary survey to the attention of the C.R.O.W. with the request to ensure a better alignment between the quality standards and the wishes of the customers.

The crucial point in the discussion will undoubtedbly be the percentage of satisfied customers which is considered desirable. Ideal (but also unrealistic) this percentage should be set at 100. The use and therefore the quality of our infrastructure is of great social significance, a point which is also recognized in section d of the Traffic and Transport Structural Plan in which the Dutch government formulates its policy objectives. For another quality aspect of the infrastructure, namely congestion, this plan mentions a (quality) standard of 2 - 5% "dissatisfied customers". This implies 95%-98% satisfied customers. It is our opinion that this percentage is a good starting point, also within the framework of road maintenance.

9. REFERENCES

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APPENDIX

Definition of the degree of the damage to block pavements

Damage definition	Description: Light damage	Description: Medium damage	Description: Serious damage
Transverse Unevenness	the distance measured between a row of 1.20 m and the road surface (cross-wise) lies between 5 and 15 mm.	the distance measured lies between 15 and 30 mm.	the distance measured exceeds 30 mm.
Surface irregularities	the local vertical deformation of the pavement lies be-tween 5 and 15 mm.	the deformation lies between 15 and 30 mm.	the deformation exceeds 30 mm.
Deformed joints	the distance between pavement blocks lies between 10 and 15 mm (for clay bricks) or between 5 and 10 mm (for concrete blocks or flags).	the joint width lies between 15 and 20 mm or between 10 and 20 mm respectively.	the joint width exceeds 20 mm.
Damage to road edge/ kerb	the support of the kerb to the pavement is somewhat reduced.	the support of the kerb to the pavement is clearly reduced, but still adequate.	the support of the kerb to the pavement is is inadequate or the kerb has at places collapsed.