

Road maintenance

The maintenance quality of the traffic areas used by cyclists is an important factor in people's desire to cycle. Poor pavement may distract one's attention from other cyclists and in some cases cause serious accidents. Furthermore, poor road maintenance can help to preserve the image of cycling as a low status mode of transport.

It is therefore a good idea to improve the quality. A practical way to start the process is to carry out an annual inspection by bicycle.



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PHOTO: Lars Bahl

Trærødder under ujævn asfalt.

tion of Danes cycle in many situations, strong political pressure arises for these problems to be solved. At the same time it is often cheaper to improve the quality of paths and tracks than of carriageways. It might therefore be a good idea to choose a higher maintenance quality on paths and tracks than on carriageways.

It is very important for cyclists that there should be no holes or unpleasant unevenness on cycle tracks and other traffic areas on which they ride. The more uneven the pavement, the more uncomfortable it is to cycle, and the more one's baggage is liable to fall off the bicycle. Furthermore, it requires more energy to cycle on an uneven surface⁷³. Finally, permanent damage can be done to the bicycle, especially to spokes, tyres and rims.

Uneven pavements reduce cyclist safety, as there is a risk of falling off, which often leads to injuries. If the cyclist wobbles, he risks running into the kerb, pedestrians or other cyclists. In certain cases the cyclist may come out in front of a car, which can result in a serious accident.

Prioritisation of road maintenance resources

The prioritisation of road maintenance resources is determined by various technical and political considerations. In order to define principles for a prioritisation of these considerations it is necessary to give careful thought to how they should be weighted.

Cyclists are sensitive to the quality of maintenance. As a large propor-

Unevenness is mainly caused by poor resurfacing after roadworks, from patches of asphalt, ramps, manhole covers and tree roots. One's own and external contractors should therefore be clearly instructed as to the necessity of carrying out asphalt repairs correctly without significant edges or deviations from the level of the existing asphalt. One possibility is to move cables etc, from beneath the areas used by cyclists to the ground beneath the footways.

Repairs of cycle tracks should be carried out with a hot-mixed asphalt of soft and small stones (< 16 mm) in a layer of less than 3 cm. Finish with this asphalt when asphalt of gravel and hard bitumen is used as base. The hot-mixed asphalt must not contain flint – use granite instead.

When possible, the asphalt should be poured from machines, among other things for lengthwise surface repairs and for larger areas. Transverse repairs usually have to be carried out manually. The methods of repair are described in the Road Directorate's "Konstruktion og vedligehold af veje og stier – Hæfte 4 – Vedligehold af færdselsarealet" [Construction and Maintenance of Roads and Paths – Booklet 4 – Maintenance of Traffic Areas].

When the damage has been caused by tree roots, repairs will as a rule have only a temporary effect as the continued growth of the tree will lift the asphalt and kerbstones once more. Sometimes it proves necessary to remove some roots by cutting them off and digging them up from under the traffic area. As this is a serious intervention for the tree, it should be done only with specialist guidance.

A smile despite unevenness.



PHOTO: Road Directorate

More serious problems occur where the tree has been planted in too narrow a verge with poor growth conditions for the roots. Depending on the age and type of the tree, felling and replanting may be considered as a solution. Problems can be preempted by good growth conditions – typically 30 cm of humus on top of 80 cm of well drained, non-compressed raw soil on top of loosened earth. As the spread of the roots normally corresponds to the extent of the tree crown, the bed should be as large as possible. An alternative solution is to cut the crown regularly, thus limiting the spread of the roots.

The decision to phase out the use of pesticides in public spaces in Denmark has rendered the maintenance of roads and paths more expensive. Unless more resources are allocated, this will make things more uncomfortable for cyclists. Sometimes maintenance using heavy vehicles produces cracks along the thin surfaces of the paths, in which weeds can grow. Once weeds take hold, the surface breaks up faster. The ban on pesticides therefore requires stronger surfaces, the use of light vehicles for maintenance and inspection of cycle tracks.

Road capital versus level of service for cyclists

Over the years, large sums have been invested in roads, and the major part of this investment is concealed beneath the wearing courses of carriageways and cycle tracks. This investment can only be preserved through on-going maintenance or resurfacing of the protective wearing courses as they are gradually but inevitably worn down.

There is as a rule close correspondence between annual expenditure on resurfacing and annual expenditure on repairs. The lower the



PHOTO: Lars Bahl

Resurfaced cycle track.

expenditure on resurfacing, the higher the expenditure on repairs and vice-versa.

The optimal economic policy for road maintenance is to ensure that the total sum of expenditure on resurfacing and repairs is as low as possible. The secret is to resurface at the precise moment when this will in the long term be cheaper than continuing to carry out repairs.

Road with many patches (repairs).



PHOTO: Linda Hansen

As cyclists are sensitive to unevenness caused by, for example, repairs, resurfacing of cycle tracks should receive higher priority, even though it might be more economical to carry out repairs. This prioritisation can only take place at the expense of resurfacing of minor roads with little bicycle traffic.

Smoothness and quality of paths and tracks

Quality goals

Quality assessments can be based on subjective or objective registrations. A subjective registration could, for instance, be an assessment of road conditions by road maintenance personnel in individual districts. Such an assessment is entirely person-dependent and mainly based on observations from daily inspection, but also on feedback from users. This on-going inspection, which is not systematic, is normally carried out by car, but there are also advantages to be derived from inspection by bicycle.

Experience from the municipality of Odense indicates that inspection by bicycle is a time-consuming task, one that will at first encounter resistance from inspectors. In the



PHOTO: Jens Erik Larsen

Remember the maintenance of pavements without asphalt.

long term, however, the inspectors involved will obtain greater insight into, for instance, the effect of minor unevenness for cyclists, so that one can expect a greater number of repairs to be initiated than after inspection by car. A final and not negligible gain is that the inspectors involved will achieve a greater understanding of traffic conditions for cyclists.

A systematic registration of deterioration should be carried out once a year each spring in a main inspection. As part of the main inspection of paths and cycle tracks, all routes should be cycled over by an inspector. Holes, patches, depressions, crack formation etc, and the extent of roadworks necessary to resurfacing should be registered. These data should then be processed in a pavement management system that iden-

tifies road sections for technical assessment. The computer programme then writes out prioritised resurfacing and repairs lists taking due account of budgetary parameters. The measurement of unevenness with a comfortmeter bicycle will give a correct objective registration.

The municipality of Copenhagen has cycled over its entire system of cycle tracks and paths and registered each section in one of three categories for pavement quality. This is a sufficient number of categories in connection with subjective inspection.

After the possibility of using a cycle track, pavement quality is the factor that exercises the greatest influence on the choice of cycle route in Germany ¹³.

Road inspector and his bicycle for main inspection of cycle tracks and paths.



PHOTO: Municipality of Odense

For cyclists the impact of unevenness depends on the width of paths and tracks, ie the possibility of avoiding holes, cracks, depressions etc.

Repaving

For some poor quality cycle tracks and paths the best solution is to carry out repaving, which is expensive as it is necessary to replace the base and draining construction, to reset the kerbstones and to relay the footway. Some repaving can be carried out in connection with laying or maintenance of mains, cables etc.

The possibility of financing repaving via the construction account may be considered, since it is easier to find resources for maintenance when other forms of road or path improvement are carried out at the same time.

In connection with all repaving projects, efforts should be made to improve safety and level of service for cyclists, thereby achieving optimal use of all available resources. The secret is to find ways of integrating plans for better roads, paths, cycle tracks and bicycle parking in the operating and maintenance budget. One way is cycle audits of all repaving projects.

Roads without cycle tracks

Higher priority can also be given to repairs that improve conditions for cyclists on roads without cycle tracks. Such types of repair could be the replacement of wrongly oriented gully gratings and the repair of old, unevenly surfaced main and cable excavations, especially transverse runnels and asphalt patches.

Gully gratings and manhole covers

Some gully gratings are troublesome for cyclists because of their placing, level or design. The height of these gratings can be regulated so

that they are flush with the pavement or they can be moved right into the kerb. Gratings with bars parallel to the kerb should be turned 90 degrees or replaced with a more bicycle-friendly type.

The older type of manhole cover, which rests permanently on the rim of the hole, will often present a difference of height in relation to the wearing course that is unacceptable for cyclists, and they should therefore be replaced with floating covers. They should be paid for by the owner of the sewers. Inappropriately placed sewer manholes are often expensive and difficult to move.

On traffic areas with manhole covers and gratings, cyclists will often try not to ride over them and thereby be tempted to make dangerous changes of direction. This behaviour is due to a fear of jolts and bumps, even though there is in fact no unevenness. This problem can be obviated by building the grating into the kerb, so that there is a lateral entrance to the drain. This type of drain has been used only in a few places in Denmark, and no experience of its effect has as yet been gathered.

Dialogue with the public

The Danish Cyclists Federation and other cyclists will be able to contribute well-qualified ideas for road maintenance and, possibly, proposals for other measures. A “hot line” from the Federation for the reporting of minor deterioration etc, may

be useful, as this will reduce the need for resource-demanding administration and inspection. This direct contact can also promote mutual understanding. A reporting corps of cyclists can contribute to a cheap but co-ordinated monitoring of road maintenance quality.

Time lag after new construction
In connection with repaving and new construction of roads the normal practice is to postpone surfacing until the year after the road base has been completed. This time gap is observed in order to avoid most of the and consolidation inflict the evenness of the wearing course. Painting “Temporary pavement” on the base may lead to fewer complaints and fewer irritated cyclists.

Danes believe that better maintenance of cyclists' traffic areas is the factor that can do most to promote bicycle traffic ⁶³.

Winter road maintenance

Purpose and scope

Modern urban society can only function optimally if roads and paths are easy and safe to travel on irrespective of the season and weather conditions. It is therefore necessary to take effective steps to counteract the problems that snow and ice cause on traffic areas. The “Act on winter maintenance and clearing of roads” stipulates that road administrations must provide snow-clearing and take measures

PHOTO: Road Directorate



PHOTO: Road Directorate



PHOTO: Road Directorate



Three bicycle-friendly gratings.

A Swedish questionnaire study demonstrated that winter cycling can be increased by 13-58% by better winter road maintenance ⁸.

*Help us find
The worst cycle track in town
and win a bicycle holiday for two in
Provence*

against slippery and icy conditions on public roads and paths.

Priorities and service objectives

As both roads and paths can be divided into different categories of importance, it would seem reasonable to treat them accordingly. This gives an optimal use of resources with an acceptable weighting of traffic-related, environmental and economic factors.

In practice, roads and paths can be divided into 3 categories – A, B and C – according to their importance for the economy. In order to promote cycling, also in the six winter months, it is important that cycle tracks should be given high priority.

The most used paths and cycle tracks are placed in category A. It is important that these paths and tracks have a high service level, as snow and ice will here create problems for many cyclists. Cyclists must not be tempted to use the road instead of the track. These sections are so important for bicycle traffic – for society – that the goal should be to keep them clear of serious obstacles 24 hours a day 7 days a week.

School routes and distributor cycle tracks and paths are placed in category B. Snow-clearing, salting etc are only carried out in the daytime but 7 days a week.

Category C contains short and little used cycle tracks and paths. Snow-clearing, salting etc will not normally be carried out here.

Recreational paths with, for example, gravel surfaces do not usually receive winter maintenance.

Salting, snow-clearing etc

Icy conditions on cycle tracks and paths are treated with traditional salting, gravelling or, as an alternative, with NaCl brine.

PHOTO: Municipality of Odense



PHOTO: Road Directorate



PHOTO: Road Directorate



Traditional salting on cycle tracks and paths involves a very heavy environmental load, as the concentration of salt must for technical reasons be far higher than on carriageways.

Gravelling is also accompanied by environmental costs and increases the risk of punctures and skids. Furthermore, gravel is not particularly effective for clearing ice and snow. The gravel has to be regularly removed from sewers, and because of the admixture of dangerous substances the remainder – what is left on roads and paths – has to be deposited at controlled landfills. There is a special charge for this in Denmark. Finally, gravel is a more limited resource than salt.

When performed correctly, the spreading of brine containing 22% NaCl reduces the consumption of salt by 80% in relation to traditional salting. Using brine costs roughly the same as traditional salting but only 2/3 the expense of gravelling. Spreading brine has, however, proved to be less effective for heavy snow falls and thick layers of ice ⁷⁴.

In order to deal with icy conditions effectively, it is first necessary to clear away snow that may be lying on the cycle track or path. In Denmark these two tasks can as a rule easily be carried out by the same vehicle. Powerful tractors are required in order to ensure a high level of service in all snow situations, so that the snow can be cleared from traffic areas quickly

The sweeper can not sweep every spot!

and effectively. Normally the snow is pushed into windrows over the kerbstones between the cycle track and the footway and the cycle track and the carriageway, but on narrow cycle tracks and roads the snow must be removed and driven away. Snow-removal is very costly and can only be carried out in the most necessary spots.

Sweeping

There must also be a high service level with respect to the sweeping of cycle tracks and paths. According to the importance, systematic sweeping is performed from twice monthly to once every second month.

In addition, extra sweeping is required in autumn when the leaves fall. A standby service must be available to remove objects that are dangerous for traffic and broken glass. This is especially relevant for Saturday and Sunday mornings when the nightlife leaves a lot of broken glass on roads and paths.

From construction to maintenance

In order for maintenance personnel to acquire the required knowledge concerning the purpose of the construction project and to be able to influence the construction project with their maintenance experience, it is important that maintenance per-



PHOTO: Linda Hansen



PHOTO: Road Directorate

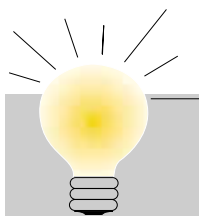
sonnel should be involved in the design process. It is also an advantage if the maintenance department is given an opportunity of inspecting the construction before the contractor finishes the project.

The following are some of the commonest problems that one detects after delivery of a construction project: wrongly oriented gully gratings, non-functioning drain con-

Just resurfaced, still the old puddle.



PHOTO: Road Directorate



PROPOSAL FOR MAINTENANCE VEHICLES

Use operating machinery of the right size – since heavy vehicles on paths can cause cracks etc – but construct new paths so that they can withstand the pressure of the vehicles it is intended to use and of illegally parked vehicles.



PHOTO: Linda Hansen

Luggage can cause single accidents.

Poor road maintenance produces bicycle accidents

Cyclists risk being involved in traffic accidents as a consequence of poor road maintenance, including inadequate winter maintenance. A good number of accidents are related to the standard of maintenance. It is not always possible to identify the actual cause of an accident. Often it is a matter of interrelated factors, which cannot be clearly separated from one another. In single accidents there are usually fewer causative factors than in collisions.

The Accident Analysis Group at Odense University Hospital has made a study of single bicycle accidents. In this connection it is interesting that only 2% of these accidents are recorded by the police as against 26% of multi-party accidents. In approximately 70% of the single accidents studied there were no defects or deficiencies on the road that could have caused the accident. In 10-15% of the accidents loose objects (branches, small stones etc) were a contributory factor, while 3-4% were due to holes in the road. Factors like asphaltramps,

roadworks, gully gratings and train rails were all insignificant⁶⁹.

It would appear that accidents could be obviated through more frequent sweeping of roads and paths and quicker repairs of holes in cycle tracks and carriageways. Roads with a poor surface quality present a serious risk of single bicycle accidents. Finally, snow-clearing should be maintained, both to reduce the risk for cyclists but primarily to increase cycling in winter.

42% of Swedish cyclists state that road surface quality is a contributory factor in accidents where slippery and icy conditions are a problem. The frequency of single accidents among Swedish cyclists rises sharply as a function of poor road surface quality⁸⁷.

structions and unevenness. During the making-good period the construction department must ensure that the contractor remedies these deficiencies.

Elements that are expensive to maintain

If cobblestones, sett paving and the like have been laid for aesthetic reasons, one should be aware that these forms of surface are more difficult and expensive to maintain and sweep than asphalt. Furthermore, uneven surfaces are often criticised by cyclists.

The blue cycle crossings are also expensive to maintain, since the price is almost double that of ordinary thermoplastic. Painted marking costs 3/4 of the price for thermoplastic, but has only 1/10 of its lifetime on cycle tracks.

The Danish Road Standards and Guidelines permit cycle tracks to be signed with a sign for cycle tracks or marked with a bicycle symbol in thermoplastic. It is cheapest to choose bicycle symbols. Cycle tracks are not normally signed in urban areas.

It is important to salt road surfaces before they become slippery or icy. With the temperature around zero on cycle tracks there is a strong risk of ice and cyclists cannot immediately detect how slippery it is. Warning systems against slippery and icy conditions are an indispensable tool for avoiding these situations.

Most cyclists ride round holes.



PHOTO: Linda Hansen