SELECTING PAVING MATERIALS, A MATTER OF OPTIMIZING ROAD QUALITY *AND* PAVIOURS' HEALTH

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SUMMARY

In the Netherlands the question of the weight of paving materials has been the subject of many discussions. Paviours require less heavy materials; their employers accept the specifications of the principals; principals design pavements with the basic assumption that the pavement should be able to withstand all possible circumstances; and the concrete industry produces the materials which are in great demand.

This vicious circle has existed for many years. *ARBOUW* and the Ministry of Social Affairs decided to try to come to a breakthrough. The Delft University of Technology was asked to specify which minimum dimensions paving materials should have so as to withstand everyday traffic loading.

Besides ergonomic consultants determined the maximum permissable weights and dimensions for manual handling of blocks, slabs, kerbs and gullies.

The results do not only show where manual paving is acceptable and where mechanical paving is required. It also turned out that in many cases materials are selected that are heavier than is necessary for adequate road construction.

INTRODUCTION

Statistics show relatively high rates of absenteeism and disability among paviours. Lumbar injuries are the main causes, followed by complaints of the knees and wrists.

Several studies have been carried out in order to assess the energetic and musculoskeletal work load. A literature review (Koningsveld, 1983) led to the conclusion that either the weight of paving materials should be lowered, or mechanical devices should be developed.

In the past three years *ARBOUW* has been active on both lines. Great support came from a committee in which representatives of all relevant fields are participating, such as employers organisations, unions, the Ministry of Social Affairs, producers of paving materials, principals, etc. Although their interests may basically conflict, they all work together in good harmony, and they all subscribe the results of research projects.

The results concerning mechanisation of paving will be presented at this congress in theme 6: Laying of Concrete Blocks. Below the study is reported which investigated the possibilities of less heavy paving materials.

RESEARCH DESIGN

A unique study was carried out by the Delft University of Technology, dept, of Highway Engineering, and ergonomic consultants (Arbo-Advies, Leiden). The university determined which minimum dimensions paving materials should have in order to withstand traffic loads. This was done on the basis of many years of road constructional research and experience and various practical studies.

The ergonomists formulated the maximum dimensions and weights for manual handling when working in a normal pace. Those were based on the guidelines, stated by the National 'Institute for Occupational Safety and Health in the United States of America. In these the handling frequency, the working method and the postures applied are being considered.

The results of these two seperate studies were compared, which led to the next conclusions.

PAVING BLOCKS

The height of paving blocks turned out to be less inportant than principals had always thought. A good preparation of the base course is the key for the road's quality, which is also shown in the paper by Nr. Van der Heijden in this session ("The minimum thickness of concrete blocks on a base course in city streets"). In almost any case blocks with a height of 80 mm or less are the best choice as far as road quality and price is concerned.

The ergonomists came to a maximum permissable weight of 4.0 kg. This is almost exactly the weight of the 80 mm concrete block which measures 105x211 mm^2.

Another important item with blocks is their width. About 25% of the Western European paviours will meet problems when handling blocks wider than 100 mm. An anthropometric and biomechanical study showed that □locks wider then 100 mm will not only lead to health complaints but also to inefficient work.

PAVING SLABS

The medium size paving slabs, which measure 300x300 mm^2 are mainly in use in pedestrian areas and bicycle tracks. These occasionally have to resist uneven and relatively heavy loads caused by motor traffic, e.g. when delivering goods, during snow shovelling or fire fighting. Those loads may damage the sials, as these break rather easily according to their small height in relation to their size. More thickness means more resistance against breaking, but at the same time more weight.

Depending or. the highest load to be expected, the minimum height can be defined. The ergonomists determined the maximum permissable load to be 7.2 kg. This means that a 30 mm height is the maximum tor manual paving. Slabs of this height can only resist passenger cars. Where there is a chance of heavier traffic, medium size slabs of at least 35 mm are necessary; these must be paved mechanically in order to prevent health disorders among paviours.

The conducting Committee considered a smaller size than 300x300 mm^2 to be unrealistic, as most bicycle tracks and all footways in the Netherlands are paved with 300x300's.

Large slabs. which measure 400x600. 500x500 or 600x600 mm^2. weigh far too much tor manual handling. Their maximum permissable weight is 27 kg; their actual weight is 38 to 58 kg.

Realistic solutions which lead to less weight are hardly thinkable, as concrete is a cheap material.

As no one can be sure that manual handling will never occur, e.g. when reconstructing the pavement, *Arbouw* is of the opinion that these slabs shall be abandoned and replaced by more acceptable materials.

KERBS

Kerbs play an essential role in the road construction. They conduct the traffic and close up the other paving materials.

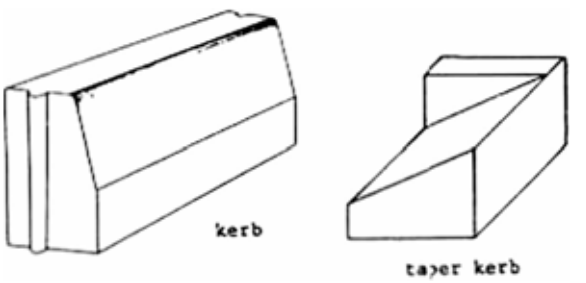
Investigations have shown that their weight is a far more important factor than their height, width and length. Special shapes could be a solution for their strength and their resistance against transverse forces, but will result in unacceptably high prices

For a 1 meter kerb the minimum weight to withstand the forces applied by a heavy truck is ±150 kg. Shorter kerbs will hardly lead to less weight, as those have to be bigger in their cross-sectional plane.

The ergonomical limit was considered to be 40 kg, when handling the kerb by two paviours, which occurs most frequently.

Therefor kerbs must always be placed mechanically. As will be shown in the session on Laying of Concrete Blocks (Koningsveld; Vievermans), various kinds of equipment are available and can be used at competing costs.

Taper kerbs, which are in use for ramps, are very hard to handle. In fact it is quite simple to replace these by standard blocks (±100x200 mm^2).





Alternative for taper kerbs

GULLIES

Concrete gullies are far too heavy to be handled manually without a serious health hazard. Their weight is in the order of 70 to 90 kg. The ergonomically acceptable limit is 28 kg.
The best solution are synthetic gullies, which weigh 25 to 30 kg, and which are strong enough to withstand the traffic loading.
Mechanical handling is necessary where concrete gullies are prescribed.

CONCLUSIONS

Traditional considerations are often the reason that pavements are designed with materials that are more heavy than is necessary to withstand the traffic loading.
Minimum dimensions of paving materials are a great contribution to less occupational diseases and to less absenteeism. Besides they will benefit the control over the costs and maintenance of road constructions.

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