INTERLOCKING CONCRETE BLOCK PAVEMENTS - A VIABLE ALTERNATIVE

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ABSTRACT

The use of concrete masonry blocks, frequently interlocking in form, has gained favour over the last 15 years as a substitute for concrete or sprayed or mixed bituminous materials. The criteria for selecting paving materials have usually assigned a high priority to factors relating to cost and availability where these are consistent with the provision of hard and durable pavement surfaces; pavements with a bituminous wearing course and cast in place concrete have usually met these criteria. Although there has always been a place for more costly materials where appearance has been an important factor governing material selection, the use of masonry block paving in roads and footways has expanded dramatically in spite of a cost burden frequently experienced as a result of its use. This paper discusses the use of concrete masonry blocks as a pavement material in the local government context and examines the reasons for and the benefits of this comparatively new material on the Australian construction scene. It records some impressions which may lead to wider experimentation and innovation in the use of block pavements but recognises the need to record experience or promote formal research. The paper aims to stimulate thought from which solutions may flow.

INTRODUCTION

The development of earth tracks into surfaced roads arising from the dominance of the motor car has seen a natural progression in the use of materials which form part of a high production system - materials that are either available or can be produced, handled and transported in high volumes and can be shaped on the pavement bed by high-production mechanical equipment into durable road and pedestrian pavement surfaces. Emphasis has been placed on the improvement of design and performance of those mechanical pieces to produce and transport materials to form increased lengths of more servicable pavement.

A DESIGN PHILOSOPHY

The dominance of the motor car and its impatient driver has led to many roads becoming 'urban freeways', whereas their primary function is that of residential access.

This preoccupation by designers towards roads that portray standards of engineering excellence has created conditions in which motorists are almost encouraged to travel faster, with a consequent reduction in safety levels in areas where roads are required to perform that primary access function for the convenience of residents in residential precincts.

Traffic speeds can be effectively reduced by the introduction of control devices into the street system. Such devices are frequently a positive means of ensuring that drivers will suffer discomfort and possible danger unless they reduce speed and exercise caution. A more subtle device is the creation of a total street environment in which the motorist will feel disposed to reduce his speed to a level compatible with the degree of safety expected in that environment. In combination, these two options form an ideal solution.

A road design concept that is gaining acceptance with designers is the notion that drivers will react differently in different environments. If this is so, it follows that environments in the roads at various levels in the hierarchy of roads should be sufficiently different to evoke that different response, particularly as it relates to the residential street system.

One of the factors influencing driver behaviour is the perception he has of the road environment, including the perception of the response he may be called on to exercise arising from unforseen but likely events within that environment. Consequently, the appearance of the road and its roadsides takes on a new importance and reaction time to unexpected events may be directly proportional to the angle of the cone of vision and the width of the road pavement.

Some residential streets carry less than 100 vehicles per day and others well below 1000 vehicles per day, whilst some of those carrying higher volumes could well be subject to traffic management techniques including a reduction of pavement width as a means of either reducing speed or reducing volume or both.

The use of masonry blocks in residential streets can satisfy all of the appearance criteria necessary to alert a driver to the 'difference' in his environment and the need to exercise a degree of care that may be thought to be unnecessary on a more conventional road pavement.

CONCRETE MASONRY BLOCK PAVEMENTS

careful design of road pavements using segmental concrete masonry blocks can make a major contribution towards road safety at a total cost that closely approximates that of a conventionally-designed pavement using conventional materials.

Masonry blocks can be used as a total road pavement or in combination with bituminous materials where it is desirable by a change of colour or texture of the pavement to emphasise a particular feature to improve road safety. Examples of this system are the change of pavement materials at intersections to either identify the whole of the intersection area or to define minor roads leaving a higher-volume road, or to define areas where pedestrians generally cross roadways. In these cases, the colour used may have relevance in the particular streetscape or it may be chosen because of its quality of colour contrast to adjacent materials in all light conditions. The question of texture and indeed shape may also have relevance to the total streetscape.

When used as a pedestrian pavement material, masonry blocks offer almost unlimited opportunity for design freedom using colour and form in combination in pavements that add interest to the scteetscape and provide convenient surfaces for all pedestrian use.

A degree of caution has been exercised in the determination of design pavement thickness when masonry blocks are to be used as a wearing course in road pavements. One would expect a reduction in pavement thickness, determined by conventional methods, when masonry blocks are used, but this has not generally proven to be the case, with a resultant cost increase. This conservatism is understandable when proven solutions have all included an impervious surface to assist in the maintenance of a stable pavement and subgrade, whereas masonry blocks depart from this principle and allow the intrusion of water into the pavement. Consequently, the soaked CBR value of the subgrade is an appropriate design consideration.

It is likely that this conservatism has been a significant factor detracting from the wider use of masonry blocks. Alternatively, the cost factor in isolation may well have had an inhibiting effect on their use as the cost per square metre of a concrete block road pavement is likely to exceed the cost of a bitumen pavement in cases other than where the blocks can be laid on a sandy subgrade. However, the total road cost may be no more than when using conventional road widths and materials if the road is narrowed to the width necessary to provide for the traffic volumes attracted by the road in question.

DESIGN CONSIDERATIONS

Design conservatism relating to the use of concrete masonry blocks is understood as engineers are more frequently judged by their failures than their successes. Although it is clear that more practical research needs to be undertaken, it is speculated that a variation in design and construction techniques could result in a reduction in total pavement depth and a cost saving on the total pavement construction.

The variation proposed in this paper uses a water-proof membrane between the lower level of the pavement and the sand bedding for the masonry blocks to provide a barrier to the entry of water into the pavement through the masonry block surface. A sprayed bituminous primer may be more suitable than a plastic-type membrane as maintenance or replacement procedures would be simplified. However, the pavement thickness required to support construction plant without undue deflection may be critical where economy is the primary factor.

The cross-section shown in Fig. 1 may serve as a useful basis for experimentation and research.

The pavement width is a significant factor influencing the cost of street works, and reductions in width consistent with good design practice will result in speed reduction and may allow for the use of a higher class pavement material. It can be shown that the cost of road works decreases with a decrease in width until the width is such that normal construction plant and vehicles cannot operate economically. This limit appears to be about 3.5 m between the inner faces of any concrete edging in the form of a channel or otherwise.

Where pavements are reduced to 2.5 m between concrete faces, the cost could be 1.5 times the cost of a wider pavement on a unit area basis. In any case where a pavement is 3 m wide or less, alternatives such as segmental paving materials may be more economical.

PROBLEMS IN USE

When concrete masonry blocks are used to achieve either a colour contrast or a particular effect from the use of colour, care should be exercised in the choice of colour and the wearing charactersitics of the block. Many of the lighter-coloured blocks tend to discolour from oil or food stains and the scuffing of rubber tyres, whilst in other cases the colour changes because of abrasion of the surface, with a loss of the matrix revealing the aggregate colour. This sometimes contrasts with the matrix colour.

Any colour change is particularly relevant where conspicuity is an important factor in material selection, as any discolouration may dull the reflective quality of the material and yield disappointing results.

Care should be taken in the selection of a block shape and laying pattern to determine its relationship to the road alignment and so minimise or control edge cutting. It will be appreciated that interlocking block shapes limit the opportunity to

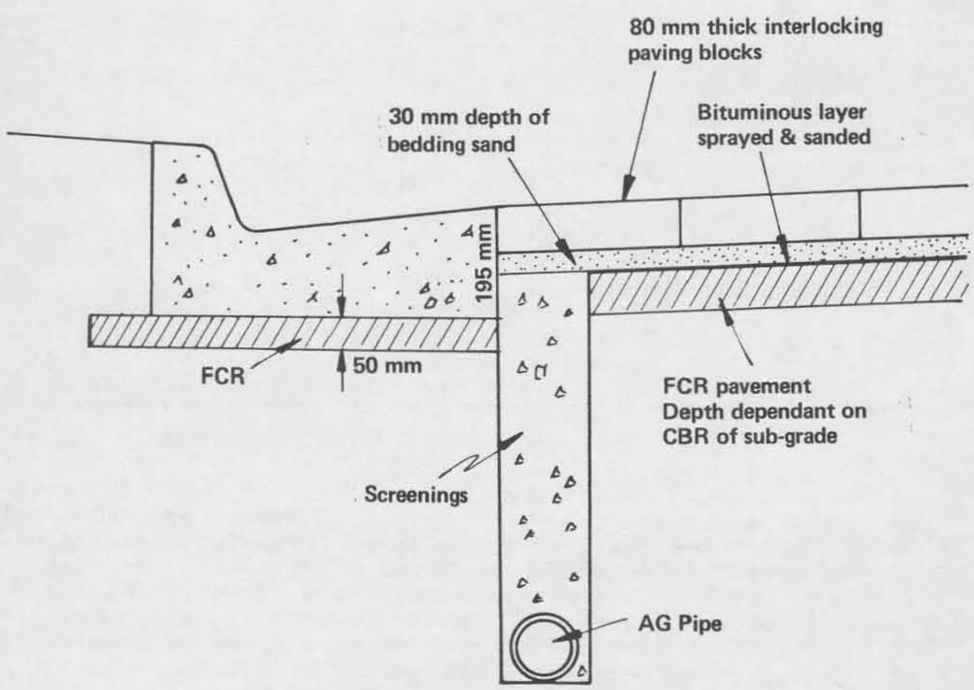

Fig. 1 - A suggested cross-section design

'creep' to conform to the longitudinal road alignment, whereas rectangular blocks afford that opportunity at the expense of the strength characteristics of the interlock. Interlocking blocks laid in a herringbone pattern at 45 degrees to the direction of traffic appear to be an optimum solution.

CONCLUSION

The use of concrete masonry blocks offers a broader horizon for practical innovative designers. Their use in residential roadways introduces a component of more human scale into an area traditionally dominated by the motor car.

Although experience gained and research undertaken enables the designer to reach many conclusions with confidence, it is likely that the greater cost is over-riding other important factors.

Further examination and research is necessary to determine whether the advantages derived from design and construction techniques can either overcome the disadvantages of additional cost or at least legitimise them.

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