THE USE OF CONCRETE BLOCK PAVING IN THE CITY OF ENFIELD, SOUTH AUSTRALIA

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ABSTRACT

This paper outlines the experience of the City of Enfield, Adelaide, in the use of concrete block paving for both aesthetic and structural purposes over the last ten years. Initial use of concrete block paving resulted from work associated with expansive clay subgrades and the belief that very little could be gained by using expensive subgrade treatments when constructing footpaths. Experimental work confirmed that concrete block paving was the most cost efficient method of constructing paths on reactive clay soils. Several other significant projects are described, including streetscape schemes and the use of concrete blocks in open trapezoidal drains. Methods of weed control and the control of salt inception by the use of moisture barriers are also described.

INTRODUCTION

The City of Enfield is located within the north-eastern suburbs of Adelaide and encompasses 5100 ha. The length of residential streets under the control of The City of Enfield amounts to 366 km, of which approximately 180 km are constructed on expansive pleistocene clay subgrades. The City is responsible through its engineering workforce for the maintenance and construction of the residential streets within its boundaries.

Information gathered in the mid-1970s in the State of South Australia led Council officers to believe that there was very little that could be gained by expensive subgrade treatments when constructing footpaths. The failure of a number of concrete-paved footpaths at the joints, and the expensive nature of the reinstatement work, led to experimentation with interlocking concrete block pavers laid over a very thin base. As a result of these trials, and following public reaction, it became Council policy in 1977 to use concrete block paving when constructing footpaths on expansive clay subgrades.

Apart from the obvious advantages of ease of reinstatement after service utility damage, buckling of the order of 250 mm was accommodated, and the pavers could be easily reinstated aa a result of these deformations.

In 1981 the Council undertook its first major streetscape scheme in a street that had badly deteriorated. Trials were conducted using concrete block pavers in a street located on a reactive clay subgrade.

Council have also embarked on a program of construction of major outfall drains in concrete block pavers.

This paper details some of the information which was used to assist in making a final decision to use concrete block pavers, and experience gained in the use of pavers over the last ten years.

FOOTPATHS

Having made a decision to proceed with concrete block pavers, the Council trialled a number of test pavements to determine the most acceptable pavement for use on expansive clays. These trials were necessary because it was plainly obvious that the traditional methods of determining pavement thickness were not applicable on reactive clays because the California Bearing Ratio (CBR) of these materials are extremely high, both in summer and in winter.

The winter condition was never at any time, even in the open field condition, anywhere near saturated; generally the moisture content at the surface was approximately 25-30 per cent, with a value in excess of 40 per cent in the saturated condition.

The trials revealed that the subgrade was capable of withstanding normal residential traffic volumes at entranceways, where the load limit was restricted to less than 3 t, with a 100 mm thick crushed rock pavement.

Subsequent trials revealed that the conventional Unipave block rotated on the edges when laid in the herringbone pattern if a concrete edge strip was not provided. At that time, the concrete edge strip was costing approximately $1 per linear metre. To reduce the construction costs, Council officers designed a concrete block paver which interlocked in two directions (see Fig. 1). This block was patented and given the name Pace-Pave. A local manufacturer purchased the equipment necessary to produce the paver, and the Council subsequently proceeded to lay aapproximately 20 km of footpaths per annum, including driveway access to properties, with this paver shape.

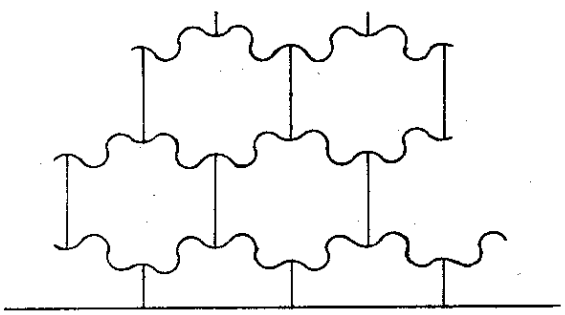

Fig. 1 - Pace-Pave block

WEED CONTROL

Council experimented with a number of weed control methods, including the use of a soil steriliser below the pavers called Erase. This proved to be unsuccessful due to its effect on trees, both on the streets and in properties. The contractors also complained that fumes were emitted from the product during construction.

Subsequently it was decided to experiment with forticon sheeting, both on top and under the pavement. The method finally adopted, because of its effectiveness, was the use of plastic sheeting above the pavement, i.e. between the bedding sand and the blocks. The plastic sheeting ensured that the jointing sand did not penetrate into the underlying bedding sand.

COSTS

The cost of construction of the paths was generally equivalent to the cost of construction with concrete and substantially less than bitumen. The pavement used in the path consisted of a 25 mm thick bedding sand layer with the pavers laid directly on top, compared with the pavement in the driveways: 100 mm of crushed rock, 25 mm of bedding sand, and 76 mm thick pavers.

The Council are currently constructing paths using the Pace-Pave block for $18 per square metre. This is a contract rate which includes the cost of excavation, laying of the sand, placement of the forticon plastic sheet on top of the sand, and installation of the pavers. The price also includes the reinstatement of the nature strip to match the top level of the paver.

STREETSCAPE SCHEMES

RESIDENTIAL STREETS

In 1981, Council, on the advice of the Engineer, decided to experiment with the use of concrete block pavers in conjunction with the Residential Streetscape Schemes. The scheme which was devised included the use of block paving at the thresholds and at deviations in the street. The street that was first constructed in this way was Reece Avenue at Klemzig. It included control pavement sections with variable pavement thickness. Intense planting of trees was undertaken on each side of the street in an attempt to maintain the moisture content in the expansive clay subgrades at a constant level.

The street was constructed in this manner to provide aesthetic appeal to the resident and also to indicate a change of direction in the street alignment. The pavers also marked the location of intersections.

Subsequent observations of surface deflections in the street have shown that the bitumen pavement has cracked concentrically around trees and near heavy vegetation, but the block paving has remained intact. The lateral strength of the blocks has obviously assisted in reducing the effects of sideways contraction of the subgrade at the road surface. Again, the Pace-Pave paver was used, and its characteristic two-dimensional strength has assisted in reducing cracking through the pavement.

Subsequently, other streets have been constructed using concrete block pavers, both because of their aesthetic appeal and the obvious advantages of high lateral strength.

INDUSTRIAL STREETS

Concrete pavers have been installed on a trial basis in the Wingfield industrial area. The aim was to improve the skid resistance of the pavement and overcome the viscous roll effects currently experienced with bitumen-sealed pavements. This particular phenomenon is quite common on industrial intersections where the conventional bitumen treatments rut and move in a viscous fashion as a result of forces induced by industrial traffic.

To date, the block paving at these intersections has reduced the amount of deflection and has had obvious observed advantages in the improvement in skid resistance over the conventional bitumen paving.

DRAIN CONSTRUCTION

In 1984, Enfield Council investigated several alternative options for the construction of an open drain in the alluvial flat portion of the City near the sea. The drain had a design grade of 0.11 per cent and required a flow cross-section as shown in Fig. 2.

The final alternatives considered were an earth-lined drain, a concrete-lined drain and a concrete block paving-lined drain. The difference in cost between the construction of the concrete block paver-lined drain and the concrete-lined drain was only marginal. The Council's works program was such that the work would have to be undertaken either by contract or as part of a Community Employment Program. This latter alternative was chosen because of its reduced cost to the Council. Accordingly, a program was developed, the total estimated cost of which was $661,000.

DESIGN

The pavement design was carried out in accordance with the design curves prepared by the Cement and Concrete Association of Australia (Hodgkinson and Morrish 1982). The CBR of the subgrade at the base of the channel was almost zero. Therefore it was necessary to improve the subgrade strength. Based on previous experience with low-CBR subgrades, a poly-weave mesh fabric was used to distribute the load.

The design load was calculated according to AASHO as approximately 10 equivalent standard axle loadings per annum.

SALT INCEPTION

As a result of work undertaken in other locations within this area, there was concern as to the possible effects of salt absorption by the pavers. The sulphate content was found to range between 0.03 and 0.16 per cent, which was reasonably low; however, it is a common occurrence in the Wingfield area for sulphate contents to be markedly greater than this. Therefore special attention was given to reducing sulphate penetration. The results of solute testing also showed that the sulphate with the greatest concentration was magnesium sulphate, which is known to be the most damaging of all the soluble salts and can cause serious failure of concrete products. After discussions with concrete block paving manufacturers in Holland, who had some experience in the use of concrete block pavers in a high sulphate environment, it was concluded that it would be necessary to provide a moisture barrier to prevent sulphates from entering the pavers. Accordingly, plastic sheeting was placed between the pavement and the paver.

HYDROSTATIC PRESSURES

Two parallel seepage drains were used at the outer extremities of the drain, with inter-connecting rises to the base of the drain at 6 m intervals, to avoid hydrostatic forces building up below the paving units. Subsequently it was found that these were also needed during construction. The seepage drains and risers were found to be working adequately subsequent to construction.

INTERFACE BETWEEN DRAIN, FLOOR AND WALL

It was decided to manufacture a precast concrete unit to provide for the sharp interchange between the floor and walls of the drain. Precast units were also used to provide an edging strip at the top edge of the drain.

CONSTRUCTION

Construction proceeded in accordance with the predicted methodology and the compaction method at the base of the drain was achieved by the use of a double-drum 32 RDE roller.

The compaction of the wall of the drain was carried out using the same equipment; it was found that the machine was able to manoeuvre up the side of the walls without difficulty.

CONCLUSIONS

The use of concrete block paving in the City of Enfield has proven successful in four applications.

(1) Footpaths and driveways on reactive (expansive) clays.

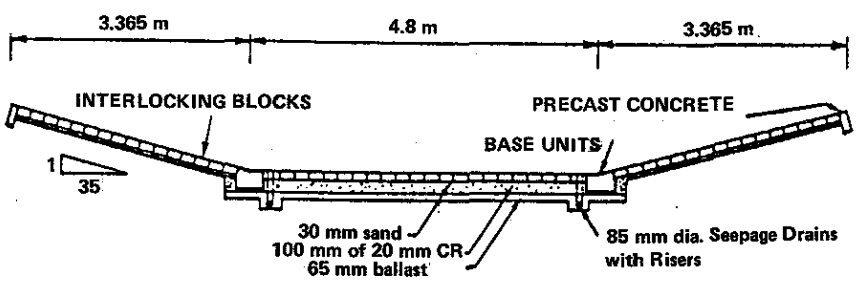

Fig. 2 - Cross-section of trapezoidal drain

(2) Streetscape schemes, where they have been used in the following applications:

(a) to provide lateral restraint to stretching of the pavement;

(b) to provide an aesthetic treatment to the street; and

(c) to warn drivers of an approach to an intersection or a change in direction of a street.

(3) The use of concrete block paving in intersections is still under trial. However, it has already been found that skid resistance is improved and lateral movement of the surface is not experienced.

(4) The use of concrete block paving in open trapezoidal drains has proved to be successful and has a particular applicability when Community Employment Programs are envisaged, and some aesthetic appeal is desired.

REFERENCE

HODGKINSON, J.R. and MORRISH, C.F. (1982). The design of interlocking concrete pavers for road traffic. Cement Conc. Assoc. Aust. Tech. Note, TN40, March.

Mr Pitman graduated in civil engineering from the South Australia Institute of Technology in 1978. He also has obtained the Municipal Engineer's Certificate. He joined the staff of the City of Enfield in 1973 and was appointed City Engineer in 1981. He has been actively involved in reactive clay soil research in conjunction with SAIT over a long period. Mr Pitman is also a member of the South Australian Local Government Engineers Association.
