Interlocking concrete paving - the state of the art in Australia

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Introduction

MUCH of the early European work with interlocking paving was ignored in Australia, because the method of construction was regarded as too labour intensive, and therefore too costly, and too dependent on traditional hard-won skills to suit Australian industry.

However, during a visit to Europe in 1972, and to Mexico City in 1973, the author began to appreciate the enormous potential for interlocking pavement and to suspect that the introduction of self locating complex profile units had transformed the need for skills in the laying process.

Discussions with the concrete masonry industry - which was anxious to extend its product range and market penetration - resulted in some pilot installations in South Australia. These proved conclusively the simplicity of the construction process and its suitability to Australian conditions. The demonstration areas won an excellent response from both the general public and from municipal and design authorities, encouraging an immediate commencement of local production.

Manufacture

The concrete masonry industry in the mid seventies was well equipped with modern high production American machinery - much of it fully automated. Most of the plants were less than 15 years old and geared to the manufacture of high quality facing block as well as to general walling products. Machines were generally from Besser, Columbia and Bergen stables with post-manufacture handling equipment installed by Besser, Columbia, Beco and Johnson. All product was either low pressure steam cured (with or without the admission of flue gases) or autoclaved and cubed on pallets for delivery to the site. This equipment was designed to produce and handle hollow units, up to 200 mm high, having high quality vertical faces with aesthetically pleasing textures. The quality of the "bedding" faces was not a primary concern.

When the concept of introducing interlocking paving was first embraced, the primary problem was to use existing excess machine capacity to manufacture solid units 60-100 mm high, whilst maintaining productivity, and to achieve high quality dense horizontal surfaces from a vertical extrusion process. The provision of chamfers to upper arrises further complicated manufacture and necessitated modification of stripper heads and extended cycle times. Unfortunately, in the early stages, collisions between the stripper head and the vibrating mould were all too frequent and the destruction of expensive moulds was an inevitable consequence. There was also a tendency for the stripper head to "tear" the upper surface, leaving the head contaminated and "bird-bath" concavities in the wearing surfaces of the units produced.

Significant modifications to cycle sequences, mould and stripper heads, the heating of stripper heads, and variable compacting cycles were tried with varying degrees of success; but all such changes tended to reduce productivity.

However, manufacturers have persisted, despite these problems, and through combinations of these changes and greatly improved mix design have had some success. A large volume of production is and will continue to be produced on American plant.

As demand for the product has been stimulated there has been a shift towards the use of European manufacturing equipment. Three major manufacturers now use Knauer stationary multi-layer machines, whereas others have modified and adapted presses originally engaged in lime-silica or concrete brick production.

A notable phenomenon of the Australian market has been the success of the Cobblestone. This is a solid rectangular prism - the approximate equivalent of two bricks in size - which can be produced on its side to give high productivity on American machines. The equivalent of chamfered arrises are then achieved by rumbling the unit after manufacture. It currently accounts for some 60% of the interlocking paving market, possibly because those manufacturers using American plant have been keen to give this unit priority in their promotion of concrete block paving.

A recent development has been the introduction of the unchamfered I-shaped unit. One manufacturer has developed a successful technique for producing this on its side on a Columbia machine without serious reduction in cycle times. It is anticipated that this will become one of the preferred profiles for manufacturers using Columbia plant.

Performance of interlocking pavement

From the first phase of introduction it became evident that, if interlocking pavement were to achieve its full potential in Australia, then a finite method of pavement design, suited to Australian conditions, was needed as a matter of some urgency. Careful enquiries in Europe failed to detect any significant investigation into the performance of interlocking pavements. Design appeared to be based on empirical assumptions developed from many years of experience with stone setts and interlocking pavers. Australian engineers, lacking this experience, were reluctant to accept insurances that the resulting pavements were performing well in Europe even under the most arduous loading and subgrade conditions.

As a first step, Cruickshank[1] proposed an interim design method based on envisaged load traffic classifications and estimated subgrade conditions. Recommended sub-base thicknesses were developed from first principles, derived from local approaches to flexible pavement design. A similar recommendation was made by Dr Knapton[2] following his test programme he conducted at Wexham Springs. However, his design solutions were based on Road Note 29, an approach that was far too conservative to yield competitive pavements compared to Australian flexible pavement design. Further, the test pavements at Wexham Springs overlaid a concrete slab, and Australian engineers tended to be sceptical of the validity of translating the test results obtained to normal field conditions.

It was obvious that full-scale tests of typical pavements, under repeated loads, leading to the development of Australian design criteria, were

essential if the engineering potential of interlocking pavements was to be realised.

Research Programme

Early in 1977 it was learned that the full-scale road simulator at the University of New South Wales was becoming available for a limited period for test programmes under private sponsorship. The Concrete Masonry Association of Australia approached Dr Shackel to carry out a pilot study on the simulator to determine whether useful design data could be obtained. The results of this were so promising[4] that a full-scale programme was developed and undertaken with the assistance and co-sponsorship of the Cement and Concrete Association of Australia.

This programme called for a comparison of the performance of various combinations of sub-base thickness, paving unit and sand bedding thicknesses overlaying a sub-grade which had been extensively tested previously in earlier research into flexible pavements. The results of this research[5] were tabled at a workshop of the Australian Road Research Board and will form part of Dr Shackel's paper to this conference. As a result a basis of design[6] was proposed, based on limiting criteria for plastic deformation. This involved considerable extrapolation of test data, because of the high quality subgrade on which the test pavements had been constructed, and Dr Shackel recommended some caution in its use for subgrades having CBRs in the range of 2-8%.

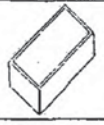
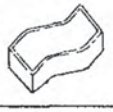
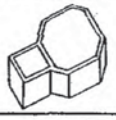
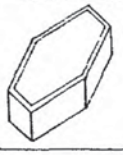
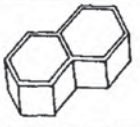
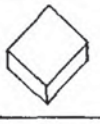
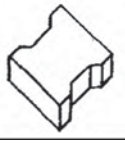
Unfortunately, the intended extension of this research to include poorer quality and saturated subgrades was not possible because of Dr Shackel's commitment to take up an appointment with the NITRR in Pretoria, shortly after the ARRB workshop. The Australian industry was delighted when it learned that the NITRR had decided to extend his work by large scale testing of interlocking pavements laid over poorer quality subgrades and using sub-base materials of indifferent quality.

The author was privileged to see this test programme in progress and also to hear at first hand the preliminary results of this research[7] at the Symposium on Precast Concrete Paving Block held under the joint auspices of the Concrete Society of Southern Africa and the Concrete Masonry Association of South Africa in Johannesburg in November 1979.

These tests largely confirmed the design approaches developed previously by Dr Shackel[6] but with some important qualifications, namely.

1. The shape of the paving unit and the degree of interlock obtained was critical to the performance of the pavement.
2. Tolerances in the manufacture of the paving unit and the accuracy of laying, ie maintenance of uniform joint widths, appeared to have a significant influence on the pavement performance.
3. An increase in paving unit thickness from 60 mm to 80 mm improved pavement performance significantly, although an increase in thickness from 80 mm to 100 mm produced a relatively lower performance increment.
4. The strength of the paving unit had no significant effect on the structural performance of the pavement.
5. With some slight adjustment, the extrapolated design curves proposed earlier gave quite satisfactory factors of safety for the full range of subgrade conditions, and the sub-base thickness proposed could be regarded as conservative (and capable of possible reduction in the

TABLE 1: Types of pavers manufactured in Australia

Illustration	Trade Name	L (mm)	W (mm)	H (mm)	Number per m²
	Unipave	225	112.5	60 80	39
	Ezipave	220	110	60 80	40
	Pavelock	200	100	60 80	50
	Rectangular Paver	220	110	60 80 100	42
	Interpave	225	112.5	60 80	39
	Symmetry Pavers	278	112	60 80	29.5
	Unidecor	230	140	60 80	38
	Abbey Stone	230	130	60 80	41
	Hexy-Lock	255	145	60 80	37
	Cobblestone	230	185	(50) 75 80	23.5
	Keystone	190	190	60	32

future as further test results are obtained).

Manufacturing specifications

Meanwhile, the Concrete Masonry Association of Australia had drawn up proposed standard specifications for the manufacture of paving units for adoption by the Australian industry. These were presented to the Johannesburg Symposium[3]. How–ever, in the light of Dr Shackel's findings, and after consultation with him, these specifications were sub–stantially modified, prior to publi–cation in March 1980 - see Reference 9 - as the Interim Specification for Interlocking Paving Units.

The major considerations are the shape of the paving unit, manufac–turing tolerances, and characteristic compressive strength. These types of shape have been defined in the light of Shackel's findings.

Shape Type A are dentated units which key into each other on all four faces, arc capable of being laid in herringbone bond and, by their plan geometry when keyed together, resist the spread of joints parallel to both the longitudinal and transverse axes of the units.

Shape Type B are dentated units which key into each other on two faces only, are not capable of being laid in herringbone bond and, by their plan geometry when keyed together, resist the spread of joints parallel to the longitudinal axes of the units, and rely on their dimensional accuracy of laying to interlock on the other faces.

Shape Type Care rectangular units with chamfers between the upper (wearing) surface and the sides, or rumbled units which do not key together and rely on their dimensional accuracy and accuracy of laying to develop interlock.

Tolerances are ± 2 mm for all horizontal dimensions, in order to permit laying with tight control of joint widths. Tolerances for the height of the unit arc more generous at ± 3 mm. recognising that a substantial proportion of units are manufactured on American equipment which would be taxed to meet tighter tolerances, particularly for 60 mm units; yet at the same time avoiding severe lipping between adjoining units should centres of gravity tend to align under prolonged traffic loads, as suggested by recent Dutch research[10].

Two grades of unit based on characteristic compressive strength have been nominated, viz 35 MPa and 45 MPa. These recognise that there are only limited areas of Australia subject to freeze-thaw problems and reflect the type of equipment used for manufacture. The limits set were chosen to guarantee reasonable abrasion resistance.

It was intended to nominate limits for abrasion resistance but. despite prolonged investigations and checks on the various test methods in use in other countries, it has been concluded that, at this point in time, there is no easily performed, reliable test suited to regular production testing. Since any shortcomings with abrasion resistance are usually matched by poor strength character –istics, it has been decided, as a interim measure, to rely only on compression strength assessment.

Types of pavers

The types of pavers manufactured in Australia are given in Table 1. The first profile introduced and manu–factured under licence was Unipave in 60, 80 and 100 mm thicknesses. It was selected for the following reasons:

(a) It gave optimum utilisati of the pallet area of a 3 block machine.

(b) It had an excellent vertical interlocking face area to plan area ratio.

(c) It suited herringbone and stretc bonds and had chamfered arrises.
(d) It was t unit making the major market gains in Germany because of its outstanding performance and the ease with which it could be laid.

This profile - and its derivatives, one of which was the outstanding per–former in Shackel's tests in South Africa - has been very successful in Australia, and continues to dominate the municipal, road and industrial hardstanding market, except in Queensland, where the Pavclock unit predominates. The latter exhibited similar performance characteristics to the Unipave profile in the tests done at the University of New South Wales.

Old Town Centre, Bankstown NSW, where 75mm Cobblestones have been used for all pedestrian /service vehicle areas.



The Quadrant at Launceston, Tasmania, where 75mm Cobblestones were used to complement the Victorian architecture in this city centre pedestrianised street.



TABLE 2: Extract from TN 34 (see reference 11)

Traffic Classification	Anticipated Traffic Loading				Required Paving Units			
	No. of vehicles per day > 3 tonnes gross	Max. wheel load (tonnes)	Total Equivalent Standard Axle(1). repetitions after 20 years' service	Examples of Usage	Shape Type(2).	Minimum Thickness	Laying Pattern(3).	Strength Grade(2).
A	0-15	2.3	$0 - 4.5 \times 10^4$	Multi-dwelling driveways car parks, cul-de-sacs. Malls not accepting delivery vehicles(4)	A B C	60mm(4) 60mm(4) 75mm	H or S S H or S	35 35 35
B	15-45	2.3	4.5×10^4-1.4×10^5	Minor residential streets. Commercial carparks.	A B C	60mm 80mm 80mm	H or S S H	35 35 35
C	45-150	2.3	1.4×10^5-4.5×10^5	Residential streets. Malls accepting vehicular traffic(4,5)	A B C	60mm(4) 80mm(5) 100mm(5)	H S H	35 35 35
D	150-450	2.3 (on road) 5.0 (off road)	4.5×10^5-1.4×10^6	Minor through roads etc. in urban areas with 60 km/h limit Industrial Hardstandings(6)	A	80mm	H	45
E	450-1500	2.3 (on road) 5.0 (off road)	1.4×10^6-4.5×10^6	Major through roads in urban areas within 60 km/h limit. City streets, bus interchanges. Industrial Hardstandings(6)	A	80mm	H	45
	Maximum contact (tyre) pressure	Max. wheel load (tonnes)	Total Load Repetitions after 20 years' service					
X	> 900 kPa	20	1×10^6-3.5×10^6 (Indicative only)	Heavy industrial hard-standings. Container yards handling straddle carriers.	A	80mm	H	45
Y	> 900 kPa	45	1×10^6-3.5×10^6 (Indicative only)	Container yards handling transtainers.	A	80mm	H	45

Table. Traffic Classifications and Required Paving Units

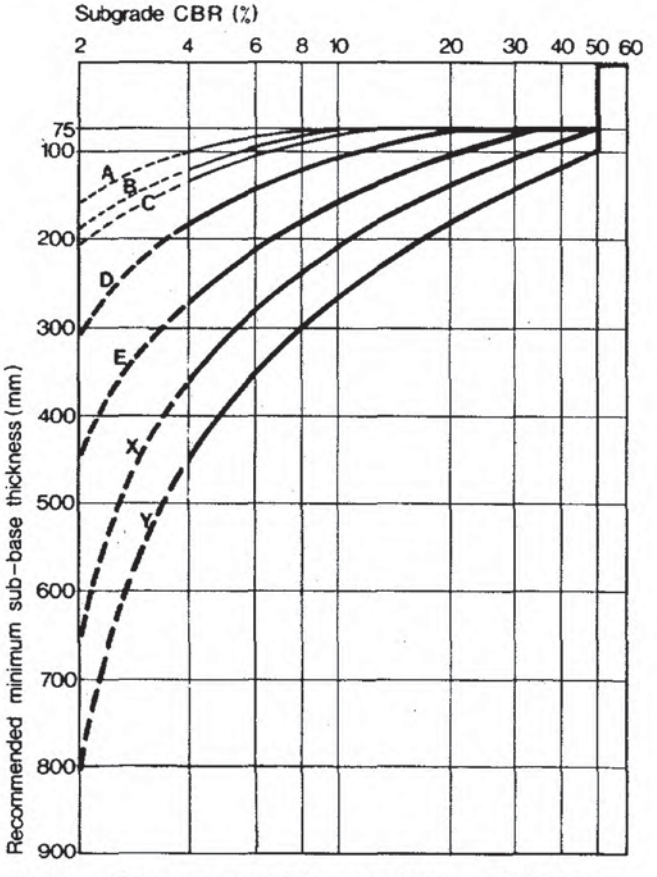


Figure. Recommended Minimum Sub-base Thicknesses

Notes to Table

(1) ref. NAASRA Pavement Thickness Design Manual.

(2) See MA15, Interim Specification for Interlocking Concrete Paving Units, clauses 4.3 and 4.5.

(3) H = Herringbone; S = Stretcher bond and Basket-weave.

(4) 80mm units may be required to cope with high point loads imposed by fire fighting equipment etc.

(5) For malls laid over sound established pavements 75mm cobblestones or 60mm Shape Type B units may be suitable.

(6) Excluding areas where straddle carriers are in use or where vehicles operate on common alignments.

Notes to Figure

1. For a C.B.R. <4%, subgrade improvement by stabilisation should be considered.
2. Sub-base material should have a minimum C.B.R. of 50%. See also Clause 3.4.

Architectural rather than engineer–ing demands led to the introduction of Unidecor. Abbeystonc. Symmetry pavers and Hexylock pavers.

The outstanding success story, as mentioned earlier, is the Cobble–stone. This was first developed in Melbourne by Monier lamited as a replacement for secondhand basalt setts, recovered from the old port roadways. These had long been favourite elements in both private garden and municipal park land–scaping. As supplies became exhausted prices soared, frustrating a well-established public demand. Monier Limited had recently developed a technique for producing a multi-chromatic concrete brick, which was rumbled after manu–facture to remove arrises. The same technique of rumbling proved successful with a double-brick-sire unit and so the Cobblestone was born. Units are now manufactured in a range of sizes, but the 230 x 185 x 75 mm is the most popular, probably because it is the most aesthetically pleasing, particularly when laid in random bond. The unit stands upto light traffic well, and is more easily laid than the chamfered brick type unit, because its irregular appear–ance favours a random bond. Because of its pleasing scale it blends well with most environments and is finding extensive use in pedestrian street repaving schemes, and in national parks. It is also a popular paving element for used-car sales yards. However, domestic applications predominate as it is the unit most favoured by the home handyman.

Colours of units

Pigmented units tend to dominate the Australian market for home improvements, municipal footpaths, and architectural applications.

Favoured colours are manganese brown, light sandstone, both light and charcoal greys and bright red. White units arc used but mainly for surface delineation. Pale straw coloured units, based on a local off–white cement, have been used most successfully to infill traffic islands and median strips in busy thorough-fares in Tasmanian cities. The choice of colour was dictated by road safety considerations, to case driver identifi-cation of road and island geometry and pedestrians using the islands or median strips, particularly under poor lighting or inclement conditions.

Design of pavements

An updated Interim Design Guide for the Design of Interlocking Pavements'[1] based on Dr Shackel's work and recommendations, has now been published by the Cement and Concrete Association of Australia.

Three design factors are worth considering:

(a) the estimated traffic loading.

(b) the strength and performance characteristics of paving units, and

(c) the strength of the subgrade.

In the recommended design procedure the designer first identifies the anticipated traffic conditions and then selects the shape, thickness, and preferred laying bond for the paving unit. Granular sub-base thicknesses are then read off relative to sub-grade bearing capacity as assessed by the California Bearing Ratio (Table 2).

For the lighter trafficked pavements a number of options are offered based on matched performance characteristics of various shape, thickness, and laying pattern combinations. For heavier traffic loads, only Shape A. 80 mm units laid in herringbone bond are recommended.

It should be noted that, for all pavement classifications, an arbitrary sub-base depth of 75 mm minimum is specified This is considered to be the practical limit of mechanical spreading equipment.

However, if the designer is confident that:

(a) the subgrade has adequate stren (CBR above 20).

(b) the t fic is likely to be light (A. B, or C) with no wheel loads over 2.3 tonnes, and

(c) the consequences of large rut depths or pavement failure under extreme combination of loading and



Town House at Frankston, Victoria, where 60 mm Unidecor units were used for car access ways.



Cream coloured Unipave units were used to make these traffic islands in Hobert, Tasmania, visually conspicious at all times.

environmental conditions are understood and accepted,

then the crushed rock sub-base may be omitted.

Construction of pavement

Australian construction practice has been modelled on the recommendations of Knapton[2] and Lilley & Collins[12] and the 1976 film "Concrete Block Paving", produced by the Cement and Concrete Association, London.

Following Shackel's findings[5] regarding improved pavement performance using sand bedding having less than the 50 mm uncompacted thickness recommended by the foregoing, a figure of 30mm± 10 mm uncompacted thickness was adopted. As most major trafficked pavements are laid by construction teams either employed by, or under the supervision of, the manufacturer of the paving units, it has been possible to directly assess the practicability of using this sand thickness over the past 18 months. To date no particular problems have been experienced despite the need to control subgrade preparation and final trimming of the compacted sub-base to within ± 10 mm of the design profiles - a much stricter requirement than in most flexible pavement construction.

Consequently, Hodgkinson, in the "Interim Outline Specification for Construction of Trafficked Interlocking Concrete Pavements"[1]' (published to complement the Interim Design Guide) has recommended the adoption of this figure.

The number of load repetitions necessary to achieve the "locked-up" condition described by Shackel[5 7 14] has resulted in a long hard look being taken at the adequacy of present compaction procedures using a small plate vibrator for - typically - three passes to bring the units to design profile and to eliminate all lipping between adjacent units prior to filling of joints. Von Langsdorf[15] reported success with the use of normal road-building vibrating rollers in the construction of a wharf at Bremerhaven to break paving clusters into individual units and to achieve full compaction of the pavement. It is hoped that a test strip to be constructed in conjunction with the Australian Road Research Board will offer an opportunity to test pavement performance relative to various compactive techniques. An obvious field for future work is to determine whether most of the plastic deformation occurring very early in the life of the pavement and well before final lock-up can be corrected by recompaction of the pavement prior to lock-up.

TABLE 3: Recommended grading limits for bedding sand

Sieve size	9.52 mm	4.75 mm	2.36 mm	1.18 mm	600 μm	300 μm	150 μm	75 μm
% Passing	100	95-100	80-100	50-85	25-60	10-30	5-15	0-10

Lacking specific data in this regard, Hodgkinson[13] has been content to recommend that where maintenance of the design profile and the rideability of the surface is critical, and where heavy vehicular loads are expected early in the pavement's life, consideration should be given to pre-loading the pavement using a heavier compactive effort to supplement the plate vibrator prior to acceptance of service traffic.

Laying

Laying complex profile units has been found to present little problem given proper setting out and adequate supervision. Most work in Australia is done by unskilled labour under skilled supervision. Typical laying rates, on straightforward work overlaying a properly-prepared sub-base, are 100 m^2 of completed pavement per 4 man team per 8 hour day. Generally it is found that laying rates achieved with units running 40 per m^2 are in excess of those for units running 50 per m^2. Optimum laying rates also demand units having a mass of less than 4 kg and units which can be comfortably hand held.

Because of the tendency of some members of a team to lay "tighter" (ie with smaller joint spacing) than others, it has been found good practice to rotate all members of the team regularly through all tasks. This tends to overcome any potential problems in this regard, particularly on large areas of paving where it is necessary to marry together the work of more than one laying team.

The major effort in the laying of paving continues to be the depalletising of units and their conveyance to the laying face. Whilst recent German and South African developments in purpose-made trolleys make a considerable contribution to the potential reduction of the problem, it remains an area worthy of study if greater productivity is to be achieved.

Sand

A number of severe efflorescence problems have been encountered with interlocking pavements. These problems have generally been traced to soluble contaminants in either the bedding or joint filling sand. Consequently Hodgkinson[13] has recommended that all bedding or joint filling sand be free from soluble salts or contaminants before acceptance for pavements where appearance or skid resistance are critical factors.

Sand grading limits recommended for bedding sand are given in Table 3.

Edge restraint

The need for adequate edge restraint has to be emphasized constantly to ensure proper practice. Unfortunately, research to the present time has not measured the stresses induced at either longitudinal or transverse abutments and so no specific data are available on which to base design procedures. To date the use of standard municipal kerb and gutter profiles has proved adequate for longitudinal edge restraint for road pavements over a properly constructed subgrade and sub-base. Hodgkinson[13] recommends that sub-base construction should extend beneath the edge restraint over its full width to provide a sound footing for the edge restraint and to control swelling of expansive subgrade soils which could otherwise lead to heaving or tilting of the edge restraint.

In pavements designed for heavy wheel loads in poor and saturated subgrade conditions such as container terminals on reclaimed harbour foreshores, considerable rotations have been occasionally observed even when massive concrete edge restraints have been used. Whilst it is probable that the failure mechanism is related to shear failures within the subgrade, edge restraint design for these applications is an area requiring further research.

Service access

One of the principal reasons underlying the selection of interlocking paving for footpath and pedestrian street construction has been the comparative ease of access to underground services, without the risk of permanent despoilage of the pavement. This was clearly borne out in the Oxford St Mall in Bondi Junction, NSW, where extensive renewals of underground telephone cables had to be undertaken shortly after paving was laid, and before the mall was complete. Sections of the paving were successfully lifted and relaid throughout this work with few breakages. However, lifting units once the "locked-up" condition has been reached has proved less easy than first expected. Current practice is to insert masonry anchors into about four adjacent units and then lift them out with a car jack. This breaks bond and allows flanking units to be removed with relative ease although extensive disturbance of adjoining units may result. Where

the pavement is laid to a substantial fall (say in excess of 2%), it has been found necessary to wedge the pavement by timbering across the service trench to prevent relaxation and creep from closing the opening created, If this is not done, reinstatement of the disturbed units can be an expensive and time consuming task involving extensive cutting and retrimming with consequent despoilage of finished appearance.

Applications

Curent usage of interlocking paving is in the order of 3 million m} per annum. The major contracts to date have been for repaving streets converted to pedestrian use. Typical Installations have been the use of: Pavelock in the Townsville Mall, Queensland; Unidecor in Oxford St mail. Bondi Junction, NSW; and Cobblestones in The Corso, Manly, NSW; Bankslown Mall, NSW; and the outstanding Quadrant in l.aunces(on, Tasmania.

In these applications interlocking paving demonstrates many of its inherent advantages, eg the ability to produce an aesthetically pleasing pavement in a wide range of pleasing colours, having a pleasant scale, which can accept delivery, emergency, service and construction vehicles and the high point loads from fire-fighting equipment, mobile cranes, etc. and grant comparative case of access to services, yet is easily replaced if spoiled or damaged. They also emphasize one of the few disadvantages of the material, ic the problems associated with staining from foodstuffs, oil droppings and chewing gum. Suitable coatings and the possible incorporation of admixturcs to help overcome these problems arc being investigated as is the problem of cleaning, but so far Utile progress has been made. Admittedly, removal and reinstatement is one solution, but at best this is a clumsy approach.

Residential street construction is a growing area of application. Successful sub-divisional streets have been completed in Western Australia. South Australia and Victoria. The Housing Commission in New South Wales and the Housing Trust in South Australia have made excellent use of the material in residential street construction, particularly for access routes to medium density town house developments.

Inner city street repaving schemes have been completed in Melbourne. Adelaide and Hobart. The most recent of these in Hobart was Salamanca Place - a most attractive and carefully preserved historical area of the waterfront. Here 80 mm Unidecor units were laid over an existing flexible pavement to handle normal street traffic and industrial traffic servicing the flanking warehouses, and to provide an aesthetically pleasing environment to complement both the historical structures and the street fair held in the area each weekend.

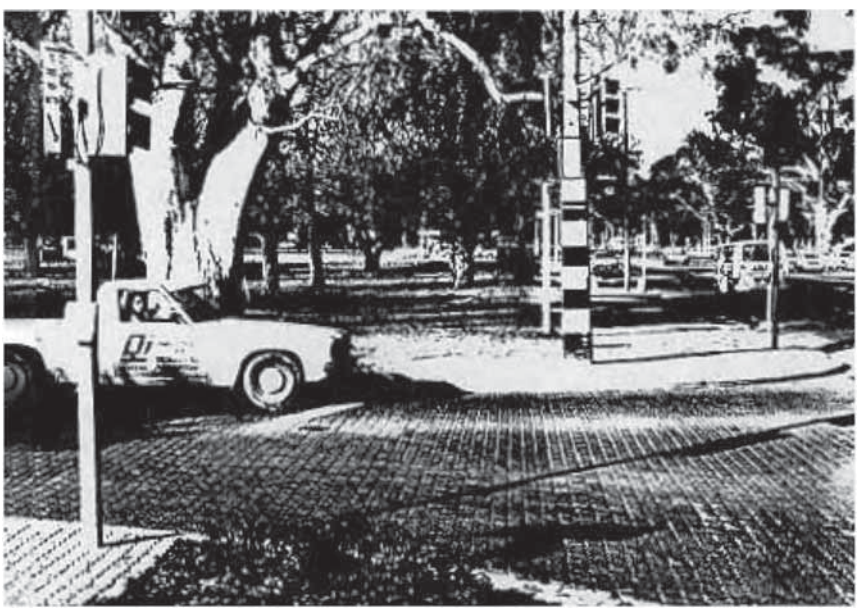
The conversion was completed only a few weeks prior to a mishap causing diversion of all traffic servicing the bayside suburbs through Salamanca Place, for a period of several weeks. Despite the pavement having not been designed for such a traffic load, it has performed perfectly.

Heavy duty engineering applications are only now in the development phase following publication of the various research papers and design and construction guides. It is in this area that interlocking paving offers the greatest cost advantage over competitive materials particularly overlaying in areas with poor quality subgrades or where settlement may occur. Completed works include a container and blister copper wharf area in Townsville, and container wharf areas in Melbourne and Adelaide. Heavy industrial hardstandings have been put down in most Slates and arc performing well. A major transport terminal is near completion in Melbourne and a bus/ rail interchange has been in service in that city for about a year. AD the last have followed Shackel's design recommendations. Performance is being monitored io provide field validation of the design proposals.

Adelaide, where interlocking paving was first introduced, remains the showpiece for the material. Outstanding work has been done by Adelaide Council in the upgrading of



The terracotta and buff coloured 100 mm thick Pavelock units contrast with the standard grey units allowing the underground services to be delineated (Townsville Wharf, Queensland),



A rumble strip of 60 mm Unipave units used to warn driven that they are nearing an intersection (Adelaide, South Australia).

old residential streets in the North Adelaide area to make them safer roadways for the cross-overs, driveways, street intersections, pedestrian crossings, and discharge points to peripheral collector streets. The resulting work is held in great regard by the design and town planning professions as a unique contribution to improving the urban landscape.

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