CONCRETE PAVEMENT TYPES

1. INTRODUCTION

Original concrete pavements, which have been built in Victoria since early this century, still exist mainly as residential streets. Many of the very old concrete pavements on arterial routes have since been overlaid with asphalt. Old concrete roads were also designed and built with an asphalt wearing course (i.e. as composite pavements) rather than a surface treatment later on.

In the last 20 years, design and construction techniques for placing concrete have virtually eliminated the characteristic 'thump-thump' ride of the older concrete pavements and using sophisticated mechanical pavers it is possible to achieve concrete pavements with satisfactory ride qualities (NAASRA roughness less than 50 counts/km).

2. TYPES OF CONCRETE PAVEMENTS

Three main types of concrete pavement are used in contemporary roadworks as follows:

A. PLAIN JOINTED CONCRETE PAVEMENT (PCP)

These are the most common type of concrete pavements used in Victoria.

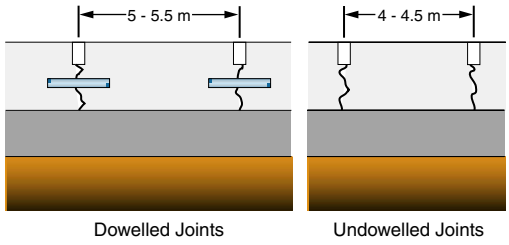
Plain concrete pavements do not contain steel reinforcement. Shrinkage cracking in the concrete is catered for by the regular sawing of transverse joints across the pavement usually at 4.2 m spacing. The concrete base is normally placed on a highly bound subbase for heavily trafficked roads. This subbase which is usually 5 MPa Lean Mix Concrete or 5% Cement Treated Crushed Rock is used to resist erosion, limit pumping and provide support to the joint. Steel fibres or mesh can be added to increase resilience where unconventional slab geometry is used.

(i) Undowelled Joints

Load transfer is provided by aggregate interlock across the joint with short (4 m to 4.5 m, typically 4.2 m) slab lengths. Performance is optimised for long uninterrupted runs using slipform paving.

(ii) Dowelled Joints

Galvanised steel dowels (dowel size is dependent on slab thickness[1]) placed at 300 mm spacing across the transverse contraction joint can be used to provide vertical load transfer from one slab to another. Dowelled joints are generally used with lean mix concrete subbases and correct positioning of dowels is important.



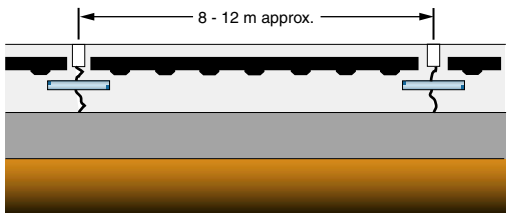
Plain Concrete Pavement

B. JOINTED REINFORCED CONCRETE PAVEMENT

Jointed Reinforced Concrete Pavements (JRCP) have slab reinforcement to control mid slab transverse cracking, allowing longer slab lengths to be used (typically 8 to 12 m). These are also typical of the slab lengths of very old concrete pavements.

Due to the increased amount of shrinkage of each slab compared to PCPs, dowels are mandatory at each transverse joint to transfer vertical shear forces from slab to slab and to reduce stress transfer to the subbase.

This type of pavement is now rarely used except in urban areas where reinforcing is desirable over variable ground support and around drainage pits. JRCP is preferred to PCP in piece meal construction.



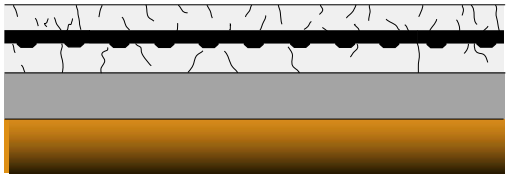
Jointed Reinforced Concrete Pavement

C. CONTINUOUSLY REINFORCED CONCRETE

This pavement contains no contraction joints and is suited to construction where low routine maintenance is required for very heavily trafficked pavements, particularly if traffic can not be easily re-directed to allow for maintenance. This type of pavement controls the spacing and width of transverse cracks by using longitudinal reinforcement for the entire length of the pavement.

The cost of providing and placing the steel reinforcement bars increases the initial capital cost of these type of pavements by about 30% when compared to plain jointed pavements of the same thickness. However, this cost is offset by low maintenance expenditure.

In all of the above pavement types, longidinal joints are typically tied.



Continuously Reinforced Concrete Pavement

3. ECONOMIC CONSIDERATIONS

Concrete pavements are more likely to be cost competitive, especially on a 'whole-of-life' cycle costing basis which includes routine and periodic maintenance costs where:

- traffic volumes or design traffic loadings are high,
- very poor foundation conditions exist, or
- low maintenance and rigid pavements are preferred.

Uniformity of support is essential for rigid pavements and use of a selected material over expansive subgrade is recommended.

For major road construction, VicRoads allows industry to propose alternative flexible and rigid pavement types by competitive tendering. These tenders are evaluated using a whole-of-life cost analysis.

For typical major urban roads the initial construction costs of concrete pavements are similar to the costs of bound flexible pavements (eg. Deep Strength Asphalt Pavements).

4. DESIGN PRINCIPLES

Rigid pavement thickness is designed to satisfy two main criteria:

Fatigue strength - *which is the structural adequacy of the pavement required to withstand the predicted number of heavy load repetitions without fatigue cracking over the design life; and*

Subgrade/Subbase erosion resistance - *which limits the effects of repeated pavement deflections at slab edges, joints and corners, thus controlling the erosion of foundation and shoulder materials.*

5. STRUCTURAL DESIGN

The structural design method is described in Austroads 'Pavement Design'[1]. Additional information is given in VicRoads Technical Bulletin No. 37[2].

Functional design and joint detailing and construction requirements are detailed in RTA (New South Wales) manuals[3,6].

6. NOISE

For vehicle speeds greater than 70km/hr road/tyre noise from hessian dragged concrete surfaces can be louder than for asphalt surfaces[5]. In urban areas especially, an Open Graded Asphalt (OGA) may be applied to reduce traffic noise levels. Refer to GeoPave Technical Note 4[4] for details on placing OGA surfacing over concrete.

7. REFERENCES

1. AUSTROADS. (1992). *Pavement Design. A Guide to the Structural Design of Road Pavements.*

2. VicRoads. (1993). *VicRoads Guide to Pavement Design*. Technical Bulletin No 37.

3. Roads and Traffic Authority of NSW. (1992). *Concrete Pavement Manual*. Design and Construction.

4. VicRoads. (1993). *Open Graded Friction Course Asphalt*. GeoPave Technical Note 4. August 1993.

5. Yeo R.E.Y. and Foley G (1996). *Bituminous and Concrete Surfacing Trial : Report on Performance Monitoring. AAPA 10th International Asphalt Conference, Perth Australia.*

6. Roads and Traffic Authority of NSW. (1996). *Concrete Roundabout Pavements - A Guide to Their Design and Construction.*

8. CONTACT

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