TMC – Tinni Management Consulting

PAVEMENT INFORMATION NOTE

Issue No. 30

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24 09 2009

Explanatory Notes Regarding Design of Composite Pavements

Purpose

These notes have been compiled to provide an overview of the design parameters for the commonly called Composite Pavements. The correct terminology is in fact: Deep Strength Asphalt (DSA) on cemented subbases. They are intended for designers who may not be familiar with this type of pavement or its formal acceptance as an alternative Heavy Duty pavement. The pertinent design references are also quoted.

Background

Pavements are classified either as rigid or flexible. The various types of concrete pavements are "rigid", with all other types being "flexible". Any composite pavement is thus defined as a flexible pavement and is designed using a mechanistic design procedure, which now has a computer program called CIRCLEY. This is the basis of the Austroads Pavement Design Guide and is used by all States.

In the case of NSW, the RTA classifies composite pavements as Heavy Duty Pavements and further subdivides them as:

- deep strength asphalt over cemented subbase and
- deep strength asphalt over lean mix concrete subbase.

Besides the alternative composite pavements, the other acceptable Heavy Duty pavements are: plain concrete pavement (PCP), continuously reinforced concrete pavement (CRCP) and full depth asphalt (FDA).

Austroads References

The design guidelines for both rigid and all types of flexible pavements are provided by the "Austroads Pavement Design – A Guide to the Structural Design of Road Pavements (2004)".

Clause 6.6.1
"Concrete can be used as a subbase in either flexible or rigid pavements and also as a base in rigid pavements".

Clause 6.6.2
"Lean mix concrete subbase should have a 28 day compressive strength of 5 MPa (with fly ash) or 7 MPa without fly ash)".

"The construction of both rigid and flexible bases over poor subgrades is facilitated by the adoption of a concrete subbase. For example, poor subgrades may preclude the achievement of adequate compaction in unbound or cemented granular materials or asphalt, which comprise the lower layers in flexible pavements".
"Where subbase concrete is used in the design of flexible pavements, the characteristics which must be known and evaluated for structural design purposes are modulus, Poisson's ratio and the response to repeated loading".

Clause 8.2.4
"To inhibit reflective cracking the pavement should provide a minimum cover equivalent to 175 mm of AC over the cemented material" As AC is the most expensive constituent in the pavement structure, this is the basic criterion used in the composite pavement design.

Table 8.2 – Catalogue of Example Design Charts
Austroads provides 24 graphs as Examples of Design for various configurations of flexible pavements (AC on granular, AC on cemented bases of 2000 MPa and 5000 MPa elastic modulus and FDA on various subgrade strengths). Of these, 12 relate specifically to AC on cemented material. These graphs are useful for quick comparison of the likely pavement thicknesses and for preliminary costing. The detailed designs are always done with CIRCLEY.

Table 6.5 - Cemented Materials Elastic Modulus
The Guide gives the presumptive design values of the elastic modulus for various cemented materials as follows;

- Lean mix concrete – 10,000 MPa
- Base with 4-5% cement – 5,000 MPa
- Subbase quality crushed rock with 2-4% cement - 3,500 MPa
- Subbase quality natural grave with 4-5% cement - 2,000 MPa

Table 6.11 - Typical Australian Asphalt Modulii (MPa)
The following are for typical Australian DGAs based on laboratory testing using indirect tensile testing procedures with standard test conditions and 5% air voids:

Binder	Aggregate		
	10 mm	14 mm	20 mm
C170	3,500	3,700	4,000
C320	4,500	5,000	5,500
C600	6,000	6,500	7,000
Multigrade	4,500	5,000	5,500

RTA References

RTA Technical Direction 2003/05 of 11 June 2003:
"Where the base course consists primarily of layers of AC, this is termed Deep Strength Asphalt Pavement. The subbase course may typically be bound pavement material or lean mix concrete".
"To relieve moisture from AC layers, effective edge drains are recommended as part of the pavement structure of Full Depth and Deep Strength Asphalt pavements. This will decrease the potential of moisture damage, but the asphalt

must still be designed, produced and placed so that it can withstand the presence of moisture in the pavement".

RTA Supplement to Austroads Guide (Dec 2005):
Clause 6.6.2 – Subbase Concrete in Flexible Pavements
"For design purposes the mass concrete subbase can be assumed to be isotropic with a modulus of 10,000 MPa and a Poisson's Ratio of 0.2. The modulus value is low when compared to actual laboratory test values, but is considerably realistic….."
Table 8.A
"The minimum asphalt thickness over cemented subbases, including lean mix concrete is 175 mm"
"The maximum layer thickness of any cemented layer (excluding LMC) in a new pavement is 200 mm to ensure full compaction……..Multiple layers of bound pavements are to be avoided".

In Summary

1 There is a basic difference in the design methodology for design of composite pavements using lean mix concrete subbase and cemented material subbase:

- For LMC subbase, the minimum base AC thickness of 175 is adopted and then the subbase concrete thickness calculated to suit the traffic loading. Concrete does not have a thickness criterion. This could be, say, 220 mm.
- For cemented material subbase, the maximum subbase thickness of 200 mm is adopted and then the asphalt base thickness calculated for the particular traffic loading. This could be, say, 280 mm.

Generally there is a significant difference in the construction costs,

2 For AC on cemented materials, especially LMC, the design ensures that the dominant distress mode is fatigue in AC. This principle is also termed "top down design" as pavement failures or "end of life" conditions commence on top, ie in the AC rather than the Subbase.