TMC – Tinni Management Consulting

PAVEMENT INFORMATION NOTE

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Concrete Pavement Slab Replacement – Simpler Can Be Better

Ref. National Conference on Preservation, Repair and Rehabilitation of Concrete Pavements. St Louis, Missouri April 2009

The following are extracts from the paper by Jim Grove (FHWA), Jim Cable (Cable Concrete Consultation) and Peter Taylor (NCPTC):

- (Unfortunately) many agencies approach patch design and construction from the mindset of conventional concrete paving, which results in a number of unique properties of a patch being overlooked.
- "Patches" should only be designed to match the remaining life of the pavement. (**Designing for longer life is a waste of public funds).**
- The opening strength of the concrete should be sufficient to carry the immediate loading when opened to traffic.
- The Co-efficient of Thermal Expansion of the patch mix should be similar to, or less than, the existing concrete to prevent stresses from differential movements between the patch and the existing pavement. (This is an academic requirement as the CoTE of a pavement that may be 20 years(?) old would not be readily available. Matching the type of coarse aggregate would be ideal if possible).
- Currently the minimum opening strength of the concrete is an empirically established limit and often by "gut feel".
- Cylinder strengths were used to assess, but the specimens do not really represent the pavement condition of a large mass under a curing membrane where the strength gain is different and the lateral confinement will also increases the bearing capacity. Nowadays, in-place testing methods like maturity testing can more closely estimate the concrete strength in place.
- Less strength is required of the patch to provide a service life corresponding to the remaining life of the pavement.
- Okamoto (FHWA) has shown that the opening strength does not have to be much above the final set level.
- Americans already replace slabs in a 6 – 8 hour window.
- High early strength concrete is not recommended as the faster it gains strength, the sooner strength gain will slow down or stop.
- Calcium Chloride accelerators will normally create significant amounts of heat, hence there is the likelihood of cracking as the concrete cools. This can also induce "thermal shock" (ie 20ºC differential in the temperature gradient) which will also initiate cracking.
- Extra cement will increase the heat of hydration, drying shrinkage, cracking and cost.
- Okamoto and other researchers have shown that a 254 mm slab with compressive strength of 7.18 MPa (flex 1.38 MPa) would not experience

fatigue damage after 10,000 cycles of standard (US) axle passes. (Our minimum thickness for PCP is actually 250 mm).

Conclusions:

1 Use conventional concrete with no accelerator.
2 Use age as the only criteria for opening to traffic. (Under controlled curing and temperature).

Notes:
1 ACPA recommends 1.72 MPa flex (8.9 MPa compressive);
2 Davis and Darter recommend 1.38 MPa flex (7.2 MPa compressive)

3 Tinni recommends 9 MPa compressive strength as sufficient for opening.