

MINUTES: TTCC/NCC Fall Meeting
October 6-8, 2009 – St. Louis, MO

Tuesday, October 6 - Research and Technology Transfer Activities of National Interest

CP Road Map, Mix Track Research and Technology Transfer Projects – Peter Taylor

Within the Mix and Design track of the CP Road Map the projects presently underway include:

- TPF-5(179) – Permeability
- Oklahoma & Michigan - Air void system
- TPF-5(117) – Ternary project
- Optimizing cement content
- TPF-5(205) – MDA

❖ **TPF-5(205) Mix Design and Analysis (PowerPoint 1Taylor)**

- Acoustic Setting Time Device: Temperature has been used as an indicator – but is temperature a sufficient indicator? It does not show whether interaction between chemicals has occurred. Using sounds as an indicator that connectivity has occurred looks promising.
 - Ultrasonic equipment? Sharp change will indicate lack of stiffing
 - Hyper-Pave tech brief – on using sound waves, Pulse Velocity
 - Leif Wathne: ACPA/PCA joint engineering bulletin, "Design and Proportioning of Concrete Paving Mixtures" (EB401) is now in final editing, to be printed in early 2010.
- Mix proportioning
 - Many approaches:
 - Biggest issue on fineness modulus: Mix based on fineness + variance factor. Used by ACI, Hover, and PCA
 - Void density (Compass). Take minimum void and add paste
 - Specific surface (Day) How much water does it take to wet the aggregate
 - Workability factor (Shilstone)
 - ICAR approach
 - Choose aggregate
 - Use Compass aggregate system and compare theory with mixtures
 - Early testing is showing maximum density and power 45 curve about the same
 - When void is determined, choose paste quantity
 - Is the workability much different and does it really affect the concrete? This is being addressed in another project
 - Choose paste quality
 - What cementitious materials, admixtures
 - Need to put it all together, determine the level of precision needed.
 - Air Void *Test Methods to Evaluate the Air-Void System in Fresh Concrete (PPT 2-Ley)*
 - Volume is not the only measurement, need spacing also
 - Pressure meter measures void in the paste, but also measures the voids in the rock – 1.8% error in void due to aggregate.
 - Rollermeter – needs about 20 minutes for it to work; too long for every truck, and method is too difficult to maintain quality for an entire day.
 - Unit weight method - only measures volume, no indication of size or spacing.
 - AVA: Shows promise. Shows distribution and size and in theory it should work but, we need to work on the where and how of the variances
 - CT scanner – awesome equipment, non-destructive, accurate – but unrealistically expensive.
 - Hover Meter (modified pressure meter): Promising and deserves continued testing
 - Quantifies air-void system instantly in fresh concrete
 - Investigates a sample of significant size
 - Economical and Field ready

Questions:

- Have you found any indication that air bubbles that are too small will affect freeze-thaw? No, not yet.
- Time line: when do you anticipate knowing about the viability of the Hover Meter? Working to figure out the paste by next summer. Planning to have some test models by the end of next summer.

❖ **TPF-5(117) Performance Properties of Ternary Mixes – Paul Tikalsky (3 Tikalsky)**

- Project started in 2004, and in 2010 it's moving into Phase 3, the field application
- Phase I report is out. Going back to compare the wet kiln used in the Phase 1 testing to the dry kiln presently being used.
- Finalize Phase II concrete mixtures and define concrete performance test and data
 - Can you add fly ash to some of these mixes? Class C fly ash, F fly ash, F2 fly ash
 - All of these met the pozzolanic index
 - Found the admixtures had the same problems in testing at ISU and Penn State lab. More complicated mixtures need to be tested with admixtures used in the field.
- Phase III: field testing: Looking for more states.
 - Because of asphalt issues in Utah, both refining plants are not producing and Utah DOT has switched to concrete.
 - Salt Lake County - Contractor said the Ternary blend was easier to work with, finish smoother
 - PennDOT will be paving two bridges on a major truck route, using the same contractor, same crew – looking at two ternary mixes

Questions/comments:

- Re: Utah projects. Has saw window changed with higher scms? Decision was made not to tell the contractor/crew the mix was different. The crew's only comment was that the day "went smoother" than normally. Saw time was the same.
- On bridge decks it's a bit slower
- Keep salts off during drying period to alleviate scaling issues
- F2 fly ashes come from Saskatchewan basin and Texas. (North Dakota is part of Saskatchewan basin)

❖ **Joint Deterioration - Dan DeGraaf**

- States are reporting a major problem with joint deterioration. i.e. A pavement tested at the plant showing 6% air, and when placed 0-3%, etc.
- Many think water penetration is the problem and lower air makes the problem worse. Something needs to be done quickly.
- Procrete is a colloidal silicate of interest. It is being used to waterproof joints. The liquid becomes gel like after being injected; this gel resists water
- Air void system can be a problem – could Procrete solve the problem for concretes that have compromised air void system that are already in place

Questions/comments:

- Does the Mix track group need to develop a protocol that determines whether it's "snake oil" – a protocol that can test each of the materials to determine viability?
- We can't wait forever – need to try some of these on problem roads, need to do SOMETHING to treat the joints to keep the deterioration from getting worse.
- Has anyone done any freeze-thaw testing on Procrete material?

❖ **Paste Quality Study – Larry Sutter (4-Sutter)**

- AVA – lots of interesting things, but it doesn't do a good job of determining total air.
- Sorptivity: generally what we expected: high sorptivity = bad freeze-thaw, low sorptivity=good freeze-thaw.
- AASHTO has test, ASTM has no test for absorption of aggregate.
- Even if number is not absolutely correct, Air void can be an indicator,

- How many tests can be run? AVA can take up to an hour to run 3 tests.
 - Need to have qualified person running these tests.
- ❖ **TPF 5-207 Determination of Joint Deterioration in Concrete Pavements – Peter Taylor (5-Taylor)**
- Non-uniformity of air system seems to be something we should look at
 - See PowerPoint slides for field examples
 - Slides show water saturation area and joint deterioration
 - Pooled fund project will look at types of sealants and when they should be used
 - Research team is still developing work plan, but will start project this fall (2009)
- ❖ **TPF 5(179) Evaluation of Test Methods for Permeability (Transport) and Development of Performance Guidelines for Durability - Tommy Nantung (6-Nantung)**
- Six phase project
 - Phase I - Survey of methods is complete; final draft of methods in use (survey) and available methods (lit review) is being written
 - Evaluation of Transport Tests
 - Sorption
 - Diffusion
 - Permeability
 - Potential Application of Fluid Ingress in a Partially Saturated System (Pavement)
 - Summary:
 - Lit. Review Highlighted Numerous Tests
 - Test methods are being preliminarily evaluated
 - Work is using properties to predict performance for practical problems
 - Correlations are being developed for other durability related problems
 - Open House In Spring

Pavement Research and Technology Transfer Projects – Brett Trautman, Moderator

- ❖ **CP Road Map update – Paul Wiegand (7-Wiegand)**
- Detailed information on tracks and teams are available on the CP Tech website
 - Need more people involved
 - Work plan is to meet with DOTs and find out what research is being done, what are priority projects, strengths of each location
 - This information will allow the Center to assist with research teaming and Tech Transfer for on-going or completed research
 - CP Tech Center will create a research booklet for each state participating in the Road Map information meeting – the booklet will be a quick summary of projects advancing the Road Map
- ❖ **Recommendations on dowel basket standardization – Matt Zeller (8-Zeller)**
- Need standardization or at least streamlined specifications for the manufacture of dowel baskets.
 - The questionnaire indicated most states fell into a close range, only a few were outside the “norm”
 - Discussion:
 - Position of the dowel cap works for the majority
 - Is the base part of the decision on dowel bars? Treated base is considered safety net if dowels aren't working. If that safety net is lost, will thickness of dowels become important?
 - V or J leg? Number of attachments varies.
 - What is the benefit? How much money can be saved?
 - If states are already close to the recommendation, not much savings will be realized, but others could see significant savings
 - How much more will the states who do not agree to recommendation have to pay for “special” dowels?

- States need to look at rationale for dowel basket being used. Why do neighboring states have different specs? Is there science behind it, or is it just history and reluctance to change.
- Will there be a document developed to answer question as to why?
- Bigger problem with dowel legs rather than load transverse.
- Will dowel bar design be reviewed? Coating thickness? Diameter? Depth of insertion?
- Dowel Basket Attachment Application evaluation – Carlos Haddad, Hilti (8b-Haddad)
 - If the base is different there will be different gradation.
 - Will be very difficult to standardize attachment.
 - Up to contractor as to how to attach – the standardization is that the basket won't move
 - End result should be performance based

Action Item:

- Maria Masten, Minnesota DOT, will head up a technical committee to draft DOT dowel basket specification
- Draft spec will be distributed for comment via the ListServe before the Spring NCC meeting.
- CP Tech Center will publish a tech brief of various techniques and the appropriate situation for each

❖ **Concrete Overlay Field Application Support – Dale Harrington (9-Harrington)**

- Program to use concrete overlay program finding the general comments are: Not comfortable with concrete overlays. Who else has done this? Can our contractors do this?
- Research on
 - Paving control
 - Traffic management
 - Separation layer
 - Opening strength
- What would be useful to workshop participants?
 - Tech brief on “value” of concrete overlays – 50%
 - Video of example projects – 10%
 - Video to tell story – 10%
 - Tech brief of current prices across the country, not marketing, but value in each state
 - Tech brief on alternate bidding
 - Information from NCC on how concrete will save money over asphalt – not a marketing piece, but facts and figures
- 6 hr workshop available through ACPT
- Overlay field program needs more field research sites.

Action Item:

- Send Dale Harrington/CP Tech Center names of individuals at DOTs that need to hear about Overlays
- Reminder this information is available on the website.

❖ **TPF-5(183) Improving the Foundation Layers for Concrete Pavements – David White**

- Although the pavement type, thickness etc is similar, the base is highly variable. Is there an optimum base to support the pavement?
- Project is part of the Long-life pavements track of the CP Road Map. Will need to figure out base before we can really answer question of long life.
- FWD gives really good information on what the base is like
- Project should help with M-E PDG. M-E PDG needs more data to verify differences, field control of what is being built. This project will help with input parameters, demonstrate quality control, and measure the things that are being used for construction process.
- Research being done in PA, MI, and IA

- PA had transverse cracking in 10 yr old pavement. Trying to inject foam that will harden to increase the stiffness of the base. Team will continue to investigate.
- All participants invited to a TAC meeting for the Foundations project in the evening for more specifics on the project. Minutes from TAC meeting are available.

❖ **Improving the Durability and Economy of Portland Cement Concrete through Internal Curing – Bruce Jones (10-Jones)**

- For many years we have cured concrete from the outside in; internal curing cures concrete from the inside out. Internal Curing is supplied via internal reservoirs, such as absorbent lightweight aggregate, which has been pre-saturated.
- Internal curing
 - Reduces Autogenous Shrinkage
 - Reduces Cracking
 - Hydrates more of the cement
 - Increases strength from first 24 h and beyond
 - Keeps Relative Humidity High
 - Reduces Self Desiccation
 - Reduces Chloride Permeability
 - Improves Durability
- Hydrocure

❖ **Initiating Cracks in PCC Pavements – Malcom Lim (11-Lim)**

- Increase cracking predictability.
- In order to influence the cracking formation, a small separation at the top of the PCC pavement is needed. The depth of separation can be minimized to an inch or less to allow for a visually pleasing appearance
- Utilizes current saw cutting methods
- Location of the initiator – inline with the dowel bar maximizes the influence on the location of the crack
- The initiator influences the behavior of the crack – predictable cracking behavior
- Overall thickness of separation can be $\frac{1}{4}$ to $\frac{3}{8}$ inch wide – slab depth dependant
- The initiator provides a discontinuity within the PCC pavement.
- The initiator reduces the critical stressing area to form the crack – area above the initiator
- The ability to control cracking characteristics. The precise location (longitudinal translation approx 1 in.) of the saw cut becomes a little less critical.
- May influence the saw cutting window
- Provide savings through better performance of the pavement slab