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INDUSTRY RESOURCES/RESEARCH REPORTS Chota Motala Interchange in South Africa

Implements CRCP

During the last 20 years, the number of road commuters in Pietermaritzburg, KwaZulu Natal, South Africa has rapidly grown. The N3 is the main artery between the city of Johannesburg and the port of Durban. Due to very heavy traffic on the N3 highway, residents have experienced overwhelming levels of traffic congestion.

To improve the overall transportation along Gauteng Province's major arterial freeways, in March 2010, the South African National Roads Agency Limited (SANRAL) began the construction of a multi-level interchange, the overlay and the widening of 3 km (1.9 mi) of the N3 through the area. The contract was awarded to Group 5 for R 280 million (\$35 million).



The existing Chota Motala bridge was lengthened and widened to 7 lanes. A new 223 m long (732 ft), incrementally launched bridge was constructed.

The concrete overlay of the existing 28-year-old jointed concrete pavement consisted of 180 mm (7 in) of Continuously Reinforced Concrete Pavement (CRCP) paved onto a 50 mm (2 in) of asphalt interlayer. The total area of CRCP will be around $100,000 \text{ m}^2$. (120,000 yd²). Due to the high levels of traffic congestion, the overlay was constructed in lane widths of $3.5~{
m m}$ ($11.5~{
m m}$ ft). In some cases the pavement was constructed in half-lane widths due to the position of the temporary columns for the launched bridge.

Bryan Perrie, Managing Director of the Cement & Concrete Institute (South Africa) and ISCP Board Member









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Night Paving of **Unbonded Overlay** - Paving of Unbonded Overlay aving of the nded Overlay Completed Unbonded Overlay

Open House for Unique Three-Pavement Concrete Overlay Project in Virginia, USA

The Virginia Department of Transportation (VDOT) is near completion of a unique 3-pavement overlay project on US 58 Westbound, Southampton County, Hampton Roads District in Franklin, Virginia, USA. On August 23, 2012, an Open House was held at Paul D. Camp Community College in Franklin, Virginia and was sponsored by the Virginia DOT, Virginia Center for Transportation Innovative Research (VCTIR) and the American Concrete Pavement Association, Mid-Atlantic Chapter (ACPA-Mid-Atlantic). The National Concrete Pavement Technology Center (CP Tech Center) partnered in the effort by providing selection, design and construction assistance throughout the project.

Moderated by Chung Wu, VDOT Hampton Roads District Materials Engineer, the Open House included a meeting to learn about VDOT's long-term performance evaluation of bonded and unbonded concrete overlay technology on this 3-pavement project as well as the cost effectiveness of extending the service life of existing CRCP. About 90 people attended the meeting, a luncheon, and field visits to the completed unbonded overlay and the bonded section under construction.







The total project length is approximately 8.5 km (5.25 mi). The existing pavement is a four-lane divided, rural highway with the majority being CRCP (7.68 km /4.77 mi) constructed between 1986 and 1988, with .77 km (.5 mi) Jointed Reinforced Concrete Pavement (JRCP) constructed in 1952.

This is a unique project, as it includes 3 pavement rehabilitation techniques of existing CRCP:

- 1) Bonded concrete overlay on CRCP
- 100 mm (4") thick
 - Surface preparation including full-depth patching and shot blasting - Reduced grade change
- 2) Unbonded concrete overlay on CRCP

 - 180 mm (7") thick unbounded concrete overlay
 25.4 mm (1") Porous Friction Course (PFC) as the separation layer with drainage capacity
- 1.83 m x 1.83 m (6 ft x 6 ft) joint spacing 3) Reconstruction of JRCP
- - 280 mm (11") thick jointed plain concrete pavement
 - 5 m (15 ft) joint spacing with doweled joints
 254 mm (10") aggregate subbase

and these sections are opposite a 140 mm (5.5") Hot Mix Asphalt (HMA) overlay (on the same CRCP pavement).

The project also highlights:

- Complicated Maintenance of Traffic (MOT) with many crossovers and accesses
- Very tight construction schedule: contract executed on May 22, 2012 to completion date on September 21, 2012
- On-going research by VCTIR to continuously monitor the project through construction and for long-term performance
- FHWA Concrete Mobile Lab on site for both the bonded and unbonded concrete overlay construction

The completed portion of the project presented very good results. The construction was completed on time, the concrete was of high quality and the ride quality is excellent. The third phase of the project is currently under construction and the entire project is scheduled to be completed September 21, 2012.

This is a unique project, existina





THESIS ABSTRACT

FRACTIONATED RECLAIMED ASPHALT PAVEMENT AS A COARSE AGGREGATE REPLACEMENT IN A TERNARY BLENDED CONCRETE PAVEMENT By Alexander Sebastian Brand

Graduate College of the University of Illinois at Urbana-Champaign, 2012, Urbana, Illinois Adviser: Professor Jeffery R. Roesler

Due to increasing quantities of fractionated reclaimed asphalt pavement (FRAP) generated from rehabilitation projects, the Illinois State Toll Highway Authority (Tollway) initiated a study to determine the application of the coarse fraction of FRAP in concrete. The concrete mix proportions contained 0, 20, 35, and 50% FRAP replacement levels by weight of the coarse aggregate. Two other by-product materials, ground granulated blast furnace slag and fly ash, were utilized as partial replacements for cement. A cementitious content of 824lb/m³ (630 lb/yd³) was used, which consisted of 65% Type I Portland cement, 25% Grade 100 slag, and 10% Class C fly ash. Past research efforts have primarily studied the effects of RAP on the hardened properties in concrete, but there have been limited studies on the comprehensive effect on the fresh, hardened, and durability properties of a single source of FRAP in concrete at various replacement levels.

In this study, as the FRAP content increased, it was found that the workability increased (even with lower water reducing admixture dosages), the unit weight decreased, and the air content remained relatively unaffected although somewhat more variable. A hardened air void analysis revealed acceptable parameters for freeze/thaw durability, but the hardened air content was found to be higher than measured volumetric fresh concrete air content. The concrete was workable for good pavement constructibility at all levels of FRAP replacement tested.

The compressive, split tensile, and flexural strengths all decreased with increasing coarse FRAP contents. The compressive strength decreased up to 39% with a FRAP content of 50%. Similarly, with 50% FRAP, the split tensile strength decreased as much as 52% and the flexural strength decreased approximately 33%. At 35% FRAP replacement, the Illinois Department of Transportation (IDOT) compressive strength requirement of 3500 psi at 14 days could still be met, while at 50% FRAP, the FRAP concrete mixture was 0.3% below this strength requirement. Based on the third-point (four point) flexural strength requirement of 650 psi at 14 days.

Similar to the strength properties, both the static and dynamic elastic moduli decreased with increasing FRAP content. The elastic modulus was reduced by 30% at 50% FRAP while the dynamic modulus decreased by 46% (at 4°C) with 50% FRAP replacement. At 21°C, the dynamic modulus was about 15% higher than the static elastic modulus for the control (0% FRAP) concrete, but at 50% FRAP, the static elastic modulus was 11% higher than the dynamic modulus. From the dynamic modulus tests, the phase angle only increased approximately 1° with the addition of 50% coarse FRAP to concrete. Changes in temperature and frequency did not significantly affect the concrete dynamic modulus at all testing ages and FRAP contents.

The concrete fracture properties with single edge notched beam specimens revealed that the critical stress intensity factor was generally reduced with the addition of FRAP. Despite the reduction in tensile strength and peak load at specimen failure with increasing quantities of FRAP replacement, both the total fracture energy and initial fracture energy were relatively unchanged. This fracture behavior suggests the load capacity of concrete slabs with FRAP will not be reduced at the same rate as the concrete tensile strength reduction.

In this study, the concrete free drying shrinkage was found to be unaffected by the coarse FRAP replacement levels and total cementitious content utilized. At the 0% and 50% FRAP contents, specimens under restrained ring shrinkage (AASHTO T334) did not crack after 90 days. The 50% FRAP ring experienced lower restrained shrinkage strains and higher stress relaxation at later ages relative to the control concrete, indicating potential positive tensile creep benefits of concrete containing FRAP. A rapid chloride penetration test was also conducted, and it was found that the FRAP content did not affect the chloride penetrability after an age of 56 days. The freeze/thaw durability was found to be suitable, with all mixes having a durability factor greater than 85 after 300 freeze/thaw cycles, although higher FRAP contents did reduce the durability factor relative to the control. A test for alkali-silica reactivity (ASTM C1260) evaluated the virgin coarse aggregate, the virgin fine aggregate, the fine FRAP particles (passing the #4 sieve), and the FRAP coarse aggregate with the binder extracted. The test revealed that the virgin fine aggregate was mildly reactive while the other aggregates were negligibly reactive. According to the IDOT specifications, the addition of supplementary cementitious materials or the use of a low-alkali cement would likely mitigate the expansion due to alkali-silica reaction in the fine aggregate.

Another FRAP source was also evaluated to determine the effects of a "dirty" unwashed FRAP, which contained a higher amount of fine particles (passing the #4 sieve) compared to the washed "clean" FRAP used in the main part of the study. The dirty FRAP was either washed or dry sieved to remove the fine particles or unprocessed before concrete batching. The removal of the fine particles did not improve the compressive and split tensile strengths of the concrete relative to unprocessed dirty FRAP concrete, but all dirty FRAP mixes, processed and unprocessed, up to 50% coarse FRAP met the IDOT strength requirements at 14 days.

Based on the results from this study, the replacement of virgin aggregate with 50% coarse FRAP in concrete will still produce acceptable paving concrete in terms of fresh, strength, durability, shrinkage, and fracture properties. Although the main mix design and FRAP source used for this study met the IDOT strength requirements at coarse FRAP contents up to 35%, a secondary "dirty" FRAP source as well as mixes tested by an independent laboratory were found to meet the IDOT strength requirements up to 50% FRAP.

CALL FOR ABSTRACTS & PAPERS DIGEST

December 31, 2012 Call for abstracts due for the 14th International Winter Road Congress to be held in Andorra, February 4-7, 2014. The theme is: ""*Reconciling road safety and sustainable development* in a context of climate change and economic constraints". For information, please go to: http://www.aipcrandorra2014.org/?lang=en.

UPCOMING EVENTS

SEPTEMBER 2012

SWIFT 2012 Conference and Trade Show September 17 - 21, 2012 in Banff, Alberta, Canada http://www.swiftconference.org/

Technology Transfer Concrete Consortium (TTCC) and National Concrete Consortium (NCC) Septermber 18, 2012 in Seattle, Washington, USA http://www.cptechcenter.org/t2/ttcc_ncc_meeting.cfm



FHWA ACPT International Conference on Long-Life Concrete Pavements September 18-21, 2012 in Seattle, Washington, USA http://www.fhwa.dot.gov/pavement/concrete/2012conf.cfm

7th Symposium on Pavement Surface Characteristics (SURF 2012) September 19-22, 2012 in Norfolk, Virginia, USA http://www.cpe.vt.edu/surf2012/index.html

4th International Conference on Accelerated Pavement Testing (APT 2012) September 19-21, 2012 in Davis, California, USA http://ucprc.ucdavis.edu/APT2012

Austria Concrete Paving Day September 25, 2012, 10:00 - 18:00, in Vienna, Austria www.zement.at ("Termine 25.09.2012 Österreichischer Betonstraßentag")



Tenth International Conference on Superplasticizers and Other Chemical Admixtures in Concrete October 2012 in Prague, Czech Republic http://www.intconference.org/

Twelfth International Conference on Recent Advances in **Concrete Technology and Sustainability Issues** October 2012 in Prague, Czech Republic http://www.intconference.org/

10th International Symposium on Brittle Matrix Composites (BMC10) October 15-17, 2012 in Warsaw, Poland

http://bmc.ippt.gov.pl/



2nd International Conference on Sustainable Construction Materials: Design, Performance and Application (SusCoM2012)

October 18 -22, 2012 in Wuhan, Hubei Province, China http://public.whut.edu.cn/zspj/suscom2012/

5th International Congress on Sustainability of Road Infrastructures October 29-31, 2012 in Rome, Italy http:// www.siivroma.it

NOVEMBER 2012

2012 International Pavement Engineering Conference (IPEC) November 1-3, 2012 in Busan, South Korea http://www.ipec2012.or.kr

2nd International Conference on Civil Engineering and Building Material (CEBM 2012) November 17-18, 2012 in Hong Kong http://www.iasht.org/cebm/

ACPA's 49th Annual Meeting November. 26 - 30, 2012 in Marco Island, Florida, USA http://www.pavement.com/Events_and_Programs/Events/index.asp

JANUARY 2013 **FEBRUARY** 2013

ISCP NEWSLETTER AUGUST 2012 VOLUME 9, NUMBER 8 92nd Annual Meeting of Transportation Research Board (TRB) January 13-17, 2013 in Washington, D.C., USA http://www.trb.org/AnnualMeeting/AnnualMeeting.aspx

9th Concrete Conference & Exhibition: Concrete for Sustainable Construction February 11-13, 2013 in Manama, Kingdom of Bahrain http://www.concrete9.org

For events taking place in March 2013 and beyond, please go to: http://www.concretepavements.org/calendar.htm.



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ISCP invites ISCP members and friends to submit articles and calendar items to the Editor-in-Chief for future issues.

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Please visit the **ISCP Website** at www.concretepavements.org for more information about ISCP.

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