IRA A. FULTON SCHOOLS OF ENGINEERING

Leading engineering discovery and innovative education for global impact on quality of life.

Fiber Reinforced Asphalt Concrete (FRAC)

Jeff Stempihar, P.E.

Graduate Research Associate

November 17, 2010

ASU Arizona State University

Overview

- Background
- Types of Fibers
- Benefit of Fibers
- Work at ASU
- Summary
- Challenges
- Future Work

Background

- Work began in the early 1950's
- Fiber types
  - Polyester, glass, asbestos, polypropylene, carbon, cellulose, etc.
  - Recycled fibers
  - Blended fibers
- Mixed performance results

Fiber Reinforcement Benefits

- Provides interconnection between aggregates
  - Improves strength and ductility
  - Resistance to rutting and cracking

FORTA™ Fiber Blend

- FORTA™ Corporation
  - Manufacturer of synthetic fibers for asphalt and concrete
  - Developed asphalt fibers in 1982
    - Three blends for HMA, WMA and patching mixes
  - Fibers provide three dimensional reinforcement
  - Blend of polypropylene and aramid fibers
  - ¾” & ½” lengths
    - Depends on aggregate size

FORTA™ Fiber Blend

- Polypropylene
  - Chemically inert
  - Non-corrosive
  - Non-absorbent

- Aramid
  - High tensile strength
  - Non-corrosive
  - High temperature resistance

Work at ASU

- Boeing Parking Lot
- Evergreen Drive - Tempe, AZ
- Airport Cooperative Research Program
  - Graduate Student Grant
- Future Work

Evergreen Drive Project

- Local surface street
- Deteriorated pavement conditions
- Severe rutting/shoving at intersections

Evergreen Drive Project

- No repair work done
- Milled edges to match curb
- 2” HMA overlay
  - Dense graded control mix
  - 1 lb/ton FORTA™ fibers
  - 2 lb/ton FORTA™ fibers
- Staggered test sections
- PG 70-10
- 5% binder content
- 7% air voids

Evergreen Drive Project

- Laboratory testing performed at ASU
- Concluded that 1 lb/ton of FORTA™ fibers was sufficient
  - Minimal benefits observed by adding 2lb/ton
  - Additional fibers complicate mixing and fiber dispersion in HMA
- Inclusion of FORTA™ fibers provided the following benefits:
  - Better resistance to shear deformation (triaxial test)
  - Lower permanent strain accumulation (permanent deformation test)
  - E* values were 80% higher than the control mix at 100°F (37.8°C)
  - Higher tensile strength and fracture energy
  - Improved fatigue life

Evergreen Drive Project

- Field survey (2 years)
  - Lack of pavement preparation evident
    - Cracks in all sections
  - Control sections had 3 times more low severity cracking than fiber reinforced test sections
- 2nd field survey
  - Planned for 2011

ACRP – Graduate Student Project

- Determine the feasibility of FRAC for airfield use
- Laboratory evaluation of airfield FRAC mixes
- Life cycle cost analysis
- Candidate projects
  - Jackson Hole Airport runway mix (2009)
    - FAA P-402 porous friction course with 1 lb/ton FORTA™ fibers
  - Sheridan County Airport runway mix (2011)
    - FAA P-402 porous friction course with 1 lb/ton FORTA™ fibers

ACRP – Graduate Student Project

- Jackson Hole Airport - Why specify FRAC?
  - Temperature changes from: -40°F to 41° F (winter) & up to 104°F in the summer
  - Elevation requires higher approach speeds
  - Short runway length
  - Accommodates planes such as the 757 and A320
  - Snow plowing caused raveling in existing pavement

- Mixture Properties
  - PG 64-34 binder
  - 5.7% asphalt content
  - 1 lb/ton FORTA™ fibers
  - 1-1/2” overlay

Sieve Size	% Passing	P-402 Control Points
3/4"	100	100
1/2"	82	70-90
3/8"	57	40-65
No. 4	22	15-25
No. 8	12	8-15
No. 30	6	5-9
No. 200	2	1-5

ACRP – Graduate Student Project

- Laboratory testing
  - In progress
- Field survey (1 year)
  - Good performance
  - No raveling

Summary

- FRAC can provide additional service life
  - ASU laboratory test results
  - Based on use of 1 lb/ton FORTA™ fibers
  - Slows crack development
  - Resists permanent deformation
- FRAC may be effective on airfields
  - Used for challenging climate /loading conditions
  - Fewer runway closures for pavement repair

Challenges

- Mixing process is difficult
  - Can produce clumps
- Dispersion of fibers
- Simplified QA test(s) needed
  - Determine % fibers
  - Quantify strength increase

Future Work

- Refine ASU fiber extraction method
- Investigate fiber dispersion within HMA
- Develop QA test protocol for fiber reinforced asphalt

Questions?

jeffrey.stempihar@asu.edu