

Background & Objective

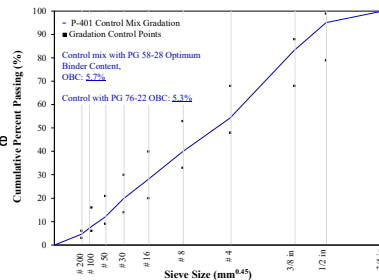
- Fiber Reinforced Asphalt Mix (FRAM) resist the rutting and cracking issues in warm and cold climate regions, respectively.
- According to fiber manufacturer, the recommended dosage had minimum mix design issues and maximum performance enhancement.
- Literature identified the claim true for given binder type. However, no consensus among the researchers about the recommended dosage for different climatic conditions.
- This study initiated with the following objective:

Goal: Evaluate the mix design (volumetric) properties and performance for FRAM using warm (NJ) PG 76-22 and cold (Alaska) region PG 58-28 binders for Airport surface mix (FAA P-401).



Materials

- Federal Aviation Administration (FAA) P-401 surface course was used for PG 76-22 and PG 58-28.
- The basalt, fiberglass, and carbon are added at 0.16% dosage, however, polyolefin/ Aramid (PFA) are added at 0.05% dosage.



Experimental Testing Program

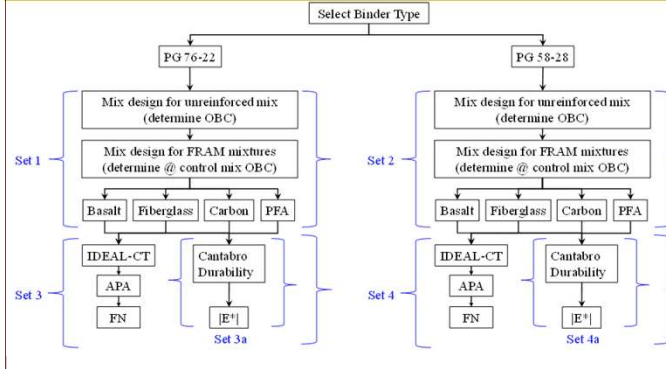
Volumetric Properties:

- Impact of Binder Grade:** Comparison of Mix Set 1 and Mix Set 2
- Impact of Fiber Type:** Comparison results of Mix Set 1 or Mix Set 2 with control.

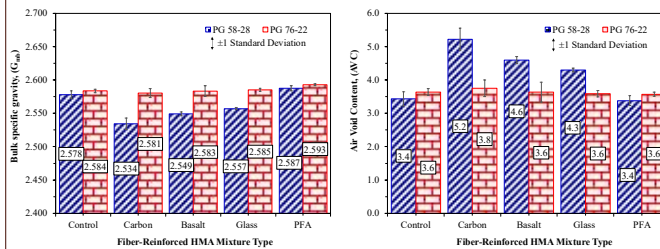
Performance and Mechanical Properties:

- Impact of fiber and binder grade:** Set 3 and Set 4 compare the performance of different fibers for both binder grades.
- Impact of fiber and binder grade:** Set 3a and Set 4a determine the impact of fiber and binder grade on mechanical properties.

Experimental Testing Program



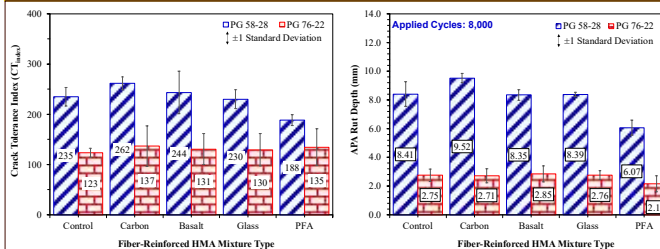
Mix Design Results



Volumetric Properties:

- Bulk specific gravity decreases for softer binder PG 58-28, no impact for stiffer binder PG 76-22. Indicate the compactability issues for FRAM.
- Air voids increased for softer binder PG 58-28, indicates higher binder content required, showed same OBC for warm region binder PG 76-22.

Performance Results



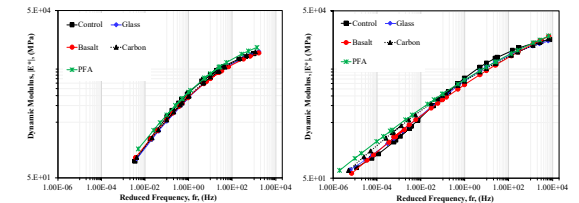
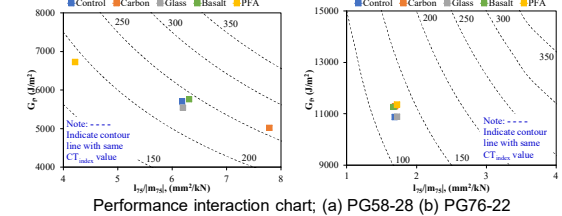
(a) IDEAL-CT

(b) APA rut depth

- Cracking performance on average enhanced 11% for carbon reinforced mix, irrespective of binder type.
- PFA reinforced mix showed higher rutting resistance by 28% and 21% for PG 58-28 and PG 76-22, respectively.

Performance Results

- PFA mix indicate higher G_f (toughness) and carbon fiber increased the I_{75}/I_{75S} (elasticity) of mix for cold region binders PG 58-28.
- No impact on toughness or elasticity for PG 76-22.



- PFA reinforced mix showed higher $|E^*|$ at lower frequency, regardless of binder grade, indicates higher rutting potential.
- FRAM are highly durable than the control mix.
- Fiberglass and basalt mixes indicates the lower loss (%).
- The strong adhesion between fiber and binders resist the breaking down of mix.

Conclusions

- Manufacturer recommended dosages (0.16%) impacted the volumetric properties of softer binder.
- The threshold fiber dosage depends on binder grade and fiber type.
- PFA 0.05% mix is the highly resistant to rutting performance, irrespective of binder type.
- No significant improvement in cracking performance was observed regardless of binder grade.
- FRAM mixtures are more durable than the control mix. Fiberglass and basalt fiber mixes showed least loss (%) compared to other fibers.

Acknowledgement

Funding under PE 0602784A, Project T53 "Military Engineering Applied Research," Task 08 under Contract W913E521C0020, managed by the U.S. Army Engineer Research and Development Center (ERDC). Special thanks are also due to Keith Sterling from AE Stone, Scott Nazar from Forta, and all fiber suppliers for providing the materials used in this study.