HIGHLIGHTER

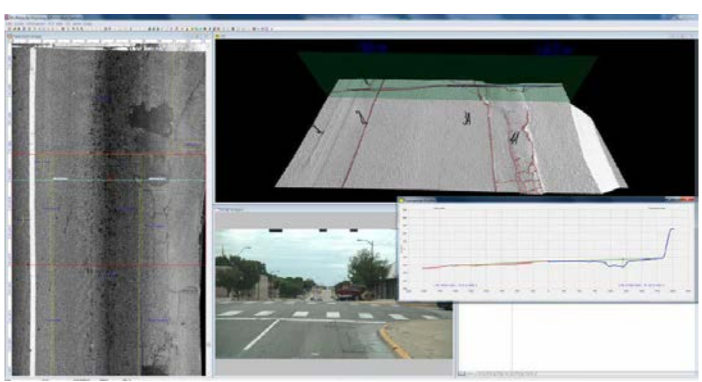
DEVELOPMENT OF AN ASPHALT PAVEMENT TEST FACILITY AT THE OSU UNMANNED AERIAL VEHICLE FACILITY

September 2017

OVERVIEW Unmanned aerial vehicles (UAVs), commonly referred to as drones, have been widely used for various applications, such as security, search and rescue, monitoring of infrastructure systems, package delivery and disaster management. Oklahoma State University (OSU) developed an airport runway facility near Elgin, Oklahoma (pictured right) to evaluate lightweight UAVs. The Roadway Design Squad at OSU has been involved with the preliminary design of this project, which consists of construction of an approximately 12-foot wide by 375-foot long taxiway and 60-foot wide by 2,400-foot long runway. There is a planned expansion to the runway in the near future. The construction of this facility and the planned expansion offers an excellent opportunity for the Oklahoma Department of Transportation (ODOT) to participate in the construction and have a dedicated test facility for the evaluation of environmental impacts on pavement materials.

RESULTS The objective of this study was to assist in the construction of the UAV runway to develop a pavement that can be used as a test facility for evaluating environmental impact on pavement materials including but not limited to plant-mixed warm and hot mix asphalt pavements, high reclaimed asphalt pavement (RAP) and reclaimed asphalt shingles (RAS) mixes, asphalt surface treatments, pavement preservation treatments, 100% RAP cold mixes and aggregate bases with surface treatments.

Runway pavement data analyzed in this effort included pavement roughness, longitudinal profiling, surface texture, and friction. Two rounds of data collection were conducted in 2014 and 2015 to assess surface characterization and evaluate performance for the UAV runway. Several state-of-the-art data collection devices were used, including the OSU 3D laser imaging technology (named as PaveVision3D Ultra, example output shown left) for 1mm 3D runway surface data, Grip Tester for continuous surface friction, dynamic friction tester (DFT) for dynamic friction coefficients, AMES high speed profiler for pavement roughness (International Roughness Index, IRI) and macro-texture (mean profile depth, MPD), SurPRO 3500 walking profiler for surface longitudinal profiling, and the portable LS-40 3D Surface Analyzer for ultra-high resolution pavement texture.



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FINAL REPORT ~ FHWA-OK-17-01
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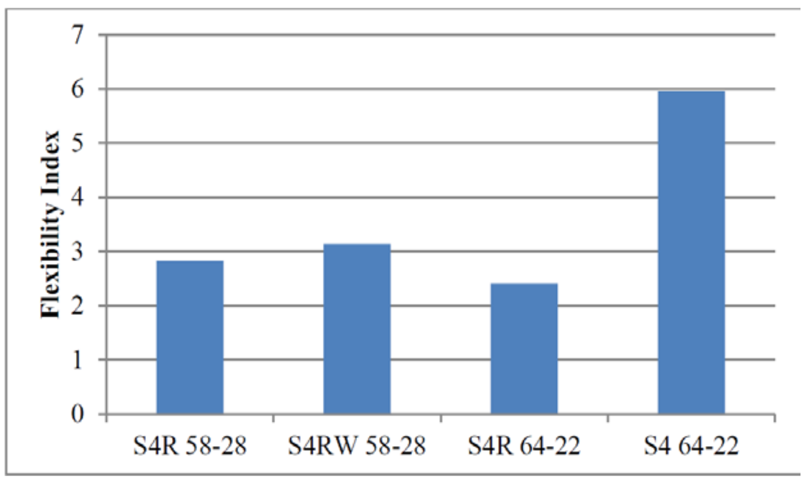
Results showed no cracking nor noticeable rutting based on the collected 1mm 3D runway surface data, which was expected with the new construction. The runway also demonstrated a low surface roughness in terms of IRI values. The mean LS-40 MPD values are 1.2363 mm and 1.2113 mm in 2014 and 2015, and no significant difference of MPD was found based on statistical pared t-test. Since Grip Tester simulates the principle of ABS technology and maintains peak friction during data collection, the measured Grip fiction coefficients are higher than the DFT friction numbers. The average Grip Tester friction coefficient is 0.917 in 2015, which indicates that the runway has a superior skid resistance performance. The DFT friction coefficients in 2014 and 2015 are 0.4617 and 0.6171 respectively.

The study effort also described the placement and evaluation of a runway shoulder mix consisting of a high binder replacement mix using PG58-28 OK binder. The north half of the shoulder was placed using warm mix technology, foamed asphalt. For the south half of the shoulder, the same mix was placed without using the warm mix technology. To better understand the effects of using a softer grade binder (PG 58-28) on recycled mixtures compared to the typically used PG64-22 binder, two additional mixes were sampled. The third mix sampled was the same mix as the mixtures used for the shoulder, but used a PG64-22 binder. The fourth mix used the same aggregates as the other three mixes, but contained no RAP and used PG64-22 binder. This allowed comparisons of the RAP mixes with different grades of binders to a virgin mix, a comparison of the impact of a softer binder on the recycled mixes and the effect of the warm mix technology. The testing protocol included the following:

- Theoretical Maximum Specific Gravity, AASHTO T 209
- Binder content, AASHTO T 308
- Recovered gradations, AASHTO T 30
- Lab molded mix properties (AASHTO R 35): [Air Voids (Pa), Voids in Mineral Aggregate (VMA), Voids Filled with Asphalt (VFA)]
- Dynamic modulus, AASHTO TP 79
- Semicircular bend (SCB) test, AASHTO TP 124

Results (shown right) show that the flexibility index yielded from the SCB test ranked the cracking resistance of the four mixtures as expected, with the virgin mix, S-4 PG64 having the best cracking resistance followed by the WMA W S-4 R PG58 mix, the HMA S-4 R PG58 mix and then the S-4 R PG64 mix. To prevent the use of brittle high binder replacement mixtures, ODOT should consider adoption of a SCB test.



Compaction testing (Nini) did not indicate that the two shoulder mixes were tender; however, they were near the upper specification limit. It could not be determined if the softer binder or the fact that the mixes were produced over the optimum asphalt content caused the possible tender behavior. The dynamic modulus testing did not completely show the trends that were expected. The results showed that the two recycled mixes with PG58-28 binder, W S-4 R PG58 and S-4 R PG58 would be softer than a recycled mix with PG64-22 binder, S-4 R PG64, but not as soft as a virgin mix with PG64-22 binder, S-4 PG64. The dynamic modulus testing did not indicate a softer mix for the WMA mix, W S-4 R PG58, compared to the HMA mix, S-4 R PG58.

POTENTIAL BENEFITS This work demonstrated benefits for the Oklahoma Department of Transportation through the construction and operations at a test facility for evaluating the impact of environmental factors on various pavement materials and mix designs.