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The FAA's Technical Center uses the HVS-A (left) to research aircraft tire pressure. Engineer Navneet Garg (right) stands inside the HVS-A, which he customized for the agency.

In this article, the second in a series, FocusFAA looks into the customized heavy-vehicle simulator the Tech Center has developed to research asphalt pavement at airports, especially during the high-temperature months of summer. In the first article, we looked at new technology sponsored by the FAA that could be more cost beneficial and efficient in de-icing runways.

Paving the Way to Better Airport Asphalt

Navneet Garg is reliving his childhood on a grand scale as a project manager at the FAA's William J. Hughes Technical Center. He is the engineering brains behind the customized heavy-vehicle simulator the Tech Center uses to research the effects of high aircraft tire pressure on asphalt pavement at airports.

"When I accepted this equipment and moved it with the remote, I was thinking that as a child, I used to play with remote-controlled cars," said Garg, who works at the FAA's National Airport Pavement Test Facility. "I never thought I'd move something that weighs similar to a Boeing 737 with a remote control."

The custom-designed heavy-vehicle simulator (airfield version), or HVS-A, is part of the new National Airport Pavement and Materials Research Center and the related Safety Technology Building on the Tech Center campus in Atlantic City, N.J. The Tech Center acquired the HVS-A in November 2013 and took possession of both facilities this March. They will enhance the research that the Tech Center has been conducting at the pavement test facility since 1999.

The original facility features a rail-based test vehicle inside a fully enclosed building. It does a great job examining the impact of wheel loads on lower layers of pavement. But it cannot heat the pavement effectively because it moves over rails.

By contrast, the HVS-A is mobile and includes an automated heating system with 12 heating panels inside the structure. The machine gives engineers the ability to replicate and analyze the damage that heavy commercial jets can do to the top asphalt layer of pavement when it gets hot, particularly during the slow-moving trek between the gate and runway.

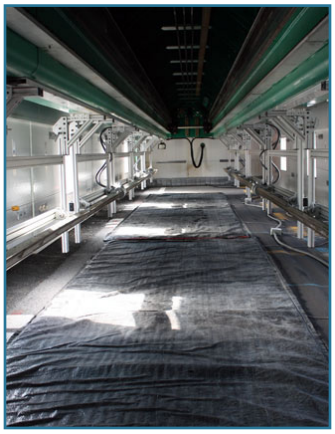
"If you look at a pavement structure," Garg said, "the layer that gets affected most by environment and is directly in contact with aircraft wheels is the asphalt layer. So the design and performance of that layer becomes very critical because whatever happens below is how the top layer behaves."

The older rail-based test vehicle also uses full landing gear to gauge the impact of wheel-load interactions at lower depths, but within the HVS-A, one wheel is enough for testing. "We can use high pressure in the tires, and because of the insulation panels on the sides and the heating panels inside, we can heat the pavement to 150 degrees Fahrenheit and maintain it," Garg said.

The HVS-A gives the Tech Center the ability to test asphalt materials at very high tire pressures and temperatures, he added. This is important because even at airports as far north as John F. Kennedy International

Airport in New York, pavement temperatures can reach 140-150 degrees Fahrenheit. The new generation aircraft, such as the Boeing 787 and Airbus 350, have tire pressures in the range of 220 to 250 pounds per square inch.

The ability to move the HVS-A by remote control is just one of a handful of features that the manufacturer added for the FAA. Other adaptations include modifications that better simulate the behavior and weight of airplane tires and the ability to see how pavement is affected by the repetitive nature of airplane arrivals and departures.



Heating panels run along each side of the path that the wheel follows in the HVS-A. (Photo: ATO)

The FAA's HVS is the Mark VI Airport model. It is about 130 feet long, 16 feet wide and 14 feet high, and it weighs about 240,000 pounds.

"There is only one other machine in the world that does airport pavement. That's used by the U.S. Army Corps of Engineers [in Vicksburg, Miss.]," Garg said. "But this machine has a lot more advanced features."

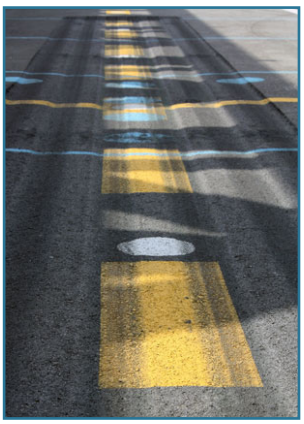
Engineers have used the HVS for some initial pavement tests on the Tech Center grounds over the past year-and-a-half. For instance, they have studied the effect of high aircraft tire pressure on asphalt concrete surface at 120 degrees Fahrenheit.

The remote control will be used to move the HVS-A between the existing outdoor pavement test strips and two more strips inside a new fabric building, which will allow for testing in a more controlled environment and for continuous research.

The building "will help us control the moisture content better than on the outside," said Jeffrey Gagnon, manager of the airport pavements sub-team. "... Once we're done with the test strips outside and need to reconstruct them, we'll move inside and then back again."

Garg said a key objective of the test facility and the HVS-A is to research environmentally friendly technologies like warm-mix, stone-matrix and recycled asphalt pavements. Current FAA advisory circulars lack guidance on such asphalts because of the limited knowledge about how high tire pressure and heavy gear loads affect airport pavement performance. This is the primary reason for the limited use of "green" pavement materials.

Research at the test facility is aimed at increasing the use of greener materials, more durable airport pavements and locally available materials modified with admixtures that enhance pavement durability, workability or strength. This will help save money by lowering the costs of initial construction, maintenance and repairs.



This pavement strip shows the impact of running simulations with the HVS-A. (Photo: ATO)

"If we can show that the performance of materials such as warm-mix asphalt is the same or better than the traditional mix," Garg said, "then we can develop standards and specifications for use on airports, and airports can start using those technologies."

The test facility and HVS-A also make it possible to test materials and ideas other than pavement. Gagnon noted, for instance, that the agency tested the performance of airfield paint markings under full-scale loads in high temperatures.

"It provides us the ability to be more forward-thinking, more up to date on new materials that are coming onto the market and whether they can be used on airfield pavements," he said.

Watch a video of the HVS-A in action at:

www.airporttech.tc.faa.gov/pavement/pic/hvs.mp4

Visit the Branch Website at:
www.airporttech.tc.faa.gov/

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