paving applications, but minimize their cost by not involving as much labor," said Ishee. For instance, does 24-inch deep pavement need to be heated throughout, or would a few inches of surface material suffice? "If it's just the surface that needs heating," said Ishee, "then heating the bottom 20 inches, you're kind of wasting your money."

Another research track being pursued as part of PEGASAS is centered at Purdue University. Researchers there are considering incorporating "phase change" materials (PCMs) into runway pavement that can store heat and light and slowly release it at freezing temperatures to help melt snow and prevent ice buildup.

The PCMs are derived from plant and vegetable oils. When the oils melt, energy is absorbed into the PCMs. When temperatures cool down, this material will start to crystalize, and that process actually releases energy. "Some of that testing has been done and it appears it's crystalizing the way you want it to do," said Leah Liston, a graduate student at Purdue University, who has been working on the project. "It's very promising and exciting."

The work on these PCMs has earned Liston recognition as outstanding student of the year by the Department of Transportation.

Patricia Watts, FAA Centers of Excellence Program Director, Leah Liston, Outstanding Student of the Year, and Professor Bernie Tao.

"I really found it intriguing that there is such a broad application for this material — sidewalks. roadways, shingles," said Liston. "I thought that would be really beneficial and impactful … for keeping people safe."

Leveraging the knowledge base and enthusiasm of academia at universities such as Binghamton, Iowa State, Purdue, and Nebraska has its own rewards.

"They just have so much energy," said Ishee, referring to the graduate students who are working on PEGASAS-related research. "It's just a joy and a pleasure to work with them. The students are so deep into aviation and interested in the research they're doing. It's nice to know we have a younger group coming in behind us to carry the torch, so to speak."

The goal of the Airport Technology Research and Development Branch is to accommodate the projected traffic growth and establish an operational environment that is free of accidents and fatalities.

We aim to achieve this goal through continuously improving the system and maximizing the use of existing facilities and by developing new standards, criteria, and guidelines to plan, design, construct, operate, and maintain the Nation's airports and heliports.

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Federal Aviation Administration
William J. Hughes Technical Center
Atlantic City International Airport, NJ 08405

The Heat is On…the Runway

This photo, taken at the airport in Oslo, Norway, shows the potential for heated pavement technology — in this case, geothermal heating. Note the taxiway and gate area are free of snow and ice.

In this article, Focus FAA discusses research sponsored by the William J. Hughes Technical Center into cost-beneficial methods to de-ice runways and other airport areas during winter. Part two of this series, to be posted tomorrow, will look into the customized heavy-vehicle simulator the Tech Center has developed to research the effects of high aircraft tire pressure on asphalt pavement at airports, especially during the high-temperature months of summer.

Even before the United States got caught in this winter's headlock, FAA research into de-icing airport runways was heating up.

Over the past few years, the agency has sponsored research into a number of innovative techniques to prevent snow and ice buildup on airstrips. The research is centered on more cost-effective — and environmentally friendly — ways to deal with Mother Nature when she turns a cold shoulder to humans.

Charles Ishee in the FAA Airport Technology R&D Branch oversees all of the agency's research into pavement heating technology at the William J. Hughes Technical Center in Atlantic City, N.J. He came to the FAA a year and a half ago from the U.S Air Force, where he worked at the Kindall Research Laboratory.

Ishee's team has interviewed five general aviation and five major commercial airports to research the cost of ice and snow removal. The success of

the FAA's research depends, said Ishee, on "how much we expect the cost to be if we put in our system. Where is it cost beneficial to utilize heated pavement for an airport?"

To that end, the FAA has funded a project at Greater Binghamton Airport in New York. Three years ago, the agency pitched in about $375,000 from the Airport Improvement Program to help the University of New Binghamton investigate the use of geothermal heating to keep runways clear at the local airport.

The project is the culmination of a computer science class project that began during the 2009 FAA Design Competition. The first phase in 2010 began with rehabilitating the main ramp pavement at the airport. The project required removing old pavement, offering a perfect opportunity to install the heating prototype under a portion of the newly paved surface. The second phase, which is nearing its end, involves gathering data about how effective the prototype has been in preventing ice buildup and melting snow. If it proves successful and cost effective, the third phase would be to install geothermal wells for the whole airport.

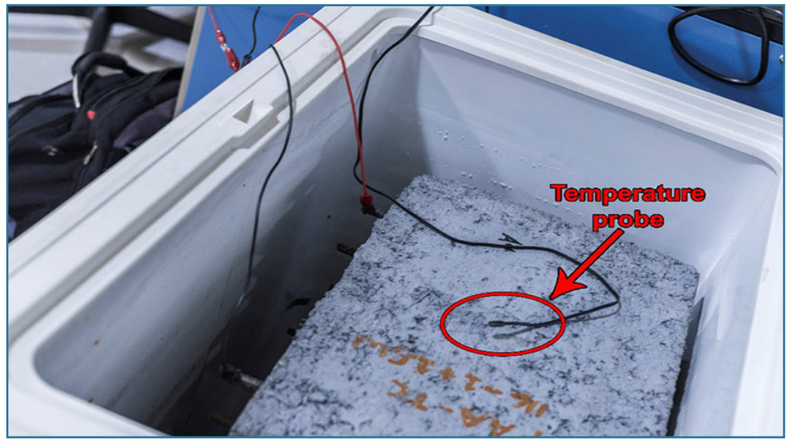
"Although just a segment of the ramp will be fitted with the geothermal technology, in the end the research will provide us with the real data needed to determine the extent we could use this in the future," said Broome County Commissioner of Aviation Carl Beardsley, an advisor to the project. Ishee, who works in the FAA's NextGen organization, said the FAA expects to receive a paper collecting all the data by June.

In the meantime, the University of Nebraska is performing tests on electrically conductive concrete. It is exploring incorporating metal fibers in concrete, and then running metal strips every two feet in concrete slabs. When the metal strips are electrified, the metal fibers inside the concrete heat up and start the de-icing process.

The university tested the technology in concrete being used to renovate a local bridge, which has weathered five years of monitoring.

"The deicing performance is outstanding," said Christopher Tuan, the principal investigator for the University of Nebraska – Lincoln. The power consumption cost — at $200 for a 150 foot x 40 foot two-lane highway — has proved "very reasonable," he added.

The catch, said Tuan, was the cost. "The materials I used were top of the line, so it was very expensive. It's expensive to implement on a large scale." With a $280,000 grant from the FAA, Tuan is now working on phase one: formulating a mix that will make the technology "economical, while maintaining durability, strength, and de-icing performance."



A concrete test slab is seen here in a deep freezer at the University of Nebraska-Lincoln.

He eventually will test the phase-one technology on a 20 x 10 foot slab of concrete. "Once it's proven economical and durable, we're going to do a large-area test at the Tech Center's tarmac," said Tuan.

A substantial amount of heated pavement research is being conducted through the FAA's PEGASAS project — which stands for Partnership to Enhance General Aviation Safety, Accessibility, and Sustainability. This research is conducted under the auspices of the Center of Excellence (COE) for General Aviation at the Tech Center. It leverages the energy and inspiration of academia by offering research professors and graduate students the opportunity to do real-world research into issues of importance to aviation.

Peter Sparacino

Despite the name of the COE, PEGASAS could have applications for major airports as well. "General aviation can be an incubator for larger airports," said Pete Sparacino, program manager for the General Aviation COE. "If it works at a GA airport, then they could apply it to a larger airport."

He explained that some of the technologies being tested are better suited for smaller airports that don't have the resources to keep up with heavy snow and icing. The technology might prove more economical and feasible than deploying the large teams of plows and snow blowers often seen at large airports in the Midwest and Northeast. Some types of technology are better suited for warmer climate airports, while others might be more appropriate for states like Alaska, with extreme temperatures. The technologies can be used solely for runways, or might be more economically employed around gate areas, aprons, or taxiways with difficult geometry that makes them difficult to clean using conventional methods.

The bottom line is that the new technologies could offer expanded options for airports. The key is the cost/benefit ratio. "If you're able to keep the runways open, or the taxiways, or areas around the terminal, it helps to increase capacity," Sparacino said. "But where is it economical? Part of the project is to do a financial analysis to determine where it is that it's economical to use heated pavements on an airport."

Iowa State researchers have been funded under the PEGASAS program to do just such a financial analysis of three different technologies:

- Electrically conductive concrete, such as that being tested at the University of Nebraska-Lincoln;
- spraying various nanomaterials — such as DuPont's Teflon — onto pavement test samples. The idea is to produce pavements that repel water that would prevent snow and ice from sticking and make it easier for plows to clean up after a storm. Ishee compared it to Rain-X, the popular product that drivers spray on their windshields to repel rain without having to use their windshield wipers.
- hydronic systems, which circulate heated liquid through pipes, warming the pavement and melting any snow and ice from the surface.

Iowa State's Halil Ceylan checks a test slab that uses heated pavement technology to melt snow and ice. One of the goals of the research project is to help smaller airports clear runways during winter storms. Photo by Christopher Gannon.

Iowa State also is considering more efficient ways of constructing heated pavement. "The idea is to look at different ways to use traditional