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On a rainy Oct. 1 in New Jersey, a G-4 Gulfstream aircraft overran its runway on landing at Teterboro Airport. But the crew and passengers were uninjured when the aircraft came to a safe stop amid a pile of crushed concrete. The successful stop marked the seventh aircraft save by Engineered Material Arresting Systems (EMAS), informally labeled “crushable concrete” in the aviation industry.

The mixture of lightweight concrete and foaming agent, which creates air pockets as it cures, making it crushable, is installed at the end of 51 runways at 35 U.S. airports. When an aircraft’s tires hit the engineered concrete, the material collapses and provides enough drag to safely decelerate the plane.

Engineered Arresting Systems Corp. (ESCO) of Logan Twp., N.J., in partnership with the FAA, the Port Authority of New York and New Jersey, and the University of Dayton Research Institute created the material.

University of Dayton researchers Bob Cook (retired), Mike Bouchard, Geoffrey Frank, Michael Craft, James Higgins and Scott Stouffer made a number of contributions toward the development of runway arresting systems during a 15-year period that began in the late 1980s. Contributions include materials and structures development and testing, design recommendations and an analytical model to predict how aircraft would behave when running over the arresting beds.

Frank, a research engineer in structures and mechanical systems, recalls making occasional trips to LaGuardia airport in New York City, where he and colleagues had set instrumentation at the end of a runway to measure jet blast speeds and acoustic and ground-vibration levels created by aircraft at takeoff.

“The first generation beds worked well at stopping aircraft, but didn’t fare as well under the conditions created by jets taking off over them,” Frank said. “So we sat in a van near the end of the runway and recorded jet blast speeds and vibrations created by a number of different aircraft, so the manufacturer would know what conditions the material would need to withstand.”

Other University of Dayton researchers tested the material for heat and cold tolerance and moisture permeability.

The FAA requires that commercial airports have a runway safety area where feasible. But many airports cannot meet the required safety extension of 1,000 feet beyond the end of a runway because of obstacles such as highways, railroads, severe drop-offs in terrain or bodies of water. In those cases, arresting beds – at a standard length of only 600 feet – can provide effective stopping power; shorter beds can also be installed if lack of land precludes a standard bed.

John F. Kennedy International Airport in New York City installed the first EMAS bed in 1996.

Since then the arresting beds have been successful at stopping all seven overruns on runways where the material is installed. In a Nov. 1 Aviation Week & Space Technology magazine story by James Ott, FAA manager Rick Marinelli said none of the arrested planes suffered serious damage, and passengers and crew have sustained only minor injuries when there were injuries at all.

"Every aircraft that's been arrested has flown away,” Marinelli said in the story.

Bouchard, who served as the Research Institute’s principal investigator for a program to improve the system’s durability, said EMAS is a great safeguard, especially when it sits between a runway end and a sharp land drop, a body of water or residential area.

"The material has proven not only to save aircraft, but it's also very likely to have saved lives," he said.

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