Enhancing Runway Safety Areas at San Francisco International Airport

Research Tools Inform Decision Making and Compliance

EDITOR'S NOTE: Much of the information in this article derives from an Airport Cooperative Research Program (ACRP) publication, "Improving the Safety of Runway Safety Areas," released in the ACRP Impacts on Practice series, October 2015, and available at www.trb.org/ACRP/Blurbs/173761.aspx.

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Landing and takeoff overruns, undershoots, and veer-offs account for most of the accidents that occur on or near an airport runway. Conditions at the airport may contribute significantly to the probability and to the severity of the accidents. Runway safety areas (RSAs) improve the safety of airplanes and can turn potential accidents into minor incidents.

Problem

Under normal conditions, RSAs should be capable of supporting aircraft without causing damage to the vehicle or injury to the passengers. In the 1960s, the Federal Aviation Administration (FAA) introduced new design standards that increased the size of RSAs to reduce the severity of aircraft incidents. U.S. airports were required to comply with these standards and to improve RSAs by the end of 2015.

Many of the runways at airports built before the 1960s did not match the new dimensions for RSAs; in addition, terrain and environmental conditions at some airports made the extension of RSAs impractical. These facilities therefore needed to improve their runways' safety in other ways. FAA has worked closely with airports to meet as many of the RSA requirements as possible.

Solution

Research conducted under ACRP focused on safety considerations for RSAs (*1*). The research built on findings from earlier ACRP projects (*2*), which introduced a methodology for the risk assessment of RSAs. Risk assessments are used to predict the likelihood of common accidents at airports and to help inform airports' efforts to improve the safety of RSAs.

PHOTO: T. F. GREEN AIRPORT

Installation of an engineered materials arrestor system at the end of a runway was part of an improvement program at T. F. Green Airport in Rhode Island.

The latest research expanded the scope of the findings and incorporated several additional methodologies for improving RSAs. The research identified four primary alternatives for improvements (see Figure 1, below):

- Extend the RSA laterally and longitudinally,
- Modify or relocate the runway to expand the RSA,
- Reduce the declared distance available for sudden stops or takeoffs, and

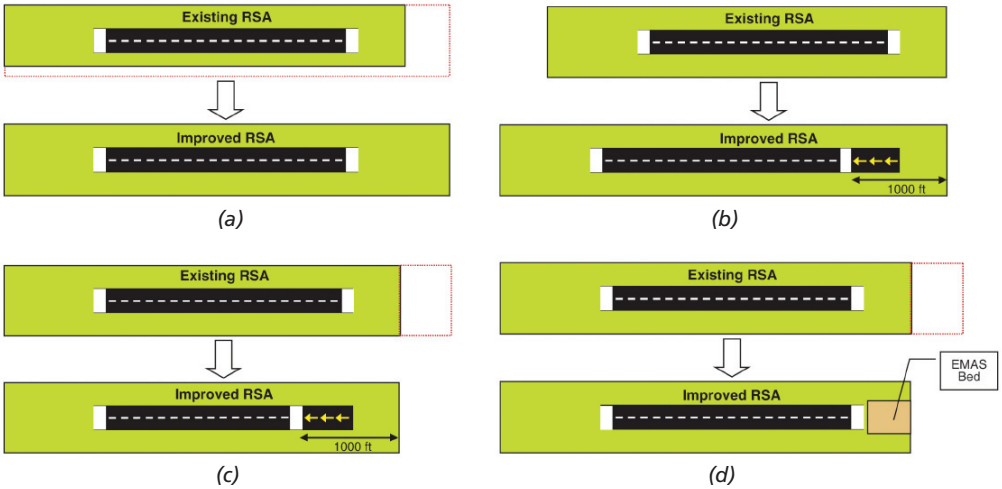

FIGURE 1 Basic alternatives for improving a runway safety area (from ACRP Report 50): (*a*) extending the RSA, (*b*) relocating the runway, (*c*) using declared distances, and (*d*) using EMAS.

◆ Install an engineered material arresting system (EMAS).

The report analyzes each alternative individually and in combination with the others, providing guidance to airport operators who are looking to improve the safety of their RSAs.

The research included a functional hazard analysis for the types of incidents that relate to RSAs—including landing overruns, landing veer-offs, landing undershoots, takeoff veer-offs, and takeoff overruns. The research team analyzed more than 1,400 accidents and incidents that had occurred since 1980 and developed a three-part risk model. The model evaluates the probability and consequences of an event under certain operating conditions, including the aircraft performance, the weather, the RSA's characteristics and geometry, and the presence of an EMAS at the site.

The project also developed Runway Safety Area Risk Analysis software, or RSARA, which can perform a full-risk assessment of individual and multiple runways. The software input data include historical operations, historical weather, the characteristics of the runways, the characteristics of the RSAs, and general information about the airport.

From these data, the software generates the average risk for each type of incident by runway, by RSA section, and by the airport's total risk. The model was validated against the historic accident rate at a sampling of airports representative of conditions across the United States.

Application

At San Francisco International Airport (SFO), several runways met the FAA requirements for enhanced RSAs. The airport charged a task force to study improvements, and the effort identified approximately 30 alternatives that would meet the FAA RSA mandates, but at varying levels of cost. The airport's site constraints—such as a major highway off one end of the runways and the San Francisco Bay off the other end—affected the costs.

An SFO project team considered every alternative for enhancing the RSAs and complying with FAA mandates. Applying the tools and guidance developed through ACRP research, the SFO team identified the two most cost-effective alternatives for enhancing the RSAs. The alternatives, however, would achieve 97 percent of the FAA safety requirements.

Benefits

The ACRP research had helped the SFO project team identify viable alternatives for achieving nearly 100 percent of the FAA-mandated RSA requirements. The SFO Bureau of Planning and Environmental Affairs, however, noted that achieving 100 percent—with a standard RSA layout but no EMAS—would have required extending the runways farther into the San Francisco Bay and would have cost the airport at least several hundred million dollars. The airport ultimately chose to shift the location of the runways and to use EMAS.

The ACRP evaluation methodology therefore helped the team reach a financially feasible decision that made a safe airport safer and that avoided unnecessary environmental impacts. An added benefit was the completion of the work by late 2014, a year ahead of the FAA deadline.

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Photo: San Francisco International Airport

Aerial view of San Francisco International Airport (SFO).

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Suggestions for Research Pays Off topics are welcome. Contact Stephen Maher, Transportation Research Board, Keck 486, 500 Fifth Street, NW, Washington, DC 20001 (202-334-2955; smaher@nas.edu).