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Aquaplaning

- too much water on the runway?

Aquaplaning is a phenomenon that can occur when a layer of water builds up between the aircraft's tires and the runway surface. It may result in a situation where braking action on the wheel is not effective.

Aquaplaning poses a serious risk to aviation safety during heavy rain, and it is most frequent in the tropics. It has been a contributing factor in some aircraft incidents and accidents, such as the Qantas Flight 1, which skidded off the runway in Bangkok on 23 September 1999. Luckily there were no casualties, but 38 people were injured and the aircraft suffered some costly damage.

Accurate information on water level thickness on the runway could help pilots to make better decisions on how to land safely. Until recently, a comprehensive and reliable method for assessing the thickness of the water layer has not been available.

What can be done to avoid aquaplaning?

Aircraft can use its tire brakes, flaps, spoilers and reverse thrust to decelerate its speed, for example. These

Singapore's Changi Airport has established itself as a major aviation hub in the Asia Pacific. It has a capacity to handle 70 million passangers a year.

methods are usually enough, but unexpected conditions during landing may result in their ineffective use.

As grooves across the runway surface help drain excess water, they may decrease the risk of a landing aircraft ending up in an aquaplaning situation. However, a gooved runway won't completely eliminate the risk in heavy rain.

Information on water layer thickness on the runway can be gathered using different methods. One option is to take direct measurements using runway surface sensors. However, this method is not always very reliable, as it is a spot measurement only, and does not account for pooling or the runway's characteristics.

A more sophisticated approach relies on modeling the ways in which the water flows off the runway. Indirect measurement can be calculated based on rain intensity measurements and a runway surface analysis method called aquamapping.

Singapore at the forefront of development

Due to its tropical location, Singapore is prone to heavy rain. This is one of the reasons why Singapore now leads the way in addressing safety risks caused by aquaplaning.

The project was first kicked off when the Civil Aviation Authority of Singapore (CAAS), which provides air navigation services at Singapore FIR and Changi Airport, received feedback from pilots on the need for more precise and real-time information on the thickness of the water layer on the runway.

Although Changi Airport's runways are already designed to ensure rapid water run-off, CAAS recognised that more could still be done. CAAS contacted Vaisala to find a reliable way to measure water level on the runway in real-time situations. This was a completely new endeavor for both parties, as there was no existing solution available in the market.

The project started in November 2007, and the new system - tailored and developed for the needs of Changi Airport - was installed for testing in December 2008. So far, the results have been encouraging.

Explaining CAAS' initiative in this project, CAAS' Director of Air Traffic Services Mr Ng Tee Chiou said: "CAAS constantly seeks innovative ways to improve operational efficiency. We believe in leveraging new technologies that will enhance the safety and efficiency of air traffic operations. We hope that Vaisala's water level measurement tool will aid air traffic controllers to pass on essential runway information to pilots, thereby boosting the level of flight safety."

How does the warning system work?

Instead of relying on simple but rather unreliable spot measurements only, an intelligent aquaplaning warning system is built around a thorough understanding of the runway topography, combined with water flow-off modeling. It computes and displays the estimated water layer thickness on runway zones using a specific equation that takes into account the precipitation values and the flow-off value.

The flow-off value from the runway surface is based on empirical measurements on the runway zones, performed prior to system calibration. The flow-off values can be defined independently for each runway zone. The precipitation values are based on precipitation sensor measurements in each of the runway zones. Vaisala's aquaplaning warning system is patented.

Installing the system requires a comprehensive site survey of the airport in question as well as a good understanding of the airport's requirements and the runway's technical details. Once these have been established, suitable sensor locations can be identified and the system can be installed. After installation, the system requires annual calibration, as runway conditions change due to normal wear and tear or resurfacing, for example.

Moving forward

Information on the thickness of the water layer on the runway in heavy rain supports decision-making and increases airport safety and efficiency. The next phase of the Singapore pilot project is to establish the best working practices between air traffic controllers and pilots regarding communications relating to aquaplaning. Sharing this critical information in an efficient manner can save both lives and money.