US ports vulnerable to devastating earthquake damage

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If a repeat of the 1906 San Francisco earthquake were to occur, and the Port of Oakland were so severely damaged that it took as long as two years to resume full operations, what would be the impact on the U.S. economy?

U.S. ports serve as crucial gateways for international trade, but they're particularly vulnerable to damage in an earthquake. Western U.S. ports in Oakland, Los Angeles, Long Beach and Seattle are at the greatest risk for earthquake damage, but eastern U.S. ports in Charleston, S.C., and Savannah, Ga., are also at risk.

A new project led by the Georgia Institute of Technology aims to develop strategies to help safeguard ports from earthquake damage. The project, sponsored by the National Science Foundation (NSF), has $3.6 million in funding over the next five years.

"Ports are a critical civil infrastructure system," said Glenn J. Rix, a professor in Georgia Tech's School of Civil and Environmental Engineering and the project director. "Given the growth in international trade, we don't think seismic risks at ports have received the proper amount of attention. If a large portion of a major U.S. port such as Oakland or Los Angeles were out of service for a year because of an earthquake, there would be significant economic consequences for the United States."

In 1995, a magnitude 6.9 earthquake struck in Kobe, Japan, causing

extensive damage to both the city and its port, the sixth largest in the world at the time. The port required $8.6 billion and two years to repair. By 2003, the Port of Kobe had fallen to 32nd largest in the world and will likely never recover the lost business.

Ports are particularly vulnerable to damage during earthquakes because wharves are often built on unstable ground that is prone to liquefaction -- a process that causes soil to lose its strength as a result of ground shaking. The large cranes used to load and unload containers from ships are also susceptible to damage from ground shaking and deformation.

The project's goal is to help port authorities and other stakeholders manage seismic risk more effectively.

"Modern ports are large, complex systems," said Rix. "Our project team includes researchers and practitioners with expertise in civil engineering, logistics, risk analysis, and social science to address seismic risk issues in every aspect of the system."

A key part of the project is to evaluate methods of preventing damage to wharves and cranes using large-scale tests. The team will perform these tests at four labs that are a part of the George E. Brown Jr. Network for Earthquake Engineering Simulation (NEES), a program initiated by NSF to advance the field of earthquake engineering with a shared network of experimental sites and tools, an archive of earthquake data and earthquake engineering simulation software.

The team will also investigate applying the same approach to managing risks from other natural hazards, including hurricanes.

"We learned an important lesson from the experience of Gulf Coast ports following Hurricane Katrina," Rix said. "The physical damage was minor compared to the impact of the displaced labor force on port

operations, which emphasized the need to examine the entire port system."

Source: Georgia Institute of Technology

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