Building a better bridge to survive tsunamis

By BRENNA VISSER
Cannon Beach Gazette

Colin Murphey/The Daily Astorian

Several bridges and roads in Seaside have been deemed potentially problematic in an earthquake and tsunami.

Colin Murphey/The Daily Astorian

A new study could help communities like Seaside determine how to improve aging bridges.

The way bridges are assessed for tsunami risk needs to be rethought, new research suggests.

In a study published by Oregon State University and the University of Nevada, Reno, researchers found that previous assumptions about how force from a tsunami impacts bridge infrastructure don't necessarily hold true.

Most studies have only looked at the total force a tsunami puts on a bridge, rather than how force impacts individual components like girders, the horizontal beam that supports the deck, and bearings, the part that provides a resting surface between the columns and the deck.

Standard girder bridges are built with the assumption that all of the stresses from a tsunami are being transmitted and absorbed through the foundation.

The study found that different types of force brought on by a sustained rushing wall of water actually transfers a large amount of pressure onto the supporting parts of the bridge, like the girders, deck chambers, bearings and connections. These parts are not factored in when designing for tsunami resilience.

The finding is important, said Pedro Lomonaco and Solomon Yim, Oregon State researchers who contributed to the study, because it can help engineers understand why bridges fail and lead to more tsunami-resistant bridges along the Oregon Coast.

"The breaking of the bearing connections was the main type of bridge damage seen in recent tsunamis, showing that it's critical to quantify what the tsunami is doing to these components and decipher the underlying physics," Yim said.

Deadly examples

The need to better understand wave impacts on coastal bridges was largely motivated by seeing bridges destroyed during tsunamis off Japan and Indonesia. Over the past 15 years, big earthquakes have caused tsunamis that killed more than 250,000 people and caused more than $200 billion in damage, the study estimates, washing away or dislodging hundreds of bridges.

The research could help coastal cities like Seaside, which has several aging bridges that are expected to fail in a tsunami.

The topic has been raised recently by City Councilor Tom Horning, a geologist who has long advocated retrofitting bridges as a top priority for the city.

With two major rivers to cross before getting to higher ground, having bridges that can last will be crucial to maintaining evacuation routes.

"Bridges are one of the easiest, fastest connection points to help people after an emergency," Lomonaco said. "If you don't have the bridges, there is nothing you can do."

To find answers, researchers simulated a tsunami on a model bridge at the O.H. Hinsdale Wave Research Laboratory's Large Wave Flume in Corvallis.

Part of what researchers found was that most bridges are built too rigidly, Yim and Lomonaco said.

Instead of seeing the concrete columns under a bridge as inflexible blocks, imagine them like springs. When the tsunami hits the deck of a bridge it will bend, making it vibrate both back and forth and up and down.

The bridge deck and pilings not only feel the static forces coming from the earthquake and tsunami, but the additional pressure from these vibrations.

"We are changing the paradigm ... to the concept of thinking about how a bridge is moving, changing," Yim said.

The irregular shape of traditional trusses and girders also creates unaccounted-for turbulence, they said. In general, the wall of water should be moving in one direction, but when it has to go through trusses, the water weaves in and out, adding different hydrodynamic forces that can compromise the bridge's stability.

"The high pressure that developed under the bridge played a significant role on the stability of the bridge, and different mitigation measures were tested, from closing the gaps between girders to incorporating venting on the concrete deck," Lomonaco said.

More research

Given how young the area of study is, more research is needed to understand why certain bridges survive and why others do not, the team says.

But researchers hope the study gives engineers a better understanding of the physics of what happens when a tsunami slams into a bridge and opens the door to designing coastal spans that are better able to withstand giant waves.

"Think back 10, 15 years ago, the tsunami was not even considered," Yim said. "We've come a long ways."

Ocean changes impact Northwest salmon

Salmon will not be immune to the effects of ocean acidification

By JES BURNS
Oregon Public Broadcasting

A new study suggests that salmon will not be immune to the effects of ocean acidification.

Scientists found that changes to ocean chemistry disrupt a fish's ability to smell danger in the water.

Researcher Chase Williams of the University of Washington exposed young coho salmon to the elevated ocean CO2 levels expected over the next few decades. He then dropped in an odor that normally makes the fish react as if a predator is near. The fish ignored it.

"They're still smelling odorant, but the way their brain is processing that signal is altered … Before, they would avoid this predator odor and now they're more indifferent to it," Williams said.

The results are concerning because salmon rely on smell to avoid danger, find food and to find their way back to spawning grounds in West Coast rivers.

Co-author Andrew Dittman is a scientist with the federal Northwest Fisheries Science Center. He said the results could apply to other salmon species.

"The mechanisms involved … are very similar. So the expectation would be that we would see relatively similar phenomena in the other species as well," he said.

The ocean absorbs about 25 percent of the carbon dioxide in the atmosphere. The more CO2 humans emit, the more saturated the ocean becomes, thus lowering the pH of the water.

Ocean acidification has already started to have negative effects on the Pacific Northwest's shellfish industry. Knowledge about potential impacts on other ocean species is still limited.

The study was published in the journal Global Change Biology.

Help eliminate invasive ivy along the Skipanon River

Cannon Beach Gazette

Invasive English ivy has a foothold along the Skipanon River in Warrenton, where it climbs into Sitka spruces and other native trees, causing them to rot and ultimately topple.

The North Coast Land Conservancy is seeking volunteers for a stewardship day on Saturday, Jan. 26, from 10 a.m. to 1 p.m. to tackle ivy in the conservancy's Skipanon Forest Habitat Reserve.

The spruce forest-and-swamp habitat type that characterizes the property is considered globally rare. The land conservancy scheduled this stewardship day in the winter, when the deciduous vegetation has died back and it's a little easier to move around, but volunteers can still expect rough walking.

Most of the ivy at Skipanon Forest is growing on large Sitka spruce trees, but there may be some on the ground as well. Handsaws, loppers, and other tools will be used to remove this invasive vine.

E-mail stewardship director Melissa Reich at melissar@nclctrust.org or call 503-738-9126 to attend.